An implementation model for integrated coastal management in South Africa – from legislation to practice

by

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DECLARATION

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SUMMARY

In South Africa the government's progress in developing policy in support of people-centred Integrated Coastal Management (ICM), as expressed in the Coastal Policy and the Integrated Coastal Management Act, is commended. However several challenges pertaining to policy implementation remain which constitute the primary need for this research. Indeed, South Africa already has many pieces of the ICM implementation puzzle, but a structured framework or model to assist in achieving a workable, integrated system is still lacking.

The aim of this research is to design an implementation model for ICM within the South African context and to propose a novel and innovative generic process for the design and refinement of such models. This aim is achieved by addressing four research questions, namely: (i) Can contextual, country-specific knowledge be harnessed to design a prototype ICM implementation model for South Africa?; (ii) Is the prototype design workable (or compatible) in the existing coastal marine statutory and governance system of South Africa (i.e. a practical validation)?; (iii) Is the prototype model for South Africa scientifically credible and how can insights into the uniformities contributing to improved integrated environmental management (IEM) and ICM be applied to assess such credibility as well as inform refinements to the model (i.e. a theoretical validation)?; and (iv) Can a generic process for the design and refinement of country-specific implementation models be derived from the research methodology applied in this study? Design science was selected as the primary strategy of inquiry for this study and a mixed-methods approach was used, claiming that the specific focus is real-world practice. Qualitative and quantitative methods are used to execute this research.

This research demonstrates a method where experience and country-specific knowledge are harnessed to design a prototype ICM implementation model for South Africa and, in doing so, experientially capturing important emerging paradigms for improved ICM implementation – as identified in the scientific literature – namely the ecosystem-based management, spatial planning and cooperative environmental governance paradigms. In the prototype design, the ecosystem-based management and spatial planning paradigms are combined with traditional problems- or issues-based approaches, applied in many of the earlier ICM models. Personal experience also confirmed the importance of informed and well-established actor involvement in coastal management (cooperative environmental management) which manifested in the inclusion of the important avenues of actor involvement (i.e. the support elements) in the prototype model. Moreover, South Africa's sector-based governance system is accommodated in the design by anchoring the management programmes component (remaining largely sector-based) between the resource vision, objectives and zoning component and the monitoring and evaluation component, implying that management programmes remain grounded in an ecosystem-based approach and subservient to the agreed vision and objectives, and needs of the coastal ecosystem.

A practical validation, using the management of land-based activities as case study, reveals that approaches to coastal management in South Africa, grounded in the current statutory framework of the country, can largely be aligned with the approach proposed in the prototype implementation model. Indeed it is inefficiency or a lack of operationalisation of existing legislation that may pose the biggest challenge for effective implementation of this model. Because the prototype model is designed to accommodate sector-based management programmes, it can be extended to accommodate sectors or activities other than those presented in the case study, such as conservation, transportation (shipping) and fisheries. Consequently, the prototype model can be applied in South Africa without any substantive adaptation of the existing statutory framework. Clearly, the challenge of effectively operationalising existing statutes remains.

A critical review of relevant scientific literature provides information on and understanding of uniformities in IEM, the broader domain within which ICM is nested, using the key paradigms that contribute significantly to the improved implementation of IEM, to express such uniformities. It became apparent from studying the evolution of ICM over the last two decades that many of the key paradigms that significantly contribute to improved implementation of IEM have also proved valuable in the implementation of ICM. The insight gained from scientific literature was applied in determining fourteen evaluation criteria with which to assess of the scientific credibility of the prototype design. The subsequent assessment of the prototype design confirmed that the collective learning in IEM (and ICM) implementation over the last two decades is consolidated in this prototype design, apart from two aspects, namely scientific support networks and sustainable financial support. These were not initially defined as key components for ICM implementation in South Africa, but in retroflection proved to be valid; South Africa has established independent scientific networks outside the realm of government that coordinate scientific research in support of coastal management, and the explicit recognition of these scientific support networks in the prototype model will highlight their importance to ICM. Also, the inclusion of a sustainable financial support mechanism as a key component in the model will significantly enhance the importance and necessity of having a sound funding strategy associated with ICM implementation in South Africa.

Considering the prototype design and its practical and theoretical validation, two interdependent but distinctive adaptive cycles emerged. The refined model therefore incorporates these dual, adaptive cycles coined the resource and actor cycles. The resource cycle is much in alignment with the original components of the prototype design, but a distinct modification is the inclusion of the demarcation of the geographical boundaries of coastal management units as a separate component in the model. In essence, the components in the actor cycle represent the key actor groups involved in the governance system for ICM. These components reflect the original support elements in the prototype design but include the two additional components identified in the theoretical validation, namely scientific support and financial support mechanisms. The revised model with its dual, adaptive cycles contributes an implementation perspective to the growing body of scientific literature on social-ecological systems. In this literature, the ecological system is viewed as intricately linked with and affected by the social system as depicted by the interlinked resource and actor cycles of the revised model.

Further, a practical and novel three-step generic process for the design and refinement of country-specific ICM implementation models is proposed, based on the design-science approach applied in this study. First, the process involves the design of a prototype model, primarily based on local knowledge within the country-specific context. Second, the process entails dual validation procedures, namely an empirical validation and theoretical validations. Finally, the outcome of the validation process is used to refine and improve the prototype design. Further, the refined model design proposed in this study is posed as a suitable prototype design for countries with similar sector-based coastal management milieus to South Africa.

The research reported here does not offer a complete solution to the identified problem as there are manifold angles from which to approach effective and sustainable ICM. In this study an *implementation* angle was chosen, more specifically from a *practical environmental management perspective* that recognises important economic and social elements and interactions. Opportunities exist for researchers in other expert fields to investigate ICM policy implementation in South Africa from their perspectives. For example, ICM can also be viewed from purely economic, public administration, social or educational stances. In particular, techniques such as science mapping could be used to identify whether paradigms exist that constitute uniformities in IEM and ICM in addition to the ten key paradigms studied in the research. Any new characteristics deriving from the analysis of the additional paradigms can then be used to refine the evaluation criteria for the assessment of the scientific credibility of ICM implementation models. Knowledge gained and innovations made in such studies can be integrated into the ICM implementation model presented here to continuously improve its operationalisation.

This research provides two main products, namely a workable and scientifically sound implementation model for ICM in the South African context and a generic process for the design and refinement of country-specific ICM implementation models, both requiring adaptive management approaches.

OPSOMMING

In Suid-Afrika is die regering se vordering in die ontwikkeling van beleid ter ondersteuning van volksgesentreerde Geïntegreerde kusbestuur, (GKB), soos verwoord in die Kusbeleid en die Geïntegreerde Kusbestuurwet, prysenswaardig. Daar is egter nog verskeie uitdagings met betrekking tot die uitvoering van beleid wat neerkom op die primêre behoefte vir hierdie navorsing. Suid-Afrika het inderdaad reeds baie stukkies van die GKB-implementeringslegkaart, maar 'n gestruktureerde raamwerk of model om te help met die daarstelling van ‘n werkbare, geïntegreerde stelsel ontbreek nog.

Die doel van hierdie navorsing is om 'n implementeringsmodel vir GKB te ontwerp binne die Suid-Afrikaanse konteks en 'n nuwe en innoverende algemene proses vir die ontwerp en verfyning van sulke modelle voor te stel. Hierdie doelstelling is bereik deur vier navorsingsvrae aan te spreek, naamlik: (i) Kan kontekstuele, land-spesifieke kennis ingespan word om ‘n prototipe GKB-implementeringsmodel vir Suid-Afrika te ontwerp? (ii) Is die prototipe-ontwerp werkbaar binne (of vergelykbaar met) die bestaande kusmariene statutêre- en bestuursstelsel van Suid-Afrika (d.w.s. ‘n praktiese validasie)? (iii) Is die prototipemodel vir Suid-Afrika wetenskaplik-geloofwaardig en hoe kan insig in die eenvormighede wat bydra tot verbeterde geïntegreerde omgewingsbestuur (GOB) en GKB toegepas word om sodanige geloofwaardigheid te bepaal, asook die verfyning van die model in te lig (d.w.s. ‘n teoretiese validasie)?; en (iv) Kan 'n algemene proses vir die ontwerp en verfyning van landspesifieke implementeringsmodelle afgelei word van die navorsingsmetodiek wat in hierdie studie toegepas is? Ontwerpwetenskap is gekies as die primêre strategie van ondersoek vir hierdie studie en 'n gemengde-metode benadering is gebruik, met die aanspraak dat die spesifieke fokus werklike wêreldspraktyk is. Kwalitatiewe en kwantitatiewe metodes word gebruik om hierdie navorsing uit te voer.

Hierdie navorsing demonstreer 'n metode waar eie ervaring en land-spesifieke kennis ingespan is om 'n prototipe GKB-implementeringsmodel vir Suid-Afrika te ontwerp, en in die proses is belangrike opkomende paradigmas vir verbeterde GKB-implementering – soos geïdentifiseer in die wetenskapsliteratuur – ondervindelik vasgevang, naamlik die ekostelsel-gebaseerde bestuur, ruimtelike beplanning en samewerkende omgewingbestuur paradigmas. In die prototipe-ontwerp, is die ekosisteem-gebaseerde bestuurs-en ruimtelike beplanning paradigmas met tradisionele probleem- of uitkoms-gebaseerde benaderings gekombineer – soos toegepas in baie van die vorige GKB-modelle. Persoonlike ondervinding het ook die belangrikheid van ingeligte en goed gevestigde akteursbetrokkenheid in kusbestuur (samewerkende omgewingsbestuur) bevestig wat uitgeloop het op die insluiting van die belangrike roetes van akteursbetrokkenheid (d.w.s die ondersteuningselemente) in die prototipe-model. Verder is Suid-Afrika se sektorgebaseerde bestuurstelsel geakkommodeer in die ontwerp deur die Programbestuurskomponent (grootliks sektorgebaseerd) te anker tussen die hulpbron visie, doelwitte en sonerings komponent en die monitering en evaluering komponent, wat impliseer dat die bestuursprogramme gegrond bly binne 'n ekosisteem-gebaseerde benadering en ondergeskik bly aan ooreengekomde visie en doelwitte, en behoeftes van die kusekosisteem.

'n Praktiese validasie, waar die bestuur van land-gebaseerde aktiwiteite as gevallestudie gebruik word, toon dat die kusbestuursbenadering in Suid-Afrika, gegrond op die huidige statutere raamwerk van die land, grootliks in lyn gebring kan word met die benadering soos voorgestel in die prototipe implementeringsmodel. Inderdaad dit is die onbevoegdheid of 'n gebrek aan operasionalisering van die bestaande wetgewing wat die grootste uitdaging vir die doeltreffende implementering van hierdie model inhou. Omdat die prototipemodel ontwerp is om sektorgebaseerde bestuursprogramme te akkommodeer, kan dit uitgebrei word na ander sektore of aktiwiteite as dié wat in die gevallestudie getoon is, soos bewaring, vervoer (skeepsvervoer) en vissery. Gevolglik kan die prototipe-model toegepas word in Suid-Afrika sonder enige substantiewe aanpassing van die bestaande statutêre raamwerk. Duidelik, die effektiewe operasionaliseer van bestaande wette bly ‘n uitdaging.

'n Kritiese oorsig van die toepaslike wetenskapsliteratuur verskaf inligting oor, en begrip van, die ooreenstemmings in GOB, die breër gebied waarbinne GKB ingebed is, deur gebruik te maak van die sleutelparadigmas wat ‘n beduidende bydrae tot die verbetering van die implementering van GOB maak. Dit het duidelik geword uit die bestudering van die evolusie van GKB oor die laaste vier dekades dat baie van die sleutelparadigmas wat bydra tot verbeterde implementering van GOB ook waardevol blyk te wees in die uitvoering van die GKB. Die insig verkry uit wetenskapliksliteratuur is aangewend om die veertien evalueringsmaatstawwe saam te stel vir die beoordeling van die wetenskaplike geloofwaardigheid van die prototipe-ontwerp. Die daaropvolgende beoordeling van die prototipe-ontwerp het bevestig dat die kollektiewe kennis in GOB (en GKB) implementering oor die afgelope twee dekades in hierdie prototipe ontwerp gekonsolideer is, behalwe vir twee aspekte, naamlik wetenskapsondersteuningsnetwerke en volhoubare finansiële ondersteuning. Dit was aanvanklik nie gedefinieer as belangrike komponente vir GKB-implementering in Suid-Afrika nie, maar het in heroorweging tog geldig geblyk te wees; Suid-Afrika het onafhanklike wetenskapsnetwerke wat wetenskapsnavorsing ter ondersteuning van kusbestuur buite die regeringsraamwerk koördineer en die uitdruklike erkenning van hierdie wetenskapsondersteuningsnetwerke binne die prototipe-model sal die belangrikheid daarvan in GKB beklemtoon. Ook, die insluiting van 'n volhoubare finansiële ondersteuningsmeganisme as 'n sleutel komponent in die model, sal die belangrikheid en noodsaaklikheid om ‘n 'n gesonde finansiële strategie wat verband hou met GKB-implementering in Suid-Afrika daar te stel, aansienlik verhoog.

Na oorweging van die prototipe-ontwerp en die praktiese en teoretiese validasies het twee interafhanklike, maar kenmerkende aanpasbare siklusse te voorskyn gekom. Die verfynde model sluit dus hierdie dubbele, aanpasbare siklusse in, genaamd die hulpbron- en akteurssiklusse. Die hulpbronsiklus is meestal in ooreenstemming met die oorspronklike komponente van die prototipe-ontwerp, maar ’n duidelike verandering is die insluiting van die afbakening van kusbestuureenheidsgrense as 'n aparte komponent in die model. In wese verteenwoordig die komponente binne die akteurssiklus die sleutel-akteursgroepe wat betrokke is in die GKB-bestuurstelsel. Hierdie komponente reflekteer die oorspronklike ondersteuningselemente binne die prototipe-ontwerp maar sluit die twee addisionele komponente wat in die teoretiese validasie geïdentifiseer is in, naamlik wetenskaplike ondersteuning en finansiële ondersteuningsmeganismes. Die hersiende model met die twee interafhanklike, aanpasbare siklusse dra ’n implementeringsperspektief by tot die groeiende liggaam van wetenskapliksliteratuur rondom sosiaal-ekologiese stelsels. In hierdie literatuur word die ekologiese stelsel gesien as intrinsiek gekoppel aan en geaffekteer deur die sosiale stelsel, soos voorgestel in die intergekoppelde hulpbron- en akteurssiklusse in die hersiende model.

Verder is 'n praktiese en nuwe, generiese drie-stap-proses vir die ontwerp en verfyning van land-spesifieke GKB- implementeringsmodelle voorgestel, gebaseer op die ontwerp-wetenskaplike benadering wat in hierdie studie toegepas is. Eerstens behels die proses die ontwerp van 'n prototipe-model, hoofsaaklik gebaseer op plaaslike kennis binne die land-spesifieke konteks. Tweedens behels die proses dubbele validasie-prosedures, naamlik 'n empiriese validasie en ‘n teoretiese validasie. Ten slotte word die resultaat van die validasie-prosedures gebruik om die prototipe-ontwerp te verfyn en te verbeter. Verder word die verfynde model-ontwerp wat in hierdie studie voorgestel word, gereken as ‘n geskikte prototipe-ontwerp vir lande met soortgelyke sektorgebaseerde kusbestuursmilieus as Suid-Afrika.

Die navorsing wat hier aangebied word is nie 'n volledige oplossing vir die geïdentifiseerde probleem nie, aangesien daar verskeie hoeke is waaruit doeltreffende en volhoubare GKB benader kan word. In hierdie studie is 'n *implementeringshoek* gekies, meer spesifiek 'n *praktiese omgewingsbestuur perspektief* waarbinne belangrike ekonomiese en sosiale elemente en interaksies erken word. Opwindende geleenthede bestaan vir navorsers binne ander kundigheidsvelde om GKB-beleidsimplementering in Suid-Afrika te ondersoek vanuit hulle perspektiewe. Byvoorbeeld, GKB kan ook ondersoek word vanuit suiwer ekonomiese, publieke administrasie, sosiale of opvoedkundige oogpunte. Meer spesifiek, tegnieke soos wetenskapskatering kan gebruik word om vas te stel of daar paradigmas bestaan wat neerkom op eenvorminghede binne GOB en GKB, benewens die tien sleutelparadigmas wat in hierdie navorsing bestudeer is. Enige nuwe eienskappe afgelei van die analise van die addisionele paradigmas kan dan gebruik word om die evalueringsmaatstawwe vir die asessering van die wetenskaplike geloofwaardigheid van GKB implementeringsmodelle te verfyn. Kennis en innovasie van sulke studies kan opgeneem word in die GKB-implementeringsmodel wat hier aangebied word om voortdurend die operasionalisering daarvan te verbeter.

Die navorsing lewer twee hoofprodukte, naamlik ’n werkbare en wetenskaplike geloofwaardige GKB-implementeringsmodel binne die Suid-Afrikaanse konteks en 'n algemene proses vir die ontwerp en verfyning van land-spesifieke implementeringsmodelle vir GKB beide met aanpasbare bestuur as vereiste.

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ACRONYMS AND ABBREVIATIONS

ACLME	Agulhas Current Large Marine Ecosystem
AfroBIS	African Node for the Ocean Biogeographic Information System
ANZECC	Australian and New Zealand Environment and Conservation Council
BCC	Benguela Current Commission
BCLME	Benguela Current Large Marine Ecosystem
C.A.P.E.	Cape Action for People and the Environment
CARA	Conservation of Agricultural Resources Act (No 43 of 1983)
CBO	Community-based Organisation
CEA	Cumulative Effects Assessment
CEC	Committee for Environmental Coordination
CERM	Consortium for Estuarine Research and Management
CFR	Cape Floristic Region
CICAP	Cross-sectoral Integrated Coastal Area Planning
CMPP	Coastal Management Policy Programme
CSIR	Council for Scientific and Industrial Research
CZM	Coastal Zone Management
DAFF	Department of Agriculture, Forestry and Fisheries (National)
DEA	Department of Environmental Affairs (National)[1]
DEADP	Department of Environmental Affairs and Development Planning (Western Cape Province)
DEAET	Department of Economic Affairs, Environment and Tourism (Eastern Cape Province)
DEAT	Department of Environmental Affairs and Tourism (National)
DFO	Department of Fisheries and Ocean (Canada)
DMR	Department of Mineral Resources (National)
DoT	Department of Transport
DPGL	Department of Provincial and Local Government (National)
DST	Department of Science and Technology (National)
DWA	Department of Water Affairs (National)[2]
DWAF	Department of Water Affairs and Forestry (National)
EA	Environmental Assessment
EDCs	Endocrine Disrupting Chemicals
EEZ	Exclusive Economic Zone

[1] In 2009 government department structures in South Africa changed. The Department of Environmental Affairs (DEA) was separated from Tourism and no longer existed as the Department of Environmental Affairs and Tourism (DEAT)

[2] In 2009 the Department of Water Affairs (DWA) was separated from Forestry and no longer existed as the Department of Water Affairs and Forestry (DWAF)

EIA	Environmental Impact Assessment
EKZN Wildlife	Ezemvelo KwaZulu-Natal Wildlife
EMP	Environmental Monitoring Programme or Plan
EPA	Environmental Protection Agency
ESSIM	Eastern Scotian Shelf Integrated Management
FAO	Food and Agriculture Organization (United Nations)
FEE	Foundation for Environmental Education
FIG	Federation Internationale des Geometres
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GESAMP	Group of Experts on the Scientific Aspects of Marine Environmental Protection
GIS	Geographical Information System
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
ICM	Integrated Coastal Management
ICMA	National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008)
ICOM	Integrated Coastal and Ocean Management
ICZM	Integrated Coastal Zone Management
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IM	Integrated Management
IMO	International Maritime Organization
IOI-SA	International Ocean Institute Southern Africa
IPCC	International Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
KZN	KwaZulu-Natal
LFA	Logical Framework Approach
LMEs	Large Marine Ecosystems
LOMAs	Large Ocean Management Areas
M&E	Monitoring and evaluation
MARPOL	International Convention for the Prevention of Pollution from Ships 1973/78
MBO	Management by Objectives
MCC	Municipal Coastal Committee
MECs	Members of the Executive Committee
MINMECs	Committees of Ministers and Members of Executive Councils
MINTEC	Ministerial Technical Committee
MLRA	Marine Living Resources Act (No. 18 of 1998, amended 2000)

MPA	Marine Protected Areas
MSP	Medium-sized Project (GEF)
NAF	National Advisory Forum
NCC	National Coastal Committee
NEMA	National Environmental Management Act (No. 107 of 1998)
NGO	Non-governmental organisation
NOAA	National Oceanic and Atmospheric Administration
NPA	National Programmes of Action
NRF	National Research Foundation
NRMMC	National Resource Management Ministerial Council (Australia)
NSBA	National Spatial Biodiversity Assessment
NSDP	National Spatial Development Perspective
NWA	National Water Act (No. 36 of 1998)
OECD	Organization for Economic Cooperation and Development
OBM	Objectives-based Management
PCC	Provincial Coastal Committee
PCWG	Provincial Coastal Working Group
PDCA	Planning-doing-checking-acting (Deming cycle)
PGDS	Provincial Growth and Development Strategies
PSDF	Provincial Spatial Development Framework
PSDS	Provincial Growth and Development Strategies
RBM	Results-based Management
SAAMBR	South African Association for Marine Biological Research
SAAQIS	South African Air Quality Information System
SABS	South African Bureau of Standards
SADCO	Southern African Data Centre for Oceanography
SAEON	South African Environmental Observation Network
SANCOR	South African Network for Coastal and Oceanic Research
SANParks	South African National Parks
SBWQFT	Saldanha Bay Water Quality Forum Trust
SDCA	Stakeholder Dialogue and Concerted Action
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SES	Social Ecological System
SET	Science, Engineering and Technology
Sida	Swedish International Development Cooperation Agency
SoE	State of Environment
TPC	Thresholds of Probable (or Potential) Concern
Transnet NPA	Transnet National Ports Authority

UKZN	University of KwaZulu-Natal
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USA	United States of America
USAID	United States Agency for International Development
VOS	Voluntary Observing Ships
WESSA	Wildlife and Environment Society of South Africa
WIO	Western Indian Ocean
WRC	Water Research Commission

CHAPTER 1 COASTAL MANAGEMENT IN SOUTH AFRICA AND FUTURE CHALLENGES

This dissertation investigates the design of an implementation model for effective integrated coastal management (ICM)[1] in South Africa. This introductory chapter commences with an overview of the management of South Africa's coastal marine[2] environment (hereafter referred to as coastal management) leading into the purpose of this research. This is followed by a section on the research methodology and finally the structure of the dissertation is discussed.

1.1 COASTAL MANAGEMENT IN SOUTH AFRICA

In order to provide context to the research, a brief historical overview of coastal management in South Africa is provided in the section, followed by a discussion on some of the main future challenges.

1.1.1 Historical overview

A concise history of coastal management in South Africa is provided in Glavovic's (2006) paper entitled "The evolution of coastal management in South Africa: Why blood is thicker than water"[3] in which he illustrates the significant shift that occurred in the 1990s when a predominantly biophysical and bureaucratic view transformed into a participatory approach driven by human development imperatives and the need to promote sustainable livelihoods. This shift towards a sustainable, development-orientated approach fostered people-centred integrated coastal management (ICM) in the belief that this promises greater security for coastal ecosystems compared with the more traditional nature-centred approach to ICM. The shift led to the release of a new coastal management policy in June 2000, the *White Paper for Sustainable Coastal Development in South Africa* (hereafter referred to as the Coastal Policy), which is a formal, written statement expressing the South African government's intent to promote sustainable coastal development through ICM (South Africa 2000a). Glavovic (2006) attributes the enabling environment for this transformation to five key factors, namely:

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1 GESAMP (1996: 3) defines ICM as "a broad and dynamic process that . . . requires the active and sustained involvement of the interested public and many stakeholders with interests in how coastal resources are allocated and conflicts are mediated. The ICM process provides a means by which concerns at local, regional and national levels are discussed and future directions are negotiated." The definition of ICM is explored in greater detail in Chapter 2.

2 I choose to use the term 'coastal marine environment' to define the broad environmental domain central to this dissertation. By this I include estuaries, the shoreline as well as marine waters and sub-surfaces beyond the shorelines roughly to the edge of the continental shelf, excluding the distant oceanic domain. Generically, the geographical boundaries of this domain are somewhat fuzzy. However, for site-specific management of the coastal marine environment agreement on the exact boundaries is important as is explored in greater detail in Chapter 3 (prototype model design).

3 Nel & Kotzé (2009) interpret 'water'' and 'blood' as the 'green' and 'brown' perspectives, respectively, on the environment. The green perspective addresses the biotic (living) and (non-living) elements of the earth system and their interactions occurring within a closed system where energy may leave the system, but matter is recycled. The brown perspective argues that humans are an integral part of the earth systems and their social issues (brown capital) thus form part of the environment. In their view, the term environment is further complicated "…when it fuses with the principles of sustainability and sustainable development, as it introduces economic issues and parameters to the discourse." Nel & Kotzé (2009: 3).

- The transition from apartheid to democracy (in the mid-1990s) that provided a window of political opportunity that facilitated the development of a distinctive deliberative and collaborative approach to coastal policymaking;
- The Coastal Management Policy Programme (CMPP), a process established for the development of the coastal policy in dialogue with all coastal stakeholders (i.e. a government-civil society partnership) that secured support from these stakeholders, including government and ultimately the Cabinet;
- The financial support provided by the British government (i.e. foreign aid), catalytic for initiating the CMPP (and underpinning some policy-implementation efforts through to 2005);
- Alignment of the policy with the dominant political agenda in South Africa around poverty eradication, moving coastal issues from the political periphery to the centre-stage and prompting government to invest significantly in coastal management; and
- The vision, commitment and activism of a relatively small group of individuals from diverse sectors and organisations who were central to bringing about the change in thinking about ICM.

Through the policy-development process it became apparent that even though administrative regulations and expert analysis are necessary elements of coastal management, they are certainly not sufficient to promote sustainable coastal development because coastal management is an inherently political endeavour that is best approached through the creation of meaningful opportunities for public participation and the establishment of partnerships that include government, business, civil society, and the scientific and professional communities. Also, focussing on the value of coastal ecosystems, and the potential opportunities they offer for sustainable coastal development, was considered a more effective strategy for promoting ICM than "portending coastal catastrophe unless development is brought under control" (Glavovic 2006: 899). "Yet, notwithstanding the broad support for the new coastal policy, the apparent success of the CMPP was overshadowed by a nagging doubt: would the sound rhetoric and good intentions of the coastal policy be converted into practical reality?" (Glavovic 2006: 899).

In 2006, six years after the release of the Coastal Policy, Glavovic (2006) concluded that although progress had been made on several fronts in terms of policy implementation, efforts were still at a relatively early stage. Many challenges remained, including:

- Converting the Coastal Policy into law that reflects both the substance and soul of the policy;
- Sustaining the government-civil society partnership that had its origin in the CMPP to prevent policy implementation efforts being dominated by single sectors – government, and the Department of Environmental Affairs (DEA), in particular;
- Improving knowledge of and understanding about people-centred ICM; and
- Building commitment and institutional capacity to promote people-centred ICM.

In 2008, parliament finally approved the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (hereafter referred to as ICMA) (South Africa 2009a), giving legal status to the Coastal Policy. It is noteworthy that there are several existing (older) environmental laws that also support the "sound rhetoric and good intentions" (Glavovic 2006: 899) of the Coastal Policy although they are not explicitly linked to the policy. These include the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (South Africa 2002), the Local Government: Municipal Systems Act (No. 32 of 2000) (South Africa 2000b), the National Water Act (No. 36 of 1998) (hereafter referred to as NWA) (South Africa 1998a), the Marine Living Resources Act (No. 18 of 1998) (hereafter referred to as MLRA) (South Africa 1998b), the National Environmental Management Act (No. 107 of 1998) (hereafter referred to as NEMA) (South Africa 1998c) and the International Convention for Prevention of Pollution from Ships Act (No. 2 of 1986) (South Africa 1986). The intricate relationship between these laws and the ICMA will be explored in Chapter 2.

In international development and public management literature, policy is usually presented as a formal, written statement, often referred to as a white paper (De Coning 2006). For the purposes of this dissertation, policy is defined as a statement of intent. Policy is the articulation of basic principles to be pursued to attain specific public goals. As such, policy interprets the values of society and is usually followed by pertinent project and programme management actions related to implementation (De Coning 2006). This concept is also echoed in Glavovic's (2009) policy cycle where 'implementation' is defined as an explicit element in the cycle, following policy approval. In terms of coastal management in South Africa, the Coastal Policy (South Africa 2000a) captures these basic principles for South Africa, while the ICMA gives legal status to these principles. Effective *implementation* of ICM is now the critical element in attaining the public goals of the Coastal Policy.

1.1.2 Challenges

Although the promulgation of the ICMA holds great advantages for ICM, *policy implementation* remains a major challenge. In 2008, the then Minister of Environmental Affairs and Tourism in the foreword of South Africa's National Programme of Action for Protection of the Marine Environment from Land-based Activities (DEAT 2008: i) stated that "South Africa's coastal marine environment is a place of tremendous beauty and a home to over thirty percent of our country's population. It is a national asset supporting a diverse range of uses, including fishing, recreation, mining and agriculture. Our coast already contributes significantly to the national economy and yet has further potential to support the development and upliftment of our nation. However, for this to take place our marine environment requires careful management and protection from detrimental activities."

Threats to the coastal marine environment of South Africa have been described in numerous studies (e.g. Lombard et al. 2004; Turpie 2004; Clark et al. 2002; DEAT 2006). Clark et al. (2002) identified four major threat categories (or problem types):

- Overexploitation of marine living resources;
- Physical alteration and destruction of habitat (e.g. coastal development, mining, mariculture, non-extractive recreational activities) primarily as a result of urban development;
- Reduction in quantity and quality of freshwater entering the coastal marine environment; and
- Marine pollution (including alien invasive species).

In 2004, as part of South Africa's National Spatial Biodiversity Assessment (NSBA), a panel of scientists with expertise in the coastal marine environment provided an overview of the extent and severity of the impacts associated with specific problem types, and some specific human activities (Lombard et al. 2004). In their rating over-exploitation of living marine resources was considered the greatest problem contributing to the deterioration of marine biodiversity in South Africa, although marine pollution (e.g. through wastewater disposal) and the physical alteration and destruction of habitat (e.g. through climate change, coastal development and mining) were also significant factors. The human activities contributing to the major problem types originate in sectors[1] as listed in Table 1.1. Legislation and implementation efforts (e.g. the management strategies, administrative and governance structures) remain largely sectoral (DEAT 2008).

Table 1.1 Key sectors and associated problems posing potential threats to the coastal marine environment in South Africa

KEY SECTOR	ASSOCIATED PROBLEM			
	Over-exploitation of living resources	Physical alteration and destruction of habitat	Modification in freshwater flows	Marine pollution
Fisheries	●	●		●
Water supply		●	●	
Waste and wastewater		●	●	●
Coastal development		●	●	●
Mining and exploration		●	●	●
Transport (shipping)		●		●
Agriculture and forestry		●	●	●

Source: Derived from DEAT (2008)

There are a number of causes underlying these problem types. Clark et al. (2002) argued that in the South African case, the factors posing a threat to the coastal marine environment include population pressure, poverty and inequality, inadequate knowledge and awareness, and inadequate financial resources (DEAT 2008).

Considering the problems and their underlying causes threatening South Africa's coastal marine environment, and the diversity of sectors involved, it is unlikely that a totally *sectoral approach* will provide effective management of this valuable resource. Considering this, Glavovic's (2006) challenges to people-centred ICM in South Africa, namely preventing implementation efforts from being dominated by single

[1] Sector or sectoral within the context of this dissertation refer to the separate, often autonomous, line functions allocated to government departments in South Africa. Key sectors that may be relevant to coastal management include fisheries, water supply, waste and wastewater, coastal development, mining and exploration, transport (shipping) and agriculture and forestry.

sectors, improving knowledge and understanding of people-centred ICM and building commitment and institutional capacity still hold true to a large extent. Herein lie the major challenges to achieving effective implementation of ICM in South Africa.

1.2 RESEARCH PURPOSE

Reflecting on the history and future challenges of coastal management in South Africa, the government's progress in developing policy in support of people-centred ICM, as expressed in the Coastal Policy and the ICMA, is commendable. However several challenges pertaining to *policy implementation* remain and they constitute the primary need for this research. In this section first the broader rationale for this research is explained, then the specific focus adopted here within the context of the broader rationale. Finally, the research aim and research questions are formulated.

1.2.1 Research rationale

Notwithstanding the South African government's progress in developing policy in support of people-centred ICM, as expressed in the Coastal Policy and the ICMA, I consider a *structured framework or model to facilitate policy implementation* as a key requirement (or need) to overcome these challenges. Indeed, South Africa already has many pieces of the ICM implementation puzzle, but a structured framework or model to assist in achieving a workable, integrated system is still lacking.

The importance of considering the country-specific context in designing a model of this nature, including existing coastal management initiatives, has been affirmed widely. For example, the Global Programme of Action (GPA) to protect the marine environment from land-based activities states that "As needs and priorities vary greatly between countries, action has to be tailor-made" (UNEP/GPA [2006: i]. Also, "Whichever a country's situation, it is important to realise up front that the NPA [National Programme of Action] process should not try to re-invent the wheel, it should above all build upon existing programmes, assessments and research" (UNEP/GPA 2006: 33).

1.2.2 Specific focus adopted for this dissertation

The research presented does not claim to offer a complete solution to the identified need. There are diverse angles from which to study effective and sustainable ICM. I choose to approach it from an *implementation* viewpoint and more specifically from a *practical environmental management perspective*, recognising important economic and social elements and interactions. Other positions on the identified need could be purely economic (e.g. incentive or financial support models), public administration (e.g. detailed analysis of the various institutions involved in coastal management), social (e.g. exploring public consultation and awareness approaches) or educational (e.g. investigating innovative avenues for public education and capacity building) perspectives.

I chose the *implementation* point of view because it aligns with my field of expertise. Over the past twenty years I have worked as a scientific researcher and management consultant in the Council for Scientific and Industrial Research (CSIR) focusing on integrated and ecosystem-scale approaches to marine water quality management (e.g. Taljaard & Botes 1995; Oelofse et al. 2005; Taljaard 2006a; 2006b; Taljaard, Monteiro & Botes 2006; Taljaard et al. 2006; DEAT 2008; UNEP/Nairobi Convention Secretariate & CSIR 2009) and estuary management (e.g. DWAF 1999; Van Niekerk & Taljaard et al. 2003; Van Niekerk, Taljaard & Schonegevel 2006; DWAF 2008; CSIR 2009a; Taljaard, Van Niekerk & Joubert 2009; Taljaard et al. 2009). As a management consultant I have been actively involved in designing local coastal management programmes (e.g. Taljaard & Monteiro 2002), I have provided specialist inputs to ecological water-requirement studies in estuaries (e.g. Taljaard et al. 2005) and I have designed and implemented environmental monitoring programmes in the coastal marine environment (e.g. CSIR 2009b).

The above argument also applies to the manner in which I test the application of the proposed ICM implementation model within the South African context, where I mainly focus on alignment with legislation, environmental management practices and institutions relevant to implementation of ICM and address the alignment with underlying economic, public administration, social and educational practices in the country less extensively.

1.2.3 Research aim and questions

Within the broader policy process (De Coning 2006; Glavovic 2009), this research primarily focusses on *policy implementation*, in particular the coordination, integration and operationalisation of policy pertaining to the coastal marine environment. Thus I aim to achieve two goals, namely:

> First, to design a workable and scientifically-sound *implementation model for people-centred integrated coastal management (ICM) within the South African context;* and
>
> Second, to propose *a generic process for the design and refinement of country-specific ICM implementation models* for broad international application.

I consider four research questions appropriate to addressing the research aim, namely:

- Can contextual, country-specific knowledge be harnessed to design a prototype ICM implementation model for South Africa?
- Is the prototype design workable in or compatible with the existing coastal marine statutory and governance system of South Africa (i.e. extensive existing legislation and numerous initiatives already in existence, but governed under a largely sector-based system) (i.e. the empirical or practical validation)?
- Is the prototype model for South Africa – designed mainly from a contextual, country-specific perspective – scientifically credible and how can insights into the uniformities[1] which contribute

[1] While it is acknowledged that ICM implementation is contextual, varying around the world with the variety of situations in which it is applied (Stojanovic, Ballinger & Lalwani 2004), there are success factors that are common, here referred to as uniformities. Paradigms are later used as frames for reporting such uniformities.

significantly to improved implementation of integrated environmental management (IEM) and ICM be applied to assess such credibility as well as inform refinements to the model (i.e. the theoretical validation)?

- Can a generic process for the design and refinement of country-specific implementation models be derived from the research methodology applied in this study?

The research aim and associated questions are addressed through a number of research activities listed in Table 1.2 and discussed in detail in Section 1.4.

Table 1.2 The research activities of this study

RESEARCH ACTIVITY	
a	Design a prototype model for the implementation of people-centred ICM in South Africa, based on expert knowledge within the South African situation and guided by an overview of selected international ICM implementation models.
b	Validate the prototype design empirically (or practically) to assess the compatibility within the existing milieu of the South African coastal marine environment, using the management of land-based activities as case study.
c	Validate the prototype design theoretically by assessing it against criteria derived from scientific literature based on insights into the uniformities which contribute significantly to improved implementation of IEM, the broader domain within which ICM is nested.
d	Refine the prototype design, where appropriate, based on the outcome of the validation process.
e	Propose a generic process for the design and refinement of country-specific ICM implementation models, based on the design-science approach adopted in this study.

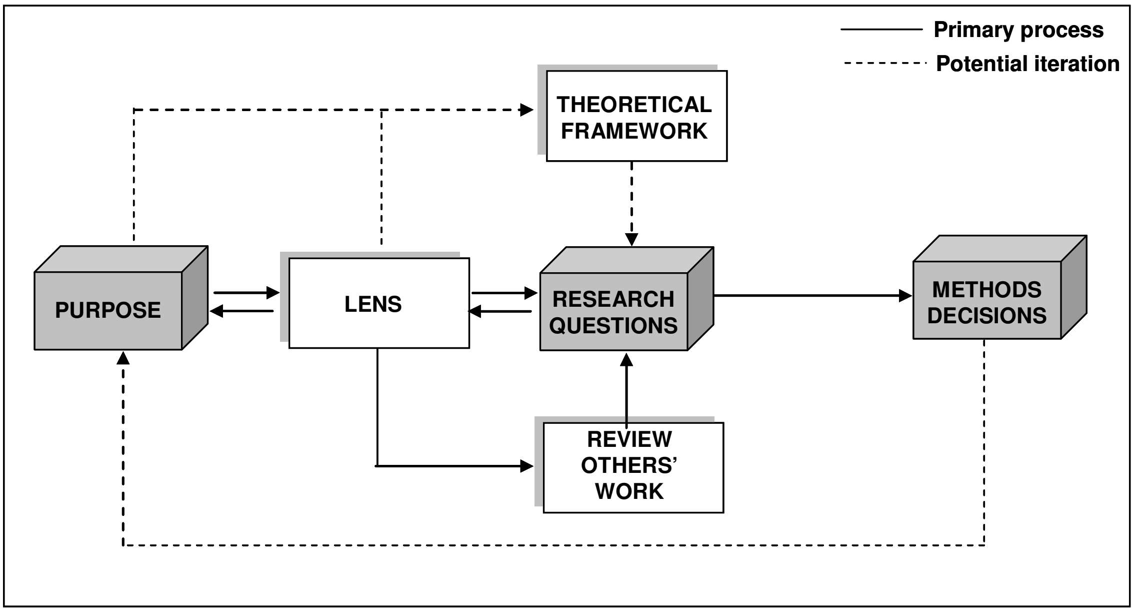
1.3 RESEARCH METHODOLOGY

In this section, I describe the research process (or framework) by which the research activities were executed to address the research aim and research questions. The first section gives the motives for selecting the particular research methodology, while the second section describes the research framework adopted for this study and the third section details the research methods followed.

1.3.1 Selection of research methodology

In his book *Research design: Qualitative, quantitative, and mixed methods approaches,* Creswell (2002) stresses the importance of adopting a general framework to provide guidance to the different facets of a particular research study. Newman et al. (2002: 174) emphasise the concept of “thinking through the research process” which they depict as a six-component process shown in Figure 1.1.

I regard *design science* as the primary strategy of inquiry for this study, so consider research processes that specifically focussed on design. Bots (2007), for example, provides a conceptual framework for design science within complex social-technical systems, which are also relevant to complex social-ecological



Source: Newman et al. (2002: 174)

Figure 1.1 Newman's generic research process

systems (SES)[1] such as the coastal marine environment (Adger et al. 2005). Bots (2007) views the design research process as a sequential transformation process among four elements:

- A problem (CP) or need;
- Design problem formulation (DPF) – an abstract description of the problem in terms of means and ends;
- The design (D), where available knowledge is used to make a design, which is a representation of an artefact, the environment within which it will be realised and the actions (or tasks) required to realise the artefact; and
- Realisation of the artefact (A) (i.e. solving the problem or addressing the need).

Comparing the generic research process of Newman et al. (2002) and the design science framework of Bots (2007), the former explicitly acknowledges the contextual element in research (represented by the 'lens') influenced by a researcher's field of expertise, for example. The Newman-process also emphasises the importance of placing research in an appropriate theoretical framework, and in the context of previous work conducted in a specific field. Bots (2007), on the other hand, refines the method decision element of Newman et al. (2002) for a design-science process which is the primary strategy of inquiry for this study. An adapted design research process is derived for this study by combining the complementary elements of the two approaches as depicted in Figure 1.2.

[1] Anderies, Janssen & Ostrom (2004: 18) define a social-ecological system (SES) as "… an ecological system [ecosystem] intricately linked with and affected by one or more social systems. An ecological system can loosely be defined as an interdependent system of organisms or biological units. Social, simply means 'tending to form cooperative and interdependent relationships with others of one's kind'."

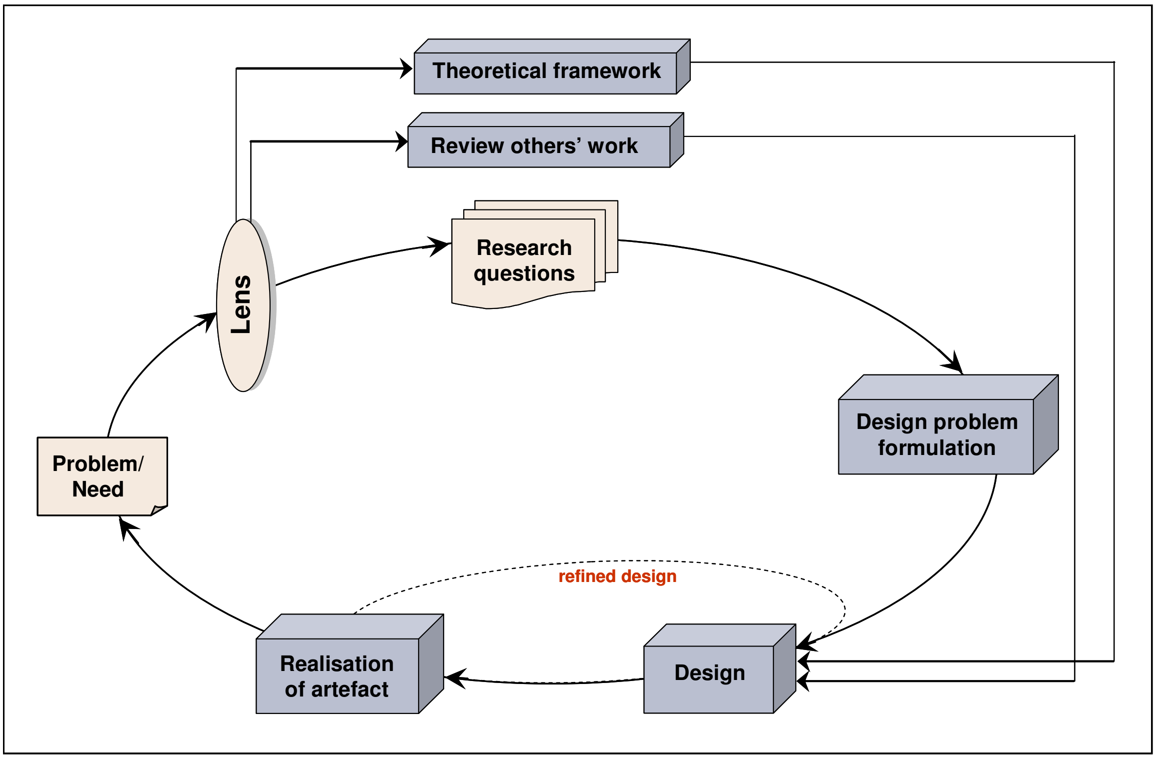


Figure 1.2 Adapted design-science research process for this study

Within the context of this adapted design-research process, the detailed research framework for the study is presented in the next section.

1.3.2 Detailed research framework for this study

In the adapted design-science research process the research aim, presented in Section 1.2.3, captures the problem or need for this study. The lens – symbolising the researcher's contextual perspective which influences the research approach and outcome – has been described in Section 1.2.2 and in essence the three-fold lens comprises:

- *Policy implementation* in the context of the broader policy process as described by De Coning (2006) and Glavovic (2009) and viewed from a practical management-orientated perspective which recognises important economic and social elements and interactions because this is the researcher's primary field of expertise;
- *Existing South African situation*, i.e. many pieces of the ICM puzzle, largely sector-based existing policies, legislative frameworks and implementation efforts pertaining to the coastal marine environment, although not organised into a workable, integrated system; and
- *Own knowledge, experience and insight* gained through research and consultation in marine water quality and estuary management in the Southern African context.

The research questions of the study, formulated in Section 1.2.3, address the research aim through the contextual perspective of the lens. Proceeding into the other elements of the adapted design science research process, the detailed research framework for this study is presented in Figure 1.3. Research activities (Table 1.2) corresponding with different elements in the framework are also highlighted. Country-specific information – represented by the researcher's own experience, consultation with other scientists and managers, as well as available information relating to coastal management in South Africa – provides the basis from which the design problem formulation is derived. A review of the evolution of ICM implementation contextualises this research within the international arena also highlighting future challenges in this field (review others' work).

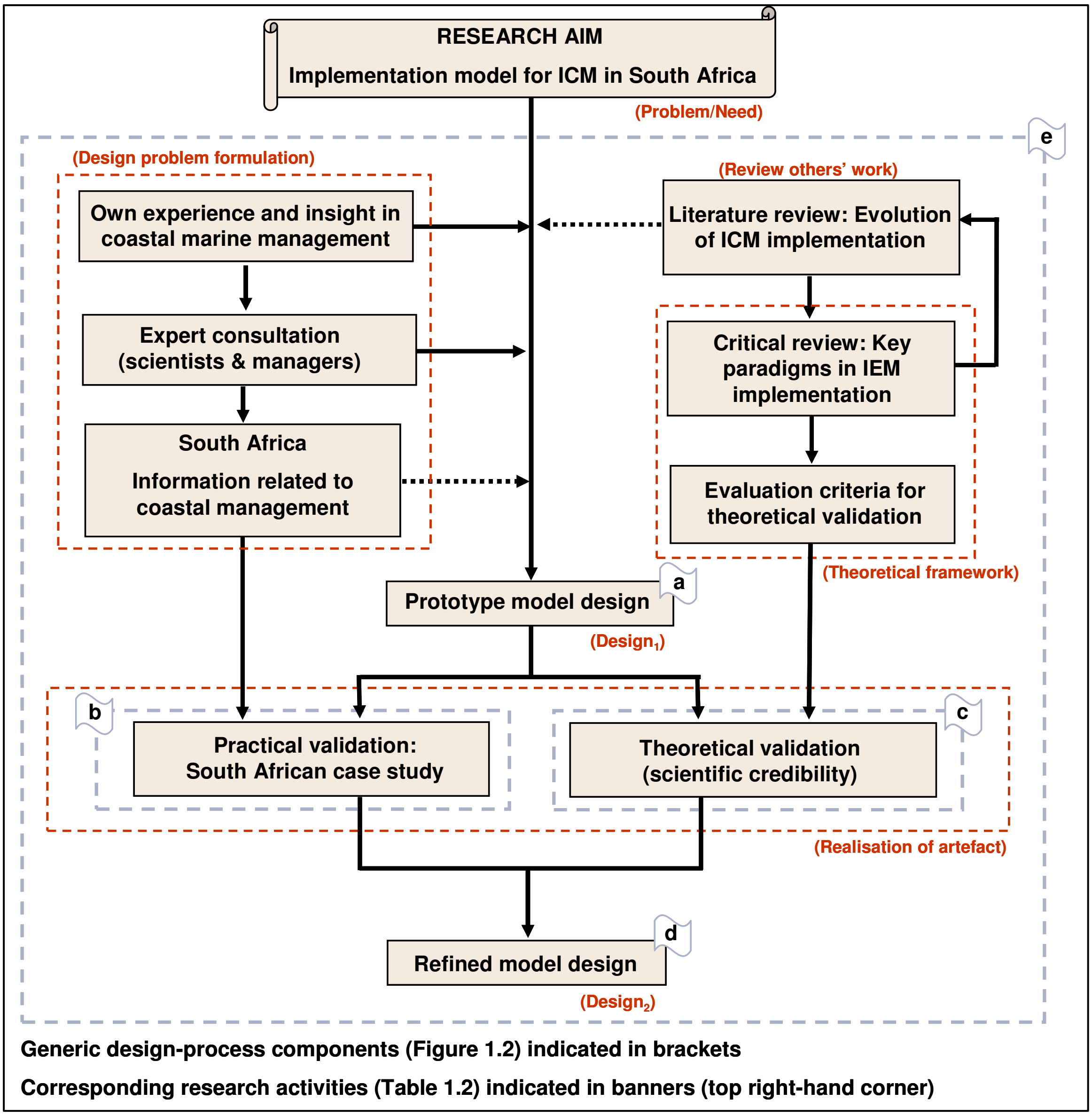


Figure 1.3 Detailed research framework for designing an implementation model for ICM in South Africa

The prototype model design (Design$_1$) primarily arose from a specific need to develop an implementation framework for South Africa's national programme of action (NPA) to protect the marine environment from land-based activities, an obligation that the country had to fulfil under the GPA. This initial design is largely derived from contextual knowledge, as manifested in the researcher's own experience and country-specific information, as well as guidance provided by the GPA, for example the document *Protecting coastal and marine environments from land-based activities: A guide for national action* (UNEP/GPA 2006).

The validation of the prototype design (Realisation of artefact) is achieved though: a) an *empirical (or practical) validation;* and b) a *theoretical validation*. For the practical validation, South Africa's national programme of action (NPA) – dealing with the management of land-based activities in the coastal marine environment – serves as case study.

The practical validation draws on the contextual, country-specific knowledge gained during the design problem formulation element (Figure 1.2). The theoretical validation draws on a critical scientific review (Chapter 3) on the implementation of IEM, the broader domain within which ICM is nested (theoretical framework in Figure 1.2). In particular, the review focusses on key paradigms[1] which contribute to improved implementation of IEM, some of which may not have been fully acknowledged in the implementation of ICM. A critical review on the evolution of ICM provides a means of determining the extent to which these key paradigms have been applied in the implementation of ICM. Finally, this knowledge is then used to develop evaluation criteria for the theoretical validation of the prototype design (capturing the essence of the theoretical framework). The outcome of the practical and theoretical validations is used to propose refinements to the prototype model design ($Design_2$).

1.3.3 Research methods

The methods that can be applied to conduct research are typically classified according to three generic approaches (Creswell 2002; Newman et al. 2002), namely the:

- *Quantitative* approach, where knowledge claims are usually based on postpositivist perspectives (e.g. cause-and-effect thinking, reduction to specific variables, use of measurement and observation and testing of theories), the strategies of enquiry includes experiments and surveys; and the collection and analysis of data are achieved by pre-determined methods;
- *Qualitative* approach, that characteristically use constructivist (e.g. multiple meanings of individual experiences, socially and historically constructed meanings, intending to develop patterns and theories) and/or advocacy/participatory knowledge claims (e.g. political, change-orientated, collaborative, issues-orientated) using strategies of enquiry such as storytelling[2] (Bailey & Tilley 2002), grounded theory[3]

[1] Paradigms are described as overarching sets of ideas constituting the conceptual basis of a specific domain. It reflects the deep structure of the domain in that it consists of ideas, perceptions, views and the underlying assumptions (Frantzeskaki et al. 2010).

[2] A form of meaning construction with the underlying premise being that individuals make sense of their world most effectively by telling stories. "In the qualitative paradigm, reality meaning is understood as …a representation [of reality] from one particular point of view" in contrast to the quantitative understanding of reality as truth, "…a social and physical reality which exists independently of our experiences of it'" (Bailey & Tilley 2002: 575).

[3] A qualitative research method in which the inquirer generates a general explanation (a theory) of a process, action, or interaction shaped by the views of a large number of participants (Creswell et al. 2007).

(Creswell et al. 2007) and action research[1] (Barkerville 1999; Dick 2002). Open-ended, emerging data are collected with the intent of distilling out characteristic concepts, categories and themes.

- *Mixed-methods* approach, where knowledge claims are primarily based on pragmatic perspectives (e.g. consequence of actions, problem-centred, pluralistic and real-world practice orientated) using strategies of enquiry that are sequential, concurrent and/or transformative procedures. Quantitative and qualitative methods are used to provide the database.

A design-science approach was selected as the primary strategy of inquiry for this study (as explained in Section 1.3.1). Within the design-science framework a mixed-methods approach is used because the specific focus of this research is orientated to real-world practice. Elements of a qualitative approach, such as action research, are used in the prototype design which is initially based on contextual (incomplete) knowledge (e.g. researcher's own experience and country-specific knowledge), but later improved and refined through validation processes. This sequential strategy of enquiry is appropriate for this research because of statements in the literature that stress the contextual nature of ICM implementation (e.g. Cicin-Sain & Knecht 1998) and the importance of considering country-specific knowledge (e.g. UNEP/GPA 2006). Such contextually designed prototypes can then be subject to finer, practical and theoretical scrutiny through validation processes following an incremental, adaptive approach. In the validation of the prototype design I incorporate quantitative research methods. Empirical information relevant to coastal management in South Africa is used to inform the practical validation of the prototype design to test its workability in the current South African context. Information is sourced from the scientific literature on the uniformities encountered in the effective implementation of IEM and ICM to inform the theoretical validation of the prototype in order to assess scientific credibility. The research methods are expanded on below.

The method applied in the development of the prototype design ($Design_1$ in Figure 1.3) involves the following:

- A review of ICM implementation models, specifically focussing on the information and guidance provided by the GPA in documents such as *Protecting coastal and marine environments from land-based activities: A guide for national action* (UNEP/GPA 2006) which, as one of the most recent international ICM implementation models, effectively consolidates international best practice on such matters; and
- My own knowledge, experience and insight (researcher experience) (Flyvbjerg 2001) in the field of coastal management, in particular marine water quality and estuary management, which I gained as scientific researcher and management consultant in the CSIR over the past twenty years. This

[1] A flexible spiral process which allows action (change, improvement) and research (understanding, knowledge) to be achieved simultaneously. The understanding allows more informed change and at the same time is informed by that change. People affected by the change are usually involved in the action research. This allows the understanding to be widely shared and the change to be pursued with commitment (Barkerville 1999; Dick 2002).

experience was also significantly influenced over the years, by colleagues at the CSIR as well as co-workers in government and other institutions.

The first iteration toward improving the prototype design is the empirical (or practical) validation (included in the realisation of the artefact in Figure 1.3). This is undertaken as a specific case study in South Africa focussing on the management of land-based activities. Even though the case study concentrates on management of land-based activities in the coastal marine environment, it is suitable – as it represents a sufficiently diverse range of activities and associated sectors (15 activities involving approximately 10 sectors) – for demonstrating the degree of compatibility in existing South African coastal management circumstances. Available information sourced through CSIR's information services, and the worldwide web and contributions from coastal marine scientists at the CSIR are used to describe the South African coastal marine milieu relevant to this case study. This information was verified by experts in coastal management in South Africa using the National Advisory Forum (NAF) – a medium specifically appointed by the South African government to oversee the NPA development and implementation process – as a platform (members of the forum are listed in Appendix A). Members include representatives of government departments (mainly from the national and provincial tiers) and non-governmental organisations having an interest in the protection of the coastal marine environment or the management of activities which may influence, or be influenced by, the state of the coastal marine environment. The forum is chaired by a representative from the national department responsible for the environment, appointed as South Africa's lead agent or coordinator of the NPA process. Inputs and comments from the forum members were sourced at NAF meetings (held on 27 April 2007, 30 October 2007, 28 February 2008 and 21 April 2008). The detailed output of this information-gathering exercise is captured in the document *South Africa's national programme of action for protection of the marine environment from land-based activities* of which I was the main author (DEAT 2008). Relevant aspects of the coastal marine environment, distilled from the above document, are reiterated in this dissertation in order to demonstrate the degree of compatibility of the prototype design. To demonstrate the degree of compatibility at the local level, the Saldanha Bay/Langebaan Lagoon system is used as an example. This particular system was chosen because first it is recognised as one of the coastal areas in South Africa where aspects of ICM have been implemented most successfully and, second because most of my own knowledge and experience on coastal management were gained through projects undertaken for the Saldanha Bay Water Quality Forum Trust (SBWQFT) in the area (e.g. Taljaard & Monteiro 2002).

The second iteration toward improving the prototype design is the theoretical validation (also included in realisation of the artefact in Figure 1.3). For this validation, evaluation criteria developed as part of this dissertation are applied. The criteria are grounded in a critical review of published scientific information (sourced through CSIR's information services and the worldwide web) on the implementation of IEM, the broader domain within which ICM is nested, centering on the key paradigms that significantly contribute to improved *implementation*, again reflecting the focus (or context) adopted for this dissertation (refer to Section 1.2.2). This knowledge is used to develop evaluation criteria to assess the scientific credibility of the prototype design (i.e. the theoretical validation). Critique and information generated through the validation process are used to propose a refined model design ($Design_2$ in Figure 1.3).

Finally, the experience gained in the application of the design-science research framework applied in this study (see Section 1.3.2) is employed to propose a practical and novel generic process for the design and refinement of country-specific ICM implementation models for wider international application (the last research activity in Table 1.2).

1.4 STRUCTURE OF THE DISSERTATION

This introductory chapter has provided the rationale as well as the research aim, objectives and research methodology of the study. Essentially, this study follows a design-research process as the primary strategy of inquiry, incorporating a mixed-methods approach, largely grounded in pragmatic perspectives (e.g. problem-centred, pluralistic and orientated to real-world practice).

Chapter 2 commences with a critical review of the implementation of IEM, the broader domain within which ICM is cased. The review focusses on the key paradigms that significantly contribute to improved implementation of IEM, some of which have not been fully acknowledged in ICM implementation. This is followed by a critical review on the evolution of ICM, particularly of the past two decades, and explores the extent to which the paradigms have been applied in ICM implementation. A brief overview on integrated water resource management (IWRM) − a practical management approach strongly aligned to that of ICM − is then presented. Finally, evaluation criteria applicable in the theoretical validation of a prototype model (initially based on contextual knowledge) are derived to assess the model's scientific credibility.

After the critical review (Chapter 2), the subsequent chapters encompass:

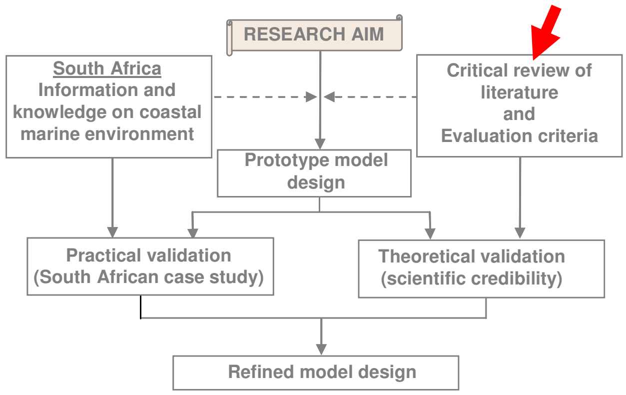
- An overview of South Africa's coastal marine environment (the playing field) (Chapter 3);
- The design of a prototype model for the implementation of ICM in South Africa (Chapter 4); and
- An empirical validation (assessing practical compatibility) and a theoretical validation (assessing scientific credibility) leading to a refined model design based on the outcome of the validation and finally, a proposed process for the design and refinement of country-specific ICM implementation models (Chapter 5).

