INVESTIGATING THE FEASIBILITY OF ESTABLISHING A SOUTH AFRICAN MARINE CADASTRE

By

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As the candidate's Supervisor I agree/do not agree to the submission of this dissertation

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DECLARATION 2 - PUBLICATIONS

Title: *"A Seamless Land-Sea Cadastre: A South African perspective"*
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Dedicated to my beloved Mum

(1964-2013)

ABSTRACT

Human interaction with the marine environment is increasing at a rate at which marine management systems cannot keep pace. The land cadastral systems are deemed to be well-established and understood thanks to hundreds of years of development. Meanwhile, as marine technological innovations advance and population density in coastal areas grows, human interaction with the oceans is evolving, making existing systems in place for their management seem out-dated. In South Africa, the declaration of Project Phakisa to unlock the oceans economy, which has been relatively untouched, acknowledges the potential benefits that can be extracted from the sea. A land cadastral system consists of graphically depicted boundaries that have been surveyed, and a register that assigns any rights, restrictions and responsibilities to the area enclosed by such surveyed boundaries. Management of marine property rights is not dissimilar to the land cadastre insofar as there being parallel survey and registry components. Internationally, marine cadastre initiatives are being researched and implemented to update marine management systems while there is recognition for convergence of land and sea based spatial data infrastructures. This study explores the need for the development of a seamless cadastre across the land-sea interface for South Africa by assessing the perceptions of stakeholders that deal in land and/or marine environments. The study investigates access to land versus marine spatial data, legal and technical aspects, components and features of a possible marine cadastre. By adopting a case study strategy using both qualitative and quantitative inquiry approaches, the rendered results presented later in the dissertation have increased reliability resulting from the processes of data triangulation.

The main findings indicate that the spatial and accompanying registration component of the land-based cadastral system is sufficient to form the cornerstone of land administration in SA. The literature review and canvassing of persons related to the geospatial fraternity indicates, via analysis of a questionnaire and interviews, shortcomings in good ocean governance. Although a marine cadastral system is feasible for SA, it is beset with spatial, technical, legislative and institutional issues that need ironing out. The unification of the land and possible marine cadastral systems would enable a single land-sea spatial data infrastructure that would mute the effects of an uncertain land-sea interface.

TABLE OF CONTENTS

CHAPTER ONE

1.0. Introduction

1.1. Background and problem statement

Oceans cover over two-thirds of the Earth's surface and play a pertinent role in regulating weather patterns and sustaining plant and animal life (Binns, 2004). Marine environments are diverse and require effective social, economic and ecological management. The United Nations (UN) (2003) has identified coastal areas as where human population density and maritime economic potential is expected to be the highest in coming years. As such, there is a growing need for countries to investigate how to manage their coastal jurisdictions in an efficient manner.

South Africa (SA) has approximately 3000 km of coastline and has jurisdiction over a large maritime area (Cropley, 2014). Division of this maritime area into coastal zones is set out in the Maritime Zones Act 15 of 1994 (MZA). These zones radiate outwards beginning at baselines at the land-sea interface, are virtual and curvilinear in nature. A baseline is defined in Section 2 of the MZA as either the low water line, the line between two coordinates, or baseline terminal coordinates, listed in Schedule II of the MZA or the outer limits of internal waters. In the MZA, internal waters refer to all water landward of baselines such as harbours, estuaries and others. An example of a baseline would be the two points joining the two most outer land based points on either side of a port to "enclose" the harbour. From these baselines, the coastal zones radiate outward at intervals prescribed in Sections 4 to 8 of the MZA. Since these zones are defined mathematically as a distance from points on land, their outer limits over the ocean are referenced to landward terminal coordinates and are not physically demarcated. These zones overlap in certain instances (see Chapter Two, Figure 2.3) and the reference terminals of baselines may not coincide with the low water line that may be affected by tidal forces, harbour construction works and other changes that may influence low water lines. This causes uncertainty in marine boundaries and the rights, restrictions and responsibilities (RRRs) that stakeholders have regarding their interaction with the sea.

Within these general zones, numerous stakeholder activities occur in an overlapping, and sometimes conflicting manner. SA's land-based cadastral system consists of a regulated profession, is well-supported by legislation, is well-maintained by regulated processes, documents and beacons that physically demarcates the ground in different sizes for different

uses. In comparison, the integrated management of the marine space is lacking. In SA, there are numerous measures for spatial management of marine space. The measures include policy, legislation and adherence to international conventions amongst others. However, such measures lack coordination, are task-specific and therefore leave gaps in integrated marine management.

There is extensive research into marine cadastres in many countries as the need for fully integrated management systems has been identified (Enemark *et al*, 2010). The needs of different countries, their legislation, social development and economic development should factor into the design of an appropriate (fit-for-purpose) marine cadastral system (Enemark *et al*, 2010). No two marine cadastral systems should be the same although in their design, similar principles should be followed.

There is a necessity for the perceptions of various stakeholders to be ascertained as to the need and the feasibility of a marine cadastral system in SA, and whether the existing cadastral system, designed for use on land, can be extended offshore.

1.2. Research Question

Can the existing South African land based cadastral system's framework be adapted to include marine cadastre?

1.3. Aim and Objectives

1.3.1. Study Aim

The aim of this study is to investigate the feasibility of extending the SA land-based cadastre offshore to provide similar property rights administration offshore.

1.3.2. Study Objectives

To achieve the stated aim, a number of objectives were identified and are outlined as:

1. *To investigate South Africa's history of marine property management.*

   This was done by reviewing local and international policies, conventions and legislation pertaining to marine management.

2. *To review the land based cadastral system of South Africa.*

   The land-based cadastral system was evaluated in addition to the relevant policies and the spatial data infrastructure that SA employs. Key areas in the land cadastral framework were identified to incorporate into a future marine cadastre.

3. *To identify stakeholders and their interactions with the offshore property rights*

The literature review assisted in exposing a preliminary list of stakeholders while further identification of stakeholders was achieved along with objective four.

4. *To determine the rights, restrictions and responsibilities of identified stakeholders.*

   This was accomplished by using the questionnaire and interviews with stakeholders, and the review of literature and legislation. Their interaction with the offshore property rights were explored to identify factors motivating the need for a South African marine cadastre.

5. *To conduct a comparative analysis of the design of marine cadastres and the design of the current SA cadastral system.*

   This was done by assessing marine cadastral models that were developed for other countries as to which aspects are relevant to SA

1.4. Research significance

The future sustainability of the World's oceans is uncertain in light of intensifying ocean use. Ocean activities are being bundled as a package of rights, restrictions and responsibilities (RRRs) with an associated spatial component that is very similar to long standing land cadastral systems (Binns, 2004; Binns *et al*, 2004; Collier *et al*, 2001; Ng'ang'a *et al*, 2004; and Nichols and Monahan, 1999). Many countries have identified ocean management as a priority for sustainable development and improved management approaches are being researched for implementation (Abdulla *et al*, 2014; Binns *et al*, 2004; Boateng, 2006; Chong, 2006; Fowler and Treml, 2001; Hoogsteden, 2001; Ng'ang'a, 2004 and Nichols *et al*; 2000). Consequently, these authors position marine cadastre as a viable tool for improving ocean management. However, many spatial data, technical, institutional and legislative challenges are present.

Although there are generic definitions for marine cadastre offered by several researchers like Binns *et al* (2004), Fowler and Treml (2001), Ng'ang'a (2004), Nichols *et al* (2000) amongst others, each country must take consideration of its own unique circumstances in developing country specific solutions to address shortcomings in ocean management. This study addresses land and marine cadastres, and makes recommendations that will hopefully lead to improvement of marine management.

1.5. Thesis structure

In order to achieve the stated aim and objectives and ensure a response to the stated research question above, a structured and rational progression is required. Stated below are brief chapter summaries that highlight the thesis structure.

Chapter One: Introduction

A brief background to the research is introduced. The problem to be addressed by the research is explored along with the aim and objectives. The significance of the study is highlighted.

Chapter Two: Literature Review

Related literature is reviewed in this chapter. Human relationships with coasts and oceans, history of SA marine activities and management, status of SA marine surveys, factors for improved ocean management, stakeholder identification, SDI, domestic and international policies are covered. Additionally, definitions for marine cadastre and international initiatives are discussed. Thereafter land cadastre is discussed and a comparison to marine cadastre is presented. The analysis of this information reveals research gaps that reinforce the significance of this study.

Chapter Three: Research Methodology

Research methodologies and those most applicable to the study are discussed. Detailed description of the research strategy and four research stages are given.

Chapter Four: Data Analysis

This chapter is an extension of Chapter Three where statistical theory and processes of data analysis is discussed.

Chapter Five: Results and Discussion of Findings

The results are summarized, evaluated and presented in textual and graphical format. Other relevant literature and secondary data are integrated where appropriate into the discussion.

Chapter Six: Conclusion and Recommendations

The conclusions of the research are presented and recommendations are then drawn from the key findings of the research conducted.

CHAPTER TWO

2.0. Literature Review

2.1. Chapter introduction

This chapter examines literature on the human relationship with the coast and oceans, the history of SA marine management and factors driving the need for improved ocean management. Discussion on spatial data infrastructure (SDI), policies, definitions of a marine cadastre, its investigation internationally and implementation are covered. The role of SDI as a management tool is highlighted with the existing land cadastre, being an SDI in itself, reviewed.

2.2. Human relationship with oceans and coasts

The oceans and coasts have for millennia been a food source for many and later provided a way for travel and exploration. In as early as 3000BC, it is estimated that early civilizations found ways to explore with canoes and boats fitted with oars, which were later wind-powered (Strain, 2006). The use of lighthouses and mountaintop features were the earliest points of reference for spatial guidance for sailors who stayed within sight of the coastlines (Hattendorf, 2007). Global ocean voyages and circumnavigation began between the 15th and 16th centuries. This resulted from improved ship building techniques and the solution of the longitude problem. (May and Holder, 1973). The ability to cross the oceans and cover large distances by sea led to enormous opportunities in trade and industry, colonization and slavery via international waters without imposition of the usual land-based restrictions such as trade taxes and blocks (Strain, 2006).

The colonization of the world naturally led to more ocean trade routes developing and coastal developments around ports. The economic benefit of trade and transportation routes inevitably resulted in conflict from piracy, pollution and conflicting claims of rights over coastal areas by participating countries (Hattendorf, 2007). The First and Second World Wars are associated with large-scale investments in technological development which later introduced new maritime industries causing coastal countries to lay and defend claims to their respective coastal zones due to their newly discovered economic potential (Strain, 2006).

The increased interactions with the marine space of countries initially centred on navigation, transportation, trade, food supply via fishing and resource extraction (precious metals/stones, oil and gas). Succeeding research and subsequent technological innovations led to more

intense ocean use and discovery of new interactions with marine space. These included intensified fishing and resource extraction, shipping, transoceanic communication cables and fibre optic cables for internet connections, roads, railways, tunnels, tourism, waste and ammunition dumps, marine mapping and others (McDonald, 2013; Sink *et al*, 2012; Strain, 2006 and Binns, 2004).

Research by the International Federation of Surveyors (FIG) (2006) indicates intensified use of the ocean will heighten as 6 billion people are envisaged to live within 200km of coastlines by the year 2025. Currently, about half the world's population (3 billion people) live within this band (FIG, 2006). The depletion of terrestrial resources is directly related to increased ocean interactions and the respective myriad of overlapping and conflicting interests (Figure 2.1).

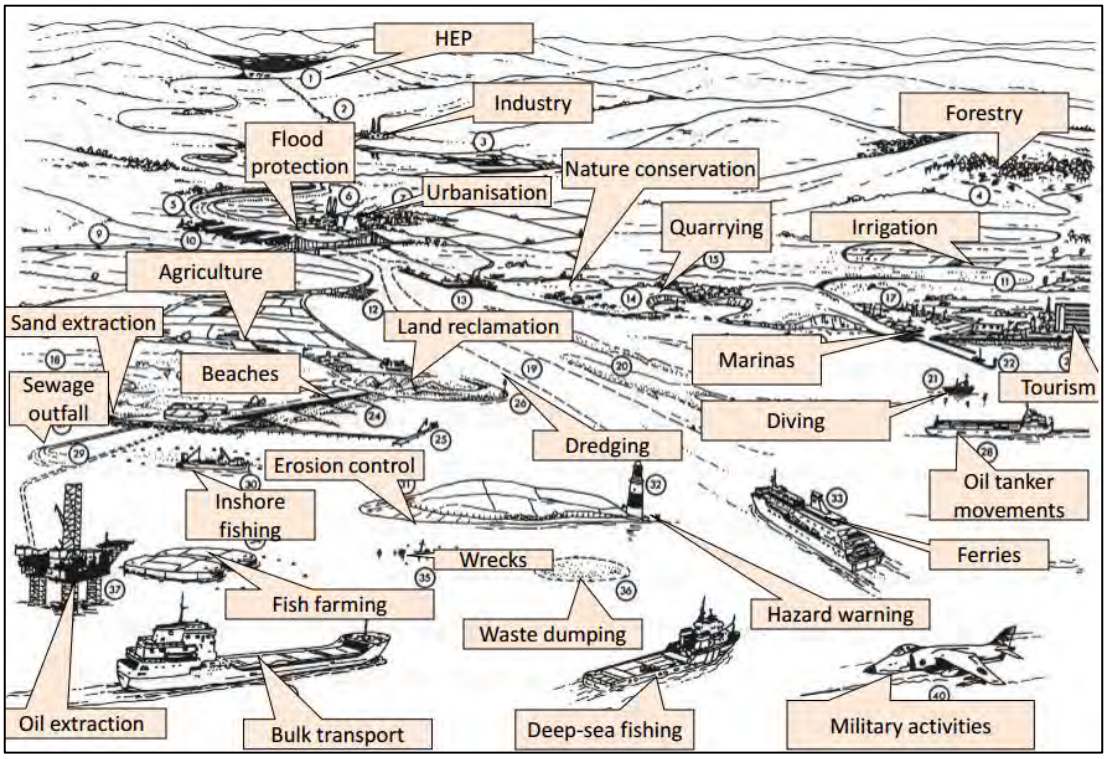


Figure 2.1. Sketch showing a variety of overlapping uses of coastal areas (adapted from Jolliffe and Patman, 1985:3)

The international trend of exponential population growth will accelerate the depletion of renewable and non-renewable resources found both on land and in oceans. All oceans and coastlines across the world are spatially interlinked requiring a design of cohesive and sustainable ocean governance.

2.3. History of South African marine management

SA forms part of an international community of coastal states bound by international policies as well as its own domestic policies. The following sub-sections uncover the history of SA marine property management and the context of this development alongside international development in marine governance.

2.3.1. The League of Nations

The League of Nations (LoN) was a result of the Paris Peace Conference that ended World War 1 and was the first international organization that had, as its mission, the maintenance of world peace (Tomuschat, 1995). The devastation of the War had resulted in 19 million deaths of soldiers and civilians whilst an estimated 21 million were wounded (Bell, 2007). Anti-war sentiment had risen sharply as a result.

Prior to the end of the War, some governments and groups had started developing plans to improve international relations and co-operation to avoid the world slumping into another conflict of such proportions (Archer, 2001). Most notable was the role of Woodrow Wilson (1983:4), the president of the United States of America (USA) who, in part of his message on the "Conditions of Peace" to the Two Houses of the American Congress, stated the following:

> "A general association of nations must be formed under specific covenants for the purpose of affording mutual guarantees of political independence and territorial integrity to great and small states alike."

President Wilson was greatly influenced by South African Prime Minister Jan Smuts who had published a treatise entitled *The League of Nations: A Practical Suggestion* (Crafford, 2005 and Smuts, 1919). At the plenary session of the Paris Peace Conference, approval was given for proposals to create a LoN. An election for a committee to draft a Covenant for all 41 participating countries was held and the draft Covenant was unanimously adopted (Crafford, 2005 and Northedge, 1986). The Secretariat was permanently relocated to Geneva, Switzerland, after initially being stationed in London, England. Article 23 of the Covenant of the LoN as quoted in Kapoor and Kerr (1986:62) states:

> "…subject to and in accordance with the provisions of international conventions existing or hereafter to be agreed upon, the members of the League will make provisions to secure and maintain freedom of

communications and of transit and equitable treatment for the commerce of all members of the League."

A committee of experts from the LoN deemed territorial waters, exploitation of marine originating products, piracy and legal status of transiting State-owned merchant trips as subjects appropriate for regulation by international agreement. (Kapoor and Kerr, 1986 and Tomuschat, 1985).

At The Hague Conference of 1930, the subjects proposed for regulation by international agreement failed on determining the legal status of territorial waters, but a committee constituted by the conference later prepared draft articles on the legal status of the territorial sea and the right of innocent passage (Kapoor and Kerr, 1986). Further progress by the LoN in presenting and prescribing an international agreement to ocean use stalled. This was attributed to failure by the LoN to maintain world peace, viewed as its primary objective, as international hostilities led to the start of World War 2 (Bell, 1975). The LoN lasted for 26 years, and at the end of the war, was replaced by the UN who inherited numerous agencies, organizations and pressing international matters (Osmańczyk, 2003 and Scott, 1974). The law of sea formed a central focus on the International Law Commission after the UN General Assembly was established in 1945 (Kapoor and Kerr, 1986). The report from the law commission formed the basis of the first UN Conference on the Law of the Sea, commonly referred to as UNCLOS I, held in Geneva in 1958 (Miles, 1998).

2.3.2. United Nations Convention on the Law of the Sea

During the period leading up to the collapse of the LoN and the conclusion of World War II in 1945, the evolution of seafaring and other maritime activities, spurred on by technological improvements, led to the USA laying official claim to all resources found adjacent to its coastline to the outer extent of its continental shelf (O'Connel, 1982). Many other countries laid similar claims which was seen as a fundamental shift in the longstanding principle of the Freedom of the Seas (*Mare Liberum*) documented by Hugo Grotius in 1608 (Mitchell *et al*, 2001) and the more recent LoN. Due to increasing maritime conflict, four Geneva Conventions were introduced at the sitting of the UN General Assembly in 1958 to assist in maritime governance and management (Miles, 1998). These conventions were the High Seas Convention (HSC), Continental Shelf Convention (CSC), Conservation of Fisheries Convention (CFC) and the Convention on the Territorial Sea and Contiguous Zone (CTSCZ) (O'Connel, 1982). The four Geneva Conventions were codified in 1958 and were the first attempts on an international agreement on Maritime Law (Kapoor and Kerr, 1986). These

conventions recognized a coastal country's right to territorial and contiguous zones without defining their outer extremities. This, according to Binns (2004), created uncertainty in marine jurisdictions. The conventions were target-specific in their provisions and only bound a minority of coastal countries i.e. only 56 were bound by the HSC, 53 to the CSC, 35 to the CFC and 45 to the CTSCZ (O'Connel, 1982). Problems between countries with different economic standards and political regimes became more commonplace by application of the four Geneva Conventions and forced the UN to convene a second conference on the law of the sea (UNCLOS II) in 1960 (Miles, 1998). UNCLOS II failed to pass a single convention that would bind all participating countries.

Geo-political reconfiguration, mainly from shifting World powers and colonialist countries releasing countries under their control during the period of World War II to that of UNCLOS II failure, led to many independent States emerging with newfound leadership and future political ideologies (Kapoor and Kerr, 1986). These newly-independent states felt that their rights in international decision-making were not properly represented at UNCLOS I and II, and pushed forth a review of all accepted codes on the law of the sea (Miles, 1998). In 1970, the UN General Assembly acknowledged that all countries with their respective landmasses were linked by oceans and took cognizance of rising pressures from new states and intensifying ocean use (Sohn *et al*, 2010). UNCLOS III was then convened in 1973 and held for several months each year where a single convention was agreed to by 150 participating countries in December 1982 in Montego Bay, Jamaica (Kapoor and Kerr, 1986).

The United Nations Convention on the Law of the Sea (UNCLOS III or just UNCLOS) became "the largest, most complex and most difficult global negotiations ever hosted by the United Nations" (Miles, 1998). The UNCLOS drew from the Geneva Conventions and simultaneously introduced new legal concepts for more holistic coverage of the law of the sea. As significantly more countries accepted its provisions, compared to uneven numbers ratifying the four Geneva Conventions, the climate for conflict was reduced and conflict resolution channels were opened (Miles, 1998). All legal and political regimes and different levels of socio-economic development of countries, defined maritime zones, international conservation matters and natural migratory movement of fauna was covered by UNCLOS (UN, 2009).

2.3.3. South African marine property management

Marine boundaries are human constructs and only awareness of them can serve for interaction with them in a manner that does (or does not) prescribe to the intentions of why they were created in the first place (Ng'ang'a *et al*, 2004). In SA, these boundaries are

created and maintained by the framework of domestic legislation and international conventions. Marine boundaries enclose areas or volumes in which the same sovereign, jurisdictional and administrative rights occur. As a result, the classification of marine boundaries is associated with the RRRs they enclose. Management of RRRs first requires instructions from overarching governance mechanisms.

Governance can be described as the enactment of legislation and continual monitoring of its proper implementation (management) by the governing institutions mandated for the various allied functions (Fukuyama, 2013). The primary goal for governance is to ensure the wellbeing of society or the object being managed. Governance requires prior knowledge to inform decision making inclusive of possible effects of those decisions (Strain, 2006). The most pervasive player in governance is the government itself (Stanbury, 1993) thus also the responsibility to secure marine jurisdiction to protect and conserve marine fauna and natural resources and sustainable extraction of socio-economic benefits (Ng'ang'a *et al*, 2004). A complicating factor may be that no country operates on its own and is expected by common law, to adhere to international laws and conventions to function properly. The relationships with other countries for bi-lateral activities are important to ensure socio-economic welfare.

The previous sections provided a brief overview of global evolution of ocean management from the Freedom of the Seas, World Wars and to UNCLOS. The timeline of this evolution is illustrated in Figure 2.2.

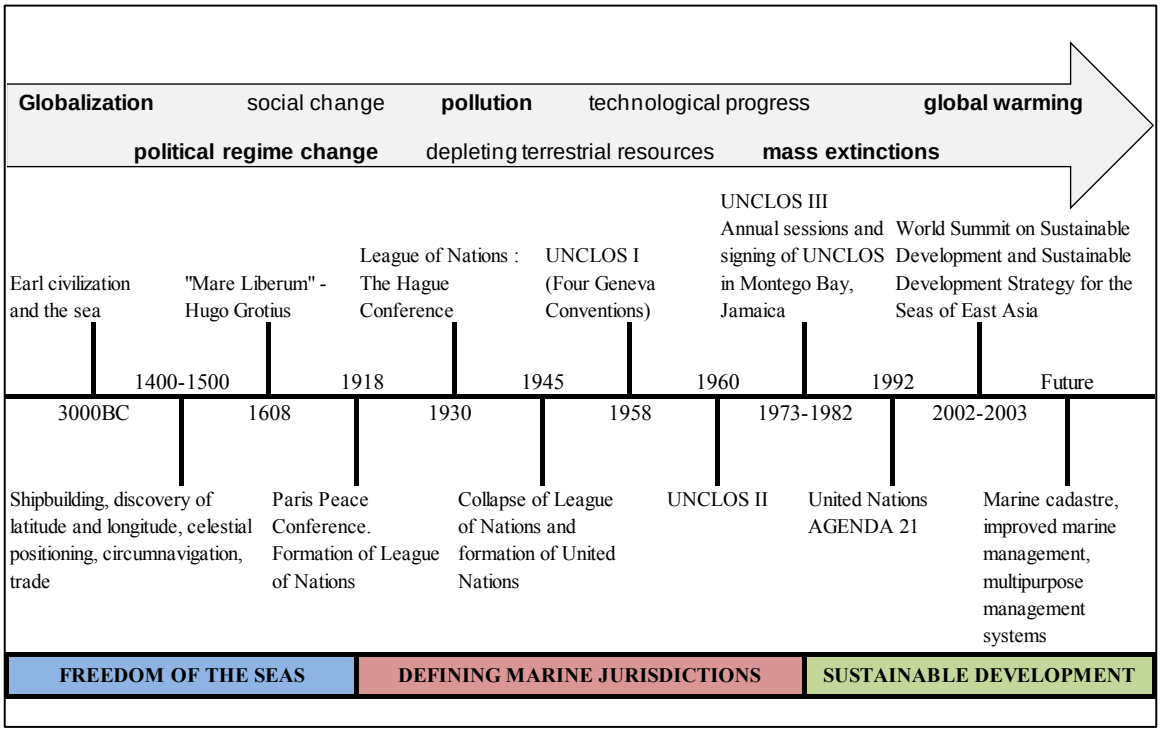


Figure 2.2. Global evolution of marine management (adapted from Strain *et al*, 2006:432)

A defined space, or recognised jurisdiction, is required for application of governance and management (Devine, 1992). SA is a signatory of UNCLOS and ratified the Convention thereby claiming a marine jurisdiction over which to preside while also submitting to international RRRs.

2.3.3.1. South Africa's marine jurisdiction

Good governance entails assurance measures so that key decision makers do not abuse their positions of authority (Glazewski, 2013). According to Strain (2006), good governance requires planning, policy-making, regulations, policing and conflict resolution. The existing MZA refers to maritime zones and their boundaries. The implication of existing maritime boundaries means SA has existing boundaries for meeting functions for which they were initially designed. However, in the face of increasing human activities overlapping in marine space, general marine boundaries such as those prescribed in the MZA may be not fully capable of assisting good governance.

SA signed the UNCLOS in December 1984. However, the Department of International Relations and Cooperation (DIRC) ratified the Convention in December 1997 (DIRC, 2006). Prior to SA ratifying the convention, introduction of the MZA as domestic legislation, created and defined characteristics of maritime zones first appearing in Articles 3, 4, 33, 57 and 76 of the UNCLOS. The MZA defines the different coastal zones up to and including the continental shelf that is 200 nautical miles (NM) from the baselines. The low water line, line between two coordinates as listed in Schedule II of the MZA, or the closing lines that separate internal water bodies (harbour openings, estuaries and river mouths) from the open sea determines the baselines. The purpose of the MZA is stated in the Act as *"to provide for the maritime zones of the Republic; and to provide for matters connected therewith"*. Figure 2.3 shows the coastal zones that are defined in UNCLOS that SA has extended into domestic legislation by the MZA.

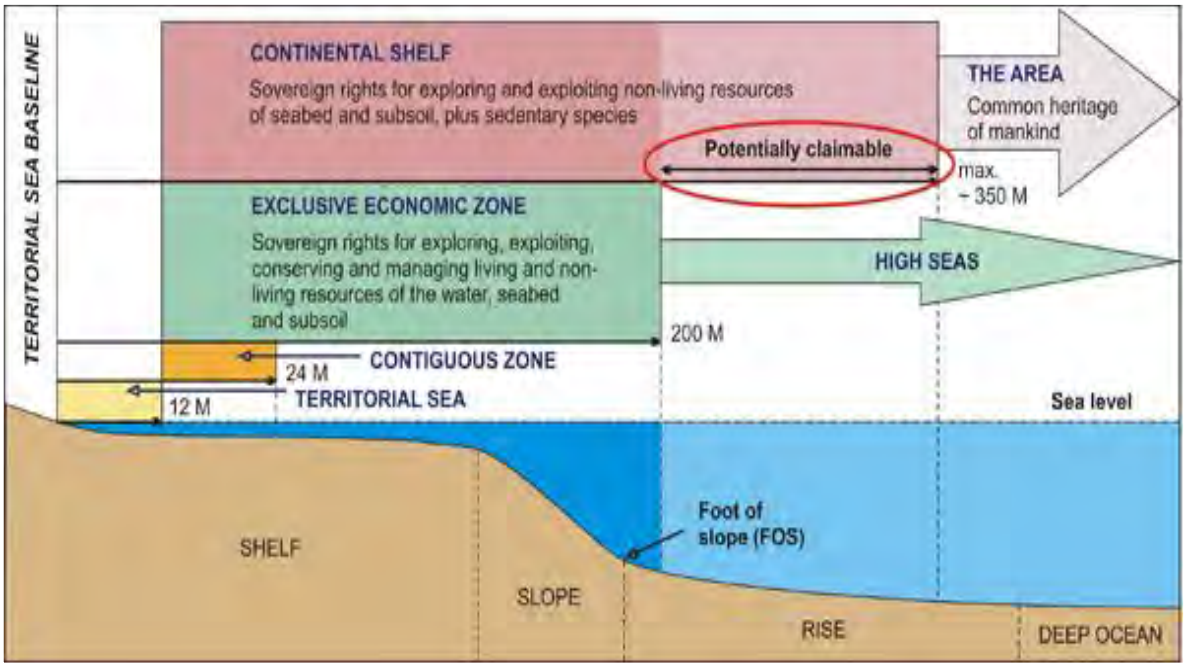


Figure 2.3. Cross-section view of coastal zones as defined in UNCLOS. M represents nautical mile, which is approximately 1 852 metres (source: UN, 2003).

Figure 2.4 shows the extent of the SA mainland and island marine jurisdictions. The vast area of the SA Exclusive Economic Zone and coastline (inclusive of islands) highlights the responsibility for marine management held by virtue of UNCLOS by the SA government.

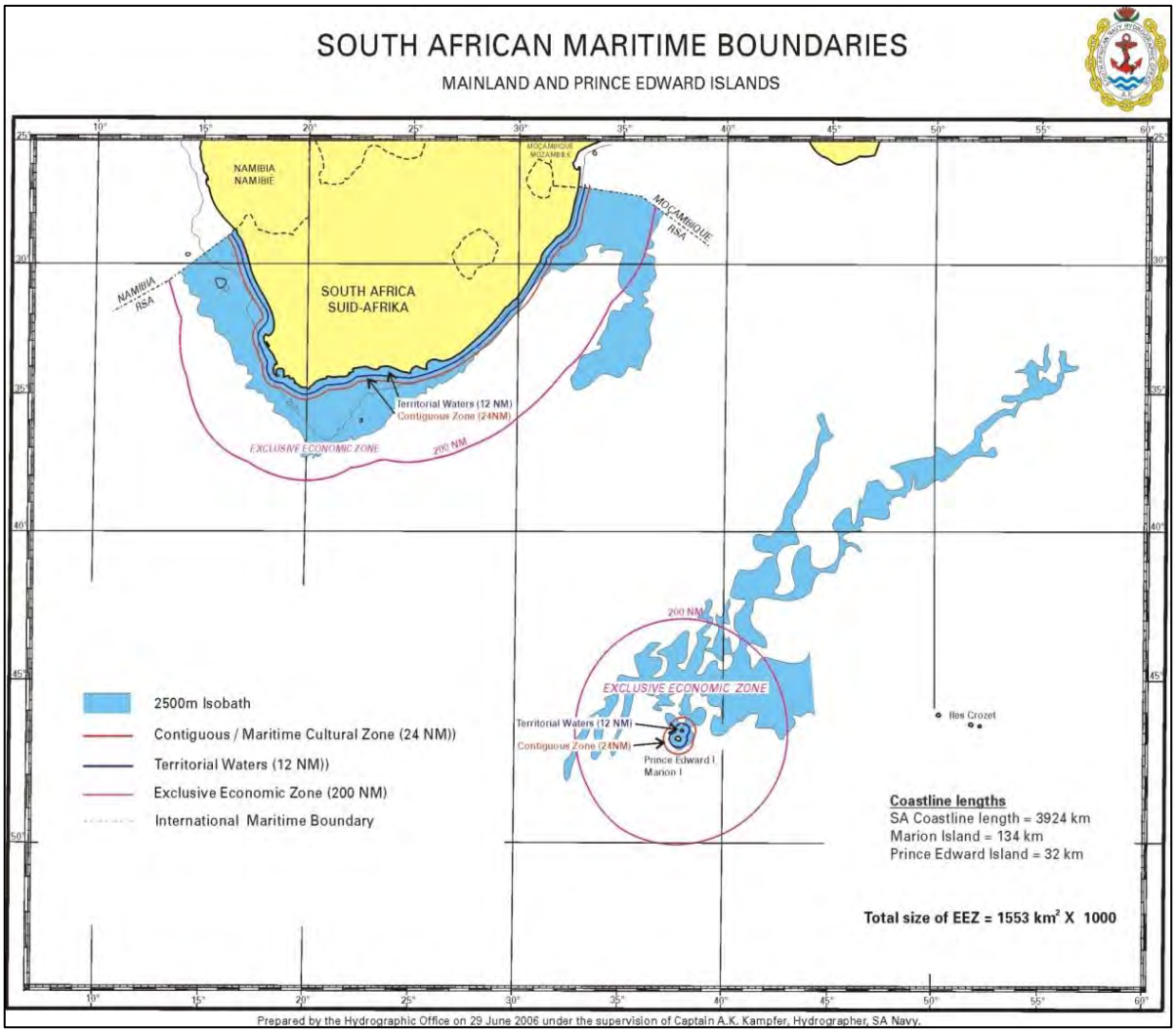


Figure 2.4. Marine jurisdiction of SA in terms of the MZA. NM represents nautical mile, which is approximately 1 852 metres. (Used with permission from the SA National Hydrographic Office)

Declaration of maritime zones defined in UNCLOS meant adoption of internationally recognized marine space and jurisdictional responsibilities (Binns, 2004). SA's declaration of maritime zones using the MZA, as the MZA is based of UNCLOS, is summarised in Table 2.1.