In the concluding chapter (Chapter 6) the extent to which the research aim and the questions have been achieved is discussed and the new scientific understanding and knowledge gained through this study. Future research opportunities in the field are highlighted and specific actions to improve ICM implementation in South Africa are recommended.

A simplied version of Figure 1.3 (depicting the research framework) is inserted at the beginning of each chapter to orientate the reader. An arrow indicates the topic addressed in the specific chapter.

CHAPTER 2 UNIFORMITIES IN INTEGRATED ENVIRONMENTAL MANAGEMENT AND INTEGRATED COASTAL MANAGEMENT: CRITICAL REVIEW AND DEVELOPMENT OF EVALUATION CRITERIA

A critical review of scholarly achievements in the field of ICM is undertaken to provide the scientific context for this research. Stojanovic, Ballinger & Lalwani (2004: 274) in their review of ICM success factors state that "… it is interesting to note that a common goal behind these post-modern [sic] approaches to research is a desire to acknowledge that applications of ICM vary around the world with the variety of situations in which they are applied. Whilst this is an important point, it may be said that this is merely emphasising differences, as opposed to *uniformities* [own emphasis] that are found." While the practical validation of the prototype model design proposed in this dissertation aims to evaluate its country-specific workability, the theoretical validation aims to evaluate its scientific credibility which, in turn, requires an understanding of the generic uniformities that contribute to effective implementation of ICM worldwide.



In determining these uniformities, the net is cast widely to cover the key paradigms that contribute significantly to the improved implementation of integrated environmental management (IEM)[1], the broader domain in which ICM is encased (Section 2.1). One can justify this initial, broad assessment based on the understanding that the coastal marine environment is a component of the environment in general so that the generic paradigms applicable to IEM are also applicable to ICM, although some of these may not have been fully incorporated in existing ICM implementation models.

Attention in this chapter then turns to ICM, in particular to specify the uniformities already recognised in this domain, using the various paradigms as frames for reporting such uniformities. This is achieved by exploring the evolution in the implementation of ICM over the past two decades, as well as highlighting the challenges

[1] Nel & Kotze (2009) argue that the terms environmental management and integrated environmental management (IEM) have been used in many different contexts or meanings, as these evolved over time. For environmental management they quote a definition by Barrow (2005: 15), i.e. "…a process concerned with human-environment interactions, which seeks to identify what is environmentally desirable, what are the physical, economic, social and technological constraints to achieving this; and what are the most feasible options."

Further Nel & Kotze (2009) concluded that – referring to earlier work by Nel & Du Plessis (2004) – integration concerning IEM should include: integration between spheres of government; recognition of the integrated nature of the environmental management cycle; recognition to address all phases of projects or developments from planning, design, authorisation, construction, operationalisation through to post-authorisation verification of compliance, (e.g. monitoring and evaluation); integration of the use of various environmental governance strategies and tools; recognition of the human-environment system as a closed system; alignment of government policies and strategies across all spheres; alignment of administrative practices, procedures and instruments; integration between different spheres of government and their line functionaries; and integration of the environmental management cycle and the decision-making cycles in this process.

in this field to identify some plausible new uniformities. To gain perspective on practical management approaches strongly aligned with that of ICM, a brief overview on IWRM follows.

Reflecting on the critical review of key paradigms in IEM and the evolution of ICM, the final section reports on the derivation of evaluation criteria to be applied in the theoretical validation. The theoretical validation aims to determine the scientific credibility of an ICM implementation model, given that the implementation model was initially based on contextual knowledge.

2.1 KEY PARADIGMS IN INTEGRATED ENVIRONMENTAL MANAGEMENT

The selection of the key paradigms that contribute significantly to the improved implementation of IEM, was determined primarily on the basis of my experience in the implementation of environmental management and from the scientific literature. Using these information sources, ten paradigms considered to significantly contribute to improved implementation of IEM were identified. These are displayed in Figure 2.1.

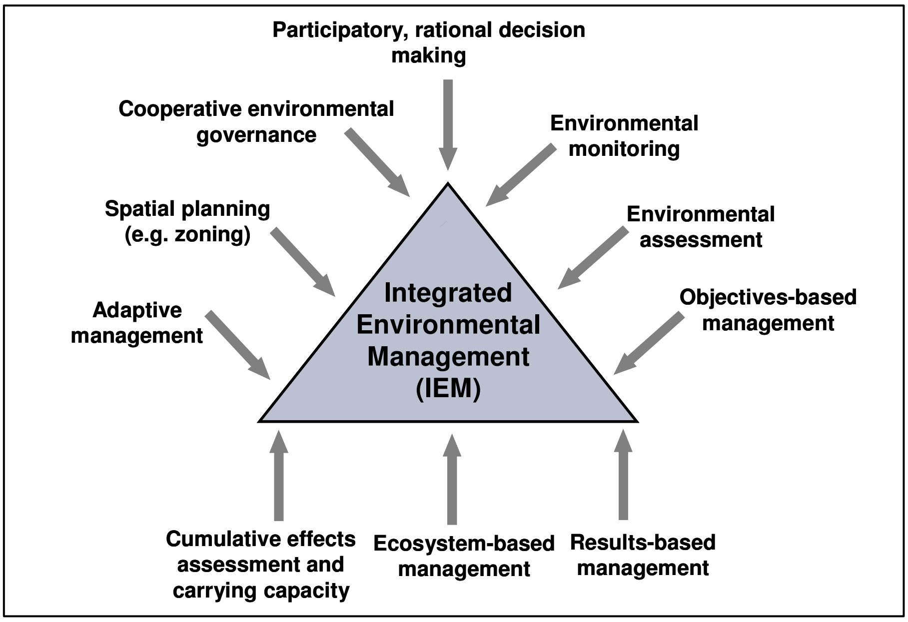


Figure 2.1 Key paradigms that significantly contribute to IEM

The theoretical bases of these ten paradigms are discussed in Sections 2.1.1 to 2.1.10. At the end of each section a bulleted list summarises the distinguishing characteristics of each paradigm so as to enable easy recognition of the applications of a paradigm in practice. Knowledge of the characteristics of the key paradigms is then used as the basis to identify them as possible uniformities in effective implementation of ICM as manifested in its evolution over the past two decades (Section 2.2) and to derive the evaluation criteria (Section 2.3).

2.1.1 Participatory, rational decision making

Participatory, rational decision making evolved from the field of economics (Simon 1955). "Traditional economic theory postulates 'an economic man' who in the course of being 'economic' is also 'rational'. This man is assumed to have knowledge of the relevant aspects of his environment which, if not absolutely complete, is at least impressively clear and voluminous. He is assumed also to have a well-organised and stable system of preferences, and a skill in computation that enables him to calculate, for the alternative courses of action that are available to him, which of these permit him to reach the highest attainable point on his preference scale" Simon (1955: 99). However, over the years it has become evident that the theory of rational-economic behaviour is not fully applicable to individual decision making as no decision maker can know all alternatives or consequences, nor are preferences stable. Responding to this realisation, Simon (1955) introduced the brother of 'economic man' referred to as 'administrative man', and the concepts of 'bounded rationality'[1] and 'satisfice'[2] (Simon 1957; 1991). At the level of individual decision making, these two concepts are manifested as limitations, namely cognitive and resource limitations (decision makers – like all other people – have a natural limited mental capacity and are therefore only able to cope within these limits and with a limited volume of information) and behavioural variations and biases (interpretations of what is seen and expected are affected by past experiences, by the availability of information and examples, by individual norms and values and by expectations) (Simon 1957; Kørnøv & Thissen 2000). The concept of rational decision making is challenged even more at the complex multi-actor level (March 1991; Kørnøv & Thissen 2000). The complexity at the multi-actor level stems from the divergent interests among actors[3] on the one hand and their divergent individual perceptions of reality on the other hand (Van de Riet 2003).

Within complex multi-actor settings, such as in environmental management, three cornerstones for realising progress in policy and decision making emerge as depicted in Figure 2.2. First, sound policy or decision-making debates depend strongly on knowledge that is scientifically valid but also relevant (Van de Riet 2003). The important role of valid science in global policy and decision making is well captured by Agre & Leshner (2010: 921) who state that "virtually every major issue now confronting society has a science and technology component, and this means that the need for general scientific understanding by the public has never been larger, and the penalty for scientific illiteracy never harsher." However, scientific information must be relevant to a particular situation because attention is viewed as a scarce resource (Kørnøv & Thissen 2000). Second, *appropriate process management* in which actors agree to abide by a process so as to achieve the 'most rational' decision-making outcomes (Van de Riet 2003), is essential. An adequate set of agreed-upon rules for interaction and decision making is a necessary condition for effective and efficient substantive deliberation between actors (Kørnøv & Thissen 2000). Last, participatory rational decision making requires stable, *participatory actor involvement*. Participatory approaches for decision making in complex multi-actor

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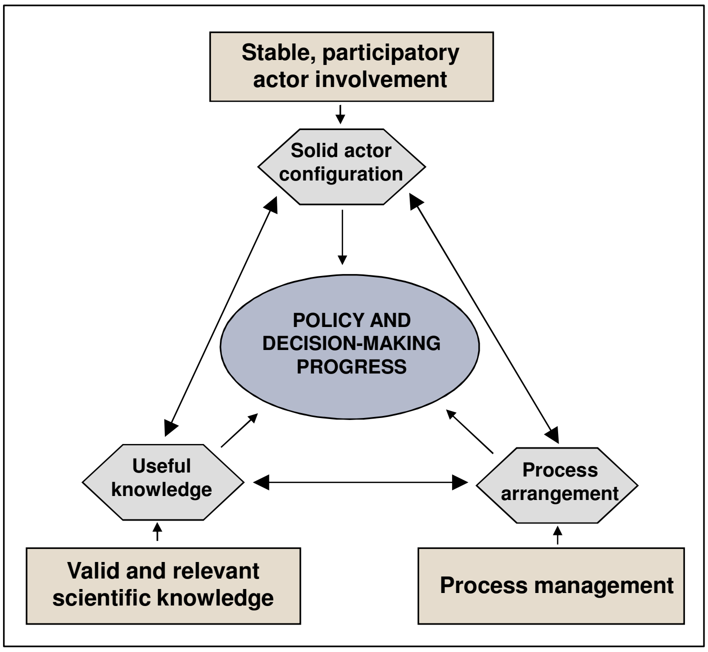
1 "… the [cognitive] limits upon the ability of human beings to adapt optimally, or even satisfactorily, to complex environments" (Simon 1991: 132).

2 "… organisms adapt well enough to 'satisfice'; they do not, in general 'optimize'." (Simon 1957: 261).

3 Actors refer to individuals or groups that all have their own interests and concerns in a resource, in this case the coastal marine environment. Some groups, e.g. authorities, control a part of the resource or control activities that may influence the resource, but are all necessary for effective policy implementation (Hermans 2005).



Source: Adapted from Van de Riet (2003: 4)

Figure 2.2 Conceptual model for realising progress in policy and decision making within complex multi-actor settings

settings are located somewhere on a continuum between consensus-oriented processes in pursuit of a common interest and compromise-oriented negotiation processes aiming at the adjustment of particular interests (Van den Hove 2006). Participative modes of interaction involve relevant actors in the policy preparation process, relevant parties being determined by their formal position (e.g. government authority), their control of relevant resources (e.g. money and expertise), their power to hinder or block implementation (e.g. lobby groups and implementers) or by their stakes in the issue (e.g. proponents of some policy) (Kørnøv & Thissen 2000). Debates on actor-based values (normative debates) are also important, primarily for increasing the mutual understanding of the viewpoints of different actors so as to adjust frames and to construct new joint views as a basis for action (Miser & Quade 1985; Kørnøv & Thissen 2000). In complex, multi-actor decision-making processes, recognition of the different types of roles and contributions – and different types of problem situations – is particularly important (Kørnøv & Thissen 2000). Solid actor configurations focus on achieving changes in the institutional characteristics (i.e. norms and ways of dealing with governance) of a decision-making network to enable stable patterns of social relations among actors to take shape around a specific problem or programme (Van de Riet 2003).

Summarising, the participatory, rational decision making paradigm is reflected in environmental management when the following characteristics are present, namely:

- *Valid and relevant scientific knowledge*;
- *Appropriate process management*; and
- *Stable, participatory actor involvement*.

Some of these characteristics may be shared by other paradigms in IEM and are not unique to the participatory, rational decision making paradigm as will become apparent in Table 2.1 and in the discussion of the following sections.

Table 2.1 Summary of the key paradigms that contributed to improved implementation of IEM and their associated characteristics

CHARACTERISTIC	PARADIGM									
	Participatory, rational decision making	Environmental monitoring	Environmental assessment	Objectives-based management	Results-based management	Ecosystem-based management	Adaptive management	Cumulative effects assessment and carrying capacity	Spatial planning	Cooperative environmental governance
Participatory, actor involvement	●		●	●	●	●				●
Valid and relevant scientific knowledge	●		●							●
Proper process management	●		●	●	●					
Cooperative institutional structures across tiers of government and sectors with clearly defined roles and responsibilities	●					●				●
Established compliance and results-based objectives, indicators and targets		●		●						
Monitoring and evaluation programmes measuring against predetermined objectives, indicator and targets		●			●		●			
Resource objectives set within the social-ecological system			●	●	●	●			●	
Geographical delineation of ecosystem management units and zoning of use areas						●		●	●	
Environmental management recognised as an iterative, adaptive process (learning-by-doing)							●			●
Acknowledgement of ecosystem limitation to support ecological, social and economic goods and services (e.g. carrying capacity and cumulative effects)								●	●	
An enabling legal framework										●
The development of education and awareness programmes										●
The development of capacity building programmes										●
Sound funding structures (financial support) for long-term sustainability										●

2.1.2 Environmental monitoring

The practice of monitoring dates more than 5000 years to the Egyptians who regularly monitored the grain and livestock production in their country (Kusek & Rist 2004). Monitoring comprises "a continuous function that uses the systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing development intervention with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds" (Kusek & Rist 2004: 12). Closely associated with monitoring, but distinctly different, is evaluation defined as "the systematic and objective assessment of an ongoing or completed project, program, or policy, including its design, implementation, and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact, and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned into the decision-making process of both recipients and donors" (Görgens & Kusek 2009: 2).

Environmental monitoring and evaluation (M&E) comprise three generic functions: *environmental description* (descriptive monitoring); *environmental regulation* (regulatory monitoring); and *results-based M&E* (Harvey 1984; Kusek & Rist 2004). Results-based M&E differs from traditional implementation-focussed monitoring (i.e. descriptive and regulatory monitoring) in that the former moves beyond an emphasis on inputs and outputs to an emphasis on outcomes and impacts (Linkov et al 2006). Results-based monitoring and evaluation became a powerful management tool assisting policymakers and decision makers to track progress and demonstrate the impact of a given project, programme, or policy. In recent years a results-based approach to monitoring and evaluation has been applied increasingly throughout the world instead of only applying the more traditional implementation-based approach adopted by many governments (Kusek & Rist 2004).

Therefore, the environmental monitoring paradigm is reflected in environmental management when the following characteristics are recognisable:

- *Descriptive* monitoring, aimed at gaining improved scientific knowledge and understanding of environmental systems;
- *Regulatory* monitoring, aimed at testing compliance against objectives as well as the effectiveness of policies and associated actions; and
- *Results-based* monitoring and evaluation, aimed at evaluating the impact of projects, programmes and policies against predetermined objectives.

The characteristics of the monitoring paradigm, therefore, echo the importance of valid scientific knowledge already encountered in the participatory, rational decision making paradigm, yet go further in specifying the type of knowledge considered relevant and valid in the monitoring paradigm (see Table 2.1).

2.1.3 Environmental assessment

Although rooted in rational planning theory developed in the 1950s, specific requirements for environmental assessment (EA) were first formulated in terms of the National Environmental Policy Act in the USA in 1969 (Jay et al. 2007). Before this, the consideration of environmental aspects in strategic and project decision making largely took place in an incremental manner. To remedy the unsatisfactory situation, formal

EA was introduced as a pro-active instrument for addressing environmental consequences before practical action. Typically, EA is undertaken at two levels (Fisher 2002), each discussed in the next subsections respectively:

- Individual project level (e.g. a marina development), referred to as *environmental impact assessment (EIA)*; and
- Plans, programme or policy level (e.g. a regional coastal development plan), referred to as *strategic environmental assessment* (SEA).

2.1.3.1 Environmental impact assessment

In essence, EIA is a systematic process for considering possible impacts and the environmental consequences of a proposed project (or action) before the decision making (Jay et al. 2007). The primary purpose of this *anticipatory, participatory environmental management* tool is to supply decision makers with an indication of the likely environmental consequences of their actions, so to support environmentally-sound development. The EIA process typically involves *scientific analysis* of the likely effects on the environment recorded in a report, followed by public consultation on the report and accommodation of comments in the final report when making the final decision. Finally, the public is afterwards informed about the decision (Fisher 2002; Jay et al. 2007).

2.1.3.2 Strategic environmental assessment

Wood & Djeddour (1989) coined the term strategic environmental management (SEA) (Partidário 2007). SEA is defined as a range of analytical and participatory approaches that aim to *integrate environmental considerations* into policies, plans and programmes and *to evaluate the interlinkages between economic and social considerations* (Partidário 1996). SEA is also referred to as the big brother of EIA and has been applied in countries worldwide (Fisher 2002). It does not constitute a substitute for traditional EIA project tools, rather it is complementary to these (OECD 2006). While being valuable and relevant at the individual project level, it has been found that the established EIA procedures, methods and techniques have only limited application at the level of policies, plans and programmes. SEA, on the other hand, allows for the integration of environmental considerations – alongside social and economic aspects – into strategic decision making at all stages and tiers of development (OECD 2006).

However, the theoretical foundations for SEA are still under development and there is no consensus yet (Herrera 2007; Bina 2007; Wallington et al. 2007; Partidário 2008). In their introductory paper in the special issue on SEA theory of the journal *Environmental Impact Assessment Review*, Wallington et al. (2007) captured some of the latest thinking on SEA, as well as future challenges. This was discussed in a conceptual framework for SEA comprising three elements. Firstly, the substantive purpose and values (i.e. the raison d'être) of SEA which originally was environmental sustainability, although debates have since oscillated between the original purpose versus the 'triple bottom line' interpretation of sustainable development (as simultaneously addressing social, economic and environmental values). There are arguments for and against extending the purpose of SEA to the triple bottom line interpretation. A benefit of extending the purpose of SEA is that the interpretation may promise to be politically advantageous and able to more broadly extend the influence of environmental assessment. However, a benefit of actively embracing the original, environmental purpose is that it distinguishes SEA from all other forms of strategic assessment. In recent debates, the pendulum is swinging toward the original purpose (e.g. Bina 2007). Accordingly, the challenges lie in articulating a constructive relationship between SEA and other processes which aim to influence strategic-level decisions, and in clarifying SEA's distinctive role in this important alliance (Wallington et al. 2007). Secondly, the strategies chosen to achieve the substantive purpose of SEA, identifies two ideal type strategies, i.e. procedural[1] and transformative[2] strategies. The procedural and transformative strategies are, however, considered to be complementary and mutually reinforcing, requiring creative synthesis, as dictated by a particular situation. This dual strategy of SEA is also articulated by Partidário (2008: 86) who states that "The new understanding of SEA finds support in arguments that planning is not about predicting the future, but it is instead about helping to shape the future! As such SEA is not so much about predicting the environmental impacts of plans, and the mitigation, but more about assisting planning process decisions in conceiving more environmentally sound plans, strategically promoting environmental opportunities and avoiding negative environmental consequences. ... SEA has a fundamental role in sustainability processes, and SEA should be flexible and adapted to the specific situation of application." Lastly, the mechanisms for the operationalisation of SEA (i.e. methods, techniques and tools) which largely depend on the type of strategy selected for a particular situation. Assuming some "creative synthesis" of the two "ideal type" strategies, the mechanisms should also be a "creative synthesis" between some kind of critical reflection associated with a political approach, and the systematic, disciplined methodologies characteristic of a more technical approach (Wallington et al. 2007).

Summarising, the environmental assessment paradigm is reflected in environmental management when the following characteristics are recognisable, namely:

- *Participatory, anticipatory management,* aimed at *informing decision making* (based on *sound scientific knowledge*) on environmental consequences before practical action (EIA); and
- *The integration of environmental considerations – alongside social and economic aspects –* into strategic decision making at all stages and tiers of development cooperation (SEA).

However, the means by which some of these characteristics are to be achieved are still under development. As for the participatory, rational, decision-making paradigm, actor participation, appropriate process management (requirement for anticipatory management) and sound scientific knowledge are important

[1] Assuming substantive rationality in decision making (e.g. looking for the 'best' means to achieve a given set of objectives) and procedural rationality, (e.g. decisions are improved by following a rational step-wise approach through problem formulation, identification of alternatives, assessment of impacts, etc.) with a clearly identifiable single decision maker or decision-making body makes a one-time key decision (i.e. a technical-rational model).

[2] Intentionally political, by raising environmental awareness at the political level, and by contributing to organisational learning thus aiming to contribute to the longer-term changes in the values, objectives, behaviours and practices of actors and institutions.

characteristics of the environmental assessment paradigm. The latter extends appropriate management processes to also include strategic management as indicated in Table 2.1.

2.1.4 Objectives-based management

Objectives-based management (OBM) or management by objectives (MBO) was first outlined by Drucker in 1954 in his book *The practice of management* (Drucker 1954). The core concepts, according to Drucker, are to avoid the activity trap of getting so involved in day-to-day activities that their main purpose or objective is forgotten. Also, instead of just the top-managers being involved, *all managers* should participate in the strategic planning process to improve the implementability of a plan, as well as in implementing a range of performance systems designed to help the organisation stay on the right track.

The concept of OBM was recently introduced to environmental management with the aim of integrating ecological concerns with national political structures and governance processes. OBM is essentially an outcomes-orientated management system. Objectives for a future (or desired) state of the environment are set. Politicians (or stakeholders) can determine environmental (or resource) objectives to be implemented and assessed by civil servants in national, regional, and local contexts (Edvardsson 2004; Wibeck et al. 2006). The objectives may be divided into three categories, including:

- *Ecosystem (or environmental) objectives*, which define the requirements of the ecosystem or a future state for the physical, chemical, and biotic environment;
- *Human use (social and economic) objectives*, which provide goals to ensure the sustainable use of (coastal) resources and space; and
- *Institutional objectives*, which provide a governance framework or strategy for management (Walmsley et al. 2007).

For each of the above, outcome indicators (with associated target values) are required, providing a *quantitative measure to assess the degree to which objectives have been met* or will be met for a specific plan, programme or policy (Walmsley et al. 2007). Management strategies (or programmes) are then developed to reach such objectives.

Walmsley (2004), in his review on the application of OBM in ocean (or coastal) management jurisdictions, found that, in general, this paradigm was only applied in a few ocean management programmes and that most initiatives focussed solely on fisheries and did not take other marine resources or uses into consideration. He concluded that OBM is a relatively new science in marine management programmes and that there is still much uncertainty in the application thereof, despite the recognition that the development of such objectives is important. Many of the initiatives focussed on the ecosystem component of marine management and neglected the social, economic, and governance components.

The objectives-based management paradigm is fully reflected in environmental management when three characteristics are present, namely:

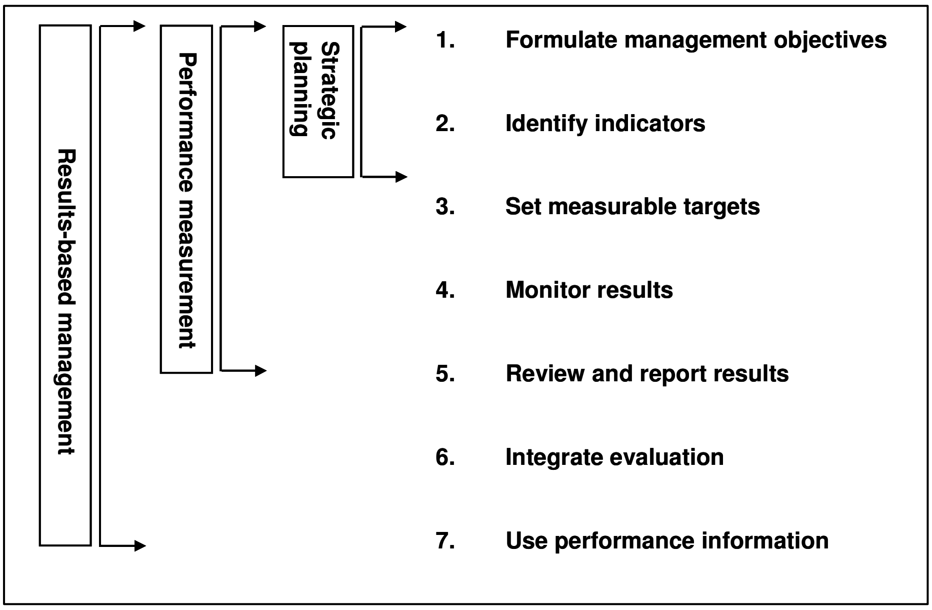
- A *participatory process* to set objectives involving all levels of management, pervading into the organisational system;
- Objectives *not only for the natural environment, but also including social, economic and institutional objectives*; and
- *Quantitative measures to test compliance*, using selected outcome-based indicators (and associated target values).

The importance of participatory actor involvement again comes to the fore in this paradigm, as in the paradigms discussed previously (participatory, rational decision making and environmental assessment). Results-based monitoring (testing compliance against indicators) also emerged as a main characteristic, similar to the monitoring paradigm indicated in Table 2.1. The objectives-based management paradigm, however, emphasises the importance of setting objectives at a holistic environmental scale (including the natural, social and economic domains).

2.1.5 Results-based management

Results-based management (RBM) is a management approach that some development cooperation agencies introduced in the 1990s (Binnendijk 2000). It is the management tool that succeeded impact assessment approaches such as environmental impact assessment (EIA), social impact assessment and economic assessments (e.g. cost-benefit analysis and social cost-benefit analysis), and was introduced to assess the environmental, social and economic consequences of development projects before they start (Roche 1999). A predecessor of RBM was the logical framework approach (LFA) which had its origin in the US military planning processes (Bakewell & Garbutt 2005), stemming from the *objectives-based management paradigm* (Dearden & Kowalski 2003). Embedded in the RBM approach is *result-based monitoring* (Kusek & Rist 2004). Today, LFA, and the closely related RBM approach, are the most common methodologies for the evaluation of development aid projects across the world (Roche 1999; Crawford 2003).

In essence, RBM approaches are focussed on achieving results (Ortiz et al. 2004). RBM "… rests on the tracing of causal connections between project inputs (or activities), outputs and objectives, with the latter divided into immediate objectives (or project purpose) and wider objectives (or programme goal)…" (Crawford 2003: 79). RBM comprises the seven distinct phases as presented in Figure 2.3. The first three phases or processes generally relate to a results-oriented planning approach, also referred to as strategic planning. Collectively the first five are usually included in the concept of performance measurement, while all seven phases combined are essential to an effective results-based management system (Binnendijk 2000: 10).



Source: Adapted from Binnendijk (2000: 11)

Figure 2.3 Seven phases of results-based management (RBM)

RMB approaches, such as LFA, are essentially focussed, inwardly-orientated approaches best suited to evaluating lower-level projects where clear outputs can be achieved within a specific time span and where quantitative data for evaluation are more readily available (Crawford 2003; Bakewell & Garbutt 2005; Dearden & Kowalski 2003; Muspratt-Williams 2009). The approach is, however, less suited to tracking performance at higher levels, e.g. within programmes and policies (Crawford 2003). Dearden & Kowalski (2003: 502) state that "One of the most important points to be stressed is that no log frame [alternative term used for LFA] should be an end in itself. Instead, it should be thought of as the product of a *participatory planning process* [own emphasis] that is user driven and objectives led."

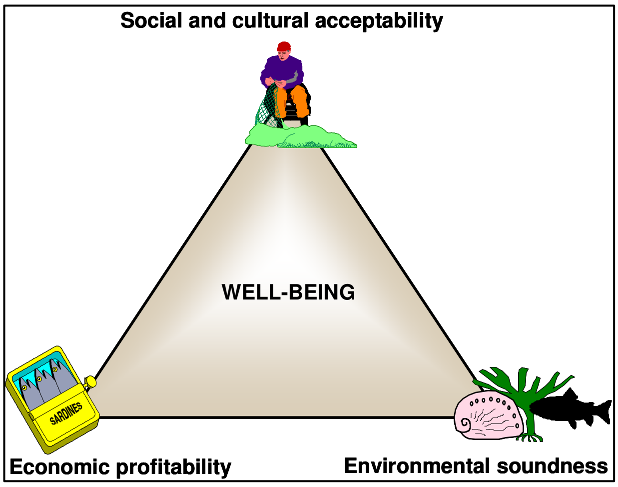
The results-based management paradigm is reflected when the following characteristics are recognisable, namely:

- *Participatory, actor involvement*;
- *Objectives* set to define the purpose of projects and goals of programmes;
- Appropriate *process management*, specifically at the project or programme level where quantitative data for evaluation are more readily available; and
- *Monitoring and evaluation* of progress towards the achievement of predetermined objectives based on preselected indicators and targets.

The results-based management paradigm combines characteristics from other paradigms to create a focussed, outcomes-based approach for management at project and programme levels. As do most of the preceding paradigms, this paradigm, as Table 2.1 shows, supports participatory actor involvement and appropriate process management. Further, the paradigm reflects characteristics encountered in both the objectives-based management paradigm (objectives setting) and the environmental monitoring paradigm (results-based monitoring).

2.1.6 Ecosystem-based management

Traditionally, management of natural resources and the environment is organised around specific uses or sectors such as fisheries, agriculture, water supply and demand, wastewater and housing development, each with their own governing structures (UNEP 2006). However, experience has shown that an exclusively sectoral approach not only results in conflict among different uses, but also in the ineffective and inappropriate use of valuable, and often limited, human and financial resources. This led ecosystem thinkers (e.g. Costanza 1998; Pretty & Ward 2001) to the realisation that natural resources and the environment can be managed much more effectively if the *ecosystem becomes central* and *management occurs through cooperative governance between different sectors* – referred to as ecosystem-based management (UNEP 2006). In essence, ecosystem-based management recognises that plants, animals and human communities are interdependent and interact within a particular physical environment forming *distinct spatial units* referred to as ecosystems (UNEP 2006). This approach recognises humans and development as an integral part of an ecosystem. However, development within this ecosystem needs to be sustainable, defined as development that "…meets the needs of the present without compromising the ability of future generations to meet their own needs…" (United Nations 1987:1). Thus, to be sustainable, human interaction (development) should be economically profitable, environmentally sound, and socially acceptable. These three considerations are represented as the vertexes of the sustainability triangle enclosing well-being as illustrated in Figure 2.4.



Source: Adapted from Moomaw (1996: 426)

Figure 2.4 The sustainability triangle

Moomaw (1996: 426) argued "that being near a vertex or along just one edge of the triangle will not produce a state of well-being, and is certainly not sustainable. Well-being is represented by the area enclosed within the plane of the triangle, and requires the presence of a successfully functioning culture (social environment), a sound economy, and an intact environment that is capable of delivering natural resources and ecosystem services. Promoting well-being in a sustainable fashion requires that a society be located somewhere in the interior of the triangle. Just where will depend upon the values of the society, the effectiveness of the economy, and the conditions imposed by the environment."

The ecosystem-based management paradigm is particularly aligned with the primary goal of ICM, namely "to achieve sustainable development of coastal and marine areas and reduce vulnerability, meanwhile improving the biodiversity, among coastal ecosystems" (Balchand, Mooleparambil & Reghunathan 2007: 19). To achieve this goal, it is necessary to protect the biodiversity and functioning of coastal ecosystems (i.e. the natural environment) so as to support important (beneficial) uses of the marine environment (i.e. social and economic values). Enhanced interaction between science and society is supported by moving from a centralised, top-down approach to governance to a decentralised regional and local approach to *resource management in which multiple stakeholder groups are involved*. Also, the incorporation of soft factors such as the values, attitudes, interests, and aspirations of stakeholders into the process is supported in this paradigm. If not, escalation of conflicts may ensue (Bruckmeier 2005; Weinstein et al. 2007).

The above exposition tells us that the ecosystem-based management paradigm is expressed in environmental management when the following characteristics are evident, namely that:

- The *ecosystem and its goods and services* (i.e. natural environment, social and economic dimensions) are placed *central* in the management process (versus sectors being central to the management process);
- The concept of *spatial scale* is incorporated, where plants, animals and human communities *are* interdependent and interact within distinct *spatial* units referred to as *ecosystems*;
- *Participatory actor involvement* (i.e. resource management in which multiple stakeholder groups are involved); and
- Management of the ecosystem is required to occur through *cooperative governance between different sectors and stakeholder groups.*

As with most others, this paradigm supports participatory actor involvement. Similar to the participatory, rational decision making paradigm it requires the establishment of multi-sector, cooperative governance systems as evidenced by Table 2.1. While the characteristics of the environmental assessment and objectives-based management paradigms do alert to the importance of managing the environment in its entirety, namely the natural environment, social and economic dimensions, this characteristic particularly comes to the fore in the ecosystem-based management paradigm. Further, this paradigm elevates the importance of the demarcation of the spatial boundaries of environmental management units.

2.1.7 Cumulative effects assessment and carrying capacity

Cumulative effects assessment (CEA) is an "integral part of environmental assessment at both the project and the more strategic level" (Therivel & Ross 2007: 365). In essence, CEA cuts across the environmental assessment processes (Ross 1998; Therivel & Ross 2007) and comprises four main steps, namely:

- Describe the valued ecosystem components (scoping);
- Determine existing and future human activities, as well as their causes and how these have affected and will be affecting the valued ecosystem components are determined (context);
- Predict the cumulative effects of the project or plan under investigation in combination with the effects of other human activities, as well as determining the significance of the effects; and
- Recommend management options to address these cumulative effects.

Important in the management of *cumulative effects* is the *selection of appropriate scales*, e.g. spatial extent, temporal scale and level of detail. If the scales selected for a CEA are inclusive, they enhance the ability to manage incremental (cumulative) effects of activities of which the effects may be insignificant at the individual scale (Therivel & Ross 2007).

A crucial concept in the context of cumulative effects is that of carrying capacity. McLusky & Elliott (2004) and Elliott et al. (2007) argue the importance of this concept, not only in its ecological context, but more appropriately concerning environmental and societal demands. Carrying capacity can be variously defined, such as:

- Ecological carrying capacity, for example the number of individuals in a population that the resource or habitat can support;
- Physical carrying capacity, referring to the number and types of activities that an area can spatially accommodate before the onset of change in environmental quality);
- Assimilative capacity, that refers to the waste or sediment load that a resource or habitat can accommodate before the species diversity and numbers are affected),
- Social carrying capacity, measured as the human population densities an area can sustain before numbers start to decline because of actual or perceived amenity decline; and,
- Economic carrying capacity, indicating the extent to which an area can be changed before the economic goods and services are adversely affected.

Carrying capacity acknowledges the need to consider cumulative effects and use changes in ecosystem services (whether measured by function or value) when evaluating consequences and trade-offs. Significant challenges remain in understanding the specifics of how different combinations of activities interact cumulatively and where nonlinearities exist in the way activities affect ecosystems. Still, these must be taken into account by management processes (Halpern et al. 2008). Mapping techniques can be applied for a realistic consideration of cumulative impacts on the environment (Ban, Alidina & Ardron 2010), effectively combining the paradigms of cumulative effects assessment and spatial planning (or zoning). Ultimately, the desired quality and acceptability of an ecosystem may be politically motivated and based on human beliefs, values and preferences. The desired quality and acceptability of an ecosystem may also change with time (Simenstad, Reed & Ford 2006). Therefore, in the environment carrying capacities are not fixed, static, or simple relations and are dependent on technology, preferences, and the structure of production and consumption (Arrow et al 1995). Ultimately, the resilience of natural systems may only be assessed by intelligent perturbation and response observation, also referred to as 'adaptive management' which is further discussed in Section 2.1.8.

The cumulative effects assessment paradigm and the concept of carrying capacity are reflected in environmental management when the following characteristics are present:

- *Cumulative effects* are considered when evaluating the environmental consequences and tradeoffs of goods and services within an ecosystem, thereby acknowledging *limitations* of the ecosystem to sustainably support different goods and services; and
- The *concept of scales* (e.g. *spatial* extent, temporal scales and level of detail) is incorporated.

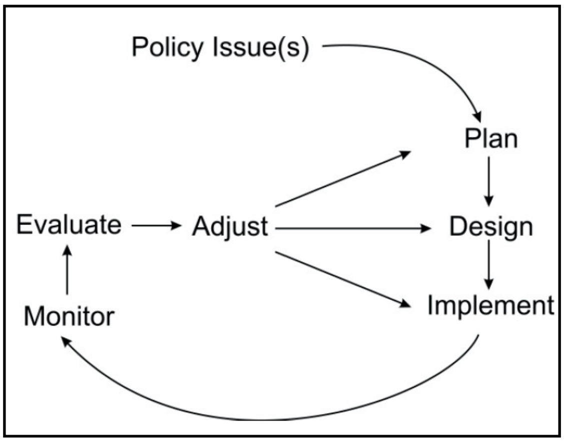
Despite being viewed by some as integral to the environmental assessment paradigm, this paradigm is distinctive in that it specifically addresses the concept of ecosystem limitations and reiterates the importance of considering spatial scales (similar to the ecosystem-based management approach in Table 2.1).

2.1.8 Adaptive management

"Current uncertainties in our understanding of ecosystems require shifting from optimisation-based management to an adaptive management paradigm" (Linkov et al. 2006: 92). The origin of the concept of adaptive management dates from the early 1900s when ideas of scientific management were being pioneered (Haber 1964; Bornmann 1999). In complex and dynamic environmental systems it is important to be realistic about the limitations of (predictive) environmental assessments, typically undertaken prior to action. Herein lies the value of adaptive management that "*builds on learning – based on common sense, experience, experimenting, and monitoring – by adjusting practices based on what was learned* [own emphasis]" Bornmann et al. (1999: 506). Adaptive management focusses on accelerating learning and adapting through partnerships finding common ground where actors learn together to create and maintain sustainable ecosystems to support human needs indefinitely (Bornmann 1999). Adaptive management adjusts for system changes, bifurcation, and the unexpected (Noble 2000). Central to the adaptive management paradigm are sound *monitoring and evaluation* programmes to support learning and adaptation.

A generic representation of an adaptive management cycle is provided in Figure 2.5 illustrating the important feed-back loop (or opportunity to adjust) from the monitoring and evaluation phases to the planning, designing and implementation phases of a specific practice. In this depiction of the adaptive management cycle, policy issues are viewed as external events. Adaptive management implementation models comprise

a) *reactive* adaptive management (or crisis management) driven by one or more external factors, like threats to human life or property; b) p*assive* adaptive management (management by monitor-and-correct) involving the implementing of a single policy or decision where anticipated outcomes or targets are established and monitoring and evaluation programmes are used to measure success; and c) *active* adaptive management, involving learning and adaptation through experimenting with alternative practices and management (Walters 1986; Hilborn 1992; Bornmann et al. 1999 and Gray 2006).



Source: Gray (2006: 4)

Figure 2.5 Adaptive management cycle

The adaptive management paradigm is incorporated in environmental management when the following characteristics are present, namely:

- An *iterative, adaptive approach* to management that builds on learning, i.e. doing-by-learning as a result of uncertainties in the understanding of ecosystems; and
- Sound *monitoring and evaluation* programmes to support learning and adaptation in the management system or model.

The adaptive management paradigm shares characteristics with the environmental monitoring paradigm as shown in Table 2.1. However, the adaptive management paradigm goes further and introduces the use of iterative, adaptive approaches as a requirement in managing complex systems.

2.1.9 Spatial planning

Jentoft & Chuenpagdee (2009: 7) have remarked that "What makes systems are their [geographical] boundaries as they delineate which components, relationships and interactions occur. System boundaries are actual as well as analytical, natural as well as socially constructed. These boundaries determine the scale of the systems, which could be small – like a lake for a natural system or a local community for a social system – or large – like a large marine ecosystem or a coastal industrial zone. At the boundary, relationships and interactions among system components would be fewer and less intense."

Spatial planning (or zoning) is one of the commonest systems of use control in terrestrial environments and it has the following well-defined characteristics (Courtney & Wiggen 2003):

- Zoning is a regulatory tool for the implementation of a plan which may be nothing more than a desire to reinforce existing patterns of uses, a general notion about separating incompatible uses or, ideally, a comprehensive plan for desired future use based on an understanding of the value and carrying capacity of the natural resource, economic trends, growth projections, societal needs, capacity of infrastructure, and interrelationships among uses and activities;
- Zoning is the division of a community into uniform districts or zones;
- Within each zone certain uses are permitted and others are not which is the essence of zoning, i.e. the segregation of incompatible uses so that different uses do not have adverse effects on each other. More recently, regulations also allow a mix of uses within a zone, under specified criteria designed to ensure compatibility and coexistence. Furthermore, refinements to conventional zoning have been developed to improve the protection of natural resources or better accommodate multiple management priorities;
- All properties within a zone are subject to the same set of regulations governing three principal factors: use, dimensions, and density. If a proposed use conforms to the regulations, a permit is issued. In more and more land-use zoning systems, the process of determining compliance requires a review of the proposal against a set of approval criteria that seek to ensure that the use is compatible with existing uses and has minimal impact on its surroundings; and
- Land-use zoning is comprehensive, though this is a relatively recent development. The precursors of contemporary zoning were limited to separating a few specific uses from the rest of the community. Now, almost universally, zoning covers entire jurisdictions and the complete range of uses and circumstances likely to be encountered. Zoning is relatively stable, but not static or inflexible. It can be changed and is changed to accommodate new objectives of the community or to respond to new information.

When focussing on the coastal marine environment, two concepts linked to the spatial planning paradigm are evident: ocean zoning and marine cadastre-based planning. They are expounded in the next two subsections.

2.1.9.1 Ocean zoning

Ocean zoning is a planning tool that emerged from the land-use planning methodologies developed in the 1970s (Agardy 2010). It has become a crucial step in making ecosystem-based, sea-use management a reality (Douvere 2008). Spatial management of ocean uses is not an entirely new concept. There are numerous historical examples − most being sector-based, such as ship channels, disposal areas, military security zones, concession zones for mineral extraction, aquaculture sites, and most recently marine protected areas (Courtney & Wiggen 2003; Douvere 2008).

There are a number of aspects that are unique to the application of zoning to the ocean. For example, the ocean is largely a publicly-owned resource, where all regulatory, management, or resource utilisation decisions are made in the interest of the public, while land zoning is typically the regulation of private property. Also, ocean zoning is more complex in that it needs to address and manage activities on the ocean's surface, in the airspace above, throughout the water column, and on and beneath the seabed. It is conceivable that one area of the ocean could support multiple uses (by different sectors) or several management objectives simultaneously and it is also possible that one use or environmental objective would preclude all others. Further, ocean zoning also has a temporal dimension, prohibiting uses for a period or on a seasonal basis (Courtney & Wiggen 2003).

In essence, there are two components to an ocean zoning plan: 1) a *map* that depicts the zones and 2) a *set of regulations or standards* applicable to each type of zone. For some zones the regulations might be very protective of marine resources or habitat by allowing very few compatible uses, and excluding any use that would undermine the goal of resource protection. In other zones where resource protection is less of a priority, more intensive use might be allowed based, presumably, on the suitability of the area for such uses (Courtney & Wiggen 2003; Agardy 2010).

Ocean zoning is by nature also cross-sectoral because its purpose is to allow activities within a zone that are compatible, making good economic sense (Norse 2008). If done coherently and with clear resource objectives in mind, spatial planning requires acknowledgement of and management for the *cumulative and interactive impacts* of different activities. Furthermore, zoning makes economic sense by providing an explicit approach to resolving conflicts and determining trade-offs (Halpern et al. 2008). Carton (2007) has confirmed the power of maps as a communication tool in a multi-actor context. Ocean zoning and the associated spatial analysis tools (e.g. GIS technologies and spatial multi-criteria analysis) serve the dual purpose of advancing the technical understanding of the management area under discussion and improving the ability to effectively engage actors in the process of environmental management (Courtney & Wiggen 2003).

In the coastal marine environment human activities occur over various spatial and temporal scales, as do the ecosystem processes with which these activities interact and affect. As a result, understanding the influence of an activity on the ecosystem (and its uses), requires not only knowledge on the intensity of the activity, but also on its spatial extent and frequency of occurrence relative to the ecosystem's spatial and temporal dynamics. Boundaries of coastal ecosystems are necessarily porous, no matter how large the ecosystem or how definitive the boundary. Processes from outside the defined area will inevitably affect the proximate ecosystem under management (Halpern et al. 2008). Therefore, to define meaningful *geographical boundaries of a coastal management unit,* these scale issues must be taken into account (Halpern et al. 2008). For example, specific aspects to consider in setting such boundaries include: The anticipated spatial influence of human activities and developments, both close to the activity (near-field) as well as at distant locations (far-field); Nearness of depositional areas where pollutants can accumulate – these can be at distant locations for specific sources, particularly where the source discharges into a very dynamic environment but subsequently the discharged material is transported to an area of lower turbulence, and; Possible synergistic effects in which the negative impacts resulting from a particular activity could be aggravated by another activity or even through interaction with natural processes (Taljaard, Monteiro & Botes 2006).

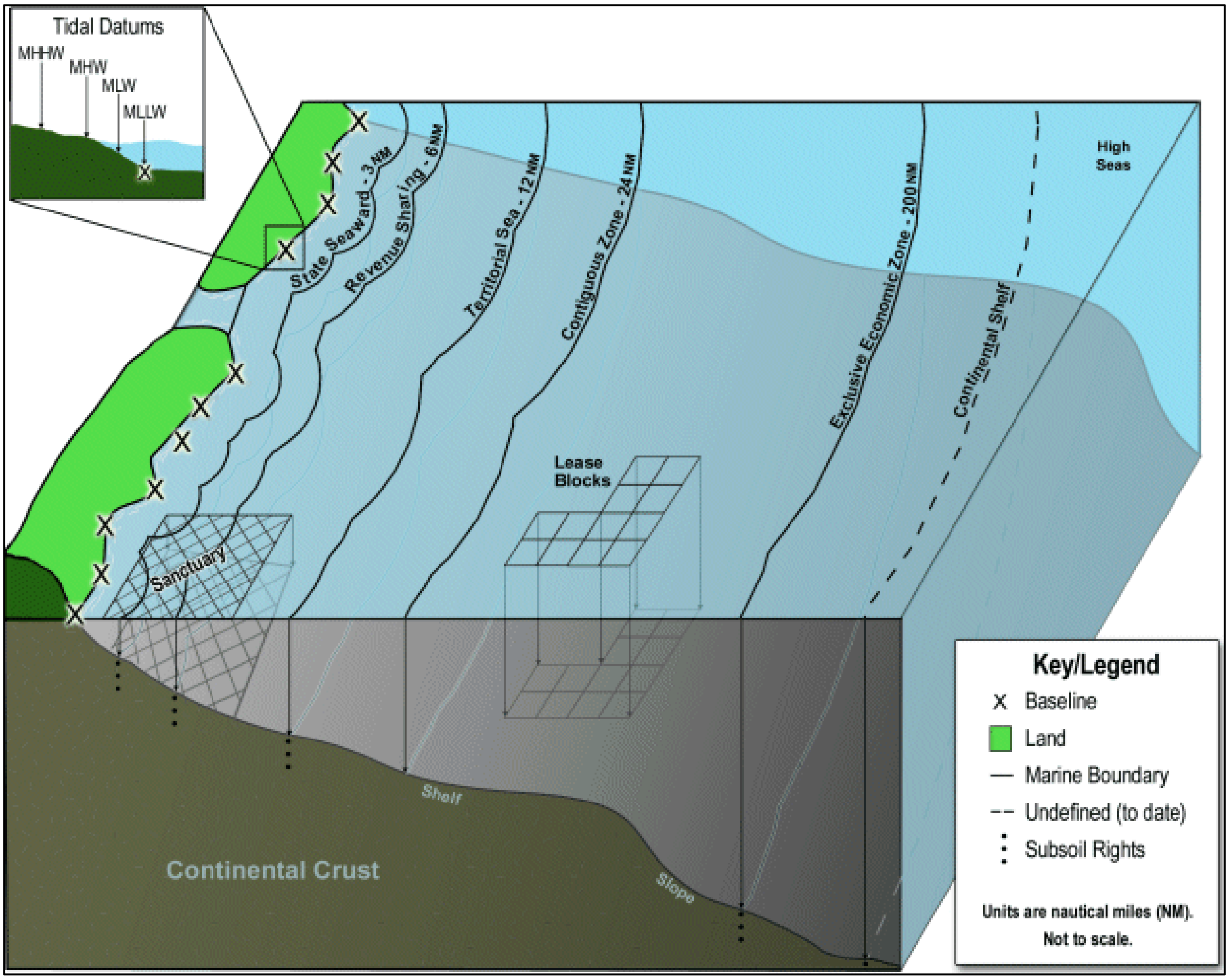
Spatial planning can occur at different spatial scales. For example, the Canadian ocean action plan comprise two spatial domains: Large ocean management areas (LOMAs) that comprise relatively large sections of oceans space aimed at addressing integrated management over larger and more complicated areas of ocean use; Nested within each LOMA is a network of smaller coastal management areas (CMAs) or other ocean management zones such as marine protected areas in which management issues that arise at local scale are addressed (DFO 2002; Mageau et al. 2005; Rutherford, Herbert & Coffen-Smout 2005; Guenette & Alder 2007; Walmsley et al. 2007).

2.1.9.2 Marine cadastre-based planning

Spatial planning within the coastal marine environment is also echoed in marine cadastre-based planning (Rajabifard et al. 2003; Ng'ang'a et al. 2003; Binns et al. 2004). In 1982 the United Nations (1982), through the United Nations Convention on the Law of the Sea (UNCLOS), made an attempt to streamline ocean governance by focusing nations' interests on their offshore resources and by providing a legal mechanism for a nation to extend its claim as far seaward as the continental shelf. UNCLOS created a complex three-dimensional mosaic of private and public interests. By superimposing national coastal management programmes, jurisdiction and administration issues, it became clear that associated three-dimensional spatial limits for decision-making purposes were crucial – leading to marine cadastre-based planning. In essence, the marine cadastre provides a means for *delineating, managing and administering legally definable boundaries* in the marine environment.

Examples of such boundaries include those demonstrated by Forse & Collier (2003), the various three-dimensional elements of which are depicted in Figure 2.6 and constitute the following five types:

- International maritime boundaries;
- Internal (landward) maritime boundaries;
- Federal or state boundaries within coastal waters;
- Administrative and jurisdictional boundaries such as those used to define marine protected areas, restricted fishing zones and other areas where operational restrictions apply; and
- Tenure boundaries such as those delineating mariculture or aquaculture leases, petroleum exploration and mining leases, cable and pipeline servitudes and areas granted under native title claims.



Source: NOAA (2009: 1)

Figure 2.6 An example of a marine cadastre plan

The practical outcome of the marine cadastre concept is the ability of users and stakeholders to describe, visualise and realise spatial information in the marine environment, where the marine cadastre describes the location and spatial extent of rights, restrictions and responsibilities which are visualised through the continual updating of accurate digital spatial data systems to enable users to realise them (Todd 2001).

In coastal planning and management, comparability between the marine cadastre and its land-based counterpart is important in bridging the gap between the terrestrial and marine environments (Widodo 2003). Aspects to consider include:

- Development planning for various types of urban, industrial and tourism activities;
- Waste disposal management from local farms, coastal residents, tourist or recreational users, which have outlets or run-off into the marine environment;
- Public health and safety issues involving oil companies, local residents and other marine users;
- Environmental issues between local residents, fisheries and environmental organisations;

- Commercial and recreational fishing activities within and around marine parks; and
- Commercial harvesting of living and non-living natural resources.

Summarising, the spatial planning paradigm captured in these two planning concepts is evident in environmental management when the following characteristics are present, namely:

- The identification of *common geographical boundaries for environmental management units* at the appropriate scales (e.g. national, regional and/or local) to facilitate effective, integrated management;
- The acknowledgement of *ecosystem limitation,* implicit in concepts such as ocean zoning and marine cadastre planning;
- A *means for delineating, managing and administering legally definable boundaries* in the marine environment; and
- The zoning of *specific uses and associated specifications or objectives* for the different zonal types (expressed either in terms of regulations, standards or target values).

Similar to the cumulative effects assessment and carrying capacity paradigm, the spatial planning paradigm acknowledges the importance of spatial scales in ecosystem limitation. However, the spatial planning paradigm also requires the setting of specific objectives for the different spatial units, a characteristic that it shares with objectives-based management paradigm in Table 2.1.

2.1.10 Cooperative environmental governance

In the 1990s the emerging environmental agenda engendered a growing awareness of the need to create social institutions to facilitate sustainable human-environment interaction, through the concept of cooperative environmental governance (Young 1997). In essence, cooperative environmental governance acknowledges the theory of pluralism, which in a general sense is the acknowledgement of diversity or difference (Paavola 2006). This same theory is also central to democratic political systems (Dahl 1961). Lijphart's (1999) book *Patterns of democracy*, distinguishes two types of democracy, the majoritarian (or Westminster) model and consensus (or consociational) model. The essential difference between these two types of democracy is best articulated in Lijphart's (1999: 1-2) own words: "Defining democracy as government by and for the people raises a fundamental question: who will do the governing and to whose interests should the government be responsive when the people are in disagreement and have divergent preferences? …One answer to this dilemma is: the majority of people. This is the essence of the majoritarian model of democracy. …The alternative answer to the dilemma is: as many people as possible. This is the crux of the consensus model."

A number of determinants within the cooperative environmental governance paradigm are particularly relevant to environmental (coastal) governance in South Africa, namely environmental law; institutional design; governing of common-pool resources; adaptive governance of social-ecological systems (SES); awareness raising and capacity building; and policy-relevant science and technology. Each of these six determinants is discussed separately in the next subsections.

2.1.10.1 Environmental law

Environmental law sprang from the confluence of two significant shifts in societal thinking in the 1960s (Plater 1994). The first – the Rachel Carson paradigm[1] – states that "although humans naturally try to maximise their own accumulation of benefits and ignore negative effects of their actions, a society that wishes to survive and prosper must identify and take comprehensive account of the real interacting consequences of individual decisions, negative as well as positive, whether the market place accounts for them or not" (Plater 1994: 982). The second – the pluralist paradigm – represents the shift in governance structure from "a bipolar market/regulatory government paradigm to a multipolar, actively pluralist model" (Plater 1994: 982).

The vast, continuous development of environmental law since the 1960s is the result of a structural change brought about by the confluence of the Rachel Carson and pluralist paradigm (Plater 1994). The establishment of environmental law created a consistent body of case law that recognised the broad legitimacy of environmental protection.

2.1.10.2 Institutional design

The key elements in the design of environmental governance institutions comprise a) structural and sectoral tiers; b) governance functions and their organisation; and c) formulation of key institutional rules according to which systems operate (Paavola 2006; Hague & Harrop 2007; Biermann & Pattberg 2008).

The hierarchical *structure* of governance ranges from the international level to the local level and constitutes the structural tier in environmental governance institutions, whereas the *sectors* or sector-specific actor groups (e.g. fisheries, water, waste management and mining) constitute the sectoral tier in environmental governance institutions (Hague & Harrop 2007; Biermann & Pattberg 2008). The two-dimensional concept of structural and sectoral tiers in institutional design is schematically illustrated in Figure 2.7. For example, an institution that operates across sectors, but at a single hierarchical level is termed a cross-sectoral institution. Alternatively, an institution that operates within a sector, but across several hierarchical levels is termed a multi-level institution.

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1 Rachel Carson's (1962) (a marine biologist with the United States Fish and Wildlife Service) book *Silent spring* is widely credited as the most important trigger of the movement that brought environmental consciousness to the fore.

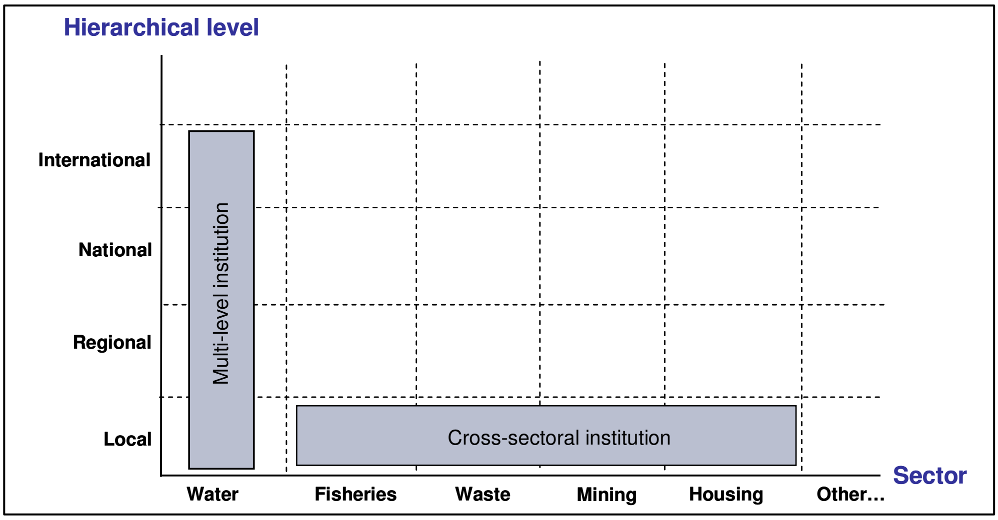


Figure 2.7 Hierarchical and sectoral tiers relevant in the design of cooperative environmental governance institutions

In cooperative environmental governance, there are a number of generic functions. General environmental governance functions include regulation of authorised resource users and distribution of benefits, exclusion of unauthorised users, provisions and the recovery of its costs, monitoring, enforcement, conflict resolution and collective choice (Ostrom 1990; Agrawal 2002; Paavola 2006). The organisation of governance functions occurs in three functional groups, which can both cut across or cohere with the existing structural and sectoral tiers. The three functional groups include i) The operational level where individuals make decisions within the constraints of operational rules (e.g. constraints imposed by regulations); ii) The collective choice level, where authorised actors make collective choices (e.g. deciding on constraints to be included in regulations) based on institutional rules; and iii) The constitutional level (e.g. decisions related to actors' authority and procedures) based on constitutional rules (Kiser & Ostrom 2000; Paavola 2006).

Finally, key institutional rules associated with different functions need to be formulated, including exclusion rules (determining, for example, prohibited activities), entitlement rules (key factors in determining environmental outcomes and the distribution of resource use benefits), monitoring rules (determining what is to be monitored and by whom) and decision making rules, determining whose interests are recognised, participants in environmental decisions, and the rules and procedures to be followed when making decisions. Although there are generic aspects to the design of cooperative environmental governance institutions, as described above, the detailed design is dependent on the specific situation, i.e. "the nature and scale of the governance problem, the institutional design of governance solutions, and its transaction cost implications influence the choice and performance of governance solutions" (Paavola 2006: 100). However, this complexity of formal governance solutions, and the associated division of labour and decision-making authority, should not be seen as obstacles for cooperative environmental governance. They create a system of checks and balances which spreads power, creates transparency and accountability, and fosters democracy in environmental management (Paavola 2006).

2.1.10.3 Governing common-pool resources

A major challenge in cooperative environmental governance is the governing of common-pool resources (Ostrom et al. 1999) which are classically referred to as the commons (Hardin 1968). Coastal marine ecosystems are acknowledged as examples of a common-pool resources (Ostrom et al. 1999). New institutionalism, coined by March & Olsen (1984) to denote a more sociological view of institutions – outside of the more traditional economic view – has informed a great deal of research on the governance of the commons (Paavola 2006). The governance of common environmental resources is increasingly based on *simultaneous, multi-level solutions* (e.g. at the local, national and international levels) which call for *innovative ways to accommodate and deal with institutional diversity*, for example, dealing with traditional national policies based on the enforcement power of the state in conjunction with solutions based on voluntary cooperation (Ostrom 2005; Paavola 2006). In common-pool resources interdependence causes environmental conflicts and pressure to be resolved by establishing, modifying or reaffirming institutions with the aim to strike a particular balance between conflicting interests (Pavoola 2006). Here the choice of governance institutions should be a "matter of social justice rather than of efficiency", reflecting both distributive (e.g. whose interests and values will be realised by the establishment, change or affirmation of governance institutions) and procedural (i.e. justifying the decisions to those whose interests and values are compromised and facilitating learning and transformation of values and motivations of actors) justice (Paavola 2006).

2.1.10.4 Adaptive governance of social-ecological systems

Folke et al. (2005) stress the importance of the social dimension of environmental governance. It often happens that natural scientists do the science first and governments set their agenda first, both parties underestimating the importance of complex social dynamics within social-ecological systems (SESs) such as building trust and power relations. The SES is also an adaptive process. Many long-lived SESs have adapted their institutions to the particular pattern of variability experienced over time as well as the broader economic, political and social system in which the systems are located. However, the adaptation to particular types of variability could make the system vulnerable to others, thus the importance of understanding such vulnerabilities in the adaptations of SESs (Janssen, Anderies & Ostrom 2007).

The social dimension of environmental governance (also referred to as adaptive governance systems) comprises four prerequisites, as highlighted by Folke et al. (2005) in their review of this topic. These prerequisite are that: All sources to *build knowledge and understanding* of the resource and ecosystem dynamics must be mobilised; *Ecological knowledge* must continuously feed into adaptive management practices; The system is characterised by *flexible institutions and multi-level governance* systems, and; It must deal with external perturbation, uncertainty and surprise. This implies that governance not only be in tune with the dynamics of the ecosystems under management, but it is also necessary to develop capacity to deal with change in climate, governmental policies and other externalities (combining the paradigms of cooperative environmental governance and adaptive management).

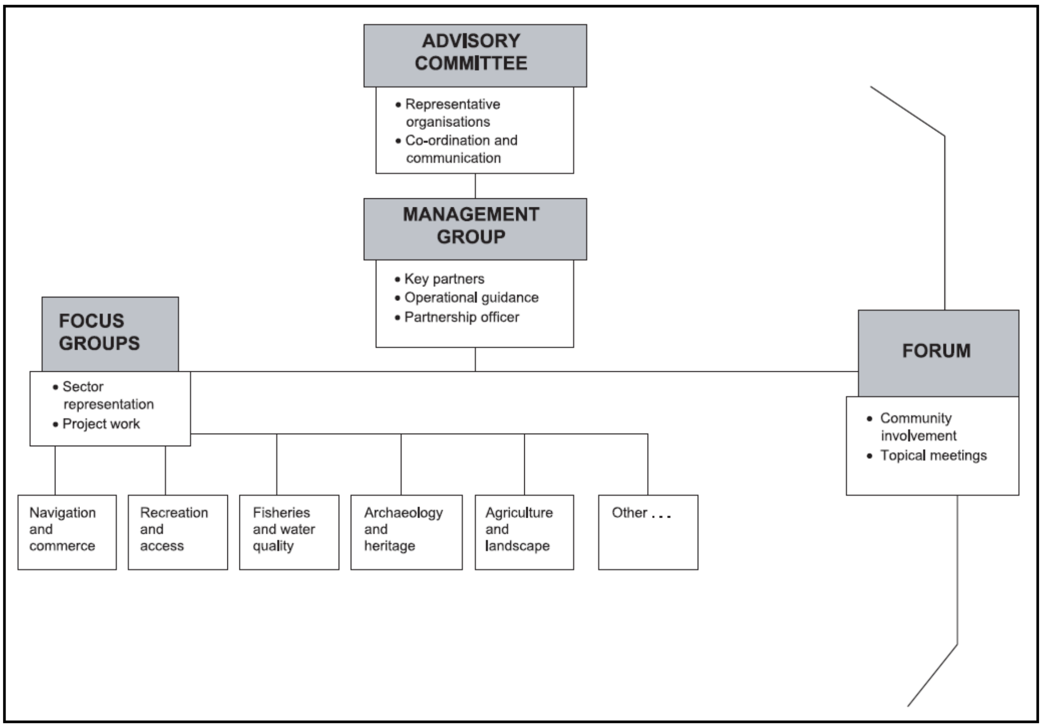
Glavovic (2008) has demonstrated the value of addressing social complexities in coastal governance with an example in Fiordland where a unique and globally significant marine environment along New Zealand's coast was facing increasing pressures from fishing and tourism, among others. This prompted a local community (including fishers, tourism operators, scientists, environmentalists, community members and representatives from the indigenous people) to explore alternative economic opportunities. Initial mistrust and suspicion were overcome by facilitated discussion which led to the establishment of the Guardians of Fiordland's Fisheries and Marine Environment Incorporated (the Guardians) that played an integral role in the successful implementation of integrated environmental management in the region. Challis & McCrone (2005) attributed the success of this institution to eight key factors (a useful point of reference for developing a conceptual foundation for adaptive governance of SESs):

- The process was community-driven as opposed to being led by government;
- A shared vision was defined for the area, focusing on common values and love for the system rather than sector-based interests;
- Information was shared and a common knowledge base was developed jointly (i.e. scientific and local knowledge were integrated, and in the process trust was built);
- A creative and independent facilitator was pivotal to overcoming differences and in securing agreements;
- The process was supported by government funding and technical expertise – enabling the community to function without being pressured by limited resources or dominant interests;
- Adequate time to develop trust in the process and in each other was allowed;
- Political support from both local and national government was present; and
- Professional support for administrative aspects (e.g. organising meetings and maintaining a transparent record of community consultation efforts) was provided.

Another model example is provided by coastal partnerships in the UK where many coastal initiatives are characterised by a partnership approach, reflecting the paradigm shift in the modern state toward more inclusive, participatory, joint governance (Stojanovic & Barker 2008). The structure of an example coastal partnership is illustrated in Figure 2.8. These partnerships are formed from different government agencies, local authorities, private sector organisations and interested bodies working together across the land-sea interface. Most coastal partnerships in the UK are run on a voluntary basis with financial support from partners (primarily local authorities and government agencies), similar to the Saldanha Bay Water Quality Forum Trust (SBWQFT) in South Africa (Van Wyk 2001; Taljaard 2006a).

2.1.10.5 Awareness raising and capacity building

Another central element of cooperative environmental governance is the *continuous development of awareness and capacity – through appropriate education and training programmes –* spanning local communities and extending to national-level politicians (Chua, Huming & Chen 1997; Olsen & Christie 2000; Cicin-Sain et al. 2000; Smith 2002; Le Tissier et al. 2004; Barker 2005; Hills et al. 2006).



Source: Stojanovic and Barker (2008: 347)

Figure 2.8 An example structure of a coastal partnership

Consequently, capacity development initiatives must be extremely varied to meet the diverse needs. Training must be tailored to match the requirements of target groups (Hills et al. 2006). Based on experiences in the Asia-Pacific region and with specific reference to ICM, Hills et al. (2006) consider three generic themes key to successful capacity development programmes, namely:

- Identification of training needs in terms of the specific requirements of target groups (i.e. the goals of the training);
- Development of an appropriate training style and approach as well as content to permit the delivery of the integrated knowledge and skills required for implementation (i.e. the structures and processes of the training); and
- Maximisation and measurement of the impact of training, and any associated ongoing sustainability issues (i.e. the outcomes of the training).

2.1.10.6 Policy-relevant science and technology

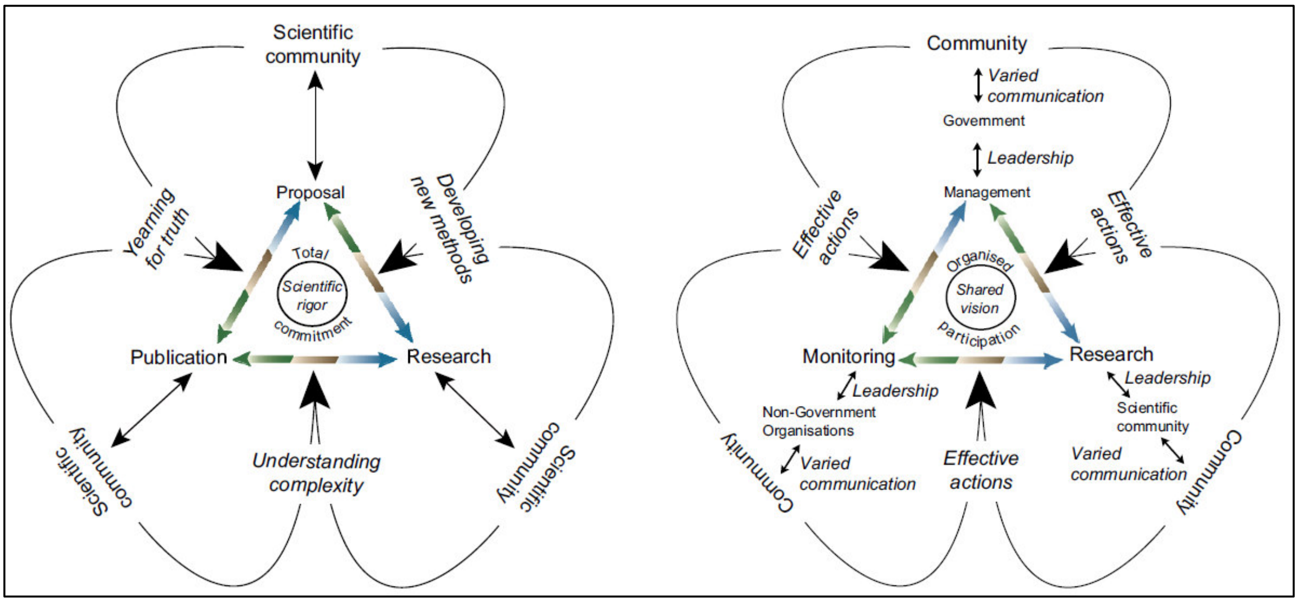
Cooperation between scientists and government has been part of the political agenda in the industrialised countries for well over a century. For example, during the industrial revolution scientific experts played a growing role in shaping governmental responses to a range of health, safety and environmental problems

(Jasanoff 1987). Until the 1960s, cooperation between scientists and decision makers appeared fairly unproblematic, but the era of innocence of policy-related science ended in the 1970s when "the environmental movement gathered momentum, focusing attention on hitherto unsuspected risks to health and the environment" (Jasanoff 1987: 200). At the time many scientific controversies arose where, for example, government officials responded to scientific assessments produced in-house without securing scientific support from outside government, failing to acknowledge the need for clear role separation between science and policy (Jasanoff 1995). In this context the idiom of co-production of science and policy evolved to support the notion that science and policy are two distinctly different activities following their own principles, but that they are interlinked and strongly influence one another (Jasanoff 2004; Knol 2010). There is increasing recognition that sustainable decision making needs to be based upon sound scientific evidence, also in coastal areas, exchanging transdisciplinary research and knowledge across environmental, cultural, social and economic science disciplines (Von Bodungen & Turner 2001; Stojanovic et al. 2009; Knol 2010). Such scientific knowledge and evidence should, however, be "insulated from the appearance of politics in order to play an effective role in certifying that its findings conform to standards judged acceptable by the scientific community" (Jasanoff 1995: 279). Because of the strong human ecological footprint in the current era – the so-called anthropocene –the next major scientific focus is probably going to be on sustainability (Dennison 2008).

Following a historical review of scientific progress, Dennison (2008) holds that the shift to sustainability will involve solving rather than just studying environmental problems. One of the key requirements of scientific problem solving involves interactions outside the field of science, including the development of a shared vision, agreed upon by scientists and other stakeholders. A schematic comparison of these complementary foci of environmental science is made in Figure 2.9. The shift toward problem-solving environmental science, strongly echoes key elements of other paradigms discussed earlier, such as participatory, rational decision making and management by objectives, thus calling for agreement on a shared vision (and associated objectives) among scientists and other stakeholders.

In summary, the cooperative environmental governance paradigm is represented in environmental management through:

- An *enabling legal framework* that recognises the legitimacy and the need for environmental protection;
- Appropriate institutional design for the governance of common environmental resources within *multi-level and cross-sectoral structures (incorporating different tiers of government across sectors)* that fulfil generic governance functions, but of which the detailed design is dependent on specific situations. This calls for innovative ways to accommodate and deal with institutional diversity;



Source: Dennison (2008: 193)

Figure 2.9 Key elements in studying environmental problems (left) versus solving environmental problems (right)

- Sound *funding structures or models* to sustain effective environmental governance and operationalisation at all tiers (i.e. national, provincial and local);
- *An adaptive process for governing of the social-ecological system*;
- Continuous development of *education and awareness, and capacity* as central elements of environmental governance; and
- *Co-production of science and policy*, supporting the notion that policy-related science and technology forms an essential component of environmental decision making and environmental problem solving, but that science is a distinctly different activity from policy and follows its own principles. These two activities are, however, interlinked and strongly influence one another.

The cooperative environmental governance paradigm supports participatory actor involvement, specifically through the design of multi-level, cross-sectoral institutions as indicated in Table 2.1. Further the paradigm supports an adaptive approach to managing the environment, as does the adaptive management paradigm. The characteristic of valuing relevant scientific knowledge is shared with the participatory, rational decision making paradigm and the environmental assessment paradigm. However, the cooperative governance paradigm goes further in specifying the requirement of an enabling legal framework and placing the focus on awareness and capacity building and sound funding structures.

Section 2.1 was devoted to discussing key uniformities in effective implementation of IEM, using different paradigms as the frames for such uniformities, and distinguishing the main characteristics for each paradigm, by exploring their theoretical bases. From Table 2.1 it is evident that several of these characteristics are not unique to a particular paradigm, but instead are shared amongst paradigms. For example, participatory actor involvement is a characteristic shared by the participatory, rational decision making paradigm, the environmental assessment paradigm, the objectives-based management paradigm, the results-based management paradigm, the ecosystem-based management paradigm and the cooperative environmental governance paradigm. In the next section the spotlight falls on ICM, particularly, to specify the uniformities already recognised in this domain and to highlight some of the future challenges to ICM implementation so as to be able to identify the possible new uniformities.

2.2 EVOLUTION OF INTEGRATED COASTAL MANAGEMENT

In this section the evolution of ICM over the past two decades is examined to establish the extent to which uniformities contributing to effective implementation of IEM (covered in Section 2.1) have been encountered in the implementation of ICM, using the different paradigms as the currency for reporting such uniformities.

Following a short discussion on the definition of ICM, a number of ICM frameworks and models that have been developed and applied internationally are reviewed and the paradigms incorporated in each are highlighted. I then reflect on the international learning from the ICM experience, the sustainability of ICM and the future challenges in three separate sub-sections. Finally, I recount the uniformities encountered in the implementation of ICM and identify possible new uniformities hinted at in the future challenges.

2.2.1 Definition of ICM

Before the twentieth century, utilisation of the sea was limited to a few purposes (e.g. fishing and navigation) that rarely influenced one another. Accordingly, the traditional sector-based approaches to ocean and coastal management sufficed. However, rapidly increasing use of the coastal marine environment created conflicts that could not be addressed adequately within sector-based management structures precipitating a need for an integrated approach to coastal management (Cicin-Sain & Knecht 1998).

What is now widely recognised in the literature as integrated coastal zone management or integrated coastal management (ICM) was conceived in the early 1970s as coastal zone management (CZM) and consolidated in the USA when the Coastal Zone Management Act was passed in 1972 (Cummins, Mahon & Connolly 2002; Tobey & Vlok 2002). This act set the scene for the first acknowledged national CZM programme, prompting other countries in the developed world to take an interest in coastal management. In the 1980s, the term 'integrated' was added when it became clear that the effective management of coastal areas requires an intersectoral approach. The main difference between the two approaches is that ICM is a more comprehensive approach than ICZM, the former taking account of all of the sectoral activities that affect the coast and its resources and dealing with economic and social issues as well as environmental (ecological) concerns (Post & Lundin 1996). The inclusion of ICM as one of the principal recommendations of Agenda 21, at the United Nations Conference on Environment and Development (UNCED) (the Earth Summit) in

Rio de Janeiro in 1992, gave the concept both international prominence and political legitimacy (Cummins et al. 2002; Tobey & Vlok 2002).

The Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) defined the overall goal of ICM as "to improve the quality of life of human communities who depend on coastal resources while maintaining the biological diversity and productivity of coastal ecosystems" (GESAMP 1996: 2). The concept of an integrated approach to coastal management incorporates four dimensions, namely:

- *Geographical*, taking account of interrelationships and interdependencies between the terrestrial, estuarine, littoral and offshore components of coastal regions;
- *Temporal*, supporting the planning and implementation of management actions in the context of a long-term strategy;
- *Sectoral*, taking account of interrelationships among the various human uses of coastal areas and resources as well as associated socio-economic interests and values; and
- *Political and institutional*, providing for the widest possible consultation between government, social and economic sectors and the community in policy development, planning, conflict resolution and regulation pertaining to all matters affecting the use and protection of coastal areas, resources and amenities (GESAMP 1996).

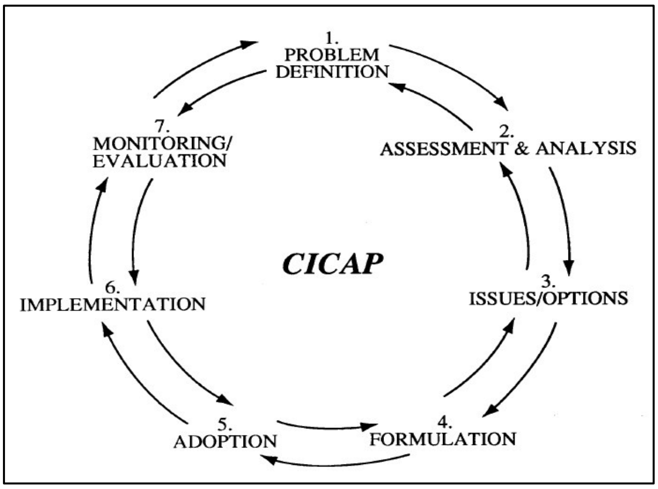
In principle, ICM provides an ability to balance development and conservation, to ensure multi-sectoral planning, and to facilitate participation and conflict mediation (Christie 2005). The essence of ICM is cleverly captured in the following quote: "Integrated [coastal] management and planning is essentially a simple and common sense approach to use, protect and conserve oceans and coastal waters" (DFO 2002: 9).

2.2.2 ICM implementation models and frameworks

As ICM gained international prominence and political legitimacy, especially through its inclusion as one of the principal recommendations of Agenda 21, the need arose for appropriate frameworks or models to assist countries across the world in its implementation. Eight prominent international examples selected from the literature are discussed next with the aim of illustrating the evolution of design frameworks and models in the planning and implementation of ICM.

2.2.2.1 Cross-sectoral integrated coastal area planning framework

One of the earliest conceptual frameworks for planning and implementation of ICM was prepared under the auspices of the International Union for Conservation of Nature and Natural Resources (IUCN) and is referred to as the cross-sectoral integrated coastal area planning (CICAP) process illustrated in Figure 2.10 (Pernetta & Elder 1993). Pernetta & Elder (1993) emphasise that this process is continuous and iterative, with intrinsic feed-back routes that allow for continuous reassessment and redefinition of actions in the seven elements as well as future changes in the coastal ecosystem.



Source: Pernetta & Elder (1993: 42)

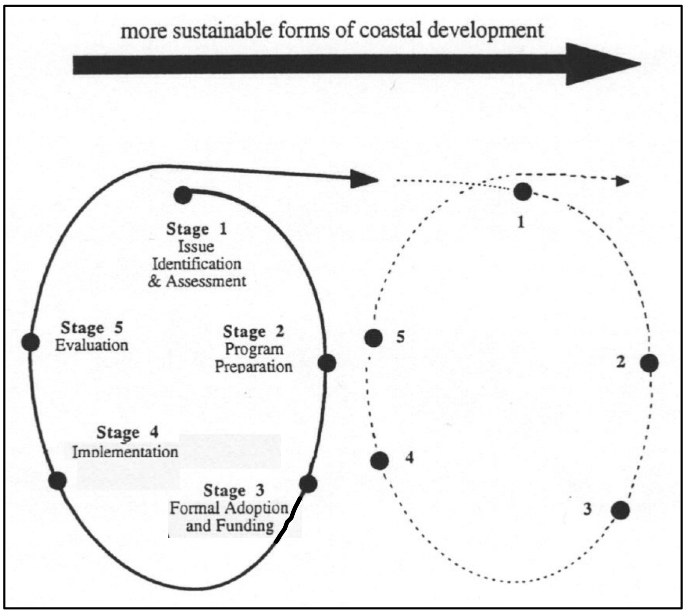
Figure 2.10 The cross-sectoral integrated coastal area planning (CICAP) process

The CICAP process includes seven elements considered to be "the irreducible, minimum discrete set of actions that must be undertaken in order to provide a planning and management framework which takes account of the uniqueness and complexity of each coastal location and planning situation" (Pernetta & Elder 1993: 41). In their opinion the process is able to accommodate the wide range of political, institutional and ocean-related spatial scales, at the same time providing a means of integration and resolving competing interests in the coastal area in a sustainable manner. The authors view this process as continuous and iterative, with feedback routes for continuous reassessment and redefinition, strongly supporting an adaptive management approach.

In my view the CICP framework (Figure 2.10) reflected a strong results-based management (or issues-driven) approach, recognising elements of the environmental assessment (assessment and analysis), environmental monitoring (monitoring/evaluation) and adaptive management (continuous and iterative process) paradigms (referring to Section 2.1). However, the framework is less explicit in reflecting the characteristics of paradigms such as participatory, rational decision making, ecosystem-based management, objectives-based management, spatial planning and cooperative environmental governance, although the latter may be inferred by the term cross-sectoral integrated in its title.

2.2.2.2 The ICM cycle

In 1996, the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) proposed their conceptual framework – the ICM cycle depicted in Figure 2.11 – by drawing on experience from programmes in different geographic and socioeconomic settings. The ICM cycle was primarily a modification of the CICAP process (Pernetta & Elder 1993) also incorporating the dynamic nature of ICM planning and implementation, with feedbacks among different stages that may alter the sequences of stages or the repetition of some stages.

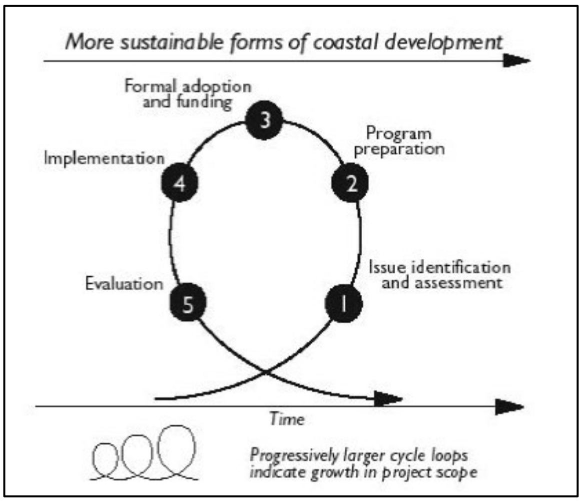


Source: GESAMP (1996: 6)

Figure 2.11 GESAMP's stages of the ICM cycle

Olsen, Lowry & Tobey (1999) later adapted the earlier design of GESAMP (1996), mainly in its graphic presentation here called the Olsen's ICM cycle (Figure 2.12).

Olsen, Tobey & Hale (1998) reiterated the cyclic nature of the ICM cycle allowing for a learning-based approach to coastal management, considering that ICM was a young endeavour for which not all answers were known. In this manner, progress toward effective coastal management and sustainable forms of coastal development can be made incrementally by analysing and learning from experience over several decades, thus also supporting a strong adaptive management approach (Olsen & Christie 2000).

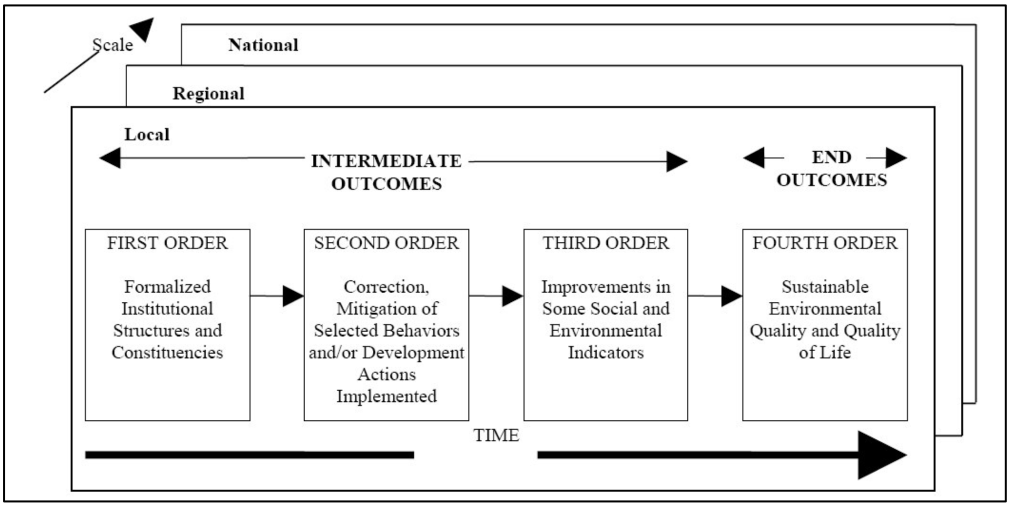


Source: Olsen, Lowry & Tobey (1999: 8)

Figure 2.12 Olsen's ICM cycle

Similar to the CICAP model, Olsen's ICM cycle explicitly acknowledges paradigms such as results-based management, environmental monitoring, environmental assessment and adaptive management. In the modified ICM cycle, Stage 2: Program preparation, encompasses a suitcase of numerous sub-tasks including the definition of a vision for the future, realistic and tangible qualities of the environment – supporting ecosystem-based management to some extent. Compared to the CICAP model, Olsen's approach is participatory, rational decision making. Cooperative environmental governance is inferred in the model, but not identified as an explicit component.

Olsen and his co-workers introduced the assignment of intermediate outcomes of initiatives as a sequence of achievements leading logically to the ultimate goal (or end outcome) of ICM to accommodate the fact that the time scales in which the ultimate goals are achieved lie beyond the duration of the first generation or first few generations of an ICM programme (Olsen, Tobey & Kerr 1997; Olsen 1998) (Figure 2.13).



Source: Olsen (1998: 617)

Figure 2.13 The concept of incremental ordering of ICM outcomes

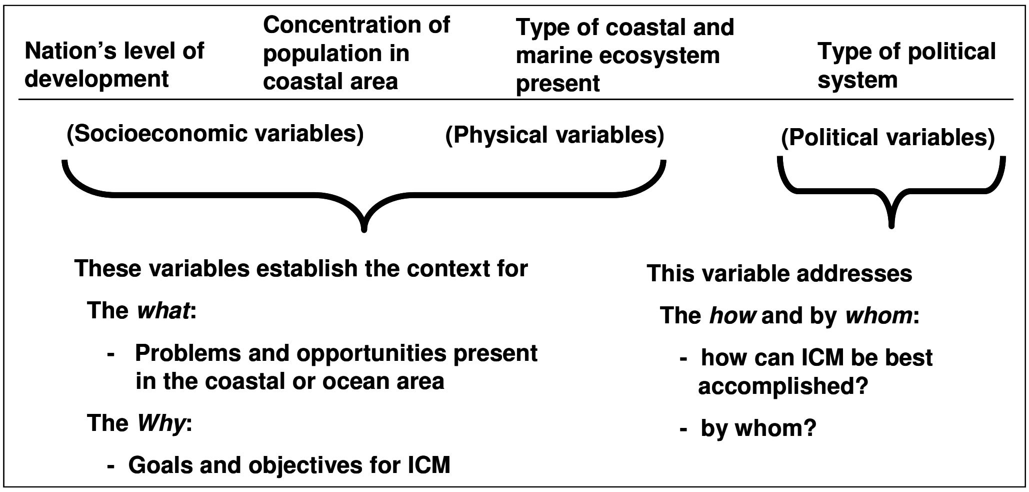
This incremental concept (i.e. intermediate outcomes being explicitly articulated throughout the management process) was visualised as the first-, second-, third- and fourth-order intermediate outcomes and is strongly embedded in the objectives-based management paradigm.

2.2.2.3 Cicin-Sain and Knecht's guidelines on ICM

Cicin-Sain & Knecht (1998) in their book *Integrated coastal and ocean management concepts and practice* specifically stress the notion that ICM is not a "…one size fit all concept" (Cicin-Sain & Knecht, 1998: 9) but rather it requires tailoring to country-specific needs. To this end the authors distilled a typology of ICM contexts (including socioeconomic, physical and political variables) captured by four variables (Figure 2.14), the argument being that this typology can assist countries in identifying the most relevant and applicable management model for ICM. The variables are:

- A country's level of development;

- Concentration of population in the coastal zone;
- Type of coastal ecosystems it contains; and
- Type of political system in place.



Source: Cicin-Sain & Knecht (1998: 122)

Figure 2.14 A typology of ICM contexts

The importance of correctly typing ICM organisational (or institutional) structures to facilitate its successful implementation was particularly well demonstrated in studies conducted in the People's Republic of China showing how organisational structure proposed internationally had to be altered to accommodate the country's specific political system (Chua, Huming & Chen 1997; Lau 2005). In particular, the institutional dimension of the ICM "…is designed to overcome the fragmentation inherent in single-sector management approaches (fishing operations, oil and gas development, etc.), in the splits in jurisdiction among different levels of government, and in the land-water interface" (Cicin-Sain & Knecht 1998:1). However, the authors stressed that ICM should not be viewed as a replacement for single-sector resource management, rather it provides a means of strengthening and enhancing existing management initiatives and gives a platform for conflict resolution across sectors, echoing Ostrom's (1990) so-called generic functions of cooperative environmental governance.

In their practical guide to ICM, Cicin-Sain & Knecht (1998) distinguish the following phases in the ICM process:

- Set the stage for ICM;
- Consider intergovernmental, institutional, legal and financial requirements ;
- Build the science and information base to inform ICM;
- Formulate and approve an ICM programme; and
- Implement, operate and evaluate the ICM programme.

For the implementation, operational and evaluation phases the authors considered aspects such as the securing of an *enabling legal framework*, *spatial planning*, the *involvement of interested and affected parties, public conflict management and consensus building,* and *monitoring and evaluation* as key components (Cicin-Sain & Knecht 1998). Therefore these authors, in their approach to ICM, specifically articulated the importance of paradigms such as participatory, rational decision making, cooperative environmental governance (specifically related to institutional design and appropriate scientific support) and environmental monitoring and touching on the importance of spatial planning, whilst being less expressive on paradigms such as ecosystem-based management, results-based management and adaptive management.

2.2.2.4 World Bank ICM guidelines

The World Bank guidelines on ICM (Post & Lundin 1996) were published in 1996 and supported three primary objectives, namely to:

- Strengthen sectoral management, e.g. through legislation, staffing and training;
- Protect and preserve biodiversity mainly through prevention of habitat destruction, pollution and overexploitation; and
- Promote rational development and sustainable utilisation of coastal resources.

In line with Cicin-Sain & Knecht's (1998) guidelines, the World Bank (Post & Lundin 1996) earlier acknowledged the need for countries to develop ICM models uniquely suited to the nature of their coastal areas, institutional and governmental arrangements and socio-economic conditions. A number of important, distinguishing characteristics of effective ICM were provided (Post & Lundin 1996) so that the prerequisites for effective ICM implementation are to:

- Move beyond traditional approaches which tend to be sector-orientated and fragmented, to managing the coastal marine environment as a whole using *an ecosystem-based approach* (ecosystem-based management);
- Establish a process that *advises government* on priorities, trade-offs, problems and solutions (results-based management);
- Create a *dynamic and continuous process* for administering the development, use and protection of the coastal marine environment and its resources toward *democratically agreed objectives* (adaptive management, objectives-based management and results-based management);
- Initiate a multidisciplinary, holistic process recognising *interactions between coastal systems and uses* (ecosystem-based management);
- Maintain a *balance between protection of valuable coastal ecosystems and coastal-dependent economies* (ecosystem-based management);

- Operate within established *geographical limits* as defined by government bodies (element of spatial planning and environmental assessment);
- Seek input from *important stakeholders* to establish policies of equitable allocation of resources (participatory, rational decision making);
- Set up an *evolving process*, often requiring iterative solutions to complex issues (adaptive management);
- Integrate sectoral and environmental needs – ICM should be implemented through *specific legal and institutional arrangements* at appropriate levels of government and the community (cooperative environmental governance);
- Provide *mechanisms to reduce or resolve conflict*, e.g. involving resource allocation or approval of licences and permits (environmental governance); and
- Promote *awareness at all levels of government and the community* about the principles and value of ICM (environmental governance).

Reflecting on the characteristics of the paradigms discussed earlier in Section 2.1 most of the features resemble those of key paradigms such as participatory rational decision making, objectives-based management, results-based management, adaptive management, ecosystem-based management and cooperative environmental governance and touch on the importance elements of spatial planning and environmental assessment. While the World Bank's guidelines do reveal characteristics of several key paradigms acknowledged to be effective in IEM implementation, they lack a conceptual, structured framework that articulates linkages between the different components to better guide implementation.

2.2.2.5 European Union ICZM recommendations

Recognising the urgent need for an integrated and strategic approach to the management of coastal areas of Europe, the European Commission advocated eight key elements for effective ICZM as part of the European Union's ICZM recommendation of 2002 (European Commission 2002), namely:

- Adopt a broad overall perspective (thematic and geographic) which considers the *interdependence and disparity of natural systems and human activities* with an impact on coastal areas (environmental assessment; ecosystem-based management);
- Adopt a long-term perspective which reckons with the *precautionary principle* and the *needs of present and future generations* (participatory, rational decision making; cooperative environmental governance);
- Apply *adaptive management* as a gradual process which will facilitate adjustment as problems and knowledge develop. This implies the need for a sound scientific basis concerning the evolution of the coastal zone (adaptive management; results-based management; cooperative environmental governance);

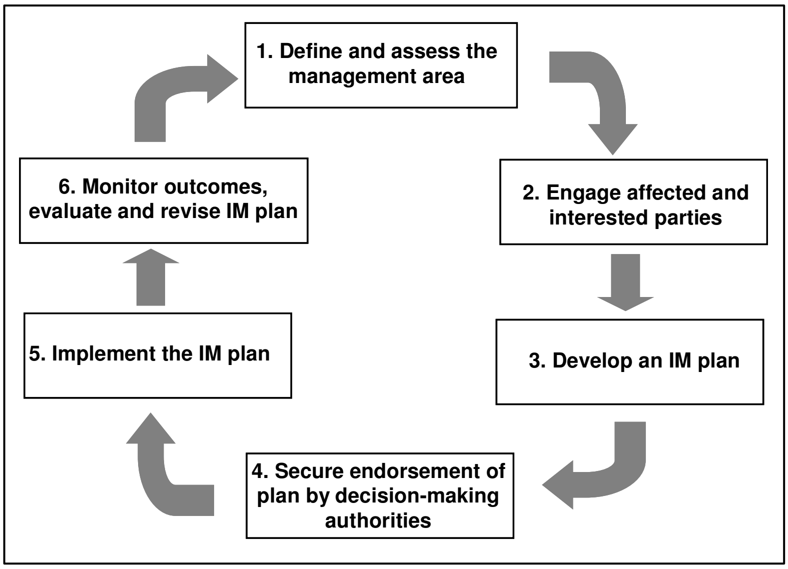
- Acknowledge *local specificity* and the great diversity of coastal zones, which will make it possible to respond to practical needs with specific solutions and flexible measures (adaptive management which recognises the contextual nature of ICM);
- Work with natural processes and respect the *carrying capacity of ecosystems* which will make human activities more environmentally friendly, socially responsible and economically sound in the long run (cumulative effects assessment and carrying capacity; ecosystem-based management);
- Involve *all the parties* concerned (economic and social partners, the organisations representing coastal zone residents, non-governmental organisations and the business sector) in the management process, for example by means of agreements based on shared responsibility (participatory, rational decision making; cooperative environmental governance);
- Support and involve *relevant administrative bodies* at national, regional and local level between which appropriate links should be established or maintained with the aim of improved coordination of the various existing policies. Partnerships with and between regional and local authorities should apply when appropriate (cooperative environmental governance); and
- Use a *combination of instruments* designed to facilitate coherence between sectoral policy objectives and coherence between planning and management (cooperative environmental governance).

These eight key elements of effective ICZM in the EU repeats some characteristics of the participatory, rational decision making, environmental assessment, results-based management, ecosystem-based management, adaptive management, cumulative effects assessment and carrying capacity and cooperative environmental governance paradigms. Notable is the European Commission's recognition of the need to address the carrying capacity of ecosystems in ICM. The key elements are, however, less expressive regarding the characteristics of the spatial planning, objectives-based management and environmental monitoring paradigms. A conceptual, structured framework articulating linkages between the different components to better guide implementation was also lacking.

2.2.2.6 Canadian implementation model

In 2002, Canada introduced its policy and operational framework for integrated management of estuarine, coastal and marine environments (DFO 2002) intended as a working document for the country's oceans management community. Their integrated management (IM) model comprises six interrelated stages as shown in Figure 2.15.

The Canadian IM model contains features of several of the important paradigms supported in earlier models such as participatory, rational decision making, environmental monitoring, environmental assessment, objectives-based management, results-based management, adaptive management and cooperative environmental governance.



Source: Adapted from DFO (2002: 24)

Figure 2.15 Canadian integrated management (IM) model

The Canadian model also recognises an important element of spatial planning, by introducing the concept of management areas (Stage 1). Specifically, the Canadian approach acknowledges that "each ecosystem interacts and nests within other ecosystems" (DFO 2002: 3), and that ultimately ocean and coastal management comprise a system of IM programmes, including a network of marine protected areas. Here a number of LOMAs were identified within which smaller CMAs could be nested. Importantly, the linkages between a CMA both to adjacent coastal landmass and waters and to the LOMA in which it is nested have to be considered. An important rationale for CMAs is to "enable local communities to play a stronger role in issues affecting their future by matching local capabilities and development priorities to the opportunities and carrying capacities of the local ecosystem" (DFO 2002: 19).

The selection of the management areas has to be based on ecological, economic and social considerations and for it to succeed the areas must be manageable, reflecting the responsibilities and jurisdictions of existing management authorities. However, the geographical boundaries have to include an area sufficiently large to provide an appropriate context for management at the ecosystem level (DFO 2002). Although the model did not explicitly include *zoning of use areas* (spatial planning) within the management units as a discrete element, supporting text notes the value of mapping existing and potential activities which, in conjunction with ecological assessments, can assist in defining threats and potential *cumulative effects* (supporting the paradigm cumulative effects). Mapping was also considered "relevant to address issues of multiple and conflicting use and aid in the application of ocean-use planning and zoning tools" (DFO 2002: 27). Although not identified as a discrete element in the IM model, the importance of an overarching vision and ecosystem-based and socio-economic objectives is acknowledged in accompanying text thereby supporting the ecosystem-based management paradigm.

2.2.2.7 Australian implementation model

Australia's oceans policy, adopted in 1998, positioned the country as a world leader in this arena (Haward & Vince 2009). Valuing the coastal zone as one of the country's most important assets led to the endorsement of their framework for a national cooperative approach to integrated coastal zone management in 2003 (NRMMC 2006). While recognising that different jurisdictions had different legislative and administrative frameworks for managing the coastal zone, this national cooperative approach sought "to address cross-border and sectoral issues, harmonise joint action towards management of common issues, and encourage investments from all jurisdictions" (Australian Government 2009a: 1). The framework envisaged two major outcomes, namely: a) managing coastal issues that are at the national scale and scope; and b) managing coastal issues where complementary arrangements will work better. To achieve these outcomes, priority issues were identified within two key themes; namely the catchment-coast-ocean continuum using an integrated approach and coastal issues for national collaboration. Table 2.2 expounds these two themes.

Table 2.2 Themes and priority issues identified in Australia's framework for a national cooperative approach to integrated coastal zone management

THEME	PRIORITY ISSUE
Catchment-coast-ocean continuum: an integrated approach	Integration across the catchment-coast-ocean continuum
Coastal issues for national collaboration	Land- and marine-based sources of pollution
	Managing climate change
	Introduced pest plants and animals
	Planning for population change
	Allocation and use of coastal resources
	Capacity building

Source: Adapted from Australian Government 2009a: 14

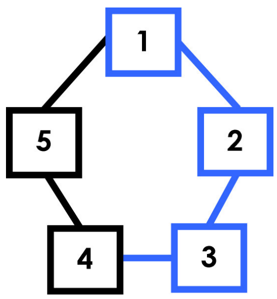
In 2006, an implementation plan for this framework was adopted in consultation with key stakeholders (NRMMC 2006). The implementation plan (or model) identified strategic priority areas linked to the priority issues identified in the framework and it set out implementation objectives and actions (addressing the objectives-based management paradigm) required to address the priority areas. Importantly, the actions identified in the implementation plan had to build, where feasible, on existing *management initiatives at all levels of government* through the efficient allocation of existing resources, i.e. it involves a cooperative environmental governance approach.

The implementation plan also recognised the importance of *environmental monitoring*, as do most implementation models discussed above. In accordance with the aim of building on existing initiatives, the implementation plan proposed that the national monitoring and evaluation framework that had already been established by the Australian National Resource Management Ministerial Council be used in this regard (NRMMC 2006). The purpose of the national monitoring and evaluation framework is to assess progress through the development of accurate, cost-effective and timely information on the health of the coastal resources (among others) and on the performance of related programmes, strategies and policies.

The Australian implementation plan (or model) advocated a particularly strong results-based management approach, explicitly *identifying priority areas and associated implementation objectives and actions* at a national level. While drawing upon important paradigms such as the adaptive management and cooperative environmental governance – as do most of the other implementation models – it is less supportive of the spatial planning paradigm compared with the Canadian IM model (e.g. the identification of manageable, management areas for implementation). Also, while noting the importance of ecosystem-based management, the identification of an overarching vision and objectives for the coastal marine environment (the resource) are not articulated as a key element within the implementation plan. A conceptual, structured framework articulating linkages between the different components to better guide implementation is not provided.

2.2.2.8 The GPA framework

A global programme of action for the protection of the marine environment from land-based activities (GPA) was adopted by the governments of 107 countries and the European Commission in 1995 expressing their commitment to preventing the degradation of the coastal marine environment from land-based impacts and threats (UNEP 1995). To assist governments, a best-practice guide entitled *Protecting coastal and marine environments from land-based activities: A guide for national action* was published in 2006, including an implementation framework or model (UNEP/GPA 2006). The flexible cyclical umbrella framework comprises five interlinked steps, each involving specific tasks as illustrated in Figure 2.16. The design, one of the most recent implementation models of its kind, applies to ICM, albeit design with the management of land-based activities in mind. The framework includes tasks such as initial preparation and identification of problems, identification of constraints and opportunities, the formulation of realistic strategies and actions and implementation of these and, finally, monitoring, evaluation and revision.



Developing realistic NPA actions (planning):

Step 1: Initial preparations

Step 2: Identification of problems, constraints and opportunities

Step 3: Formulating realistic strategies and action toward successful NPA implementation

Toward successful NPA implementation:

Step 4: Implement national measures and activities

Step 5: Monitoring, evaluation and revision

Source: Adapted from UNEP/GPA (2006: 32)

Figure 2.16 GPA's framework for integrated management of land-based activities in coastal management

Like earlier models, the vision and setting of (resource) objectives were not highlighted as explicit stages. Rather, the framework reflected a strong issues- or problems-based approach, as was the case with the CICAP model (Pernetta & Elder 1993) and the ICM cycle (GESAMP 1996; Olsen, Lowry & Tobey 1999). Similar to these earlier models, the GPA framework explicitly acknowledged paradigms such as participatory, rational decision making, environmental monitoring, environmental assessment, results-based management and adaptive management.

Although not explicitly articulated in the schematic framework design, the GPA guidelines introduced the concept of programme support elements (reflecting several aspects within the cooperative environmental governance paradigm) (UNEP/GPA 2006). These included aspects such as:

- Organisational arrangements to coordinate among sectors and sectoral institutions;
- Legal and enforcement mechanisms (e.g. need for new legislation);
- Financial mechanisms (including innovative approaches to provide continuing and predictable programme funding);
- Means of identifying and pursuing research and monitoring requirements in support of the programme;
- Contingency planning;
- Human resources development and education; and
- Public participation and awareness.

These aspects largely address the institutional structures and initiatives necessary for the successful operationalisation of a management programme.

2.2.3 Learning from the ICM experience

The variety of implementation models proposed for ICM and their applications reveals no international, generic blueprint for ICM that can be applied routinely to yield predictable and desirable outcomes. Rather, ICM models require continuous evaluation, learning-by-doing and site-specificity in their application. Learning-by-doing was viewed as a priority emerging issue by the GESAMP at their meeting in 1996 and they stressed the importance of documenting learning from ICM experience and developing evaluation methods to assist in this regard (Olsen, Tobey & Kerr 1997). In this section some of the important learning gained through ICM evaluation worldwide is assessed. The literature on this topic is so extensive that the assessment is limited to a selection of review articles published on the matter of ICM application spanning the period from the early 1990s to the late 2000s (e.g. Sørensen 1993; Olsen, Tobey & Kerr 1997; Cicin-Sain & Knecht 1998; Olsen 1998; Olsen, Lowry & Tobey 1999; Lowry, Olsen & Tobey 1999; Olsen & Christie 2000; Tobey & Vlok 2002; Stojanovic, Ballinger & Lalwani 2004; Yao 2008). This list is not exhaustive, but it punctuates significant contributions which highlight some of the key lessons learnt over these two decades.

2.2.3.1 Sørensen's review

One of the earlier reviews on the proliferation of ICM was Sørensen (1993) in which the following important characteristics of an (effective) ICM process became apparent:

- It is a *dynamic process* that continues over time (adaptive management);
- It has a governance arrangement to *establish multi-sectoral policies and make allocation decisions* (cooperative environmental governance);
- It uses *one or more management strategies* to rationalise allocation decisions (cooperative environmental governance);
- Its management strategies recognise the *relationships between coastal systems* (ecosystem-based management); and
- It has a *geographic boundary* with seaward and inland limits (spatial planning).

Even at the early stages of development, ICM reflected characteristics of several key paradigms encountered in IEM covered in Section 2.1, for example the adaptive management, cooperative environmental governance and ecosystem-based management paradigms. The reviewer acknowledged the importance of setting boundaries for the coastal system (spatial planning) but this paradigm was not explored further in this early review.

2.2.3.2 Cicin-Sain & Knecht's review

Cicin-Sain & Knecht (1998) reviewed patterns in the ICM programmes of twenty-two selected nations, ranging from developed through to developing countries. Whereas, in their opinion, it was difficult to find a general model of successful ICM because of the absence of objective evaluative information on the different ICM programmes, the authors distilled a number of requirements for the successful implementation of ICM, namely:

- National level coordination and intergovernmental coordination (cooperative environmental governance);
- Recognised value of the coastal marine environment (cooperative environmental governance);
- Long-range ICM planning and marine zoning (spatial planning);
- Combined ocean and coastal management (cooperative environmental governance);
- Considered traditional (indigenous) management practices (cooperative environmental governance; participatory rational decision making);
- A built community-based ICM programme (cooperative environmental governance); and

- Public involvement in the ICM programme (participatory rational decision making).

These factors strongly reflect the importance of cooperative environmental governance and rational, participatory decision making, and underline the value of zoning (or spatial planning) in ICM implementation.

Public participation and consensus-building, in the institutional dimension were early on seen to be crucial in the ICM process (Cicin-Sain & Knecht 1998). Several practical aspects specifically proved essential to the eventual success of the ICM process:

- Assessed *need for ICM* likely to arise, for example from the failure of existing management structures, or new management requiring more holistic approaches;
- Framed *concept of ICM*, e.g. a clear picture of ICM in obtaining government's support, presenting it as a means of strengthening and enhancing existing management initiatives rather than as a replacement. ICM can then be viewed as a means of improving sector-based programmes and aims to better their outcomes through the use of a more formalised and harmonised mechanism;
- No *potential barriers to ICM,* e.g. by assuring actors with important sectoral management responsibilities in coastal areas of their vital role in the successful implementation of such a programme; and
- Developed *political will to undertake ICM*, e.g. making a decision that may have some political cost will be far easier if decision makers are provided with timely information on aspects related to the benefits and costs of the programme.

These aspects clearly support the participatory, rational decision making and cooperative environmental governance paradigms.

2.2.3.3 Reviews by Olsen and co-workers

The work by Olsen and his co-workers in the late 1990s (e.g. Olsen, Tobey & Kerr 1997; Olsen 1998; Olsen, Lowry & Tobey 1999; Lowry, Olsen & Tobey 1999; Olsen & Christie 2000) provides insights into the implementation of ICM projects and programmes in the USA (e.g. Rhode Island – as reported in Schwartz 2005) and in developing countries (e.g. Philippines and Sri Lanka – in Olsen & Christie 2000). These projects were largely sponsored by international donor funding, like the United States Agency for International Development (USAID), the United Nations Development Programme (UNDP), the Global Environmental Facility (GEF) and the Swedish International Development Cooperation Agency (Sida). Drawing on their experience in the application of ICM, Olsen, Lowry & Tobey (1999) identified key features in the ICM process that make implementation successful and adaptable to the specific qualities of different countries and regions, namely:

- Recognition that coastal management is primarily *concerned with the processes of governance* (cooperative environmental governance);
- Operation at both the *national and local levels*, with strong linkages between levels (cooperative environmental governance);
- An *open, participatory and democratic process*, with opportunities for all stakeholders to contribute to planning and implementation (participatory, rational decision making);
- Programmes built around issues that have been identified through an *inclusive participatory process* (results-based management; participatory, rational decision making);
- Constituencies built on support effective coastal management by *informing the public* about the long-term implications of the issues being addressed and demonstrating the benefits of improved management (cooperative environmental governance);
- The *best available information* for planning and decision making (cooperative environmental governance);
- Commitment to building *national capacity* through short- and long-term training, learning-by-doing and cultivating host country colleagues who can forge long-term partnerships based on shared values (cooperative environmental governance);
- Completed loop between planning and implementation as quickly and frequently as possible, using small projects that demonstrate the effectiveness of innovative policies (results-based management);
- Recognition that programmes *undergo cycles* of development, implementation and refinement, building on prior successes and adapting and expanding to address new or more complex issues (adaptive management); and
- Set *targets for monitoring and assessing performance* (objectives-based management; environmental monitoring).

Olsen and his co-workers specifically demonstrated the value of the participatory, rational decision making adaptive management, results-based management and cooperative environmental governance paradigms in the ICM process. They expanded on the objectives-based management paradigm through the introduction of interim outcomes or objectives (with specific targets) in the broader ICM process and also emphasised the important role of environmental monitoring as a means of assessing performance against specified targets.

2.2.3.4 Review by Tobey & Vlok

Some ten year ago Tobey & Vlok (2002: 288) in their review on ICM, remarked that “Progress since Rio in making the transition between a concept and an operational reality is remarkable. In 1992, ICM was a fledgling discipline that was in an initial phase of discovery. Today, ICM is the accepted organising framework for advancing societies toward long-term goals of sustainable coastal development.” They identified central characteristics of effective ICM programmes – which they saw as increasingly well-defined practice – to be:

- *Strategic and adaptive design effecting change* – understanding the dynamism of the ICM process and its responses to different socio-economic, political, and cultural conditions (environmental assessment; ecosystem-based management; adaptive management);
- *Participatory and deliberative* – organising ICM through participatory and collaborative processes;
- *Integration* – success depending on the coordination of effort and effective interorganisational linkages for multiple use management (cooperative environmental governance);
- *Application of science to management* – one of the most fundamental tenets underlying the ICM concept being that decision making is based on the use of the best information and science available (participatory, rational decision making; cooperative environmental governance); and
- *Capacity development* – recognising capacity limitations and needs as part of the strategic and adaptive process of ICM, balancing the scope and complexity of agendas with a realistic appraisal of capacity (cooperative environmental governance).

While these characteristics align with the content of paradigms such as environmental assessment, adaptive management, ecosystem-based management, participatory, rational decision making and cooperative environmental governance, the incorporation of paradigms such as results-based management (e.g. identification of specific issues and problems to focus management effort) and spatial planning (e.g. demarcation of management units) was absent.

2.2.3.5 Stojanovic and co-workers' theoretical realisms

Although by the mid-2000s lessons learned through ICM experience had been documented well, Stojanovic, Ballinger & Lalwani (2004) observed that theoretical realism was not commonly or rigorously applied in ICM research. Accounts of practice in ICM were often followed by conclusions about what is successful and the lesson learned with little explanation as to how the conclusions were reached or why this is so. Interestingly, the power of human intuition meant that such conclusions were usually quite valid, but Stojanovic and co-workers insisted that more rigorous research methods could lead to greater confidence and clearer explanations, and prevent fallacious thinking. Drawing from other fields of environmental management, they were able to distil a number of important (common) explanatory factors or uniformities as requirements for successful ICM. They were to be *participatory* (i.e. the process offers opportunities for common contribution and balanced sharing of activities); *long-term* (i.e. recognition environmental management needs more than brief views of environmental circumstances to understand and manage links between the human and natural environment); *focussed* (i.e. management driven toward clearly important or tractable issues so that solutions can be demonstrated); *incremental* (i.e. an iterative management process that proceeds in a step-by-step manner); *adaptive* (i.e. capacity for environmental management to adjust or alter to become suitable for new situations); *comprehensive* (i.e. sufficiently wide scope and full view of issues); *precautionary* (i.e. an approach or activities undertaken in advance to protect against possible danger or failure); *co-operative* (i.e. a process by which agencies operate together and are coordinated, to a single end); and *contingent* (i.e. seeking to account for local variations in strategy, environment or task). As anticipated these factors exhibit many of the characteristics of the major paradigms discussed earlier because the original theories within which these are rooted and the paradigms themselves were sourced from the same field, namely environmental management. However, these factors do not patently reveal features associated with spatial planning (e.g. zoning) and ecosystem-based management (e.g. centralisation of ecosystems) paradigms, possibly indicating that these factors are still emerging uniformities in ICM.

2.2.3.6 Yao's review

A recent review on the ICM experience by Yao (2008) distils the lessons learnt in integrated ocean and coastal management[1] applications in China and Canada – nations which have recognised the importance of the sustainable development of the coastal marine environment through integrated management approaches. Some outstanding lessons and uniformities for success gleaned from the analyses recommend the:

- Use of an *ecosystem-based approach* rather than only administrative and political considerations (ecosystem-based management);
- Incorporation of *strategic environmental assessment (SEA) in the ICM process* as a means of integrating environmental considerations into decision making at a strategic level, and the assessment of the impacts of policies, programmes, and plans on the management area and stakeholders (environmental assessment);
- Establishment of *appropriate institutional structures* that encompass full jurisdiction, address potential internal conflict, provide for multi-user conflict resolution mechanisms, decentralise national government authority to allow greater local government and community involvement and decision making and are able to enact and implement legislation effectively (cooperative environmental governance);
- Ensurance of *public education and awareness* and empowerment of the public in resource management (cooperative environmental governance);
- Building of *meaningful participation frameworks* to ensure participation by all interested and concerned stakeholders, ultimately adding to the credibility of ICM (participatory, rational decision making);
- Establishment of an *independent, multidisciplinary science expert group* that can interact with management bodies (cooperative environmental governance); and

[1] Integrated coastal and ocean management (ICOM) is an emergent term derived from ICM or ICZM. ICOM expands from coastal management areas to include the marine portions and sometimes land-based watersheds, which can satisfy the integration of the land-sea interface (Chircop & Hildebrand (2006) in Yao (2008)).

- Implementation of m*onitoring and evaluation* as early as possible as it provides essential information to assist decision makers and managers to link management efforts (input and output) with outcomes (recorded through environmental monitoring).

These Canadian and Chinese studies once more show uniformities that support the participatory, rational decision making, ecosystem-based management, environmental monitoring, environmental assessment and cooperative environmental governance paradigms. However, the results-based management (e.g. the importance of identifying specific issues or problems in order to focus management effort) and spatial planning (e.g. demarcation of management units and zoning of uses) paradigms appear to be less relevant in their experience with ICM implementation.

2.2.4 Sustainability of ICM

Toward the mid-2000s, with ICM well-established as an organising framework for achieving the long-term goals of sustainable coastal development (Tobey & Vlok 2002), attention turned to factors that influence the sustainability of ICM. Christie and co-workers (e.g. Christie 2005; Christie et al. 2005: 469) noted, with reference to sustainable ICM, that "A sustainable ICM process is one that supports sustainable coastal resource use beyond the termination of an ICM project. It is adaptive and multi-sectoral as appropriate and is supported by a stable source of financial and technical resources."

In the ICM process sustainability was recognised as a multifaceted issue with no simple resolutions. In their literature review, Christie et al. (2005) identified a number of salient directives to foster ICM sustainability, namely:

- Establish an *enabling legal framework* – clear rights, responsibilities, and authorities among stakeholders and harmonised laws from the international to national to local levels such that laws at distinct levels are complementary and not contradictory (cooperative environmental governance);
- Establish *stable institutional commitment and accountability* – inclusive of government ministries, non-governmental organisations and informal local institutions (cooperative environmental governance);
- Involve *communities.* Although recognised as key to ICM sustainability, the community and ICM project characteristics that foster long-term sustainable management are not well developed but they are gaining attention (participatory, rational decision making);
- *Understand the economic value of coastal ecosystems*, ranging from direct benefits to services such as shoreline protection. These ecosystems are often greatly undervalued owing to the perception that resources are inexhaustible. ICM therefore needs to balance economic growth with sustainable resource use (ecosystem-based management).
- Understand that *healthy bio-physical conditions* underpin economic and other benefits in coastal systems (ecosystem-based management); and

- Ensure *properly designed programmes* –the challenge is to sustain success through proper programme design (cooperative environmental governance).

The same authors (Christie et al. 2005) listed a number of important factors deemed imperative for the successful design of sustainable ICM programmes, namely:

- *Effective management of ICM-derived outcome* – it requires both community involvement and achievement of desired benefits to impact ICM sustainability (cooperative environmental governance);
- *Participatory management* – while community-based and local government-led management regimes are often not ideal from an ecological perspective, they remain a critically important element in ICM from a socio-economic perspective, particularly in developing countries where institutional structures to support large-scale interventions are often lacking (participatory, rational decision making);
- *Integration in difficult contexts* – ICM depends on integration within and between multiple governance levels (cooperative environmental governance);
- *Long-term commitment* – this is essential to the success and sustainability of ICM, not only requiring institutionalisation and financial commitments, but also long-term commitment of national and expatriate leaders. Often the successes of individual ICM efforts can be traced directly to relatively small groups of committed individuals who have dedicated their careers to this effort (cooperative environmental governance);
- *Continued evaluation and adaptation based on sound research* – including mandate-responsive focusing on improving the art of ICM and monitoring of impacts, as well as mandate-independent research that challenges ICM orthodoxies through consideration of innovative science and management alternatives as well as the underlying goals and assumptions associated with ICM agendas (environmental monitoring).

Reflecting on the work of Christie and co-workers the importance of the participatory, rational decision making, ecosystem-based management, adaptive management and cooperative environmental governance and environmental monitoring paradigms for sustainable ICM becomes self-evident.

2.2.5 Challenges for ICM

Contemplating future prospects for the management of coastal resources through ICM into the 21st century, Weinstein et al. (2007: 43) concluded that: "Conflict mitigation, consensus building, trade-offs, sacrifice, and compromise will become the norms for sustainable coastal management, because growing demands on coastal resources can no longer be met by access to unexploited resources. Because of the multidimensional nature of these conflicts – their normative framework, complex knowledge basis, and the amalgam of empirical knowledge – the task will not be easy, but progress is being made with current efforts at *ecosystem-based management*…" [own emphasis]. Crowder & Norse (2008: 772) reiterate the importance of ecosystem-based management in ICM, stating that "The abrupt decline in the sea's capacity to provide crucial ecosystem services requires a new *ecosystem-based approach* [own emphasis] for maintaining and recovering biodiversity and integrity. Ecosystems are places, so marine spatial planners and managers must understand the heterogeneity of biological communities and their key components (especially apex predators and structure-forming species), and of key processes (e.g., population connectivity, interaction webs, biogeochemistry) that maintain them, as well as the heterogeneity of human uses. Maintaining resistance and resilience to stressors is crucial. Because marine populations and ecosystems exhibit complex system behaviour, managers cannot safely assume they will recover when stressors are reduced, so prevention is a far more robust management strategy than seeking a cure for degraded systems."