Table 2.1. Comparison of maritime zones found in UNCLOS and the MZA. NM represents Nautical Mile, approximately 1 852 metres.

ZONE	UNCLOS	Maritime Zones Act, 15 of 1994
Territorial Sea Baselines (TSB)	Line from which the seaward limits of countries maritime zones is measured. This line separates internal and external (seaward) waters. ***Articles 5 to 16***	***Section 2*** of the Act defines the baseline. The low water line or line separating internal and seaward (external) waters.
Territorial Waters	This is the band of the ocean, adjacent to the TSB and does not extend more than 12 NM out to sea from the TSB. ***Articles 3 and 4***	***Section 4*** of the Act agrees with the UNCLOS definition. SA has full sovereign rights but must allow foreign ships rights to innocent passage.
Contiguous Zone	12M band of sea adjacent to territorial waters and does not exceed 24 NM from TSB. ***Article 33***	***Section 5*** of MZA agrees with UNCLOS but SA does not have sovereign jurisdiction over this zone but has the rights to enforce its customs, immigration, emigration, fiscal and sanitary laws and regulations.
Maritime Cultural Zone	No dimensions specifically provided for but ***Articles 149 and 303*** cover maritime items of cultural significance.	This zone is adjacent to territorial waters but extends up to 24 NM from TSB. In respect of any archaeological or historical artefacts, SA has the same rights as its territorial waters. ***Section 6***
Exclusive Economic Zone (EEZ)	Extends from outer limit of Territorial Sea (12NM from TSB) up to, but not exceeding 200NM from TSB. Dimensions described in ***Article 57*** and characteristics in ***Part V (Articles 55 to 75)***	Agrees with UNCLOS dimensions. SA has the right to explore and exploit all natural resources in its EEZ and with respect to such have the same rights and powers as that of its territorial sea. ***Section 7***
Continental Shelf	Band adjacent to the territorial sea to the outer edge of the continental margin up to a distance of 200 NM. An area beyond 200 NM although the shelf may extend there, is part of the High Seas. The continental margin consists of the seabed and subsoil of the shelf, the slope and the rise. It does not include the deep ocean floor with its oceanic ridges or the subsoil. ***Part VI (Articles 76 to 85)***	Agrees with UNCLOS definition. SA can exploit the shelf's resources as per Article 77 of UNCLOS but all mining activities are subject to terrestrial mining legislation. ***Section 8 and Schedule 3.***

In addition to the zones created in UNCLOS for claimed marine jurisdictions of coastal countries, Article 76 provides for claiming an extended continental shelf. SA placed two claims for an extended continental shelf (DIRC, 2006). The first claim is for extension of

the SA mainland's continental shelf and the second is a joint claim with France for the extension around Prince Edward and Crozet Islands (DIRC, 2006). The claims will be heard by the UN Commission on the Limits of the Continental Shelf (UNCLCS) and, if successful, would, according to Jordan (2013), add an additional 1.9million square kilometres to SA's maritime jurisdiction (Figure 2.5).

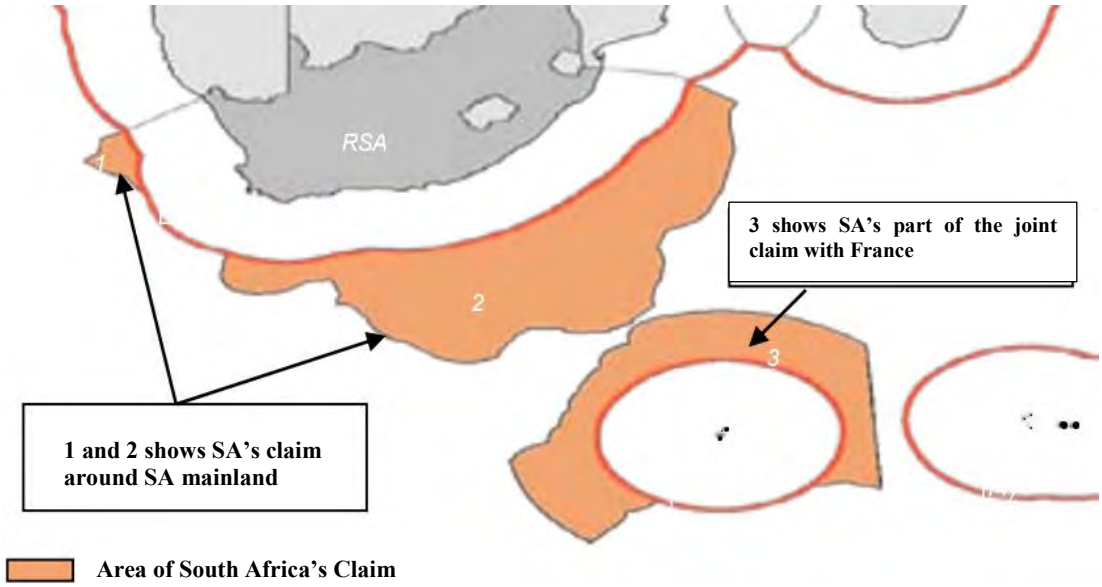


Figure 2.5. UNCLOS Article 76 claim for an extended continental shelf (adapted from Petroleum Agency of SA, 2012)

The High Seas (Part VII of UNCLOS) is not specified in the MZA. The High Seas falls beyond the 200 NM limit of the EEZ and continental shelf (or extended continental shelf if successfully claimed) (Figure 2.6). All countries, coastal or otherwise, have the same rights to enjoy freedom of navigation, flights over, marine installations, fishing and scientific research in the High Seas but are subject to certain provisions of UNCLOS (Binns, 2004).

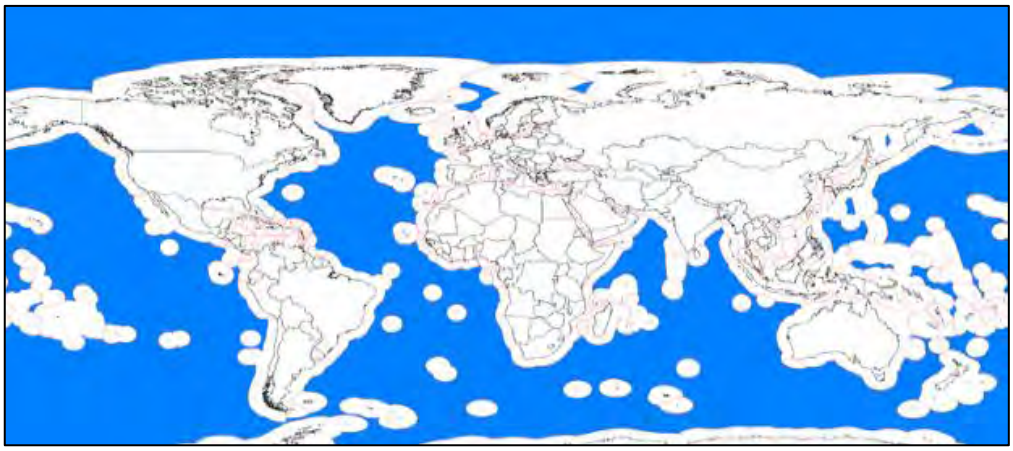


Figure 2.6. Map illustrating the high seas. All areas in blue are considered part of the high seas and are not subject to national appropriation (source: Hollis, 2013)

The portion of the seabed beyond the EEZ and recognized continental shelf is termed "The Area" in Article 1 of UNCLOS (Hollis, 2013). Holiss (2013:1) adds, "it would be inaccurate to say that the Area is the seabed underneath the High Seas, since the High Seas can overlap portions of continental shelf that are subject to national sovereignty". The resources of The Area, as stated in UNCLOS Articles 136 and 137, are designated for the "common heritage of mankind" and no nation may lay claim to the seabed or the resources contained therein. A profit sharing agreement between companies involved in extracting resources from The Area must first be accomplished and subsequent profits shared with developing countries (Hollis, 2013). The biggest criticism of UNCLOS is its reliance on a countries' domestic legislation to implement its provisions (Hollis, 2013). This results in varying interpretations of UNCLOS provisions creating a climate for countries to excuse violations in the marine jurisdictions of other countries. Although significant provisions are found in UNCLOS for ocean management, there is a trade-off between each country's prescriptive and enforcement jurisdictions. Prescriptive jurisdiction refers to a country's legislature having the rights to create, amend or repeal legislation and further create institutions for legislative enforcement (Bedjaoui, 1991). Prescriptive jurisdiction is a necessary, but not sufficient, form of enforcement as enforcement is dependent on capital resources and clear mandates.

The maritime zones, although well defined in UNCLOS and domestic legislation, are broad maritime zones. Within these zones lie conflicts between UNCLOS, prescriptive and enforcement jurisdictions. The natural order of the sea and its resources is not reflected in application of UNCLOS in its segregation and allocation of the ocean (Hollis, 2013). As SA's MZA is derived of UNCLOS, the critique of UNCLOS is carried forward. The increasing use of marine space is bound to test existing governance at regional and global levels.

2.4. SA marine activities

SA has marine jurisdiction spanning approximately 3000km of coastline out to the limits of the EEZ 200 NM away. Within the general maritime zones established by the MZA, numerous stakeholder activities occur. These activities are governed by sets of legislation. The following sections outline the main prescriptive and enforcement jurisdictions of the major sectors in the SA marine environment. Stakeholders and their activities are identified, and pressure maps showing these activities in the SA marine jurisdiction are shown.

To facilitate spatial assessment, the pressures from marine activities were summarized by Sink *et al* (2011) to approximately 8km by 8km grids resulting in a scale capable of accommodating finer-scale datasets closer to the shoreline and coarser-scale datasets further out at sea (Sink *et al*, 2011). The pressure values depicted at the top of Figures 2.7, 2.10, 2.12, 2.13, 2.18 and 2.21 were reduced to a 0-1 range. The formula p=d1/d80 was used, where d1 is the raw pressure data in the 8km by 8km grid, d80 the 80th percentile of the pressure values for a particular data set. Any values over 1 were assigned a value of one. The closer the calculated pressure value is to 1, the higher the associated marine activity. Some datasets, in the spatial analysis by Sink *et al* (2011) had very high values which would have hidden any low to moderate value datasets potential, therefore the decision to cap values at 1.

The maps shown in Figures 2.7, 2.10, 2.12, 2.13, 2.18 and 2.21 also show the 200m and 500m isobaths (lines joining points of equal depth below water).

2.4.1. Mining, oil and gas

Mining and energy on and offshore is under adjudication of the National Department of Minerals and Energy (DME). Offshore prospecting concessions for oil and gas were issued to international companies after passing the Mining Rights Act (No. 20 of 1967) (MRA). The first offshore well was drilled in 1969 in the Pletmos Basin of the southern coast of SA, and though promising discoveries in oil and gas reserves were found, international political sanctions due to increasing racial segregation forced potential prospectors to withdraw (Oberholzer, 2012). Post-apartheid SA established PetroSA and Parliament subsequently passed the Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA) that repealed the whole MRA. The MPRDA is clear in stating that ownership and custodianship of offshore minerals and petroleum resources vests in the State. Since the first offshore oil wells were drilled over “300 appraisal, exploration and production wells have been drilled offshore” (Oberholzer, 2012: 158). Figure 2.7 shows pressure maps of offshore distribution of wells provided by the SA National Biodiversity Institute (Sink *et al*, 2012).

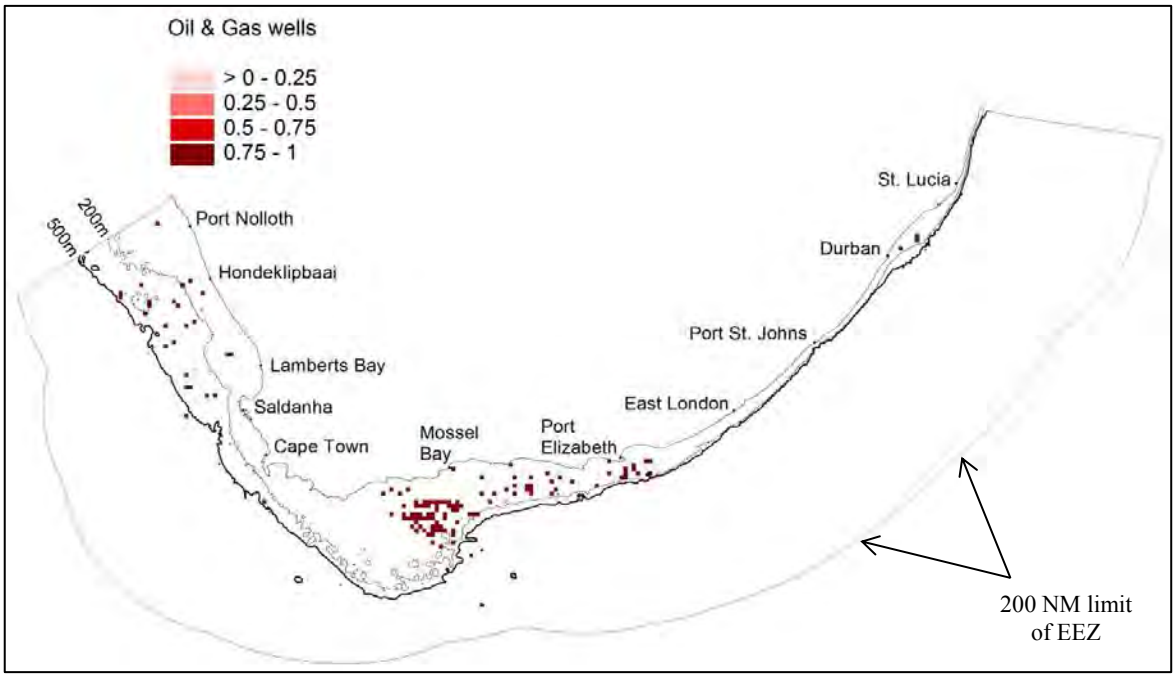


Figure 2.7. Distribution of Oil and Gas Wells within the Exclusive Economic Zone of South Africa (Source: Sink *et al*, 2012:116).

In accordance to SA legislation applicable to offshore permits and rights to oil and gas, competitive bidding is required with supporting assessment of the lease block's potential as a drilling site. Sink *et al* (2012) identify the Agulhas Bank as one of the most economically significant offshore areas with high levels of activities (prospection, production of petroleum and commercial fisheries). The Bredasdorp Basin situated on the Agulhas Bank has been the focus of most activity in recent years (Figure 2.8).

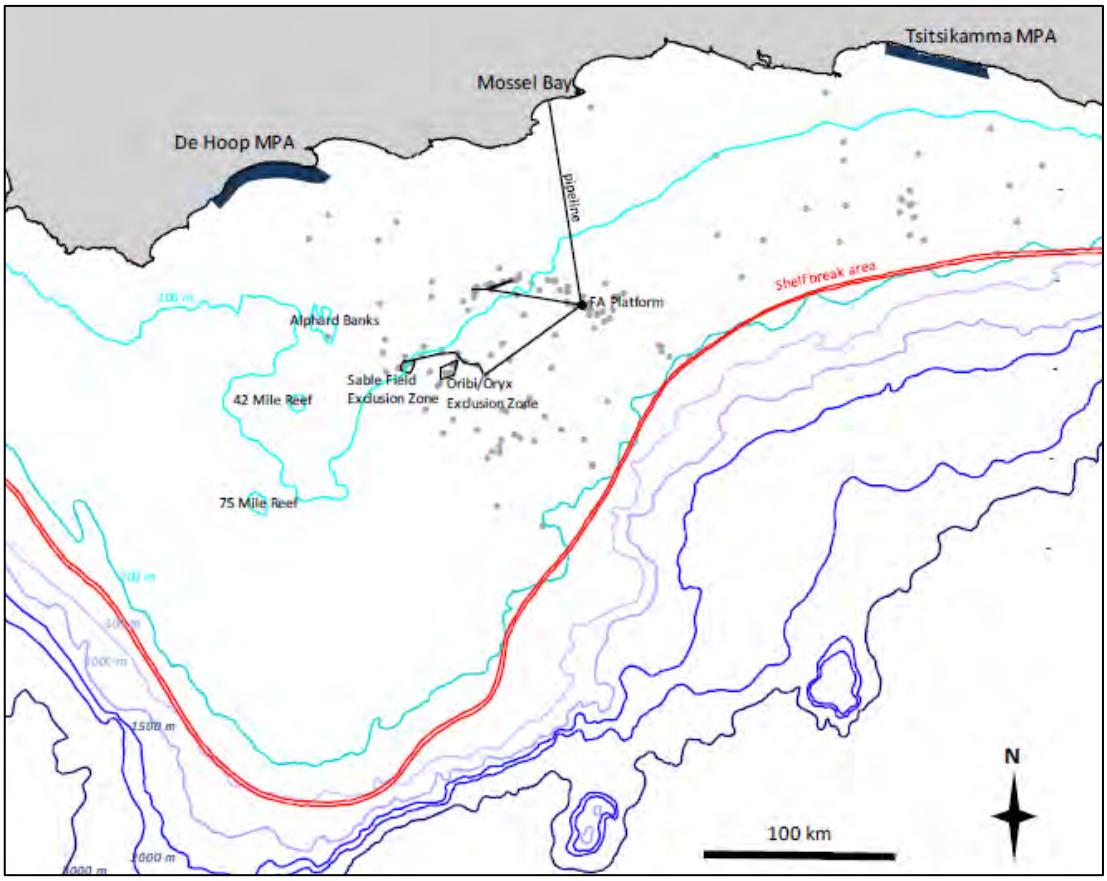


Figure 2.8. High intensity of activities in the Bredasdorp Basin on the Agulhas Bank (Source: Sink and Attwood, 2008:14).

Other than significant economic benefits derived from petroleum activities, the impact on the natural environment and marine species can be significant due, but not limited, to the following:

i. Seismic echo sounding once exploration permits and production rights are issued (Oberholzer, 2012)

ii. Discharge of "production water" from activities that consists of warm water from the oil reservoir, dissolved and dispersed oils, high salt concentrations, heavy metals, polycyclic aromatic, sediment plumes, hydrocarbons, reduced oxygen levels and on occasions naturally occurring radioactive material (Kloff & Wicks, 2004 cited in Sink and Attwood, 2008). There is no control of containing production water discharged into the ocean from spreading.

iii. Oil spills and gas leaks. These are rare, with severe consequences for marine environments and coastal zones (Sink and Attwood, 2008).

iv. Marine to terrestrial pipelines and shipping vessels transporting oil and gas.

The spatial management of offshore oil and gas permits and rights is administered by the Petroleum Agency of SA (PASA) in terms of the MPRDA (PASA, 2014) Lease block areas are allocated as the sea can never be owned, and permit or right holder information is attached (Figure 2.9). The stringent requirements in the MPRDA must be met and these include environmental impact assessments, pipeline and cable geolocation, bathymetric and seismic surveys, oil or gas yield potential etc. This implies that bidders for control of lease blocks from the State must be familiar with their RRRs and these should be detailed to the satisfaction of the Minister of Mineral Resources (PASA, 2014)

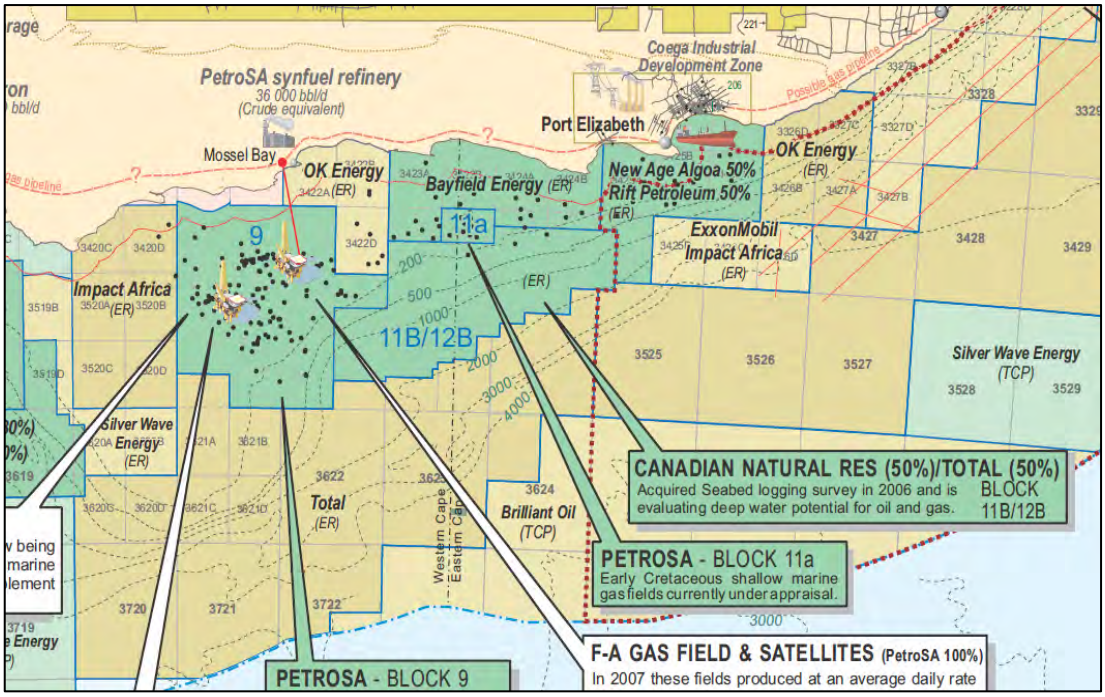


Figure 2.9. Extract of lease block allocation by the Petroleum Agency of SA in terms of the MPRDA (Source: PASA, 2014)

The example of the impacts of the Agulhas Bank is applicable to all offshore exploration and production of oil and gas. Additional to offshore activities of oil and gas drilling, shore and near shore, mining for minerals is prevalent along the coastline of SA. Five types of shore or near-shore mining are considered a threat to coastal regions and marine biodiversity in SA, namely; i) sand winning, (ii) diamonds, (iii) phosphate, (iv) fossil fuels and (v) titanium (Lombard *et al*, 2004). Dredging and use of heavy machinery in coastal zones (pressure map depicted in Figure 2.10) negatively impacts natural habitats and if sustained for decades, as is the case in Namibia, development of near-shore sand walls can alter coastlines and currents and affect marine activities of other stakeholders in the vicinity (Sink *et al*, 2012).

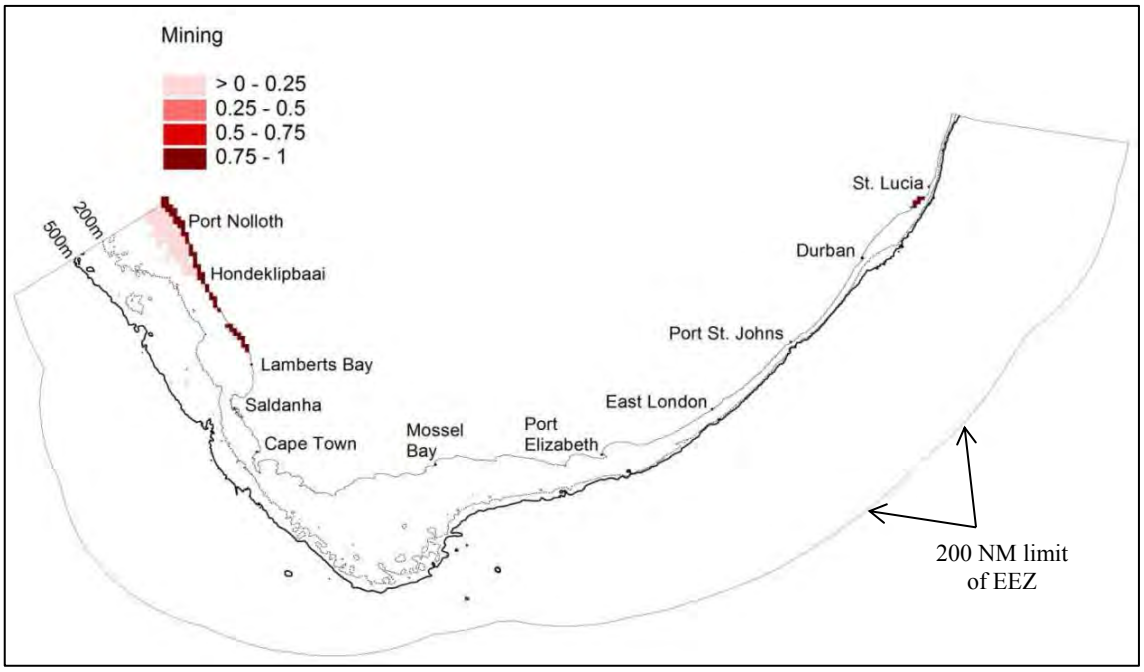


Figure 2.10. Shore and near-shore mining for diamonds and other unspecified minerals of SA (Source: Sink *et al*, 2012:115).

The most significant legislation and regulatory bodies for petroleum and mining are shown in Table 2.2. This framework extends into the entire recognised marine jurisdiction of SA. The regulatory framework, especially the MPRDA, does not discriminate substantially between onshore and offshore hydrocarbons (Oberholzer, 2012). The most significant differences lies in title deeds required for onshore mining permits and rights to a piece of land while lease blocks are allocated offshore by the State. This distinction of rights allocation is based on a mix of private and State land ownership compared to the entire marine jurisdiction vesting in the State.

Table 2.2. Regulatory framework governing shore, near-shore and offshore mining, petroleum and gas drilling industries.

Legislation	Main purpose of legislation as related to offshore property	Regulatory and oversight bodies/institutions
Constitution of the Republic of South Africa Act 108 of 1996	Provides for laws to be enacted through to ensure sustainable development	National Assembly and National Council of Provinces
MPRDA	Ownership of minerals and petroleum resources of SA vests in the State. The State is the custodian.	Access to mineral and petroleum resources handled by the Petroleum Agency of SA
Mining Titles Registration Act 16 of 1967 (MTRA)	Enables registration of exploration and production rights with the controlling agency.	Mining and Petroleum Titles Registration Office
Petroleum Pipelines Act (No. 60 of 2003	Regulates submarine to shore petroleum pipeline infrastructure and management.	National Energy Regulator of SA (NERSA)
Gas Act 75 of 2002	Regulates issuing licences and construction of offshore gas facilities	

The National Environmental Management: Integrated Coastal Management Act 24 of 2008 (ICMA) does not directly regulate on-shore and near shore mining activities. The ICMA falls under the broad "umbrella" legislative instrument of the National Environmental Management Act 7 of 1998 (NEMA) managed by the Department of Environmental Affairs (DEA) for all matters concerning SA's environmental protection and sustainability (DEA, 2014). Mining is governed by the MPRDA that adopts the environmental conservation principles found in Section 2 of NEMA (DEA, 2014).

Although the legislative framework and institutions are active in governing mining, petroleum and gas drilling industries, the range of activities across all maritime zones is diverse and governed by a wide range of legislation and institutions. Furthermore, there is little integration or information sharing across sectors of activity. The spatial extent of each activity right is also not conveyed between sectors, despite any overlapping RRRs

2.4.2. Fisheries and marine aquaculture

2.4.2.1. Fisheries

The Marine Living Resources Act 18 of 1998 (MLRA) which supersedes the Sea Fishery Act 12 of 1988 governs the fisheries sector although numerous sections of the older Act remain in force (Hara *et al*, 2008). In committing to sustainable fisheries, SA is part of the Ecosystems Approach to Fisheries Management defined by the UN Food and Agriculture Organization (FAO) (DEA, 2014). The Department of Agriculture, Forestry and Fisheries (DAFF) manages catch seasons for marine species and total catch quantities for commercial, subsistence, recreational and small-scale fisheries (DEA, 2014). Commercial fishing rights and permits are applicable to particular areas near-shore and offshore, as approved by the DAFF, thereby specifying the spatial extent of these RRRs. In specifying seasons, the dimension of time is added to spatial management of fisheries.

Twelve proclaimed fishing harbours exist along the SA coastline. These are termed "State immovable assets" by the Government Immovable Asset Management Act 19 of 2007. The landward sides of these harbours are managed by the National Department of Public Works (NDPW) and the seaward side by the MLRA. Lombard *et al* (2004) state that SA has a significant variety of fishing activities categorized into three sectors:

i. **Commercial sector**. A commercial fisher must obtain commercial fishing rights to catch and sell fish and include large-scale trawl and longline fisheries, nets to encircle shoaling fish (pelagic purse seining), rock lobster fisheries and commercial line-fishery (Sink *et* al, 2012). Commercial fishing rights are leased by the State for 15 years and are not viewed as property rights therefore revocation of these rights is not construed as expropriation in terms of the Expropriation Act 63 of 1975 (Department of Environmental Affairs and Tourism (DEAT), 2005). Only the DAFF Ministerial approval allows transfer, division or consolidation of commercial fishing rights, variation of catch quantities or moratoriums of any fishing in terms of the General Policy on Allocation of Commercial Fishing Rights (DEAT, 2005).
ii. **Recreational sector** : A recreational fisher fishes for sport or for personal consumption. Monetary gain is not allowed and a permit is required. Activities include recreational line-fishing, harvesting intertidal species and recreational crayfish harvesting. The DAFF publishes Recreational Fishing pamphlets that are handed to successful applicants of fishing permits. The pamphlets outline fish types, where they may be caught and within a specified time to allow depleted fish stock to recuperate when protected by out of season periods. All SA Post Offices, the DAFF

website and the Marine Coastal Management Fishery Control Office makes the pamphlets available.

iii. **Subsistence and small-scale commercial sector**: This sector is now a recognised sector in SA (Witbooi, 2002). This sector includes permit systems, allocation procedures and monitoring and is in the development phase with possibility of being split into separate sectors in the future (DEAT, 2014). Section 13 of the MLRA makes provision for formal identification and recognition of fishing communities, subsistence fishers and declaration of exclusive coastal zones for use by subsistence fishers (Hara *et al*, 2008). To date, the provision of Section 13 has not been met regarding the allocation of exclusive fishing zones along SA's coastline (Sowman, 2006). This affects clarity on rights allocation leading to illegal fishing (Isaacs, 2006).

The enforcement of fishing quotas is governed by the MLRA but also spans all spheres of government in a top down manner (Figure 2.11).

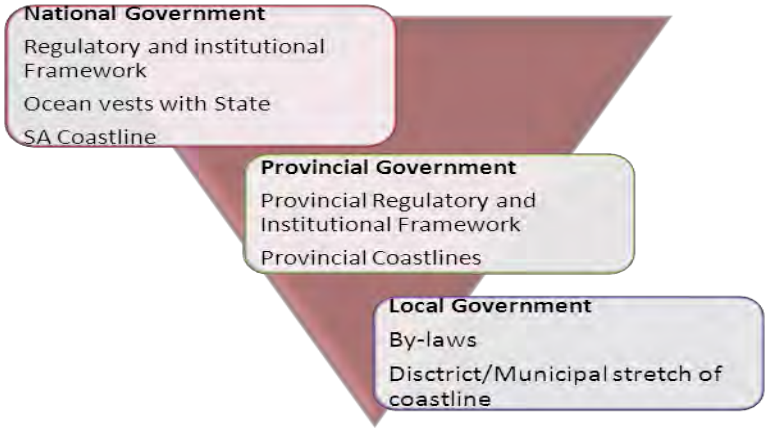


Figure 2.11. Top-down approach to ocean management

The pressure maps shown in Figure 2.12 highlight some types of fisheries in SA's EEZ. Not all types of fisheries are shown, as the purpose of these maps is to indicate the overlapping nature of the fishing sector by different stakeholders.

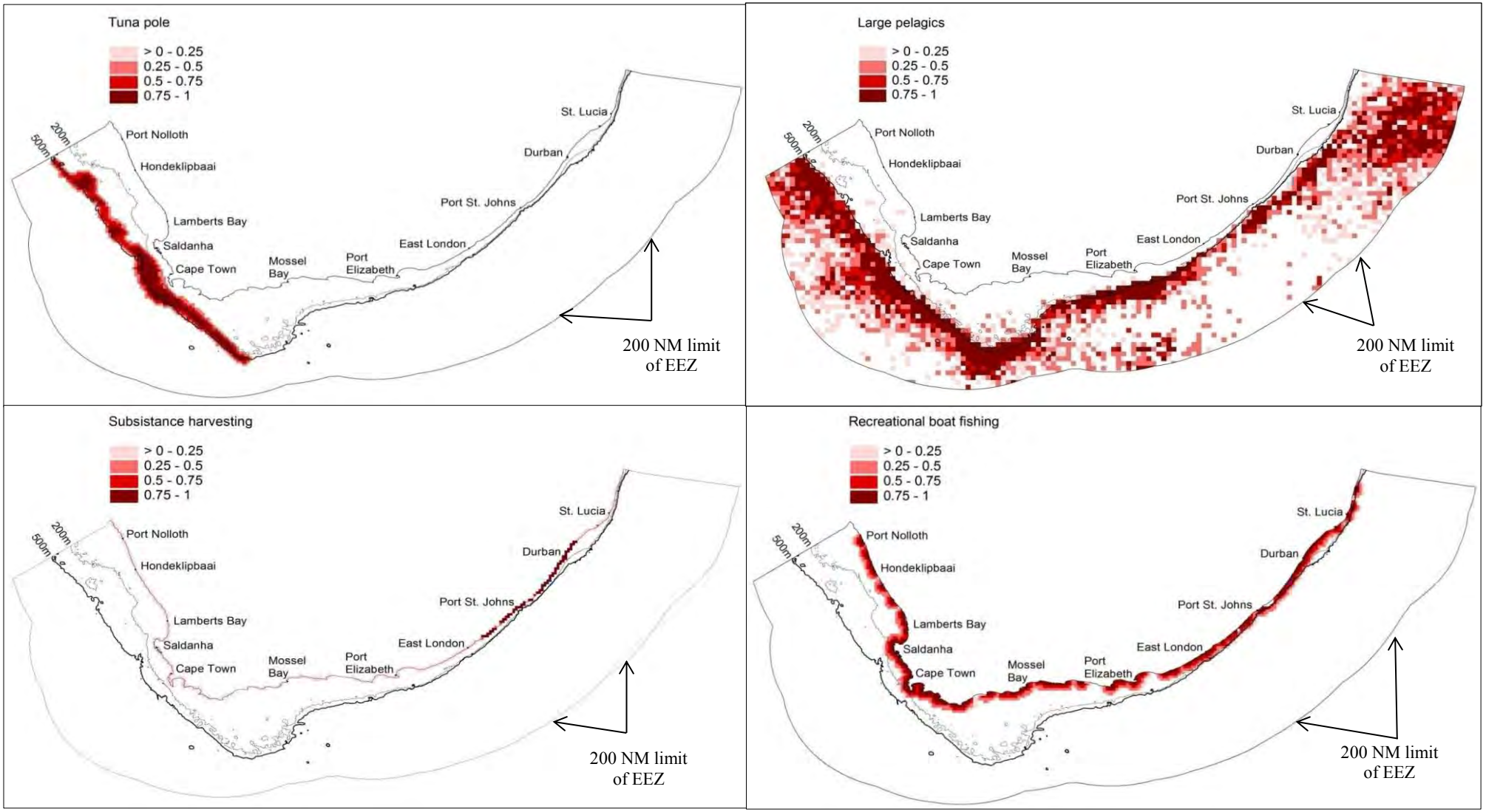


Figure 2.12. Different types of fishing activities (shades of red) along SA coast and EEZ (Source: Sink *et al*, 2012:101,105,138,135).

2.4.2.2. Marine aquaculture

The Marine Aquaculture (MA) is governed by the MLRA under the DAFF and within the confines of other national environmental legislation and regulations. In terms of the MLRA, each type of MA activity requires applications for rights (DEA, 2014). The Marine Aquaculture Working Group assesses each application for its viability, socio-economic and environmental characteristics (DEA, 2014). In the early 1990s the MA industry grew then declined from the start of the new millennium resulting in insignificant contribution to MA products on a regional and global scale (Rana, 2011). The pressure map shows the distribution of MA sites along the SA coastline, particularly cages placed in the ocean (Figure 2.13).

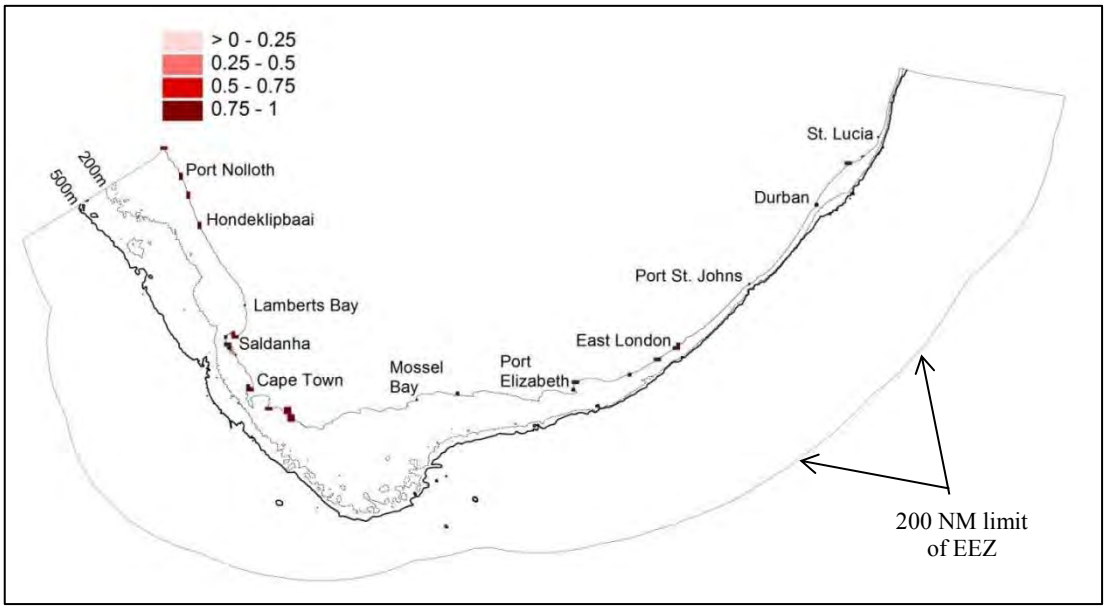


Figure 2.13. Existing marine aquaculture (Source: Sink *et al*, 2012:111).

MA is profitable considering the little space and resources required to operate, yet it has proven detrimental to marine biodiversity as it introduces alien invasive species, diseases and habitat loss (Lombard *et al*, 2004). SA's coastline is deemed unsuitable for marine aquaculture yet terrestrial aquaculture has potential to safeguard naturally occurring marine species that may be accidentally exposed to exotic species (Rana, 2011).

2.4.3. SA Bioregions and Marine Protected Areas

The 2004 SA National Spatial Biodiversity Assessment Technical Report on the SA marine environment segregates the SA marine jurisdiction on a national scale (Lombard *et al*, 2004). The report specified:

i. Inshore and offshore bioregions, associated water temperatures and large-scale habitat differences.
ii. Tidal zones varying from mean spring high and low tides (which are not always submerged by water along coastline and tidal estuaries) to supratidal zones (riverine estuaries) and subtidal zones (always submerged).
iii. Topographic zones from the land-sea interface and all tidal zones to the continental shelf, its slope, and abyss.
iv. Depth strata – subdivision of topographic zones into depth profiles (e.g. 10 – 20 m depth range).
v. Substratum types – division of coastal areas and marine jurisdiction, dependent on content of sub-stratum e.g. muddy sediments, rocky ledges, reefs or mixed types.
vi. Marine ecosystems
vii. The distribution of marine species and habitats.

The separation of marine space was not an easy task and was dependent on a variety of government and private sources with dataset deficiencies (Lombard *et al*, 2004). The segregation listed above informs on the coastal and offshore regions that are most prone to degradation from climate change and impinging human activities like mining, marine aquaculture, oil and gas drilling. Irreplaceability analyses undertaken by Lombard *et al* (2004) reveal the degree that rehabilitation can be affected if complete destruction of habitats occurs (Figure 2.14). These in turn help identify areas for marine protection.

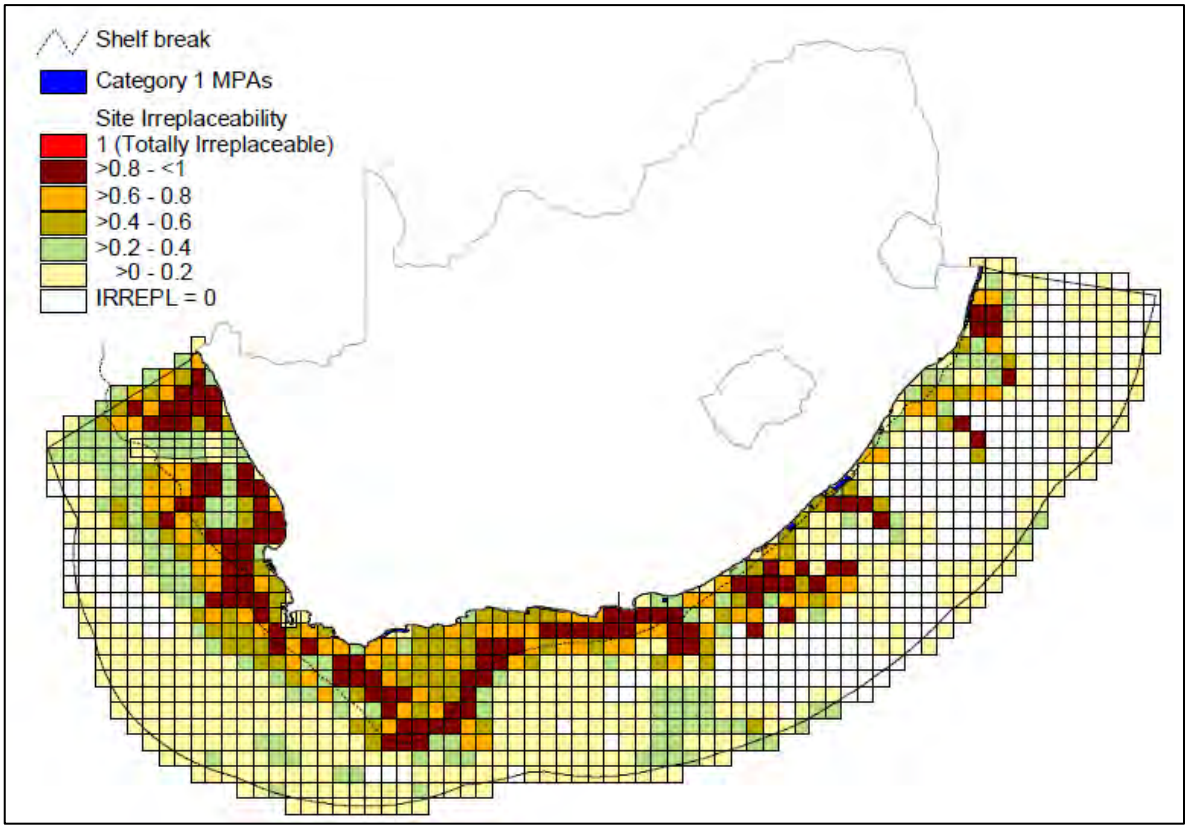


Figure 2.14. An extract of irreplaceability analyses of 20' x 20' grid intervals with unitless scale ranging from 0 (replaceable) to 1 (irreplaceable) (Source: Lombard *et al*, 2004)

Marine Protected Areas (MPAs) are declared for the protection of marine fauna and flora and the physical marine environment upon which they depend (DEA, 2014). MPAs are declared in terms of Section 43 of the MLRA. Currently, all declared MPAs fall within the SA EEZ, with potential for additional MPAs once the extended continental shelf claim is addressed by the UNCLCS. There appears to be a bias towards coastal MPAs as 9% of the SA coastline is completely conserved , 14% of SA marine jurisdiction within the 12 NM zone conserved with usage rights attached, and just 0.16% further offshore, being MPAs (Sink and Attwood, 2008).

Proclaimed MPAs and their distribution in terms of the MLRA are shown in Figures 2.15 and 2.16 respectively. MPAs are differentiated according to the following zones:

i. *No-take* – where extractive use is not permitted
ii. *Extractive use* – permits to some form of extractive use throughout MPA
iii. *Mixed no-take and extractive use* – extraction of critically endangered fauna and flora are prohibited while some forms of extractive use are not.

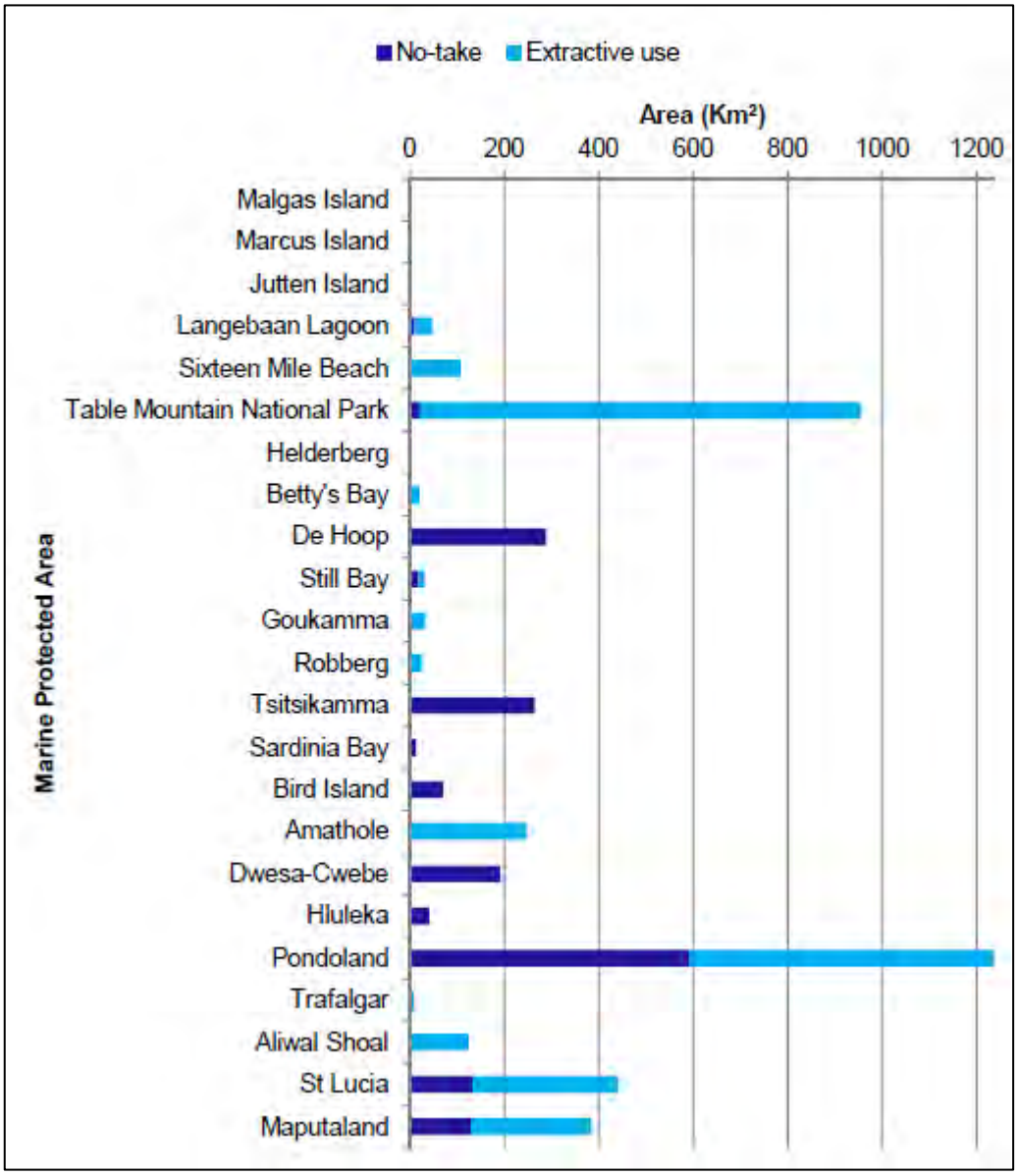


Figure 2.15. Histograms of take/no-take extractive use and mixed MPAs (Source: Sink *et al*, 2012:145)

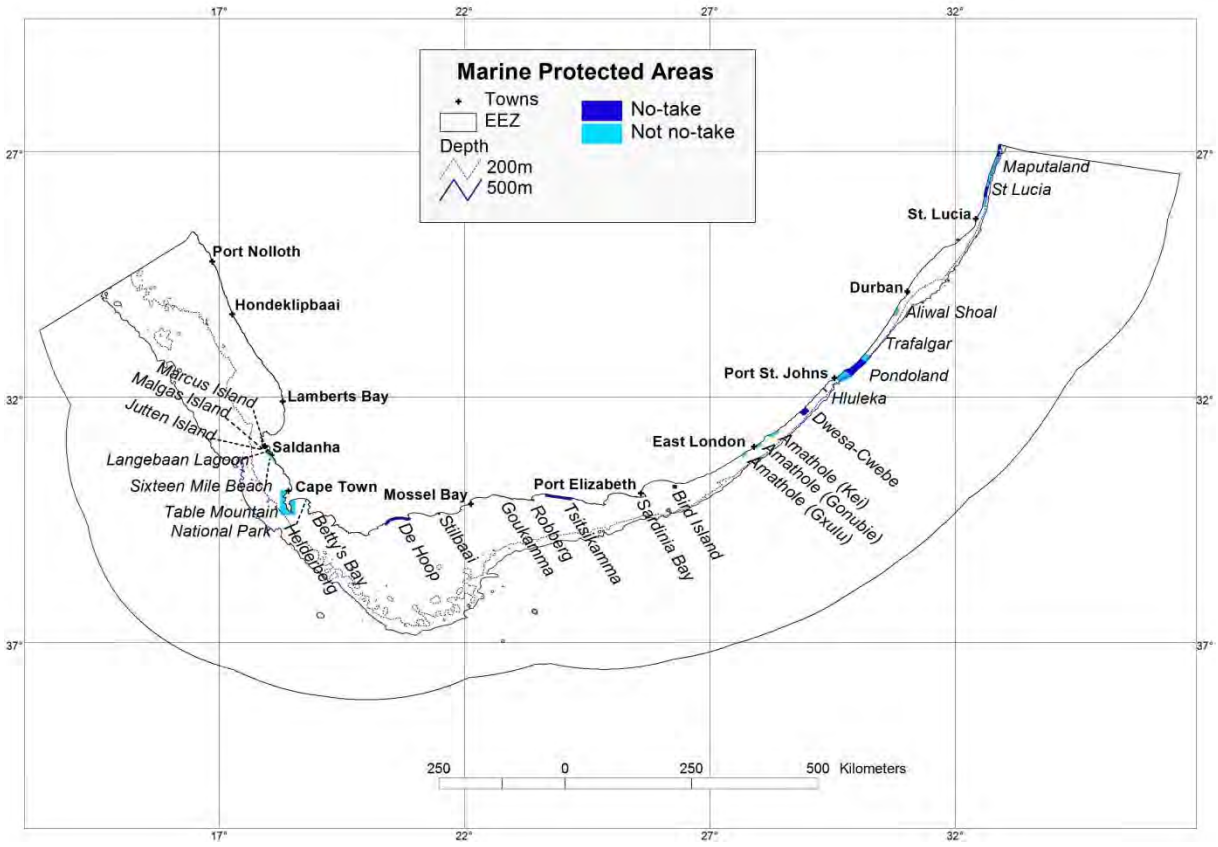


Figure 2.16. Distribution of MPAs along SA coastline (Sink *et al*, 2012:148)

Sink and Attwood (2008) identify the target authorities and interested parties responsible for present and future sustainability of MPAs.

i. National Department of Environmental Affairs and Tourism
ii. Marine and Coastal Management Agency
iii. The DME
iv. Petroleum Agency of SA
v. SA Maritime Safety Authority
vi. National Ports Authority
vii. SA Navy
viii. SA National Biodiversity Institute
ix. Industry Stakeholders (fisheries, marine aquaculture, mining, oil and gas, shipping, undersea communications, defence, waste disposal, research)
x. General public
xi. National Department of Agriculture, Fisheries and Forestry.

Although many different State and private stakeholders have varying degrees of marine interests, knowledge of the spatial extent is a necessity for MPAs to achieve their objectives of long-term sustainability (Robinson and De Graaff, 1994). Sink and Atwood (2008:4) identify "systematic planning based on best available scientific and socio-economic research" for conservation planning initiatives to combat marine activity pressures. Spatial identification of all marine stakeholder activities together with enforcement rules and regulations would realize marine conservation targets in a manner that is socio-economically viable.

To keep abreast of constant change, on-going alignment of legislation and targets is necessary. By committing to international conventions and creation/updating of domestic legislation, SA has acknowledged the need for active protection and sustainability of the marine environment (Table 2.3)

Table 2.3. Summary of main conventions and domestic legislation for MPAs

Convention on Biological Diversity, 1992. SA is signatory and as a result, requires on and offshore protected areas (Sink and Attwood, 2008)
World Summit on Sustainable Development, 2002 (WSSD) Held in Johannesburg and global targets were set in ocean management (Sink and Attwood, 2008)
World Parks Congress, 2003 Congress built on the WSSD Plan of Implementation and recommended a minimum of 20 – 30% of each habitat type be protected at global scale by representative MPA networks.
MLRA Legislative tool for proclamation of different MPA types and for reducing possible conflict arising from different and competing uses by different maritime sectors.
National Environmental Management : Protected Areas Act 57 of 2003 Promotes protection and conservation of ecological areas representative of SA biodiversity and includes terrestrial landscapes and marine seascapes (Sink and Attwood, 2008). MPAs are not proclaimed under this act but there is reason to do so as MLRA does not recognise mineral rights in MPAs. This would permit dual proclamation of MPAs and more stakeholder accountability
National Environmental Management : Biodiversity Act 10 of 2004 Promotes the protection and conservation of natural biodiversity
NEM : ICMA

The value of spatial information was demonstrated by the segregation of the SA marine jurisdiction at national scale. To enforce associated legislation which provides for MPAs,

MPAs must first be spatially identified. Figure 2.14 illustrates analysis of irreplaceable oceanic resources and it is evident that coastal areas are significantly more at risk requiring enhanced protection measures compared to the outer segments of the EEZ. The distribution of MPAs does not correlate with the recognized maritime zones of the MZA suggesting the broad definitions of maritime zones contained therein are insufficient for conservation matters reliant on legally defined spatial extents. Conditions relating to MPAs are attached to their proclaimed spatial extents and these areas and uses compete with other marine sectors with separate information systems such as fisheries, dumping, offshore discharge, mining, undersea cables, marine tourism. The disparate systems, based on a variety of legislation demonstrated by the MLRA, not including mining prohibitions that can have negative effects on MPAs, should be consolidated into a consistent SDI tool to support decision-making. Proclamation of MPAs adjacent to terrestrial protected areas using different legislation and enforcement institutions creates a spatial strip along the land-sea interface, that is a critical transitional area, with uncertainty of which legislation is applicable in its management.

2.4.4. Offshore installations

Offshore installations include marine outfalls, communication cables, and mining-related infrastructure. Section 2.4.1 dealt with offshore installations related to mining, oil and gas. These were predominantly oil and gas wells (including rigs) and pipelines linking them to the terrestrial environment.

Marine outfalls

All discharges directly into the sea, in terms of Section 69 of the ICMA, must be authorized by the Minister of Environmental Affairs through the provision of a coastal waters discharge permit after the necessary environmental impact assessments are conducted and approved (DEA, 2014). Effluent from industries, desalination plants or stormwater runoff into drainage systems, that can contain waste and may be of a different temperature to sea water, directly impinges on other stakeholder usages by uplifting sediment into plumes and affecting composition of chemical concentrations of natural sea water (Figure 2.17 and pressure distribution in Figure 2.18).

Permits for marine outfalls are issued by the DEA: Oceans and Coasts who must report on impacts of discharges once every three years to the National Coastal Committee (DEA, 2014). The NEMA: Environmental Impact Assessment Regulations governs marine discharges.

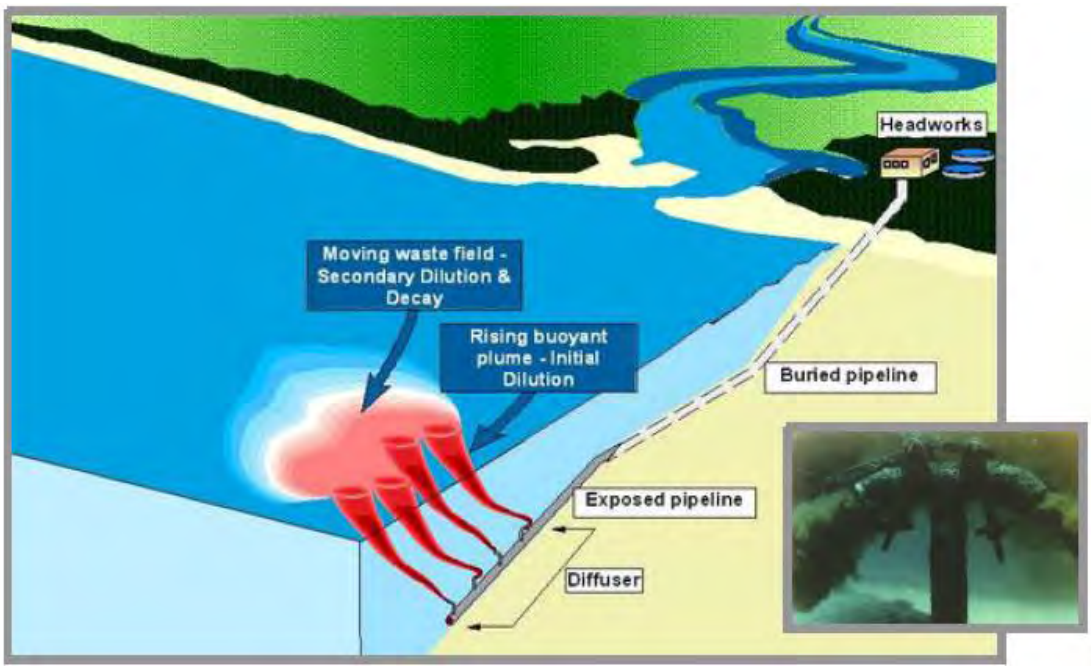


Figure 2.17. Cross-sectional view of industrial effluent discharge (Source: DWAF, 2004)

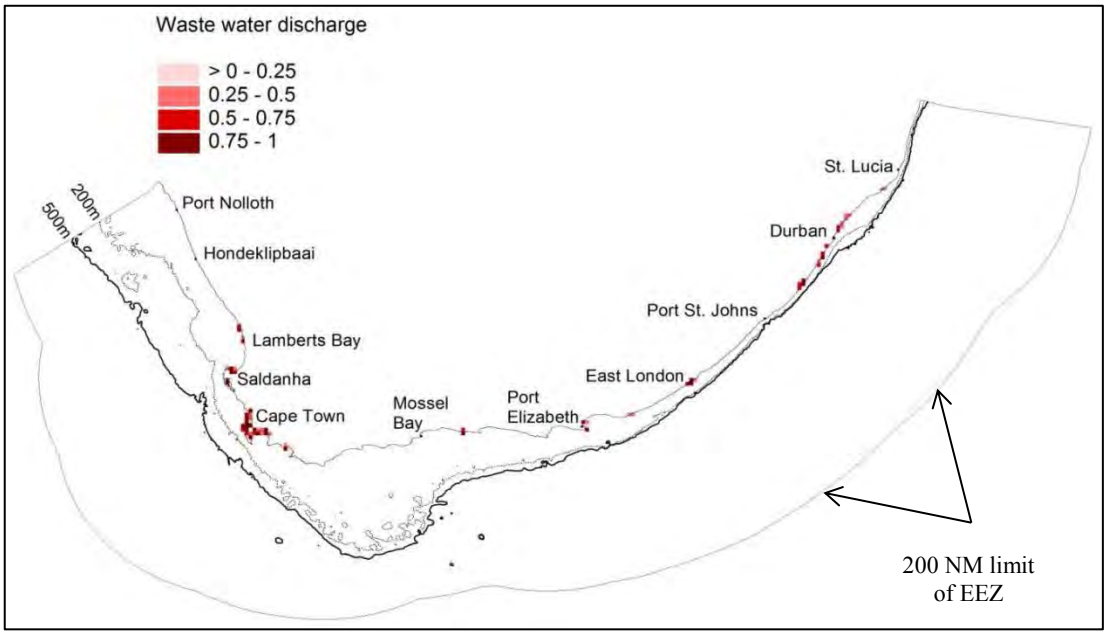


Figure 2.18. Discharge concentration points along SA coastline (Source: Sink *et al*, 2012:125).

Submarine communication Cables

In the technological age, communication is vital. Undersea cables are a necessary component as these form shorter connection distances compared to transmissions from

geostationary satellites and better quality data is transmitted at lower cost (Atkinson and Sink, 2008). These cables have a 1 NM activity exclusion zone on either side of them very similar to width servitudes found on land. The first intercontinental submarine cables were installed in 1993 and the last in 2012 (Figure 2.19). The cables link SA to the rest of Africa and other continents.

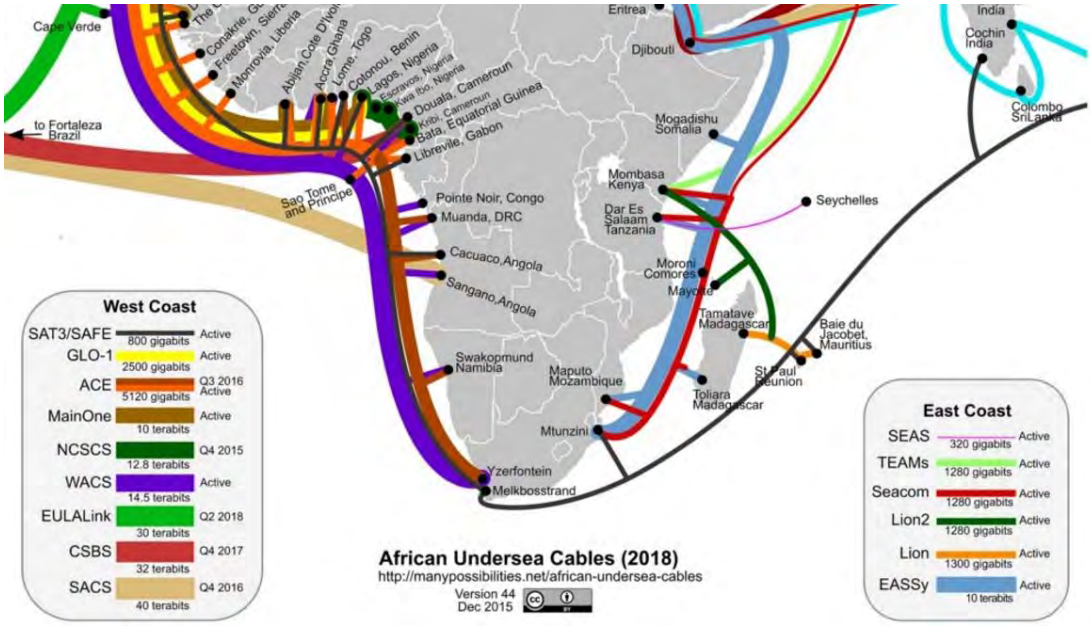


Figure 2.19. Submarine communication cables linking SA to the rest of Africa and the world (Source: Song, 2015)

According to Atkinson and Sink (2008), no environmental concerns are anticipated for laying of cables although they may pose safety threats. However the Electronic Communications Act 36 of 2005 (ECA), as amended, makes provisions in Section 21 for all other relevant government departments to be approached for obtaining any permit, authorization or approval. A "cable" includes undersea cables as per Section 1 of ECA implying that it falls within the scope of NEMA.

2.4.5. Marine Heritage

The National Heritage Resources Act 25 of 1999 (NHRA) governs heritage areas and objects. The NHRA is applicable to both terrestrial and marine environments. The SA Heritage Resources Agency (SAHRA) in terms of Section 39 of the NHRA undertakes compilation of inventory of National Estate and falls under the mandate of the National Department of Arts and Culture. National Estate is defined as heritage places or objects that have historical, cultural and environmental significance (SAHRA, 2014). In terms of marine related heritage, SAHRA established the Maritime and Cultural Heritage Unit (MUCH) that is changing the perception that marine heritage includes more than just shipwrecks within the EEZ. The aim of MUCH is to reflect SA's past relationship with water (SAHRA, 2014).