The increasing need to incorporate spatial planning in environmental management is well motivated (Douvere 2008). Australia, Belgium, China, Germany, the Netherlands, the United Kingdom and the USA have all begun to implement or experiment with marine spatial planning (e.g. Crowder et al. 2006; Chua, Bonga & Bermas-Atrigenio 2006; Day et al. 2008; Dalton, Thompson & Jin 2009). The development of marine cadastral systems to assist the sustainable management of marine resources is increasingly evident in the United States (e.g. Fowler & Treml 2001), Canada (e.g. Nichols, Monahan & Sutherland 2000), Australia (e.g. Binns et al. 2004), New Zealand (e.g. Grant 1999) and the Netherlands (e.g. Barry, Elema & Molen 2003), particularly at the national and regional scales (e.g. bioregional planning areas). However, the explicit incorporation of ocean zoning and the marine cadastre in ICM implementation models − beyond its traditional application within fisheries and conservation management areas − is still under exploration (Weinstein et al. 2007). For Weinstein et al. (2007: 46) spatial planning holds promise in overcoming some of the future challenges for ICM. They claim that "*Ocean zoning* [own emphasis] – the regulation (and allocation) of access to and use of specific marine geographic areas to help protect the environment, support economic development, and create equitable access to the ocean – is necessary for the successful management of coastal resources and watersheds." This is echoed by Crowder et al. (2006: 617) concluding that "Problems in ocean resource management derive from governance, not science. Ocean zoning would replace mismatched and fragmented approaches with integrated regulatory domains." Since activities and their associated consequences are necessarily spatially explicit, managing the coastal marine environment spatially makes intuitive sense (Halpern et al. 2008). Norse (2008: 5) also posits ecosystem-based zoning as a workable approach for future consideration in ICM, noting that "Smart observers rightly point out that the USA and other countries are already zoning their waters. Government agencies that oversee certain sectors grant them rights to use specific places in the sea for specific purposes, such as oil drilling. But they are doing it piecemeal. Ignoring the interests of other sectors and of conservation fosters uncertainty, litigation and political strife. A sector-by-sector ocean "land rush" that yields piecemeal de facto zoning is hardly ecologically sound, economically efficient, or fair and wise governance. Comprehensive ecosystem-based zoning – a transparent, public participatory, adaptive process for establishing ecological and socioeconomic objectives throughout a government's jurisdiction – is a far more workable way to govern what happens in the sea." Foley et al. (2010) views the concept of ecosystem-based marine spatial planning (MSP) as a means to successfully support healthy coastal and ocean ecosystems and to sustain human uses of such systems. Because a key goal of ecosystem-based management is to maintain the delivery of ecosystem services to humans, they argue that MSP should be based on ecological principles that articulate the scientifically recognised attributes of healthy, functioning ecosystems. Such principles include maintaining or restoring native species diversity, habitat diversity and heterogeneity, key species, and connectivity. Moreover, MSP also needs to account for context and uncertainty.

Finally, a major challenge for future sustainability of ICM lies in cooperative environmental governance as Weinstein et al. (2007: 47) perceptively reflect: "It is the performance and long-term capacity of this diverse array of entities (including scientific and educational institutions) from global to local scales that will ultimately determine the tempo and mode of transition to sustainability. Our fate rests in societal action involving all stakeholders, consensus building, and accepting the compromises and sacrifices that will ensure environmental and social justice for all. … In the end, the successful transition to ecosystem-based management rests on *a complex infrastructure that translates science-based information into public policy* [interpreted to include appropriate environmental governance]..." [own emphasis].

Cicin-Sain & Knecht (1998: 303) proclaim some tough challenges for ICM in stating that: "Designing and implementing an effective ICM program is not an easy task. Agencies must overcome competitive tendencies and be willing to coordinate and harmonise their policies and programs. Policy makers must have the political will to put effective measures in place and provide the necessary resources. And coastal stakeholders must be willing to invest their time and energy in the effort. This having been said, there really is no other choice: the gifts the world's coasts and oceans provide can be ensured only in this way." Succinctly this implies cooperative environmental governance.

Evidently, the main challenges for sustainable ICM lie in the improved implementation of the ecosystem-based management, spatial planning and cooperative environmental governance paradigms.

2.2.6 Uniformities in ICM implementation

Reflecting on the evolution of ICM and using paradigms as the currency to report uniformities, most of the paradigms that contribute to improved IEM implementation (see Section 2.1) were also evident as uniformities in ICM implementation. Table 2.3 summarises the main uniformities that were supported by the different models and frameworks as well as those that came to the fore in the review studies.

While different models and review articles emphasise different combinations of uniformities, paradigms such as participatory, rational decision making, environmental monitoring, environmental assessment, objectives-based management, results-based management, adaptive management and cooperative environmental governance are well-established as important uniformities in ICM implementation. Other paradigms, such as the ecosystem-based management paradigm, the cumulative effects assessment and carrying capacity paradigm and the spatial planning paradigm, appear to be less established in ICM practice, although their value comes to the fore in the review studies that did recognise them as uniformities. Indeed Cicin-Sain & Knecht (1998), Weinstein et al. (2007), Crowder & Norse (2008) and Norse (2008) argue that further exploration of paradigms such as the ecosystem-based management paradigm and the spatial planning paradigm is required to significantly improve the effectiveness and sustainability of ICM in future. The exploration of innovative avenues to enhance cooperative environmental governance is also encouraged.

Table 2.3 Summary of the key paradigms (uniformities) supported in the reviewed ICM literature

ICM MODEL, FRAMEWORK OR REVIEW	PARADIGM (UNIFORMITY)									
	Participatory, rational decision making	Environmental monitoring	Environmental assessment	Objectives-based management	Results-based management	Ecosystem-based management	Adaptive management	Cumulative effect assessment and carrying capacity	Spatial planning	Cooperative environmental governance
CICAP framework (Pernetta & Elder 1993)		●	●		●		●			◖
Sørensen review (1993)						●	●		◖	●
Olsen & coworkers' reviews (1990s)	●	●		●	●		●			●
World Bank ICM guidelines (Post & Lundin 1996)	●		◖	●	●	●	●		◖	●
ICM cycle (GESAMP 1996; Olsen, Tobey & Kerr 1997; Olsen 1998; Olsen, Tobey & Hale 1998; Olsen, Lowry & Tobey 1999)		●	●	●	●	◖	●			◖
Guidelines by Cicin-Sain & Knecht (1998)	●	●							●	●
Cicin-Sain & Knecht review (1998)	●								◖	●
European Union ICZM recommendations (European Commission 2002)	●		●		●	●	●	●		●
Canadian policy and operational framework for integrated management of estuarine, coastal and marine environments (DFO 2002)	●	●	●	●	●	◖	●	◖	●	●
Tobey & Vlok review (2002)	●		●			●	●			●
Stojanovic and coworkers' review (2004)	●	●	●	●	●		●	●		●
Christie & coworkers' review (2005)	●	●	●			●	●			●
Australian framework for a national cooperative approach to integrated coastal zone management (NRMMC 2006)		●	●	●	●	◖	●			●
GPA framework (UNEP/GPA 2006)	●	●	●		●		●			●
Yao review (2008)	●	●	●			●				●

● = incorporated; ◖ = incorporated to some extent

I will later propose a prototype design (Chapter 4) aimed at combining the ecosystem-based management, cumulative effects assessment and carrying capacity and spatial planning paradigms in an ICM implementation model for South Africa, together with the other well-established uniformities and I will expand on the importance of the cooperative environmental governance paradigm. I will also demonstrate – within the ICM implementation cycle – the role of focussed (sectoral) management programmes, illustrating how the results-based management paradigm can be applied most appropriately in a broader ecosystem-based management approach.

2.3 INTEGRATED WATER RESOURCE MANAGEMENT

The preceding sections demonstrated alignment between IEM and ICM using paradigms to frame the uniformities. In this section I briefly explore advances in integrated water resource management (IWRM), a management approach considered to be strongly aligned with that of ICM.

Although, the history of IWRM goes back to the 1930s, it received renewed attention in the principles adopted in Dublin in preparation for the 1992 Earth Summit held in Rio de Janeiro (ICWE 1992). Most definitions of IWRM portray it as an approach to improve efficiency in water use (the economic rationale), promote equity in access to water (the social or developmental rationale) and to achieve sustainability (the environmental rationale) (Butterworth et al. 2010), resembling the vertexes of the sustainability triangle (see Figure 4.2) that is central to the ecosystem-based management paradigm.

The goals of IWRM implementation − as typified by Lenton & Muller (2009) − show strong resemblance with the uniformities observed in effective implementation of IEM and ICM, involving a) sound investment in infrastructure, b) strong enabling environment, including goal setting, legislation and financial allocation mechanisms, c) clear, robust and comprehensive institutional roles, including for stakeholder participation, and d) effective use of management and technical instruments (Butterworth et al. 2010).

While the IWRM approach is still widely embraced, it has attracted wide criticism over the past decades. Despite the costly and time-consuming reforms to this approach, substantial benefits remain to be seen (Butterworth 2010). The demarcation of management units (spatial planning) attracted criticism where the river basin or catchment has been viewed as too large a unit (e.g. Wester & Warner 2002; Lankford & Hepworth 2010) for effective management, posing smaller sub-units − such as aquifers or wetlands − as more appropriate. Another criticism concerned the comprehensive or so-called 'full' IWRM that thus implies a move away from traditional sub-sector foci to a more holistic approach, which may be both unattainable in the near future and undesirable in many contexts (Molle 2008). Also, emphasis has been generally given to policy and institutional reforms at the national or catchment level with a specific focus on managing demand among users. Scholars in IWRM now argue for a much greater focus on locally rooted, pragmatic and adaptive approaches that encourage integration from within sectors and build upon existing institutions and participation mechanisms. This so-called 'lighter' form of IWRM is viewed as "an expedient, 'satisficing' compromise to avoid the harder task of 'full' integration" (Butterworth et al. 2010: 77), the benefit being immediate results (or early wins) while creating a support base for 'full' IWRM.

The EMPOWERS approach presents an example of an implementation model for 'light' IWRM (Moriarty et al. 2010). Conceptually, the approach comprises two pillars, namely the stakeholder dialogue and concerted action (SDCA) and a framework. The SDCA engages actors at all levels in facilitated dialogue to take agreed action, while the framework or programme cycle guides and structures the actor dialogue process along a number of steps, including visioning, assessing, strategising, planning, implementing and reflecting.

This glimpse into the practice of IWRM revealed many of the uniformities encountered in effective implementation of IEM and ICM. For example, the use of smaller spatial management units nested within larger units (DFO 2002). Further, the value of approaching integrated resource management in an incremental, adaptive manner, and the importance of appropriately engaging actors at all levels, emerged from practical experience in both IWRM and ICM. Learning from IWRM, therefore, further strengthened the validity of uniformities distilled previously and to be used as the basis for the proposed evaluation criteria for use in the theoretical validation of ICM implementation models that is the topic of the next section.

2.4 DEVELOPMENT OF EVALUATION CRITERIA

In the preceding Section 2.1 key uniformities in effective implementation of IEM, using different paradigms as the frames for reporting such uniformities were discussed. In particular the main characteristics for each paradigm were distinguished, as a means of easily recognising the application of such paradigms in practice, by exploring their theoretical bases. The main characteristics of the different paradigm are summarised in Table 2.1. In Section 2.2 the evolution of ICM practice over the last two decades were analysed. In this analysis it was demonstrated that the uniformities that contribute to IEM implementation are also evident as uniformities in ICM implementation (Table 2.3). IWRM also echoed many of these uniformities. In this section, evaluation criteria – based on the knowledge gained through the foregoing – are proposed for use in the theoretical validation of ICM implementation models.

The characteristics of the ten paradigms are considered to constitute the building blocks of the uniformities in IEM and ICM implementation. Such building blocks form an appropriate set for constructing criteria against which the scientific credibility of contextual, country-specific ICM implementation models can be validated. Accordingly, the characteristics listed in Table 2.1 are translated into clear statements which constitute the criteria for evaluating the design of such ICM implementation models. In this process, the formulations of the criteria are adapted to clarify their practical meaning. For instance, the characteristic "The social-ecological system is considered and resource objectives are set within this broader context" is translated to the criterion "Model considers the coastal ecosystem in its entirety (i.e. as a social-ecological system) with the coastal system as the central focus (rather than specific issues, problems or sectors) through which cooperative governance occurs between different sectors". This results in a full set of fourteen evaluation criteria as listed in Table 2.4. The extent to which an ICM implementation model meets these criteria reflects the degree to which scientific learning on the uniformities in ICM practice has been incorporated in its design.

This chapter commenced with a critical review on the uniformities that contribute significantly to the improved implementation of IEM using different paradigms as the frames for reporting such uniformities. Distinguishing characteristics were also derived for each paradigm by exploring the theoretical bases of each, as a means of easily recognising the application of such paradigms in practice. The attention then turned to ICM, in particular to specify the uniformities already recognised in this domain, using the various paradigms as frames for reporting such uniformities. This was achieved by exploring the evolution in the implementation of ICM over the past two decades. Some of the challenges to ICM implementation were also highlighted to identify feasible new uniformities. Most of the paradigms that contribute to improved IEM implementation also exhibited valuable uniformities for ICM implementation. Paradigms such as participatory, rational decision making, environmental monitoring, environmental assessment, objectives-based management, results-based management, adaptive management and cooperative environmental governance are well-established as important uniformities in ICM implementation while paradigms such as

Table 2.4 Evaluation criteria derived from the scientific literature to assess the scientific credibility of prototype ICM implementation models

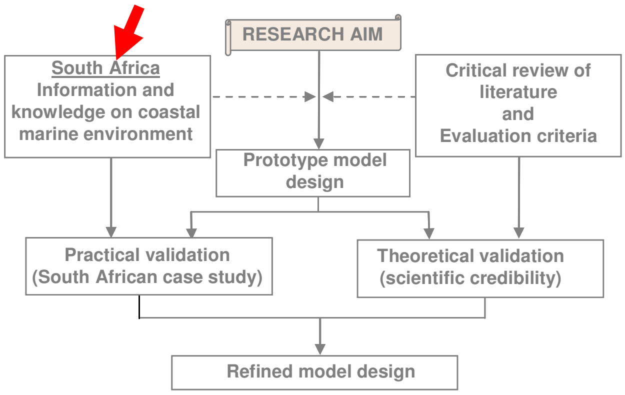
NO.	CRITERION
1	Model acknowledges *participatory, actor involvement*.
2	Model acknowledges *valid and relevant scientific information and knowledge* (scientific support) as an integral element.
3	Model requires clear *process management* to be adhered to so as to achieve a desired outcome.
4	Model requires *cooperative institutional structures* – across tiers of government and sectors and with clearly defined roles and responsibilities, embedded in a sound legal framework.
5	Model requires the establishment of overarching (common) *objectives, and associated indicators and targets* related to the (central) coastal system against which to measure compliance (i.e. providing the environmental limits or thresholds of potential concern to be adhered to by activities potentially affecting the coastal system), as well as to assess results-based outcomes (i.e. extent to which ICM initiatives were able to achieve such overarching objectives for a coastal system).
6	Model requires *monitoring and evaluation* programmes to be established.
7	Model considers the *coastal ecosystem in its entirety* (i.e. as a social-ecological system) with the *coastal system as the central focus* (rather than specific issues, problems or sectors) through which cooperative governance occurs between different sectors – the essence of the ecosystem-based approach.
8	Model requires the delineation of *coastal management units* and the geographical demarcation as well as geographical *zoning of different uses or use areas* within management units.
9	Model presents ICM as an *iterative, adaptive process.*
10	Model acknowledges the concept of *ecosystem limitation*.
11	Model requires an enabling *legal framework.*[1]
12	Model acknowledges *continuous development of education and awareness* as an integral element.
13	Model acknowledges *continuous capacity-building* programmes as an integral element.
14	Model acknowledges *sound funding structures* (financial support) as an integral element.

[1] In the context of the broader policy process (e.g. De Coning 2006), ICM implementation models fall within the *policy implementation* phase, assumed to have been preceded by the policy initiation, policy design, policy analysis and statutory phase (e.g. where policy has been converted into law). In theory, therefore, *implementation* should follow the *formulation of enabling law*. However, I consider a proper, enabling legal framework as key to effective ICM implementation, in particular the sector-specific legislation aimed at governing the *management of specific activities* to prevent or mitigate impacts on the coastal marine environment.

ecosystem-based management, cumulative effects assessment and carrying capacity and spatial planning appear to be less established. Even so, their value comes to the fore in the reviews, models and evaluations that did recognise them as important uniformities.

Utilising the above foundational knowledge, fourteen evaluation criteria were formulated against which the scientific credibility of contextual, country-specific ICM implementation models can be validated. In Chapter 5, these evaluation criteria are applied to the prototype design of an ICM implementation for South Africa – largely based on contextual, country-specific experience and knowledge – to assess its scientific credibility. The entries in Table 2.4 are numbered to enable easy identification of the different criteria in its application later on. But first, in the next chapter attention turns to the South African coastal marine environment and its existing management – crucial background information to consider in the design of an ICM implementation model for the country.

CHAPTER 3 SOUTH AFRICA'S COASTAL MARINE ENVIRONMENT



To conduct the practical validation of the prototype design it is necessary to first analytically describe South Africa's coastal marine environment as it relates to the influences and management of land-based activities This account is provided in this chapter.

Available information (sourced through CSIR's information services and the worldwide web) and contributions from coastal marine scientists at the CSIR are used to give account of South Africa's coastal marine environment in the form of a case study of the management of land-based activities. This information was verified by experts in coastal management in South Africa who comprise the National Advisory Forum (NAF) – the platform instituted by the South African government to oversee the NPA development and implementation process. A more detailed coverage is given in the document *South Africa's national programme of action for protection of the marine environment from land-based activities* (DEAT 2008) of which I was the main author. Information considered relevant to the practical validation of the prototype design are extracted from the latter document and reported in this chapter.

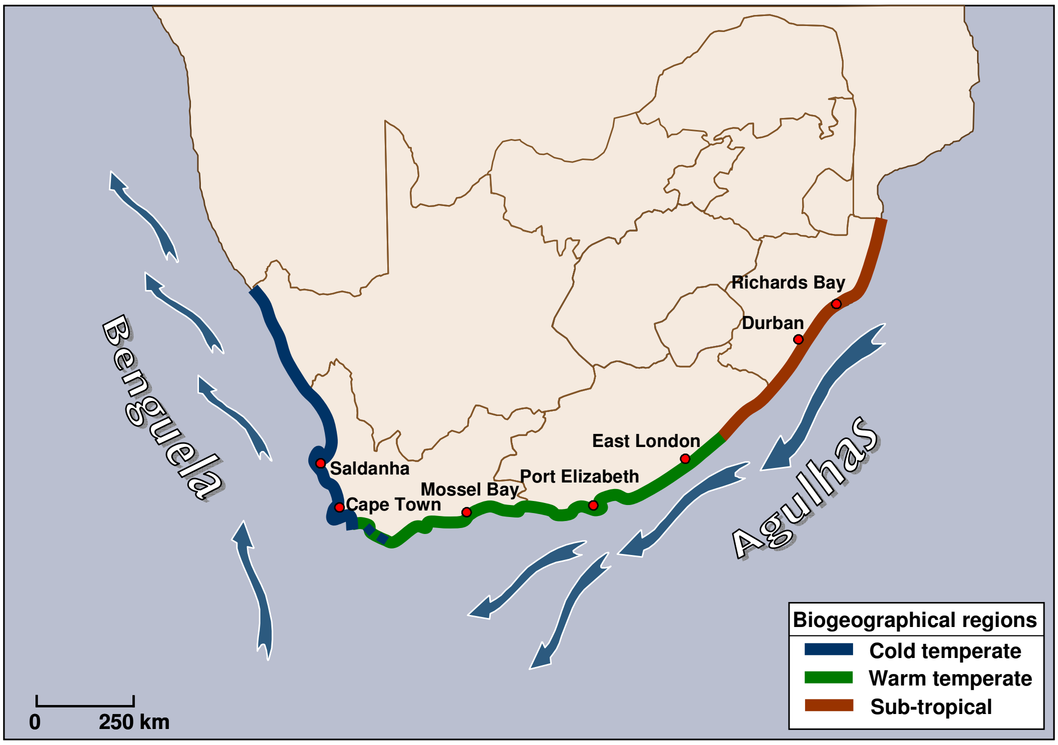
First, South Africa's coastal marine ecosystems are briefly discussed to exemplify the resources' diversity and complexities. Then the importance of South Africa's coastal marine environment, the key threats to it (focusing on land-based activities) and critical aspects to be aware of and consider in ICM implementation are presented. A brief summary on the health status of the coastal marine environment follows to provide an understanding of the status quo. Finally, the complex, sector-based legal framework of South Africa is examined and comments are made on the main actor networks operating in the coastal marine environment.

3.1 COASTAL MARINE ECOSYSTEMS

South Africa's coastal marine environment stretches from the Orange River on the west coast to Ponta do Ouro on the east coast, a distance of approximately 3000 km. The ICMA defines the lateral boundaries of the coastal marine environment from about 1 km inland of the high water-mark extending to the exclusive economic zone (EEZ) (South Africa 2009a). In the following sub-sections the diversity and complexity of South Africa's coastal marine ecosystems are explored regarding the coastal climate, important oceanographic features and biodiversity.

3.1.1 Coastal climate

The South African coast shown in Figure 3.1 spans three biogeographical regions (or coastal climatic zones), namely the cool temperate west coast, warm temperate south coast and subtropical east coast (Brown & Jarman 1978).



Source: Adapted from DEAT 2008

Figure 3.1 Biogeographical regions and currents along the South African coast[1]

Within the cool temperate region, the climate ranges from semi-arid (extended periods of low to no rainfall interspersed with short flash-rain events) along the western boundary to Mediterranean (dominated by seasonal winter rainfall) along most of the south-western region. In the warm temperate region along the south coast, rainfall is largely bi-modal, with peaks in spring and autumn, while the (wet) subtropical region along the east coast is dominated by seasonal summer rainfall (Davies & Day 1998). River inflow patterns to the coastal marine environment is determined by these climatic conditions, together with the size and shape of the river basins, the latter controlling the magnitude and flow distribution of run-off (Reddering & Rust 1990).

3.1.2 Oceanography

The coastal marine environment of South Africa spans two of the 64 large marine ecosystems (LMEs) of the world, namely the Benguela Current large marine ecosystem (BCLME) and the Agulhas Current (ACLME) (NOAA 2010). LMEs are relatively large areas of ocean space, approximately 200 000 km² or greater,

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[1] In order to provide a clear view of the distribution of coastal currents along the South Africa coast, I deviate from a conventional rule in cartography to place coastal city and town names in the sea.

adjacent to the continents where primary productivity in coastal waters is generally higher than in open ocean areas. The extent and geographical boundaries of the LMEs are based on four ecological (or ecosystem-based) – rather than political or economic – criteria, namely bathymetry, hydrography, productivity and trophic relationships (NOAA 2010). The Benguela and Agulhas Currents are sharply contrasting currents.

The Benguela Current on the west coast, comprises a general equatorward flow of cold water in the South Atlantic gyre (equatorward volume transport is estimated at 15 x 10^6 m^3/s) and dynamic wind-driven upwelling close inshore at certain active upwelling sites (Shannon 1985; Lombard et al. 2004). The temperature regime in the Benguela Current region is strongly seasonal, with average surface temperatures ranging between 21^{o}C and 15^{o}C in summer and between 17^{o}C and 13^{o}C in winter (Boyd & Agenbag 1984), broadly reflecting changes in insolation, upwelling, vertical mixing and horizontal advection (Shannon 1985). As a result of upwelling the coastal marine environment along the west coast is characterised by high nutrient supplies to the upper layers resulting in high primary production (i.e. dense plankton blooms). Decay of large deposits of organic-rich matter along the west coast reduces the dissolved oxygen content of the bottom waters to extremely low levels in the mid and inner continental shelf (Lombard et al. 2004).

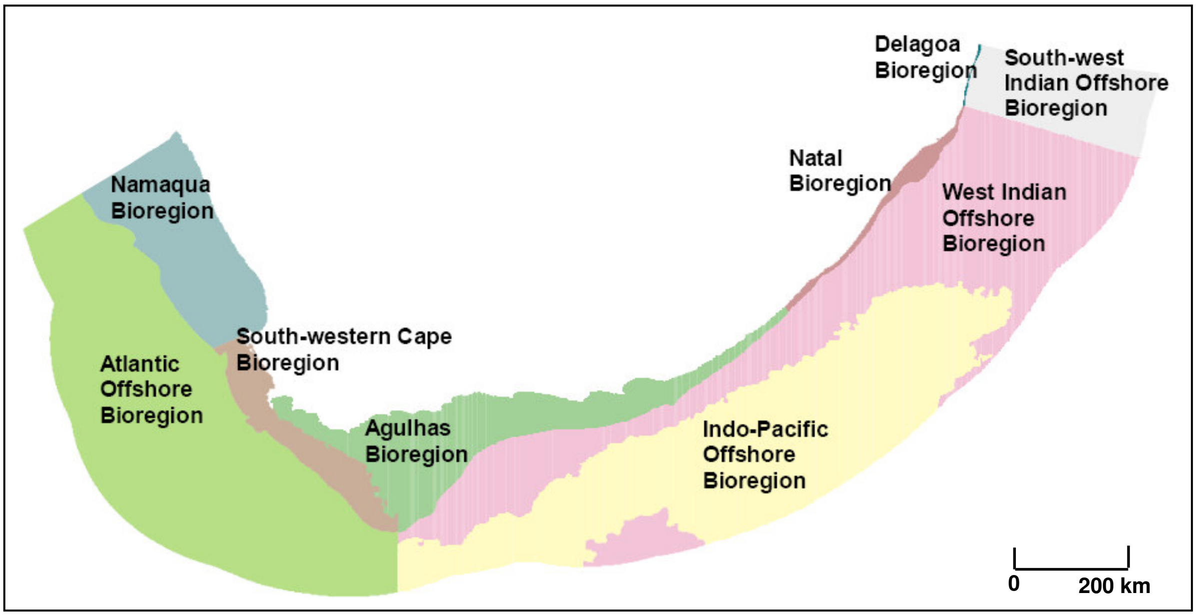
The Agulhas Current flows strongly southward along the east coast (southward volume transport estimated at 70 x 10^6 m^3/s, considered the largest western boundary current in the world). Sea surface temperatures in the region show a decline of about 2^{o}C moving from north the south, with maximum average temperatures ranging from 28^{o}C (summer) and 23^{o}C (winter) in the north and from 25^{o}C (summer) and 21^{o}C (winter) in the south (Lutjeharms 2006). Compared to the west coast, primary production is much lower owing to the warm, nutrient-poor tropical waters introduced from the equatorial region of the western Indian Ocean. Coastal waters, therefore, are typically blue and clear (Lombard et al. 2004), except in areas adjacent to larger, turbid river systems such as the larger systems located along South Africa's east coast in the sub-tropical biogeographical region (Figure 3.1).

Along the south coast, upwelling of nutrient-rich sub-photic water occurs along the shelf break and at promontories along the southern coastline, creating an intensive, dynamic mixing region, intermediate in terms of temperature and productivity between the Benguela and Agulhas LMEs (Lombard et al. 2004).

There are some 300 river catchments draining into the coastal marine environment of South Africa. These catchments range in size from very small (<1 km^2) to very large (>10 000 km^2) (Reddering & Rust 1990). Of these rivers about 290 support functional estuaries (Van Niekerk 2010 pers com). These estuaries constitute much of the sheltered marine habitat along South Africa's coastline and consequently they are important for biodiversity as well as socio-economic development (Clark et al. 2002).

3.1.3 Biodiversity

The strong oceanographic variability is reflected in the division of the marine biodiversity zones (Branch et al. 1994; Heemstra & Heemstra 2004; Lombard et al. 2004) in the South African coastal marine environment depicted in Figure 3.2.



Source: Adapted from Lombard et al. (2004: 20)

Figure 3.2 Bioregions within South Africa's coastal marine environment

Based on large-scale biological variability and biogeography, plus large-scale habitat differences related to different current systems with different temperatures and productivity, the coastal marine environment is subdivided into nine bioregions. The nine bioregions can be further subdivided according to water depth strata (i.e. supratidal, intertidal, shallow photic, deep photic, sub-photic, upper slope, lower slope and abyss), creating 34 so-called biozones (Lombard et al. 2004: 10), demonstrating the diversity and complexity of the coastal marine environment.

Together with the complex interactions between the oceans and the atmosphere, combined with high variability in rainfall patterns, it is not surprising that South Africa displays such high levels of marine biodiversity within such a small area (Lombard et al. 2004). Some 10 000 species of plants and animals have been recorded, representing 15% of the global marine species diversity (DEAT 2006). In broad terms, plants and animals are distributed according to the distinctive physical characteristics of the different regions. The coastal marine environment along the west coast is characterised by high primary productivity and low species diversity, but it supports large populations of some species. The coastal marine environment along the south coast is a transition region between the east and west coasts, showing characteristics of both areas. Its coastal marine environment has a high biological diversity and moderate productivity. The coastal marine environment along the east coast becomes increasingly warm and tropical northwards, and is characterised by increasing species diversity but smaller populations (DEAT 1998).

3.2 VALUE OF THE COASTAL MARINE ENVIRONMENT

South Africa's coastal marine environment is a rich and diverse national asset, providing important economic and social opportunities for the human population. As a result, coastal populations have developed a strong reliance on these resources for commercial opportunity and gain, food, recreation, and transport. Also, coastal resources have facilitated job creation and general economic upliftment in coastal regions. Historically, the industrial centre in South Africa was in the interior of the country near the gold mines along the Witwatersrand. However, over the years the country's economy evolved from a strong dependence on primary production activities to increased manufacturing and service industries to lately becoming increasingly dependent on port facilities for the export of such processed products. Consequently, the coastal cities have developed and expanded rapidly. Since the 1980s the major coastal cities of Cape Town, Port Elizabeth, East London, Durban, and Richards Bay (Figure 3.1) have experienced the fastest economic growth of all cities in the country (DEAT 2006).

The coastal marine environment of South Africa is therefore:

- An *economic place* where commercial, recreational and subsistence activities take place;
- A *social place* where people from different cultures meet, where people enjoy themselves and where people come to relax and find spiritual peace; and
- A *biophysical place* where land, sea and air meet and interact, and where reefs, beaches, sand dunes, rocky headlands and wetlands support a wide range of coastal biodiversity (Evett 2005).

Importantly, these three components are interrelated with the social and economic value of the coastal marine system largely depending on the health and productivity of the biophysical component.

The direct economic benefits from coastal resources in South Africa are estimated to be approximately 35% of the country's annual gross domestic product (GDP) (Evett 2005). Direct economic benefits include the marine fishing industry, port and harbour development and attractive lifestyles, and recreational and tourism opportunities offered by a coastal location. Furthermore, the coast provides indirect economic benefits such as the erosion control provided by coastal features such as dunes and high cliffs which protect built and natural features along the coast (including roads, buildings and farmlands) from the damaging effects of waves and wind, and it allows waste assimilation, detoxification and recycling through coastal wetlands, forests and grasslands. These indirect benefits account for an additional 28% of the country's GDP (Evett 2005).

In addition to the economic benefits, the coastal marine environment provides enormous social benefits that many people enjoy. For some people, the coast is a place of cultural or spiritual significance and many South Africans also see the coast as a place of recreation. The coast also provides many educational and scientific opportunities which are not easily quantifiable in monetary value. Tourism, recreation and leisure activities have developed into a global growth industry and South Africa's coast has particular value in this regard (Evett 2005).

3.3 THREATS TO THE COASTAL MARINE ENVIRONMENT

In Chapter 1 four major threats to South Africa's coastal marine environment were touched on, namely: overexploitation of marine living resources; physical alteration and destruction of habitat; modification in freshwater flows; and pollution (Clark et al. 2002; DEAT 2006; Lombard et al. 2004; Turpie 2004). The identification of key activities posing a threat to the coastal marine environment, if managed inappropriately, is a critical consideration in the ICM implementation process, as this provides guidance and direction to the type of management programmes required. A list of land-based activities posing threats and their associated threats to the coastal marine environment of South Africa has been prepared as part of South Africa's NPA in consultation with members of the NAF (DEAT 2008). These activities and problems are cross-tabulated in Table 3.1. Evident in the table is the diverse range of problems associated with the different activities.

Table 3.1 Major land-based activities, as well as potential problems associated with such activities if managed inappropriately

LAND-BASED ACTIVITY	PROBLEM MANIFESTATION											
	Siltation	Modification of streambeds	Coastal erosion	Destruction of dunes and sandy shores	Destruction of coastal habitat	Microbial contamination	Eutrophication	High suspended solids	Marine litter	Thermal pollution	Toxic chemical pollution	Alteration of salinity distribution and nutrient supply
Climate change	●		●	●	●			●				●
Coastal infrastructure development	●	●	●	●	●	●		●				●
Mining	●	●	●	●	●			●			●	●
Freshwater flow modification	●	●	●	●	●			●				●
Municipal wastewater		●				●	●	●	●		●	●
Industrial wastewater*						●	●	●		●	●	●
Urban storm water						●	●	●	●		●	
Agricultural practices	●					●	●	●			●	●
Port and harbour operations	●	●	●	●	●	●	●	●	●		●	●
Off-road vehicles			●	●	●							
Solid waste disposal									●		●	
Atmospheric deposition							●				●	
Introduction of alien vegetation					●							
Harvesting of living resources**					●							
Aquaculture**				●	●	●	●	●			●	

Source: DEAT (2008: 2-10)

* Including wastewater from fish and food processing industries, textile industries, tanneries, paper and pulp mills, chemical and pharmaceutical factories, fertilizer factories, desalination plants, power stations (e.g. cooling water).

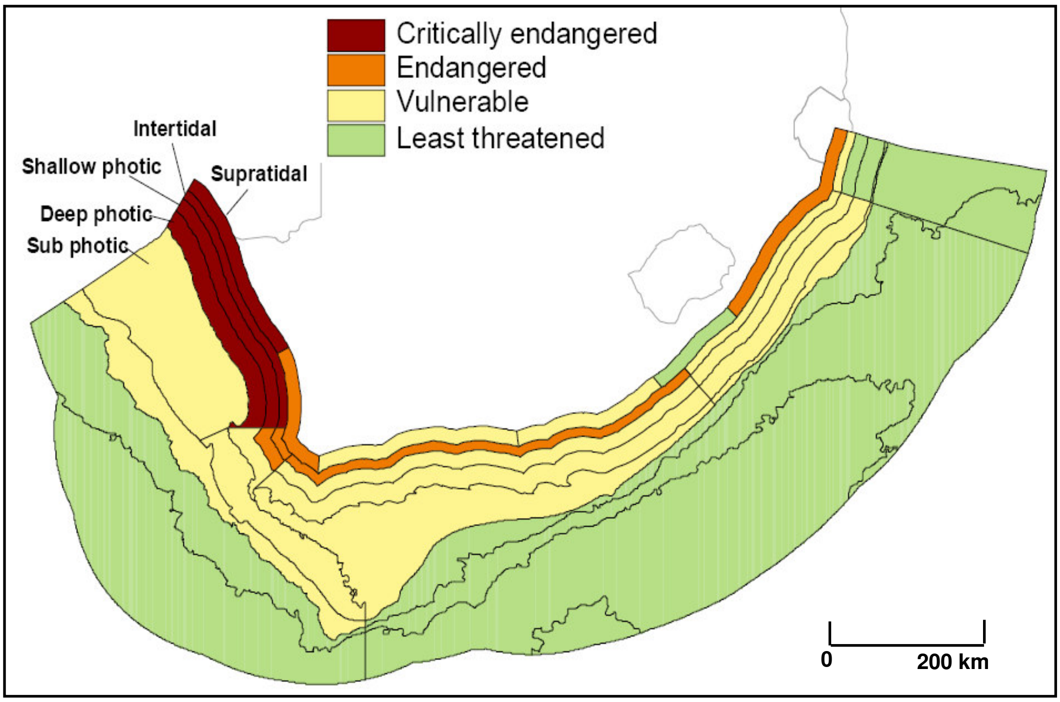
** Here limited to impacts on physical habitat and pollution (as noted).

Further, this type of information is relevant to management as it highlights possible cumulative or synergistic effects where numerous activities occur within a specific coastal ecosystem or management unit. Judging by the diversity of land-based activities and the vast range of (often overlapping) problems potentially associated with the different activities, consideration of cumulative or synergistic impacts on the coastal marine environment is crucial, particularly in the coastal ecosystems adjacent to major coastal cities.

3.4 HEALTH STATUS OF THE COASTAL MARINE ENVIRONMENT

South Africa's National Spatial Biodiversity Assessment (NSBA) of 2004 was the last comprehensive, national assessment done on the health status of the coastal marine environment of the country (Lombard et al 2004; Turpie 2004). A revision of this assessment is currently in progress.

Based on the 2004 assessment depicted in Figure 3.3, 65% of South Africa's marine biozones were threatened. As mentioned earlier, biozones were derived by subdividing the nine bioregions in Figure 3.2 in different water-depth strata (Lombard et al. 2004: 10, Figure 7.1). Of these biozones, 12% were critically endangered, 15% were endangered and 38% were vulnerable (Lombard et al. 2004).

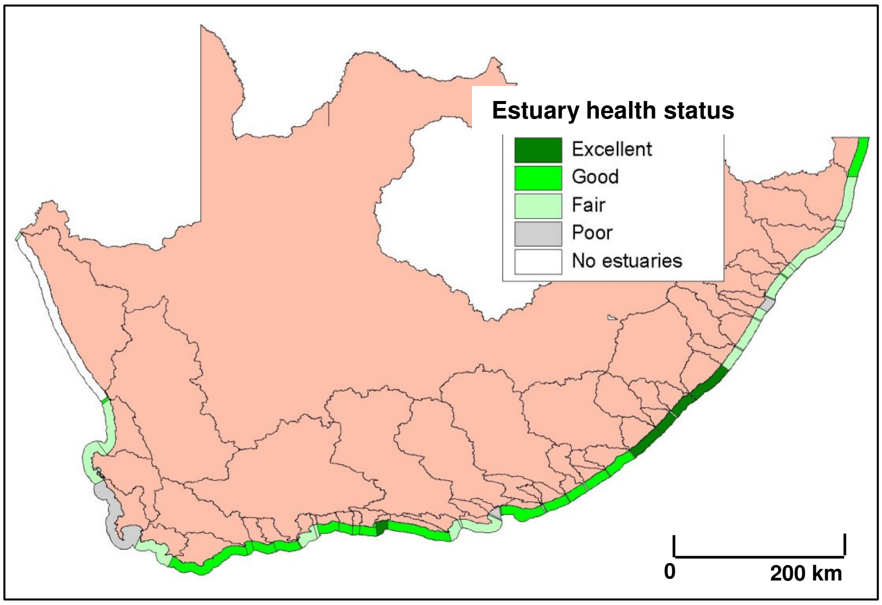


Source: Adapted from Lombard et al. (2004: 85)

Figure 3.3 Ecosystem health status of marine biozones in South Africa, based on available information and expert judgement

Further, the 2004 NSBA concluded that although 28% of South Africa's estuaries were still in an excellent condition, the rest have been impacted to a greater or lesser degree; 31% were in good condition, 25% in fair condition and 15% in poor condition as shown in Figure 3.4 (Turpie 2004).

In light of the 2004 health assessment, few areas in the coastal marine environment have been untouched by anthropogenic interference and the current NBSA assessment will quite likely report further degradation. This expected trajectory of (negative) change strongly motivates the need for an effective implementation framework for ICM in South Africa.



Source: Adapted from Turpie (2004:14)

Figure 3.4 Health status of South African estuaries

3.5 LEGAL FRAMEWORK RELEVANT TO COASTAL MANAGEMENT

South Africa has an extensive legal framework governing the coastal marine environment (see Appendix B). This legal framework includes at least 19 international obligations and agreements, 11 national policies (White Papers) and approximately 46 national acts. This is further supported by an array of national regulations, best-practice guides, as well as numerous provincial acts and local by-laws which are discussed in greater detail in DEAT (2008). The most recent overviews on international and national legislation pertaining to South Africa's coast and marine systems are provided by Glavovic & Cullinan (2009) and McLean & Glazewski (2009).

South Africa's Coastal Policy (South Africa 2000a) is a pivotal document, expressing national government's intent to promote sustainable coastal development through integrated management. This policy (South Africa 2000a: 26) sets the following vision for South Africa's coastal and marine environment:

"We, the people of South Africa, celebrate the diversity, beauty and richness of our coast and seek an equitable balance of opportunities and benefits throughout it.

We strive for sustainable coastal development – involving a balance between material prosperity, social development, cultural values, spiritual fulfilment and ecological integrity, in the interests of all South Africans.

We strive for a time when all South Africans recognise that the coast is ours to enjoy in a spirit of community.

We look forward to a time when all South Africans assume shared responsibility for maintaining the health, diversity and productivity of coastal ecosystems in a spirit of stewardship and caring.

We seek to guide the management of our coast in a way that benefits current and future generations, and honours our obligations and undertakings from local to global levels."

The Coastal Policy further sets out national strategic goals and objectives for coastal management organised into five broad themes:

- Governance and capacity building;
- Our national asset;
- Coastal planning and development;
- Natural resource management; and
- Pollution control and waste management (South Africa 2000a).

To demonstrate the complexity, and particularly the sectoral nature of South Africa's legal framework[1], Table 3.2 provides an overview of the key national acts related to the coastal management. Acts in South Africa that give legal status to international agreements and obligations, as well as the objectives and goals of policies, are primarily initiated at the national level, with some aspects delegated to the provincial or local (municipal) level (DEAT 2008). National legislation related to the coastal marine environment or legislation on the management and control of activities which may affect this environment is extensive. However, apart from overarching, enabling legislation such as the Constitution of the Republic of South Africa Act (No. 108 of 1996) (South Africa 1996) and NEMA (South Africa 1998c), the others are largely *sector-based*, i.e. different sectors (or activities) are governed under different acts and by different government departments as illustrated in Table 3.2. The perceived fragmentation of our marine legislation may be a reflection of the "complexities of environmental management and therefore by definition probably precludes simple unified answers" (Müller 2009: 92).

Considering the fragmentary nature of the existing legal framework governing the coastal marine environment of South Africa, an ICM implementation framework for the country will have to accommodate a strongly sector-based (or fragmented) regime which, according to Müller (2009), may not be that much an unrealistic expectation.

3.6 GOVERNANCE STRUCTURES AND ACTOR INVOLVEMENT

South Africa chose consociational democracy[2] as the basis for its political system after apartheid (i.e. post-1994) (Karume 2003). Consequently, our political system supports pluralist theory[3] – viewed as a key pillar

[1] Similar to the national legislation, provincial and local legislation in South Africa are also strongly sector-based (DEAT 2008). However, for the purposes of this study I choose the national legislation to illustrate the sectoral nature of South Africa's legal regime.

[2] A technical, political science term referring to a power-sharing democracy

[3] Decision making resides mostly in the governmental framework, but many non-governmental groups are using their resources to exert influence, with no single group having all the power but each group being powerful enough to secure its own legitimate interests.

Table 3.2 Key sectors, legislation and responsible government authorities relevant to ICM

KEY SECTOR	KEY LEGISLATION	RESPONSIBLE GOVERNMENT AUTHORITY
Conservation	National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (South Africa 2009a)	Dept. of Environmental Affairs (DEA)
	National Environmental Management: Biodiversity Act (No. 10 of 2004) (South Africa 2004a)	
	National Environmental Management: Protected Areas Act (No. 57 of 2003) (South Africa 2004c)	
	World Heritage Convention Act (No. 49 of 1999) (South Africa 1999a)	
	National Heritage Resources Act (No. 25 of 1999) (South Africa 1999b)	
	National Parks Act (No. 57 of 1976, as amended) (South Africa 1976)	South African National Parks (and DEA)
Fisheries	Marine Living Resources Act (MLRA) (No. 18 of 1998, amended 2000) (South Africa 1998b)	Department of Agriculture, Forestry and Fisheries (DAFF)
Water supply	National Water Act (NWA) (No. 36 of 1998) (South Africa 1998a)	Dept. of Water Affairs (DWA)
	Water Services Act (No. 108 of 1997) (South Africa 1997)	
Waste and wastewater	NWA (No. 36 of 1998) (South Africa 1998a)	DWA
	Water Services Act (No. 108 of 1997) (South Africa 1997)	
	ICMA (No. 24 of 2008) (South Africa 2009a)	DEA
	National Environmental Management: Air Quality Act (No. 39 of 2004) (South Africa 2004d)	
	National Health Act (No. 61 of 2003) (South Africa 2004b)	Dept. of Health, Metropolitan and district municipalities
	National Environmental Management: Waste Act (No. 59 of 2008) (South Africa 2009b)	DEA
Coastal development	ICMA (No. 24 of 2008) (South Africa 2009a)	DEA
	Local Government: Municipal Systems Act (No. 32 of 2000) (South Africa 2000b)	Dept. of Provincial and Local government and municipalities
	National Building Regulations and Building Standards Act (No. 103 of 1977 amended 1982, 1984, 1989, 1995, 1996) (South Africa 1977)	Dept. of Trade and Industry
Mining and exploration	Mineral and Petroleum Resources Development Act (No 28 of 2002) (South Africa 2002)	Dept. of Mineral Resources (DMR)
Transport (shipping)	International Convention for Prevention of Pollution from Ships Act (No. 2 of 1986) (South Africa 1986)	Dept. of Transport
	Marine Pollution : Control and Civil Liability Act (No. 6 of 1981) (South Africa 1981)	DoT (prevention) and DEA (combating)
	National Ports Act (No. 12 of 2005) (South Africa 2005)	DoT and Transnet National Ports Authority
Agriculture and forestry	Conservation of Agricultural Resources Act (CARA) (No. 43 of 1983) (South Africa 1983)	DAFF
	National Forest Act (No. 84 of 1998) (South Africa 1998d)	DAFF

of cooperative environmental governance. The adoption of a more pluralistic slant to environmental issues is clearly evident in South Africa's post-1994 legislation. For instance, the Coastal Policy (South Africa 2000a) aims to transform coastal management in the country from a predominantly biophysical and bureaucratic approach (i.e. a scientific approach (Baker 1987)) into a participatory approach (i.e. a pluralistic approach (Dahl 1961)) driven by human development imperatives and the need to promote sustainable livelihoods (Glavovic 2006). Intergovernmental relations and cooperative governance are rapidly evolving in South Africa, "…not only because of its constitutional/legal framework but also because of the statutory commitment of the various spheres of government to the implementation of the principles of co-operative government and intergovernmental relations" (Malan 2005: 226).

Müller (2009: 92) emphasises the importance of taking particular context in consideration in the selection of governance modes, where the focus should not be "on mutually exclusive alternatives, but rather on finding the right 'mix'." The modes of environmental governance (Hanssen, Klausen & Winsvold 2007) distinguished in South Africa include:

- *Hierarchy*, using authoritative (integrating and supervisory) structures to establish formalised procedures which are implemented through a vertical chain of command;
- *Network*, characterised by informal, self-regulatory, non-hierarchical relationships between actors with no clear distinction between different spheres of society (e.g. the public and private sectors); and
- *Market,* where collaboration is achieved through the willingness and self-interest of participants to exchange resources (Müller 2009).

In the following sub-sections some of the principal governing structures pertaining to the coastal marine environment in South Africa are highlighted, namely the authoritative institutional structures (mostly reflecting the hierarchical mode of governance) and other types of actor involvement (mostly reflecting the market and network modes of governance).

3.6.1. Authoritative institutional structures

Various government departments, to a greater or lesser degree, have established in-house institutional structures and arrangements through which they fulfil their environmental mandates. However, the complex nature of ICM demands cross-sectoral, multi-level institutional structures. The ICMA provides for a range of cross-sectoral, multi-level governance structures to facilitate ICM in South Africa through the national, provincial and local coastal committees (South Africa 2009a), but these still need to be established.

Referring to existing institutional structures, the need for cross-sectoral structures for environmental management has been recognised by the South Africa government. Under NEMA, the Committee for Environmental Coordination (CEC) has been created to promote the integration and coordination of environmental functions, including the management of the coastal marine environment, by all the relevant organs of state. At the national and provincial level, the Committees of Ministers and Members of Executive Councils (MINMECs) are examples of intergovernmental institutions (Malan 2005), e.g. the Environment and Nature Conservation MINMEC. These institutions were created to promote executive intergovernmental relations and comprise ministers and provincial members of the executive committee (MECs). MINMECs still face numerous challenges: they are informal, advisory and executive implementation[1] bodies and consequently do not have real decision-making powers. The roles and functions of the various MINMECs are being formalised through the direction of the Intergovernmental Relations Framework Act (No. 13 of 2005) to enable these institutional structures to have more binding decision-making powers (Malan 2005). The Ministerial Technical Committee (MINTEC) is another institutional structure set up to facilitate coordination between the national department of environment and provincial environmental departments. Working groups meet regularly to discuss and advise on issues of biodiversity and heritage, impact management, pollution and waste management, and planning and reporting.

The CEC, MINMECs and MINTEC largely operate at a cross-environmental strategic level so that more specific institutional structures, primarily focusing on the coastal marine environment, are necessary. To some degree, such governance structures have been established in support of ICM, but a much greater effort is required to ensure effective cooperative governance throughout the different tiers of governance, i.e. at national, provincial and local levels.

In response to the Coastal Policy, coastal provinces (Northern Cape, Western Cape, Eastern Cape and Kwa-Zulu-Natal) have already set up provincial structures, referred to as Coastal Working Groups. Their main purpose is to coordinate coastal management issues between the provincial departments of environment and other departments, as well as with extra-governmental organisations (e.g. community-based organisations (CBOs), NGOs, research organisations, and recreational and user groups) that play a role in coastal management issues in a province.

Existing local institutional structures concerned with coastal management mostly reflect a network mode of governance. Existing local institutions related to coastal management in South Africa include:

- Pipeline monitoring committees, forums and technical steering committees (e.g. along the KZN coast).
- Coastal marine water quality forums (e.g. Saldanha Bay Water Quality Forum); and
- Estuarine forums (e.g. Bot, Bushmans, Kariega, Great Brak and Mtentu estuaries) (DEAT 2008).

One of the most successful local institutions is the Saldanha Bay Water Quality Forum Trust (SBWQFT) (Van Wyk 2001; Taljaard 2006a). The SBWQFT is a voluntary organisation comprising officials from local (e.g. municipality), regional (e.g. regional office of the Department of Water Affairs (DWA)) and national authorities (e.g. DEA), representatives from all major industries in the area (e.g. national port authorities, seafood processing industries, mariculture farmers) and other groups having common interests in the area (e.g. tourism). Funding is raised by applying the polluter-pays principle whereby major industries that use or

[1] These institutions have executive powers to implement decisions, but not to make decisions.

discharge into, the marine environment, contribute. Financial resources are used to commission scientific investigations that inform decisions on the management of the area by advising the relevant government authorities; to commission coordinated joint monitoring programmes in the area; and to produce communication tools to inform the wider community. *Bay Watch* (SBWQFT 2004) offers an example of an annual publication that performs this task. Salient prerequisites for the success of such a local management institution – based on an analysis of the SBWQFT – include:

- An enthusiastic champion who will persevere;
- Active involvement of relevant government authorities (e.g. with executive powers in the domain of marine pollution and related matters);
- Regular monitoring and evaluation of the success and/or failure of management plans;
- An existing mechanism to generate funds to commission joint scientific investigations and to produce communication tools to inform the wider local community (e.g. local newsletters); and
- Involvement of all role players, either actively through membership of the instiution, or through regular public feedback meetings (at least annually or biannually) (Van Wyk 2001; Taljaard 2006a).

Also relevant to coastal management in South Africa are the multinational (intergovernmental) institutional structures which have been set up for the management of the LMEs bordering South Africa, such as the Benguela Current Commission (BCC). The BCC, the first in the world to be based on the LME approach to ocean governance, provides a platform for Angola, Namibia and South Africa to introduce an integrated, multisectoral approach to managing the BCLME. In 2006 the governments of Namibia and South Africa signed an interim agreement leading to the establishment of the BCC. The interim agreement was signed by the Angolan government in 2007 (BCC 2010).

3.6.2 Other actor involvement

In South Africa involvement of the general public – an obvious requirement for people-centred ICM – is largely achieved through educational and awareness programmes and market modes of governance. Here Coastcare is an example (DEA 2009a). Coastcare is a programme of the South African government established to assist with education and the exchange of information about coastal issues primarily aimed at the implementation of South Africa's Coastal Policy. Through Coastcare, DEA launched the Working for the Coast Project, an initiative that provides jobs and training for unemployed people in coastal communities to create and maintain a cleaner and safer coastal marine environment – an example of a market mode of governance. South Africa also takes part in the International Coastal Cleanup campaign involving large numbers of public participants through a series of regional initiatives (Ocean Conservancy 2009). NGOs are involved in numerous coastal awareness-raising initiatives in some of the coastal provinces, for example Coastwatch established in KwaZulu-Natal (KZN) under the auspices of the Wildlife and Environment

Society of South Africa WESSA (WESSA-KZN 2010). WESSA has two coastal education centres in KZN and this NGO supports numerous education projects that highlight the value of the coast. Ushaka Sea World in Durban also supports many educational projects aimed at communicating the importance of the coastal marine environment (SAAMBR 2009). Environmental education and information also is central to South Africa's Blue Flag campaign (Blue Flag South Africa 2010), an international initiative that encourages local authorities (municipalities) to provide clean and safe beaches for local populations and tourists (FEE 2006; 2009).

The scientific community in South Africa plays an important role, both in the development of legislation for coastal management and in the implementation thereof, where government departments often commission scientists outside government to assist with development and implementation. For example, scientists (myself included) were commissioned to develop South Africa's operational policy for the disposal of water containing waste to the marine environment of South Africa in collaboration with related stakeholders (DWAF 2004a; 2004b; Taljaard et al. 2006).

The scientific community in South Africa has also established a number of networks to coordinate research in the coastal marine environment, thus providing an avenue for government to access independent scientific advice. Three examples are the South African Network for Coastal and Oceanic Research (SANCOR), the Consortium for Estuarine Research and Management (CERM) and South Africa's Water Research Commission (WRC). SANCOR is a non-statutory body "…that generates and communicates knowledge and advice in order to promote the wise and informed use and management of marine and coastal resources and environments" (SANCOR 2010: 1). Through its activities, the network aims to achieve "…a healthy marine and coastal environment, rich in opportunities for human advancement and managed on the basis of excellent information, generated through well coordinated research and development of scientific capacity… [and it] …promotes, facilitates and co-ordinates excellence in marine and coastal research and education for the benefit of South Africa" (SANCOR 2010: 1). CERM is an organisation that concentrates on estuarine systems, providing a platform for South African scientists and resource managers to collaborate in promoting the wise management of estuaries through joint participation in research, training and technology transfer (CERM 2010). The WRC was established in 1971, in recognition of the national importance of generating new knowledge and promoting the country's water research purposefully and spurred by the view that water would be one of the country's most limiting factors in the 21st century. "The WRC provides the country with applied knowledge and water-related innovation, by continuously translating needs into research ideas and, in turn, transferring research results and disseminating knowledge and new technology-based products and processes to end-users. By supporting water-related innovation and its commercialisation, where applicable, the WRC seeks to provide further benefit for the country" (WRC 2010: 1).

Recognising the importance of long-term environmental research, the South African Environmental Observation Network (SAEON) was established in 2002 (SAEON 2009). SAEON is a research facility that maintains nodes (environmental observatories, field stations or sites) linked by an information management network to serve as research and education platforms for long-term studies of environmental change. Two of these nodes – Elwandle (coastal inshore) and Egagasini (marine offshore) – are linked to the coastal marine environment. Now linked to SAEON, the Southern African Data Centre for Oceanography (SADCO) – a data management and storage facility – has been in existence since the 1960s SADCO is funded by a number of organisations that collect data in the marine environment of South Africa and Namibia (SADCO 2009). Data are obtained from local marine organisations, universities, the South African Weather Service and international data sources and cover the following source types:

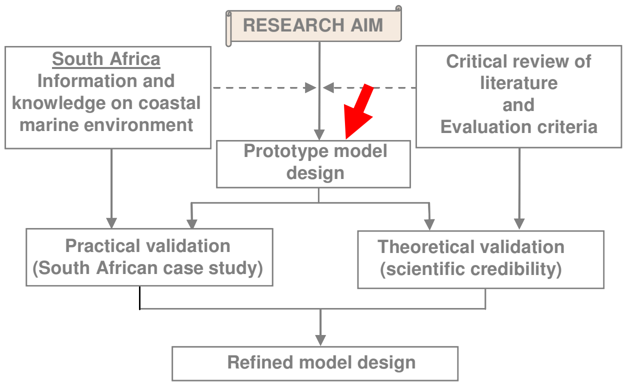
- Hydrographic station data with vertical profiles of sea temperature, salinity, oxygen content, nutrient loads;
- Surface weather reports from voluntary observing ships (VOS) including information on waves, wind, swell, sea-surface temperature;
- Moored current meter and thermistor string data;
- Automatic weather station data along the coast;
- Chemical data (compounds in the water column, in organic tissue and in sediment);
- Automatically recording temperature sensor data; and
- Wave data from wave buoys.

Through SADCO, a large amount of geo-referenced information on marine species has been loaded in the African Node for the Ocean Biogeographic Information System (AfroBIS) (SADCO 2009). These long-term, quality controlled data sets are extremely valuable for building understanding and establishing long-term trends in oceanographic features in the marine environment of the Southern African region and are used widely by marine scientists both nationally and internationally.

Capacity building and skills development have become a major concern in South Africa, also insofar as they affect competent management of the coastal marine environment. Recognising the urgency of this situation the national department responsible for science and technology (DST), in collaboration with the National Research Foundation (NRF), has created programmes for enhancing the skills and competencies of unemployed graduates and postgraduates in science, engineering and technology (SET) (DST 2006). In so doing, the South African government is determined to optimise skills development and to increase the resource allocation for innovation, research and development and to expand the pool of young researchers in science, engineering and technology (DST 2009). These initiatives can enhance capacity within government and rebuild critical mass of researchers in science, engineering and technology, also in coastal management. Concerning coastal matters, the International Ocean Institute Southern Africa (IOI-SA), for example, offers capacity building programmes to improve the sustainable livelihoods of poor and underprivileged people living in coastal areas (IOI-SA 2009).

This chapter has overviewed the bio-physical and governance characteristics of South Africa's coastal marine environment – the playing field in which the prototype design will be operational. The overview has reiterated the value of South Africa's coastal marine environment and its ecological and socio-economic value. It confirmed that legislation and implementation efforts (e.g. the management strategies, administrative and governance structures) remain largely sectoral, notwithstanding the South African government's progress in developing policy and legislation in support of integrated people-centred ICM, as expressed in the Coastal Policy and the ICMA. A structured framework or model to facilitate policy implementation is still lacking to join the different pieces of ICM implementation puzzle. The information presented in this chapter is also later applied in the practical validation of the prototype model (Chapter 5), but first the design of the prototype model is presented in the next chapter.

CHAPTER 4 PROTOTYPE MODEL DESIGN FOR EFFECTIVE IMPLEMENTATION OF INTEGRATED COASTAL MANAGEMENT



The design of the prototype model primarily arose from a specific need to develop an implementation framework for South Africa's national programme of action (NPA) to protect the marine environment from land-based activities, an obligation that the country had to fulfil under the global programme (the GPA). As discussed in Section 1.3.3, the prototype (or initial) design is largely based on guidance given by the GPA (UNEP/GPA 2006), as well as country-specific, contextual knowledge based on my own experience in coastal management. In the first section of this chapter, the main considerations in the design of the prototype model are presented where after the prototype design is presented. In the following five sections, the model's components are discussed in detail, highlighting specific aspects to consider in the envisaged implementation of the model.

4.1 MAIN CONSIDERATIONS

The GPA proposes the flexible, cyclical, implementation framework (or model), already featured in Figure 2.16, for coastal management pertaining to land-based activities that includes specific components or tasks, namely initial preparation and identification of problems, identification of constraints and opportunities, the formulation of realistic strategies and actions and their implementation and, finally, monitoring, evaluation and revision (UNEP/GPA 2006). This framework largely advocates a focussed *problems- or issues-driven approach.* The GPA guidelines also introduce the concept of support elements (UNEP/GPA 2006) referring to structures and initiatives necessary for the successful operationalisation of national programmes (this supports the cooperative environmental governance paradigm). These support elements cut across the other components or tasks proposed in the model and are essential for the successful operationalisation of the programme (UNEP/GPA 2006).

Weinstein et al. (2007) and Crowder & Norse's (2008) work on the challenges to ICM advocates an ecosystem-based management approach to ICM. Weinstein et al. (2007) also view the delineation of the appropriate ecosystem management units and explicit mapping of uses within such units (spatial planning) as an important challenge to ICM implementation, thus lending further support to the ecosystem-based approach. These and other authors (e.g. Cicin-Sain & Knecht 1998) also encourage the exploration of more innovative avenues to enhance cooperative environmental governance.