The Maritime Cultural Zone from the MZA is not sufficient in meeting the targets of MUCH. MUCH processes applications from anyone to proclaim marine heritage and reviews heritage impacts on the environment.

The SA Maritime Archaeology Development Programme, in collaboration with the Netherlands, identifies legacy sites that enable SAHRA to show the full scope of MUCH (SAHRA, 2014). These sites include, but not limited to:

i. Ship wreck sites
ii. Coastal fish weirs
iii. Maritime seascapes (fully and temporarily submerged)
iv. Unique micro and macro bioregions for scientific research.

Other than sites, heritage objects include, but are not limited to:

i. Those recovered from the soil or waters of SA marine jurisdiction like archaeological and paleontological objects, "living fossils", meteorites and rare specimens (SAHRA, 2014).
ii. Military objects lost to sea.
iii. Objects of scientific and technological interest.

Heritage sites and objects are gazetted nationally and provincially and permits are required for access, and in the case of objects, for export. Stakeholders in maritime heritage include (SAHRA, 2014):

i. The Centre for International Heritage Activities.
ii. DEA: Oceans and Coasts
iii. Ezemvelo KZN Wildlife
iv. Museums (e.g. Robben Island and Natal Maritime Museum).
v. Tertiary academic institutions for scientific research.
vi. Wildlife and Environmental Society of SA

2.4.6. Shipping

The majority of SA's trade is done by sea with major international trading partners and this necessitates shipping being a fundamental economic sector. The geographical location at the southern tip of the African continent places SA at an internationally critical trade node. SA is a maritime nation with major natural and manmade ports scattered along the coastline with Durban Harbour being the largest and busiest in Africa (Gründling *et al*, 2006). Passing ships use SA ports for refreshment and maintenance stops. Cargo vessels significantly

outnumber passenger ships and are responsible for carrying a variety of bulk products (petroleum, fruits, coal, manufactured goods, automobiles and other resources and products) resulting in 90% of trade by sea (Motlohi, 2013).

The high cargo movement and vessel traffic volumes necessitated the Traffic Separation Scheme (TSS) prepared by the SA NAVY Hydrographic Office (SANHO) that is applicable to all vessels in SA EEZ (SA Notices to Mariners, 2007, cited in Atkinson and Sink, 2008):

i. Laden eastbound vessels to steer a minimum of 25 NM away from coastal baselines.
ii. Laden westbound vessels to steer a minimum of 20 NM away from coastal baselines.
iii. Avoid MOSSGAS of Mossel Bay and the Alphard Banks.
iv. Vessels travelling between SA ports are exempt from the above two points but must remain a minimum of 10 NM from prominent coastal points dependent on weather and tidal conditions.
v. Seasonal changes affect the distance that laden vessels may travel in relation to the SA coastline.

Annual revision of the TSS depends on any significant changes to routes if port capacities change or new ports developed. The case of the Durban Dig Out Port south of the current Durban Harbour would have an effect on the TSS. The image of the TSS shows the restrictions on vessel movement in SA waters and restricted areas around MOSSGAS and the Alphard Banks (Figure 2.20).

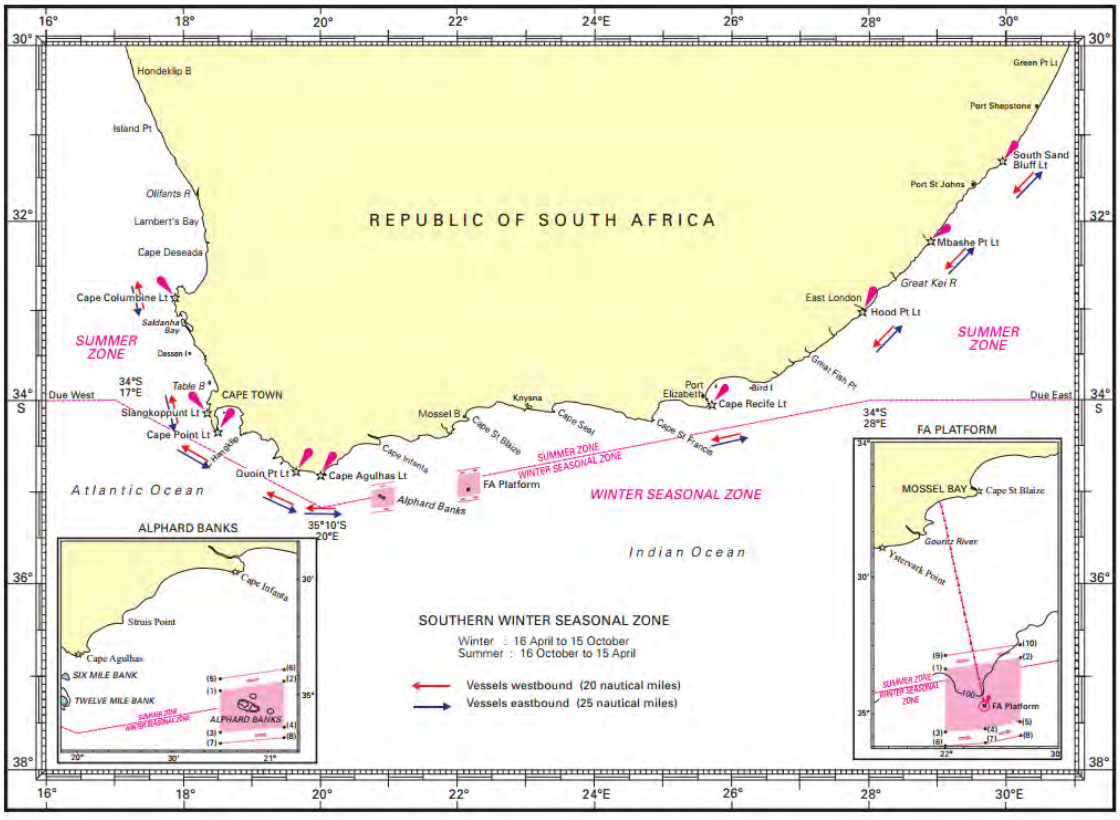


Figure 2.20. Traffic Separation Scheme applicable to SA's EEZ (Source: SANHO, 2014a:12)

The general restrictions listed above are shipping industry specific. The pressure map (Figure 2.21) demonstrates that almost all of the SA EEZ is subject to vessel traffic all throughout the year. The spread profile of vessel traffic, although at small scale, is indicative of overlapping many other marine activities.

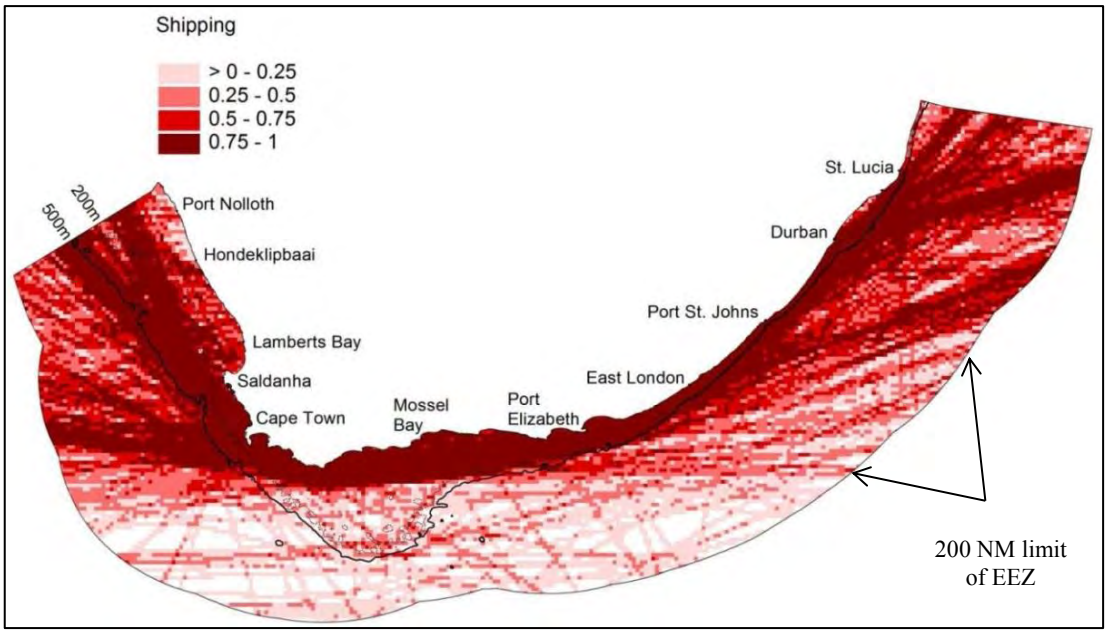


Figure 2.21. Scaled pressure values of shipping vessel traffic in SA EEZ (Source:Sink *et al*, 2012:119)

Shipping legislative and institutional framework

The National Department of International Relations and Cooperation (DIRC) is committed to promoting SA's national interests and promoting the country's international profile (DIRC, 2014). The DIRC participates and assesses draft international conventions along with other relevant government departments and decides if SA should become a signatory, and if it does, timeframes on establishing domestic legislation. SA is part of the UN and a collective of 170 countries forming the UN International Maritime Organization (IMO) (IMO, 2014). The IMO is the leading specialized organization in international maritime matters with focus on maritime safety and the preservation of the marine environment (IMO, 2014).

SA joined the IMO Council in 1995 as a Category C member (DIRC, 2014). This membership category is for a limited number of countries that have special interests in maritime transport/navigation and large volume of sea traffic, particularly cargo and fuel (IMO, 2014 and DIRC, 2014). Excluding the overarching UNCLOS, listed in Table 2.4 are pertinent IMO Conventions that SA is signatory to (DIRC, 2014):

Table 2.4. List of pertinent Conventions from the UN IMO that SA is signatory to

International Convention for the prevention of pollution from ships
Protocol to the International Convention for the prevention of pollution from ships
International Convention on Maritime Search and Rescue
International Convention for safe containers
London Convention on the Prevention of Marine Pollution
International Convention on Civil liability for oil pollution damage
Convention on the International regulations for preventing collisions at sea
International Convention for the Safety of Life at Sea
International Convention for the Safety of Fishing Vessels
International Convention on the Control of Harmful Anti-fouling Systems on Ships
MARPOL Convention (on marine pollution)
International Convention for the Control and Management of Ship's Ballast Water and Sediments
Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf

SA has two national departments and one agency that are front-runners in regulating the shipping industry in terms of navigation, cargo, safety and pollution. These are the National Department of Transport (DoT), DEAT and the SA Maritime and Safety Authority (SAMSA) (SANHO, 2014a). The SANHO, primarily responsible for marine hydrographic surveys and nautical charts, publishes notices to mariners on a continuous basis and these provide practical terms of reference for complying with ocean navigation, cargo, pollution and safety-of-life (SANHO, 2014a). Most of the legislation listed in Table 2.5 is domestic interpretations of the IMO Conventions and UNCLOS (SAMSA, 2013). This facilitates norms and standards for the global shipping industry.

Table 2.5. Shipping legislative and institutional framework for SA

Merchant Shipping Act 2 of 1981
Marine Traffic Act 57 of 1951
Marine Pollution (Control and Civil Liability) Act 6 of 1981
Carriage of Goods by Sea Act 1 of 1986
Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986
Marine Pollution (Intervention) Act 64 of 1987
Maritime Zones Act 15 of 1994
Wreck and Salvage Act 94 of 1996
SA Maritime and Safety Authority Act 5 of 1998
Ship Registration Act 58 of 1998
Dumping at Sea Control Act 73 of 1980
Admiralty Jurisdiction Regulation Act 105 of 1983
National Water Act 36 of 1998
Southern African Development Community Protocol on Shared Watercourses
National Contingency Plan for Prevention and Combating of Oil Pollution from Ships (derived of the Convention on Oil Pollution Preparedness, Response and Co-operation that SA is not signatory to).
African Maritime Transport Charter
African Integrated Maritime Charter
National Ports Authority (Transnet)
NEM ICMA
White Paper on the NEM of the Ocean (NEMO)

The shipping industry is beset with large volumes of legislation and Conventions. These all relate to the spatial area of SA's marine jurisdiction wherein a host of other activities occur. SA is a maritime nation with extensive use of maritime space and spatial datasets are not necessarily updated due to the target-specific nature of spatial data collection through industry-specific projects (Sink *et al,* 2012). The fractured approach to building a unified marine spatial data set for the ocean can negatively affect ocean activities and marine ecosystems. The implication is that different stakeholders may not know their own RRRs or those of others in terms of their existence and their spatial extents.

2.4.7. Pollution and dumping

Pollution and dumping of waste is an on-going problem that is twofold. The first problem is that of pollution from ships directly into the sea and the second is related to terrestrial activities. SA being party to the IMO and member of the International Hydrographic Organization (IHO), domestic application of controlled pollution and dumping is administered by the lead agency SAMSA (Atkinson and Sink, 2008). Shipping related management of pollution and dumping is covered by the listed Conventions, domestic legislation and protocols listed in Tables 2.5 and 2.6 of Section 2.4.6.

The respective government departments via NEMA and associated environmental legislation govern pollutants emanating from land. Provisions are included for dumping approved materials on shorelines, dredging, coastal infrastructure development, and offshore sumps for waste disposal, harmful chemicals, effluent and storm water discharge. State departments responsible for terrestrial environmental concerns consult their counterparts responsible for offshore environmental management regarding the crossover from land to sea.

2.4.8. Navigation, Naval and defence activities

The SA Navy is responsible for defending the waters of SA and preparation of navigational charts. For rapid response times to maritime incidents, the Navy regularly undertakes military practice and exercises in closed of coastal and offshore areas (SANHO, 2014a). These practice and exercises from SANHO (2014a) include:

i. Test firing of weapons.
ii. Sound testing
iii. Anti-aircraft technology tests and flight practice
iv. Submerged, semi-submerged or suspended explosive mines
v. Air-to-air/water/ground, ground-to-ground/water/air and water-to-water/ground/air weapon tests
vi. Submarine exercises and weapons testing.
vii. Demolitions areas

The military practice and exercise areas (PEXA) are situated along the coast of SA with some declared National Key Points. The locations of the PEXA are not shown on the SANHO navigation charts and those affected charts have notes referring to the applicable PEXA chart (SANHO, 2014a). This notifies users of whereabouts of the PEXA and that navigators are entering areas with possible naval activities. Annual publications, listing PEXA closed areas using geographical coordinates are made in the SA Notices to Mariners (SANHO, 2014a). Atkinson and Sink (2008) report occasional conflict between the SA Navy and coastal fisheries. The SA Notices to Mariners also provide terms of reference for reporting unusual marine activities, oil slicks, illegal dumping and a system of maritime signals, distress calling and weather effects. Regularly updated navigational hazards, offshore obstructions, maritime boundaries, bathymetry, shoaling fish, vessel traffic, MPAs, vessel traffic separation schemes amongst other marine related features and activities are collected by SANHO. The information for each activity type is not collected all at once. This is done when the need arises resulting in datasets of different epochs, standards and detail density. The navigational area for coordinating transmitted radio navigational warnings and maritime safety information is depicted by enclosing lines of latitude and longitude in Figure 2.22.

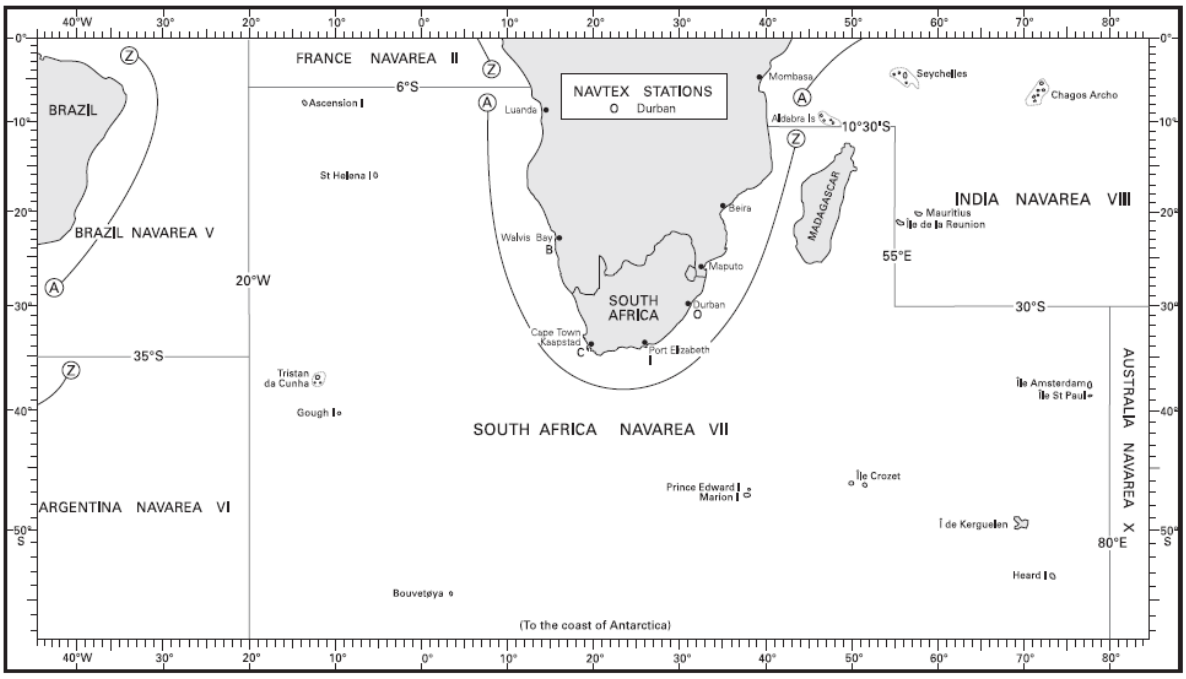


Figure 2.22. SA NAVAREA (Source: SANHO, 2014a)

The SA Notice to Mariners No. 20/2014 lists four lighthouses along the coastline that are fitted with unencrypted Differential Global Positioning Systems (DGPS) by the Transnet National Ports Authority (SANHO, 2014a). The DGPS is currently on trial encouraging

real-time kinematic positioning of vessels by mariners that is referenced to the four land based reference stations. SANHO is specific on weakening and unreliable signal further away from participating lighthouses and suggest use of a secondary and independent positioning system to cross-reference geolocation of vessels (SANHO, 2014a).

2.4.9. Coastal areas and development

The coastal area is economically and legislatively significant. This is where the transition from land to sea occurs and where the jurisdictions of certain legislation and enforcement agencies starts, ends, or overlaps. Coastal areas experience marine recreation tourism and extensive scientific research (Hall, 2005). Blue Flag status has been lost to numerous beaches from human and industrial waste washing out to sea from rivers that are fed by surface water from informal settlements and industrial areas (Davids and Mthethwa, 2014). Environmental scientific research is most evident on and near shorelines due to ecosystem diversity, biodiversity and contrasting depth profiles (Sink *et* al, 2012, Atkinson and Sink, 2008, Sink and Attwood, 2008 and Lombard *et al*, 2004). The majority of legislation described in other marine activities presented within Section 2.4 is applicable to the coastal zone of SA where most human activity is present. The most specific law that applies to the coastal zones is the ICMA and the recently published White Paper on the National Environmental Management of the Ocean (NEMO) (DEA, 2014).

2.4.9.1. The ICMA

Integrated Coastal Management promotes defensible scientific information together with principles of cooperative governance across all spheres of government for sustainable coastal development (Celliers *et al*, 2009). The ICMA meets the obligation of Section 24 of the South African Constitution relevant to protection of the environment for present and future generations and largely replaces the Sea Shore Act 21 of 1935 (SSA) (Whittal and Fisher, 2011). In order to achieve sustainable coastal development targets, Celliers *et al* (2009) identify the following themes evident in the ICMA:

i. Extensive public consultation is a necessary objective for environmental protection.
ii. Democratic decision-making.
iii. The absence of "top-down" prescriptive legislation and governance. Cooperative governance between spheres is key.
iv. A natural resource *and* people-centred approach.
v. Land and sea usage influences are difficult to divide.

The ICMA falls under the over-arching NEMA and both must be read in tandem. The ICMA prevails over NEMA regarding ocean conflicts, as the ICMA is specific in its offshore

provisions. The ICMA is applicable to the entire SA EEZ, internal waters, estuaries, islands, ships and aircraft in SA territory up. However, the application of the ICMA has a range of inland boundaries from the High Water Mark (HWM) as set out in the Act itself. Therefore, it is a legislative tool for the meeting point for the management of various State, private and civil society coastal activities in the coastal zone. This translates into a tool for managing overlapping and conflicting ocean usages. Table 2.6 indicates the statutory plans derived from various laws across all spheres of government.

Table 2.6. Statutory plans for coastal management (adapted from Celliers *et al*, 2009)

	SPHERE OF GOVERNMENT	**SATUTORY PLANS**
COOPERATIVE GOVERNANCE	**National** (Administered by relevant Minister)	- Environmental implementation of Environmental Management Plan (via NEMA) - National Biodiversity Framework (NEM: Biodiversity Act 10 of 2004).
	Provincial (Administered by relevant Member of the Executive Council)	- Provincial Strategic Environmental Assessment (via NEMA and from "National" above) - Provincial Economic Development Strategy
	Local (Administered by relevant Municipal Manager)	- Integrated Development Plan (Local Government: Municipal Systems Act 32 of 2000) (MSA). - Municipal Strategic Environmental Assessment (via NEMA and above two spheres). - Municipal Spatial Development framework (via MSA). - Municipal Land Use management System (via MSA)

2.4.9.2. White Paper on the National Environmental Management of the Ocean

To support NEMA and the ICMA, NEMO was published by the DEA in Government Gazette No. 37692. Acknowledgment of the complex nature of ocean governance, failures and challenges at domestic and international levels were identified and these informed six ocean governance objectives:

" 1. Coordinating and supporting the implementation of the relevant statutory and institutional frameworks;
2. Establishing mechanisms for sectoral data collection and sharing;

3. Creating and maintaining a shared national knowledge base on the human activities, status and functioning of the ocean;
4. Establishing integrated ocean sustainable development and conservation ocean plans by the undertaking of strategic environmental impact assessments and the use of spatial planning tools;
5. Enhancing national human and technical capacity to better understand and utilise ocean resources and opportunities; and
6. Pursuing regional and international cooperation and governance mechanism ”

(DEA, 2014:6)

NEMO aims to be a modern approach to ocean management (Lombard, 2014). The current sectoral approach is impractical in achieving integrated coastal management targets as different legislation, institutional mandates and irregular datasets are relied upon. The key to unlocking economic and environmental potential and preserving their integrity lies with aligning domestic legislation, institutions, international conventions and bodies against a robust, updated, cross-sector consistent spatial data backdrop.

2.4.10. Summary of SA marine activities

Sections 2.4.1 to 2.4.9 illustrate some of the major marine activities evident in SA waters with stakeholder RRRs. Key institutions are identified for implementation and enforcement of legal provisions found in extensive international and domestic legislative frameworks. The sectoral approach to ocean governance and management is demonstrated and can be described as task specific. The cumulative pressure maps of marine activities considered by Sink *et al* (2012) show the overlapping nature of marine activities from the SA shoreline to continental shelf edge within the EEZ (Figure 2.23). The cumulative pressure map asserts the view that marine activities are intense around urban areas of high population densities, close to coastlines and in offshore mining areas. High levels of human interaction with marine space are associated with major economic centres. The main issues pertaining to marine governance are summarized below:

i. SA has a large internationally recognized marine jurisdiction with the potential of spatial extension if the extended continental shelf claim is awarded.
ii. Large variety of international and domestic legislation and institutions.
iii. The SA coastline is constantly changing due to natural and manufactured causes.
iv. The numerous stakeholders with associated RRRs.
v. The complex nature of overlapping natural and human marine interests in an environment that is temporally volatile.
vi. A consistent spatial data framework relevant to all marine interests is lacking

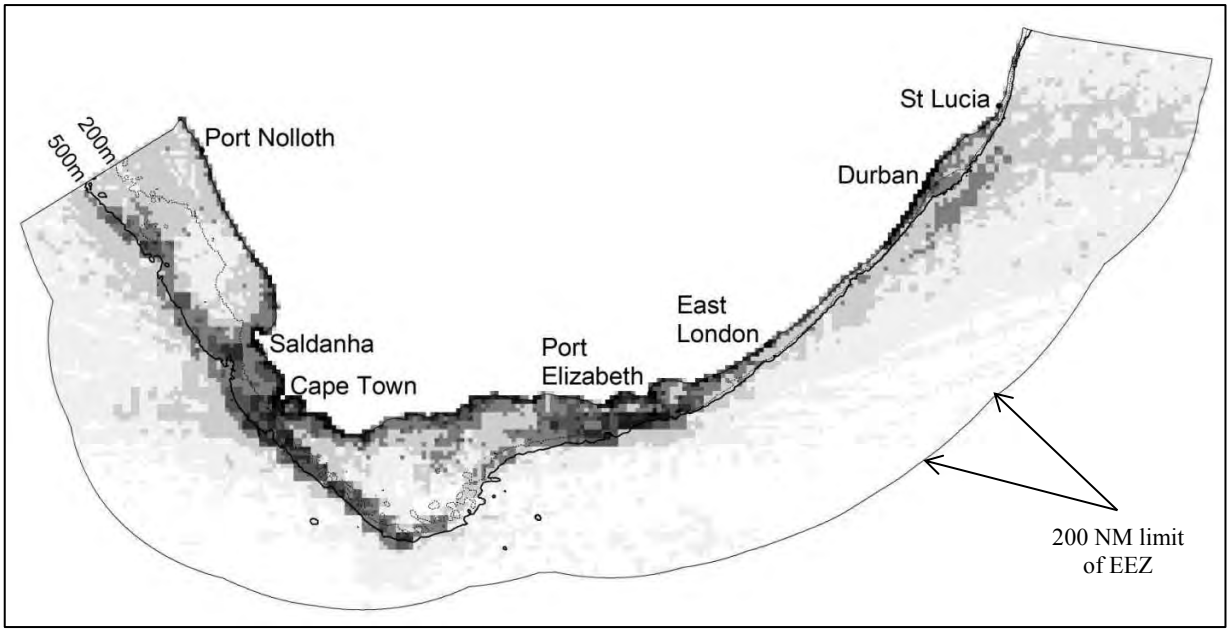


Figure 2.23. Cumulative pressures of marine activity pressure layers. Darker shades indicate more intense marine activities (Source: Sink *et al*, 2012:140)

The current SA ocean management system shows a complex regime with overlapping jurisdictions of legislation, institutions, the State, industries and civil society. This invariably leads to lack of coordination and cooperation between different state agencies and stakeholders in a diverse marine environment with numerous overlapping RRRs. Marine spatial planning and RRRs management needs clear and concise legislation without dualities and uncertainties (Douvere, 2008). Standardised SDI would be critical in spatially defining legal spaces of different legislative jurisdictions and stakeholder marine activities to improve SA ocean governance. The need to do so has already been identified by NEMO (DEA, 2014).

2.5 Status of SA marine surveys

SA marine surveys can be divided into two categories. The first relates to geographical/geophysical surveys that map natural seascapes, coastlines, maritime zones in terms of the MZA and human activity consequences. The second relates to surveys regarding natural biodiversity.

The SANHO is responsible for all offshore hydrographic surveys and for charting Namibian waters that is still the responsibility of SA (SANHO, 2014b). The SANHO has the following principle functions (SANHO, 2014b):

i. to conduct hydrographic surveys and produce paper nautical charts and electronic navigation charts (ENCs)

ii. produce hydrographic publications including List of Lights and Radio Signals and three volumes of Sailing Directions;
iii. maintenance of a tide gauge network and to provide tidal information;
iv. collect General Bathymetric Chart of the Oceans (GEBCO) data;
v. issue monthly Notices to Mariners;
vi. provide hydrographic survey training;
vii. provide a Maritime Safety Information, and
viii. provide a Chart Depot and Chart Agent service for access to information.

SA has a long history of marine surveys dating back to the early 1900s when the first surveys were conducted by hand lead lines (SANHO, 2014b). This method involved weighted measure tapes dropped into shallow coastal waters to measure depth to a maximum of 20m and were subject to accuracy concerns due to the unstable nature of survey vessels on water (Young, 2009). Hand lead lines were used for Admiralty Fair Charts (SANHO, 2014b). Fair Charts show an accumulation of marine related data on paper (Guy, 2000). As technology progressed to 1960, rudimentary single-beam echo sounders were introduced for depth measurements fitted to vessels and further offshore positions were measured by horizontal sextant angles and triangulation for near-shore positioning. Post 1960, saw progress to multi-beam echo sounders and improved real-time positioning methods that improved the accuracy of hydrographic surveys (Young, 2009).

SA's offshore hydrographic surveys is still a mix of all survey methodology used since the early 1900s (Figure 2.24). The spread of hydrographic surveys by SANHO displays large swaths of the SA coastal areas. Hydrographic surveys are more detailed where most activities occur. The high intensity activity areas are surveyed with technology that is more modern. Large sections of coastline still require updates with newer technology while a significant proportion of the EEZ away from the Territorial and Contiguous Zones are left relatively unsurveyed.

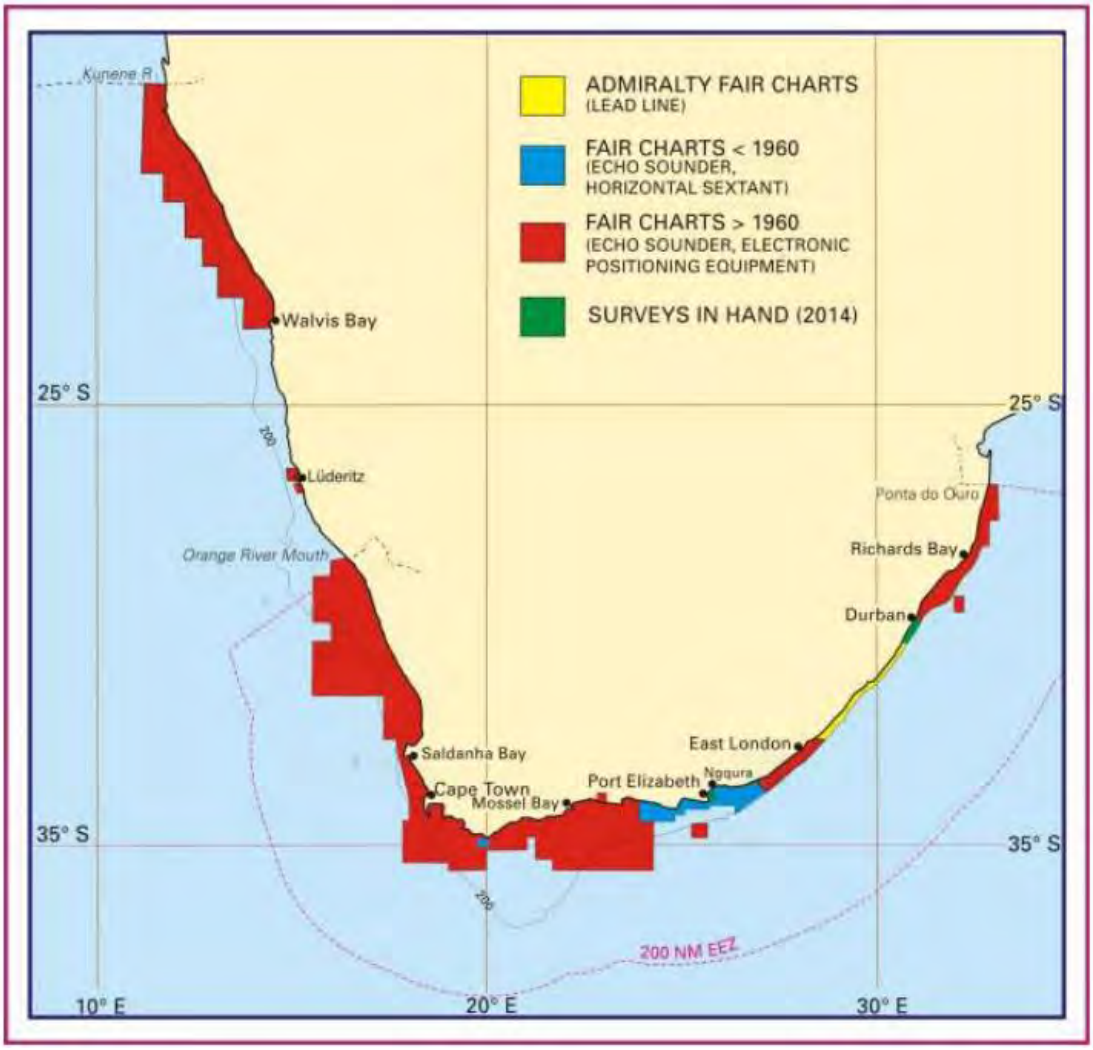


Figure 2.24. Status of hydrographic surveys of the South African and Namibian coast (Source: SANHO, 2014b:12)

Although outer reaches of EEZ appears unsurveyed, data exists for the SA EEZ in the form of bathymetric data reduced of satellite altimeter observations and gravity anomalies (Marks and Smith, 2006) and in analogous format from the GEBCO (SANHO, 2014b). GEBCO was halted in accordance to IHO Resolutions and consisted of 20 Collector Plotting Sheets that recorded echo soundings by vessels traversing the SA EEZ (SANHO, 2014b). The SANHO has converted the analogue GEBCO data to digital format that would assist interested stakeholders and contribute to the International Bathymetric Chart of the West Indian Ocean Project (SANHO, 2014b). Additional to the maritime zones surveyed in accordance to the MZA and incomplete survey of SA waters (Figure 2.24), the section of the claimed extended continental shelf falling out of the currently recognized EEZ has been surveyed using modern standards (DIRC, 2014). This makes evident a gap in the status of marine surveys in SA already encumbered by different survey standards since the early 1900s that are relied on to this day.

The ICMA introduced previously also makes provisions for coastal zones different to that found in the MZA as it recognises the complex nature of human activities found in coastal areas. The complexity of the ICMA prescribed zones, which are all not always surveyed and demarcated, leaves them boundaries referred to only on paper (Figure 2.25).

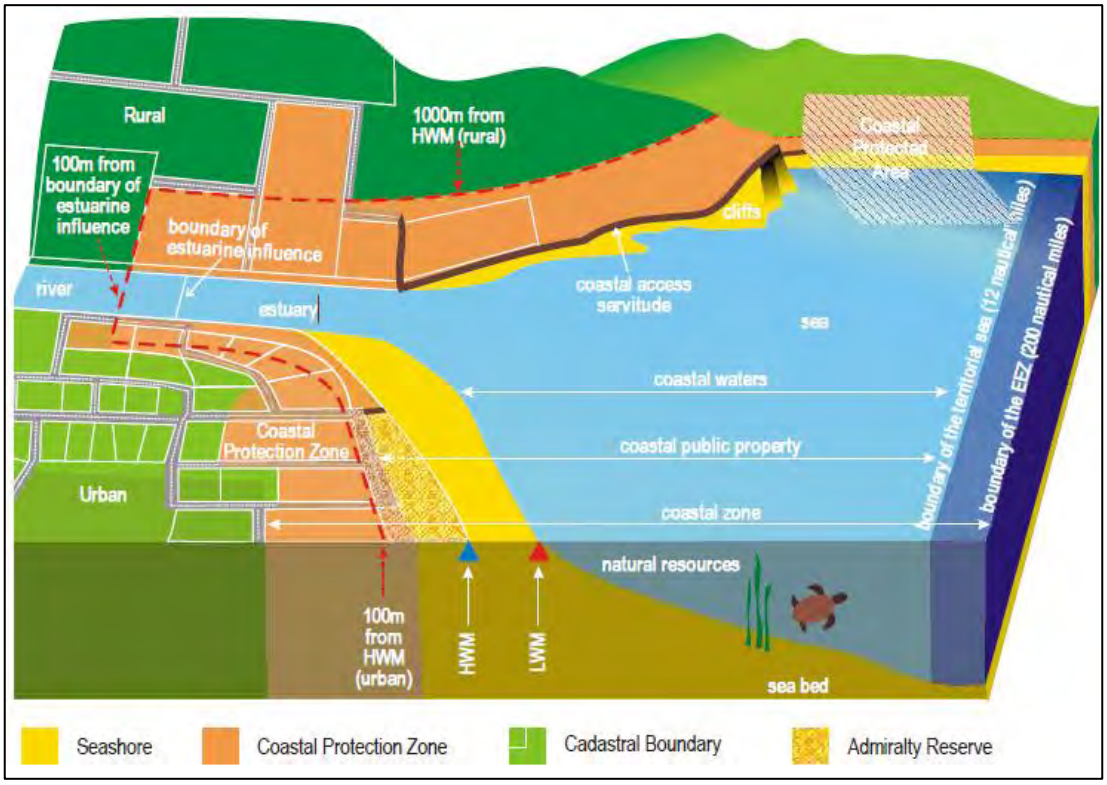


Figure 2.25. ICMA Coastal Zone of South Africa (source: Celliers *et al*, 2009:100)

The position of the High Water Mark (HWM) is relevant to the ICMA as this is the line of variable height (not a contour) from which various components are referenced (shown in Figure 2.25.). The HWM is subject to movement over time due to soil erosion or accretion and is defined in Section 1 of the ICMA as the highest line reached by coastal waters excluding the line reached by exceptional or abnormal weather or sea conditions, or estuaries closed from the sea. Research and propositions of practical examples of the legal position of the HWM by Williams-Wynn (2011) show that the HWM is not a constant line or contour and is subject to interpretation of available evidence such as debris, erosion, accretion, and coastal rock discolorations.

Regardless of maritime zones and boundaries, SA marine space is home to a diverse range of fauna and flora. Natural biodiversity disregards manmade boundaries, varies seasonally and is affected by unnatural human ocean usages that can be advantageous or detrimental.

Section 2.4.2. elaborates on the survey of spatial biodiversity of SA. Limitations of accurate biodiversity mapping include out-dated spatial datasets, different scales, different organizations collecting data for different needs, the land-sea interface and related spatial data (Sink *et al*, 2012 and Lombard *et al*, 2004).

The hydrographic and biodiversity survey status of SA waters appears fractured. This aligns the survey status to the sectoral approach of ocean governance and management. To avoid "redundant effort, inefficiency, [and] ineffectiveness", current sectoral approach to ocean governance requires coordination (Neely *et al*, 1998:1).

2.6. Factors influencing ocean management

As discussed in Section 2.2, freedom of the seas had to be altered due to marine jurisdictions being claimed and defined. This focus soon changed to sustainable development of oceans. Sustainable development involves meeting the needs of today's world without compromising the needs of the future generations. Overlapping social, economic and environmental aspects comprise the key concepts for sustainable development.

Exponential coastal population growth and increased marine activities are envisaged in the coming decades (FIG, 2005 and 2006). Many major metropolitan areas are situated in coastal plains and about 70% of marine pollution has terrestrial sources (Strain, 2006). Social, economic and environmental aspects of the South African context of marine activities and management were discussed in Section 2.4 and numerous shortcomings in sustainable development are evident. Attempts were made, as shown in the following sections, in recent decades to escalate the importance of sustainable development.

At the 1992 UN Conference on Environment and Development (UNCED) in Rio de Janeiro, informally referred to as "The Earth Summit 1992", the phrase "sustainable development" was attached to modification of human behaviour regarding consumption of natural resources and the divide between rich and poor nations (UN, 1997). Agenda 21 recognises inequalities in extraction and consumption of natural resources, rapid population growth and shift, poverty and affluence, health concerns, degradation of land, air and water amongst several other pressing issues affecting sustainable development (Robinson, 1993 and Robinson *et al*, 1993). Agenda 21 is a non-binding action plan aimed at countries to identify and act upon their risks and suggests that there are roles for everyone from national government, private industries, academic institutions and civil society to contribute towards sustainable development as action or inaction has ripple effects (Lafferty and Eckerberg, 2013). Chapter 17 of Agenda 21 is relevant to sustainable ocean management and draws on UNCLOS. Chapter 17 provides detailed steps for achieving sustainable development of coastal areas, marine resources, enclosed and semi-enclosed seas (UN, 1997).

The following programme areas are listed in Chapter 17 of Agenda 21:

a) Integrated management and sustainable development of coastal areas, including exclusive economic zones;
b) Marine environmental protection;
c) Sustainable use and conservation of marine living resources of the high seas;
d) Sustainable use and conservation of marine living resources under national jurisdiction;
e) Addressing critical uncertainties for the management of the marine environment and climate change;
f) Strengthening international, including regional, cooperation and coordination;
g) Sustainable development of small islands.

Since the 1992 UNCED, the UN has hosted several world meetings on sustainable development. The 2002 World Summit on Sustainable Development (WSSD) was held in Johannesburg and partial failure of Agenda 21 was recognised, however, the goals of Agenda 21 were reaffirmed under the "Programme for the Further Implementation of Agenda 21" (UN, 2002). The same aims of Chapter 17 for sustainable development of oceans was raised and carried forward. The Johannesburg Plan of Implementation and Millennium Development Goals (MDGs) were determined at the 2002 WSSD. The year 2015 was set as the target for achieving the MDGs.

In 2012, the Rio +20 UNCED was held to review the past two decades of sustainable development goals. Focus was set on achieving political support with clear and practical measures on reaching objectives on sustainable development while considering changing political, technological and conservation regimes (Leggert and Carter, 2012). The 2015 deadline for the MDGs was revised and, for purposes of continuity, renamed the "Sustainable Development Goals" (UN, 2012).

The on-going UN conferences raise both positive and negative outlooks on attempts for sustainable development, both on land and sea. It is encouraging that dialogue between nations is occurring. Regional and global circumstances change but constant revision of sustainable development targets as had occurred over the past decades will delay actionable implementation. The delays are attributed by Leggert and Carter (2012) to the UNCED being voluntarily binding. This leads to an inconsistent approach by countries tackling

sustainable development targets. This is similar to the challenges faced with the four Geneva Conventions regarding marine management insofar as voluntary participation is concerned.

2.7. Spatial Data Infrastructure

Thus far, marine activities and the need for improved ocean management has been discussed. All activities have a location component and access to reliable, applicable and current SDI is a fundamental base upon which management should rest. The capability of visualizing resources, activities or features using spatial data representation enables better planning, management and protection measures by creating and attaching RRRs (Strain, 2006). Spatial data would the relation and interaction of activities in a two, three, or four-dimensional space. Spatial data itself differs from SDI. Spatial data refers to the location of a feature using numerical values on a geographical coordinate system. Spatial data is a component of SDI.

SDI has varying definitions in different countries and to different levels of implementation and detail within those countries (Strain, 2006). SDI components consist of interconnected users, norms and standards, tools, spatial and metadata that can be queried to show relationships between different types of information related to defined spaces (Borzacchiello and Craglia, 2013). The knowledge gained from a collection of different datasets allows linkages to be drawn between different activities and locations, subsequent map production and analysis to inform decision-making (Mapping Sciences Committee, 1995, cited in Strain, 2006).

Rajabifard *et al* (2002) suggest critical components for SDI (Figure 2.26). However, SDI is viewed as dynamic in nature as all information acquired maybe used for a variety of applications (Kok and van Loenen, 2005; and Rajabifard *et al,* 2002).

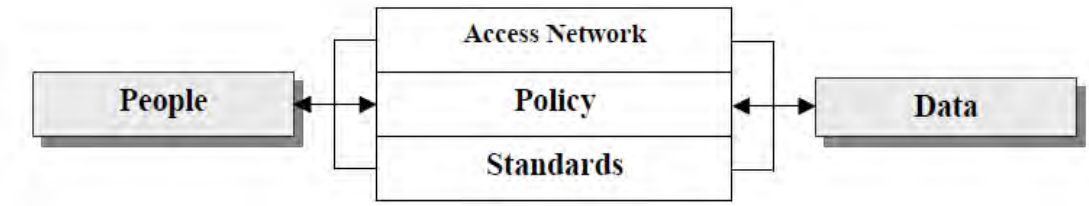


Figure 2.26. SDI components (source: Rajabifard *et al*, 2002:24)

Data that can be used for multiple purposes are fundamental and any other data ancillary according to Bishop *et al* (2000). Examples of fundamental data are digital elevation models, cadastral data, transport, aerial imagery, fauna and flora distribution, state jurisdictions, addresses and identity numbers (Strain *et al*, 2006). Interoperability of data is necessary across all stakeholder groups so that data output from SDI queries are spatially consistent

and represent reality. Standardization of disparate and often duplicated datasets that are held in data silos by different state and private organizations is required for reliable SDI (Clark, 2011). Standardization and unification of disparate datasets would curb unnecessary duplication and drive down costs and includes:

i. Content standards
ii. Geodetic reference systems
iii. Accuracy
iv. Data dictionaries and symbolism
v. Data quality and frequency of updates.
vi. Accessibility rights that include open-source, sensitive or private data, licencing and pricing models.

The last point above is included within the "access networks" component (Figure 2.26). Access networks make data available to users via online portals, data directories or data houses and are constrained to the applicable policies and standards of the institution administering the SDI (Strain, 2006).

The use of SDI is becoming more widespread across government agencies as cooperative governance is acknowledged as a driver for improved service delivery and sustainable development. SA promulgated the Spatial Data Infrastructure Act 54 of 2003 (SDIA) that aims to create an electronic catalogue, determine standards and prescriptions for spatial information sharing, and to provide for the capture and publishing of metadata. Existing policies, such as the SDIA, govern other components of SDI. The SDIA provides standardization parameters for data derived of other policies e.g. gazetted municipal boundaries or legally defined maritime zones.

The "people" component (Figure 2.26) is most significant as people supply, create or use spatial data that can be applied to elections, taxation, land administration, socio-economic analyses, natural resource management, environmental impact analyses (EIAs) etc. (Strain, 2006). As with a hierarchical state management (the three spheres of government), SDI hierarchy has been proposed by Rajabifard *et al* (2000) where the level of detail, types and distribution of detail of spatial datasets reduce in scale from corporate through to global SDIs (Figure 2.27). The hierarchical model shows that the lower tiers support those above enabling simultaneous "bottom-up" and "top-down" approaches to SDI and the importance of collaboration between all stakeholders (Strain, 2006).

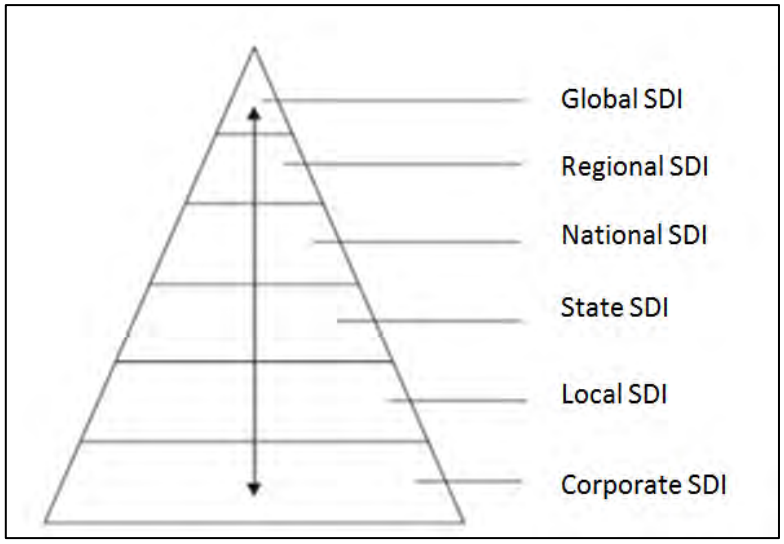


Figure 2.27. Hierarchical SDI declining in detail from base to apex as scale increases (source: Rajabifard *et al*, 2000:47)

The ultimate purpose of SDI is to "facilitate the exchange and sharing of spatial information" (Strain *et al*, 2006). Inevitably, it is the political will and policies of a country that influences the content of SDI and as political regimes differ globally, no two SDIs are the same.

SDI design as discussed above makes no differentiation between terrestrial and marine SDI applications. Both land and sea have spatial components with associated activities that can benefit from a streamlined SDI design. As humans are land dwelling creatures, focus on land SDI development outpaces that of SDI designed for offshore applications. Marine SDI is viewed as a missing component from most national SDIs (Bartlett *et* al, 2004). The views discussed in Section 2.6 exposes the need for better marine property and RRRs management systems.

2.8. Cadastral Systems

A cadastral system has multiple purposes but the two most recognized purposes are those of creating security of tenure and for taxation (Enemark *et al*, 2010). The etymology of the English word *cadastre* came through the French from the Late Latin word *capitastrum,* meaning a register for tax, and through the Greek's *katastikhon*, meaning "down the line" in reference to the angles and distances between monuments defining a parcel of land (Chisholm, 1911). In modern times, cadastral systems matured into formal systems of land tenure information (Barry and Roux, 2012). This links the various RRRs to geometric descriptions of land parcels that is described graphically and verbally on registered diagrams, title deeds and leases. This provides the State and rights holders an invaluable tool to record

ownership rights. Cadastral systems have been used in different forms in many countries over hundreds of years. The South African land cadastre is explored in the following sections. Thereafter the international theory of a marine cadastre is discussed.

2.8.1. South African land cadastre

The word "land" has different meaning to different people and is dependent on its use (Tjia and Coetzee, 2012). In SA, land is an economic resource and tax base providing critical income to maintain the operations and functions of local government. Land cadastral systems throughout the world have reputation for reliability, clarity and legitimacy to guarantee security of private land ownership (Kaufmann and Steudler, 1998). Land cadastral systems were created initially to provide a property tax base, but evolved to better manage private land but social change. However, globalization, interconnection of businesses and technological progress has led to a rethinking of traditional cadastral systems (Kaufmann and Steudler, 1998). This is relevant to post-Apartheid SA that ushered in social change, rapid urbanization, population growth, land reform and further industrialization.

The Cadastral Template Project (CTP), set up by the Permanent Committee on GIS Infrastructure for Asia and the Pacific a decade ago, had the aim of uncovering the entire social, institutional and conceptual context of a country's cadastral system (Rajabifard *et al,* 2007). The objectives of the project summarized by Rajabifard *et al* (2007), Steudler *et al* (2003) and Hull (2014) were to:

i. learn the role cadastre plays in a country's SDI,
ii. compare best practice as a basis from which to improve cadastres
iii. identify key cultural contexts hindering effective land administration.

The CTP consisted of a comprehensive questionnaire to collect country specific cadastral information. The CTP is open for all countries to complete. The SA Chief Surveyor-General (CSG) completed the CTP questionnaire and therein stated the purpose of the SA cadastral system as

> "The primary function of the Cadastral System in South Africa is to define (delineate and document) ownership rights. Any land that has not been transferred from the state to a juristic person remains the property of the State. Any juristic person that has been granted freehold rights is free to trade (transfer at market value) that immovable property. Accurate delineation of the ownership rights has enabled the development of a Cadastral Information System, which

> forms the basis for land valuation, land taxation, development planning, local authority demarcation and land administration".
>
> (Riba, 2010)

The statement provided by the CSG indicates that the SA cadastral system forms a fundamental base for numerous social and economic activities. The Cadastral Template for SA includes the following (Riba, 2010):

i. *Freehold ownership* - the greatest rights over land allowing owners to use it at will within legal limits or title conditions, dispose or sell it, use it for loan security or exclude its use by other who have no rights over it.

ii. *Leasehold ownership* - contract between an owner and another person to use his/her property for a specified time.

iii. *Servitudes* – a registered right vested in a person who derives some advantage from another's property

iv. *Sub-surface rights* – rights to minerals and petroleum (In terms of the MPRDA, all mineral and petroleum resources are by default the property of the State and have been severed from the land parcel and via application to the DME and following its prescribed processes, can mineral rights be acquired by private entitities)

v. *Sectional Title* – enables portions of buildings to be owned with undivided ownership of common property.

vi. *Permission to occupy* – Black people could not own land during Apartheid and were issued letters, sometimes with a locality plan attached, to occupy land that was held in trust by the State. These were never registered at Deeds Registries and are currently being converted to freehold ownership.

vii. *Other discriminatory tenure practices* inherited from Apartheid that is being dealt with within the confines of the SA Constitution and Land Reform programme.

The SA cadastral system, in view of the CTP, still guarantees security of private ownership but also includes measures to deal with pressures forcing it to adapt. The pressure from increased urbanization and population growth sees communal living in sectional title schemes becoming more prevalent. Upgrading of discriminatory land tenure to constitutionally acceptable tenure standards has provided millions of people access to the land economy in post-Apartheid SA.

2.8.2. Historical outline of SA cadastral system

SA has a rich and complex history that influenced the cadastral system in place today. Evolved Roman-Dutch law imported into SA exists alongside increasingly recognised indigenous customary laws (Cawood and Minnitt, 1998). The first land surveyor arrived about five years after Jan van Riebeek established the first European colony in the Cape in 1652 (Riba, 2010). The Cape Colony (Cape of Good Hope) was a necessary refreshment station for the spice trade route to the East by the Dutch East India Company (VOC) (Hodson, 2004). As the colony grew, new types of livelihoods outside servicing the VOC developed. Farmers and occupation of land plots outside the colony increased in number and a land management system was needed. The VOC issued land without any surveys and as more land was requested, a Land Registry similar to that in use in the Netherlands was introduced (National Geo-spatial Information (NGI), 2013). The initial tenure types were freehold, leasehold, quitrent or eiegendom (Duly, 1968). These tenure types were attached to a Title Deed and graphical depiction of the land parcel (NGI, 2014).

After British invasion and occupation of the Cape towards the end of the 18th century, Governor Sir John Cradock introduced the Cradock Proclamation of 1813 (Cawood and Minnitt, 1998). The Proclamation enforced that no recognition be given to property sales in the absence of surveys and registration (Hodson, 2004 and Riba, 2010). The Proclamation "converted loan tenure to perpetual quitrent" (NGI, 2013). The British rectifying the rudimentary Dutch land management system, viewed the Proclamation as early land reform and subsequent contestation by the Dutch settlers lead to a Commission of Inquiry (Hodson, 2004). The Commission disregarded the Dutch and used the Proclamation to entrench control of the Cape by establishing the first Surveyor-General's Office (SGO) and Deeds Registry Office (DRO) in Cape Town (Tennant and Jackson, 1895). The new British government unsettled the Dutch who left the Cape in large numbers between 1832 and 1837 to new provincial frontiers of the Orange Free State, Transvaal and Natal (Hodson, 2004). The Great Trek, as the exodus became known, formed the three new independent states in SA with individual governments, separate from the Cape (Cawood and Minnitt, 1998). The Dutch, predominantly farmers, became known as the Boers. Leaders of the Boer Republics agreed with the Cape Colony to form the Union of SA in 1910. This agreement came after the English annexed Natal from the Boers in 1843 and therein installed the Cape land system (Hodson, 2004). Rapid colonisation of the interior resulted from the discovery of precious metals and stones. This subsequently necessitated a land registry in Pretoria in 1866 (Cawood and Minnitt, 1998). Thereafter, three more land registries were opened in each independent state (Lester and Teversham, 1995).

Despite the Cradock Proclamation reforming the earlier Dutch system to land management by enforcing surveys and title registration, the surveys were “haphazard and careless... Maps were compiled by fitting together diagrams on a trial and error basis and imagination, guesswork and blatant omission were the compiler's tools in getting the pieces to fit” (NGI, 2013:1). Sir David Gill was appointed Her Majesty’s Astronomer at the Royal Observatory at the Cape of Good Hope in 1879 (Calder Wood, 1943 and Zakiewicz, 2005). Gill recognised the need for addressing the fractured survey system to avoid future land disputes over boundary positions and commenced with the first South African National Geodetic Survey in 1883 from which all future surveys could be referenced (Hodson, 2004; NGI, 2013; Smith, 2006 and Zakiewicz, 2005).

The current cadastral system in SA, is due to the influence of the spread of the British throughout SA and is based on Roman-Dutch laws, which the British decided to keep. After the Union of SA was established in 1910, several discriminatory laws were passed to subjugate native Blacks and they were not permitted to own land. Indigenous customary tenure was disregarded except for areas demarcated as reserves that later became known as homelands.

In 1927, the Land Survey Act 9 of 1927 (LSA) was passed. The LSA was derived from best practice in other countries and relied on physical surveys and beaconing of boundary bend points to enclose properties (Hodson, 2004). The LSA gave further legal recognition of surveyed properties graphically depicted on diagrams after approval by established SGOs. The LSA did not make it mandatory for surveys to be linked to the national geodetic framework. The SGO is a public office that records all changes in cadastral boundaries. Surveys submitted to the Office are regulated by the LSA provisions and regulations. The 1927 LSA was amended several times and was replaced by the Land Survey Act 8 of 1997 which highly regulates the work of members of the survey profession in terms of standards and accuracies. Ultimately, application of the LSA should result in every land parcel being surveyed, every survey linked to the national coordinate system, every land parcel being given unique identifiers and archived at provincial SGOs with the survey records of the field observations and survey methodology used by the professional land surveyor (Hodson, 2004). The diagrams map property on the ground in two dimensions and form the spatial component of the South African cadastral system. The other components comprise the RRRs incorporated into cadastre by the land use planning and property taxation administered in SA by municipal authorities and by deeds registration at the Deeds Registration Office (DRO).

The Deeds Registries Act 47 of 1937 (DRA), as amended, is modelled after Roman-Dutch Law where land transfers were to occur before a judge and recorded in a register of transactions (Hodson, 2004). In the modern setting, land registration is the dominant function of the deeds registry and includes documentation of land transactions by taking into account legal facts, legal consequences and the size, location and usage of land parcels (Henssen, 1981). In Hodson (2004) and Nichols (1993), land registration is described as an officially recognised and systematic approach for managing land tenure with information about people, RRRs and the land itself. Shange (2010:7) explains an official land registration system as processes managed and information kept by an appointed government institution supported by systems that has "policies, standards, and procedures in place to collect, validate, maintain, and provide access to the information".

Land registration is a public-private sector partnership where legal documents are prepared by conveyancers and approved by lawyers in the employ of DROs. The issued title deed represents a legal land transaction and gives the holder:

i. Tenure security over the uniquely numbered land parcel with a similarly unique title deed register number.
ii. Defines ownership rights.
iii. Highlights other non-real rights related to that land parcel.
iv. Offers the holder entrance into the land economy (mortgage bonds, collateral, bank loans etc.)
v. The wording of the title deed and definition of the location of parcel boundaries reduces conflict and disputes that may arise.

No title registrations may occur without an approved SGO diagram mapping the land parcel as it appears on the ground. The inclusion of RRRs and using land on the property market incorporates a large number of other legislation that spans all spheres of government and government departments. These include minerals and energy, municipal systems, taxation, valuation, environmental concerns, planning etc. The spatial representation on legally derived diagrams from SGOs and text documents in the form of the deeds from the DROs together form the basis for all land development and the land economy in SA.

2.8.3. Registration of mineral and petroleum interests in South Africa

The DME is responsible for adjudicating mining and energy interests on land and offshore, but within the 200 NM limit of the SA EEZ. Section 2.4.1 discussed the history and legislation of mining offshore and offshore prospecting and production of minerals and petroleum is much closer to the SA coastline. The DME's mandate is to ensure that

prospecting and production of resources obtained from mining employs the correct environmental management protocols (Atkinson and Sink, 2008).

On land, the DRO is responsible for registering title deeds in terms of the DRA other than mining related rights. Land-based and offshore-based marine rights are registered in terms of the provisions of the MPRDA and specifically the MTRA. The main difference between on and offshore applications for mining related rights to the DME involve a title deed for most onshore applications as these rights must be linked to the national land cadastral system.

Prior to the MRA being repealed by the MPRDA the holder of a right in terms of the MRA was defined as "-the owner of the land or, if the right to such mineral in respect of the land is severed from the ownership of the land, the person in whose name to such mineral is registered in the deeds registry concerned". Cawood and Naidoo (2010:201) assert that the rights issued by the MRA, and later, the Minerals Act 50 of 1990 had "real rights" status which included mineral rights ownership, licences, leases and other prospecting authorizations. These fell into the definition of immovable property and registration at DROs was required. Registration required a diagram of property first surveyed by a professional land surveyor and approved by the SGO.

In terms of the MPRDA all mineral and petroleum resources are by default the State's property and completely severed from the land parcel. Offshore, all such resources vests with the State. Once the MPRDA was passed, the State became custodian of all mineral and petroleum resources and the real rights status of mining rights was converted to limited real rights status thus losing their status of being immovable property. All historical mining real rights held prior to the MPRDA being passed, were phased out using the provisions of Schedule II. This led to all existing mining associated rights becoming limited real rights incapable of being registered as DROs. The MPRDA resulted in significant amendment of the MTRA in 2003 (via Government Gazette No. 25762). The main change, according to Cawood and Naidoo (2010), other than the change of status of rights, was the replacement of the previous Mining Titles Office with the Mining and Petroleum Titles Registration Office (MPTRO) to enhance tenure security of holders of any form of mining limited real rights. The MPTRO is "responsible for the registration of exploration and production rights, and keeps a record of all reconnaissance and technical cooperation permits" (Oberholzer, 2012:159).

The MTRA distinguishes between a diagram and plan, when either is required, and the technical and spatial information needed for an application for mining related rights to the DME. It is generally accepted in SA than any cadastral boundary/beacon survey and

certification of that boundary or beacon is reserved for the registered professional land surveyor. The MTRA sets aside survey diagrams for preparation by professional land surveyors, as SG approval is necessary. Either mine surveyors or professional land surveyors can prepare plans under the MTRA. The MPRDA, on the other hand, does not specifically differentiate between a plan and diagram. A professional land surveyor must prepare plans for mining rights. Either professional land surveyors or mine surveyors can prepare plans for all other mining applications.

Ultimately, the MPRDA and the MTRA not only shifted the historical paradigm by severing mineral rights from land parcels and vested them with the State as custodian, but also created a separate register outside of the DROs for mining rights which are limited real rights. The DRO, which registered these rights as real rights in the past, can no longer do so. The overlap between the DROs and the MPTRO occurs when property title deeds are noted to refer to registered mining title over the same property. This is done at DROs to safeguard possible future owners of properties with registered mining title. Mining title can last for up to 30 years and affects the RRRs of owners or occupants of affected properties.

2.8.4. Marine Cadastre

The influence on humankind by the sea, seabed and land-sea interface is evolving with time. Widodo (2003) identifies the rising importance of the sea and the resulting extraction of marine resource benefits as land resources are exploited and become scarce. However, the purpose of the sea has evolved as humankind developed over time and the management of marine space has come to the forefront of international research. A standardized definition for marine cadastre is complicated by the constantly changing marine zones in relation to the changing land-sea interface (Binns *et al*, 2004). Some of the changes, which happen at different rates, include global warming, natural change in shape of coastlines, sea temperature rise and so on (Binns *et al*, 2004, and Collier *et al*, 2001). Adaptable SDI is viewed as a tool to accommodate constant change in coastal and marine areas (Akıncı *et al*, 2012).

Despite challenges, numerous countries have, or still are researching and defining marine cadastre. In most cases the definition of marine cadastre is specific to a country's needs based on its past political and sea management regimes, and the direction the country is heading in terms of economic growth and sustainable development. Several definitions have emerged in response to the global realization that there is a need to improve administration of coastal and marine environments. In the first definition according to Robertson *et al* (1999:6), marine cadastre is defined as:

> "A system to enable the boundaries of maritime rights and interests to be recorded, spatially managed and physically defined in relationship to the boundaries of neighbouring or underlying rights and interests".

Nichols *et al* (2000) defines marine cadastre as an information system that encompasses both the nature and the spatial extent in property rights and interests with respect to ownership, various rights and restrictions in the marine jurisdiction. In Collier *et al* (2001), marine cadastre is a tool to define, manage and administer the limits that would be legally recognized together with associated RRRs. Various other researchers are offering a number of different definitions of marine cadastre. The common thread amongst these definitions is that marine cadastre is a spatial information system. The multiple dimensions of these boundaries further complicate understanding them. The spatial depictions of marine boundaries are difficult to envisage. However, marine cadastre (being a component of marine management systems) requires access to spatial information that is reliable and accessible to all stakeholders.

2.8.4.1. International Marine Cadastre

Many countries have recently identified alarming degradation of coastal areas and that sustainable and integrated management is required. The similarity of issues faced by different countries led to cadastral systems for the marine environment being researched and developed as management tools in North America (Canada and the USA), New Zealand and Australia. These countries each have different geographical layouts, marine jurisdictions, histories of marine management and political regimes, yet have all recognized that geospatial precision linked to RRR clarity and allocation is necessary to improve marine management systems.