In developing implementation models for marine water quality and estuary management (e.g. Taljaard, Monteiro & Botes 2006), I became aware of the importance of centrally placing the ecosystem and of explicitly agreeing on common, overarching environmental quality objectives (an important aspect of ecosystem-based management) – rather than allowing different sectors to derive their own, often conflicting objectives – when operating in strong sector-based governance systems as obtains in South Africa. My experience confirmed the value of delineating appropriate geographical boundaries of ecosystem management units and mapping uses within such units (spatial planning), thus providing the most suitable approach for acknowledging and addressing potential cumulative or synergistic effects (cumulative effects assessment and carrying capacity). The value of participatory institutional structures also became apparent (cooperative environmental governance).

I demonstrated the incorporation of elements reflecting the paradigms ecosystem-based management, spatial planning, cumulative effects assessment and carrying capacity and cooperative environmental governance in a marine water quality management framework in a publication presented as part of this dissertation in Appendix C (Taljaard, Monteiro & Botes 2006). The identification of common, overarching environmental objectives and zoning of uses is captured as an explicit action in the framework – in the establish environmental quality objectives component – where such objectives are derived in a four-step approach, that:

- Define the *geographical boundaries* of the study area at the ecosystem scale;
- Define important *aquatic ecosystems and designated uses* within the specified area;
- Define management goals for important aquatic ecosystems and designated use areas; and
- Determine site-specific (measurable) *environmental quality objectives*, pertaining to sediment and water quality requirements (Taljaard, Monteiro & Botes 2006).

The framework also recognised the importance of cooperative environmental governance (referring to the management institutions and responsibilities component) where the success of management institutions relied on sound and easily accessible scientific information to empower stakeholders to participate in the decision-making process and that management institutions include all relevant interested and affected parties to facilitate a participatory approach in decision making. The framework also articulated the role and importance of a sound legal framework within which to execute an management process of this sort (Taljaard, Monteiro & Botes 2006).

In light of these main considerations the next section presents a prototype design for South Africa that expands on the more traditional problems- or issues-based approaches applied in many earlier ICM models (recall Section 2.2.2) – mostly grounded in the result-based management paradigm – to more strongly reflect the ecosystem-based management, spatial planning, cumulative effects assessment and carrying capacity and cooperative environmental governance paradigms identified in the literature as uniformities to consider more seriously in the implementation of ICM.

4.2 PROTOTYPE MODEL

I chose to use a typical results-based framework or problems- or issues-based approach (e.g. UNEP/GPA 2006) as the basis for the design of the prototype model, thereby acknowledging the value and relevance of this approach as applied in many of the earlier ICM models. Figure 4.1 conceptually illustrates the thought process followed in the prototype design, largely evolving from a problems- or issues-based management approach into a more ecosystem-based management approach.

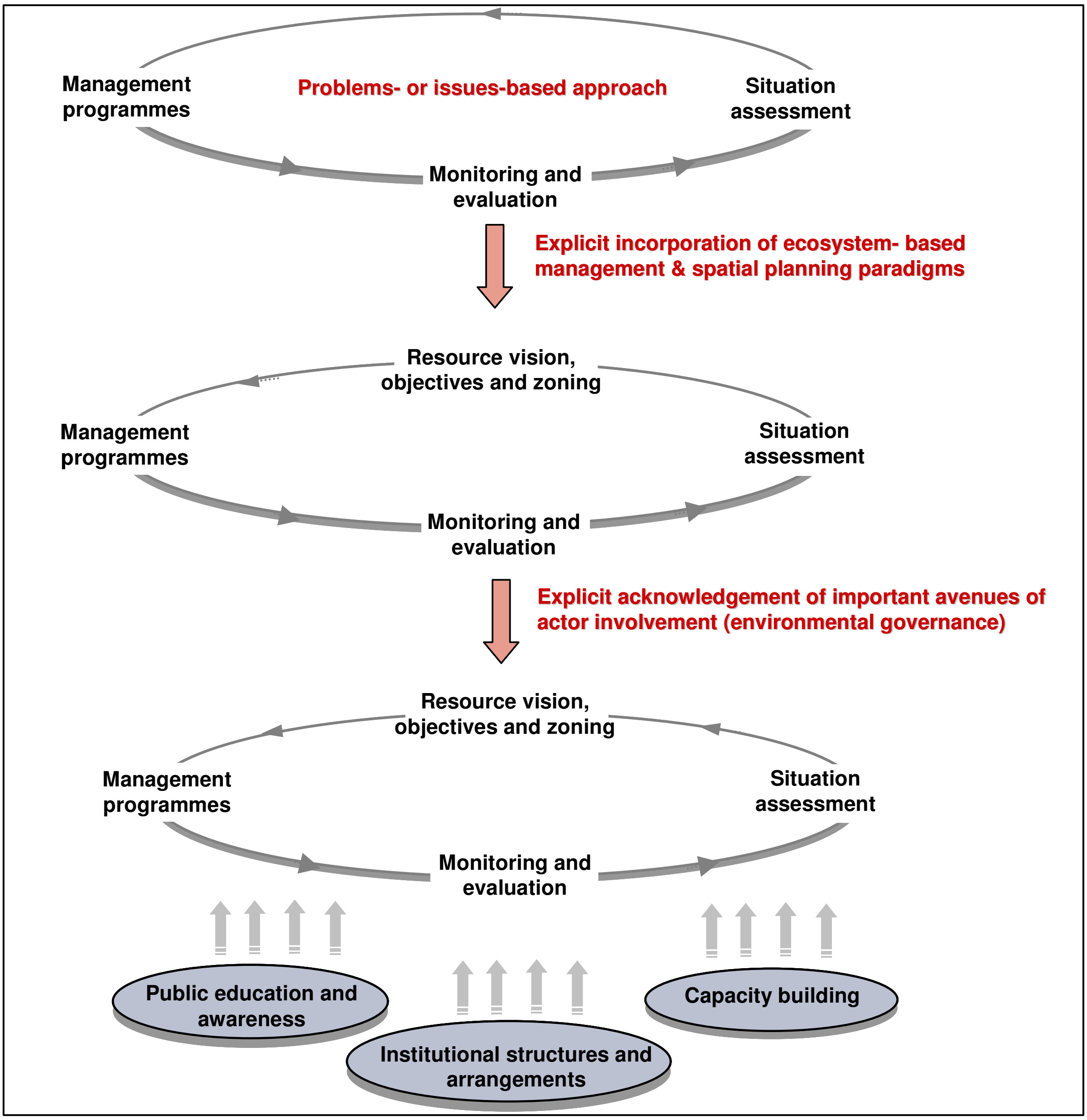


Figure 4.1 Evolution of the prototype model design for ICM implementation in South Africa

Traditional components (or tasks) of a problems- or issues-based management approach typically prescribe the:

- Performance of a *situation assessment* (e.g. gather knowledge and scientific information on the coastal marine environment, and identify problems and their management as well as constraints and opportunities);

- Development of *management programmes* (i.e. formulate realistic strategies, management objectives, action plans and implement these plans); and
- Design and implementation of *monitoring and evaluation programmes*.

I argue that the traditional, problems- or issues-based approach could be more supportive of the ecosystem-based management and spatial planning paradigms by incorporating the following components or tasks:

- Set a *vision and resource objectives*[1] for the coastal system considering ecological, social and economic aspects (i.e. putting the entire ecosystem central as advocated in the ecosystem-based approach); and
- *Zone* management units and specific uses within the unit.

The explicit inclusion of elements of the ecosystem-based management and the spatial planning (zoning) paradigms into the framework – the resource[2] vision, objectives and zoning component – shows that the ecosystem-based and problems- or issues-based approaches can be complementary rather than conflicting approaches. Further, I regard three support elements as essential for the enhancement of cooperative environmental governance in ICM implementation in South Africa (primarily revolving around the organisation and involvement of *actors*). These support elements are:

- *Institutional structures and arrangements* to facilitate effective environmental governance;
- Well-organised *capacity building* programmes; and
- *Public education and awareness* programmes and initiatives.

While the importance of identifying specific components and of articulating their logical flow is obvious, I consider informed and well-established actor involvement structures – primarily organised within these three support elements – as the crucial drivers for the successful operationalisation and sustainability of management initiatives of this nature in South Africa.

The prototype model is presented as a cyclical process to emphasise the importance of continuous adaptation based on new learning, thus allowing for a systematic refinement of the overall implementation process and to resist the "temptation to re-visit visions and objectives, targets and priorities again and again, prior to proceeding to the next step" (UNEP/GPA 2006: 53). This also reflects the policy spiral often referred to in other ICM models (the Plan-Do-Check-Act spiral depicted in Figure 4.2).

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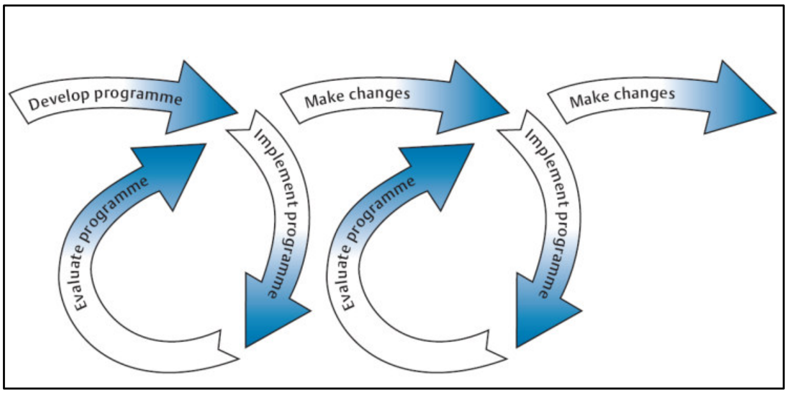
1 In the context of this study separate resource objectives and management objectives are distinguished. *Resource objectives* refer to objectives specifically related to the resource (the coastal system) and its uses, i.e. what is preferable for the coastal marine environment and what are the indicators and measurable targets that will reflect successful outcomes of such objectives? *Management objectives*, on the other hand, refer to objectives and associated indicators and target set for specific sectors (or activities) to ensure compliance with the resource objectives.

2 I specifically chose the term 'Resource' instead of 'Ecosystem' as the latter can be perceived by some to only refer to the 'biophysical system' and not the system in its entirety (i.e. also consider social and economic resource uses).



Source: US-EPA (2008: 54)

Figure 4.2 Policy spiral often referred to in ICM models

In the following sections each of the components and support elements in the prototype model is discussed, while highlighting specific prerequisites to be considered in the implementation of the model, namely the:

- Situation assessment;
- Resource vision, objectives and zoning;
- Management programmes;
- Monitoring and evaluation; and
- Support elements (institutional structures and arrangements, capacity building, and public education and awareness).

I view these components and support elements as critical corner stones for a workable implementation model, although the manner in which they are executed may vary depending on contextual factors such as the availability of data and information, human and financial resources, and political will. The prerequisites highlighted below therefore should not be viewed as rigid rules that must all be achieved for success, but rather as guidelines for implementation. ICM implementation remains an incremental, adaptive process.

4.3 SITUATION ASSESSMENT

In an implementation model, the purpose of the situation assessment is to consolidate available information on the coastal marine environment that is relevant to the management of the system. Aspects to be addressed in a situation assessment include:

- The status and importance of the coastal marine environment;
- Key sectors (and associated activities) contributing to problems, posing threats or using the natural environment;
- The existing statutory framework and governing structures; and
- Opportunities and constraints that are relevant to the coastal system.

Therefore, the situation assessment describes the ecological, social and economic contexts within which an implementation model must function. Importantly, existing management initiatives need to be identified so as not to reinvent the wheel and to ensure that the implementation of the model builds on existing programmes, assessments and research.

4.4 RESOURCE VISION, OBJECTIVES AND ZONING

This component deals with the common, overarching vision and objectives setting for the resource, as well as the geographical demarcation (zoning) of management units and uses in the resource, and was explicitly introduced to reflect elements of the ecosystem-based management (i.e. putting the ecosystem central) paradigm. The ecosystem and its goods and services (as agreed upon by stakeholders) determine the geographical boundaries of the unit, as well as the resource objectives which need to be complied with in the management of activities and/or developments potentially affecting the resource. Three distinct sub-tasks are apparent, namely the delineation (zoning) of the geographical boundaries of the management unit, the demarcation of specific use and activity zones within the management unit and the setting of a specific vision and resource objectives related to the ecosystem and its uses. These sub-tasks are discussed in turn in the next three sub-sections.

4.4.1 Delineation of management unit

A central element in the ecosystem-based management approach is the delineation of the appropriate ecosystem management unit (i.e. establishing the geographical management boundaries) (Halpern et al. 2008). Management units can be delineated at the multinational, national and regional scales, but also at the local level. Local coastal management units, often nested in large marine ecosystems (LMEs), are considered core to people-centered environmental management as they provide a platform for local communities to play a strong role in coastal management. The nesting of smaller coastal units into larger units is applied in the Canadian integrated management approach of LOMAs and their smaller (or local) CMAs (see Section 2.2.2.7).

Typically, larger marine management units cover extensive areas, subdividing a country's waters stretching from a demarcated boundary inshore out to the seaward limit of the EEZ (recall Figure 2.6). LMEs or bioregions have also been used as criteria to demarcate geographical boundaries of large marine management units at multinational, national or regional scales (e.g. DFO 2002; Australian Government 2009b; NOAA 2010). Demarcation of the geographical boundaries of the local (smaller) coastal management units is more challenging. Because most of the threats posed by intensifying human activities and ecosystem change cannot necessarily be dealt with by managing river basins, coastal zones and larger marine ecosystems in isolation (UNEP/GPA 2006), it does make practical sense to limit the size of the local management unit. Concerning the management of land-based activities, it is often the coastal marine environment adjacent to urban centres that is in the line of fire. Thus, urban centres can be appropriate departure points for setting the geographical boundaries of local coastal management units, while recognising the interactions with adjacent environments. Figure 4.3 shows where the local coastal management unit (e.g. bay, bight, estuary or harbour) adjacent to a city or town is nested in a larger marine management unit and linked to adjacent river basin (or catchment) management units (e.g. the interface with IWRM).

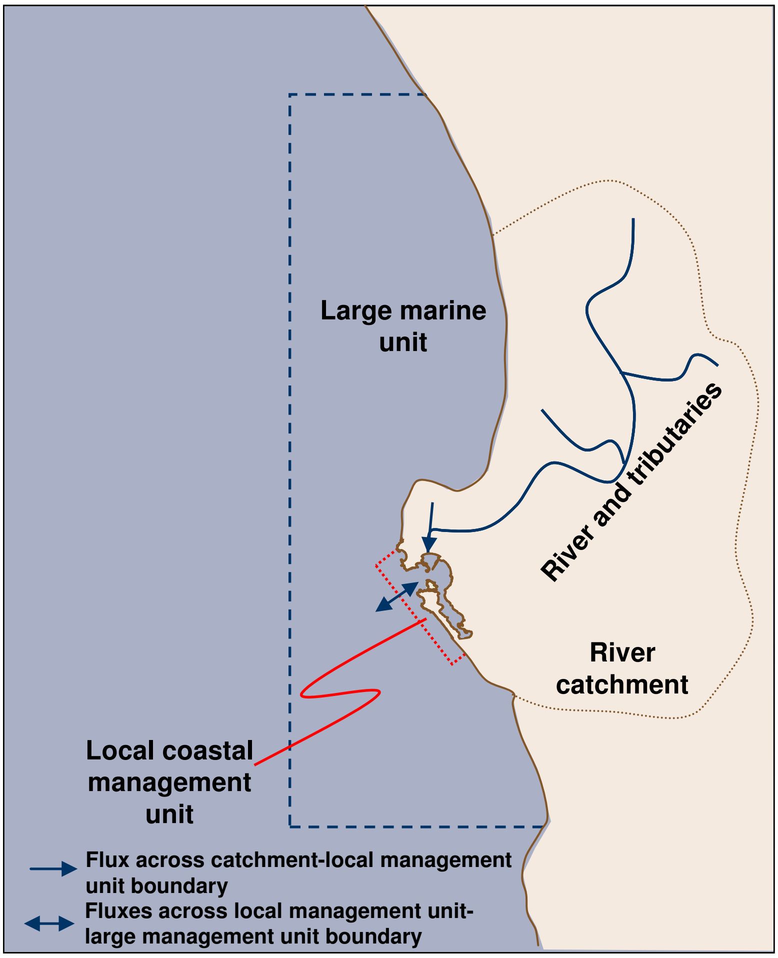


Figure 4.3 **The concept of nesting a local coastal management unit in adjacent environments**

Because the ecosystem is a primary consideration in the demarcation of management units (in accordance with the ecosystem-based approach) understanding and acknowledging ecosystem processes and functioning is essential. Qualified scientists are therefore crucial actors to involve in the demarcation of management units, in collaboration with responsible government authorities and other affected actor groups.

4.4.2 Setting specific vision and resource objectives

In ecosystem-based management not only the ecological, but also the economic, social and cultural aspects of the resource become important (UNEP 2006). All these aspects should be reflected in the common and overarching vision and resource objectives for a particular management unit. Thus, in setting a vision and resource objectives the focus should not only be on ecosystem protection (i.e. ecological resource objectives), but should also lie on important goods and services provided by the coastal ecosystem as well as the potential opportunities it offers for sustainable coastal development (i.e. social and economic resource objectives). The process of setting vision and resource objectives is hierarchical where, for example, the strategic vision and resource objectives for a country's coastal marine environment are set at the national level, while site-specific (local) resource objectives for a particular coastal management unit can best be set at the local level using locally specific knowledge.

At both strategic and local levels, the setting of the vision and resource objectives is considered a participatory, multi-actor (and multi-sector) process involving all the relevant actors (e.g. government, business, civil society, and the scientific and professional communities). The setting of a common vision and shared resource objectives, within a multi-actor (and multi-sector) context, is crucial as it prevents situations in which individual sectors define their own (often conflicting) resource objectives at the sectoral-level for the *same* coastal ecosystem. An example of this is the mining sector allocating mining rights in areas that the conservation sector wants to earmark for conservation. Conflict management is, therefore, important in the phase of setting vision and resource objectives for ICM implementation (Cicin-Sain & Knecht 1998). Further, pressures (or direct causes) as well as root (or indirect) causes of the problems in the coastal marine environment must be considered to determine whether the vision and resource objectives can be realistically attained. The carrying capacity or limits of the ecosystem for human use need to be considered as it might not be possible to reach specific resource objectives within the short-term due to existing pressures. For instance, insufficient finances to improve wastewater treatment facilities can result in non-compliance with water quality objectives in areas earmarked for recreation. In such a case, intermediate resource objectives (e.g. Olsen 1998) can be identified to provide incremental measures to track progress over time. Periodic re-evaluation and refinement of resource objectives can then be implemented to ensure that the desired vision is ultimately attained. Once the vision and resource objectives (and zoning) have been agreed upon through a multi-actor process, and the achievability has been validated against the social and economic milieu that influences or may be influenced by the coastal system under consideration, they provide an overarching measure against which the acceptability or sustainability of *management programmes* for the various sectors (or activities) can be evaluated.

Ultimately, to be useful from a management perspective, resource objectives must be translated into suitability criteria that can be defined in terms of measurable targets for appropriate indicators within the coastal system. While the zoning of uses in management units may vary, the suitability criteria related to a specific use are usually more generic, and are typically captured in regulations, standards or best-practice guidance. For example, best-practice guidelines for water and sediment quality, published by many governments across the world (e.g. DWAF 1995; ANZECC 2000; Taljaard et al. 2006b) provide guidance and information to define measurable target values for water and sediment quality indicators to achieve resource objectives related to conservation as well as to other resource uses such as recreation and mariculture.

4.4.3 Zoning of uses within management units

The geographical mapping or zoning of agreed uses and activities within the coastal management unit (Jentoft & Chuenpagdee 2009; Agardy 2010) forms an integral part of the resource vision, objectives and zoning component in the prototype model. The type and distribution of use areas in the coastal marine environment is site-specific and may vary at different geographical scales, depending on the type of activities. For example, in large marine management units zoning typically addresses uses such as marine protected areas, fishing zones, oil and mineral exploration concessions and shipping routes. Within local coastal management units, zoning typically comprises detailed mapping of: residential, industrial and commercial development areas in the coastal zone; conservation areas; recreation zones; living resources exploitation zones; mariculture areas; ports, harbours and shipping navigation routes; wastewater discharge sites; and waste dumping areas. Through zoning, the use of the resources becomes explicit, creating a communication tool accessible to all stakeholders. Maps have been shown to have great value in such multi-actor contexts, both by others (e.g. Carton 2007) and in my own experience with stakeholder consultation processes in marine water quality management programmes. Also, zoning provides a powerful spatial tool to identify and resolve potentially conflicting uses.

The identification and selection of compatible uses in a coastal management unit requires careful evaluation of ecological, social and economic opportunities and constraints (as documented in the situation assessment) while considering both the existing and future situations. Potential conflict among different use areas are likely to occur, for example, in highly used urban coastal systems and trade-offs will have to be negotiated. Strategic environmental assessment approaches can be applied to inform the decision-making process (thus supporting the environmental assessment paradigm). The demarcation of use and activity zones within management units needs to be undertaken in consultation with the relevant actors, including the responsible government authorities and affected groups. For example, in the case of local coastal management units the local authorities and stakeholders in the community will be integral to this process.

4.5 MANAGEMENT PROGRAMMES

Nel & Kotze (2009:10) aptly note that in environmental management "…the environment is not managed, but that *activities, products and services* [own emphasis] are managed to prevent undesired change to the affected environment." This argument also applies to ICM where management programmes should aim at preventing potential impacts on the environment, rather than responding only once the impacts have occurred. Ultimately, the collective aim of such management programmes is to achieve the common vision and shared resource objectives for a particular coastal management unit. Together with the agreed zoning scheme, the vision and resource objectives provide the benchmark against which to select suitable locations, technological options and compliance targets for any given activity, product or service potentially affecting the coastal marine environment. For a coastal marine perspective three important subcomponents are proposed for inclusion in the Management programmes component, namely to:

- Identify the key sectors (or activities) for which management programmes should be provided;
- Set the management objectives for the different sectors; and
- Prioritise management programmes and actions for operationalisation.

4.5.1 Identification of sectors for inclusion

The identification of specific sectors (or activities) for which management programmes need to be developed is important (the results-based management approaches often refer to this as the identification of the issues and problems) and they need to include both existing as well as planned activities (Figure 4.4).

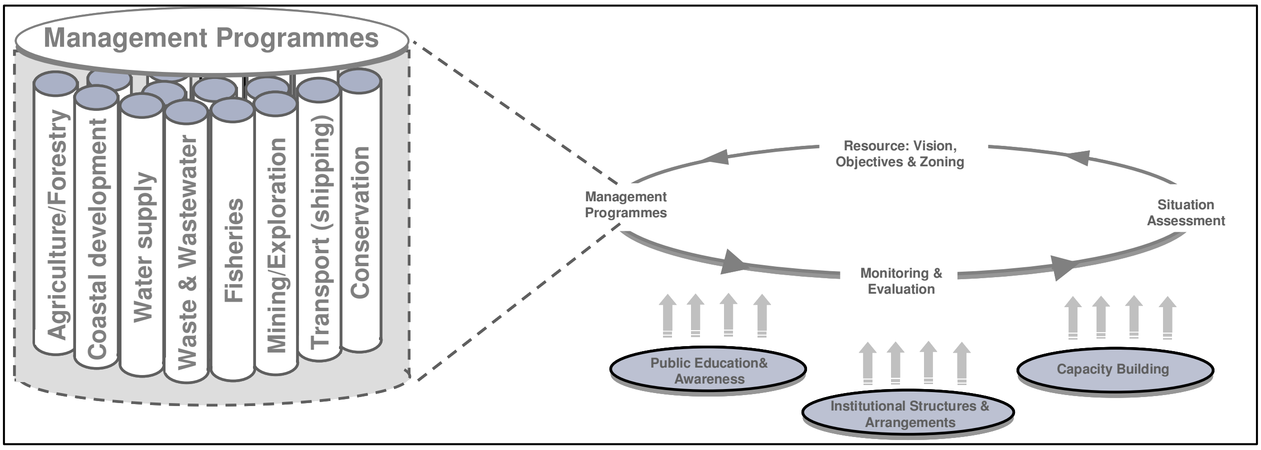


Figure 4.4 Incorporation of sector-based management into an ICM implementation model

While the common vision and shared resource objectives need to be agreed upon at the cross-sectoral (multi-actor) level, the management programmes involving the technical planning and operations of specific activities can maintain a stronger sectoral focus (i.e. accommodating sector-based statutory and institutional systems); the expertise to develop and implement these programmes typically resides with the responsible authority sectors, their service providers and the developers and managers of such activities. For example, a management programme for wastewater requires technical and engineering expertise on the technologies available to prevent, minimise, treat and dispose wastewater. These skills reside in the waste and wastewater (technical) sector and not, say, in the conservation sector although the latter may be negatively impacted by inappropriate wastewater treatment. In this way, sector-based management programme silos become embedded in an overarching ecosystem-based management model, anchored in the overarching resource vision, objectives and zoning and the monitoring and evaluation components as illustrated in Figure 4.4. This implies that management programmes, even though largely sector-based, remain grounded in an ecosystem-based approach, subservient to the agreed requirements and needs of the coastal ecosystem.

4.5.2 Setting management objectives

My experience in coastal management, dictates adherence to the following set of management objectives – applied within each of the selected sectors (or activities):

- Management and control of the activity addressed in relevant *legislation* (acts);
- *Regulations and/or best practices* (e.g. EIA regulations) to guide effective operationalisation of the legislation, including best available technologies, specification of critical limits (e.g. effluent emission targets), minimum (compliance) monitoring requirements, and efficient penalty and/or incentive systems;
- *Effective operationalisation* through the execution and enforcement of legislation, regulations and best practice using sufficiently skilled and motivated personnel, equipped with the appropriate material and financial resources throughout the *planning and design, construction, operations and decommissioning* phases of an activity. The Deming cycle[1] is a popular management model widely applied in environmental management, particularly in ISO14001-based[2] management systems (Nel & Kotze 2009); and
- *Compliance monitoring*[3] *programmes* designed and implemented to measure the effectiveness of the management programme specifically related to the sector (or activity).

These management objectives provide a structured approach to management programmes facilitating effective operationalisation of the common vision and shared resource objectives.

4.5.3 Setting priorities for operationalisation

Actions enabling the achievement of the management objectives within a particular sector (or for a specific activity) may occur at a multiplicity of government levels. For example, the legislation, regulations and best practice guides are typically formulated at the national level, while implementation and compliance monitoring typically occur at the local level. This obviously requires effective cooperative governance between the different tiers of government. Although management programmes for specific sectors (or activities) can maintain a strong sectoral focus, institutional systems facilitating cross-sectoral collaboration

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1 The Deming cycle refers to an iterative problem-solving process which includes four elements, namely planning-doing-checking-acting (PDCA). This process was made popular by Dr WE Deming (Walton 1986).

2 ISO14001 is a standard for environmental management systems, issued by the International Organization for Standardization, which aims to reduce the environmental footprint of a business.

3 In this study *compliance monitoring* refers to the monitoring that is linked to a specific sector (or activity) to establish whether that sector or activity is complying with its management objectives and the resource objectives of the coastal system that may be affected. Compliance monitoring can include monitoring of specific aspects of an activity (e.g. monitoring the effluent composition and volume) and environmental aspects (e.g. monitoring of coastal waters adjacent to the effluent discharge). The environmental component of compliance monitoring may potentially overlap between sectors (or activities). Similarly, the environmental component of compliance monitoring may potentially overlap with the overarching *monitoring and evaluation* component of the framework. These potential overlaps necessitate institutional systems to facilitate cross-sectoral collaboration.

are nonetheless crucial for the optimisation of actions, for example sharing human and financial resources across sectors in the execution of compliance monitoring programmes to be undertaken in the coastal marine environment.

Regarding prioritising of actions, the UNEP/GPA (2006) recommends considering criteria based on the:

- Scale of environmental impacts and socio-economic consequences caused by the problem (and associated activities), the nature of affected areas (e.g. sensitive areas) and the reversibility of such impacts and consequences; and
- Costs, benefits and feasibility (e.g. availability of resources) of options for action, including the long-term cost of no action.

To apply prioritisation criteria, it is imperative that the relevant information is provided to support such judgements. Typical information required to make the judgements include the following:

- Complete list of actions;
- Government department (and other actors) responsible for each of the listed activities;
- An impact rating of the consequences should the action not be executed, distinguishing between ecological impacts and socio-economic consequences (the latter provides better resolution for the prioritisation process);
- Human resource allocation necessary to execute each of the listed actions;
- Funding requirements, expressed in a budget, as well as potential sources of financing; and finally
- Time frame within which each of the actions will be executed, using the preceding type of information to decide on prioritisation.

The prioritisation process should involve responsible government departments (national, provincial and local) as well as other affected actors, such as the relevant social and economic sectors, NGOs and CBOs. Focal points for action can also be useful to facilitate cooperation across tiers of government and across different sectors (UNEP/GPA 2006). For example, the focal-point approach was adopted in the Australian ICM framework and implementation plan (NRMMC 2006).

4.6 MONITORING AND EVALUATION

Overarching monitoring and evaluation of the coastal resource and coastal governance system, in addition to compliance monitoring linked to specific sectors or activities, are fundamental to the effective implementation of ICM as they provide the means of continuously assessing progress toward achieving the overarching ‘common’ vision and ‘shared’ resource objectives. Kusek & Rist (2004: 12) define monitoring and evaluation as follows:

"Monitoring is a continuous function that uses the systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing development intervention with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds."

"Evaluation is the systematic and objective assessment of an ongoing or completed project, program, or policy, including its design, implementation, and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact, and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned into the decision-making process."

In recent years a results-based approach to monitoring and evaluation has been increasingly applied in environmental management throughout the world rather than the more traditional implementation-based approach. A major difference between these two approaches, in monitoring and evaluation, is that the implementation-based approach mainly focusses on outputs, while the results-based approach also includes outcomes (Kusek & Rist 2004). Implementation monitoring, therefore, concentrates on the achievement of actions or outputs of the sector-specific management programmes measured in terms of the management objectives (see Section 4.5.2). On the other hand, results monitoring centres on the achievement of the overarching outcomes and goals measured in terms of the common vision and shared resource objectives (see Section 4.4).

Monitoring and evaluation require dedicated long-term programmes that monitor the achievement of actions and outputs (implementation monitoring) and outcomes and goals (results monitoring). The selection of appropriate indicators is, therefore, essential as these provide the quantitative measures to evaluate progress in the operationalisation of ICM (e.g. Walmsley et al. 2007). It is logical that the appropriate (resource) indicators and associated measurable targets – earlier derived as part of the resource objectives setting process – will be beneficial in this regard. However, process indicators or quantitative measures to evaluate progress in actor involvement (e.g. institutional structures and arrangements, capacity building and public education and awareness programmes) are equally important. State of the environment (SoE) or State of the coast programmes are deemed appropriate platforms through which to operationalise the overarching monitoring and evaluation component within the ICM implementation process.

Several ICM-specific evaluation frameworks have been developed and debated over the years (see for example Burbridge 1997; Olsen et al. 1997; Olsen 2003; European Commission 2006; NOAA 2004; 2006). Specific issues tend to dominate the debates, including selection of indicators (e.g. Olsen 2003; Belfiore 2003; Pickaver, Gilbert & Breton 2004; UNESCO 2006) and output delivery versus outcomes achievement (e.g. Olsen 2002). Where these approaches largely focus on evaluating ICM initiatives, Billé (2007) argued that it was also important to evaluate the level of integration of coastal management and he proposed an analysis framework for coastal management systems that, compared with collectively set objectives, allows for evaluation of the actual implementation of ICM. He concluded that "Evaluating ICM initiatives then becomes less problematic and traumatizing since one does not implicitly assume any longer that an ICM program is the only one in charge of ICM implementation, thus accountable for it. In other words, one realizes that a coastal management program is not the only or even the main 'coastal manager'. The objectives and results of every initiative and activity remain a central reference to evaluation, but their label does not" (Billé 2007: 805).

4.7 SUPPORT ELEMENTS

The execution and sustainability of ICM implementation is largely dependent on sound multi-actor institutions and networks to facilitate integration, coordination and implementation of the process, reflected in the support elements of the model (UNEP/GPA 2006). Glavovic (2006) emphasised that meaningful opportunities for public participation and the establishment of long-term partnerships between government, business, civil society, and the scientific and professional communities are vital for people-centred ICM. Three key support elements were earlier (Section 4.2) identified for the South African implementation, namely, institutional structures and arrangements capacity building, and public education and awareness. These are explored in greater detail in the following sub-sections.

4.7.1 Institutional structures and arrangements

The implementation of a management model is ultimately driven by people (or actors). The most important route to achieving this is sound institutional structures that include all relevant actors and that facilitate partnerships and collaboration between different sectors in government, business, civil society, and the scientific and professional communities (Paavola 2006; Hague & Harrop 2007; Biermann & Pattberg 2008). Such institutional structures include *cross-sectoral institutions* (those facilitating collaboration and partnerships between the different sectors in government, business, civil society and the scientific and professional communities) and *multilevel, sector-based institutions* (those facilitating communication of strategies and actions between different tiers of governance in a top-down but also a bottom-up fashion within a single sector). An illustration of the conceptual linkages between these institutional dimensions is provided in Figure 4.5.

The complex nature of ICM requires collaboration across sectors, the cross-sectoral institutions in Figure 4.5 which have proven to add significant value to ICM implementation processes (Ostrom et al. 1999; Henocque 2001; Van Wyk 2001). It usually becomes extremely difficult and uneconomical to conduct management of a multitude of different activities within a common pool resource (in this case the coastal marine environment) in isolation from one another because of the potential cumulative or synergistic effects (Ostrom et al. 1999). This is particularly relevant to the coastal marine environment adjacent to urban centres. In such instances, collaboration is best facilitated through cross-sectoral management institutions which foster greater involvement of other actors (e.g. business, civil society, and the scientific and professional communities) that are potentially affected by or can provide support for management decisions (DFO 2002).

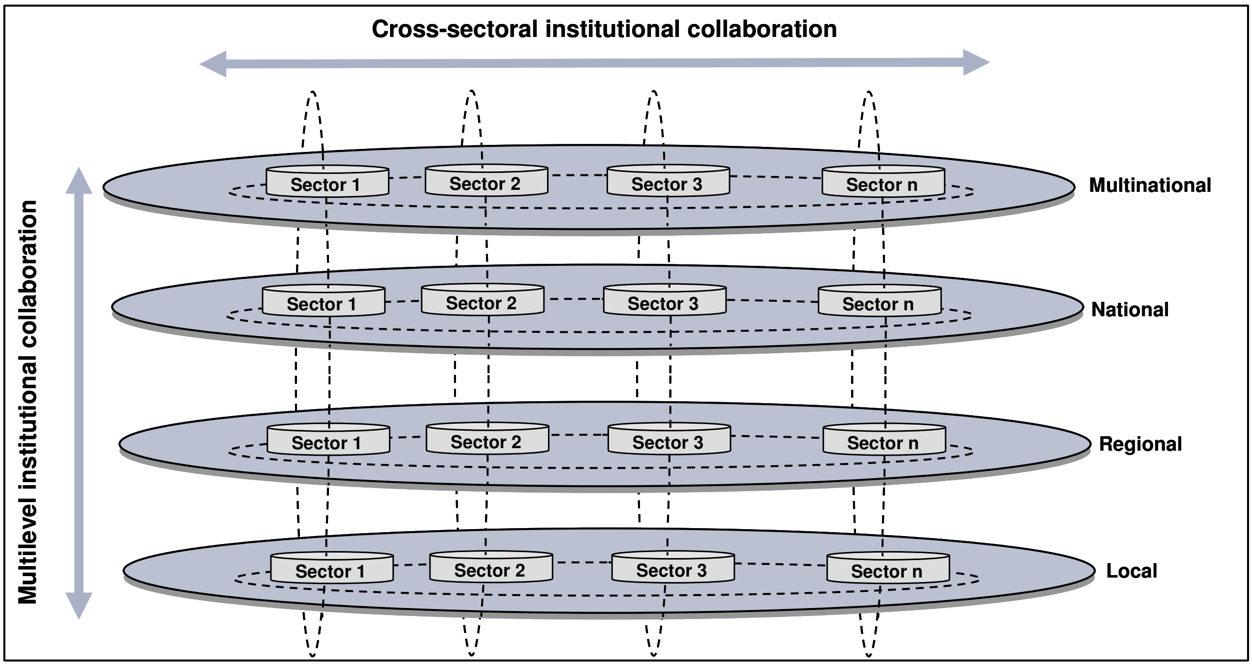


Figure 4.5 Conceptual linkages of institutional structures at the cross- and multi-sectoral levels

Not only do such institutions provide an ideal platform for participatory decision making, for example in setting the common vision and shared resource objectives, but they also fulfil the important role of being watchdogs or custodians. To have executive powers, government authorities need to be included in these institutions. However, even in instances where institutions did not have executive powers, they proved to be effective mechanisms through which to empower (and often pressurise) responsible authorities to execute their legal responsibilities, such as ensuring that licence agreements are issued or that corrective action is taken timeously in instances of non-compliance (Van Wyk 2001). Very important to the success of cross-sectoral (multi-actor) institutions is sound and easily accessible scientific information, which empowers the authorities and other actors to participate in the decision-making process (Taljaard, Monteiro & Botes 2006). Cross-sectoral collaboration typically occurs within the different tiers of governance and therefore needs to be anchored in a central platform to facilitate integration and coordination within a particular tier of governance. These roles can, for example, be fulfilled by national coastal committees, provincial coastal committees and local coastal committees that, in turn, need to collaborate to strengthen governance at the multilevel scale.

A central purpose of multilevel institutions (Figure 4.5) is to ensure communication of strategies and actions in a top-down as well as a bottom-up manner within a specific sector, as different tiers of governance usually have different roles and responsibilities within the management process. For example, at the national level the roles and responsibilities of institutions are usually focussed on the more strategic aspects, providing overarching direction, guidance and financial support for implementation (Lau 2005), while at the local level the roles and responsibilities of institutions are more focussed on 'on-the-ground' implementation (requiring top-down communication). Also, local tiers of governance – actively involved in 'on-the-ground' implementation – are ideally positioned to test the effectiveness and applicability of policies, legislation and best-practice guidelines that are typically developed at the national (or regional) levels. Hence, it is important that local institutions are consulted by higher tiers of governance to improve the policy and legal frameworks as part of the adaptive management loop (requiring bottom-up communication).

4.7.2 Capacity building

Cicin-Sain et al. (2000: 294) define capacity building as it relates to coastal management as "the design and conduct of the range of activities necessary to enhance the capacity of institutions and the individuals that comprise them to undertake effective ICM programs" and they provide a review of capacity-building efforts in the international arena.

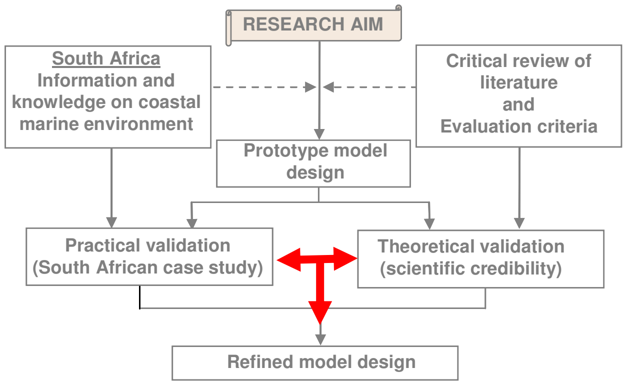
One of the main social threats to sustainable coastal management, particularly in developing countries, is diminishing (or lack of) capacity and relevant expertise, particularly at the local level, with associated ripple effects into the effectiveness and efficiency of management institutions. There are several reasons for diminishing capacity and expertise, one being the lack of continuity where government authorities are unable to maintain a critical mass of expertise to fulfil their roles and responsibilities (DEAT 2008). Effective capacity-building mechanisms are, therefore, a critical support element in the long-term sustainability of ICM implementation and should not be dealt with in an *ad hoc* manner. Capacity building requires a long-term strategy which includes the establishment of partnerships between responsible authorities and training institutions (e.g. universities) aimed at providing a workforce with qualified personnel who are appropriately trained through dedicated environmental management training programmes (Le Tissier et al. 2004). Within governing institutions, strategies for skills retention and the deployment of effective mentorship programmes for new recruits are essential.

4.7.3 Public education and awareness

Cicin-Sain & Knecht (1998: 240) aver that "An ICM program cannot survive over the long-term without the support of the general public". The key, they believe, "is a strong…public information and education program" (Cicin-Sain & Knecht 1998: 240). Thus, another distinct support element in a people-centred approach to environmental management is initiatives that facilitate the active involvement and education of civil society and the creation of awareness of, and a sense of responsibility for, environmental issues among ordinary people. These may include initiatives that physically involve civil society (e.g. beach clean-up – Storrier & McGlashan (2006)); using environmental issues to promote social equity for economically marginalised people through job creation and training opportunities (e.g. Working for Water programme – Van Wilgen, Le Maitre & Cowling (1998)); and public education (often undervalued for its ability to support environmental issues – Sinclair & Diduck (1995)).

This completes the exposition of the design of the prototype model for customised implementation in South Africa's largely sector-based governance system. The prototype design expands on the more traditional problems- or issues-based approaches applied in many earlier ICM models mostly grounded in the result-based management paradigm – to more strongly reflect the ecosystem-based management, spatial planning, cumulative effects assessment and carrying capacity and cooperative environmental governance paradigms identified in the literature as uniformities to consider more seriously in the implementation of ICM. Thus, the design is an amalgam of aspects from traditional ICM with aspects of ecosystem-based management and spatial planning as well as the concept of support elements involving the different actors in ICM implementation (cooperative environmental governance). The model accommodates sector-based management programme silos, typical of sector-based governance systems, by anchoring these in the overarching resource vision, objectives and zoning and the Monitoring and evaluation components as illustrated in Figure 4.4. This implies that management programmes, even though largely sector-based, remain grounded in an ecosystem-based approach, subservient to the agreed requirements and needs of the coastal ecosystem. In the following chapter the designed prototype is subjected to finer, empirical and scientific testing through a practical and a theoretical validation.

CHAPTER 5 PROTOTYPE VALIDATION AND REFINEMENT AND FUTURE MODEL DESIGN



This chapter addresses the empirical (or practical) and theoretical validation of the prototype design and offers refinements to the model design based on the outcome of the validation. Further, a generic process for the design and refinement of country-specific ICM implementation models is also proposed.

In the first section, the practical validation is achieved by testing the prototype model's compatibility in the existing South African context (the context described in Chapter 3). It is unlikely for the government to dramatically transform legislation and institutional arrangements pertaining to the coastal marine environment – at least not within the short- to medium term. Consequently, to be of use the model has to be applicable within the current milieu. South Africa's national programme of action (NPA) to protect the marine environment from land-based activities, an obligation the country has to fulfil within a specific time frame under the GPA, provides a suitable case study. To assess compatibility, the investigation considers the extent to which existing policies, legislation, institutional structures and other non-governmental actor involvement – related to the management of land-based activities (the case study) – can be accommodated (or not) in the prototype model design by focusing on each of the model's components in turn, as well as on the support elements. The theoretical validation follows in the second section and aims to assess the scientific credibility of the design against the evaluation criteria derived earlier (Section 2.3). The theoretical validation is followed by a section describing the refined model design, based on the outcome of the practical and theoretical validation. In the final section a practical and novel generic process is proposed for the design and refinement of country-specific ICM implementation models.

5.1 PRACTICAL VALIDATION

In this section the compatibility of the prototype design is assessed in the current South African context using the management of land-based activities as case study. At a forum meeting on 21 April 2008, the components and support elements of the prototype design were presented to members of the NAF, including the set of management objectives proposed within the component management programmes component. Forum members agreed that these components (including the set of management objectives) and the selected support elements were appropriate for inclusion in an initial implementation framework for the NPA. In the following subsections this initial vote of confidence is tested by investigating the practical compatibility of the prototype model in greater detail.

The assessment is structured around the model components namely[1]:

- Resource vision, objectives and zoning;
- Management programmes;
- Monitoring and evaluation; and
- Support elements (institutional structures and arrangements, capacity building, and public education and awareness).

5.1.1 Resource vision, objectives and zoning

The importance of setting an overarching vision and (resource) objectives for the coastal marine environment is well articulated in South Africa's Coastal Policy (South Africa 2000a). The policy, at the strategic level, supports an ecosystem-based approach, insofar as it centralises the coastal marine environment by setting a common vision and strategic goals and objectives (including ecological social and economic aspects) which were derived in a participatory, people-centred manner (Glavovic 2006). The concept of overarching resource objectives for a specific resource unit is also recognised in South Africa's NWA (South Africa 1998a). Sections 13-15 of the NWA require that a management class and resource quality objectives be determined for every water resource in the country – including estuaries – and that the suitability and authorisation of any water use within that resource be evaluated against such overarching objectives.

In accordance with the Coastal Policy, South Africa's primary piece of legislation concerning coastal management – the ICMA – recognises the importance of the delineation of geographical boundaries for the national coastal management unit and explicitly demarcates the national boundaries of the coastal marine environment (South Africa 2009a). Although the ICMA is less explicit about the specification of geographical boundaries for smaller coastal management units, for example at the bioregional, provincial or local scales, it makes allowance for the demarcation of special management areas (or units) "…if environmental, cultural or socio-economic conditions in that area require the introduction of measures which are necessary in order to more effectively – (a) attain the objectives of any coastal management programme in the area; (b) facilitate the management of coastal resources by a local community; (c) promote sustainable livelihoods for a local community; or (d) conserve, protect or enhance coastal ecosystems and biodiversity in the area" (South Africa 2009a: 40). Further, the ICMA allows for the establishment of coastal planning schemes, defined as "a scheme that facilitates the attainment of coastal management objectives by – (a) defining areas within the coastal zone or coastal management area which may – (i) be used exclusively or mainly for specified purposes or activities; (ii) not be used for specified purposes or activities; and (b) prohibiting or restricting activities or uses of areas that do not comply with the rules of the scheme" (South Africa 2009a: 40).

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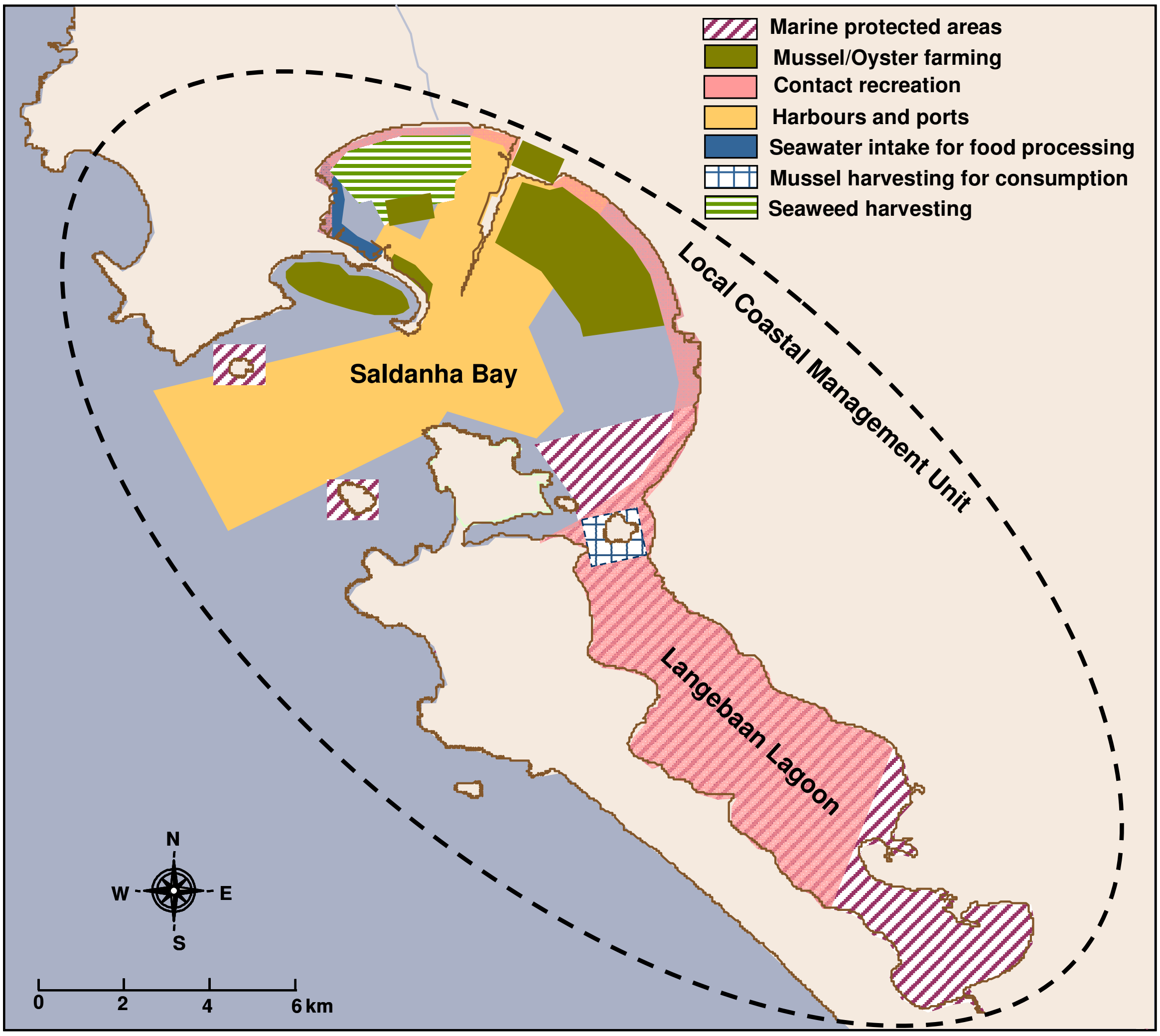
[1] The model component 'Situation assessment' is not included here because it is encapsulated in the playing field already presented in Chapter 3.

The concept of zoning and associated resource objectives for the coastal marine environment is also supported in other national legislation. For example, the Biodiversity Act (South Africa 2004a) and the National Environmental Management: Protected Areas Act (South Africa 2004d) allow for the demarcation of protected areas in coastal waters to protect biodiversity. The Marine Living Resource Act (South Africa 1998b) allows for the demarcation of protected areas aimed at protecting the country's aquatic living resources. South Africa's operational policy for the disposal of land-derived wastewater to the marine environment, a best-practice guide for marine disposal, also adopted the concept of zoning as part of its implementation framework (Taljaard et al. 2006; Taljaard, Monteiro & Botes 2006). However, despite the enabling legislation and best practices, the concept of spatial planning or zoning in the coastal marine environment, beyond the high-water mark, have not been fully embedded into the country's national spatial development processes or frameworks (e.g. National Spatial Development Perspective; Provincial Growth and Development Strategies) nor at the local level (e.g. the Integrated Development Plans and Spatial Development Framework) (DPLG 2009). Demarcation of management unit and zoning at the local scale has been applied in an *ad hoc* manner, as exemplified in the Saldanha Bay case (Figure 5.1).



Source: Adapted from Taljaard, Monteiro & Botes (2006: 539)

Figure 5.1 Saldanha Bay example of the demarcation of a local coastal management unit and the zoning of uses within the unit

Here the criterion for the selection of the local coastal management unit boundaries, in this case the embayment including Saldanha Bay and the Langebaan Lagoon, was that fluxes within this coastal ecosystem were considered greater than outward fluxes to adjacent land and coastal/oceanic systems (Taljaard & Monteiro 2002). In consultation with members of the local management institution (the SBWQFT), use areas within the embayment were mapped using a geographical information system (GIS) application. This map informed management of the bay in many aspects, one of which was the identification of potentially conflicting uses, e.g. harbour and port zones overlapping with mussel/oyster farming zones.

In principle the Coastal Policy, ICMA and several other pieces of environmental legislation support the notion of an overarching vision and objectives for a coastal marine environment, as well as the concept of spatial planning (i.e. demarcation of management units and use zoning), as proposed in the prototype implementation model. The challenge lies in the effective operationalisation of such legislation.

5.1.2 Management programmes

Over the past 15 years South Africa's greatest effort in protecting its natural environment, including the coastal marine environment, has been in the development of sound environmental policies (White Papers) and legislation (acts). Much of these policies and legislation is strongly sector-based. While such fragmentation is often cited as a major challenge in environmental management, Müller (2009) in a review of environmental governance in South Africa, maintained that this may be a misperception. In his view, capacity constraints and ineffective enforcement of legislation pose much greater challenges for environmental management in South Africa, a concern voiced since the mid-1990s.

One concludes from the above that despite numerous challenges, South Africa's legal and governing systems, although strongly sector-based, recognise the importance of establishing sound environmental management programmes. The prototype design accommodates sector-based management systems by anchoring the implementation of management programmes (remaining largely sector-based) between the resource vision, objectives and zoning component and monitoring and evaluation component, implying that management programmes remain grounded in an ecosystem-based approach subservient to agreed requirements and needs of the coastal ecosystem (Figure 4.4). To establish the extent to which the generic management objectives, proposed in the prototype model, have been achieved in management programmes of different sectors, the fifteen land-based activities identified as posing critical or potential threats to the coastal marine environment in South Africa (as part of the NPA) are tested as case studies - the results listed in Table 5.1.

For this evaluation the following four questions, derived from the set of management objectives proposed in the prototype design, were answered for each of the 15 activities:

- Are formal acts and /or legislation in place to mandate the management and control of the activity?

- Are regulations and/or best practice guidelines available to guide effective operationalisation?
- Are the resources (human, material and financial) available for effective execution and enforcement?
- Are compliance monitoring programmes undertaken?

Table 5.1 Evaluation of adherence to management objectives – as proposed in the prototype model – for selected land-based activities potentially posing threats to the coastal marine environment of South Africa

KEY SECTOR	ACTIVITY	MANAGEMENT OBJECTIVE			
		LEGISLATION	REGULATIONS/ BEST PRACTISE	IMPLEMENTATION	COMPLIANCE MONITORING
Cross-cutting to most sectors (i.e, different sectors need to consider responses to climate change, where appropriate).	Climate change	P	P	P	P
Coastal development	Coastal infrastructure development	F	F	F/P	P
	Off-road vehicles	G	G	G/F	F
Exploration and mining	Mining	G	F	F/P	F/P
Water supply	Freshwater abstraction and flow modification	G	F	P	P
Waste and wastewater	Municipal wastewater	G	G	G/P	G/P
	Industrial wastewater	G	G	G/P	G/P
	Urban storm water	P	P	P	P
	Solid waste disposal (littering)	G	F	F/P	F/P
	Atmospheric deposition	G	P	P	P
Agriculture and forestry	Agricultural practices	F	P	P	P
Transport (shipping)	Port and harbour operations (including dredging)	G	F	F	F
Conservation	Introduction of alien vegetation	G	F	F/P	F/P
Fisheries	Harvesting of living resources (relating to habitat destruction)	F	P	P	P
	Aquaculture (relating to habitat destruction and pollution)	G	F	P	P

Source: Adapted from DEAT (2008: 4-5)

Notes: G = good; F = fair; P = poor; Two symbols, e.g. **G/P,** imply that in a significant proportion of the country achievement of this management objectives is good, while still being in a poor state in other areas.

The evaluation was conducted in collaboration with scientists from the CSIR and was verified by members of the NAF during forum meetings and peer reviews of the NPA document (DEAT 2008). The outcome of the evaluation is given in Table 5.1 and it is evident from the results that although the legislation necessary to mandate the management and control of land-based activities is in place, as expected from earlier discussions, there are major shortcomings in achieving the other management objectives for most activities, including lack of capacity to implement and enforce existing legislation. Dissecting the evaluation of management programmes linked to individual sectors and activities in this manner (Table 5.1), provided not only a detailed status overview but also highlighted shortcomings, so offering guidance to the responsible authorities on prioritisation of actions. While future actions have been articulated as part of the NPA (DEAT 2008), the prioritisation of actions has not yet been completed. However, the importance of prioritisation has been acknowledged and the department responsible for the environment (as lead authority) has committed itself to facilitate prioritisation workshops as part of the operationalisation of the NPA in accordance with the prototype model's requirements (DEAT 2008).

5.1.3 Monitoring and evaluation

Within the prototype design, state of the environment or state of the coast programmes are viewed as appropriate platforms through which to operationalise overarching monitoring and evaluation programmes in the ICM implementation process. Here the model proposes dedicated long-term environmental monitoring programmes, including monitoring of the achievement of actions and outputs (implementation monitoring), as well as the achievements of outcomes and goals (results monitoring).

Monitoring and evaluation, as a component of environmental management, are embedded in South African environmental legislation. For example, NEMA requires all levels of government to submit annual reports on progress regarding sustainable environmental development practices (South Africa 1998c). One of the avenues through which this is achieved is State of environment (SoE) reporting at the national, provincial and local levels. Programmes specifically relating to coastal matters include the State of the coast and State of estuaries programmes (DEA 2009b).

More specifically, government's purpose and objectives for the SoE reporting programmes (DEA 2009b) are to:

- Provide objective, accurate and scientifically credible data and information about the condition of and prospects for the South African environment;
- Increase public understanding of these issues;
- Continue the development of national environmental indicators, and report on these indicators;
- Provide an early warning of potential problems; and

- Report on the effectiveness of policies and programmes designed to respond to environmental change, including progress toward achieving environmental standards and targets.

Following the release of the first comprehensive national SoE in 1999, the responsible department has initiated several other monitoring and evaluation-related initiatives (DEA 2009b), namely:

- Financial and technical support to provinces and municipalities to compile provincial and municipal state of the environment reports;
- Development of a guideline document on state of the environment reporting;
- The state of the environment initiative in schools;
- Development of a core set of environmental indicators;
- Development of GIS data sets; and
- A household environmental survey in collaboration with Statistics South Africa.

This research considered NEMA (South Africa 1998c) as a central piece of legislation for implementing the monitoring and evaluation component proposed in the prototype model. The SoE reporting programmes, together with data collection and management initiatives supported by, for example SAEON and SADCO (refer to Section 3.6.2) already provide the basis for effective implementation of overarching monitoring and evaluation programmes in the coastal marine environment. However, the various initiatives need to be aligned and coordinated through the responsible institutions to build toward a long-term, sustainable monitoring and evaluation programme that will truly reflect reality.

5.1.4 Support elements

The prototype design incorporates three key support elements (primarily addressing aspects associated with cooperative environmental governance revolving around the organisation and involvement of actors) of crucial importance for the successful operationalisation and sustainability of ICM in South Africa, namely institutional structures and arrangements, capacity building programmes and education and awareness programmes and initiatives. The next sub-section assesses the compatibility of the existing governing structures and actor involvement in coastal marine management in South Africa in each of the three support elements.

5.1.4.1 Institutional structures and arrangements

Institutional systems pertaining to coastal management in South Africa are largely sector-based as indicated in Table 3.2, where the various government departments, to a greater or lesser degree, have established in-house systems relating to specific sectors. Although the prototype model (Figure 4.1) recognises the role of sector-based management in ICM, cross-sectoral, multi-actor institutions are also essential for proper integration and coordination. This important consideration is acknowledged in South African legislation (e.g.

NEMA) and is supported through the establishment of cross-sectoral institutions such as the CEC, MINMECs and MINTEC, but the operationalisation of such structures to support effective implementation of ICM (in particular) remains a challenge (Section 3.6.1). Provincial coastal working groups have been established to facilitate the coordination of coastal management issues between provincial government departments and other extra-governmental organisations (e.g. CBOs, NGOs, research organisations, and recreational and user groups). They have had varying degrees of success. In terms of setting up cross-sectoral, multi-actor institutions for coastal marine management the ICMA holds great promise (South Africa 2009a). The Act, promulgated in 2008, mandates the establishment of multilevel and cross-sectoral coastal management institutions to facilitate ICM (i.e. the national, provincial and municipal coastal committees), although these structures are still in the process of being established (see Figure 5.2). Institutional structures also need to link with multinational (intergovernmental) institutions such as the Benguela Current Commission (BCC) which is operational along South Africa's west coast. Figure 5.2 is a schematic representation of the linking of institutional structures.