North America

Canada has many offshore islands resulting in 3.7 million square kilometres of ocean space (UN, 2003). Nichols *et al* (2000) asserts that focus or research should be on identifying the marine jurisdictional limits of Canada and other countries with complex coastlines and islands. Good governance of the sea is: (i) knowing what living and non-living resources there are; (ii) who holds the rights and responsibilities for their safe and orderly conservation, distribution and exploitation and (iii) the boundaries of those rights and responsibilities (Ng'ang'a *et al*, 2004). Pilot study areas were chosen with different types of MPAs, problems in delimiting provincial limits of New Brunswick and lastly, an investigation into delimiting the outer limits of Canada's continental shelf (Ng'ang'a *et al*, 2004). The study focused on spatial data and delimiting marine boundaries, excluding sustainable development objectives and suggested that a marine cadastre could be the basis

to support multipurpose marine management systems (Ng'ang'a *et al*, 2004). The study identified several challenges when identifying marine boundaries:

i. Numerous different authorities based on different mandates, legal definitions and interpretations produce marine boundaries.
ii. Data currency.
iii. Inconsistent surveys of coastlines and separation line of the land from sea.
iv. Multitude of international and domestic laws.
v. Historical usage and title claims.
vi. Ambulatory nature of the sea.

Nichols and Monahan (1999:1) explain the complexity of Canada's marine territories and define them as a "mosaic of jurisdictional, administrative and property boundaries". The confusion arising from boundary positions complicates any marine management system. Standardization, cross-sector partnerships and inclusion within the national SDI (land and sea) was identified as requirements to clarify ocean boundary delimitation and RRRs.

In the USA, policies that managed ocean space and resources have historically been developed as single purpose regimes with little thought of how they would interact with other management systems (Fowler and Treml, 2001). To remedy the disparate systems, the Coastal Services Centre (CSC) of the National Oceanic and Atmospheric Administration (NOAA) facilitated an integrated and comprehensive ocean management strategy (Fowler and Treml, 2001). The CSC implemented the Ocean Planning and Information System (OPIS) that visually represented policy and management organizations. OPIS concentrated on the south-eastern states of the USA. OPIS faced challenges of being adaptable to changing legal and political situations, new technology, mean sea level variation, reference datums, or any other necessary change envisaged or possible (Fowler and Treml, 2001)

In 2007, the US government recognized the need for a multi-sectoral approach for ocean management to include local and international policies and conventions, all stakeholders, natural resources, political regimes, population distribution and socio-economic factors (NOAA, 2009). The government understood that an information system of this type will require collaboration and data sharing and in 2007 the NOAA Integrated Ocean Observing System (IOOS) was established with Congress fully authorizing the system by promulgating the Integrated Coastal and Ocean Observation System Act in 2009 (NOAA, 2009). The NOAA IOOS provided a tool for a holistic management view of the marine space under US jurisdiction with the earlier OPIS system being absorbed into the IOOS to provide some base maps (NOAA, 2009). The NOAA IOOS was a cadastre described as a SDI in which marine and coastal RRRs could be linked, assessed, administered and managed (NOAA, 2009). The

extract of the US Marine Cadastre shows the fundamental base layers of spatial data and associated layers of other spatial information (Figure 2.28).

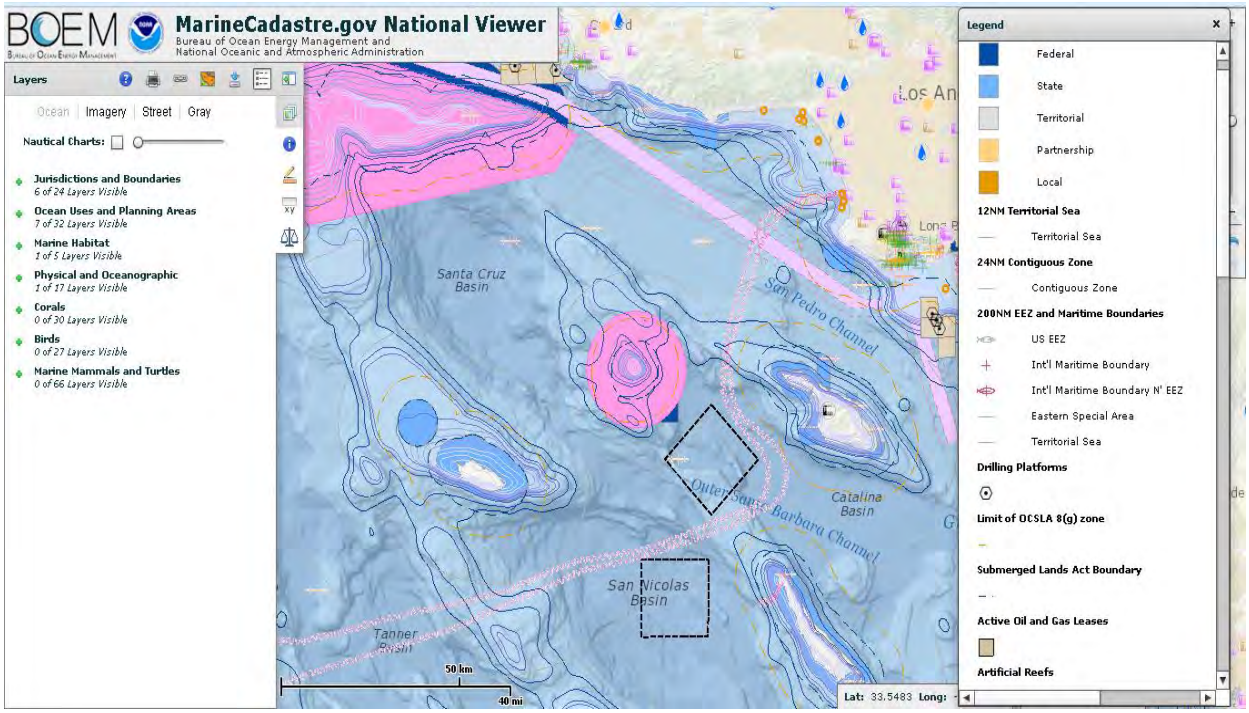


Figure 2.28. Extract of US Marine cadastre online portal (Source: NOAA, 2014)

The wealth of information collected into a single system as shown above permits many different spatial queries. For instance, any part of the map when clicked with "Legislative Atlas" selected would show all applicable overlapping international, federal and state policies. The depiction of each policy's spatial jurisdiction is also possible. Information from the portal can be exported and downloaded and stakeholders wishing to contribute any information may do so using available contact details.

The action by decision-makers to facilitate a move from fragmented management of marine space to a fully-funded policy supported program that is integrated with nationwide spatial coverage and collaboration visually clarifies overlapping mandates, stakeholder RRRs, overlapping marine activities and several other areas of past management uncertainties.

New Zealand

New Zealand consists of two main islands surrounded by several smaller ones. The collective land area is approximately 268 000 square kilometres with about 15 000 kilometres of coastline (UN, 2009). NZ ratified UNCLOS and subsequently became eligible to one of the largest marine jurisdictions in the world that is fifteen times the area of its landmass (UN, 2003). The substantial EEZ that NZ has jurisdiction over is possible by the deep southern ocean location of NZ with no immediate neighbours other than Australia.

Land Information New Zealand (LINZ) is a government entity. LINZ's principal role is to create the regulatory framework and systems for land RRRs and transactions, collecting and compiling land related geographical information and managing Crown lands (state owned land) for public benefit (LINZ, 2014). Collaboration with government and academics defined the basic framework for extending the existing measures for land management principles to the marine jurisdiction. In the Office of the Surveyor General Report (OSG) (OSG, 1999) two additional goals for LINZ were identified. The first was the need to "provide information and advice to enable the government to decide how future rights to the seabed will be defined and held" and the second was for a "national spatial referencing system that meets NZ's core land and seabed information needs" (OSG, 1999:1). NZ has recognized that by studying the principles of land cadastres and using the existing land cadastral's framework to extend similar management styles to their marine space, ocean tenure, management and governance for the benefit of the country can improve (Hoogsteden, 2001)

Australia

Australia, being in the same latitudinal range as NZ, lays claim to the second largest EEZ in the world with approximately 36 700 kilometres of coastline (Binns, 2004). Several research initiatives into marine cadastre since the year 2000 are on-going as the Australian marine jurisdiction was recognised as vitally important national asset requiring better ocean governance for sustainable development (Fraser *et al*, 2003). In June 2002, the Australian Research Council (ARC) commenced with the "Defining and Developing a Marine Cadastre for Australia" project (Binns, 2004). The first phase of the project involved a national survey to ascertain shortcomings in marine spatial data (Forse and Collier, 2003, cited in Binns, 2004). The outcomes showed:

i. Government departments were the main suppliers of offshore spatial data.
ii. Data used predominantly in environment monitoring, administration and scientific research with evidence of data silos at different standards.
iii. Uncertain land-sea interface and other marine boundaries such as the HWM, LWM and tidal plane.
iv. 3D data was more beneficial and applicable to marine activities as opposed to 2D.
v. Mass of domestic and international policies together with legislative uncertainty.
vi. Existing data meets user requirements however accessing the data is most problematic.

Pursuant to the national survey, pilot projects in the states of Victoria and Queensland were undertaken to test the research hypothesis of challenges of marine cadastre. The significant

outcomes included alignment of marine cadastre with the visions of the Australian SDI (ASDI) framework, collaboration with the nearest and largest neighbouring state of NZ, clarity on sectoral institutional arrangements and the powers of the Courts as ultimate arbiters (Fraser *et al*, 2003). Industry consultation featured prominently on the project as identification of all stakeholders and RRRs is information needed to be linked to visually render marine boundaries. However, accuracy and agreement on boundaries across all state entities and their differing definitions found in policies was identified as critical as it affects all components of the construction of a marine cadastre. Accurate boundaries form the base upon which marine cadastre may be built.

The following issues identified by Binns *et al* (2004) and Fraser *et al* (2003), pose a challenge to marine cadastre development in Australia.

i. Realising and visualising spatial extents of RRRs
ii. Identification of all stakeholders.
iii. Final marine boundaries
iv. Overlapping State jurisdictions. Different mandates and data requirements would cause duplications of similar datasets and different standards and accuracies.
v. Funding
vi. Cooperative governance
vii. Acquisition of quality spatial and metadata.
viii. Disparity of spatial and legal datasets,
ix. One national SDI inclusive of terrestrial and marine environments.

The Australian marine cadastral concept shows a simplistic view of the types of activities found on both land and sea and the transitional coastal area (Table 2.7 and Figure 2.29). The concept plan shows no discrimination between land and marine cadastres and supports the view of a single seamless cadastre across the land-sea interface.

Table 2.7. Variety of activities in Australia's marine environment (source: Binns *et al*, 2004:28)

Activity	Includes:
Tourism & Recreation	Diving
	Boating
	Fishing
	Swimming
Marine Protected Areas	Marine National Parks
	Marine Sanctuaries
Shipping	Commercial Shipping
	Freight Haulage
	Passenger Ferries
Heritage	Shipwrecks
	Indigenous Artifacts
Cables and Pipelines	Oil and Gas pipelines
	Telecommunications
	Electricity Cables

Activity	Includes:
Aquaculture Leases	Mussle Farms
	Abalone Farms
	Spat Gathering Areas
	Oyster Farms
Minerals and Energy	Mineral Exploration
	Oil and Gas Exploration
	Resource Extration
Native Title	Non-exclusive access to the sea and sea-bed.
Ocean Waste Disposal	Ammunition Dumps
	Chemical Dumps
	Jarosite Dumps
	Scuttled Vessels
	Land-based sources

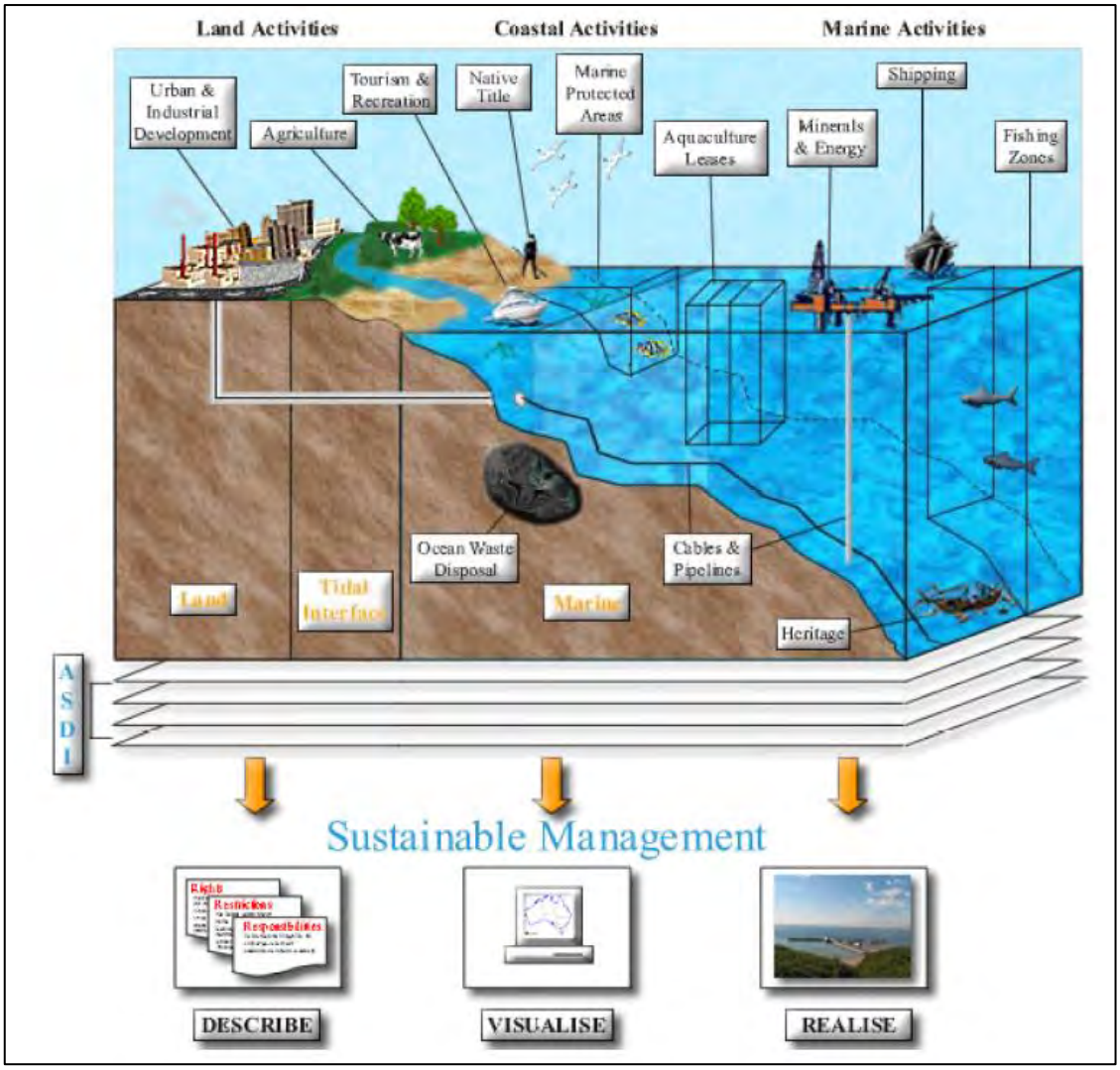


Figure 2.29. Marine cadastre concept diagram (source: Binns *et al*, 2004:27)

Similarities to the issues identified above are applicable, not only to Australia, but to NZ and North America in other concluded research and initiatives by state, private and academic entities (see NOAA, 2009; Ng'ang'a et al, 2004; Nichols *et al*, 2000; Sutherland, 2003; Sutherland, 2003; Nichols and Monahan; 1999 and OSG, 1999).

Other international initiatives

Marine cadastre as a management tool is also being explored in other countries such as Indonesia, Ghana, the Netherlands and Malaysia. Indonesia is the largest archipelagic country consisting of about 175 000 islands, 81 500 km of coastline and 5.8 million square km of internationally recognised marine space (UN, 2009). The geographic layout of Indonesia created challenges in claiming its territorial waters in terms of UNCLOS although the treaty lists processes on defining coastal baselines from which to reference maritime zones (Hernandi *et al*, 2014). Indonesia is a maritime nation reliant on the sea for economic

benefit (fishing, mining aquaculture, transportation, food etc.). Hernandi *et al* (2014) identify shortcomings and challenges in ocean management in the study and components for a multi-purpose marine cadastre are listed, though their incongruent existence with land cadastral systems is noted. Ghana, having just 550 km of coastline is faced by similar maritime challenges. As recently as 1999, the Ghanaian government introduced new land policies to address land administration shortcomings as an official cadastral system was not in place (Boateng, 2006). Boateng (2006) highlights technical, legislative and spatial challenges for a theoretical marine cadastre and stresses that more priority and focus is given to land management with a lack of political will to manage, in a sustainable manner, Ghanaian marine activities.

The competition for North Sea access rights spans 400 years mainly due to proximities of other European countries neighbouring the Netherlands (Barry *et al*, 2003). Barry *et al* (2003) adds that numerous marine activities in navigable rivers emptying into the North Sea renders the North Sea unique in global standards when compared to fewer nations competing for marine jurisdiction. Examples of nations with easily definable marine jurisdictions in terms of UNCLOS provisions are NZ, Australia and the USA due to their geographical positions and lack of numerous immediate neighbouring countries. Complexities of different legal definitions and spatial depiction of marine boundaries requires cross-country standardization (Barry *et al*, 2003). The marine space of Netherlands, roughly 57 000 square km, and a long history of land reclamation from the sea, is faced with many competing marine activities that other countries face in the global awakening to the need for enhanced ocean management.

Malaysia has recognised the need for better marine administration as discussed in the literature of Abdulla *et al* (2014), Abdul-Rahman *et al* (2011 and 2012), Chong, (2006) and in Hassan and Abdul-Rahman (2010). The Malaysian research uncovered the following:

i. Cross-sectoral recognition for better management of ocean space aligned with Malaysian sustainable development goals.
ii. Reporting on and regularly updating the national status of marine surveys and administration matters.
iii. Conceptual modelling of marine cadastre (Figure 2.30).
iv. Existing land cadastre reviews and its applicability to marine spatial depiction and rights registration.
v. 3D modelling of overlapping RRRs on land and sea.
vi. Updating and improving national SDI.

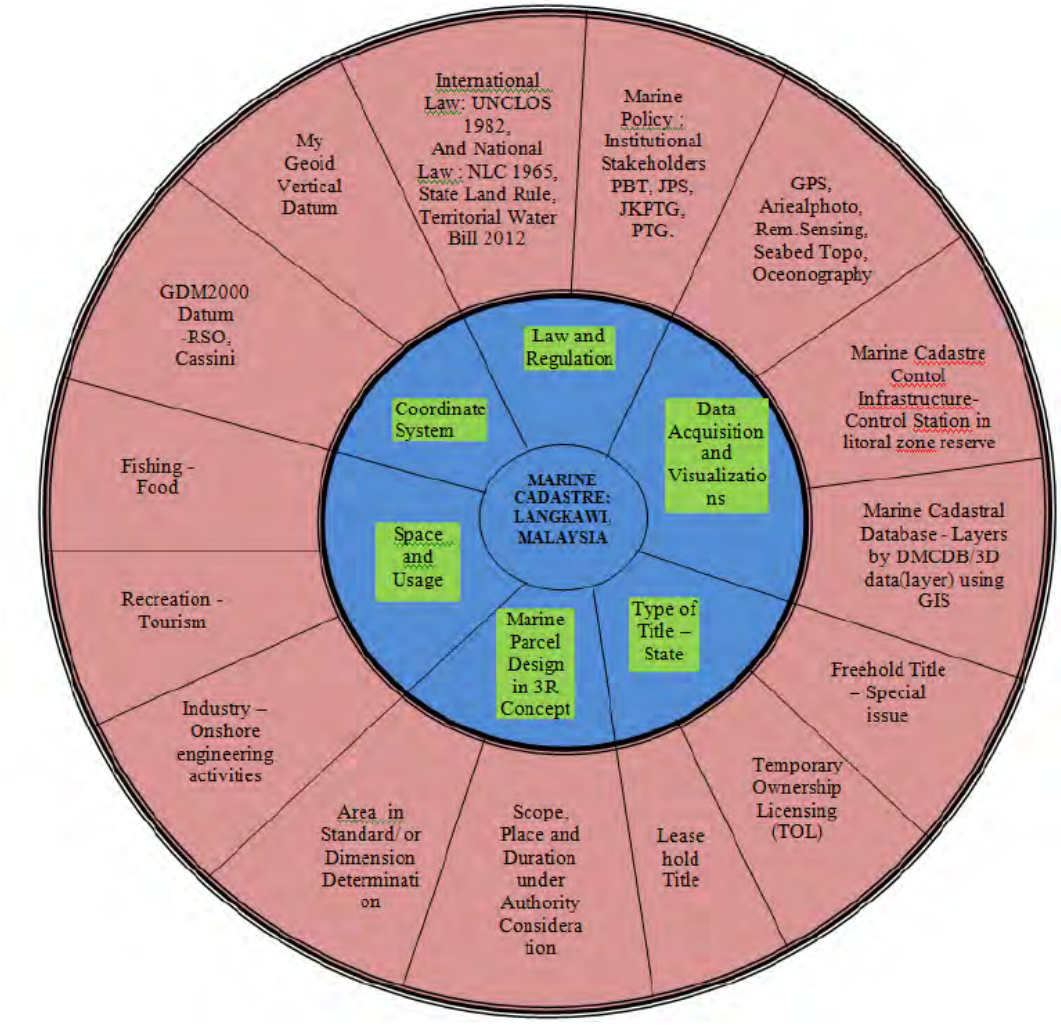


Figure 2.30. Malaysian marine cadastre conceptual model (source: Abdullah *et al*, 2014:12).

The brief overview of the approaches of various countries to marine management regardless of socio-economic and political regimes, indicates that marine cadastre is a viable option to clarifying maritime boundaries and managing/allocating RRRs. There is consistent reporting of similar legal, institutional, technical and spatial issues from research emanating from different country-level studies. The application of existing land-based cadastral principles is an emerging theme that correlates with the move towards a situation of no distinction between terrestrial and marine SDI.

2.8.4.2. Registration of marine interests

Resolving discrepancies in spatial representation of marine boundaries is only part of the solution for a marine cadastral system. Thus far, resolution of uncertain boundaries and uncertainty of marine RRRs were discussed. To secure and legally acknowledge RRRs against a spatial representation with boundaries, a register is needed (Wallace and

Williamson, 2006a). Wallace and Williamson (2006a) view the register as a tool to create order out of disorder in access to and allocation of resources and opportunities. A register is not always dependent on a spatial component, yet when the environment is concerned, where multiple activities compete in the same vicinity, their relative spatial identification attached to RRRs is vitally important for order. Difficult to perceive boundaries are associated with marine activities beyond the obvious land-sea interface as they occur in a water environment and can be subject to up to four dimensions (Williamson *et al*, 2005).

Section 2.4 explored some marine activities in the South African EEZ and though regulated, permits are hardly ever issued against a legally certain and legally enforceable spatial document. The permits and rights, although subject to environmental impact assessments in some instances, are issued by a variety of state agencies with varying degrees of conflicting and overlapping mandates. Evidence of registers of marine interests is found in the fisheries, mining, and mostly, due to the MPRDA and MTRA, in offshore minerals and petroleum mining industries. These registers may or may not have a geographical location and/or extent and each activity specific register is separately administered by different legislation and government entities. A single register to create order would best serve the multitude of other activities not requiring permits or access rights. Registries are information repositories very useful to governments and are essential for designing, building and managing property regimes (Wallace and Williamson, 2006b). The functions of registries are shown in Figure 2.31.

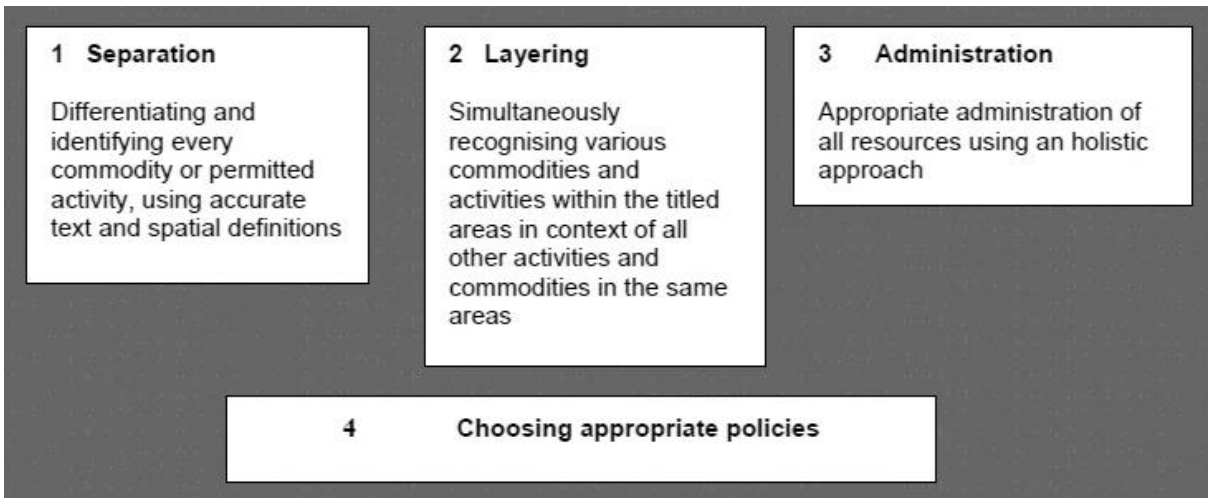


Figure 2.31. Registry functions (source: Wallace and Williamson, 2006a:213)

The explanation for the above for registry functions from Wallace and Williamson (2006a) are summarized:

i. *Separation* identifies singular interests and differentiates resource opportunities from one another for simplest visualization.
ii. *Layering* is twofold. Firstly, it involves intensive management of the singular separated resource in one spatial area (e.g. mining or fishing) and identifies all types of activities associated to that resource i.e. mining may include gold or coal mining, fishing can be for commercial of subsistence purposes. Secondly and of higher sophistication, layering identifies multiple resource co-existence in a single area by considering all resource inter-relationships with minimum disputes and conflicts of interests.
iii. *Administration* of registries is a governmental function to intelligently allocate resources and opportunities vested in government. A register can also be used by any private entity wishing to record different information types.
iv. *Policy review* is a constant for any advancing nation dealing with resource and opportunity management. A register's prominent role is to gather information for policy and decision makers. Policy is essential for compliance and enforcement and is applicable to private entity policies.

The functions of a registry do not discriminate between land and sea and can be developed for governments or private entities to better handle information. An ideal registry should map property rights, allocation and administration of RRRs (Cole and Grossman, 2002).

Cole and Grossman (2002) argue that the definition of property is open to interpretation depending on applicable laws and economics and an appropriate register can be created. Wallace and Williamson (2006a) share their view that a register for marine interests should include both spatial identification and text systems that relate to one another in a way very similar to land registers. The text would include all of the RRRs, owners and holders of permits and rights, information of the legislative controls, granting State agency or history of which the spatial extent the text relates. The spatial extent graphically represented would merely enclose the text and information it contains thereby creating "packets" of information that is easily accessible. The importance of reducing uncertain marine boundaries is reinforced; otherwise, the associated text may apply to overlapping spatial extents of uncertain boundaries and create false entitlements from encroachments.

Modern registration theory tested against existing marine registers indicates the latter is in developmental infancy internationally with narrow, sectoral approaches (Wallace and Williamson, 2006a and 2006b). Internal use of these registers for management purposes inevitably lead to register duplication, access restrictions, discordant standards, interoperability issues and institutional barriers (Williamson *et al*, 2005, Wallace and Williamson, 2006a). These challenges are diverse, however not impossible to overcome and systematic registration of marine interests proposed by Wallace and Williamson (2006a) can help identify:

i. Multiple rights/permits for the same activity and if rights/permits are oversubscribed.
ii. Merge different principle and subordinate state entities with varying mandates thus mitigating national inconsistencies in marine administration.
iii. Cross over between land and marine registration systems as the former is sufficiently developed to be extended upon.
iv. Standardization can be achieved.
v. Gaps in legislative and regulatory frameworks.

Registration of marine interests would make stakeholders aware of RRRs they hold in relation to others and can assist integrated marine management by having said RRRs explicitly worded in cognizance of legal provisions and legislative structures. These can include MPA protection, pollution monitoring and control, emergency service responses, monitoring the cross over from land to sea, coastal zone monitoring, updating hydrographic data and coastal surveys and others (specifically those covered in Section 2.4). The following chart by Wallace and Williamson (2006a:32) suggests "possible best practice standards for effective titles" in the marine environment that is modelled on land title registers.

Table 2.8. Marine titling standards (Wallace and Williamson, 2006a)

Property aspects	
Resource	Clear identification of the resource involved.
Property nature	**Statement that the title is property and what type.**
Proprietary extent	Definition of proprietary characteristics: exclusivity, transferability, divisibility, inheritability, and any limitations on these, particularly whether owners are required to personally undertake resource harvesting. (If they are, the interest is not proprietary in character).
Application process	**Statement of criteria, who will make the judgment, payment, issuing authority, entitlement to apply, limits on applications (e.g. to existing users, or vessels of particular size) and processes of prioritization of competing applications.**
Access	Statement of the nature of access: exclusive or shared. Statement of access limitations vis-à-vis other marine activities.
Use aspects	**Defined opportunities to use, to consume, to "waste".**
Fees and royalties	Statement of the fees, royalties and payments required, and the means of increasing them from time to time.
Transfer	**Statement of terms (if any) upon which the title can be transferred.**
Third party property aspects	
Overriding claims	Statement of overriding claims – native titles, recreational fishing, and prior rights (if any).
Security	**Statement of whether the title can be mortgaged and opportunities of lender for gaining possession, selling or foreclosing, and priorities among serial lenders.**
Title aspects	
Name	Lease, concession or licence; preferably, a name the public understand.
Pro formas	**Provision a pro-form "lease" in plain language in digital, Web available, and hard copy, easy print, versions preferably established by subordinate legislation.**
Grant	Authoritative description of the grant process, particularly identifying when property exists.
Time period	**Beginning and end dates clearly specified.**
Renewal	Renewal arrangements specified, including whether renewal is available after title expiration
Conditions	**Statement of all the special conditions applying to the title (which may be included by reference rather than quoted in full).**
Trading mechanisms	Guide to standard transactions: negotiated, resource banks, auction, return to government for reissue to new owner.
Trading information	**Provision for trades and prices to be publicly available.**
Equity constraints on Transfer	Limits on transfers, limits on ITQ transfers across vessel size.
Depletion of resource	**Retirement policy if resource is depleted (fish, oil, gas) or if management considerations require moratorium or suspension of access, including opportunities to claim compensation (if any).**
Forfeiture	Statement of situations in which forfeiture is available.
Termination	**Situations in which title is ended other than forfeiture.**
Link use with resource	Program for linking opportunities to use with available supply, methods of assuring public good supply.
Bond or security	**Statement of bond, security or guarantee given to ensure compliance.**
Compliance aspects	
Work plan/activity	Clear statement of the activity required.
Reports	**Specification of nature of information returns including form and timing.**
Insurances	Statement of insurances required, and information to be provided.
Cessation of title	**Statement of condition of site on relinquishment and forfeiture of bond or security.**
Enforcers	Identification of the agencies and officers able to enforce.
Entry of enforcers	**Identification of opportunities for officers to access site.**
Enforcement officer powers	Inspection of site, books and records, taking statements, and so on
Enforcement incentives	**Fines, penalties, reduction of next year's permit, revocation**

Table 2.8 is detailed on the variations in titling that can be applicable to marine activities and the resources that may be extracted. Table 2.8 also excludes key areas such as the spatial extent of a marine parcel and aspects relating to the survey and diagram, and who may prepare them. A diagram may be necessary to register title and this would ensure the title is specific to pre-determined (surveyed) areas. Registries are not dependent on the type of property being managed, but more so the RRRs and interests of multiple resources and activities created by those resources in a particular area. Property can be spatially defined and shown on diagrams while RRRs are textual. In SA, and many other countries, management of the sea vests with the State on behalf of its citizens. Therefore, only title to portions of the sea and not ownership rights can be created and allocated to interested stakeholders. A unified titling system in the form of a register would aid holistic ocean management.