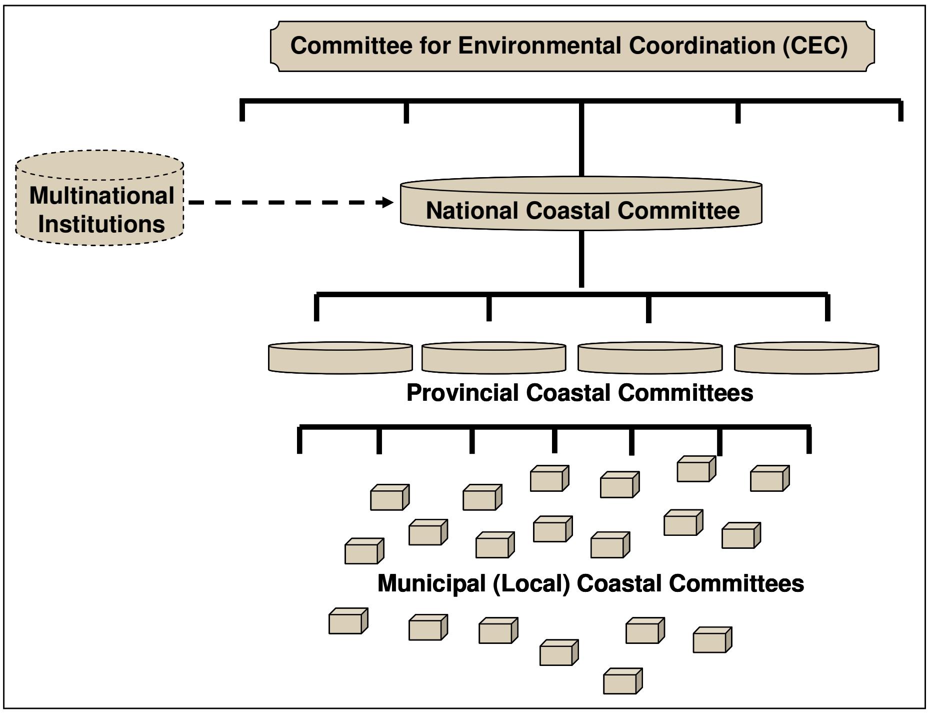


Figure 5.2 Conceptual visualisation of multilevel, cross-sectoral institutional structures for coastal management in South Africa

Appropriate representation of relevant actors or actor groups in these institutions is a crucial factor in effecting true participatory, people-centred coastal management solutions. For example, appropriate actors or actor groups for a national cross-sectoral institution in South Africa should include:

- National, provincial and local government departments responsible for the environment, marine living resources (including fisheries), water, agriculture, mineral resources (coastal mining and mineral exploration), transport, industry, agriculture, cultural matters, science and technology, finance and national strategic planning;

- Provincial coastal committees (to provide the link between national and provincial institutional structures);
- Non-government organisations operating in the coastal marine environment;
- Representation of coastal scientific and professional communities;
- National research organisations that support related research and funding of such research (e.g. WRC and NRF);
- Representation of civil society; and
- Non-government funding bodies.

The important role of local institutional structures has also been appreciated by civil society as shown in numerous (*ad hoc*) local forums established along the coast (DEAT 2008). The SBWQFT is one of the success stories as confirmed by a former chairperson: "This is a …unique forum in that, as far as I am aware, it is the only non-government body that is totally successful in melding the private sector with their contributions and the government with their overseeing capacity, to form a unit that is ultimately functional and effective." (SBWQFT 2004: 1). Although the SBWQFT concentrates on coastal water quality, this institutional structure is a suitable model for municipal coastal committees as proposed under the ICMA. Presently *ad hoc* local institutions mostly reflect a network mode of governance (Müller 2009). However, one can envisage that under the ICMA some of these institutions might later incorporate hierarchical modes of governance by, for example, migrating toward municipal coastal committees, as proposed under the Act.

5.1.4.2 Capacity-building programmes

Capacity building and skills development have become major concerns in South Africa, also because they affect competent management of the coastal marine environment. Consequently, capacity building is a priority of the government as is evident from existing efforts of the national department responsible for science and technology, the NRF and the IOI-SA (see Section 3.6.2). However, what is required is dedicated, long-term development programmes specifically aimed at improved governance of the coastal marine environment.

5.1.4.3 Public participation and awareness

The importance of public participation and awareness as a support element in the management of the coastal marine environment has long been acknowledged in South Africa as seen in the establishment of programmes such as Coastcare, Coastwatch and the Blue Flag Campaign (see Section 3.6.2). These programmes greatly contribute to creating public awareness and a sense of responsibility towards coastal issues in South Africa (e.g. DEA 2009a; Ocean Conservancy 2009) thus underscoring the importance of this support element in effective people-centred ICM as proposed by the prototype model.

The practical validation presented in this section, leads one to conclude that approaches to coastal management in South Africa, grounded in the current statutory framework, can be largely aligned with the approach to ICM implementation proposed in the prototype model. Because the model was designed to accommodate sector-based management programmes (as illustrated in Figure 4.4) the design can without difficulty accommodate sectors or activities other than those presented in the case study. Such sectors or activities may include conservation, transportation (shipping) and fisheries.

So, current approaches to coastal management in South Africa, embedded in the country's statutory framework, are compatible with the prototype model. Rather, the lack of and inefficiencies in the operationalisation of existing legislation pose the biggest challenge for effective implementation of this model. A hybrid of this prototype design is currently being tested in estuaries (CSIR 2009a) – sub-management units within the coastal marine environment (C.A.P.E. 2010).

Compatibility between the prototype model and the South African situation is maybe not unexpected as the method applied in the design of the prototype model was grounded in contextual, country-specific knowledge derived from my experience working in South Africa (see Section 1.3.3). Whereas the above exposition gives confidence in the workability (as demonstrated by the empirical or practical validation) of the model in the South African milieu, theoretical validation of the model is required to establish its scientific credibility. This is reported in the following section on theoretical validation.

5.2 THEORETICAL VALIDATION

This section addresses the theoretical validation of the prototype model (Figure 4.1) to establish its scientific credibility. The assessment of the prototype design proposed in Chapter 4 is performed against the fourteen evaluation criteria derived from published literature on the uniformities in effective implementation of IEM and ICM, as presented in Table 2.4. The outcome of the evaluation is presented below by dealing with each criterion seriatim.

Criterion 1: *(participation, actor involvement)*

Compliant. The prototype model acknowledges participatory, actor involvement. The concept of support elements (i.e. institutional structures and arrangement, capacity building, public participation and awareness) in the prototype design was incorporated to explicitly acknowledge important avenues through which participatory, actor involvement can be achieved, primarily by addressing the organisation of and cooperation between different actor groups which is crucially important in integrated management initiatives such as ICM.

Criterion 2: *(relevant and valid scientific knowledge)*

Non-compliant. The prototype model does not explicitly acknowledge valid and relevant scientific information and knowledge (scientific support) as an integral element in ICM implementation. Whereas the accessibility of valid scientific information, knowledge and decision support was assumed to be a logical requirement, the prototype model does not explicitly identify policy-related science and technology as an essential support element for environmental decision making and problem solving in ICM.

Criterion 3:

(process management)

Compliant. The prototype model requires clear process management to be adhered to achieve a desired outcome. The prototype design is presented as a cyclic framework that is transparent regarding the different components in the ICM implementation process. Also, in the management programmes component the prototype model proposes the identification of specific sectors (or activities) for which generic management objectives must be achieved to facilitate a focussed approach to the development and implementation of action plans within the different sectors.

Criterion 4:

(cooperative institutional structures)

Compliant. The prototype model requires cooperative institutional structures across tiers of government and sectors having clearly defined roles and responsibilities embedded in a sound legal framework as critical elements for effective implementation of ICM. The prototype design explicitly incorporates the establishment of appropriate cooperative institutional structures as a key support element (i.e. institutional structures and arrangements). These structures may include specific sector-based institutions (e.g. residing in a single sector), multi-level institutions (e.g. facilitating communication of strategies and actions between different tiers of governance in a top-down but also a bottom-up approach) and cross-sectoral institutions (e.g. facilitating collaboration and partnerships between the different sectors in government, business, civil society and the scientific and professional communities).

Criterion 5:

(objectives and targets)

Compliant. The prototype model requires the establishment of overarching (common) objectives, and associated indicators and targets related to the (central) coastal system against which to measure compliance, as well as to assess results-based outcomes. The prototype design is explicit about the establishment of objectives and associated indicators and targets. It distinguishes between two types of objectives, namely resource objectives (addressed in the resource vision, objectives and zoning component) and management objectives (addressed in the management programmes component). Resource objectives refer to those specifically related to the resource (i.e. the coastal system) and its uses, i.e. What is required from the coastal marine environment and what are the indicators and measurable targets that will indicate successful outcomes of such objectives? Management objectives refer to objectives and associated indicators and targets set for specific sectors (or activities) in order to ensure compliance with the resource objectives.

Criterion 6:

(monitor and evaluate)

Compliant. The prototype model requires monitoring and evaluation programmes to be established. The model views monitoring and evaluation as a distinct component in the implementation process, where the selection of appropriate indicators and measureable targets is considered essential to providing quantitative measures to evaluate progress in the operationalisation of ICM. Such indicators can be adopted from those predetermined for the resource and management objectives but can also include process indicators that provide quantitative measures to evaluate progress in, for example the development and efficiency of institutional structures, capacity building and public education and awareness initiatives.

Criterion 7:

(entire ecosystem)

Compliant. The prototype model considers the coastal ecosystem in its entirety with the coastal system as the central focus through which cooperative governance occurs between different sectors. The reason for introducing the resource vision, objectives and zoning component was to explicitly introduce the ecosystem-based approach into an implementation model. The establishment of an overarching vision and resource objectives for the coastal ecosystem in its entirety (i.e. considering ecological, social and economic aspects) provides a means of centralising the requirements of the ecosystem and its goods and services as a common benchmark for different (often sector-based) management programmes of activities in and around the ecosystem.

Criterion 8:

(delineate management units):

Compliant. The prototype model requires the delineation of coastal management units and the geographical demarcation, as well as geographical zoning of different uses or use areas within management units. In the model resource vision, objectives and zoning component the geographical demarcation of the boundaries of coastal management units, as well as the geographical demarcation or zoning of uses or use areas within the management unit are addressed.

Criterion 9:

(iterative, adaptive)

Compliant. The prototype model presents ICM as an iterative, adaptive process. The prototype design is presented as a cyclical process to emphasise the importance of continuous adaptation based on new learning, thus allowing for a systematic refinement of the overall implementation process.

Criterion 10:

(ecosystem limitations)

Compliant. The prototype model acknowledges the concept of ecosystem limitation. Although the design is not explicit in this acknowledgement, it is inferred in the resource vision, objectives and zoning component where stakeholder agreement on uses or use areas within a coastal management unit is required and, importantly, that such uses or use areas are geographically demarcated or zoned. A prime reason for including this aspect in the prototype design is own experience in marine water quality management where the explicit mapping of uses proved to be the most suitable approach to acknowledge and address potential cumulative or synergistic effects of numerous activities occurring in a single coastal system. This gives credence to the limits of the ecosystem.

Criterion 11:

(legal framework)

Compliant. The prototype model requires an enabling legal framework. In the management programmes component the prototype model explicitly acknowledges the importance of an enabling legal framework in different sectors to facilitate effective management and control of the activities within a specific sector (i.e. as one of its management objectives).

Criterion 12: *(education and awareness)*	Compliant. The prototype model acknowledges continuous development of awareness as an integral element in ICM implementation. The prototype design explicitly incorporates public awareness programmes as a key support element (i.e. public participation and awareness) which is considered as one of the important avenues to facilitate participatory, actor involvement in the implementation of ICM.
Criterion 13: *(capacity building)*	Compliant. The prototype model acknowledges continuous capacity-building programmes as an integral element in ICM implementation. The prototype design explicitly recognises the decisive role of appropriate capacity-building programmes in sustaining effective implementation of ICM, as reflected in the capacity building support element.
Criterion 14: *(funding structures)*	Non-compliant. The prototype model does not acknowledge sound funding structures (sustainable financial support) as a key support element for the implementation of ICM. The assumption was that in South Africa many aspects of ICM are already mandated to specific government departments through existing legislation and that different departments are obligated to award financial resources to fulfil their mandates in the coastal marine environment.

In assessing the prototype design against the fourteen evaluation criteria − derived from the collective learning in IEM (and ICM) implementation over the past two decades − the criteria were adhered to, apart from two criteria, namely that which related to scientific support networks (Criterion 2) and to sustainable financial support (Criterion 14). These were not included as key support elements in the prototype design. Yet, as indicated in Chapter 3, South Africa has established independent scientific networks outside the realm of government to coordinate scientific research in support of coastal management, for example CERM, SANCOR and WRC. The inclusion of scientific support networks as a key support element in an ICM implementation model is, therefore, workable and will not affect the applicability of the prototype design, but rather the explicit recognition of these scientific support networks will highlight their importance to ICM.

Concerning sustainable financial support mechanisms, many aspects of ICM are already mandated through existing legislation and therefore should have budget allocated by the responsible government departments (see Chapter 3). There are, however, components or elements in ICM implementation that are institutionally 'grey areas', i.e. components or elements not explicitly assigned to specific departments or institutions by law, such as the development of public education and awareness programmes. Also, government at local level – where many of the 'on-the-ground' efforts in ICM implementation centre − may not always have sufficient resources to finance implementation, even if mandated by law to do so. Consequently, there is a strong argument for an overarching, sustainable financial strategy for the implementation of ICM in South Africa. By including it as a decisive support element in the model enhances the importance and necessity of having a sound funding strategy associated with ICM implementation.

5.3 REFINED MODEL

The validation process has demonstrated that the current approaches to coastal management in South Africa, as embedded in the statutory framework, are compatible with the prototype model. Although the prototype model largely reflects the uniformities identified internationally as improvements to ICM implementation (as measured in the theoretical validation) its theoretical validity can be enhanced by the inclusion of two additional support elements – scientific support networks and sustainable financial support – without compromising the models applicability to the South African situation. Considering the prototype design, and its practical and theoretical validation, two interdependent, but distinctive adaptive cycles emerge as prospective additions to the model. The refined model therefore incorporates these dual, adaptive cycles coined as the resource and actor cycles as depicted in Figure 5.3.

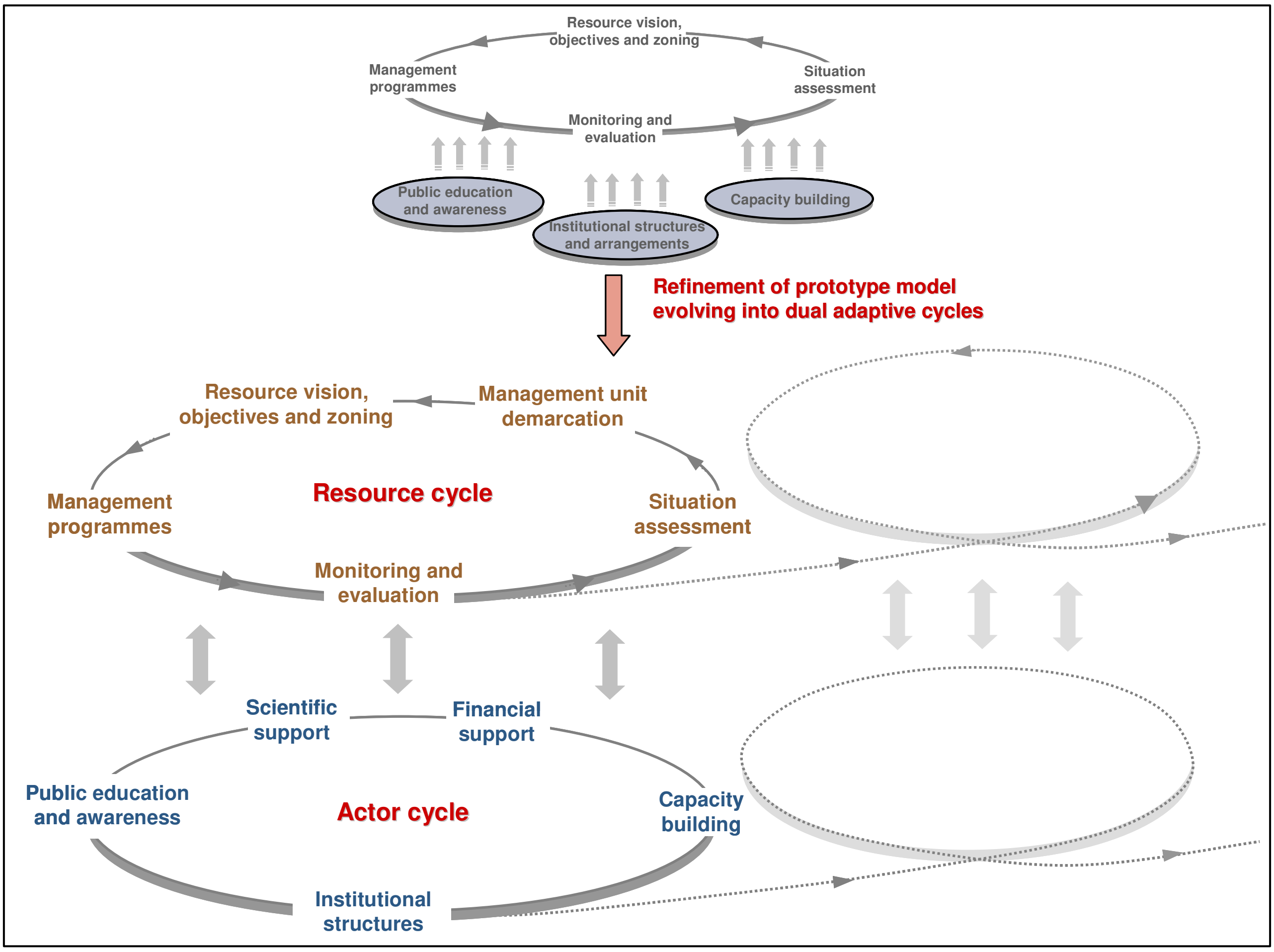


Figure 5.3 Revised model design for ICM implementation depicting dual adaptive cycles

Recalling Cicin-Sain & Knecht's (1998) typology of ICM contexts displayed in Figure 2.14, the resource cycle resembles what they label as "the context of problems and opportunities present in the coastal area and the goals and objectives of ICM (i.e. the what and the why)", established by the socio-economic and physical (type of coastal marine ecosystem) variables within the coastal unit (Cicin-Sain & Knecht 1998:122). The actor cycle, on the other hand, resembles 'the how and by whom' which largely concerns political variables.

My experience in the development and implementation of marine water quality management programmes in southern Africa convince me that socio-economic variables also play essential roles in 'the how and by whom'. For example, a nation's level of development will influence the nature of public education and awareness or capacity building programmes (e.g. taking into account the level of literacy). Since the determining variables listed above change from country to country and within countries, it is obvious that the elements influenced by these variables also change from time to time, therefore the need for adaptive cycles. Further, the revised model with its dual, adaptive cycles contributes an implementation perspective to the growing body of scientific literature on social-ecological systems (e.g. Anderies, Janssen & Ostrom 2004; Folke et al. 2005). In this literature, the ecological system is viewed as intricately linked with and affected by the social system as depicted by the interlinked resource and actor cycles of the revised model. Drawing parallels with IWRM, these two cycles largely resemble the two conceptual pillars of the EMPOWERS approach, namely the stakeholder dialogue and concerted action (SDCA) and the programme cycle (Moriarty et al. 2010). The next two sub-sections expand on the components of and rationale for each of the two adaptive cycles.

5.3.1 Resource cycle

The resource cycle primarily identifies distinct actions that are relevant to the resource (i.e. coastal marine environment) and activities in and around that resource. These (action) components are in line with the original components of the prototype model that include:

- *Situation assessment*;
- Demarcation of the *geographical boundaries of coastal management units*;
- Establishment of a *common vision and objectives for the resource* (i.e. the coastal marine environment within the demarcated management unit) and *zoning* of uses and use areas;
- *Management programmes* (i.e. identification of sectors or activities to be included in management programmes, setting of management objectives and prioritisation for operationalisation); and
- *Monitoring and evaluation* (including monitoring of the achievement of actions and outputs (implementation monitoring), as well as the achievements of outcomes and goals (results monitoring).

However, a distinct modification in the refined design is the inclusion of 'demarcation of the geographical boundaries of coastal management units' as a separate component. The geographical demarcation of coastal management units is such a fundamental aspect of ICM implementation that it warrants the addition of an explicit component in the resource cycle, rather than being hidden in the resource: vision, objectives and zoning component, as was the case in the prototype design. Priority tasks associated with each of the components in the resource cycle are summarised in Table 5.2, highlighting specific prerequisites to be considered in the implementation of the refined model.

Table 5.2 Summary of specific prerequisites associated with the components in the resource cycle of the refined model

CYCLE COMPONENT	SPECIFIC PREREQUISITE
Situation assessment	• Consolidate information on the coastal marine environment relevant to its management, including: - Status and importance of the coastal marine environment; - Key sectors (and associated activities) contributing to problems or posing threats to this environment; - Existing statutory and governing structures; and - Opportunities and constraints.
Management unit demarcation	• Delineate geographical boundaries of coastal management units, including large marine management units (typically covering extensive areas and subdividing a country's waters from a demarcated boundary inshore out to the seaward limit of the EEZ) to the smaller, local coastal management units (nested within larger management units).
Resource: Vision, objectives and zoning	• For a coastal management unit, agree on a common vision and shared resource objectives (including ecological, social and economic aspects). • Translate resource objectives into measurable targets using appropriate indicators within the coastal system or resource. • Map (or zone) agreed uses or use areas for zoned activities within the management unit (e.g. conservation areas, tourism and recreation, fishing zones, mariculture, port and harbour and navigation routes), as well as the location of activities posing potential threats within the management unit (e.g. exploration platforms, wastewater discharge sites, dumping areas).
Management programmes	• Identify sectors/activities for inclusion in management programmes. • Assess the following for each of the selected sectors/activities and identify shortcomings (future actions): - Management and control are adequately addressed in legislation (acts); - Regulations and/or best practices are available to guide effective implementation of the legislation, including best available technologies, specification of critical limits (e.g. effluent emission targets), minimum (compliance) monitoring requirements, and efficient penalty and/or incentive systems; - Effective implementation is achieved by executing and enforcing legislation, regulations and best practice using sufficiently skilled and motivated personnel, equipped with the appropriate material and financial resources throughout the planning and design, construction, operational and decommissioning phases of an activity; and - Compliance monitoring programmes are designed and implemented to measure the effectiveness of the management programme specifically related to the sector/activity. • Prioritise for operationalisation.
Monitoring and evaluation	• Develop and implement monitoring programmes on: - Achievement of actions and outputs (implementation monitoring); and - Achievements of outcomes and goals (results monitoring).

5.3.2 Actor cycle

Ultimately, ICM implementation is driven by people (actors) organised in collaborative actor institutional structures or networks that include partnerships between government, business, civil society, and the scientific and professional communities. In essence, the actor cycle identifies the basic components of such actor involvement. I depict the components of the actor involvement as a separate, adaptive cycle, thereby acknowledging that actor involvement, as part of the environmental governance system of ICM, is important (if not the most important element) and also that such involvement (i.e. 'the how and whom' according to

Cicin-Sain & Knecht (1998)) may change over time because they are influenced by political and socio-economic variables – aspects that are not static. As a result, actor involvement must be adaptable in response to changes in the political and socio-economic milieus.

In the prototype design three vital components (support elements) in actor involvement were identified for ICM implementation, namely institutional structures and arrangement, capacity building and public education and awareness. The outcome of the theoretical validation led to the addition of two vital components, namely scientific support and financial support mechanisms (see Figure 5.3). Of the components in the actor cycle, institutional structures (comprising cross-sectoral and multilevel institutional networks inclusive of all relevant actors) are the anchoring component in the actor cycle here depicted in Figure 5.4.

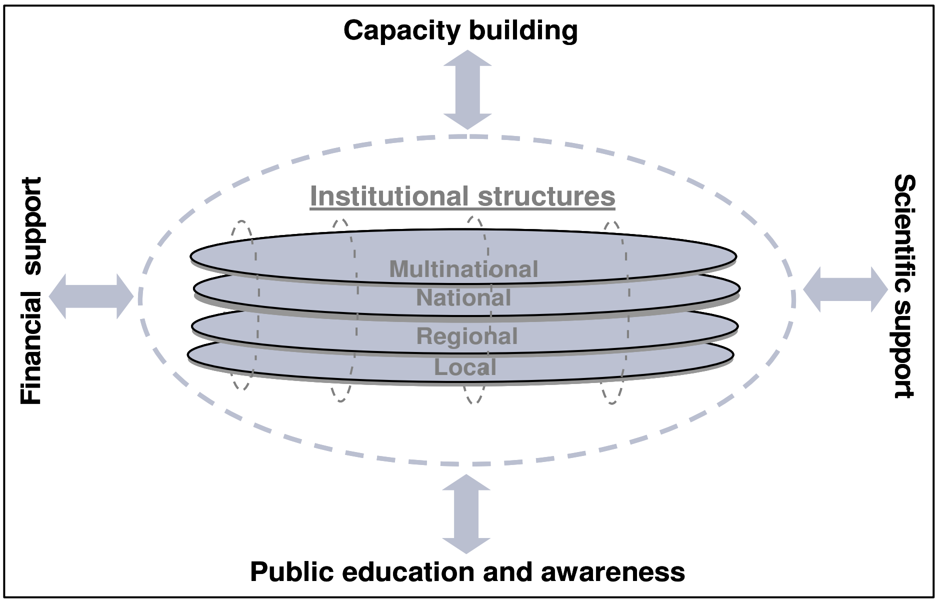


Figure 5.4: Institutional structures visualised as the anchoring component among the other supporting elements in the actor cycle

This assertion is made because appropriate institutional structures are the essential component and the main driver of ICM implementation in South Africa. Ultimately ICM implementation is driven by people (actors) organised in collaborative institutional structures or networks that include partnerships between government, business, civil society, and the scientific and professional communities. The other components in the actor cycle are the true supporting elements, that is elements that significantly contribute to the long-term success and efficiency of ICM implementation and thus its sustainability. The enabling mechanisms to develop sound institutional structures for ICM implementation are already embedded in South Africa's environmental policy and legislation. This, together with several government-driven (although largely sector-based) initiatives aimed at sustainable exploitation of, and development within, the coastal marine environment, demonstrates political will. I believe that the biggest challenge in South Africa lies in coordinating and integrating operationalisation of ICM through cooperative institutional structures. Hence my view of this as the essential actor component and the main driver of ICM implementation within the

South African context[1]. A short description of the different components in the actor cycle is provided in Table 5.3 to be considered in the implementation of the refined model.

Table 5.3 Short description of the components in the actor cycle of the refined model

CYCLE COMPONENT	SHORT DESCRIPTION
Institutional structures	Appropriate, multi-actor institutional structures are the critical routes through which to achieve cooperative management of complex management processes such as ICM. These institutional networks need to include all actors relevant to specific issues and need to facilitate partnerships and collaboration between different sectors in government, business, civil society, and the scientific and professional communities, i.e. structures that will support effective cooperative environmental governance. The design of the institutional networks needs to consider existing statutory and institutional structures and accommodate the political and socio-economic milieus of a country.
Capacity building	Effective capacity building mechanisms are a critical support element in the long-term sustainability of an implementation process and should not be dealt with in an *ad hoc* manner. Capacity building requires a long-term strategy including the establishment of partnerships between responsible authorities and training institutions (e.g. universities) aimed at providing a workforce with qualified personnel who are properly trained through dedicated environmental management training programmes. Within governing institutions strategies for skills retention and the deployment of effective mentorship programmes for new recruits are essential.
Financial support	A key support pillar for sustainable ICM is sound financial support for effective implementation in the long term, from national to local level. While the initial funding for ICM implementation often occurs on a project-by-project level, it needs to evolve into a well-designed financial model that will be sustainable in the long term. Such models can take on different shapes to fit specific socio-economic and political environments, ranging from government-funded to privately- (e.g. NGOs) funded to public-private partnerships.
Scientific support	There is increasing recognition that sustainable decision making needs to be based upon sound scientific evidence that is certified against standards judged acceptable by the scientific community and insulated from the interference of politics. The term "co-production" of science and policy supports this notion that policy-related science is an essential component of (environmental) decision making and environmental problem solving. However, despite these two activities being interlinked and strongly influencing one another, science is a distinctly different activity from policy, following its own principles. In South Africa, government-independent scientific support can be coordinated through organisations and institutions such as SANCOR, CERM and WRC, both to optimise the use of often limited resources and to prevent unnecessary duplication of effort. Importantly, these organisations and institutions must also be explicitly recognised as an important actor network within the ICM implementation cycle.
Public education and awareness	Public education and awareness is a very distinct support element in a people-centred approach to environmental management. This requires the establishment of initiatives to facilitate the active involvement of civil society and create awareness of, and a sense of responsibility for, environmental issues among ordinary people. These may include initiatives that physically involve civil society, using environmental issues to promote social equity for economically marginalised people through job creation and training opportunities and public education (often undervalued in its ability to support environmental issues).

In the implementation of the refined model, specific prerequisites to be considered within each of the components in the actor cycle include:

- Identification of main role players to be included or consulted in the element of the actor network;
- Identification of areas of collaboration and cooperation with other elements of the actor network;

[1] Other components, such as public education and awareness and capacity building may, for example, be most important in countries where ICM has not yet been embedded in policy and legislation and where local, project-based ICM programmes need ultimately to be scaled up toward the development of national policy and legislation.

- Development of an implementation programme for operationalisation, specifying strategies, objectives, actions and time frames;
- Identification of key indicators and measureable targets against which to evaluate progress; and
- Monitoring the effectiveness of operationalisation, evaluated against the key indicators and targets.

Knowledge gained in the validation process (see Sections 5.1 and 5.2) enabled me to refine the prototype model, initially designed from a strong contextual, country-specific perspective, for the implementation of ICM in South Africa. A novel feature of the refined model is the notion of dual adaptive cycles, namely the resource cycle and the actor cycles which distinguish between actions having relevance for the resource (i.e. coastal marine environment) and activities in and around that resource (i.e. 'the what and the why'), and the key elements of actor involvement in ICM (i.e. 'the how and by whom').

5.4 PROPOSAL FOR DESIGN AND REFINEMENT OF ICM IMPLEMENTATION MODELS

This study applied a specific *process* to design and refine a country-specific ICM implementation model, as depicted in the detailed research framework (Figure 1.3). First, the process involved the design of a prototype model (Chapter 4) primarily based on contextual, local knowledge in the South African country-specific context. Second, the process included a dual validation process, namely an empirical validation (i.e. to test practical applicability) (Section 5.1) that required the country-specific information provided in Chapter 3. This was followed by a theoretical validation (i.e. to test the scientific credibility) in Section 5.2 using evaluation criteria derived from the scientific literature covered in Chapter 2. Finally, the outcome of the validation process was used to refine and improve the prototype design in the previous section (Section 5.3).

As with the need for 'on-the-ground' operationalisation of ICM to follow a structured, adaptive process – as depicted in the dual, adaptive cycles of the ICM implementation model – the implementation model or framework may require refinement and adaptation from time to time. While the design of country-specific ICM implementation models needs to be contextual, the process followed in designing and refining of such models is generic or universal. The process applied in this study – as depicted in the detailed research framework – can be adapted as a practical and novel generic process for the design and refinement of country-specific ICM implementation models in future. The generic procedure for accomplishing this task is illustrated in Figure 5.5. In the generic process, a detailed assessment of recent scientific information is undertaken to establish scientific learning about ICM implementation, including the appropriate uniformities of effective and sustainable ICM implementation, both existing and anticipated unifomities (Theoretical framework$_1$). In this study, uniformities in the effective and sustainable implementation of IEM, the broader domain in which ICM is nested, were chosen as an appropriate measure. This informs the theoretical validation.

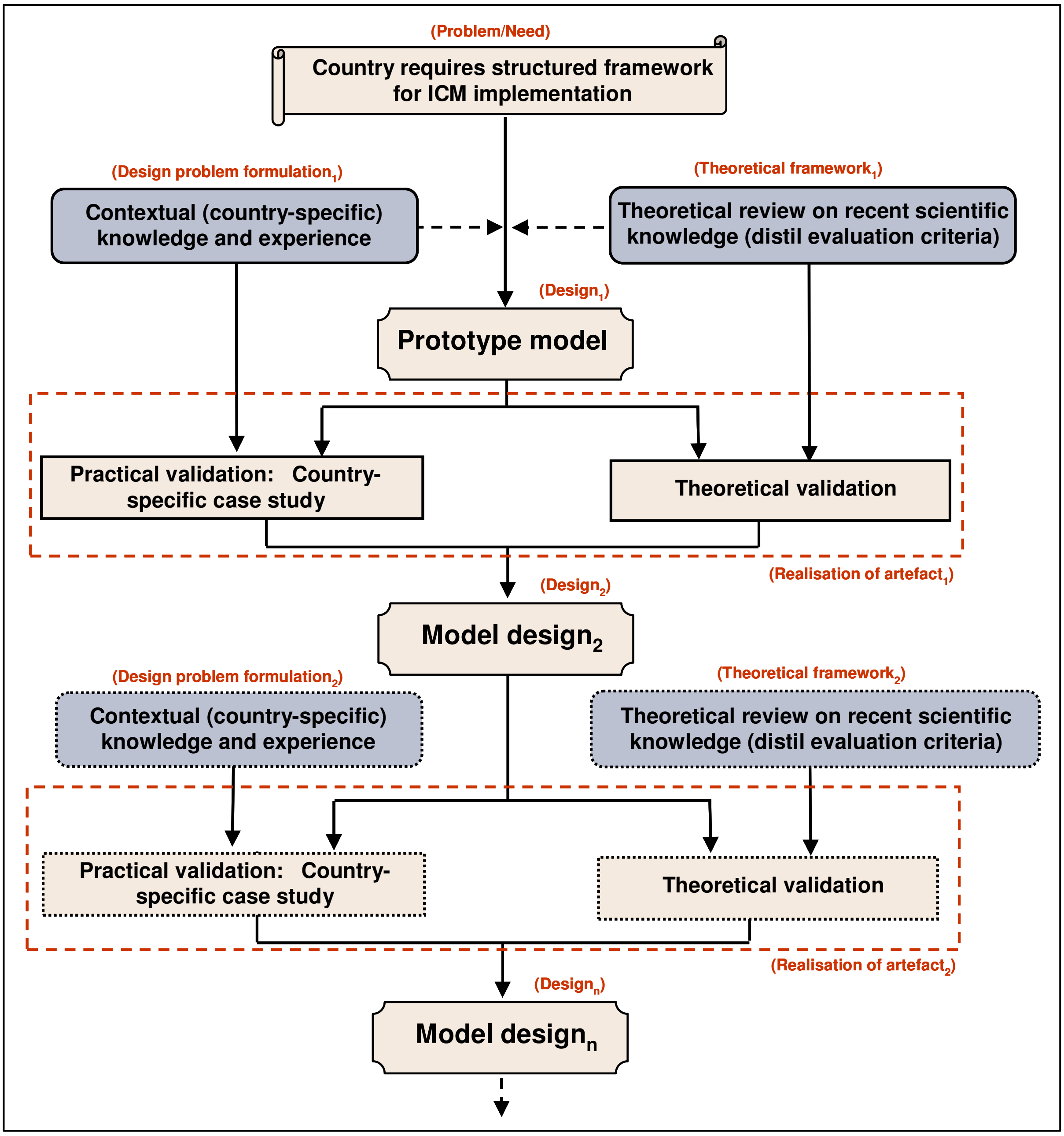


Figure 5.5 **Proposed process for the generic design and refinement of country-specific ICM implementation models**

As the figure shows, a dual validation process follows (Realisation of Artefact$_1$), namely the practical validation to assess the compatibility with the existing coastal management milieu of the country and the theoretical validation to assess the scientific credibility of the design. The outcome of the validation process is used to refine the prototype model design (Design$_2$). This process is repeated from time to time to ensure that a country's ICM implementation model remains contextual, while at the same time taking into account recent scientific learning and advancements in ICM implementation.

As for ICM implementation, the design and refinement of country-specific implementation models also require adaptive management, i.e. improving by learning. It is essential that governments recognise this requirement and put measures in place to ensure regular review and adaptation of their country-specific models. A process through which to achieve this goal has been provided above. For South Africa, this responsibility lies with the national department responsible for the environment, appointed as lead institution for coastal management under the ICMA. Despite the contextual nature of ICM implementation, the refined model design proposed in this study can be applied as the initial prototype design ($Design_1$) in countries with a similar coastal management milieu as South Africa (e.g. with extensive existing legislation and numerous initiatives in support of ICM already in existence, but governed under a largely sector-based system).

The final chapter of this dissertation follows. It concludes the research conducted in this study by demonstrating the fruition of the research aims and by suggesting new research areas to further refine and improve the ICM implementation model.

CHAPTER 6 REFLECTING ON THIS RESEARCH AND A WAY FORWARD

The aim of the research was to design a workable and scientifically sound implementation model for integrated coastal management (ICM) in the South African context and to propose a generic process for the design and refinement of country-specific ICM implementation models. Four research questions were posed, namely:

- Can contextual, country-specific knowledge be harnessed to design a prototype ICM implementation model for South Africa?
- Is the prototype design workable in or compatible with the existing coastal marine statutory and governance system of South Africa (i.e. extensive existing legislation and numerous initiatives already in existence, but governed under a largely sector-based system) (i.e. the empirical or practical validation)?
- Is the prototype model for South Africa – designed mainly from a contextual, country-specific perspective – scientifically credible and how can insights into the uniformities which contribute significantly to improved implementation of integrated environmental management (IEM) and ICM be applied to assess such credibility as well as inform refinements to the model (i.e. the theoretical validation)?
- Can a generic process for the design and refinement of country-specific implementation models be derived from the research methodology applied in this study?

In the first five sections of this concluding chapter (Sections 6.1 to 6.5) I evaluate the outcome of the different research activities and provide answers to these research questions. In so doing, I will demonstrate the achievement of the aims of this research. Finally, new research areas are suggested to further refine and improve the design and applicability of the implementation model for ICM.

6.1 A PROTOTYPE ICM IMPLEMENTATION MODEL FOR SOUTH AFRICA

The prototype model design (i.e. a workable approach for the implementation of ICM in the South African context) primarily arose from a specific need to develop a customised implementation framework for South Africa's national programme of action (NPA) to protect the marine environment from land-based activities. In accordance, with the scientific literature that stresses the contextual nature of ICM implementation and the importance of considering local knowledge, I chose to base the design of the prototype model on two main information sources, namely:

- A general review of trends in ICM implementation, specifically focussing on existing guidelines provided by the Global programme of action (GPA) to protect the marine environment from land-based activities: and

- Personal knowledge, experience and insight concerning coastal management acquired over a 20 year professional career.

Based on personal experience in designing and implementing marine water quality management models in South Africa, elements of the ecosystem-based management and spatial planning paradigms were combined with traditional problems- or issues-based approaches – applied in many of the earlier ICM models – in the prototype design, and thereby showing that the ecosystem-based and problems- or issues-based approaches are complementary rather than conflicting approaches in this type of model. Personal experience also confirmed the importance of informed and well-established actor involvement in coastal management (cooperative environmental management) which manifested in the inclusion of the important avenues of actor involvement (i.e. the support elements) in the prototype model. Moreover, South Africa's sector-based governance system was accommodated in the design by anchoring the management programmes component (remaining largely sector-based) between the resource vision, objectives and zoning, and monitoring and evaluation components, implying that management programmes remain grounded in an ecosystem-based approach and subservient to agreed requirements and needs of the coastal ecosystem.

This research, therefore, demonstrated a method where experience and country-specific knowledge were harnessed to design a prototype ICM implementation model for South Africa and, in doing so, important elements of emerging paradigms for improved ICM implementation – as identified in the scientific literature – were captured experientially. These paradigms include the ecosystem-based management, spatial planning and cooperative environmental governance paradigms.

6.2 PRACTICAL VALIDATION OF THE PROTOTYPE MODEL

Because it is unlikely that South Africa will dramatically transform its legislation and institutional arrangements – at least not in the short- to medium-term – a primary concern of the practical validation was to explore alignment with existing initiatives. The assessment was undertaken as a case study using South Africa's national programme of action (NPA) to protect the marine environment from land-based activities, an obligation the country has to fulfil within a specific time frame under the GPA. Although primarily focussed on land-based activities, the case study is appropriate as it represents a sufficiently diverse range of activities and associated sectors (15 activities involving 10 sectors) to test the model's practical validity. Empirical data and information on the South African coastal marine environment, that described the milieu in which the prototype had to be operational, were applied. This information comprised a brief overview on:

- South Africa's coastal marine ecosystems to illustrate the resources' diversity and complexities;
- The importance of South Africa's coastal marine environment; the key threats to the coastal marine environment (focusing on land-based activities);
- A summary on the health status of the coastal marine environment; and

- A synopsis on the sector-based legal framework of the country and the main actor networks operating in the coastal marine environment.

The assessment revealed that approaches to coastal management in South Africa, grounded in the current statutory framework of the country, can be aligned with the approach proposed in the prototype implementation model. Indeed it is inefficiency or a lack of operationalisation of existing legislation that may pose the biggest challenge for effective implementation of this model. Because the prototype model is designed to accommodate sector-based management programmes, it can be extended to accommodate sectors or activities other than those presented in the case study, such as conservation, transportation (shipping) and fisheries. Consequently, the prototype model can be applied in South Africa without any substantive adaptation of the existing statutory framework. Clearly, the challenge of effectively operationalising existing statutes remains.

Compatibility between the prototype model and the South African situation was therefore demonstrated. This is not unexpected as the prototype design was grounded in contextual, country-specific knowledge derived from own experience working in South Africa.

6.3 THEORETICAL VALIDATION OF THE PROTOTYPE MODEL

A critical review of relevant scientific literature provided information on and understanding of uniformities in integrated environmental management (IEM), the broader domain within which ICM is nested. The key paradigms that contribute significantly to improved implementation of IEM were used to express such uniformities. One can justify this initial, broad assessment based on the understanding that the coastal marine environment is a component of the environment in general so that the generic uniformities applicable to IEM are also applicable to ICM, although some of these may not have been fully incorporated in existing ICM implementation models. It became apparent from studying the evolution of ICM that many of the key paradigms that significantly contribute to improved implementation of IEM were also evident in the implementation of ICM. Six paradigms are well-established as important uniformities in ICM implementation, namely:

- Participatory, rational decision making;
- Environmental monitoring;
- Environmental assessment;
- Objectives-based management;
- Adaptive management; and
- Cooperative environmental governance.

Other paradigms that were less established as uniformities in ICM but which did prove valuable in the few models that incorporated them are:

- Ecosystem-based management;
- Cumulative effects assessment and carrying capacity; and
- Spatial planning.

The scientific literature also reiterates further exploration of the latter paradigms to significantly enhance the effectiveness and sustainability of ICM implementation. Similarly, more attention for innovative avenues to enhance cooperative environmental governance is encouraged.

The insight gained from scientific literature was applied in determining fourteen evaluation criteria with which to assess the scientific credibility of the prototype design. The subsequent assessment of the prototype design confirmed that the collective learning in IEM (and ICM) implementation over the last two decades is consolidated in this prototype design, apart from two aspects, namely scientific support networks and sustainable financial support. These were not initially defined as key support elements for ICM implementation in South Africa, but later were demonstrated to be omissions in the prototype. South Africa has established independent scientific networks outside the realm of government that coordinate scientific research in support of coastal management and the explicit recognition of these scientific support networks will highlight their importance to ICM. Further, the inclusion of a sustainable financial support mechanism as a key element in the model will significantly enhance the importance and necessity of having a sound funding strategy associated with ICM implementation in South Africa.

Through this research, evaluation criteria for the assessment of the scientific credibility of ICM implementation models, based on uniformities encountered in effective and sustainable IEM and ICM practices worldwide were distilled from the scientific literature. Further, the research demonstrated how such criteria can be applied to a prototype model design to assess its scientific credibility and to inform refinements to the model.

6.4 A REFINED MODEL FOR ICM IMPLEMENTATION IN SOUTH AFRICA

The validation process demonstrated the prototype model’s compatibility with the South African context. No substantive adaptation of the existing statutory framework was required. The remaining challenges lie in the effective operationalisation of the model. Further, the prototype design largely reflects the uniformities that are internationally considered to contribute to effective and sustainable implementation of IEM (including ICM). The model’s validity can be enhanced by including two additional support elements – scientific support networks and sustainable financial support.

Considering the prototype design and its practical and theoretical validation, two interdependent but distinctive adaptive cycles emerged. The refined model therefore incorporates these dual, adaptive cycles coined the resource and actor cycles. The resource cycle aligns well with the original components of the prototype design. However, a distinct modification in the refined design is the inclusion of the demarcation of the geographical boundaries of coastal management units as a separate component. It clearly emerged that the geographical demarcation of coastal management units is such a fundamental aspect of ICM implementation that it warrants an explicit component in the resource cycle, rather than being hidden in the resource vision, objectives and zoning component, as is the case in the prototype design.

In essence, the components in the actor cycle represent the chief actor groups involved in the governance system of ICM. Actor involvement is depicted as a separate, adaptive cycle, so acknowledging it as a distinct, very important part of the ICM environmental governance system and, that actor involvement may change over time as it is influenced by political and socio-economic conditions which are non-static. Actor involvement thus needs to be adaptable in response to changes in the political and socio-economic variables. The components in the actor cycle reflect the original support elements of the prototype design, including two additional vitally important components of actor involvement identified in the theoretical validation which were not included in the prototype design, namely scientific support and financial support mechanisms. Of all the components in the actor cycle, institutional structures (comprising cross-sectoral and multilevel institutional networks inclusive of all relevant actors) are the anchoring component in the cycle. It is concluded that appropriate institutional structures are the key driver of effective ICM implementation. Ultimately ICM implementation is driven by people (actors) organised in collaborative institutional structures or networks that include partnerships between government, business, civil society, and the scientific and professional communities. The other components in the actor cycle represent the supporting elements as they significantly contribute to the long-term success and efficiency of ICM implementation and its sustainability.

The revised model with its dual, adaptive cycles contributes an implementation perspective to the growing body of scientific literature on social-ecological systems. In this literature, the ecological system is viewed as intricately linked with and affected by the social system as depicted by the interlinked resource and actor cycles of the revised model.

6.5 PROCESS FOR DESIGNING AND REFINING ICM IMPLEMENTATION MODELS

Similar to the need for on-the-ground operationalisation of ICM to follow a structured, adaptive process – as proposed in the dual, adaptive cycles of the ICM implementation model – the implementation model or framework may require refinement and adaptation from time to time. While the design of country-specific ICM implementation models needs to be contextual, the process to be followed in the designing and refining of such models is generic or universal.

This study applied a specific process in the design and refinement of a country-specific ICM implementation model in three steps which was adapted as a proposed practical and novel generic process for the design and refinement of country-specific ICM implementation models in future. First, the generic process involves the design of a prototype model, primarily based on local knowledge within the country-specific context. Second, the generic process entails dual validation procedures, namely an empirical validation (i.e. to test practical applicability) that required country specific information and a theoretical validation (i.e. to test the scientific credibility) using evaluation criteria derived from the scientific literature. Finally, the outcome of the validation process is used to refine and improve the prototype design. Further, the refined model design proposed in this study is posed as a suitable prototype design for countries with similar coastal management milieus to South Africa, that have extensive legislation and numerous initiatives supporting ICM in existence, but governed under a largely sector-based system.

6.6 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE ENQUIRY

The research reported here does not offer a complete solution to the identified problem as there are manifold angles from which to approach effective and sustainable ICM. In this study an *implementation* angle was chosen, more specifically from a *practical environmental management perspective* that recognises important economic and social elements and interactions. This implementation angle was preferred because it aligned best with my field of expertise.

Opportunities exist for researchers in other expert fields to investigate ICM policy implementation in South Africa from their perspectives. For example, ICM could also be viewed from the following stances:

- Purely economic (e.g. incentive or financial support models);
- Public administration (e.g. exploring the interface and dynamics between the actor cycle and the resource cycle in coastal management);
- Social (e.g. exploring public consultation and awareness approaches); or
- Educational (e.g. investigating mechanisms to link training and education institutions with sector-based institutions, for example through educational and training programmes, professional programmes, and bursary programmes).

In particular, techniques such as science mapping could be used to identify whether paradigms exist that constitute uniformities in IEM and ICM in addition to the ten key paradigms studied in the research. Any new characteristics deriving from the analysis of the additional paradigms can then be used to refine the evaluation criteria for the assessment of the scientific credibility of ICM implementation models.

Knowledge gained and innovations made in such studies can be integrated into the ICM implementation model presented here to continuously improve its operationalisation. Possibilities also exist concerning further empirical validation of a model for ICM implementation in the South African context. This dissertation primarily focussed on investigating alignment with legislation, environmental management practices and institutional design, but is less expressive on alignment with economic, public administration, social and educational practices in the country. This situation provides opportunities for future research by scholars in disciplines such as economics, public administration, political science and education.

This research provides two main products, namely:

- A workable and scientifically sound implementation model for integrated coastal management (ICM) in the South African context; and
- A generic process for the design and refinement of country-specific ICM implementation models.

Both outputs require adaptive management approaches – that is improving by learning – and rely on regular review. For South Africa, this prime responsibility lies with the national department responsible for the environment, appointed as lead institution for coastal management under the ICMA, in consultation with all actors involved.

REFERENCES

Adger WN, Hughes TP, Folke C, Carpenter SR & Rockström J 2005. Social-ecological resilience to coastal disasters. *Science 309*, 1036-1039.

Agardy T 2010. *Ocean zoning: Making marine management more effective*. Washington, DC: Earthscan.

Agrawal A 2002. Common resources and institutional sustainability. In Ostrom E, Dietz T, Dolsak N, Stern PC, Stonich S & Weber EU (eds) *The drama of the commons*, 41-86. Washington DC: National Academies Press.

Agre P & Leshner AI 2010. Bridging science and society. *Science* 329:921.

Anderies JM, Janssen MA & Ostrom E 2004. A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* 9, 1: 18. [online] Available from www.ecologyandsociety.org/vol9/iss1/art18 [Accessed on 28 June 2010].

ANZECC (Australia and New Zealand Environment Conservation Council) 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper 4 [online]. Canberra: ANZECC. Available from www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality [Accessed on 24 June 2010].

Arrow K, Bolin B, Costanza R, Dasgupta P, Folke C, Holling CS, Jansson B-O, Levin S, Maler K-G, Perrings C & Pimentel D 1995. Economic growth, carrying capacity, and the environment. *Science* 268: 520-521.

Australian Government 2009a. *Integrated coastal zone management* [online]. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from www.environment.gov.au/coasts/iczm/index.html [Accessed on 18 November 2009].

Australian Government 2009b. *Marine bioregional planning* [online]. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from www.environment.gov.au/coasts/mbp/index.html [Accessed on 11 January 2010].

Bailey PH & Tilley S 2002. Storytelling and the interpretation of meaning in qualitative research. *Journal of Advanced Nursing* 38, 6: 574-583.

Baker, KM 1987. Scientism at the end of the old regime: Reflections on a theme of Professor Charles Gillispie. *Minerva* 25, 1/2: 21-34.

Bakewell O & Garbutt A 2005. *The use and abuse of the logical framework approach: A review of international development NGOs experiences*. Stockholm, Sweden: Swedish International Development Cooperation Agency (Sida).

Balchand AN, Mooleparambil SM & Reghunathan C 2007. Management strategies for urban coastal zones: Integrating DPSIR concepts with GIS tools in people's participatory programs. *IHDP Update* 2: 19-23.

Ban NC, Alidina HM & Ardron JA 2010. Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study. *Marine Policy* 34: 876-886.

Barker A 2005. Capacity building for sustainability: Towards community development in coastal Scotland. *Journal of Environmental Management* 75: 11-19.

Barkerville RL 1999. Investigating information systems with action research. *Communications of the Association of Information Systems* 2, 19: 1-32.

Barrow CJ 2005. *Environmental management and development*. Abingdon, Axon (UK): Routledge (Taylor & Frances Group).

Barry M, Elema I & Molen PVD 2003. Ocean governance and the marine cadastre: The Netherlands North Sea. *Geomatica* 57, 3: 313-324.

Belfiore S 2003. The growth of integrated coastal management and the role of indicators in integrated coastal management: Introduction to the special issue. *Ocean and Coastal Management* 46, 3-4: 225-334.

Benguela Current Commission (BCC) 2010. *Benguela Current Commission* [online]. Windhoek, Namibia: BCC Secretariat. Available from www.benguelacc.org/index.php [Accessed on 5 March 2010).

Biermann F & Pattberg P 2008. Global environmental governance: Taking stock, moving forward. *Annual Review of Environment and Resources* 33: 277-294.

Billé R 2007. A dual-level framework for evaluating integrated coastal management beyond labels. *Ocean and Coastal Management* 50: 796-807.

Bina O 2007. A critical review of the dominant lines of argumentation on the need for strategic environmental assessment. *Environmental Impact Assessment Review* 27, 7: 585-606.

Binnendijk A 2000. Results-based management in the development co-operation agencies: A review of experience. Paper prepared for Organisation for Economic and Co-operation Development (OECD)/ Development Assistance Committee (DAC) Working Party on Aid Evaluation. Paris, France: OECD.

Binns A, Rajabifard A, Collier P & Williamson I 2004. Developing the concept of a marine cadastre: An Australian case study. *Trans Tasman Surveyor* 6: 19-27.

Blue Flag South Africa 2010. *Blue Flag South Africa* [online]. Howick, South Africa: Blue Flag South Africa. Available from /www.wessa.org.za/index.php/Blue-Flag/Blue-Flag.html [Accessed on 19 February 2010].

Bornmann BT, Martin JR, Wagner FH, Wood G, Alegria J, Cunningham PG, Brookes MH, Friesema P, Berg J & Henshaw J 1999. Adaptive management. In Johnson NC, Malk A J, Sexton W & Szaro R (eds) *Ecological stewardship: A common reference for ecosystem management*, 505-534. Amsterdam: Elsevier.

Bots PWG 2007. Design in socio-technical system development: Three angles in a common framework. *Journal of Design Research* 5, 3: 382-396.

Boyd AJ & Agenbag JJ 1984. Seasonal temperature and salinity trends off central Namibia between 1978 and 1983 with particular reference to the cool winter of 1982. *South African Journal of Marine Science* 80, 2:77-79.

Branch GM, Griffiths CL, Branch ML & Beckley LE 1994. *Two oceans. A guide to the marine life of southern Africa.* Cape Town, South Africa: David Philip.

Brown AC & Jarman N. 1978. Coastal marine habitats. In Wiener MJA (ed) *Biogeography and ecology of Southern Africa,* 1239-1277. The Hague: W. Junk.

Bruckmeier K 2005. Interdisciplinary conflict analysis and conflict mitigation in local resource management. *Ambio* 34: 65-73.

Burbridge PR 1997. A generic framework for measuring success in integrated coastal management. *Ocean and Coastal Management* 37, 2: 175-189.

Butterworth J, Warner J, Moriarty P, Smits S & Batchelor C 2010. Finding practical approaches to integrated water resources management. *Water Alternatives* 3, 1: 68-81.

C.A.P.E. (Cape Action for People and the Environment Estuaries Programme) 2010. *C.A.P.E. Estuaries Programme* [online]. Stellenbosch, South Africa: CapeNature. Available from http://fred.csir.co.za/extra/project/CAPE_Estuaries/ [Accessed on 19 February 2010].

Carson R 1962. *Silent spring*. Boston, USA: Houghton Mifflin Publishers.

Carton LJ 2007. Map making and map use in a multi-actor context: Spatial visualizations and frame conflicts in regional policymaking in the Netherlands. PhD dissertation, Delft, Netherlands: Delft University of Technology (Faculty of Technology, Policy and Management).

CERM (Consortium for Estuarine Research and Management) 2010. *Consortium for Estuarine Research and Management* [online]. South Africa: Various institutions. Available from www.upe.ac.za/cerm/ [Accessed on 12 January 2010].

Challis J & McCrone A 2005. *Fiordland a model for future integrated marine management?* [online] Auckland, New Zealand: Seachange 05: Managing our coastal waters and oceans conference proceedings. Available from www.eds.org.nz/content/documents/seachange_papers/Ann%20McCrone.pdf [Accessed on 5 November 2009].

Christie P, Lowry K, White TA, Oracion EG, Sievanen L, Pomeroy LS, Pollnac RB, Patlis JM & Eisma R-LV 2005. Key findings from a multidisciplinary examination of integrated coastal management process sustainability. *Ocean and Coastal Management* 48: 468-483.

Christie P 2005. Is integrated coastal management sustainable? *Ocean and Coastal Management* 48: 208-232.

Chua T-E, Huming Y & Chen G 1997. From sectoral to integrated coastal management: A case in Xiamen, China. *Ocean and Coastal Management* 37, 2: 233-251.

Chua T-E, Bonga D & Bermas-Atrigenio N 2006. Dynamics of integrated coastal management: PEMSEA's experience. *Coastal Management* 34: 303–322.

Cicin-Sain B & Knecht RW 1998. *Integrated coastal and ocean management concepts and practices.* Washington DC: Island Press.

Cicin-Sain B, Knecht RW, Vallega A & Harakunarak A 2000. Education and training in integrated coastal management: Lessons from the international arena. *Ocean and Coastal Management* 43: 291-330.

Chircop A & Hildebrand L 2006. Beyond the buzzwords: A perspective on integrated coastal and ocean management in Canada. In Rothwell DR & Van der Zwaag, DL (eds) *Towards principled oceans governance—Australian and Canadian approaches and challenges,* 19-71. London and New York: Routledge.

Clark BM, Lane S, Turpie JK, Van Niekerk L & Morant PD 2002. Development and protection of the coastal and marine environment in sub-Saharan Africa: South Africa National Report Phase 1: Integrated Problem Analysis. (Office report No. GF/6010-0016). Global Environment Facility: MSP Sub-Saharan Africa Project.

Costanza R 1998. The value of ecosystem services. *Ecological Economics* 25, 1:1-2.

Courtney F & Wiggen J 2003. *Ocean zoning for the Gulf of Maine: A background paper* [online]. Main, USA: Gulf of Maine Council for the Marine Environment. Available from www.gulfofmaine.org/council/publications/ [Accessed on 5 November 2009].

Crawford G 2003. Promoting democracy from without – learning from within (Part I). *Democratization* 10, 1: 77-98.

Creswell JW 2002. *Research design: Qualitative, quantitative, and mixed methods approaches.* 2nd ed. London: SAGE Publications, Inc.

Creswell JW, Hanson, WE, Plano Clark VL & Morales A 2007. Qualitative research designs: Selection and implementation. *The Counseling Psychologist* 35, 2: 236-26.

Crowder LB, Osherenko G, Young OR, Airamé S, Norse EA, Baron N, Day JC, Douvere F, Ehler CN, Halpern BS, Langdon SJ, Mcleod KL, Ogden JC, Peach RE, Rosenberg AA & Wilson JA 2006. Resolving mismatches in U.S. ocean governance. *Science* 313: 617-618.

Crowder L & Norse E 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning. *Marine Policy* 32: 772-778.

CSIR (Council for Scientific and Industrial Research) 2009a. Proposed generic framework for estuary management plans. Version 1.1 (Report CSIR/NRE/CO/ER/2009/0128/A). Report submitted to the C.A.P.E. Estuaries Programme. Stellenbosch, South Africa: CSIR.

CSIR (Council for Scientific and Industrial Research) 2009b. Chevron Marine Outfall, Milnerton. Fourth follow-up chemical and biological monitoring survey of the marine environment. June 2009 (Report No. CSIR/NRE/CO/ER/2009/0103/B). Report submitted to Chevron South Africa Pty (Ltd). Stellenbosch, South Africa: CSIR.

Cummins VO, Mahon YC & Connolly N 2002. *Review of integrated coastal zone management and principals of best practice.* Cork, Ireland: Heritage Council by the Coastal and Marine Resources, Centre Environmental Research Institute, University College Cork.

Dahl RA 1961. *Who governs? Democracy and power in the American City*. New Haven: Yale University Press.

Dalton T, Thompson R & Jin D 2009. Mapping human dimensions in marine spatial planning and management: An example from Narragansett Bay, Rhode Island. *Marine Policy* 34: 309–319.

Davies B & Day J 1998. *Vanishing waters*. Cape Town: University of Cape Town Press.

Day V, Paxinos R, Emmett J, Wright A & Goecker M 2008. The Marine Planning Framework for South Australia: A new ecosystem-based zoning policy for marine management. *Marine Policy* 32: 535-543.

Dearden PN & Kowalsky B 2003. Programme and project cycle management (PPCM): Lessons from south and north. *Development in Practice* 13,5: 501-514.

De Coning C 2006. Overview of the water policy process in South Africa. *Water Policy* 8: 505-528.

Dennison WC 2008. Environmental problem solving in coastal ecosystems: A paradigm shift to sustainability. *Estuarine, Coastal and Shelf Science* 77: 185-196.

DEA (Department of Environmental Affairs 2009a. *Coastcare – working for the coast* [online]. Cape Town, South Africa: Department of Environmental Affairs. Available from www.deat.gov.za/ProjProg/CoastCare/index.htm [Accessed on 5 November 2009].

DEA (Department of Environmental Affairs) 2009b. *State of the environment reports*. Pretoria: Government of South Africa, DEA: Available from www.environment.gov.za/soer/index.html [Accessed on 5 November 2009].

DEAT (Department of Environmental Affairs & Tourism) 1998. Coastal Policy Green Paper [online]. Pretoria: Department of Environmental Affairs. Available from www.info.gov.za/ [Accessed on 5 November 2009].

DEAT (Department of Environmental Affairs & Tourism) 2006. *South Africa environment outlook*. Pretoria: Department of Environmental Affairs.

DEAT (Department of Environmental Affairs & Tourism) 2008. *South Africa's national programme of action for protection of the marine environment from land-based activities*. Cape Town: Department of Environmental Affairs.

DFO (Department of Fisheries & Ocean) 2002. *Policy and operational framework for integrated management of estuarine, coastal and marine environments in Canada*. Ontario: Government of Canada, Fisheries and Oceans Canada, Oceans Directorate, Ottawa.

DPGL (Department of Provincial and Local Government) 2009. *IDP Nerve Centre* [online]. Pretoria: Government of South Africa, DPLG. Available from www.idp.org.za/ [Accessed on 5 November 2009].

Dick B 2002. *Action research: Action and research* [online]. Australia: Southern Cross University. Available from www.scu.edu.au/schools/gcm/ar/arp/aandr.html [Accessed on 5 November 2009].

Douvere F 2008. The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine Policy* 32: 762-771.

Drucker PF 1954. *The practice of management*. New York and Evanston: Harper and Row Publishers.

DST (Department of Science and Technology) 2006. Keynote address by the Minister of Science and Technology, Mr Mosibudi Mangena, at the launch of 2006/07 Department of Science and Technology – National Research Foundation (DST-NRF) Internship Programme [online]. Pretoria: Government of South Africa, DST. Available from www.info.gov.za/speeches/2006/06092210151001.htm [Accessed on 6 November 2009].

DST (Department of Science and Technology) 2009. *DST Annual report 2008/20009* [online]. Pretoria: Government of South Africa, DST. Available from www.dst.gov.za/publications-policies/annual-reports/DST%20Annual%20Report%200809.pdf [Accessed on 5 Nov 2009].

DWAF (Department of Water Affairs & Forestry) 1995. *South African water quality guidelines for coastal marine waters. Volume 1. Natural environment. Volume 2. Recreation. Volume 3. Industrial use. Volume 4. Mariculture.* Pretoria: Department of Water Affairs.

DWAF (Department of Water Affairs & Forestry) (1999) *Water resource protection and assessment policy implementation process. Volume 5: Resource directed measures for protection of water resources: estuarine ecosystems component*. Pretoria: Department of Water Affairs.

DWAF (Department of Water Affairs & Forestry) 2004a. *Operational policy for the disposal of land-derived water containing waste to the marine environment of South Africa*. Water Quality Management Series Sub-Series No. MS 13.2. Pretoria: Department of Water Affairs.

DWAF (Department of Water Affairs & Forestry) 2004b. *Operational policy for the disposal of land-derived water containing waste to the marine environment of South Africa – Guidance on Implementation*. Water Quality Management Series Sub-Series No. MS 13.3. Pretoria: Department of Water Affairs.

DWAF (Department of Water Affairs & Forestry) 2008. *Water resource protection and assessment policy implementation process. Resource directed measures for protection of water resources: Methodology for the determination of the ecological water requirements for estuaries*. Version 2. Pretoria: Department of Water Affairs.

Edvardsson K 2004. Using goals in environmental management: The Swedish system of environmental objectives. *Environmental Management* 34, 2: 170-180.

Elliott E, Burdon D, Hemingway KL & Apitz SE 2007. Estuarine, coastal and marine ecosystem restoration: Confusing management and science – a revision of concepts. *Estuarine, Coastal and Shelf Science* 74: 349-366.

European Commission 2002. *Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of integrated coastal zone management in Europe*. Official Journal of the European Communities Directive No. 2002/413/EC. Brussels.

European Commission 2006. *Evaluation of integrated coastal zone management in Europe* [online]. Rupprecht Consult – Forschung and Beratung GmbH and the International Ocean Institute (Malta) for the European community. Available from www.west-vlaanderen.be/NL/BestuurRegio/kustbeheer_nl/Documents/bestuur_regio/kustbeheer/nederlands/kustbeheer_evaluation_of_iczm_in_europe.pdf [Accessed on 5 November 2009].

Evett K (ed) 2005. *Our coast for life*. Pretoria: Department of Environmental Affairs.

FEE (Foundation for Environmental Education) 2006. *Awards for improving the coastal environment: The example of the Blue Flag*. Copenhagen, Denmark: FEE.

FEE (Foundation for Environmental Education) 2009. *Blue Flag Programme* [online]. Copenhagen, Denmark: Blue Flag Programme. Available from www.blueflag.org/ [Accessed on 5 November 2009].

Fisher TB 2002. Strategic environmental assessment in post-modern times. *Environmental Impact Assessment Review* 23: 155-170.

Flyvbjerg B 2001. *Making social science matter. Why social inquiry fails and how it can succeed again.* Cambridge: Cambridge University Press.

Foley MM, Halpern BS, Micheli F, Armsby MH, Caldwell MR, Crain CM, Prahler E, Rohr N, Sivas D, Beck MW, Carr MH, Crowder LB, Duffy JE, Hacker SD, McLeod KL, Palumbi SR, Peterson CH, Regan HM, Ruckelshausm MH, Sandifer PA & Steneck RS 2010. Guiding ecological principles for marine spatial planning. *Marine Policy* 34, 5: 955-966.

Folke C, Hahn T, Olsson P & Norberg J 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30: 441-473.

Forse JE & Collier PA 2003. Assessing the need for an Australian Marine Cadastre. Paper presented at Coastal GIS Conference, Wollongong, Australia: University of Wollongong.

Fowler C & Treml E 2001 Building a marine cadastral information system for the United States – a case study. *International Journal on Computers, Environment and Urban Systems Special Issues: Cadastral Systems* 25, 4-5: 493-507.

Frantzeskaki N, Slinger JH, Vreugdenhil H & Van Daalen E 2010. Social-ecological systems governance: from paradigm to management approach. *Nature and Culture* 5, 1:84-98.

GESAMP (Group of Experts on the Scientific Aspects of Marine Environmental Protection) 1996. *The contributions of science to integrated coastal management.* GESAMP Reports and Studies No. 61. Rome, Italy: Food and Agriculture Organization of the United Nations.

Glavovic BC 2006. The evolution of coastal management in South Africa: Why blood is thicker than water. *Ocean and Coastal Management* 49: 889-904.

Glavovic BC 2008. Ocean and coastal governance for sustainability: Imperatives for integrated ecology and economics. In Patterson M & Glavovic B (eds) *Ecological economics of the oceans and coasts*, 313-342. Massachusetts: Edward Elgar Publishing Inc.

Glavovic BC 2009. Sustainable coastal development in South Africa: Bridging the chasm between rhetoric and reality. In Krishnamurthy RR, Kannen A, Ramanathan AR, Tinti S, Glavovic BC, Green DR, Han Z & Agardy TS (eds). *Integrated coastal zone management – the global challenge*, 129-154. Singapore: Research Publishing.

Glavovic BC & Cullinan C 2009. The coast. In Strydom HA & King ND (eds) *Environmental Management in South Africa* (2nd ed), 868-920. Cape Town, South Africa: Juta Law.

Görgens M & Kusek JZ 2009. *Making monitoring and evaluation systems work. A capacity development toolkit.* Washington: World Bank.

Grant D 1999. Principles for a seabed cadastre. Paper delivered at New Zealand Institute of Surveyors Conference and annual general meeting of Federation Internationale des Geometres VII Conference, Bay of Islands, New Zealand.

Gray P 2006. Adaptive management in the 21st century. In: Lemieux CJ, Zorn PA, Bellhouse TJ & Nelson JG (eds) *Monitoring in Ontario's parks and protected Areas*, 3-7. Ontario: Parks Research Forum of Ontario.

Guénette S & Alder J 2007. Lessons from marine protected areas and integrated ocean management initiatives in Canada. *Coastal Management* 35: 51-78.

Haber S 1964. *Efficiency and uplift: Scientific management in the progressive era, 1890-1920*. University of Chicago: University of Chicago Press.

Hague R & Harrop M 2007. *Comparative Government and Politics: An Introduction*. 7th ed. New York, USA: Palgrave Macmillian.

Halpern BS, McLeod KL, Rosenberg AA & Crowder LB 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. *Ocean and Coastal Management* 51: 203-211.

Hanssen GS, Klausen JE & Winsvold M 2007. Emissions trading – market, hierarchy or governance network? Proceedings of the 8th Nordic Environmental Social Science Research Conference held 18-20 June 2007. Oslo: Norwegian Institute for Urban and Regional Research.

Hardin G 1968. The tradegy of the commons. *Science* 162: 1243-1248.

Harvey T 1982. Environmental intervention: The monitoring paradigm II. Regulatory monitoring and the development of a management model. *The Environmentalist* 2: 307-319.

Harvey T 1984. Environmental intervention: The monitoring paradigm III. Implications for management, education and training. *The Environmentalist* 4: 265-279.

Haward M & Vince J 2009. Australian ocean governance – initiatives and challenges. *Coastal Management* 37, 1: 1-16.

Heemstra P & Heemstra E 2004. *Coastal fishes of southern Africa*. Grahamstown: South African Institute for Aquatic Biology (SAIAB) and National Enquiry Service Centre (NISC).

Henocque Y 2001. Urban communities and environmental management in France: The example of the Toulon Bay contract. *Ocean and Coastal Management* 44: 371-377.

Hermans LM 2005. Actor analysis for water resource management putting the promise into practice. Doctoral dissertation. Delft, Netherlands: Delft University of Technology, Faculty of Technology, Policy and Management.

Herrera RJ 2007. Strategic environmental assessment: The need to transform the environmental assessment paradigms. *Journal of Environmental Assessment Policy and Management* 9, 2: 211-234.

Hilborn R 1992. Can fisheries agencies learn from experience? *Fisheries* 17, 4: 6-14.

Hills JM, Alcock D, Higham T, Kirkman H & Le Tissier M 2006. Capacity building for integrated coastal management in Asia-Pacific. The case for case studies. *Coastal Management* 34: 323-337.

ICWE (International Conference on Water and the Environment) 1992. The Dublin statement and report of the conference. International Conference on Water and the Environment: Development Issues for the 21st century held 26-31 January 2007. Dublin: ICWE.

IOI-SA (International Ocean Institute Southern Africa) 2009. Training [online]. Available from http://www.ioisa.org.za/ [Accessed on 5 November 2009].

Janssen MA, Anderies JM & Ostrom E 2007. Robustness of social-ecological systems to spatial and temporal variability. *Society and Natural Resources* 20: 307-322.

Jasanoff SS 1987. Contested boundaries in policy-relevant science. *Social Studies of Science* 17, 2: 195-230.

Jasanoff S 1995. Procedural choices in regulatory science. *Technology in Society* 17, 3: 279-293.

Jasanoff S 2004. The idiom of co-operation. In Jasanoff S (ed) *States of knowledge: The co-production of science and social order,* 1-12. Oxford: Routledge.

Jay S, Jones C, Slinn P & Wood C 2007. Environmental impact assessment: Retrospect and prospect. *Environmental Impact Assessment Review* 27: 287-300.

Jentoft S & Chuenpagdee R 2009. Fisheries and coastal governance as a wicked problem. *Marine Policy* 33, 4: 553-560.

Karume S 2003. Conceptual understanding of political coalitions in South Africa: An integration of concepts and practices. Presented at an Electorate Institute of South Africa roundtable on Political Party Coalitions – Strengthening Democracy through Party Coalition Building, Claremont, Cape Town.

Kiser LL & Ostrom E 2000. Chapter 2: The three worlds of action: A metatheoretical synthesis of institutional approaches. In McGinnis M D (ed) *Polycentric games and institutions. Readings from the workshop in political theory and policy analysis*, 56-88. Michigan: University of Michigan Press.

Kørnøv L & Thissen, WAH 2000. Rationality in decision- and policy-making: Implications for strategic environmental assessment. *Impact Assessment and Project Appraisal* 18, 3: 191-200.

Knol M 2010. Scientific advice in integrated ocean management: The process towards the Barents Sea plan. *Marine Policy* 34: 252–260.

Kusek JZ & Rist RC 2004. *A handbook for development practitioners. Ten steps to a results-based monitoring and evaluation*. Washington DC: World Bank.

Lankford B & Hepworth N 2010. The cathedral and the bazaar: Monocentric and polycentric river basin management. *Water Alternatives* 3, 1: 82-101.

Lau M 2005. Integrated coastal zone management in the People's Republic of China − An assessment of structural impacts on decision-making processes. *Ocean and Coastal Management* 48: 115-159.

Lenton R & Muller M 2009. *Integrated water resources management in practice. Better water management for development.* London: Earthscan.

Le Tissier MDA, Hills JM, McGregor JA & Ireland M 2004. A training framework for understanding conflict in the coastal zone. *Coastal Management* 32:77-88

Lijphart A 1999. *Patterns of democracy. Government forms and performance in thirty-six countries.* New Haven: Yale University Press.

Linkov I, Satterstrom FK, Kiker GA, Bridges TS, Benjamin SL & Belluck DA 2006. From optimization to adaptation: Shifting paradigms in environmental management and their application to remedial decisions. *Integrated Environmental Assessment and Management* 2, 1: 92-98.

Lombard AT, Strauss, T, Harris J, Sink K, Attwood C & Hutchings L 2004. *South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component* [online]. Pretoria:

South African National Biodiversity Institute. Available from www.sanbi.org/biodiversity/nsba.htm [Accessed on 5 November 2009].

Lowry K, Olsen SB & Tobey J 1999. Donor evaluation of ICM initiatives: What can be learnt from them. *Ocean and Coastal Management* 42: 767-789.

Lutjeharms JRE 2006. *The Agulhas Current*. Berlin Heidelberg: Springer-Verlag.

Mageau C, Vanderzwaag D & Farlinger S 2005. Oceans policy: A Canadian case study. Paper delivered at the Ocean Policy Summit, Lisbon, Portugal.

Malan L 2005. Intergovernmental relations and co-operative government in South Africa: The ten-year review. *Politeia* 24, 2: 226-243.

March JG 1991. How decisions happen in organizations. *Human-computer Interaction* 6: 95-117.

March JG & Olsen JP 1984. The new institutionalism: Organizational factors in political life. *The American Political Science Review* 78, 3: 734-749.

McLean B & Glazewski JI 2009. Marine systems. Environmental management: An introduction. In Strydom HA & King ND (eds) *Environmental management in South Africa* (2nd ed), 455-512. Cape Town, South Africa: Juta Law.

McLusky DS & Elliot M 2004. *The estuarine ecosystem: Ecology, threats and management.* 3rd ed. Oxford: Oxford University Press.

Miser HJ & Quade ES (eds) 1985. *Handbook of systems analysis; Overview of uses, procedures, applications and practice.* Chichester: John Wiley and Sons.

Molle F 2008. Nirvana concepts, narratives and policy models: Insight from the water sector. *Water Alternatives* 1, 1: 131-156.

Moomaw WR 1996. A sustainability postscript. *Environmental Impact Assessment Review* 16: 425-427.

Moriarty PB, Batchelor CH, Laban P & Fahmy H 2010. Developing a practical approach to 'light IWRM' in the Middle East. *Water Alternatives* 3, 1: 122-136.

Müller K. 2009. Environmental governance in South Africa. In Strydom HA & King ND (eds) *Environmental Management in South Africa* (2nd ed), 68-95. Cape Town, South Africa: Juta Law.

Muspratt-Williams A 2009. Strategic thinking for non-government organisations for sustainability: A review of the logical framework approach. Masters Thesis. Stellenbosch: University of Stellenbosch, Department of Sustainable Development Planning and Management.

Nel J & Du Plessis W 2004. Unpacking integrated environmental management – a step closer to co-operative governance. *SA Public Law* 19, 1: 181-190.

Nel JG & Kotzé LJ 2009. Environmental management: An introduction. In Strydom HA & King ND (eds) *Environmental Management in South Africa* (2nd ed), 1-33. Cape Town: Juta Law.

Newman I, Ridenour CS, Newman C & Demarco GMP (Jr) 2002. A typology of research purposes and its relationships to mixed methods. In Tashakkori A & Teddlie C (eds.) *Handbook of mixed methods in social and behavioral research*, 167-188. London: SAGE Publication Inc.

Ng'ang'a S, Sutherland M, Cockburn S & Nichols S 2003. Toward a 3D marine cadastre in support of good ocean governance: A review of the technical framework requirements. *Computers, Environment and Urban Systems* 28: 443-470.

Nichols S, Monahan D & Sutherland, M 2000. Good governance of Canada's offshore and coastal zone: Towards an understanding of the marine boundary issues. *Geomatica* 54, 4: 415-424.

NOAA (National Oceanic & Atmospheric Administration) 2004. *Coastal zone management act performance measurement system*. Silver Spring USA: Office of Ocean and Coastal Resource Management.

NOAA (National Oceanic & Atmospheric Administration) 2006. *Update on coastal zone management act performance measurement system – January 2006*. Silver Spring USA: Office of Ocean and Coastal Resource Management.

NOAA (National Oceanic and Atmospheric Administration) 2009. *FGDC Marine Boundary Working Group* [online]. Charleston, USA: Coastal Services Center, NOAA. Available from www.csc.noaa.gov/mbwg/htm/cadastre.htm [Accessed on 9 December 2009].

NOAA (National Oceanic and Atmospheric Administration) 2010. *Large marine ecosystems of the world* [online]. Charleston, USA: U.S. LME Program, NOAA. Available from www.lme.noaa.gov/ [Accessed on 11 February 2010].

Noble BF 2000. Strengthening EIA through adaptive management: A systems perspective. *Environmental Impact Assessment Review* 20: 97-111.

Norse EA 2008. EBM perspective: *Ocean zoning is inevitable* [online]. Washington, USA: Marine Conservation Biology Institute. Available from http://www.mcbi.org/publications/publications.htm [Accessed on 9 December 2009].

NRMMC (National Resource Management Ministerial Council) 2006. *National cooperative approach to integrated coastal zone management. Framework and implementation plan*. Canberra, Australia: Australian Government, Department of the Environment and Heritage.

Ocean Conservancy 2009. *International coastal cleanup* [online]. Washington DC: Ocean Conservancy. Available from www.oceanconservancy.org/site/PageServer?pagename=icc_home [Accessed on 5 November 2009].

OECD (Organisation for Economic Co-Operation & Development) 2006. *Applying strategic environmental assessment: Good practice guidance for development co-operation*. (Development Assistance Committee (DAC) Guidelines and Reference Series). Paris, France: OECD Publishing.

Oelofse SHH, Viljoen P, Taljaard S & Botes WAM 2005. Discharge of water containing waste emanating from land to the marine environment: A water quality management perspective. *Water SA* 30, 5: 56-60.

Olsen SB 1998. *Coastal management: What are we learning from U.S. and international experience?* Coastal Management Report 2218. Rhode Island, USA: Coastal Resources Centre, University of Rhode Island.

Olsen SB 2002. Assessing progress toward the goals of coastal management. *Coastal Management* 30: 325-345.

Olsen SB 2003. Frameworks and indicators for assessing progress in integrated coastal management initiatives. *Ocean and Coastal Management* 46: 347-361.

Olsen SB & Christie P 2000. What are we learning from tropical coast management experiences? *Coastal Management* 28: 5-18.

Olsen SB, Lowry K & Tobey J 1999. *A manual for assessing progress in coastal management*. Coastal Management Report 2211. Rhode Island, USA: Coastal Resources Centre, University of Rhode Island.

Olsen SB, Tobey J & Hale LZ 1998. A learning-based approach to coastal management. *Ambio* 27, 8: 611-619.

Olsen SB, Tobey J & Kerr M 1997. A common framework for learning from ICM experience. *Ocean and Coastal Management* 37, 2: 55-174.

Ortiz EF, Kuyama S, Münch W & Tang G 2004. *Implementation of results-based management in the United Nations organizations. Part I: Series on managing for results in the United Nations system*. Geneva: United Nations, Join Inspection Unit.

Ostrom E 1990. *Governing the commons: The evolution of institutions for collective action.* Cambridge: Cambridge University Press.

Ostrom E 2005. *Understanding institutional diversity*. Princeton: Princeton University Press.

Ostrom E, Burger J, Field CB, Norgaard RB & Policansky D 1999. Revisiting the commons: Local lessons, global challenges. *Science* 284: 278-282.

Paavola J 2006. Institutions and environmental governance: A reconceptualization. *Ecological Economics* 63: 93-103.

Partidário MR 1996. Strategic environmental assessment: Key issues emerging from recent practice. *Environmental Impact Assessment Review* 16: 31-55.

Partidário MR 2007. Scales and associated data — What is enough for SEA needs? *Environmental Impact Assessment Review* 27: 460-478.

Partidário MR 2008. Book reviews: Theory and practice of strategic environmental assessment: Towards a more systematic approach authored by Thomas B. Fischer. *Natural Resources Forum* 32, 1: 86-87.

Pernetta JC & Elder DL 1993. *Cross-sectoral, integrated coastal area planning (CICAP): Guidelines and proncEiples for coastal area development.* Switzerland: IUCN, Gland.

Pickaver AH, Gilbert C & Breton F 2004. An indicator set to measure the progress in the implementation of integrated coastal zone management in Europe. *Ocean and Coastal Management* 47: 449-462.

Plater ZJB 1994. From the beginning, a fundamental shift of paradigms: A theory and short history of environmental law. *Loyola of Los Angeles Law Review* 27: 981- 1008.

Post JC & Lundin CG (eds) 1996. *Guidelines for integrated coastal zone management*. (Environmentally Sustainable Development Studies and Monographs Series No. 9). Washington DC: World Bank.

Pretty J & Ward H 2001. Social capital and the environment. *World Development* 29, 2: 209-227.

Rajabifard A, Collier PA & Williamson 2003. *Australian marine cadastre research and activities*. Federation Internationale des Geometres (FIG) and University of New Brunswick meeting on marine cadastre issues. September 15-16, University of New Brunswick, Canada.

Reddering JSV & Rust IC 1990. Historical changes and sedimentary characteristics of southern African estuaries. *South African Journal of Science* 86, 7-10: 425-428.

Roche CJR 1999. *Impact assessment for development agencies: Learning to value change*. Oxford: Oxfam Publishing.

Ross WA 1998. Cumulative effects assessment: Learning from Canadian case studies. *Impact Assessment and Project Appraisal* 16, 4: 267–76.

Rutherford J, Herbert GJ & Coffen-Smout SS 2005. Integrated ocean management and the collaborative planning process: The Eastern Scotian Shelf integrated management (ESSIM) initiative. *Marine Policy* 29: 75–83.

SAAMBR (South African Association for Marine Biological Research) 2009. Ushaka Sea World [online]. Durban, South Africa: SAAMBR, Oceanographic Institute of South Africa & Ushaka Marine World. Available www.seaworld.org.za/education-centre [Accessed on 5 November 2009].

SADCO (Southern African Data Centre for Oceanography) 2009. Welcome to SADCO. Stellenbosch: CSIR. Available from http://sadco.csir.co.za/ [Accessed on 5 November 2009].

SAEON (South African Environmental Observation Network) 2009. SAEON: a developing facility of the NRF funded by DST. Pretoria: SAEON. Available from www.saeon.ac.za/ [Accessed on 5 November 2009].

SANCOR (South African Network for Coastal and Oceanic Research) 2010. *The South African network for coastal and oceanic research* [online]. Cape Town, South Africa: SANCOR Secretariat. Available from http://sancor.nrf.ac.za/ [Accessed on 12 January 2010].

SBWQFT (Saldanha Bay Water Quality Forum Trust) 2004. *Bay Watch* (publication of the trust). Saldanha Bay: SBWQFT

Schwartz M (ed) 2005. *Over 30 years of accomplishments in coastal management.* Narragansett: Rhode Island Coastal Resources Management Council, Rhode Island Sea Grant.

Shannon LV 1985. The Benguela ecosystem, I. Evolution of the Benguela, physical features and processes. *Oceanography and Marine Biology* 23: 105-182.

Simenstad C, Reed D & Ford M 2006. When is restoration not? Incorporating landscape-scale processes to restore self-sustaining ecosystems in coastal wetland restoration. *Ecological Engineering* 26: 27-39.

Simon HA 1955. A behavioral model of rational choice. *Quarterly Journal of Economics* 69: 99-118.

Simon HA 1957. *Models of man: Social and rational*. New York: John Wiley and Sons Inc.

Simon HA 1991. Bounded rationality and organizational learning. *Organization Science* 2, 1: 125-134

Sinclair J & Diduck A 1995. Public education: An under-evaluated component of the environmental assessment public involvement process. *Environmental Impact Assessment Review* 15: 219-240.

Smith HD 2002. The role of the social sciences in capacity building in ocean and coastal management. *Ocean and Coastal Management* 45: 573–582.

Sørensen J 1993. The international proliferation of integrated coastal zone management efforts. *Ocean and Coastal Management* 21**,** 1-3: 45-80.

South Africa 1976. National Parks Act, Act 57 of 1976, as amended. *Government Gazette of the Republic of South Africa* 130: 5096, 28.04.1976:1.

South Africa 1977. National Building Regulations and Building Standards Act, Act 103 of 1977. *Government Gazette of the Republic of South Africa* 145: 5640, 6.07.1977:1.

South Africa 1981. Marine Pollution [Control and Civil Liability] Act, Act 6 of 1981. *Government Gazette of the Republic of South Africa* 188: 7427, 25.02.1981:1.

South Africa 1983. Conservation of Agricultural Resources Act, Act 43 of 1983. *Government Gazette of the Republic of South Africa* 214: 8673, 27.04.1983:1.

South Africa 1986. International Convention for Prevention of Pollution from Ships Act, Act 2 of 1986. *Government Gazette of the Republic of South Africa* 249: 10126, 19.03.1986:1.

South Africa 1996. Constitution of the Republic of South Africa Act, Act 108 of 1996. *Government Gazette of the Republic of South Africa* 378: 17678, 18.12.1996:1.

South Africa 1997. Water Services Act, Act 108 of 1997. *Government Gazette of the Republic of South Africa* 390: 18522, 19.12.1997: 1.

South Africa 1998a. National Water Act, Act 36 of 1998. *Government Gazette of the Republic of South Africa* 398: 19182, 26.08.1998:1.

South Africa 1998b. Marine Living Resources Act, Act 18 of 1998. *Government Gazette of the Republic of South Africa* 395: 18930, 27.05.1998: 1.

South Africa 1998c. National Environmental Management Act, Act 107 of 1998. *Government Gazette of the Republic of South Africa* 401: 19519, 27.11.1998: 1.

South Africa 1998d. National Forests Act, Act 84 of 1998. *Government Gazette of the Republic of South Africa* 400: 19408, 30.10.1998: 1.

South Africa 1999a. World Heritage Convention Act, Act 49 of 1999. *Government Gazette of the Republic of South Africa* 414: 20717, 09.12.1999: 1.

South Africa 1999b. National Heritage Resources Act, Act 25 of 1999. *Government Gazette of the Republic of South Africa* 406: 19974, 28.04.1999:1.

South Africa 2000a. *White Paper for sustainable coastal development in South Africa*. Pretoria, South Africa: Department of Environmental Affairs and Tourism.

South Africa 2000b. Local Government: Municipal Systems Act, Act 32 of 2000. *Government Gazette of the Republic of South Africa* 425: 21776, 20.11.2000:1.

South Africa 2002. Mineral and Petroleum Resources Development Act, Act 28 of 2002. *Government Gazette of the Republic of South Africa* 448: 23922, 10.10.2002: 1.

South Africa 2004a. National Environmental Management: Biodiversity Act, Act 10 of 2004. *Government Gazette of the Republic of South Africa* 467: 26436, 07.06.2004:1.

South Africa 2004b. National Health Act, Act 61 of 2003. *Government Gazette of the Republic of South Africa* 469: 26595, 23.06.2004:1.

South Africa 2004c. National environmental management: Protected areas Act, Act 57 of 2003. *Government Gazette of the Republic of South Africa* 464: 26025, 18.02.2004:1.

South Africa 2004d. National Environmental Management: Air Quality Act, Act 39 of 2004. *Government Gazette of the Republic of South Africa* 476: 27318, 24.02.2004: 1.

South Africa 2005. National Ports Act, Act 12 of 2005. *Government Gazette of the Republic of South Africa* 792 (27863), 04.08.2005:1.

South Africa 2009a. National Environmental Management: Integrated Coastal Management Act, Act 24 of 2008. *Government Gazette of the Republic of South Africa* 524: 31884, 11.02.2009:1.

South Africa 2009b. National Environmental Management: Waste Act, Act 59 of 2008. *Government Gazette of the Republic of South Africa* 525: 32000, 10.03.2009:1.

Stojanovic T, Ballinger RC & Lalwani CS 2004. Successful integrated coastal management: Measuring it with research and contributing to wise practice. *Ocean and Coastal Management* 47: 273-298.

Stojanovic T & Barker N 2008. Improving governance through local coastal partnerships in the UK. *The Geographical Journal* 174, 4: 344-360.

Stojanovic TA, Ball I, Ballinger RC, Lymbery G & Dodds W 2009. The role of research networks for science - policy collaboration in coastal areas. *Marine Policy* 33: 901-911.

Storrier KL & McGlashan DJ 2006. Development and management of a coastal litter campaign: The voluntary coastal partnership approach. *Marine Policy* 30: 189-196.

Taljaard S 2006a. *Baseline assessment of sources and management of land-based pollution in the Benguela Current Large Marine Ecosystem region* (Project Report No. BEHP/LBMP/03/01) UNOPS: Benguela Current Large Marine Ecosystem Programme.

Taljaard S 2006b. *The development of a common set of water and sediment quality guidelines for the coastal zone of the Benguela Current Large Marine Ecosystem* (Project Report No. BEHP/LBMP/03/04) UNOPS: Benguela Current Large Marine Ecosystem Programme.

Taljaard S & Botes WAM 1995. Marine water quality management in South Africa. *Water Science and Technolology* 32, 2: 281-288.

Taljaard S & Monteiro PMS 2002. Saldanha Bay marine water quality management plan. Phase I: Situation assessment (Report No. Report ENV-S-C 2002-115/1). Report submitted to the Saldanha Bay Water Quality Forum Trust. Stellenbosch, South Africa: CSIR.

Taljaard S, Monteiro PMS & Botes WAM 2006. A structured ecosystem-scale approach to marine water quality management. *Water SA* 32, 4: 535-544.

Taljaard S, Botes WAM, Oelofse SHH & Viljoen P 2006. Operational policy for the disposal of land-derived wastewater to the marine environment of South Africa. *Water SA* 32, 4: 527-534.

Taljaard S, Van Niekerk L, Huizinga P & Joubert W 2003. Resource monitoring procedures for estuaries. For application in the ecological reserve determination and implementation process (Report No. 1308/1/03). Pretoria: Water Research Commission.

Taljaard S, Van Niekerk L, Van Ballegooyen R & Huizinga, P 2005. Kromme/Seekoei catchments reserve determination study – Technical component. Comprehensive ecological reserve determination. Kromme Estuary. Appendix C: Specialist report on hydrodynamics and water quality (Report No.

ENV-S-C 2005-055B) Report submitted to the Department of Water Affairs and Forestry. Stellenbosch: CSIR.

Taljaard S, Snow, GC, Gama P & Van Niekerk L 2009. Verification of a conceptual model of water quality for small temporarily open/closed estuaries: East Kleinemonde estuary, South Africa. *Marine and Freshwater Research* 60, 234-245.

Taljaard S, Van Niekerk L & Joubert W 2009. Extension of a qualitative model on nutrient cycling and transformation to include microtidal estuaries on wave-dominated coasts: Southern hemisphere perspective. *Estuarine, Coastal and Shelf Science* 85, 407-421.

Therivel R & Ross B 2007. Cumulative effects assessment: Does scale matter? *Environmental Impact Assessment Review* 27: 365-385.

Tobey J & Vlok R 2002. Learning frontiers in the practice of integrated coastal management. *Coastal Management* 30: 285-298.

Todd P 2001. Marine cadastre – opportunities and implications for Queensland. Paper delivered at 42nd Australian Surveyors Congress – A Spatial Odyssey, Brisbane: The Institution of Surveyors, Australia.

Turpie JK 2004. *South African national spatial biodiversity assessment 2004: Technical report. Volume 3: Estuary component* [online]. Pretoria: South African National Biodiversity Institute. Available from www.sanbi.org/biodiversity/nsba.htm [Accessed on 5 November 2009].

United Nations 1982. *United Nations Convention on the Law of the Sea of 10 December 1982* [online]. New York: Division for ocean affairs and the law of the sea. Available from www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm [Accessed on 12 January 2010].

United Nations 1987. Report of the World Commission on Environment and Development. General Assembly Resolution 42/187. New York: UN General Assembly. Available from www.un.org/documents/ga/res/42/ares42-187.htm [Accessed on 9 December 2009].

UNEP (United Nations Environmental Programme) 1995. *The global programme of action for the protection of the marine environment from land-based activities*. Washington: UNEP. Available from www.gpa.unep.org/ [Accessed on 12 January 2010].

UNEP (United Nations Environmental Programme) 2006. *Ecosystem-based management. Markers for assessing progress*. The Hague, Netherlands: UNEP/GPA.

UNEP/GPA (United Nations Environmental Programme & Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities) 2006. *Protecting coastal and marine environments from land-based activities. A guide for national action*. The Hague, Netherlands: UNEP/GPA.

UNEP (United Nations Environmental Programme)/Nairobi Convention Secretariate & CSIR 2009. *Guidelines for the establishment of environmental quality objectives and targets in the coastal zone of the Western Indian Ocean (WIO) Region*. WIO-LaB Technical Report Series No. 01/2009. Kenya, Nairobi: UNEP/Nairobi Convention Secretariate.

UNESCO (United Nations Educational, Scientific & Cultural Organization) 2006. *A handbook for measuring the progress and outcomes of integrated coastal and ocean management.* (IOC Manuals and Guides 46; ICAM Dossier, 2). Paris: UNESCO.

US EPA (United States Environmental Protection Authority) 2008. *Handbook for developing watershed plans to protect and restore our waters* [online]. Washington DC: US EPA Office of Water, Non-point Source Control Branch. Available from http://water.epa.gov/polwaste/nps/handbook_index.cfm [Accessed on 5 November 2009].

Van de Riet O 2003. Policy analysis in multi-actor policy settings: Navigating between negotiated nonsense and superfluous knowledge. PhD dissertation. Delft, Netherlands: Delft University of Technology, Faculty of Technology, Policy and Management.

Van den Hove S 2006. Between consensus and compromise: Acknowledging the negotiation dimension in participatory approaches. *Land Use Policy* 23: 10-17.

Van Niekerk L & Taljaard S 2003. A framework for effective cooperative governance of South African estuaries (Report No. ENV-S-C 2005-055B). Report submitted to the Water Research Commission as part of their Eastern Cape Estuaries Programme. Stellenbosch: CSIR.

Van Niekerk L, Taljaard S & Schonegevel L 2006. Introductory course to estuarine management in South Africa. Training course manual (Report No. 1485/1/07). Pretoria: Water Research Commission.

Van Wilgen BW, Le Maitre DC & Cowling RM 1998. Ecosystem services, efficiency, sustainability and equity: South Africa's Working for Water Programme. *Tree* 13, 9: 378.

Van Wyk CF 2001. Die Saldanhabaai Watergehalte Forum Trust: 'n instrument vir beplande geïntegreerde monitering en bestuur van watergehalte. MSc thesis. Stellenbosch: University of Stellenbosch.

Von Bodungen B & Turner RK 2001. Science and integrated coastal management. An introduction. In Von Bodungen B & Turner RK (eds) *Science and integrated coastal management* 1-14, Berlin: Dahlem University Press.

Wallington T, Bina O & Thissen W 2007. Theorising strategic environmental assessment: Fresh perspectives and future challenges. *Environmental Impact Assessment Review* 27: 569-584.

Walmsley J 2004. *Developing objectives and indicators for marine ecosystem-based management: International review – Ecosystem-based management initiatives throughout the world*. Dartmouth, Canada: Government of Canada, Department of Fisheries & Ocean.

Walmsley J, Coffen-Smout S, Hall T & Herbert G 2007. Development of a human use objectives framework for integrated management of the Eastern Scotian Shelf. *Coastal Management* 35:23-50.

Walton M 1986. *The Deming management model*. New York: The Berkley Publishing Group.

Walters CJ 1986. *Adaptive management of renewable resources*. New York: McGraw Hill.

Weinstein MP, Baird RC, Conover DO, Gross M, Keulartz J, Loomis DK, Naveh Z, Peterson SB, Reed DJ, Roe E, Swanson RL, Swart JAA, Teal JM, Turner RE & Van der Windt HJ 2007. Managing coastal resources in the 21st century. *Frontiers in Ecology and the Environment* 5, 1: 43-48.

WESSA KZN (Wildlife and Environment Society of South Africa KwaZulu Natal) 2010. *Coast Watch* [online]. Howick, South Africa: WESSA. Available for www.wessa.org.za/index.php/Programs/Coast-Watch.html [Accessed on 19 February 2010].

Wester P & Warner JF 2002. River basin management reconsidered. In Turton A & Henwood R (eds) *Hydropolitics in the developing world: A southern Africa perspective*, 61-71. Pretoria: African Water Issues Research Unit, University of Pretoria.

Wibeck V, Johansson M, Larsson A & Öberg G 2006. Communicative aspects of environmental management by Objectives: Examples from the Swedish context. *Environmental Management* 37, 4: 461-469.

Widodo S 2003. The needs for marine cadastre and supports of spatial data infrastructures in marine environment – A case study. FIG Working Week 2003. April 13-17, Paris, France.

Wood C & Djeddour M 1989. Environmental assessment of policies, plans and programmes. Interim report to the Commission of European Communities. (Contract No. B6617-571-572-89). Manchester, United Kingdom: EIA Centre, University of Manchester.

WRC (Water Research Commission) 2010. *South African WRC: Profile* [online]. Pretoria, South Africa: WRC. Available from www.wrc.org.za/Pages/AboutUs.aspx [Accessed on 25 February 2010].

Yao H 2008. Lessons learned from ICOM initiatives in Canada and China. *Coastal Management*, 36:458-482.

Young OR (ed) 1997. *Global governance: Drawing insights from the environmental experience*. Cambridge: The MIT Press.

PERSONAL COMMUNICATION

Van Niekerk L 2010. Senior Scientist, CSIR. Stellenbosch. Interview on 6 July on functional estuaries along South Africa's coast.

APPENDIX A: MEMBERS OF THE NATIONAL ADVISORY FORUM

Dr Yazeed Peterson, National Department of Environmental Affairs

Feroza Albertus-Stanley, National Department of Environmental Affairs

Prince Radzuma, National Department of Environmental Affairs

Shavhani Mukwevho, National Department of Environmental Affairs

Wilna Oppel, Northern Cape Provincial Department of Department of Tourism, Environment and Conservation

Erna Groeners, Northern Cape Provincial Department of Department of Tourism, Environment and Conservation

Di Dold, Wildlife and Environment Society of South Africa (WESSA)

Patrick Dowling, Wildlife and Environment Society of South Africa (WESSA)

Dr Johann Kotzé, National Department of Tourism

Nomphelo Daniel, National Department of Environmental Affairs

Fhatuwani Tshivhase, National Department of Environmental Affairs

Kamaseelan Chetty, Western Cape Provincial Department of Environment, Agriculture and Development Planning, (Pollution and Waste)

Shadley Mackenzie, Western Cape Provincial Department of Environment, Agriculture and Development Planning

Zain Jumat, Western Cape Provincial Department of Environment, Agriculture and Development Planning

Aaniyah Omardien, World Wide Fund for Nature (WWF), South Africa: Marine Programme

Nicholas Scarr, Eastern Cape Provincial Department of Economic Development and Environmental Affairs

Leticia Greyling, Transnet: National Ports Authority (Transnet NPA)

Nazeera Hargey, National Department of Environmental Affairs

Tandi Breetzke, KZN Provincial Department of Agriculture and Environment

Dr Heidi Snyman, Water Research Commission, Pretoria

Anton Molden, South African Petroleum Industry Association (SAPIA)

Lebeau Labuschagne, Department of Minerals

Stephinah Mudau, Department of Minerals

Henry Ndlovu, National Department of Agriculture (now Department of Agriculture, Forestry and Fisheries)

Wilna Kloppers, Western Cape: Department of Water Affairs

Bill Pfaff, South African Marine Pipeline Operators Association

Derek Airey, South African Marine Pipeline Operators Association

Steven Weerts, Council for Scientific and Industrial Research (CSIR)

Susan Taljaard, Council for Scientific and Industrial Research (CSIR)

APPENDIX B: OVERVIEW OF SOUTH AFRICAN NATIONAL LEGISLATION RELEVANT TO ICM

Table B.1 Important international obligations and agreements

INTERNATIONAL OBLIGATION	SHORT DESCRIPTION
International Convention for the Regulation of Whaling (1946)	The convention was established in order to provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry. It was one of the first international fisheries conventions ever to be established and many more followed in its wake to cater for the conservation and rational use of marine living resources. South Africa ratified the convention in 1946.
International Convention for the Conservation of Atlantic Tunas (ICCAT) (1966)	This convention is responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean. Through the Convention, it is established that ICCAT is the only fisheries organisation that can undertake the range of work required for the study and management of tunas and other large pelagics in the Atlantic Ocean. South Africa was a founder member and ratified the Convention on 7 October 1967.
Civil Liability Convention (1969) as replaced by its 1992 Protocol and amended in 2000	This Convention (www.imo.org) was adopted to ensure that adequate compensation is available to persons who suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships. The Convention places the liability for such damage on the owner of the ship from which the polluting oil escaped or was discharged. The Marine Pollution (Control and Civil Liability) Act (No. 6 of 1981) gives legal effect to this Convention in South Africa.
Convention on Wetlands of International Importance especially as Waterfowl Habitat (1971) (Ramsar Convention)	The broad aims of this Convention (www.ramsar.org) are to stem the loss and to promote wise use of all wetlands. The Convention includes estuaries in its definition of wetlands. The Convention defines wetlands as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres' (which includes estuaries). South Africa presently has 17 sites designated as Ramsar sites with a total surface area of 498 721 ha, including estuaries such as the Orange, Verlorenvlei, Sout (De Hoop Vlei), Heuningnes (De Mond), St Lucia and Kosi Bay. A Wetland Conservation Bill has been proposed which will further assist South Africa in meeting the aims of the Convention (www.ramsar.org/profile/profiles_southafrica.htm).
Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) (World Heritage Convention)	The Convention (http://whc.unesco.org/en/conventin/) states that each state party to that Convention recognises the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage situated in its territory (which may include estuaries). South Africa acceded to the Convention in 1997, given legal status through the World Heritage Conservation Act (Act 49 of 1999). The Greater St. Lucia Wetland Park (1999) (renamed to the iSimangiliso Wetland Park) and the Cape Floristic Region (2004) for example, were given international recognition as World Heritage Sites.

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Table B.1 continued

INTERNATIONAL OBLIGATION	SHORT DESCRIPTION
Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (1972, as amended) (London Convention)	The London Convention 1972 is an international treaty that limits the discharge of waste that are generated on land and disposed of at sea. The 1996 Protocol is a separate agreement that modernised and updated the London Convention, following a detailed review that began in 1993. The 1996 Protocol will eventually replace the London Convention. States can be a Party to either the London Convention 1972, or the 1996 Protocol, or both. The Protocol defines dumping, amongst others as 'any deliberate disposal into the sea of waste or other matter from vessels, aircraft, platforms or other man-made structures at sea'. South Africa is a signatory to the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972, as amended (London Convention) The Dumping at Sea Control Act (No. 73 of 1980) gives legal status to the London Convention in South Africa (to be replaced by the National Environmental Management: Integrated Coastal Management Bill (www.londonconvention.org/).
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973/1978)	The MARPOL Convention (www.imo.org/) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years. The Convention includes regulations aimed at preventing and minimising pollution from ships and currently includes six technical Annexes: Annex I Regulations for the Prevention of Pollution by Oil Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form Annex IV Prevention of Pollution by Sewage from Ships Annex V Prevention of Pollution by Garbage from Ships Annex VI Prevention of Air Pollution from Ships (entry into force in May 2005) States Parties must accept Annexes I and II, but the other Annexes are voluntary. In October 2006 amendments to MARPOL designating the waters off Southern South Africa as a Special Area under the Convention. The designation will provide measures to protect wildlife and the marine environment in an ecologically important region used intensively by shipping. The International Convention for Prevention of Pollution from Ships Act (No. 2 of 1986) gives legal effect to MARPOL in South Africa, as well as Annex I and Annex II. The Marine Pollution (Intervention) Act (No. 64 of 1987) – as last amended by the South Africa Maritime Safety Authority Act (No. 5 of 1998) – also incorporates this convention into South African law.
Convention of Migratory Species of Wild Animals (1979) (Bonn Convention)	The Convention (www.cms.int/) was a response to the need for nations to co-operate in the conservation of animals that migrate across their borders. These include terrestrial mammals, reptiles, marine species and birds. Special attention is paid to endangered species. South Africa is a major partner in this Convention as it is the terminus for many of the migratory species, both the Palaearctic (birds) and the Antarctic species (whales and birds). South Africa acceded to the Convention in December 1991.
Abidjan Convention (1981) and Nairobi Convention (1985)	In 1974, the United Nations Environment Programme (UNEP) initiated the Regional Seas Programme (www.unep.org/regionalseas/) with a view to improving the control of marine pollution and management of marine and coastal resources (including estuaries). The Programme covers eleven regions. For each region an action plan was developed which included a Regional Convention and technical protocols signifying the commitment of participating countries to address, individually and jointly, their common problems. The regions including South Africa are the West and Central African region (Abidjan Convention, came into force in South Africa in 1984) and the Eastern African or West Indian Ocean (WIO) region (Nairobi Convention, came into force in South Africa in 1996).

Continued overleaf

Table B.1 continued

INTERNATIONAL OBLIGATION	SHORT DESCRIPTION
United Nations Convention on the Law of the Sea (UNCLOS) (1982)	UNCLOS (www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm) is an attempt by the international community to regulate all aspects of the resources of the sea and its uses. Among the most important features of the treaty are included navigational rights, territorial sea limits, economic jurisdiction, legal status of resources on the seabed beyond the limits of national jurisdiction, passage of ships through narrow straits, conservation and management of living marine resources, protection of the marine environment, a marine research regime and, a more unique feature, a binding procedure for settlement of disputes between States.
Southern African Developing Countries (SADC) Protocol on Fisheries (1992)	The objective of the Protocol (www.sadc.int/fanr/naturalresources/fisheries/index.php) is to promote responsible and sustainable use of the living aquatic resources and ecosystems of interest to State Parties in order to promote and enhance food security and human health, safeguard the livelihood of fishing communities, to generate economic opportunities for nationals in the region, to ensure that future generations benefit from these renewable resources and to alleviate poverty with the ultimate objective of its eradication
Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992) (Basel Convention)	The main objectives of the convention (www.basel.int/) are the reduction of the production of hazardous waste and the restriction of transboundary movement and disposal of such waste. It also aims to ensure that any transboundary movement and disposal of hazardous waste, when allowed, is strictly controlled and takes place in an environmentally sound and responsible way. South Africa ratified the convention in May 1994.
Agenda 21 (1992) as reaffirmed at the United Nations World Summit on Sustainable Development – Johannesburg Summit (2002)	Agenda 21 (www.un.org/esa/sustdev/documents/agenda21/index.htm) is an internationally accepted strategy for sustainable development, decided upon at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. Agenda 21 is, however, not legally binding on states, and merely acts as a guideline for implementation. The Johannesburg Summit presented an opportunity for current leaders to adopt concrete steps and identify quantifiable targets for better implementing Agenda 21. Agenda 21 requires, for example, the preparation of a State of the Environment Report prepared on national, provincial and local level (responsibility of the National Department of Environmental Affairs and Tourism, Provincial Departments of Environmental Affairs and Local Authorities, respectively. These may include State of the Estuaries reports.
United Nations Framework Convention on Climate Change (1992)	The United Nations Framework Convention on Climate Change (http://unfccc.int/2860.php) sets an "ultimate objective" of stabilising greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Countries ratifying the Convention agree to take climate change into account in such matters as agriculture, energy, natural resources, and activities involving sea coasts. They agree to develop national programmes to slow climate change. The Convention encourages parties to cooperate to reduce greenhouse gas emissions, share technology and carry out scientific research. South Africa ratified the Convention in 1997. The Department of Environmental Affairs and Tourism published a Climate Change Policy Discussion Document in 1998 to begin the process of formulating policies to respond to climate change both locally and internationally.

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Table B.1 continued

INTERNATIONAL OBLIGATION	SHORT DESCRIPTION
United Nations Convention on Biological Diversity (1993)	The Convention on Biological Diversity (www.biodiv.org/convention/default.shtml) has three objectives: the conservation of biological diversity; the sustainable use of biological resources; and the fair and equitable sharing of benefits arising from the use of genetic resources. As a party to the Convention, South Africa is required to develop national strategies, plans or programmes, or adapt existing ones, to address the provisions of the Convention, and to integrate the conservation and sustainable use of biodiversity into sectoral and cross-sectoral plans, programmes and policies. South Africa's response to this requirement is contained in the White Paper on the Conservation and sustainable use of South Africa's biological diversity (July 1998), given legal status through the National Environmental Management: Biodiversity Protection Act (No. 10 of 2004).
Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) (1995)	The GPA (www.gpa.unep.org/) builds on the principles of Agenda 21 and was adopted in November 1995. The programme is designed to assist states in taking action, individually or jointly, within their respective policies, priorities and resources, that will lead to the prevention, reduction, control or elimination of the degradation of the marine environment, as well as to its recovery, from the impacts of land-based activities (including pollution and developments/activities leading to the destruction of marine habitat). The GPA identifies the Regional Seas Programme of UNEP as an appropriate framework for delivery of this programme at regional level. South Africa upholds the principles of GPA.
Code of Conduct for Responsible Fisheries (1995)	The Code (www.fao.org/fishery/ccrf/en) takes cognisance of the state of world fisheries and aquaculture, and proposes actions towards implementing fundamental changes within the fisheries sector to encourage the rational and sustainable utilisation of fisheries and aquaculture. The Code is a voluntary instrument rather than a legally binding international agreement and was approved by South Africa's government in January 2002.
Convention on the Conservation and Management of Fishery Resources in the South East Atlantic Ocean (2001)	The main objective of this convention (www.fao.org/fishery/rfb/seafo) is to ensure the long-term conservation and sustainable use of fish stocks other than highly migratory stocks found in areas of the South East Atlantic beyond the limits of national jurisdiction. South Africa signed the convention in April 2001 which came into force in April 2003.
International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004)	The Convention (www.imo.org/) was adopted by consensus at a Diplomatic Conference held at the International Maritime Organisation (London) in February 2004. Invasive aquatic species are one of the four greatest threats to the world's oceans, and can cause extremely severe environmental, economic and public health impacts. The GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast) (http://globallast.imo.org/index.asp) is assisting developing countries to reduce the transfer of harmful aquatic organisms and pathogens in ships' ballast water; Implement ballast water guidelines of the IMO; Prepare for the Convention on ballast water.

Table B.2 Important national policies (White Papers) (www.info.gov.za/index.html)

WHITE PAPER	SHORT DESCRIPTION
White Paper for Sustainable Coastal Development in South Africa (June 2000)	The White Paper sets out a policy which aims to achieve sustainable coastal development in South Africa through integrated coastal management. The white paper sets out a vision, a number of principles and goals for coastal management. The key messages of the white paper are: 1) the value of the coast must be recognised; 2) sustainable coastal management must be facilitated; 3) coastal management must be co-ordinated and integrated; and 4) the government must adopt a co-operative style of management. The key action points that the white paper lays out are (INR, 2000): • Institutional and Legal Development: At a national level, the Department of Environmental Affairs (DEA) will act as national lead agent for coastal management and a new Integrated Coastal Management Act will be drafted. In the provinces lead agents for coastal management will be defined and Coastal Working Groups will be established. At a local level, local authorities will still have day-to-day coastal management responsibilities and it is proposed that some areas establish local coastal forums. • Awareness, education and training: A coastal public awareness programme will be carried out in conjunction with the education and training of coastal stakeholders and role players. • Information: A programme will be designed to monitor the state of the coast and regular state of the coast reports will be published. An information and decision-support system to assist coastal managers will be established. • Projects: A shortlist of national and provincial priority issues will be identified and programmes developed to address these issues. The National Environmental Management: Integrated Coastal Management Act (when promulgated) will give legal status to the imperatives and objectives contained in the White Paper.
White Paper on a National Water Policy for South Africa (April 1997)	The White Paper sets out the policy for the management of both quality and quantity of South Africa's water resources (including estuaries). The purpose includes: • Providing historical background regarding access to and the management of water in South Africa • Explaining current development context in which South Africa finds itself; • Explaining environmental and climatic conditions which affect the availability of water in South Africa • Putting forward certain policies • Outlining the proposed institutional framework for water management functions • Outlining steps in order to translate the policy into law and action. The National Water Act (No. 36 of 1998) gives legal status to the imperatives and objectives contained in the White Paper.

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Table B.2 continued

WHITE PAPER	SHORT DESCRIPTION
White Paper on Marine Fisheries Policy for South Africa (May 1997)	The White Paper sets out the main policy principles that the Department of Environmental Affairs and Tourism will endeavour to implement through its marine fisheries management institutions in order to achieve this overall policy objective. The objective is to improve the overall contribution of the fishing industry to the South African economy. Expansion of the sector's total activity is limited by the natural productive capacity of the living marine resources from which the activities derive, and the necessity to limit and control the total harvesting pressure according to what the resources can sustain on a long-term basis. In spite of these constraints, the fisheries sector is of great importance to the economy in several coastal regions, and for the livelihood of many communities. The fisheries policy is founded on the belief that all natural marine living resources of South Africa, as well as the environment in which they exist and in which mariculture activities may occur, are a national asset and the heritage of all its people, and should be managed and developed for the benefit of present and future generations in the country as a whole. The Marine Living Resources Act (No. 18 of 1998) gives legal status to the imperatives and objectives contained in the White Paper.
White Paper on Environmental Management Policy (May 1998)	The White Paper contains the government's environmental management policy and describes the context in which it has been developed. The White Paper has the following sections: • Introduction that sets out the concept of environment used in the policy, the scope and purpose of the policy • New vision for environmental policy and the mission of the DEA with respect to the new policy • Policy principles that must be applied in developing and testing policy • Government's strategic goals and supporting objectives to begin addressing major issues facing environmental management and the sustainable use of resources • Government's approach to governance, setting out the powers and responsibilities of the different spheres and agencies of government and the regulatory approach to environmental management. The purpose of policy is twofold: • To inform the public of what government's objectives are and how it intends to achieve its objectives • To inform government agencies and state organs what their objectives are and what they must do to achieve those objectives. The National Environmental Management Act (No. 107 of 1998) gives legal status to the imperatives and objectives contained in the White Paper.

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Table B.2 continued

WHITE PAPER	SHORT DESCRIPTION
White Paper on Spatial Planning and Land-use Management (July 2001)	This White Paper intends to satisfy the following specific needs: • Development of policies, which will result in the best use and sustainable management of land • Improvement and strengthening planning, management, monitoring and evaluation • Strengthening institutions and coordinating mechanisms • Creation of mechanisms to facilitate satisfaction of the needs and objectives of communities and people at local level. Integrated planning for sustainable management of land resources should thus ensure that: • Development and development programmes are holistic and comprehensive so that all factors in relation to land resources and environmental conservation are addressed and included • All activities and inputs are integrated and coordinated • All actions are based on a clear understanding of the natural and legitimate objectives and needs of individual land users to obtain maximum consensus • Institutional structures are put in place to develop debate and carry out proposals.
White Paper on Integrated Pollution and Waste Management for South Africa (March 2000)	This white paper outlines the government's thinking in relation to pollution and waste management. This management approach envisages pollution prevention, waste minimisation, managing the environmental impacts associated with waste and pollution, remediating damaged environments and integrating the management of various sources of waste. This Integrated Pollution and Waste Management policy is a subsidiary policy of the overarching environmental management policy, as set out in the White Paper on Environmental Policy for South Africa, and further supported by NEMA. The white paper proposes a number of tools to implement the objectives of the policy it sets out. The most significant of these is a legislative programme that will culminate in new pollution and waste legislation. One of the identified administrative actions is initiating the process of integrating pollution and waste management functions within all spheres of government, including functions relating to water and marine pollution. A remediation fund for marine pollution will also be investigated. A National Waste Management Strategy, which will form the basis for translating the goals and objectives of this policy into practice, has also been developed. The National Environmental Management: Waste Act (No. 59 of 2008) gives legal status to the imperatives and objectives contained in the White Paper.
White Paper on Development and Promotion of Tourism in South Africa (May 1996)	The White Paper provides the government's stance on tourism and describes the following: • Role of tourism in South Africa • Problems around tourism • Way towards a new tourism • Vision, objectives and principles • How to ignite tourism growth • Roles of the key players • Organisational structures. Based on an assessment of the problems, constraints and opportunities facing the South African tourism industry, the concept of "Responsible Tourism" emerged as the most appropriate concept for the development of tourism in South Africa.

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Table B.2 continued

WHITE PAPER	SHORT DESCRIPTION
White Paper: Mineral and Mining Policy for South Africa (October 1998)	The White Paper is organised into six main themes of which one addresses environmental management. The policy states, amongst other, that government will ensure that the following principles are adhered to: In order to achieve integrated and holistic environmental management, Government requires compliance with a single national environmental policy and governance within a framework of co-operative governance. The DMR will, in support of the lead agent (DEA) develop and apply the necessary to ensure the mining industry's compliance with national policy on environmental management. During decision making, a risk-averse and cautious approach will be adopted. The polluter-pays principle will be applied. A consistent standard of environmental impact management will be applied. Equitable and effective consultation with interested and affected parties. Mining companies will be required to comply with the local Development Objectives, spatial development framework and Integrated Development Planning of the municipalities within which they operate. Clear guidelines for implementation of environmental management procedures and decision making will be provided. The principles of Integrated Environmental Management (IEM) will be applied in the mining industry, including cradle-to-grave management of environmental impacts. In terms of environmental management issues relevant to estuaries, the Mineral and Petroleum Resources Development Act (No. 28 of 2002) gives legal status to the imperatives and objectives contained in the White Paper.
White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (August 1998)	Under the United Nations Convention on Biological Diversity South Africa is required to develop national strategies, plans or programmes, or adapt existing ones, to address the provisions of the Convention, and to integrate the conservation and sustainable use of biodiversity into sectoral and cross-sectoral plans, programmes and policies. South Africa's initial response to this requirement is contained in this White Paper. The White Paper specifically recognises the importance of estuaries and commits the government to a number of strategies to protect wetland areas (including estuaries). The strategies suggested cut across a number of legislative sectors such as water law, resource conservation and planning. Some of the key strategies are (INR, 2000): Facilitate the development of appropriate legislation to secure the conservation of South Africa's wetlands, and to maintain their ecological and socio-economic function Promote the establishment of a National System of Protected Wetlands as part of the protected area system Prevent inappropriate activities and development around wetlands, and that of linear development in particular. Ensure that adequate buffer strips are retained around wetlands, taking due cognisance of the 1:50 year flood line Through establishing appropriate mechanisms and procedures, recognise the functions and values of wetlands in resource planning, management and decision making. Determine the impact of commercial, recreational and subsistence fishery practices on fisheries, fish, and their habitats, and develop guidelines for managing such fisheries on an ecologically sustainable basis. The National Environmental Management: Biodiversity Act (No. 10 of 2004) gives legal status to the imperatives and objectives contained in the White Paper.

Continued overleaf

Table B.2 continued

WHITE PAPER	SHORT DESCRIPTION
Policy on Sustainable Forest Development in SA (1997)	The broad aim of the White Paper is to weld together the three strains of Indigenous Forest Management, Commercial Forestry and Community Forestry. It provides the background to the policy process, the new policy (including principals and objectives) and sets out how it intends to take policy into practice. Elements of the policy include: • Set of nine guiding principles • Goal to be pursued in the next five years • Overall policy to govern the place of forestry in the management of land, water and other natural resources • Policy for: industrial forestry, community forestry, the conservation of the natural forests and woodland, South Africa's response to global concerns about forests; Research, education and training and South Africa's relationships with states in the Southern African Development Community. The overall goal of Government is to promote a thriving forest sector, to be utilised for the lasting benefit of the nation, and developed and managed to protect the environment. The National Forests Act (No. 84 of 1998) gives legal status to the imperatives and objectives contained in this White Paper.
White Paper on National Transport Policy (1996)	The broad goal of transport is the smooth and efficient interaction that allows society and the economy to assume their preferred form. To play this role, policies in the transport sector must be outward looking, shaped by the needs of society in general, of the users or customers of transport, and of the economy that transport has to support. The vision for South African transport is of a system which will: "Provide safe, reliable, effective, efficient, and fully integrated transport operations and infrastructure which will best meet the needs of freight and passenger customers at improving levels of service and cost in a fashion which supports government strategies for economic and social development whilst being environmentally and economically sustainable".