2.9. Land vs. marine cadastres

As with land, the ocean is subject to access rights, possession and usage. The "hunter-gatherer" land tenure philosophy proposed by Grant and Williamson (1999) suggests that modern land division and ecological conservation is entrenched in human mind-set and is completely different from the mind set informing marine conservation. However, the philosophy of Grant and Williamson (1999) is contradicted by Carr (1998) who states that unsustainable ocean activities are drivers for application of similar land management practices of land parcels, ownership, laws and regulations at sea. The basic principle of marine cadastre found in literature is that it relates closely to land cadastre and the framework in place for land cadastre can be, with adjustments, applied to the marine environment (Collier *et* al, 2001; Fowler and Treml, 2001; Ng'ang'a *et* al, 2004; Nichols *et al,* 2000; Nichols and Monahan, 1999 and Widodo *et al*, 2002).

Boundaries on land are demarcated, meaning they are surveyed and beaconed (or other features like hedges or monuments or legally recognised boundary demarcation methods are used specific to a country's cadastral system). The continuous land surveys, ownership and rights transfers within prescribed procedures and policies relevant to a country alter the cadastre in an orderly and recognised fashion. Contrary to land boundary demarcation, marine boundaries are mathematically delimited with generally no physical evidence left in wake of the survey (Carrera, 1999, cited in Fowler and Treml, 2001). It is not practical and mostly not feasible or useful to *demarcate* marine boundaries in the same way practised on land. Although ocean boundaries are delimited, the multitude of definitions mathematically describing the boundaries is in itself an acknowledged challenge to marine cadastre. This creates marine boundaries that exist legally and on paper with no tangible *physical*

recognition. Physical demarcation of marine boundaries can be accomplished using digital means offered by modern technological innovations (Fowler and Treml, 2001). The leading tool for enabling marine cadastral systems proposed by Binns (2004), Fischer and Nijkamp (1993), Fowler and Treml (2001) and Fulmer (2008) is Geographic Information Systems (GIS) with real-time monitoring capabilities. The computer-aided GIS system allows information to be added at will, stored, analysed, manipulated and displayed within parameters or requirements of a query.

One major point of difference between a land and marine cadastre explained in Sesli and Uslu (2010) is that there is a mix of private and state land ownership in many coastal countries. However, ownership of marine space lies solely with the state in many countries. This offers opportunities for improved ocean governance, as a central government institution could be the meeting point of standardized SDI while simultaneously being a repository of associated RRRs from different state and private sectors. Some other differences that highlight difficulties in marine cadastre as opposed to land cadastre are explained in Collier *et al* (2001):

i. In land administration, tenure refers to the time that a particular space is lawfully occupied or possessed. However, the concept of tenure does not exist at sea due to the multiplicity of overlapping uses and temporal nature of water.
ii. It is not possible to use classical means of boundary demarcation offshore
iii. The marine environment is three dimensional – classical 2D simplifications are not adequate.
iv. Rights can vary with time, adding a fourth dimension to the spatial data.
v. It is common for multiple overlapping RRRs to exist in a single locality
vi. The baseline to which many maritime boundaries are referenced is ambulatory.

With the land cadastre, the history of a country forms the base upon which the cadastre is developed resulting in a range of different land administration systems. Similarly, marine cadastre are developed at national level, and although it can be informed by international practice, must be tailored to the local context. Rajabifard *et al* (2007) stress the importance of a link between land and marine environments instead of the prevailing international trend of managing them isolation. Table 2.9 highlights the differences and similarities between land and marine cadastres filtered from this chapter.

Table 2.9. Differences and similarities between land and marine cadastres

DIFFERENCES	
LAND CADASTRE	**MARINE CADASTRE**
Tenure (title deeds, ownership, deeds registers, RRRs recorded)	Limited tenure exists with high uncertainty levels. Registers exist in silos to allocate some RRRs but significant RRRs excluded.
Physical demarcation using monuments	Cannot employ classical means of demarcation
2D simplification (although 3D tenure exists in the case of sectional title)	3D in nature (column or volume of water from seabed to surface)
Fixed boundaries. Boundaries only change by survey on SGO approval.	Some boundaries can be fixed or some human activities mathematically delimited. Natural boundaries delimited but tend not to abide with man-made boundaries.
Integrated and multilateral state and private management institutions (co-operative governance)	Disparate institutions, operate in silos, conflicting mandates create confusion.
Multiple laws, well thought out and implemented	Multiple laws, target specific and not properly executed
Begins landward from land-sea limits with some land based management measures extending into the Territorial Waters (12NM).	Begins seaward from land-sea baselines up to EEZ (200 NM) or extended to continental shelf limit (if successfully claimed).
Usually smaller in comparison to UNCLOS recognised marine jurisdiction.	Marine jurisdiction usually larger than country's land mass area.
SIMILARITIES	
Overlapping human activities occur in both	
Coastal zone interactions are mutually intense (estuaries, tidal zones, river deltas, navigable rivers, harbours, ports, other on and near shore activities).	
Spatial data exists or can be collected. The SDI should include land and sea in one system with cadastral components.	
Require equal effort in management by separation of RRRs (especially with increasingly invasive marine technologies)	

Table 2.9 excludes the geographical layout, political situation, social and economic regimes of countries from which the information emanates, yet the diverse range of contributing authors indicates that common concerns, challenges and opportunities exist globally where land and marine cadastres are involved.

2.10. Chapter conclusion

This chapter highlighted the rising importance of the seas to mankind via interactions with the sea by early civilizations, freedom of the seas, defining marine jurisdictions and ultimately sustainable development targets. The relevance of improving ocean management systems in light of increasing marine activities competing in the same space was highlighted. SA, like many coastal countries, has a responsibility to improve ocean governance. The need to do so is more relevant now more so than ever with the declaration of Project Phakisa, an ocean intensive project aimed at boosting SA's economy via extraction of marine based resources and benefits. The sectoral approach to ocean management is evident globally. Marine cadastre has been positioned as an alternative to the sectoral approach, yet it is not without its own implementation challenges. However, research already conducted shows that solutions are possible provided shifts in political motivation and cross-sector participation in determining feasibility of marine cadastre. The main challenge involves the development of an integrated and complete SDI with significant cadastral components. Cadastral components applicable to the marine environment may be informed by historically proven land-based cadastral systems.

Although land cadastral principles have parallels at sea, a marine cadastre would some necessary unique differences. Neither land nor marine cadastres should be developed in isolation and segregation should be avoided so as to create a seamless national SDI with cadastral components. The existing land cadastre should direct marine cadastre development in such a manner that marine cadastre could seamlessly be attached thereby negating the effects of the spatial and legal discontinuity at the land-sea interface.

CHAPTER THREE

3.0. Research Methodology

Rigorous research requires that the researcher reveals and explains the chosen methodological approach so that a clear path is shown between data and the results derived from that data. A significant goal of research is that once the researcher identifies a gap in existing knowledge, that gap must be aimed to be filled to enhance the level of understanding. Jacobson and Landau (2003) explain that it is essential that such impact of research is not weakened by poor research design. Research methodology is concerned with planning, structuring and executing research in a manner that is considered scientifically sound allowing future duplication to obtain similar results (Jacobson and Landau, 2003).

This chapter introduces the research method applicable to this research and the underlying theoretical basis. These theories include positivism, interpretivism and critical realism. The different stages of the research strategy are discussed to determine the most effective means of approaching a response to the research question posed in Section 1.2.

3.1. Theoretical framework

The aim of theoretical frameworks according to Whittal (2008) is to investigate the means of knowledge creation (epistemology) and to provide an understanding of the research perception of reality (ontology). Marine cadastre is a relatively recent international development, particularly gaining momentum over the past decade. The applicability of marine cadastre to SA, by considering local perceptions of stakeholders, is pertinent in establishing its feasibility in the South African context. Discussed in the following sub-sections are research paradigms relevant to this investigation.

3.1.1. Positivism

Positivism, as defined in Kaboub (2008), declares that natural science is the exclusive source of true knowledge and any philosophical studies are rejected. Scientific methods can only explain phenomena or reality (Kaboub, 2008). Positivism lends itself towards quantitative research methodology (Denzin and Lincoln, 1998) and according to Kaboub (2008) has a start, end and emphasis on excluding speculation. However, positivism falters in understanding social relations and perceptions (Kaboub, 2008). As this study includes the use of maps, diagrams, descriptive and inferential statistics, a positivist approach is required as these tools are less influenced by bias. However, this investigation involves canvassing the opinions of stakeholders thereby incorporating a social aspect thus there is divergence from the purely positivist view.

3.1.2. Interpretivism

Interpretivism is a concept that centres on reality being socially constructed and not objectively determined (Denzin and Lincoln, 1998). Local conditions in different areas vary due to political, social, economic, climatological or geographical reasons. These influence multiple mental constructs and are dependent on the individual at a particular locale. Therefore, interpretivism can be based on three principles which together define a reality and these are, (i) consciousness (self-awareness, awareness of others and objects), (ii) action (behaviour and choices made in different situations) and (iii) unpredictability (Livesy, 2006). To assign understanding of a reality based in the real world, data that is detailed should be collected on large scale. Interpretivism is based on the idea that people who are at a specific place at a particular moment in time will have a better understanding than the researcher. A collective of multiple views from individuals would allow for patterns and generalization to be discovered.

Interpretivism is applicable to this study as marine cadastre is a recent international development with various coastal states investigating and/or implementing it based on their differing circumstances. The South African perspective requires uncovering in a holistic manner as persons, processes, institutions, policies and other phenomena are evident. Interpretivism would enable extraction of meaning to define a South African perspective (reality) on the feasibility of a marine cadastral system.

3.1.3. Critical realism

Critical realism asserts a reality that exists independent of human conception (Bhaskar, 1998). In critical realism, there is a belief that unobservable events sometimes but not always cause observable ones and the social world is understood only if there is an understanding of the structures that generate such unobservable events (Archer *et al*, 1998).

Critical realism can be applied to both social and natural sciences therefore allowing use of both positivism and interpretivism (Archer *et al*, 1998). Societies are generated by human activities and human created rules. These societies continually change due to dynamic human nature resulting in a mutually influential relationship where humans shape society, which in turn affects human activities (Bhaskar, 1998). Societies vary in time and from place to place with the human imposition of human rules. This is relevant to this study, as marine cadastre requires local perceptions drawn from local social constructs to be understood, although marine cadastre may exist elsewhere in the world.

In critical realism theory, the researcher who conducts an experiment (an observable event) finds results affected by underlying interpretations of laws and rules (unobservable events) (Bhaskar 1998). This leads to there being no complete independence between observers and

observed and that the reality of the world is socially influenced by observations made (Mingers and Willcocks, 2004).

3.2. Quantitative and Qualitative research approaches

Leedy and Ormrod (2005) and Grobbelaar (2000) describe research as falling into two broad categorical approaches, namely quantitative and qualitative approaches, although there is often a combination of both in research strategies. The following paragraphs explore the differences between quantitative and qualitative research approaches.

3.2.1. Quantitative approach

The quantitative research approach stems from the positivist view where phenomena can only be described by what can be measured or observed objectively and is the only source of knowledge (Welman *et al*, 2005). Mouton and Marais (1989) define the quantitative research approach as:

> "…the approach used by researchers in the social sciences that is more formalized as well as explicitly controlled, with a more carefully defined scope, and that is relatively close to the approach used by researchers in the natural sciences…"

A quantitative research approach in social sciences mainly involves data collection using surveys and questionnaires resulting in a superficial interaction between the researcher and researched (Denzin and Lincoln, 1998). For the purpose of this investigation, the quantitative approach would is applied in part.

3.2.2. Qualitative approach

Qualitative research stems from the anti-positivist view where objective approaches cannot be used to study human behaviour and opinion (Denzin and Lincoln, 1998). A more holistic conclusion to an inquiry can be obtained from qualitative approaches, as there is more flexibility in designing the collection of data as opposed to the rigidity of quantitative approaches. Qualitative research allows the researcher to obtain a better comprehension of an occurrence by posing an array of questions in an attempt to gather detailed impressions from research participants (Shank, 2002). Cresswell (2013) states that once data is collected from various sources relevant to the investigation, themes and descriptions can be ascertained. According to Smith (2001), people have different ideas about the world and qualitative research permits engagement with different people to determine how they assign meaning and its representation in the world. An advantage of qualitative research is that collected raw data is unstructured with a multi-dimensional nature (Robinson, 1998). In this study, the data collected are from multiple sources with different perceptions and this creates

a background for corroboration and comparison. Instead of imposing a dominant interpretation, qualitative research findings can have multiple meanings and interpretations that better equip recommendations or solutions to complex problems. Mathematical models or quantifiable parameters do not restrict qualitative research therefore, it is suited to this study as the data collected is subjective. The participants range in age, circumstance and social standing. This study will cover a large period of history with rapid technological innovation and increasing use of the sea. Mottier (2005) explains qualitative research as being reflexive as meaning is constructed via interaction between researchers and researched, and that reality is a human construct. Dowling (2005) states that the researcher is always scrutinising the position they hold in relation to their subjects. Herein enters the issue of validity and reliability of data collected, analysed and presented to define a reality.

In order to support the integrity of the study the methodology will attempt to provide a structure that can be repeated to yield similar results with few errors or biases. Documentation and paper trails are the cornerstones of reliability of the data collection and handling processes. Qualitative data can be collected via interviews, focus group discussions, documents, observations, audio-visual recordings, surveys and questionnaires amongst others as these are not direct numerical observations or recordings. This research requires the input of persons in the geospatial and legal fraternities across many spheres of the government and private sector. The main differences between qualitative and quantitative approaches, adapted from Welman *et al* (2005), are tabulated (Table 3.1):

Table 3.1. Differences between qualitative and quantitative research approaches adapted from Welman *et al* (2005).

Qualitative research approach	**Quantitative research approach**
Deals with data that cannot be measured easily	Emphasises measurement of data
Subjective data is presented (produced in the minds of research participants)	Objective data (measurements and numbers)
Data is more flexible and exploratory. Allows for deeper understanding of research subject.	Data is fed through complex structured methods to confirm or disprove formulated hypotheses.
Open to bias	Less room for bias
Dynamic and changeable	Structured and controlled
Focuses on validity of investigation	Focuses on reliability of investigation
Holistic and wide approach	Focused and particularistic approach

3.2.2.1. Types of qualitative methods

Both Welman *et al* (2005) and Collins (2000) explain various qualitative research approaches with the most common being the review or analysis of existing literature, participant observations, structured questionnaires, interviews, focus groups and case studies. In order to satisfy the research objectives, the following qualitative methods were chosen:

i. *Review of existing literature* - to position the study within a research gap, identification of stakeholders with associated activities in the land and marine related professions and analysis of relevant policies, legislation and conventions.
ii. *Interviews* – the personal perceptions, histories and experiences in an area related to a study could be collected. Qualitative interviews can be either formal, informal, conversational, topic-focused or semi-structured (Casley *et al*, 1988).
iii. *Questionnaires* – This allows for identified research participants who were identified mainly in the literature review, therefore falling within the research scope, to respond to various questions and question types. Note however, that to derive meaning from the results of the questionnaire, quantitative methods are often employed.
iv. *Focus groups* – this method is usually employed when data is collected from a group of people. Focus groups could also be seen as group interviews. The group can be specific or broad in terms of the field of expertise of each individual focus group creates a platform for open discussion and for similar or competing views to be expressed.
v. *Case study* – the method relies on multiple sources of data that can include documents, review of existing studies/literature, interviews and questionnaires amongst others. Case studies can include quantitative, qualitative or mixed data and can be described as an inquisition of real life phenomenon when the extent of such phenomenon has not yet manifested clearly (Yin, 2009).

The case study approach is applicable to this study as it uses a combination of points i to iv listed above to understand the South African context. In doing so, the results presented later in the dissertation have increased reliability resulting from the processes of data triangulation.

3.3. Research Strategy

The previous sub-section introduced the case study approach to be used in this study. This inquiry method falls into a broader research strategy. A research strategy is a plan of action giving structured direction in meeting the research objectives. This avoids a haphazard

approach that inevitably wastes time. For simplification of the research strategy, four different stages have been decided on. These are:

i. *Stage 1* – Literature review and questionnaire development.
ii. *Stage 2* – Data sources and data collection.
iii. *Stage 3* – Data analysis procedures (presented in Chapter Four)
iv. *Stage 4* – Derivation of results and discussion (Chapter Five) and conclusions (Chapter Six)

3.3.1. Stage 1- Literature review and questionnaire development

The first stage identifies the documentary dimension to marine cadastre, land cadastre and their interoperability. Legislation, policies, conventions and tools of governance pertinent to the research topic are presented in the literature review in Chapter Two. The literature reviewed shows the rigorous approaches some countries are taking in developing marine cadastre or improving marine management models. However, the South African perspective on marine cadastre requires input from local stakeholders. This resulted in the purposive sampling design which provides for researchers to apply their knowledge in selecting individuals, groups and organizations that are representative of the phenomenon under investigation Kumar (2005). The type of sampling often influences the approach to questionnaire administration. An example would be if the sample population were distributed over a wide area or not thus having implications administering the questionnaire electronically or by mail.

The reviewed literature provided a wealth of sources of stakeholders are were involved in terrestrial and marine spatial data. These stakeholders were deemed relevant to this study. The population size for respondents was not pre-determined at the onset of the questionnaire administration. The questionnaire was developed purposively to obtain the South African perspective on marine cadastre in general and of the following in particular:

i. Organization category.
ii. Business focus.
iii. Sources of spatial data.
iv. Organization supply, use and production of spatial data
v. Difficulties in accessing terrestrial and marine based spatial data.
vi. Comparison between efficiency of land cadastre and spatial management of the marine jurisdiction of South Africa.
vii. Demarcation of access rights to the sea for various overlapping activities.
viii. Marine based restrictions, boundaries and beacons
ix. Awareness of applicable legislation and its enforcement at sea.

x. Spatial representation of marine based RRRs.

xi. UNCLOS and South Africa's application to the UN under Article 76 of UNCLOS for an extended continental shelf.

xii. Features to be considered in marine cadastre.

The literature also informed types of questions the questionnaire would address. Further, it aided in the collection of contact details to which the questionnaire could be administered. Based on the selected questions, the following stakeholder organizations were identified as targets (Table 3.2):

Table 3.2. Stakeholder distribution

Stakeholder category	**Stakeholder sub-category**	**Names of stakeholder organizations**	**Stakeholder Location**
Government	National	CSG's Office of the Department of Rural Development and Land Reform (DRDLR), Chief Registrar of Deeds Office, DEAT, DAFF and DME	Pretoria
	Provincial	DRDLR SGO and DRO	All provinces serviced by these two cadastral components of DRDLR
	Local	Coastal Municipalities (EThekwini in particular)	Durban, Cape Town, East London, Port Elizabeth and Richards Bay
	Navy (Defence) SANHO	Navy Captain Hydrographer	Tokai, Western Cape
Private industry	Profession regulatory bodies, voluntary associations	South African Council for Professional and Technical Surveyors (PLATO), South African Geomatics Institute (SAGI) and Maritime Law Association of South Africa	Germiston Durban
Non-profit organizations			
Academics	Tertiary institutions Research facilities	UKZN, University of Cape Town and the Council for Scientific and Industrial Research	Durban Cape Town Pretoria
Parastatals	ESKOM TRANSNET TELKOM		National Coastal Port harbour masters

The identified stakeholders were spatially dispersed around SA and an electronic questionnaire that could be emailed or placed online was created. *Adobe Forms Central*

software was investigated and used to serve this purpose. The advantages of electronic questionnaire administration were that locations of prospective participants were not an issue and there was certainty of delivery to active email addresses. *Adobe Forms Central* offered the following features:

i. Different types of questions could be selected from built in templates and these included single option restricted, multiple options, scale rating, open ended and other question types.
ii. Help text and background information could be embedded.
iii. The questionnaire could be saved as a PDF document and emailed to prospective participants.
iv. Direct links to an online version of the questionnaire could be created and placed on websites or emailed.
v. The questionnaire was available on desktop and mobile devices and could be saved for later completion.
vi. The questionnaire could also be downloaded, saved and/or printed. This offered the respondent to return the completed questionnaire via email later.
vii. A "Submit" button was embedded which uploaded all the responses of the questionnaire to an online repository.
viii. The repository could be exported in various file formats for input into statistical software packages for analysis.

After development of the digital questionnaire it was tested amongst colleagues at UKZN to determine any technical or other issues. The testing phase proceeded without any problems. Once the questionnaire was developed and tested, other data sources were identified and data collection was initiated.

3.3.2. Stage 2- Data sources and data collection

Data sources fall into two broad categories i.e. primary and secondary data sources (Figure 3.1). Primary sources are first hand, raw and original data collected by the researcher on the topic under investigation (Storey, 1999).

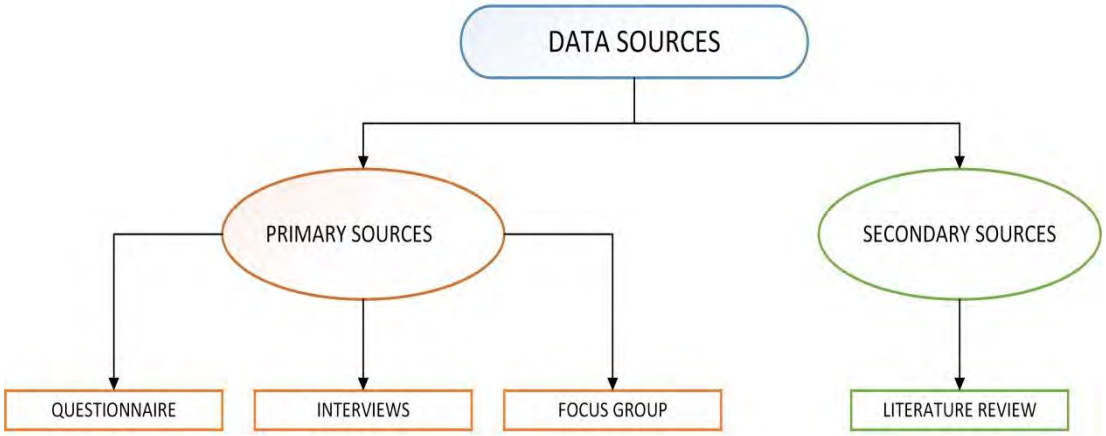


Figure 3.1. Schematic representation of the types of data sources (adapted from Storey, 1999:62)

Secondary data sources make use of existing data in the form of documents, journals, books and newspaper articles. Although not an end in itself, a review of existing literature or previous research assists in positioning new research within a research gap. Yin (2009) suggests that literature reviews provides allows for a deeper understanding of issues and complexities faced in realising the conclusion of a research project by better informing on the data collection design and process.

3.3.2.1. Primary data collection

Questionnaire development and administration

A questionnaire was chosen as a tool to obtain information from a wide variety of stakeholders over the whole of SA. The literature and stated objectives informed on the content and type of questions to be designed into the questionnaire (see Stage 1). Although the literature review offered insight into possible questionnaire respondents, review of responses to the questionnaire offered further insight and a "snowball effect" in reaching other possible participants.

The questionnaire consisted of closed (single, multiple-response and other options) and open-ended questions (Annexure 1). *Adobe Forms Central*, an online tool for designing and distributing questionnaires, was used. When the questionnaire was opened for responses, a link to an online and downloadable version was made available. This permitted targeted respondents to access the questionnaire via desktop and mobile means or to download and save a fillable copy to their local devices. The questionnaire could also be emailed to respondents or made available in hardcopy format. Once the questionnaire was completed by respondents, it could be submitted to an online repository. Questionnaires

completed by hand were manually filled into an electronic version and submitted to the online repository.

In the administration process a link to the questionnaire was placed on statutory and voluntary organizations webpages, emailed or printed and delivered. The questionnaire remained open for collection of responses for three months (May 2013 to July 2013). Reminders where sent to identified stakeholders twice during the three month period. At the closure of responses for the questionnaire, 102 valid responses were received.

Interviews

An interview offers personal contact between researcher and research participant. The interviews conducted in this research were semi-structured. Semi-structured interviews allow prepared questions to be asked with open-ended questions allowing the conversation to develop and persons being interviewed to express themselves beyond the limitations of the prepared questions (Kumar, 2005). When conversations are permitted to reach beyond the scope of prepared questions, additional information useful to the study can be obtained. The questionnaire provided the questions to be phrased to persons being interviewed with no restrictions as to the direction the interview took. Voice recordings of the interview were requested at the start of the interview with some participants approving of the request.

Focus groups

This group interview was conducted as a workshop where the research being undertaken was presented to the Cadastral Branch of the Department of Rural Development and Land Reform. The managers of the South African cadastral system provided feedback in an interactive manner. Representatives of the Chief Registrar of Deeds and Chief Surveyor General, provincial Deeds Office Registrars and Surveyors-General and their deputies attended.

3.3.2.2. Ethical considerations

Due to the involvement of research participants and their opinions being canvassed, it was important for this study to be conducted in a manner that conformed to acceptable ethical standards and practices. Ethical practice does not merely form an add-on to research but is central to the research design. For the researcher to obtain his or her aims and objectives, responsibilities and obligations to those participating in the research must be beyond reproach when evaluated. In order to meet the ethical standards required in conducting this qualitative study, ethical clearance was obtained from the University of KwaZulu-Natal's Research Ethics Committee (Annexure 2).

Dowling (2005) implies that qualitative methods often involve the invasion of someone's privacy. The purpose of the study and the use of the data collected via any means discussed in the primary data collection section preceding this section were made clear to research participants. Their personal identities would remain anonymous unless revealed with permission.

3.3.3. Stages 3 and 4

Stage 3 is presented in Chapter Four (Data Analysis). Chapter Four is thus an extension of this chapter where the chosen analytical framework is broken down further into the tools and processes used for analysing data. Stage 4 encompasses the results and consolidation of findings in Chapter Five, and conclusions in Chapter Six.

3.5. Chapter Summary

This chapter highlighted the chosen theoretical framework for this research, which is critical realism, and available methodologies applicable to this study. Further, this study showed the research strategy with further insight on the data analysis to be presented in the next chapter. By adopting a case study using both qualitative and quantitative inquiry approaches, the rendered results presented later in the dissertation have increased reliability resulting from the processes of data triangulation.

CHAPTER FOUR

4.0. Data Analysis

This chapter aims to describe statistical theory, the process of analysing data collected using the questionnaire, and the handling of information gained from interviews and focus groups. The preceding chapter showed the selection of a mix of qualitative and quantitative research approaches and this chapter is a continuation thereof.

4.1. Statistical Theory

4.1.1. Population sample

A population is the total sum of subjects who share something in common with one another while a population sample is a subset of subjects derived of that population (Sheskin, 2011). For acquiring an ideal sample, every member of a population must have an equal chance of being selected (Weinbach and Grinnell, 2010). Acquiring an ideal sample is difficult, especially in social science surveys, due to reasons not in control of the researcher (Linneman, 2011).

The questionnaire was distributed via electronic channels and in some cases on paper. SAGI, PLATO (now called the South African Geomatics Council), municipal managers, relevant parastatals, maritime law firm directors and senior academics created awareness of the existence of the questionnaire to their constituencies. The involvement of PLATO, which requires mandatory registration of members to practice in the geospatial fraternity, irrespective of the industry sub-within which they practice, offered a solution to spreading the questionnaire for voluntary completion to a wide range of individuals.

4.1.2. Descriptive and inferential statistics

Two broad categories of statistics exist, namely descriptive and inferential statistics (Sheskin, 2011). Provided collected data is checked and entered into a table with variables and associated values, these two categories of statistics can be used to obtain meaning. Variables limit the scope of the data collection process and each has attributes that differ in quantity and quality amongst respondents (Pallant, 2007). The limiting of variables and their associated values are designed in order to meet some or all of the study objectives. A variable is a question in a questionnaire whilst values are the associated options offered for selection to respondents.

Descriptive statistics involve tabulating, depicting and describing collections of data (Sheskin, 2011). Collections of data, generally, must be summarized in some fashion to be more easily understood. Descriptive statistics serve as a means to describe, summarize and

reduce to manageable form the properties of a mass of data for determination of some understanding (Haberman, 1978). This is referred to as univariat analysis that lends itself to easier depiction of many responses to a questionnaire (Pallant, 2007).

Descriptive statistics, as the name states, is for purposes of describing some area of interest found in data and aren't used for making predictions of the entire population from the sample used (Sheskin, 2011). Examples of descriptive statistics include frequency distributions (for example, the variability of the sample response to a particular question), measures of central tendency (mean, median and mode), cross-tabulations and graphs such as pie and bar charts (Frankfort-Nachmias and Leon-Guerrero, 2006). Results from descriptive statistics are usually preliminary to other types of data analyses, however, it may be the only product required in some qualitative research studies.

In inferential statistical analyses, data is used to derive conclusions (inferences) or make deductions on what the population might be thinking (Sheskin, 2011). Sample data is entered into mathematical formula (recognized statistical tests) whose output draws inferences on one or more populations from which the samples were derived (Sheskin, 2011). Generalizations of populations are gained from population samples using inferential statistics. Parametric and nonparametric procedures are two branches of inferential statistics.

4.1.3. Parametric statistics

These procedures rely on testing claims regarding parameters such as the population mean, population standard deviation or population proportion (Frankfort-Nachmias and Leon-Guerrero, 2006). Usually, certain requirements must be met before parametric procedures can be used. These requirements include assumptions about the underlying distribution of sample data (like normal or continuous distributions) and tests involve estimation of the key parameters of that distribution (e.g. mean or difference in means) from the sample data (Sheskin, 2011). Parametric statistics is opted for use in statistically analysing measurable numerical data (interval and ratio data).

4.1.4. Nonparametric statistics

Nonparametric statistics are inferential procedures where fewer requirements need to be satisfied as opposed to parametric statistics (Kvam and Vidakovic, 2007). No specific distribution for the population to follow is required. Non-parametric statistics do not require assumptions on sample data distributions and analytic methods use techniques to test claims that are distribution free (Sheskin, 2011). Nonparametric statistics is opted for use for nominal or ordinal levels of measurements, which are not quantitative. Data can either be

categorical or numerical (Linneman, 2011 and Sidney, 1957). Nominal and ordinal data are categorical data measurements (Linneman, 2011). A code is assigned to nominal data in the form of a number where no numerical value is added to the number therefore rendering such data the ability of being counted, but not ordered (Sheskin, 2011). Examples of ordinal data are gender and eye colour. Ordinal data can be placed in order (ranked) or have a rating scale attached and the data can be counted and ordered but not numerically measured (Sheskin, 2011) e.g. product A is better than B with B better than C with no quantifiable difference between the measurements rendered from an opinion survey. A purely quantitative approach to data analysis is not the case in this study although mixed methods to data analysis were selected. The questionnaire consisted of open ended, single and multiple response questions which where categorical data thus also nominal and ordinal. In order to analyse the responses of non-numerical data, no assumptions were made of its distribution therefore nonparametric statistical analysis is used in this study.

4.1.5. Advantages and disadvantages of nonparametric statistics

Many authors on matters of statistics (Linneman, 2011; Denzin and Lincoln, 1998; and Sheskin, 2006) suggest that nonparametric statistics are less robust than parametric statistical analyses. This correlates with the positivist view whereby facts gleaned of mathematically manipulated numerical data are more reliable, valid and without bias compared to information socially constructed (as in Interpretivism). Chapter Three established that social sciences could obtain data that the researcher has never thought of in the research design process and that undiscovered patterns and themes can emerge.

The following are some of the advantages and disadvantages of nonparametric statistics as understood from the literature of Linneman (2011), Denzin and Lincoln (1998), Haberman (1978) and Sidney (1957):

i. Most tests have fewer requirements than parametric tests, therefore making them simple to apply, so there is a low likelihood of tests being applied incorrectly.

ii. Procedures can be used for count or rank data therefore nonparametric statistics can be used effectively for ranking questions e.g. Rate if something is good, fair, poor.

iii. The normal distribution is inappropriate as no prior assumptions are made about any underlying distribution. This makes predictions robust in that they are not dependent on underlying distributions making it possible to yield unexpected, yet valid, results.

As with advantages, some disadvantages are evident. Nonparametric statistical tests are less powerful than parametric tests and there is increased possibility of making Type I and II errors. Type I errors (errors of the first kind) are the incorrect rejection of a true null

hypothesis that leads one to conclude that a supposed effect or relationship exists when in fact it does not (Brown, 1940). Type II errors (errors of the second kind) occur when the null hypothesis is false, but erroneously fails to be rejected (Sheskin, 2011). If the amount of data collected is minimal, then extrapolation to general themes to be applied to the population cannot be extended further than the population sample. Larger amounts of data collected from a bigger sample will lead to trends that are more acceptable. Note however, that in some cases, parametric tests can obtain the same, if not similar results, with less data.