Table B.3 National legislation (Acts) (www.info.gov.za/index.html)

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
2006	National Environmental Management: Waste Act (No. 59 of 2008)	DEA	The purpose of this Act is to reform the law regulating waste management in order to: a) protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development, b) to provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government; c) to provide for specific waste management measures; d) to provide for the licensing and control of waste management activities; e) to provide for the remediation of contaminated land; to provide for the national waste information system; f) to provide for compliance and enforcement; g) and to provide for matters connected therewith.
2005	National Ports Act (No. 12 of 2005)	Department of Transport and National Ports Authority (Transnet NPA)	Environmental aspects in commercial ports, e.g. East London and Durban (located in estuaries) are governed by the provisions in the National Ports Act which repealed the Legal Succession to the SA Transport Services Act (No. 9 of 1989).
2004	National environmental Management: Air Quality Act (No. 39 of 2004)	DEA	The aim of this act is to reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures.
2004	National Environmental Management: Biodiversity Act (Act 10 of 2004)	DEA	The objective of the Biodiversity Act is to provide for the conservation of biological diversity, regulate the sustainable use of biological resources and to ensure a fair and equitable sharing of the benefits arising from the use of genetic resources. The Act states that the state is the custodian of South Africa's biological diversity and is committed to respect, protect, promote and fulfil the constitutional rights of its citizens. It also recognises that South Africa is party to, amongst others, the Convention on Biological Diversity, the Convention on Wetlands of International Importance especially Waterfowl Habitat (Ramsar Convention) and the Convention on Migratory Species (Bonn Convention).

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
2003	National Environmental Management: Protected Areas Act (Act 57 of 2003)	DEA	The Protected Areas Act provides for: The protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas.
2002	Disaster Management Act (No. 57 of 2002)	Administered by a Cabinet member designated by the President	The Act provides for an integrated and co-ordinated disaster management policy that focusses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery; the establishment of national, provincial and municipal disaster management centres; disaster management volunteers; and matters incidental thereto.
2002	Mineral and Petroleum Resources Development Act (No. 28 of 2002)	Department of Mineral Resources (DMR)	The Mineral and Petroleum Resources Development Act contains the statutory requirements regarding the enforcing of environmental protection and management of mining impacts, including sand and coastal mining. The Act requires Environmental Management Programmes (EMP) that identify a mine's impact on the environment and provide a clear programme on how these will be managed, based on an Environmental Impact Assessment (EIA). To ensure compliance with environmental issues, the act requires consultation with each department charged with administration of any law that relates to any matter affecting the environment before an EMP may be approved.
2002	Animal Health Act (Act 7 of 2002)	Department of Agriculture	The Animal Health Act may become relevant to estuarine management in instances where systems are being utilised for mariculture activities.
2000	Local Government: Municipal Systems Act (Act 32 of 2000)	Department of Provincial and Local Government	The Municipal Systems Act (Chapter 5) deals with Integrated Development Planning (which municipalities are obliged to prepare and to update regularly) (www.info.gov.za/documents/acts/2000.htm) and with an Integrated Development Plan (IDP) is intended to encompass and harmonise planning over a range of sectors such as water, transport, land use and environmental management. It requires each local authority to adopt a single, inclusive plan for the development of the municipality which: • Links, integrates and coordinates plans and take into account proposals for the development of the municipality • Aligns the resources and capacity of the municipality with the implementation of the plan • Forms the policy framework and general basis on which annual budgets must be based • Is compatible with national and provincial development plans and planning requirements that are binding on the municipality in terms of legislation.

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
1999	World Heritage Convention Act (Act 49 of 1999)	DEA	The World Heritage Convention Act provides for the incorporation of the World Heritage Convention into South African Law. It also provides for the recognition and establishment of World Heritage Sites, the establishment of authorities and the granting of additional powers to existing organs of state tasked with the management of World Heritage Sites. For example, under this Act, Regulations in connection with the Greater St. Lucia Wetland Park (renamed to the iSimangiliso Wetland Park) (No. R.1193, 24 November 2000) (www.info.gov.za/documents/regulations/2000.htm), were promulgated to create the framework to ensure that the area would be managed, protected and developed in a manner consistent with the World Heritage Convention.
1999	National Heritage Resources Act (Act 25 of 1999)	DEA (through South African Heritage Resources Agency (SAHRA) www.sahra.org.za	The National Heritage Resources Act introduces an integrated and interactive system for the managements of national heritage resources (which include landscapes and natural features of cultural significance). One of the important elements of the Act is that it provides the opportunity for communities to participate in the identification, conservation and management of cultural resources. The Act requires that in areas where there has not yet been a systematic survey to identify conservation-worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected. Anyone who intends to undertake a development must notify the heritage resources authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Thus developers will be able to proceed without uncertainty about whether work will have to be stopped if a heritage resource is discovered.
1998	Local Government Municipal Structures Act (No. 117 of 1998, amended by Act 33 of 2000)	Department of Provincial and Local Government	The Constitution establishes three categories of municipalities. This Act elaborates on the categorisation of municipalities as defined by the Constitution. It provides for "the establishment of municipalities in accordance with the requirements relating to categories and types of municipality; to establish criteria for determining the category of municipality in an area" and other related matters. This Act includes chapters on the categories and types of municipalities; the establishment of municipalities and the functions and powers of municipalities

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
1998	National Environmental Management Act (Act 107 of 1998) (NEMA)	DEA	NEMA provides for co-operative environmental governance through the establishment of national environmental management principles, and procedures for their incorporation into decisions affecting the environment. NEMA emphasises co-operative governance and assists in ensuring that the environmental right and related rights in the Constitution are protected. NEMA requires the Department of Environmental Affairs and Tourism to be the lead agent in ensuring the effective custodianship of the environment. In particular, the Act provides that sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where subjected to significant human resource usage and development. In 2006, new Environmental Impact Assessment (EIA) Regulations were promulgated under this Act to regulate procedures and criteria for the submission, perusal, consideration and decision of application for environmental authorisation of specified activities. Regulations (which came into effect on 3 July 2006) also bear on activities within the coastal zone which require environmental authorisation before they can proceed.
1998	National Veld and Forest Fire Act (No. 101 of 1998)	DAFF	Sets out to reform the law on veld and forest and repeals certain provisions of the Forest Act of 1984. It provides for matters relating to fire protection, and fighting, offences and penalties and enforcement.
1998	Marine Living Resources Act (Act 18 of 1998) Amended 2000 (MLRA)	DAFF	The objectives and principles of the MLRA deal with the utilisation, conservation and management of marine living resources. Marine living resources include any aquatic plant or animal, whether piscine or not, and any mollusc, crustacean, coral, sponge, holothurian or other echinoderm, reptile and marine mammals and include their eggs, larvae and all juvenile stages, but does not include sea birds and seals. This MLRA governs activities in fishing harbours, e.g. Laaiplek (Berg Estuary), including harbour pollution. The Act also gives a mandate to the Minister to promulgate Regulations towards marine pollution. Orderly control and development of mariculture is also regulated under this Act (Sections 18 and 27).
1998	National Water Act (Act 36 of 1998) (NWA)	DWA	One the important objectives of the NWA is to ensure protection of the aquatic ecosystems of South Africa's water resources, including estuaries. To be able to do this effectively, the NWA requires policies to be in place that provide guidance in developing resource quality objectives, i.e. specifying aspects such as freshwater inflow, water quality, habitat integrity, biotic composition and functioning requirements. Estuaries are classified as a water resource under the NWA. Section 21 of this Act identifies certain land uses (e.g. activities resulting in stream-flow reduction such as afforestation and cultivation of crops), infrastructural developments (e.g. altering the bed, banks, course or characteristics of a watercourse), water supply/demand and waste disposal (from land-based activities) as 'water uses' that require authorisation (licensing) by DWA.

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
1998	South African Maritime Safety Authority Act (Act 5 of 1998)	Department of Transport	To provide for the establishment and functions of the South African Maritime Safety Authority; and to provide for incidental matters.
1998	National Forests Act (No. 84 of 1998)	DWA	The National Forest Act recognises that natural forests and woodlands form an important part of the environment, and need to be conserved and developed according to the principles of sustainable management. A "Natural forest" is defined as any group of indigenous trees whose crowns are largely contiguous and applies to riparian vegetation in the CFR. A licence is required to disturb natural forest which poses opportunity to develop a licence framework for estuarine forest
1997	Water Services Act (No. 108 of 1997)	DWA	The main aspects of the Water Services Act relevant to land-based pressures on the marine environment include: • Right of access to basic water supply and basic sanitation necessary to secure sufficient water and an environment not harmful to human health or well-being • Management and control of water services, in general, including water supply and sanitation • Regulation of industrial use of water, both in terms of use and disposal of effluent (possible overlap with Section 21 of the NWA) • Preparation and adoption of Water Services Development Plans (refer to Section 13 of the Act) by water services authorities that should form part of IDP's.
1996	Wreck and Salvage Salvage Act (No. 94 of 1996)	Department of Transport	The Act provides for the salvage of certain vessels and for the application of the International Convention on Salvage, 1989, to SA waters and for the repeal or amendment of certain sections of the Merchant Shipping Act (1951)
1996	Local Government Transition Second Amendment Act (Act 97 of 1996)	Department of Provincial and Local Government	The Local Government Transition Second Amendment Act also requires that all municipalities, local and district councils, draw up IDPs for the integrated development and management of their areas of jurisdiction. The requirements of this act have largely been incorporated in the Municipal Systems Act.

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION

1996	The Constitution (Act 108 of 1996)	National Government	The Constitution which is the supreme law of the Republic of South Africa, provides the legal framework for legislation regulating environmental management in general, against the backdrop of the fundamental human rights enshrined in that statute.
			
			The most pertinent fundamental right in the context of estuarine management is the environmental right (reflected in Section 24), which provides that:
			
			"Everyone has the right:
			• to an environment that is not harmful to their health or well-being; and
			• to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that –
			  • prevent pollution and ecological degradation;
			  • promote conservation; and
			  • secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."
			
			Section 24 of the Bill of Rights therefore guarantees the people of South Africa the right to an environment that is not detrimental to human health or well-being, and specifically imposes a duty on the State to promulgate legislation and take other steps that ensure that the right is upheld and that, among other things, ecological degradation and pollution are prevented.
			
			The Constitution emphasises co-operative governance and provides the legal basis for allocating powers to different spheres of government. Schedule 4 (titled "Functional areas of concurrent national and provincial legislative competence") and Schedule 5 (titled "Functional areas of exclusive provincial legislative competence") to the Constitution list the areas within which the tiers of national, provincial (Part A of the Schedule) and local (Part B of the Schedule) government have legislative mandates. In instances where provincial or local legislation are in conflict with national legislation, national legislation prevails.

1995	Development Facilitation Act (Act 67 of 1995)	Department of Provincial and Local Government	The Development Facilitation Act requires the setting of Land Development Objectives and the principles of this Act have also been incorporated into Chapter 5 of the Municipal Systems Act.
1994	Maritime Zone Act (No. 15 of 1994)	Department of Transport	The Act provides for the demarcation of maritime zones of the Republic (e.g. internal waters, territorial waters, contiguous zone, maritime cultural zone, exclusive economic zone, continental shelf) and to provide for matters relating to installations, maritime casualties and self-defence.
1993	Tourism Act (No. 72 of 1993, as amended in 1996 and 2000)	Department of Tourism	To make provision for the promotion of tourism to and in the Republic and to authorise the Minister to make regulations; and to provide for matters connected therewith.

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
1993	Local Government Transition Act (No. 209 of 1993)	Department of Provincial and Local Government	To provide for revised interim measures with a view to promoting the restructuring of local government, and for that purpose to provide for the establishment of Provincial Committees for Local Government in respect of the various provinces.
1989	Environmental Conservation Act (No. 73 of 1989)	DEA	Although many of the provisions of this Act have been repealed by NEMA, the Regulations in terms of the ECA regulating the Outeniqua and the Pennington Sensitive Coastal Areas remain in force until replaced by new regulations.
1988	Sea Fisheries Act 12 of 1988	DAFF	Defines "sea" to mean "the water and the bed of the sea … including the sea-shore and the water and the bed of a tidal river, tidal lagoon … and includes the internal waters referred to in section 3 of the Maritime Zones Act: Provided that in the case of rivers and lagoons, internal waters shall only include tidal rivers and tidal lagoons". The Sea Fisheries Act uses the same definitions for "tidal lagoon" and "tidal river" as those used in the Sea-shore Act. Along certain sections of the coast, marine reserves have been proclaimed under this Act. Marine reserves may include inter-tidal and sub-tidal areas. While some marine reserves were proclaimed to protect commercially important species such as rock lobster or abalone, others prohibited certain activities, such as boat angling or spear fishing. In a few, all marine life is protected. Part IX of this Act was replaced by the MLRA, with the exception of some provisions regulating control over the collection and removal of aquatic plants and shells.
1986	International Convention for Prevention of Pollution from Ships Act (No. 2 of 1986)	Department of Transport	This Act gives legal effect to MARPOL in South Africa, as well as Annex I (regulations on oil) and Annex II (regulations on noxious liquid substances in bulk) of the Convention.
1983	Conservation of Agricultural Resources Act (No. 43 of 1983)	Department of Agriculture	The objects of the Conservation of Agricultural Resources Act is to provide for the conservation of the natural agricultural resources of South Africa by: the maintenance of the production potential of land; the combating and prevention of erosion and weakening or destruction of the water sources; and the protection of the vegetation and the combating of weeds and invader plants.
1981	Marine Traffic Act (No. 2 of 1981)	Department of Transport.	The act sets out to regulate marine traffic in SA and to provide for matters such as regulating ship traffic and the stopping or anchoring of ships outside fishing harbours and the sinking and abandoning of ships.
1981	Marine Pollution (Control and Civil Liability) Act (No. 6 of 1981)	Department of Transport (prevention) and DEA (combating)	The Marine Pollution (Control and Civil Liability) Act provides for the protection of the marine environment from pollution by oil and other harmful substances; the prevention and combating of such pollution; and the determination of liability in certain respects for loss or damage caused by the discharge of oil from ships, tankers and offshore installations. It prohibits the discharge of oil from ships, tankers and offshore installations, but provides exemptions in the case of, for example, the oil being released as a result of damage and steps being taken as soon as practicable to stop or reduce the escape of oil. The Act provides reporting procedures for discharges of any harmful substance.

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
1980	Dumping at Sea Control Act (No.73 of 1980) Amended 1995	DEA	The Dumping at Sea Control Act provides for the control of dumping of substances in the sea (including estuaries) and gives legal effect to the London Convention in South Africa. This Act will be repealed by the National Environmental Management: Integrated Coastal Management Act (when promulgated).
1977	Environmental Laws Rationalization Act (No. 51 of 1997)	DEA	Makes provision for the rationalisation of certain Acts of Parliament which are administered by the DEA (e.g. Sea-Shore Act and Dumping at Sea Control Act), by amending those acts and by extending their application to certain areas which at present form part of the national territory of the Republic, but where other laws applied, such as Transkei, Bophuthatswana, Venda, Ciskei and other previously self-governing territories such as Kwa-Zulu.
1977	National Buildings Regulations and Building Standards Act (No. 103 of 1977)	Department of Trade and Industry	Sets requirements for the approval and installation of storm water drains. These regulations must be read together with the South African Bureau of Standards' code of practice, which also lays down detailed requirements for the design of storm water drainage systems.
1976	National Parks Act (No. 57 of 1976)	DEA through South African National Parks (SANParks)	The National Parks Act provides for the establishment of National Parks. National Park status establishes the strongest claim to permanent protection that is possible. Areas above and below the intertidal zone may be included in a National Park.
1975	Lake Areas Development Act (No. 39 of 1975)	DWA	This law (rarely used since enactment) provides for the establishment of Lake Areas (which include tidal lagoons or tidal rivers) and the opening and closing of the mouth of a tidal lagoon or a tidal river in a declared lake area. The effectiveness of this law is questionable, as only two such areas have been proclaimed under it. Those Lake Areas are managed by SANP by virtue of provisions in the National Parks Act
1974	International Health Regulations Act (No. 28 of 1974)	Transnet National Ports Authority (Transnet NPA)	The Port Health Service is responsible for the prevention of quarantinable diseases in the country). These services are rendered at sanitary airports (Johannesburg, Cape Town and Durban international airports) and approved ports. The Act also requires that every seaport must be provided with a system for the removal and disposal of excrement, refuse, wastewater, condemned food and other matter dangerous to health.
1973	Sea Bird and Seal Protection Act (No. 46 of 1973)	DEA	This Act governs the protection and control of the capture, killing and products produced from seabirds and seals.
1973	Hazardous Substances Act (No. 15 of 1973)	Department of Health and Welfare	This Act provides for the control of substances which may cause injury or ill health to, or death, of human beings by reason of their toxic, corrosive, irritant, strongly sensitising or flammable nature. To provide for the prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances and products.

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Table B.3 continued

YEAR	ACT	LEAD AGENT	SHORT DESCRIPTION
1972	Foodstuffs, Cosmetics and Disinfectant Act (No. 54 of 1972)	Department of Health and Welfare	In South Africa standards (i.e. concentration limits of constituents required by law) specifying the limits of chemical and microbiological constituents in the flesh of different marine organisms used for human consumption are covered under the Act and are listed in two regulations, i.e.: • Regulations – Marine food, 2 November 1973 (regarding Bacteriological contamination) • Regulations related to metals and foodstuffs, 9 September 1994.
1967	Physical Planning Act (No. 88 of 1967)	Department of Provincial and Local Government	The Act provides for Guide Plans that could influence the planning and location of storm water drains.
1951	Merchant Shipping Act (No. 57 of 1951)	Department of Transport	Towards preventing oil pollution at sea
1935	Seashore Act (No. 21 of 1935) Amended 1993	DEA	The Sea-shore Act provides that ownership of the sea-shore (which includes the water and land between the low-water mark and the high-water mark in those estuaries that fall within the definition of "tidal lagoons" and/or "tidal rivers") and the sea, vests in the State President insofar as it was not privately owned before the commencement of the Act (which occurred on 10 April 1935). All of the provisions of the Act have been assigned to the four coastal provinces under section 235(8) of the Constitution, except in so far as the Act regulates the sea-shore and the sea within ports or harbours (Proclamation R27/16346/6 dated 7 April 1995) (Smith & Cullinan, 2000). This Act is to be replaced by the National Environmental Management: Integrated Coastal Management Act (when promulgated – the latter draft legislation remains in the form of a Parliamentary Bill at the date of this report).

Table B.4 Selection of relevant provincial legislation

RESPONSIBLE DEPARTMENT	LEGISLATION
Western Cape Provincial Department of Environment Affairs and Development Planning (DEADP)	Cape Nature Conservation Board Act (No. 15 of 1998). This Act allowed for the establishment of the Cape Nature conservation Board (or Cape Nature). The objective of the Board is to: (a) promote and ensure nature conservation and related matters in the Province; (b) render services and provide facilities for research and training in connection with nature conservation and related matters in the Province, and (c) in pursuing the objects set out in paragraphs (a) and (b), to generate income, within the framework of any applicable policy determined by the responsible Minister or the Provincial Cabinet (www.wcpp.gov.za/Documents/act.asp).
Cape Nature and Department of Economic Affairs, Environment and Tourism (DEAET)	Cape Nature and Environmental Conservation Ordinance (No. 19 of 1974, as amended in 1999). Although this Ordinance applies principally to terrestrial land, by analogy it can be extended to estuaries because it refers to inland waters (which in turn include tidal rivers or estuaries) (www.wcpp.gov.za/Documents/act.asp).
DEAET	Ciskei Nature Conservation Act (No. 10 of 1987). There is presently no Eastern Cape conservation ordinance. The old Cape Ordinance (see above), the Ciskei Nature Conservation Act, and the Transkei Environmental Conservation Decree (see below) remain in force in their original areas of jurisdiction
DEAET	Transkei Environmental Conservation Decree 9 of 1992. There is presently no Eastern Cape Province conservation ordinance. The old Cape Ordinance (see above), the Ciskei Nature Conservation Act (see above, and the Transkei Environmental Conservation Decree remain in force in their original areas of jurisdiction
DEAET	Eastern Cape Environmental Conservation Bill (2002) The Eastern Cape Environmental Conservation Bill aims to provide for the consolidation of the laws relating to environmental conservation and the control of problem wild animals applicable in the Province, such as the Sea-shore Act (1935), Mountain Catchment Areas Act (1970), Environmental Conservation Act (1989) and the National Environmental Management Act (NEMA, 1998); Provide for coastal management and regulation of air quality and waste management in the Province (www.ecprov.gov.za/contentcategory.asp?id=20&menuid=182&mainmenuid=180).
DEAET	Protected Areas Bill (Eastern Cape) (2002). The Protected Areas Bill aims to provide for: Declaration of Provincial protected areas; Establishment of provincial Parks Board and the appointment of members thereof; and Protection of wildlife in the Province (www.ecprov.gov.za/contentcategory.asp?id=20&menuid=182&mainmenuid=180).
EKZN Wildlife	KZN Nature Conservation Management Act (1997). The KZN Nature Conservation Board is established in terms of this Act and has as its primary functions the management of nature conservation, not only within KZN, but also within protected areas in the Province. The KZN Nature Conservation Service (EKZN Wildlife) is likewise established in terms of the Act and essentially carries out the day to day operation of nature conservation in KZN and as such is accountable to the Board.

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Table B.4 continued

RESPONSIBLE DEPARTMENT	LEGISLATION
DEADP	Western Cape Planning and Development Act (No. 7 of 1999). Provides guidelines for the future spatial development in the Western Cape Province in such a way as will most effectively promote the orderly development of the area as well as the general welfare of the community concerned (www.wcpp.gov.za/Documents/act.asp).
Provincial Departments of Local Government and Housing	Land Use Planning Ordinance, 1985 (Ordinance 15 of 1985, as amended in 2004). This ordinance provides for decision making regarding land use and planning issues, including applications for rezoning, sub-division and the amendment of relevant structure and/or spatial plans promulgated in terms of this ordinance. Most planning applications received by municipalities and/or the provincial planning and environmental department are in terms of this Ordinance and include applications for departure, rezoning or subdivision, and appeals against planning decisions taken by a municipality. (www.wcpp.gov.za/Documents/act.asp)

APPENDIX C: PUBLISHED ARTICLE ON: AN ECOSYSTEM-BASED APPROACH TO MARINE WATER QUALITY MANAGEMENT

A structured ecosystem-scale approach to marine water quality management

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Abstract

Activities and developments in the coastal zone, and in adjacent catchments, pose an increasing threat to the sustainability of the natural and socio-economic goods and services supplied by marine ecosystems. Governing authorities have had to develop new policies to promote environmentally responsible and sustainable development practices, either through legislation and/or incentive mechanisms. These, in turn, created the need for holistic and integrated frameworks within which to design and implement environmental management programmes.

A structured ecosystem-scale approach for the design and implementation of marine water quality management programmes developed by the CSIR (South Africa) in response to recent advances in policies and legislation pertaining to sustainable utilisation of Southern Africa's marine environment is discussed. The framework provides an integrated scientific base within which to set, for example, wastewater emission targets, taking into account ecosystem process complexity. It also aims to support and stimulate local stakeholder empowerment and involvement.

Keywords: marine water quality, integrated management, ecosystem scale

Introduction

Agriculture, industrial and residential developments in the coastal zone and in adjacent catchments pose an increasing threat to the sustainability of the natural and socio-economic goods and services supplied by marine ecosystems, even where such developments may create other socio-economic benefits.

Historically marine water quality was managed on an individual or case-by-case basis, which did not necessarily take into account possible cumulative or synergistic effects as a result of multiple activities or developments within a specific area. To account for cumulative or synergistic effects, a more holistic approach was required – rather focusing on the ecosystem than on individual activities or developments. Recent developments in numerical modelling, in particular its ability to integrate over different spatial and temporal scales, have permitted the devel- opment of such ecosystem-scale approaches.

In order to manage potential conflict, governing authorities had to develop new policies to promote sustainable development practices, either through legislation and/or incentive mechanisms. These, in turn, also created the need for holistic and integrated frameworks within which to design and implement environmental management programmes.

Internationally, different approaches to marine water quality management have been proposed. For example, in 1990 the Water Research Centre (United Kingdom) prepared a guide, particularly aimed at providing guidance in the design, operation and maintenance of environmentally acceptable marine outfall schemes for sewage (WRc, 1990). One of the principle objectives of this guide was to 'provide a common framework for both engineers and scientists to take account of the inter-relationship between the environment and engineering aspects of marine treatment'. The framework addressed issues such as:

- Legal framework
- Environmental quality issues
- Planning of data collection studies
- Aspects of the engineering design and construction of marine outfall schemes
- Operation and maintenance (including monitoring).

In this context the United Nations Environmental Programme (UNEP) also prepared *Guidelines on Municipal Wastewater Management* (UNEP, 2002), providing practical guidance for implementing the *Global Programme of Action for the Protection of the Marine Environment from Land-based Activities* (GPA) on sewage. The need for '…a comprehensive, integrated and stepwise approach to urban wastewater management to improve human health and maintain environmental integrity…' is explicitly stated with a strong emphasis on strategies for ensuring effective institutional arrangements and social participation.

As part of the series on *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* Environment Australia provided a management framework particularly aimed at the effective application of water quality guidelines in the arena of marine water quality management (ANZECC, 2000a). The framework recognises, amongst others, the need to:

- Define primary management aims, including environmental values
- Determine appropriate water and sediment quality guidelines
- Establish monitoring and assessment programmes, focused on water quality objectives

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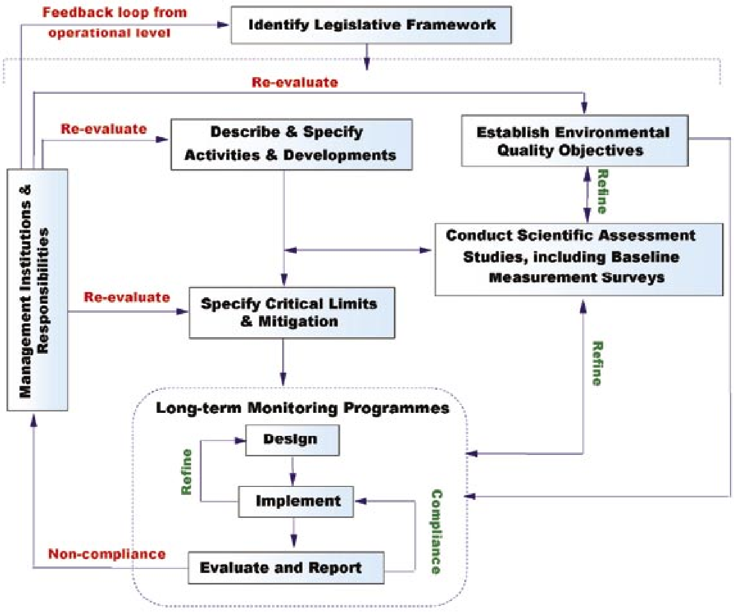

Figure 1
A framework for the design and implementation of marine water quality management programmes

- Initiate appropriate management responses, based on maintaining water quality objectives.

In South Africa, policies and legislation pertaining to the protection of the country's natural resources, including the marine environment, have improved markedly over the past 10 years. Although recognising the need for development, legislation such as the National Water Policy (April 1997), the Environ- mental Management Policy (July 1997), the Policy on Integrated Pollution and Waste Management for South Africa (March 2000), the Policy on Sustainable Coastal Development in South Africa (April 2000), the National Water Act (Act 36 of 1998), the National Environmental Management Act (Act 107 of 1998) and the Marine Living Resources Act (Act 18 of 1998), now requires that such development occur in an environmentally responsible and sustainable manner. With particular reference to the marine water quality, the Policy on Sustainable Coastal Development in South Africa has the following as two of its goals:

- To implement pollution control and waste management measures in order to prevent, minimise and strictly control harmful discharges into coastal ecosystems
- To manage polluting activities to ensure that they have minimal adverse impact on the health of coastal communities, and on coastal ecosystems and their ability to support benef cial human uses.

In response to these new legislative requirements, and taking into account international trends and advances in ecosystem- scale complexity and processes and science and technology (e.g. the application of numerical models), the CSIR (South Africa) developed a generic framework within which to design and implement marine water quality management programmes. The framework had to ensure that marine water quality-related issues were addressed in a holistic, structured and cost-effective manner, through focused procedures and clear identif cation of data and information requirements. A holistic, integrated frame- work for the design and implementation of marine water quality management programmes developed by the CSIR in response to recent advances in policies and legislation pertaining to the sustainable utilisation of South Africa's marine environment is discussed here. The framework provides an integrated scientif c base within which to set, for example wastewater emission targets (WET), taking into account ecosystem process complexity.

Although the participatory approach was not widely used in the management of marine water quality in the past, processes such as Integrated Environmental Management and Environmental Impact Assessment have called for much wider stakeholder engagement in environmental management. The framework therefore also aims to support and stimulate local stakeholder empowerment and involvement.

A similar framework was put forward by the CSIR in 1995, mainly to facilitate the effective management and control of marine outfalls along the South African coast (Taljaard and Botes, 1995). However, as a result of advances in marine water quality science and technology this framework has had to be ref ned.

Framework for Marine Water Quality Management Programme

Based on a review of international practices and the authors' own experience in the South African context, it was decided that key components to be included in marine water quality management programmes comprise:

- Identif cation of the legislative framework
- Establishment of management institutions and responsibilities
- Determination of environmental quality objectives
- Specif cation of activities/developments affecting marine water quality
- Scientif c assessments
- Design and implementation of monitoring programmes.

A schematic illustration of the linkages between these components is provided in Fig. 1. Each of the components is discussed in more detail in the following section.

Legislative framework

A marine water quality management programme needs to be designed and implemented within the statutory framework governing marine water quality and related issues in a particular country while taking into account international treaties and

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legislation. Although legislation is likely to differ from one country to another, key international programmes, treaties and conventions that may have to be taken into account, include:

- **Agenda 21:** The internationally accepted strategy for sustainable development adopted at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. Agenda 21 is a plan for use by governments, local authorities and individuals to implement the principle of sustainable development contained in the Rio Declaration. This document has signif cant status as a consensus document adopted by about 180 countries. Agenda 21 is, however, not legally binding on states, and merely acts as a guideline for implementation (www.un.org/esa/sustdev/agenda21text.htm).
- **World Summit on Sustainable Development (WSSD)** (generally known as the Johannesburg Summit) **(2002):** Formulated two new principles which are central to the philosophy of managing marine water quality at the systems scale (www.gpa.unep.org/news/gpanew.htm):
  - The call for a move away from the management of individual resources towards an ecosystem-based management of coastal systems
  - Setting of wastewater emission targets (WET) which limit the upper boundary of land-based discharge f uxes into coastal systems to a level in which ecosystem impacts are not measurable.
- **United Nations Environmental Programme (UNEP)** which was initiated in 1972 and contains several programmes pertaining to marine pollution, e.g. the Ocean and Coastal Areas Programmes and the Regional Sea Programmes (www.unep.org/).
- **Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA)**: Adopted in November 1995, designed to assist states in tak- ing action individually or jointly within their respective poli- cies, priorities and resources that will lead to the prevention, reduction, control or elimination of the degradation of the marine environment, as well as to its recovery from the impacts of land-based activities. The GPA builds on the prin- ciples of Agenda 21. The Regional Seas Programme of UNEP has been identif ed as an appropriate framework for the deliv- ery of the GPA at the regional level (www.gpa.unep.org/).
- **London Convention for the Prevention of Marine Pollution by Dumping of Wastes and other Matter (1972, amended 1978, 1980, 1989):** In November 1996 the con- tracting parties to the London Convention of 1972 adopted the 1996 Protocol, which, when entered into force, replaces the London Convention (www.londonconvention.org/Lon- don_Convention.htm).
- **International Convention for the Prevention of Pollution from Ships (MARPOL convention)** (1973/1978) is the main international convention covering prevention of pollution of the marine environment by ships as a result of operational or accidental causes and includes regulations aimed at preventing and minimizing pollution from ships (www.imo.org/home.asp).
- **United Nations Convention on the Law of the Sea (UNCLOS) (1982),** which lays down the fundamental obligation of all States to protect and preserve the marine environ- ment. Further, it urges all States to cooperate on a global and regional basis in formulating rules and standards and otherwise take measures for the same purpose. It addresses six main sources of ocean pollution: land-based and coastal activities, continental-shelf drilling, potential seabed mining, ocean dumping, vessel-source pollution and pollution from or through the atmosphere (www.un.org/Depts/los/index.htm).
- **United Nations Convention on Biological diversity (1992)** which came into force in December 1993, has three main objectives, namely the conservation of biological diversity; the sustainable use of biological resources; and the fair and equitable sharing of benef ts arising from the use of genetic resources (www.biodiv.org).

Effective legislation (together with practical operational policies and protocols) is a key requirement for the successful management of marine water quality. A sound legislative framework, for example, empowers responsible authorities to legally challenge offenders, provided that such legislation is supported by suff cient resources (both human and f nancial).

Management institutions and responsibilities

A key driving factor in the successful implementation of any management programme is the establishment of the appropriate management institutions as well as identifying their roles and responsibilities. Typically, the legislative framework within a particular country should provide specif cations and guidance in this regard.

Traditionally the responsibility for the management and control of marine water quality issues resided with the responsible government authorities as well as the potential impactors (e.g. municipalities, industry and developers). Although these traditional management structures are still important, the value of also involving other local interested and affected parties, through stakeholder forums or local management institutions, has proved to be of great value to the overall management process (Henocque, 2001; Van Wyk, 2001; Taljaard and Monteiro, 2002; Cape Metropolitan Coastal Water Quality Committee, 2003). Not only do these local management institutions provide an ideal means by which interested and affected parties can be consulted on designated uses and environmental quality objectives for a specif c area, they also fulf l the important role of local watchdogs or custodians. Although such institutions usually do not have executive powers they have been shown to be very successful mechanisms that can be used to pressurise responsible authorities to respond appropriately, for example, in instances of non-compliance.

Key to the success of local management institutions is a sound and easily accessible scientif c information base, to empower local stakeholders to participate in the decision making process. It is also essential that local management institutions include all relevant interested and affected parties in order to facilitate a participatory approach in decision-making. These should include representatives from:

- National and regional government departments
- Nature conservation authorities
- Local authorities
- Industries
- Tourism boards and recreation clubs
- Local residents, e.g. through ratepayers associations
- Non-government organisations.

It is usually extremely diff cult and f nancially uneconomical to manage marine environmental issues in isolation because of potential cumulative or synergistic effects on the receiving environment. Such collaboration is best facilitated and achieved through a joint local management institution. A local management institution being actively involved in the management of marine water quality matters at local level is also ideally positioned to test the effectiveness and applicability of legislation and policies, which are normally developed at state or provincial levels. It is also important, therefore, that these institutions be utilised by higher tiers of government as a mechanism for improving legislation related to the management of marine water quality, supporting the principle of adaptive management.

The Saldanha Bay Water Quality Forum Trust (SBWQFT) is an example of an existing local management institution that functions very well (Van Wyk, 2001). The forum was established in June 1996 through the efforts of individuals with an interest in Saldanha Bay (South Africa) who created an awareness of the need to address the deteriorating water quality in the Bay. The SBWQFT is a voluntary organization comprising officials from local (municipality, Nature conservation), regional (regional office of the Department of Water Affairs and For- estry) and national authorities (Department of Environmental Affairs and Tourism), representatives from all major industries in the area (e.g. National Ports Authority, seafood-processing industries, marine aquaculture farmers) and other groups who have a common interest in the area (e.g. tourism).

Environmental quality objectives

The ultimate goal in marine water quality management is to keep the marine environment fit for all designated uses. To achieve this goal, the quality objectives set for a particular marine environment should be aimed at protecting important marine ecosystems as well as the designated uses of the marine environment (also referred to as beneficial uses). Environmental quality objectives must be set as part of the management framework to provide a basis from which to assess and evaluate management strategies and actions.

The setting of objectives may be achieved through a four-step approach:

- Define the geographical boundaries of the study area
- Define important aquatic ecosystems and designated uses within the specified area
- Define management goals for important aquatic ecosystems and designated use areas
- Determine site-specific (measurable) environmental quality objectives, pertaining to sediment and water quality requirements.

A very important initial step in setting environmental quality objectives is to determine the **geographical boundaries** of the area within which the management framework is to be implemented. The anticipated influence of all major human activities and developments, both in the near and far field, must be taken into account, including the location of and inputs from different waste sources to the marine environment. Important issues that need to addressed, include:

- Proximity of depositional areas where pollutants introduced from one or more pollution source can accumulate – these can be at distant locations for specific sources, particularly where the source discharges into a very dynamic environment but subsequently is transported to an area of lower turbulence.
- Possible synergistic effects in which the negative impacts resulting from a particular source could be aggravated through interaction with pollutants introduced by other waste sources in the area, or even through interaction with natural processes.

The ultimate goal in the management of marine waters is to keep the environment suitable for all designated uses – both for existing and future uses (this includes the 'use' of designated areas for biodiversity protection and ecosystem functioning). The second step, therefore, is to identify and map **important aquatic ecosystems and designated uses** within the study area.

In the case of South Africa, beneficial uses of the coastal marine waters are subdivided into three categories (RSA DWAF, 1995), namely:

- Mariculture use (including collection of seafood for human consumption)
- Recreational use
- Industrial uses (e.g. intake of cooling water and water for fish processing and/or mariculture).

Both existing usage and proposed usage (as captured in strategic and future development plans) should be considered and these should be agreed upon in consultation with local interested and affected parties through the local management institutions.

The identification and mapping of important marine ecosystems and designated uses of the marine environment within a study area provide a good basis for the derivation of site-specific environmental quality objectives. The example of Saldanha Bay is presented in Fig. 2 (adapted from Taljaard and Monteiro, 2002).

Once important marine ecosystems and designated uses have been identified, broad management goals should be defined for each of the above uses. In the case of the protection of the aquatic marine ecosystem, these can be quantified in terms of the level of species diversity that needs to be maintained, while in the case of recreational or marine aquaculture areas, the management goal could be to achieve a certain rating or classification.

Agreement on the designated uses and management goals of a particular area should be obtained in consultation with local interested and affected parties (or stakeholders) through, for example, the local management institutions. Once agreement has been obtained on important aquatic ecosystems and designated uses, their location, as well as the management goals for each particular area (**site-specific environmental quality objectives**) pertaining to water quality requirements, needs to be established – the rationale being that although management goals are the real management end-points, the goals will only be achieved if certain measurable quality targets are maintained (Ward and Jacoby, 1992).

In order that environmental quality objectives are practical and effective management tools, they need to be set in terms of measurable target values or ranges for specific water column and sediment parameters or in terms of the abundance and diversity of biotic components. Environmental quality objectives can be derived from:

- National and international legal requirements (e.g. specification of constituent limits in sediments for dredging purposes under the London Convention)
- Recommended target values for a particular country (such guideline documents include those from South Africa (RSA DWAF, 1995), Australia and New Zealand (ANZECC, 2000a), Canada (Environment Canada, 2002) and the United States (US-EPA, 2002)
- Other scientific data and information sources (e.g. results from bioassay research studies).

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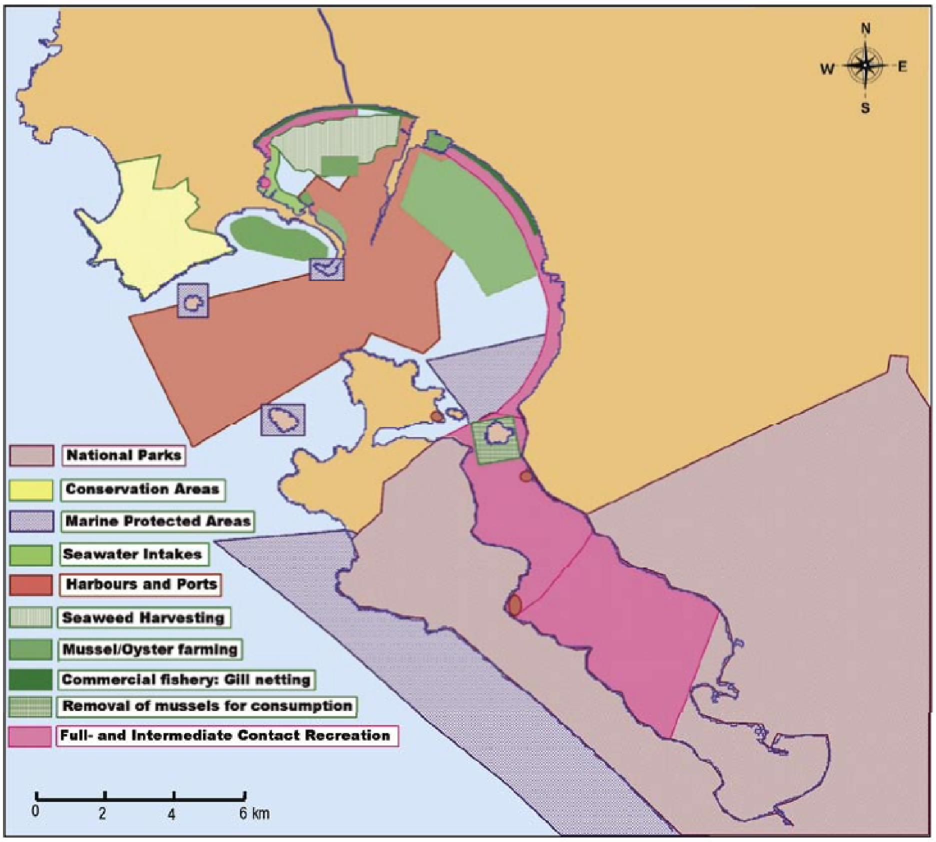

Figure 2
The location of important marine ecosystems and beneficial use areas in Saldanha Bay, South Africa (adapted from Taljaard and Monteiro, 2002)

Developments/activities affecting marine water quality

Effective management of marine pollution in a particular area requires quantitative data on waste inputs, as well as on other activities or developments that directly (or indirectly) affect marine water quality. Although anthropogenic perturbations of marine water quality are usually perceived to be the result of marine pollution sources, it is important to realise that developments that modify circulation dynamics in the marine environment, such as harbour and marina structures, can also modify these quality characteristics.

Sources of waste entering the marine environment can be categorised broadly into the following groups of activities, which either occur at sea or on land:

- Waste originating from land-based sources, including sewage eff uent discharges, industrial eff uent discharges, storm water run-off, agricultural and mining return f ows, contaminated ground water seepage
- Waste entering the marine environment through the atmosphere, e.g. originating from vehicle exhaust fumes and industries
- Maritime transportation (which includes accidental and purposive oil spills and dumping of ship garbage)
- Dumping at sea (e.g. dredge spoil)
- Offshore exploration and production (e.g. oil exploration platforms).

To ensure that possible cumulative and synergistic effects are taken into account during the scientif c assessment studies, it is important that both existing and proposed developments and activities in the study area that may potentially affect the quality of the receiving marine environment be mapped. The example of Saldanha Bay is shown in Fig. 3 (adapted from Taljaard and Monteiro, 2002). In the case of waste inputs, waste loads (both in terms of volume and constituent concentrations) need to be described and quantif ed.

Scientific assessment studies

Scientif c assessment studies are required to determine whether the marine environment is able to support important ecosystems and designated benef cial uses (as def ned in terms of the environmental quality objectives) in addition to being subject to waste inputs and other modif cations associated with activities and developments in the study area. These assessments take into account process complexity and natural variability that require the understanding of, and information on, physical, biogeochemical and biological characteristics and processes.

The level of detail required for scientif c assessment studies largely depends on the type of investigation. For example, a preliminary assessment (or 'fatal f aw analysis') is typically conducted as a desktop assessment using available data and information and expert judgement, while a detailed investigation may require extensive f eld data collection programmes and sophisticated modelling tools. In this respect, numerical modelling techniques have proven to be powerful tools (Monteiro, 1999) in that:

- Models provide a workable platform for incorporating the complexity of spatial and temporal variability in the marine environment
- Model assumptions and inputs provide a means of synthesising an understanding of the key processes and stimulating stakeholder discussion on their relevance to the objectives
- Modelling assists in def ning the most critical spatial and time scales of potential negative impacts in the receiving system

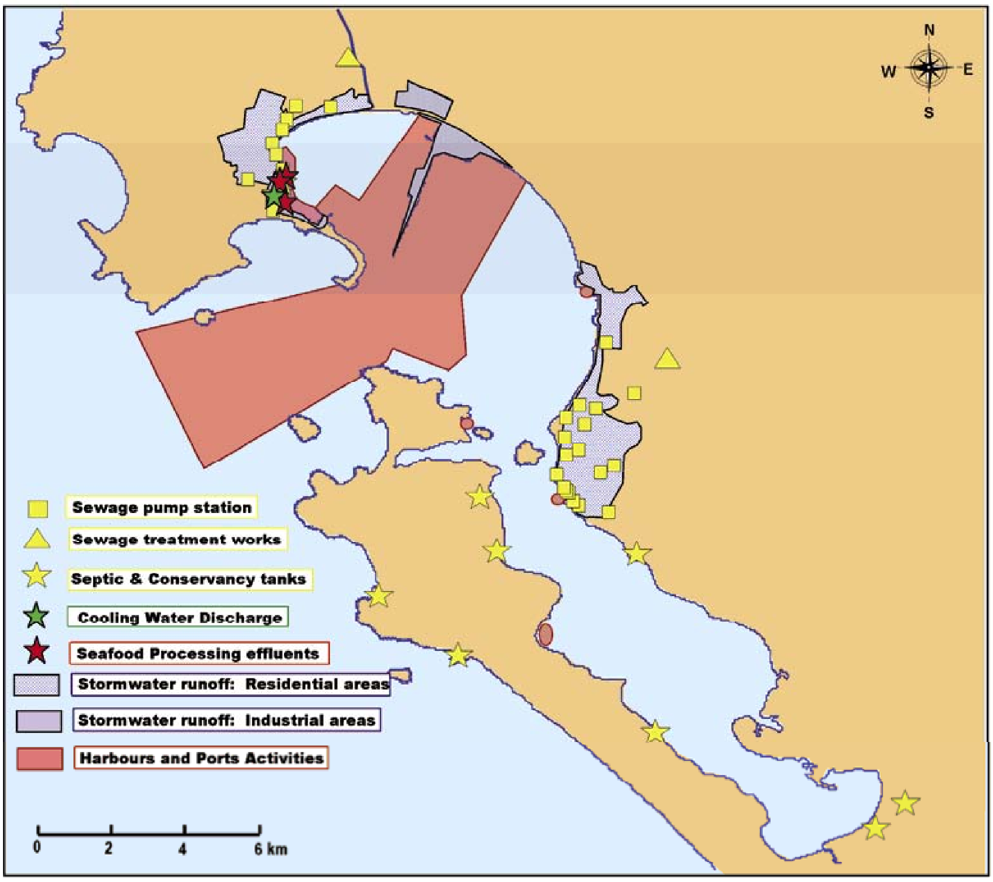

Figure 3
Location of activities and developments potentially affecting marine water quality in Saldanha Bay, South Africa (adapted from Taljaard and Monteiro, 2002)

- Model outputs provide quantitative results which can be used, together with f eld data, to check the quality of assumptions and insights.

The aim of using numerical modelling is to assess, through sensitivity analyses, the consequences of uncertainty in relation to system variability, key processes and most importantly, how these inf uence the transport and fate of contaminants. This reduced uncertainty provides greater conf dence in the reliabil- ity of the predicted outcomes and is used to focus the investment in monitoring to critical parameters at critical time and spatial scales. Quality data on the volumes (in particular f ow rates) and contaminant composition are crucial inputs to numerical modelling studies.

In the application of numerical modelling techniques, the following criteria must be met:

- The model must be appropriate to the situation in which it is utilised
- The model must be calibrated and validated against a full f eld data set adequately describing the site-specif c physical and biogeochemical oceanographic conditions (‘ground truthing’)
- A sensitivity analysis must be conducted to demonstrate the effect of the uncertainties of key parameters based on the variation in input data and controlling assumptions
- The reporting of model outputs must include a clear description of assumptions, a summary of numerical outputs, and conf dence limits and sensitivity analyses.

Key outcomes of the scientif c assessment component include:

- Ref nement of environmental quality objectives based on an improved understanding of site-specif c physical, biogeochemical and biological characteristics, processes and scale complexity
- Recommendations on critical limits for activities and developments so as to ensure compliance with environmental quality objectives (e.g. wastewater emission targets [WET])
- Recommendations on modif cations to the structural design of developments (e.g. to mitigate modif cation in circulation patterns) so as to ensure compliance with environmental quality objectives, if and where achievable
- Recommendations on mitigating actions (and/or contingency plans) to be implemented during the construction and/or operations of specif c developments and activities to minimise any risks to marine water and sediment quality.

Specification of critical limits and mitigating actions

The outcomes of the scientif c assessment studies are typically presented to the responsible management authorities and institutions for f nal decision making to provide conf rmation on specif cations regarding:

- Critical limits for developments and activities (critical limits on waste volumes and composition are typically written into licence agreements for waste disposal practices)
- Modif cations to the structural design of the development where relevant
- Mitigating actions to be implemented during the construction and/or operation of relevant developments and activities.

Based on the outcome of the scientif c assessment studies it may be necessary to negotiate ‘trade-offs’ in terms of environmental quality vs. allowing activities and developments with large

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socio-economic benefts to proceed, provided that all reasonable attempts have been taken to mitigate or minimise environmental impacts. In order to facilitate a participatory approach in decision-making, governing authorities need to take decisions on such matters in consultation with local stakeholders, e.g. through local management institutions.

Long-term monitoring programmes

Long-term monitoring forms an integral part of any management programme. In this context, it is important to note the difference between baseline measurement programmes (or sur- veys) and monitoring:

- Baseline measurement programmes refer to shorter-term or once-off, intensive investigation of a wide range of parameters to obtain a better understanding of environmental processes (e.g. as part of the **Scientific Assessment** component). The role of baseline measurement programmes is also to identify the key scales of spatial and temporal variability that need to be part of a model set-up or tested as part of the sensitivity analysis phase.
- Long-term monitoring refers to ongoing data collection programmes which are designed and implemented so as to continuously evaluate the:
  - Effectiveness of management strategies and actions in achieving compliance with critical limits and the implementation of mitigating actions, e.g. compliance with the limits on volume and composition of the wastewater discharges (i.e. source or compliance monitoring)
  - Trends and status of changes in the environment in terms of the health of important ecosystem components and designated benefcial uses in order to respond, where appropriate, in good time to potentially negative impacts, including cumulative effects
  - Whether the predicted environmental responses, identifed during the assessment process, match the actual responses
  - Whether the initial assumptions remain valid such as for example the boundary conditions and waste loads.

It is also important to remember that any long-term monitoring programme is a dynamic, iterative process that needs to be adjusted continuously to incorporate new knowledge, thereby supporting the principle of adaptive management.

Key elements of a successful long-term monitoring programme include (UNESCO/WHO/UNEP, 1992; ANZECC, 2000b; NZWERF, 2002; US-EPA, 2003):

- **Site-specific monitoring objectives**, distilled from the environmental quality objectives and critical limits previously specifed.
- **Focused and cost-effective programme design**, based on an understanding of the physical, biogeochemical and biological processes, also taking into account anthropogenic modifcations to such processes. Aspects to be addressed include:
  - *Measurement parameters* (or indicator species), depending on factors such as the characteristics of waste inputs and the sensitivity of indicator species to respond to the site-specifc anthropogenic interferences
  - *Selection of sampling locations*, depending on factors such as the predicted temporal scale of infuence, both in the near and far feld, as well as scales of greatest sensitivity in respect of the anthropogenic interferences and ecosystem responses
  - *Sampling frequency,* depending on factors such as variability in volume and composition of waste inputs, the variability in processes driving transport and fate in the receiving environment and the temporal sensitivity of the ecosystem to contaminant loading, i.e. exposure time vs. detrimental impact
  - *Sampling and analytical techniques*, depending on the selection of measurement parameters and the output that is required to evaluate properly whether monitoring objectives are complied with.

  Numerical modelling has proven to be very useful in enhancing the design of monitoring programmes and improving the interpretation of monitoring results (Monteiro, 1999). Such numerical models provide the process links that enhance the ability to diagnose problem areas as well as to anticipate problems through their predictive capacity. The benefts of numerical modelling in the design of long-term monitoring programmes include:
  - Defnition of the most critical space- and time-scales of impact in the system in that important insights are provided by the combination of the existing understanding of key processes and the model assumptions and inputs
  - Improve interpretation and understanding of the monitoring results in the context of a dynamic environment that determines the transport and fate of pollutants.

  The aim, therefore, is to use the capability of numerical models to reduce uncertainties in relation to system variability, key processes and how these infuence the transport and fate of contaminants. Traditionally, monitoring programmes to evaluate ecosystem health included intensive sampling grids to overcome the inherent uncertainties of the spatial (and temporal) variability of the system. However, with the use of numerical modelling, many of the inherent problems of the traditional approach can be overcome in that these models assist in defning the most critical space- and time-scales at which monitoring will need to be done in order to obtain the desired output.
- **Data evaluation and reporting**, where monitoring results need to be presented in a clear format, providing the appointed management institution(s) with the scientifc information necessary for effective decision making (i.e. facilitating effective adaptive management).

  Non-compliance will require management response, which may include:
  - A request to responsible parties to re-evaluate critical limits and mitigation actions, environmental quality objectives and/or the operations of related activities and developments, taking into account the latest understanding of related issues (i.e. following the principle of adaptive management).
  - Prosecution, in instances where a facility fails to comply with critical limits and mitigation actions to minimise risks to marine water quality (e.g. where these were set as legal requirements as part of a licence agreement or permit).

Conclusions

The management framework presented here has already been successfully applied in several areas. For example, it has been used as a framework for the development of management programmes in heavily utilised urban bay areas such as False Bay and Saldanha Bay, South Africa (Taljaard and Monteiro, 2002;

Taljaard et al., 2000; Monteiro and Kemp, 2004).

It also proved to be a sound basis from which to develop management and long-term monitoring programmes for marine outfalls (Monteiro, 1999). As a result, the framework has recently been incorporated into South Africa's operational policy for the disposal of land-derived wastewater to the marine environment (RSA DWAF, 2004).

The management framework has also been recommended as the preferred approach and method for the management of marine water quality in the broader Southern African context (Taljaard, 2006) through a project undertaken as part of the Benguela Current Large Marine Ecosystem (BCLME) Pro- gramme (www.bclme.org). The BCLME region includes the countries of Angola, Namibia and South Africa and the manage- ment framework has been well received by key stakeholders in the region, even though it has not as yet been off cially incorpo- rated in the national policies and legislation of all the countries.

As is the case with any process, the structured ecosystem-scale approach for the management of marine water quality discussed in this paper is by no means 'caste in stone'. It should be adjusted continuously to incorporate site-specif c requirements, as well as new scientif c knowledge and technologies, thereby supporting the principle of adaptive management.

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References

AUSTRALIA AND NEW ZEALAND ENVIRONMENT AND CONSERVATION COUNCIL (ANZECC) (2000a) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. National Water Quality Management Strategy No 4. Canberra, Australia. ISBN 0 642 19562 5.

AUSTRALIA AND NEW ZEALAND ENVIRONMENT AND CONSERVATION COUNCIL (ANZECC) (2000b) Australian Guidelines for Water Quality Monitoring and Reporting. National Water Quality Management Strategy No 7. Canberra, Australia. ISBN
0 642 19562 5.

CAPE METROPOLITAN COASTAL WATER QUALITY COMMITTEE (2003) Annual Report 2003. Report produced by the Committee, a voluntary association of senior off cials from local, provincial and national government and civil society. Catchment Stormwater and River Management, City of Cape Town, South Africa.

HENOCQUE Y (2001) Urban communities and environmental management in France: The example of the Toulon Bay Contract. *Ocean & Coastal Manage.* **44** 371-377.

MONTEIRO PMS (1999) A Modelling-Driven Environmental Baseline Assessment for the Proposed New Hood Point Outfall in East London: Sediment Biogeochemistry Baseline Study. CSIR Report ENV-S-C 99109C. CSIR, Stellenbosch, South Africa.

MONTEIRO PMS and KEMP A (2004) Water Quality Management Plan for Saldanha Bay. Phase III: Setting of Critical Loads Using a Modelling-Based Ecosystem Approach. CSIR Report ENV-C-S 2004-083. CSIR, Stellenbosch, South Africa.

NEW ZEALAND WATER ENVIRONMENT RESEARCH FOUN- DATION (NZWERF) (2002) Ray D (ed.) *New Zealand Municipal Wastewater Monitoring Guidelines*. Published by the New Zealand Water Environment Foundation, Wellington. ISBN 1-877134-40-6.

REPUBLIC OF SOUTH AFRICA DEPARTMENT OF WATER AFFAIRS AND FORESTRY (RSA DWAF) (1995) South African Water Quality Guidelines for Coastal Marine Waters. **Volume 1.** Natural Environment. **Volume 2.** Recreation. **Volume 3.** Industrial Use. **Volume 4.** Mariculture. Pretoria.

REPUBLIC OF SOUTH AFRICA, DEPARTMENT OF WATER AFFAIRS AND FORESTRY (RSA DWAF) (2004) Water Quality Management Series Sub-Series No. MS 13.2. Operational Policy for the Disposal of Land-Derived Water Containing Waste to the Marine Environment of South Africa (1st edn.) Pretoria.

TALJAARD S and BOTES WAM (1995) Marine water quality management in South Africa. *Water Sci. Technol.* **32** (2) 281-288.

TALJAARD S, VAN BALLEGOOYEN RC and MORANT PD (2000) False Bay Water Quality Review. **Volume 2**: Specialist Assess- ments and Inventories of Available Literature and Data. Report to the False Bay Water Quality Advisory Committee. CSIR Report ENV-S-C 2000-086/2. CSIR, Stellenbosch, South Africa.

TALJAARD S and MONTEIRO PMS (2002) Saldanha Bay Marine Water Quality Management Plan. Phase I: Situation Assessment. Report to the Saldanha Bay Water Quality Forum Trust. CSIR Report ENV-S-C 2002-115/1. CSIR, Stellenbosch, South Africa.

TALJAARD S (2006) Baseline Assessment of Sources and Management of Land-Based Pollution in the BCLME Region (Project BEHP/LBMP/03/01) Report submitted to UNOPS as part of the Benguela Current Large Marine Ecosystem Programme. CSIR Report CSIR/NRE/ECO/ER/2006/0010/C. Stellenbosch, South Africa (www.bclme.org). Accessed on 18 Sep 2006.

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION, WORLD HEALTH ORGANISATION & UNITED NATIONS ENVIRONMENTAL PROGRAMME (UNESO/WHO/UNEP) (1992) *Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring* (2ndedn.) An Imprint of Chapman & Hall, London, Glasgow, Weinheim, New York, Tokyo, Melbourne, Madras. ISBN 0-419-21600-6.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US-EPA) (2002) Water Quality Criteria. Off ce of Water, Off ce of Science and Technology (4304T), United States Environmental Protection Agency. EPA-822-R-02-047 (www.epa.gov/waterscience/criteria/). Accessed on 18 Sep 2006.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US-EPA) (2003) Elements of a State Water Monitoring and Assessment Program. Assessment and Watershed Protection Division, Off ce of Wetlands, Oceans and Watershed, United States Envi- ronmental Protection Agency. EPA 841-B-03-003 (www.epa.gov/ owow/monitoring/repguid.html)(Accessed on?)

VAN WYK CF (2001) Die Saldanha Baai Water Gehalte Forum Trust: 'n Instrument vir Beplande Geïntegreerde Monitering en Bestuur van Watergehalte. M.Sc. Thesis, University of Stellenbosch, South Africa.

WATER RESEARCH CENTRE (WRc) (1990) Design Guide for Marine Treatment Schemes. **Volume I**: Introduction, **Volume II**: Environmental Design and Data Collection, **Volume III**: Materials, Construction and Structural Design and **Volume IV**: Operations and Maintenance and Cost Functions. Report No. UM 1009. Swin- don, UK.

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