4.2. Process of questionnaire analysis

The flowchart in Figure 4.1 shows the process of analysing cleaned data received from the questionnaire through to derivation of results. The administration of the questionnaire and its subsequent collection was discussed in Stage 2 of the research strategy in the previous chapter.

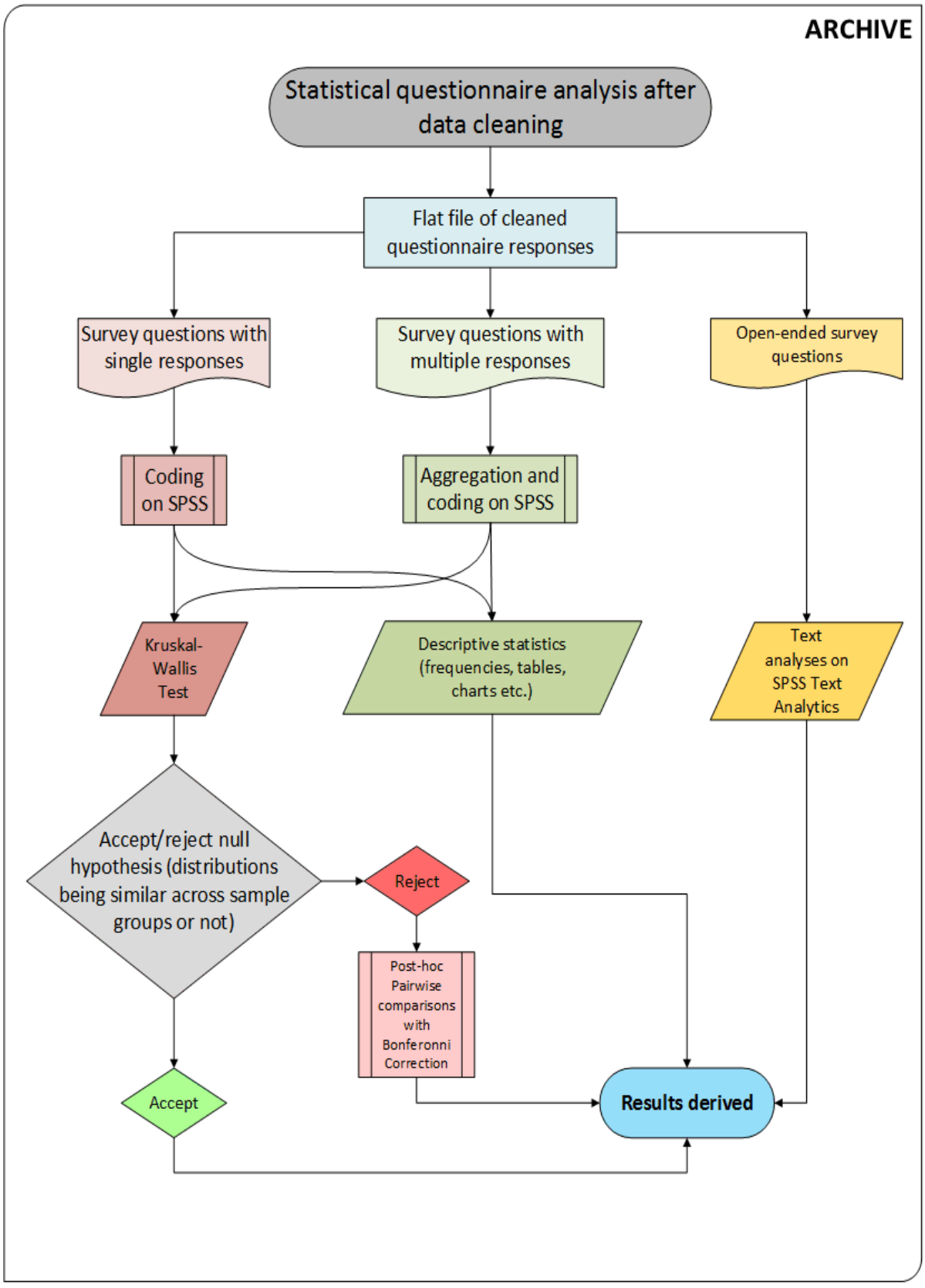


Figure 4.1. Process for analysis of received questionnaire responses

4.2.1. Exploratory data analysis and data cleaning

Exploratory data analysis (EDA) is looking at the responses received before closure of allocated time for responses to obtain an idea of what data is available to work with. This leads to either the collection of more data or saving time by stopping questionnaire administration. Data from EDA is not necessarily ready to be used "as is" in the study findings. EDA usually overlaps with data cleaning. Data collected with Adobe Forms Central was simply analysed (descriptively) using built in software for representation on charts (scatterplots, bar and pie charts). The data from the Adobe repository was then exported to a Microsoft Excel spread sheet and viewed as a rectangular "flat file' filled with text strings dependent on questions asked in the questionnaire. Each row corresponded to a research participant and columns reflected responses to individual questions.

Not all cells were filled in the Excel representation. This was due to the respondents either viewing the question as irrelevant; the respondent was not qualified to answer the question as it followed on from a preceding one or the respondent not answering questions for any reason whatsoever. These failed responses, which legitimately arise, lead to holes in the response rectangle. This was an indicator of whether or not more responses were required. EDA allows development of analysis plans that are reviewed concurrently with data collection, entry, and checking. Data cleaning involves spell checking and "locking" cells so that a single consistent data set is available for later analyses. Once data collection has ended and a final cleaned data set obtained, the findings of the study may be achieved relatively quickly.

4.2.2. SPSS

Statistical Package for the Social Sciences (SPSS) is a software package designed by International Business Machines Corporation (IBM) for the statistical analysis of numerical and categorical data (IBM, 2014). The selected software offered a variety of descriptive and inferential statistical procedures for analysing the data captured by the questionnaire. Pallant (2007) suggests that SPSS is a powerful tool for complex statistical procedures involving both numerical and categorical data.

Coding on SPSS refers to adding labels to question responses synonymous with adding unique identifiers. The different types of questions require different approaches to coding. This allows SPSS to reduce answers to questions into a manageable form without distorting results, as the labels will always relate back to the options of values a question offered.

Table 4.1 is an example of coding variables with associated values (also see Annexure 3 for SPSS codebook)

Table 4.1. Example of question (variable) coding against answer options (values).

VARIABLE	VALUE
QUESTION and (as it appears on questionnaire)	**OPTIONS (as it appears on questionnaire)**
13. Do you encounter any difficulties accessing spatial data that involves the marine jurisdiction of South Africa?	Yes No Not Sure
QUESTION REDUCTION (on SPSS)	**OPTION REDUCTIONS (LABELLING on SPSS)**
Q13ACC_MJ	1 = Yes 2 = No 3 = Not Sure

The use of numbers for labelling of options does not differentiate the options on any scale in terms of Label 1 being more superior to Label 2 and so on. Labelling categorization is nominal as no numerical values are assigned. On completion of labelling of all data from the sample population, the data is ready for descriptive or inferential statistical analyses.

4.2.3. Statistical analysis of questionnaire data

4.2.3.1. Grouping of respondents

Respondents to the questionnaire varied between all three spheres of government (national, provincial and local), private industries, parastatals and academics amongst other types. All respondents were involved in some way or other in the geospatial fraternity (creating, supplying or using spatial data, research or policy). Furthermore, respondents were involved in land only, sea only or land and sea combinations regarding spatial data. This created a mass of data with variation of responses.

SPSS allows different grouping of respondents. Grouping by like-mindedness to a particular question, by the question itself, business focus, job title, profession or sphere of government are some examples. The grouping feature of SPSS permitted varying degrees of manipulation of filtered data.

4.2.3.2. Descriptive procedures applied

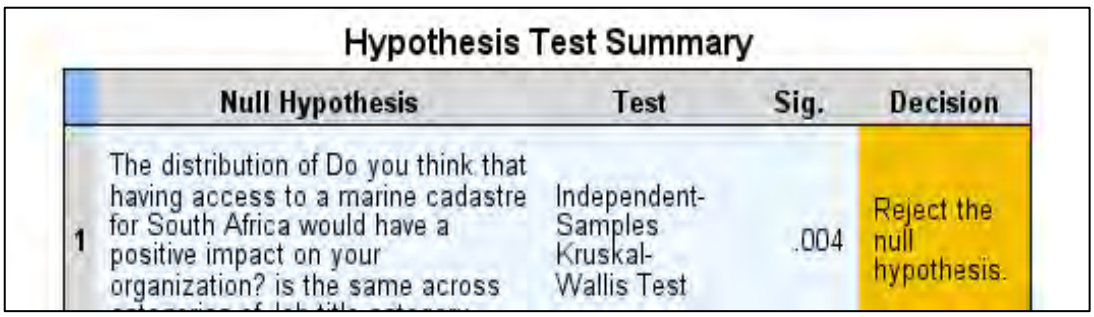
The variables had single or multiple values. Single value variables restricted respondents to selecting only one value as a response. Multiple value variables permitted an unrestricted selection of options. The “other” option in some questions, although viewed as a complicating factor in statistical analyses by Pallant (2007), provided a tool for inclusion of

information by respondents not thought of during the questionnaire design process. This further expands research scopes and surprising results relevant to a study may be obtainable.

Frequencies and cross tabulation were the descriptive procedures selected. Frequencies show the number of respondents per variable and their associated response values. Frequency queries on SPSS can be used to query per case (per respondent) or by groupings of respondents. Similarly, case or group values from one variable were matched against another in cross tabulations. An advantage of SPSS is that values of an additional variable may be added to the cross table as an additional "layer" and this offers additional insight of possible trends in a summarized display. Frequencies and cross tabulations are applicable to single or multiple value variables, are relatively simple to perform, and can be depicted on graphs or plots for enhanced understanding.

4.2.3.3. The Kruskal-Wallis one-way analysis of variance

The Kruskal-Wallis one-way analysis of variance by ranks (KW test) is a non-parametric method for testing whether samples originate from the same distribution (Sheskin, 2011). The KW test compares groups or samples from a population that seem independent and when significant results are achieved, differences in sample's distributions become evident, therefore suggesting variations in opinions to the particular survey question (Linneman, 2011). It is important that single (discrete) and not multiple values of variables be used in the test. The test does not identify where differences occur or how many differences are evident between samples but assumes that that the distribution between samples are the same, though not known. The graphic output of results of the KW test on SPSS aids in analysis. A null hypothesis (being the distribution amongst samples is the same) is tested using the KW test. The alternate hypothesis is one where differences occur between samples, but these differences are not determined by the test. To determine differences post-hoc pairwise comparisons were performed. Figure 4.2 shows an example of the KW test performed using SPSS at a significance level of 0.5.



Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Do you think that having access to a marine cadastre for South Africa would have a positive impact on your organization? is the same across	Independent-Samples Kruskal-Wallis Test	.004	Reject the null hypothesis.

Figure 4.2. Example of the Kruskal-Wallis Test.

The columns in Figure 4.2 represent the null hypothesis of this test ("Null Hypothesis"), the test run by SPSS ("Test"), the calculated significance level of this test ("Sig.") (i.e., the *p*-value), and the decision reached with regard to the null hypothesis ("Decision"). This table shows that the test was statistically significant (p = .004), which means that the null hypothesis is rejected. The test significance threshold for accepting or rejecting the null hypothesis is $P = 0.05$. The boxplots represented in Figure 4.3, represent the distribution of responses to the tested question. The distribution shapes are similar, yet they appear at different ranges from 1 to 5 (coded values of strongly agree, agree, neutral, disagree and strongly disagree respectively). This is a visual depiction of the KW test and aids in determining where responses lie for each sample group. The test does not show precisely what differences between sample groups are and further post-hoc testing is necessary to determine differences between sample groups.

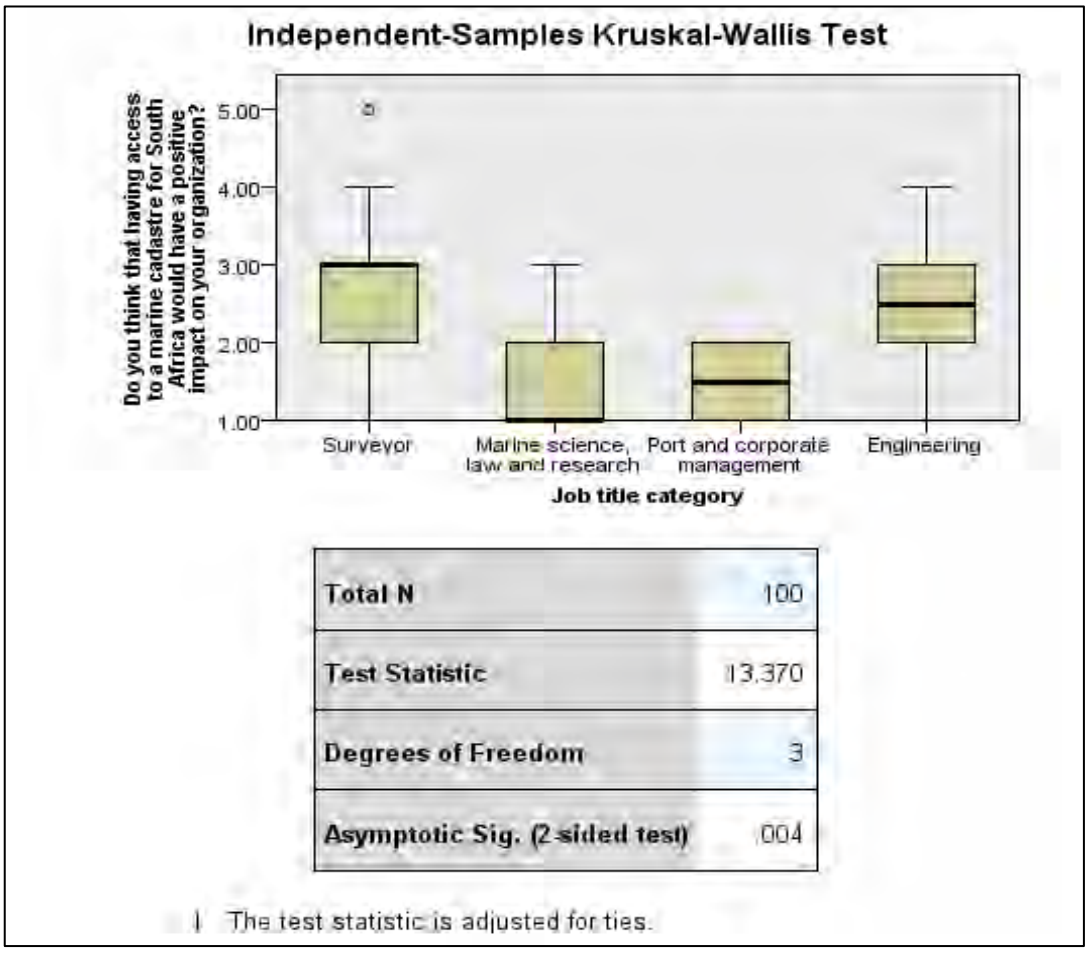
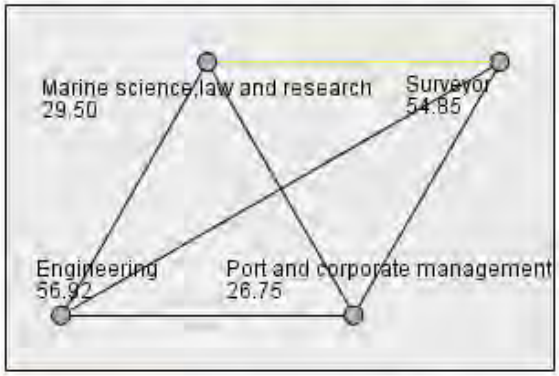


Figure 4.3. Response distribution

To determine the difference in thinking between groups a Pairwise Comparison is executed on SPSS (Figure 4.4).

Pairwise Comparisons of Job title category



Each node shows the sample average rank of Job title category.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Port and corporate management-Marine science,law and research	2.750	13.838	.199	.842	1.000
Port and corporate management-Surveyor	28.101	11.557	2.432	.015	.090
Port and corporate management-Engineering	-30.167	15.742	-1.916	.055	.332
Marine science,law and research-Surveyor	25.351	8.789	2.884	.004	.024
Marine science,law and research-Engineering	-27.417	13.838	-1.981	.048	.285
Surveyor-Engineering	-2.066	11.557	-.179	.858	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Figure 4.4. Results of Pairwise comparisons.

As multiple comparisons increase the risk of Type I errors, SPSS adjusts the significance levels using a Bonferroni correction (Abdi, 2007). The Bonferroni correction adjusts the significance value *p* calculated using the KW Test (last column in Figure. 4.4) when several dependent or independent statistical tests are being performed simultaneously on a single data set (i.e. pairwise comparisons). To perform a Bonferroni correction, the calculated significance value *p* is divided by the number of comparisons being made to obtain unique significant values for each comparison pair. In this case, six comparisons or hypotheses are

being tested; the new significance level for each comparison would be equal to $p/6$ (second last column of Figure 4.4). The statistical power of the study is then calculated based on this modified p value. The Bonferroni correction is used to reduce the chances of obtaining false-positive results (Type I errors) when multiple pair wise tests are performed on a single set of data.

There is a preference of single values (discrete) per variable when inferential statistics are used (Sheskin, 2006). Complications arise when dealing with multiple response questions (MRQ) resulting in different combinations of values as survey questions may be answered multiple valid times with varying combinations of the different options offered as responses. This necessitates further manipulation for reduction to discrete values. Aggregation reduces MRQ to discrete values.

4.2.3.4. Aggregation of multiple response questions

MRQ are defined by a degree of open-endedness as this type of survey question may yield zero or different response combinations depending on the characteristics or behaviour of the respondent (Cox and Kohler, 2011). Response combinations to a MRQ can be determined using SPSS. All possible combinations are aggregated into discrete values. Thereafter the discrete values are matched against their respective respondent thereby permitting the application of the KW test. An example of aggregation using a question from the marine cadastre questionnaire is demonstrated (Figure 4.5).

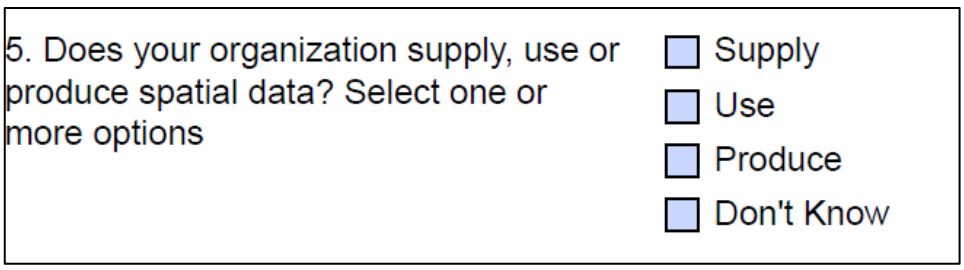
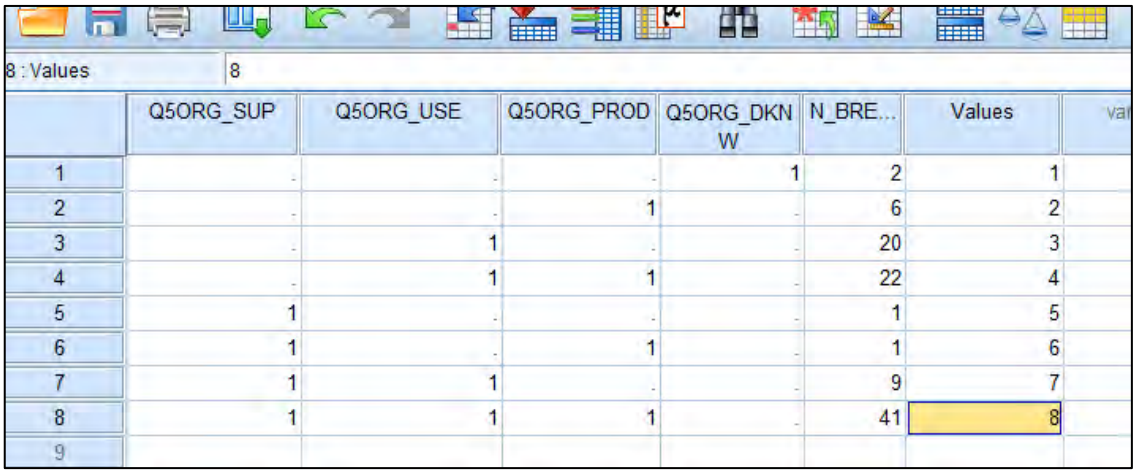


Figure 4.5. Multiple response question requiring aggregation to discrete values.

The question would allow for combinations of "Supply" through to "Produce" to be chosen. "Don't Know" is the only singular option that could be chosen.

The output in Figure 4.6 shows all eight possible combinations and frequencies of those combinations (N_BRE column).



8 : Values | 8

	Q5ORG_SUP	Q5ORG_USE	Q5ORG_PROD	Q5ORG_DKNW	N_BRE...	Values
1	.	.	.	1	2	1
2	.	.	1	.	6	2
3	.	1	.	.	20	3
4	.	1	1	.	22	4
5	1	.	.	.	1	5
6	1	.	1	.	1	6
7	1	1	.	.	9	7
8	1	1	1	.	41	8
9						

Figure 4.6. Aggregation output on SPSS

The "Values" column above allows for coding of the combinations into discrete values (Figure 4.7.).

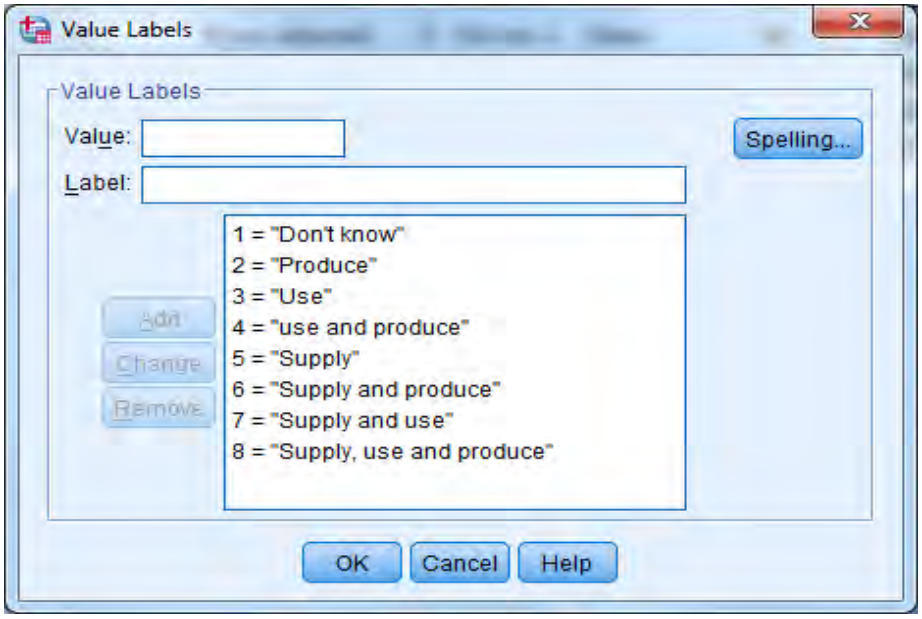


Figure 4.7. Combinations of responses reduced to eight discrete values.

Once discrete values are obtained, the KW test can be applied and if significant results were achieved, post-hoc pairwise comparisons would enable differences to be found between groups.

4.2.3.5. Open-ended question response analysis using text analytics

Text analytics (or the archaic reference of "text mining") involves taking raw text from open-ended responses to a survey question, structuring the text, deriving patterns with the structured text data and concluding the process with evaluation and interpretation of the output (Feldman and Sanger, 2006). Milner *et al* (2005) explains text analytics as information retrieval (in the form of text), lexical analysis to study words and their synonym frequencies, pattern recognition, identification of positive and negative text, clustering of similar words, graphical visualization, theme and pattern detection with the result being a mass of text reduced for evaluation and interpretation. The process must apply natural language processing so the meaning of the original text is not lost and can be traced backwards from result to original text as input by the research respondent (Srivastava and Sahami, 2009).

In the past, text mining was manually undertaken and was labour intensive but as computer aided analyses progressed, the process was automated and made substantially quicker (Feldman and Sanger, 2006). Text mining was identified in the 1980s as a business intelligence system to gather information from large fields of data to better position a product (McKnight, 2005). The valuable themes produced from text based consumer surveys allowed for improved marketing of products to assist sales numbers and improve client satisfaction (McKnight, 2005). The market research capabilities of extracting valuable information was later used in academic research and text analyses was even suggested by Hearst (1999) as a tool for uncovering new facts and trends about the World even if not explicitly stated in the text being analysed.

The questionnaire on marine cadastre consisted of open-ended questions and IBM Text Analytics provided the simplest tool in extracting themes and associations from respondents. The text data, when entered into the software, was co-referenced where words and phrases that referred to the same object were clustered (lexical analysis). Ambiguities in definitions of words were highlighted and correct meanings assigned e.g. Baker could be surname, profession or company name. Sentiment analysis was thereafter performed with extraction of subjective material like opinion, positive and negative words and sentiment. Once completed, the relationships and themes could be derived and reduced text information could be matched to individual respondents to discern trends amongst different groupings of respondents.

4.3. Interviews and focus group

The following sub-sections provide a brief overview of the interviews and focus group meeting undertaken during the course of the study. The research participants and approaches used are briefly described. The outcomes would be presented in the results chapter (Sections 5.2 and 5.3).

4.3.1. Interviews

The interviews undertaken during the course of data collection involved a semi-structured approach. The questions appearing in the questionnaire were used to guide the interview and the semi-structured approach offered the interviewee the opportunity to express his or her views without interruption. This permitted the gain of useful information. These interviews were carried out in person and permission was requested for digital recording or notes taken otherwise. Interviews were also telephonic and notes recorded. Listed below are some of the interviewees:

i. Three maritime lawyers who specialise in maritime insurance, vessel salvage, piracy, fisheries, import and export and others marine related.
ii. SA Research Chair in the Law of the Sea in Africa.
iii. An academic at the Maritime Law division at University of KwaZulu-Natal, Howard College campus.
iv. An academic whose study area is marine biodiversity and geology within the Science Department at the University of KwaZulu-Natal, Westville Campus.
v. One parastatal official.
vi. The Navy Captain of the South African Navy Hydrographic Office (SANHO) based in Tokai, Western Cape. This office undertakes marine surveys and maps the seabed of South Africa's marine jurisdiction. Navigation hazards, offshore waste sumps, ammunition disposal sumps, geological formations, navigational charts all represented on maps are prepared.

The interviews provided multiple views on marine cadastre by different professions and sectors of the South African economy, yet they all fell within the confines of the definition of a cadastre regarding a cadastral system's legal and spatial components.

4.3.2. Focus group

The feasibility of marine cadastre by extending the existing land cadastre across the land sea interface was presented to Cadastral Managers of SA (Chief Registrars of Deeds, Chief Surveyor General, Deeds Registrars, provincial Surveyor Generals, Assistant Deeds

Registrars and Deputy Surveyor Generals). Here, recording of the presentation and subsequent discussion was restricted. Notes were taken and correspondence with attendees occurred afterwards.

4.4. Study limitations

The implementation of marine cadastre is mostly in countries deemed as developed. These countries have well established infrastructure, advanced skills and geographically diverse marine territories. SA has a relatively simple geographic layout without marine based disputes evident in archipelagic countries where multiple usage rights severely overlap. Despite this, marine territories require improved management systems to effectively deal with associated RRRs. It has earlier been established that marine cadastre is a relatively new concept with varying degrees of implementation in different coastal countries, having them built with a fit for purpose design by taking consideration of domestic legislative, social and economic conditions.

Developmental states such as SA appear to have an array of socio-economic problems prioritizing the attention of decision makers and state funds. Within this greater context, this study approached marine cadastre as an extension of land cadastre across the land-interface by canvassing the geo-spatial fraternity. The limitations experienced in this study varied from lack of interest from stakeholders and poor response rates initially, therefore necessitating reminders being sent. Participation from maritime lawyers, the Mineral's Registrar, DME, offshore mining and surveying industry (who respectively hold and survey offshore rights) was seen as important to this study. However, repeated requests for input via interviews and questionnaires yielded little to no participation in the data collection phase. Although this limited the study scope to an extent and this cohort would be the biggest beneficiaries of a marine cadastral system, the research results are generalizable due to the shortcomings between the status of SA's land cadastral system and lacking of data for a similarly comprehensive marine cadastral system presented in the literature review (Chapter Two).

Respondents based in the interior of the country away from the sea were few compared to their coastal counterparts as they either had no knowledge or use of marine management systems. In this regard, the proposition of linking a possible marine cadastre to existing land cadastre provided the base knowledge of respondents well versed in land based spatial and legal systems to complete the questionnaire sufficiently with their views and opinions.

Although 102 valid responses were received, the cleaned data file presented holes where questions were not answered. This meant inconsistencies in the frequencies of responses to survey questions yet also added insight into limitations of knowledge to just their immediate

work profiles. The number of responses between different sample groups varied resulting in delays in statistical processing of data. Approaching and securing interviews with people who wished to participate posed problematic as in-person interviews were preferred. Rescheduling of dates and times or resorting to email or telephonic correspondence when schedules conflicted or were rearranged added to delays in the research work plan.

4.5. Chapter summary

This chapter presented statistical theory and detailed explanation of the analytic methods used to reduce data collected to meaningful results. Descriptive statistics and nonparametric tests proved ideal in analyses due to the qualitative nature of this study. SPSS was used for descriptive statistics (representation on charts and tables) and the Kruskal-Wallis test for inferences (nonparametric test with preference for discrete values). The exhaustive process detailed in this chapter provides methodology for repetition of analyses and negates the need for full re-explanation in the results chapter, although basic reference would be made to the selected analysis process.

CHAPTER FIVE

5.0. Results and Discussion of Findings

The methodological theory and process of data analysis was comprehensively discussed in the previous two chapters. Subsequently, this chapter presents and discusses the results systematically. In terms of orientation of the contents of this chapter, the results are focused within the context of the research question, aim and objectives. The first part focuses on results derived from the questionnaire responses. Here, the respondents are presented. The respondents' views on spatial data regarding the terrestrial and marine environments, respondents' interaction with legislation/policies/conventions and lastly opinions on marine cadastre are evaluated. Key trends and themes between respondent groups and the respondents themselves are provided. The first part of the results presentation is then supported by the second, which are the outcomes of interviews and focus group meetings.

5.1. Questionnaire analysis

5.1.1. Questionnaire respondents

The questionnaire yielded 102 valid responses in the period allocated for its administration and collection. As the questionnaire was administered online (and four paper copies) a wide variety of responses were received from a range of people. In respect of the total valid responses received, when further analysed, 69.6% of respondents reported their organization category as the private industry, 18.6% represented all three spheres of government while the remaining 11.8% comprised parastatals, non-profit organizations and academics (Table 5.1).

Table 5.1. Organizational category of respondents

Category	Frequency	Percent
National Government	8	7.8
Provincial Government	5	4.9
Local Government	6	5.9
Academia	5	4.9
Private Industry	71	69.6
Non-Profit Organization	2	2.0
Parastatal	5	4.9
Total	102	100.0

The high total of voluntary input from the private industry category as opposed to other categories was initially concerning. Further analyses of respondents showed that respondents varied in job title within their respective organizations (Table 5.2).

Table 5.2. Cross-tabulation of organization category and job title

Organizational category	Job Title										Total
	Professional Land Surveyor	Manager	Lecturer/professor	Scientist/Oceanographer/ Hydrographer/Marine Biologist	Port Manager	Candidate Professional Land Surveyor	Engineering (Professional and Technical)	Mapping	Eskom	Survey technician	
National Government	3	1	0	2	2	0	0	0	0	0	**8**
Provincial Government	2	0	0	0	0	1	0	0	0	2	**5**
Local Government	1	0	0	0	0	0	3	0	0	2	**6**
Academia	1	0	2	2	0	0	0	0	0	0	**5**
Private Industry	64	0	0	3	1	1	1	1	0	0	**71**
Non-Profit Organization	0	0	0	2	0	0	0	0	0	0	**2**
Parastatal	0	1	0	0	2	0	1	0	1	0	**5**
Total	**71**	**2**	**2**	**9**	**5**	**2**	**5**	**1**	**1**	**4**	**102**

The professional land surveyor in private industry was the largest group of respondents (64). Further analysis into categorization of respondents regarding their business focus resulted in five prominent areas as illustrated in Figure 5.1. The respondents' main area of business focus is within the mapping category. The response in this specific category is relevant as responses received are certainly from a spatially aware background.

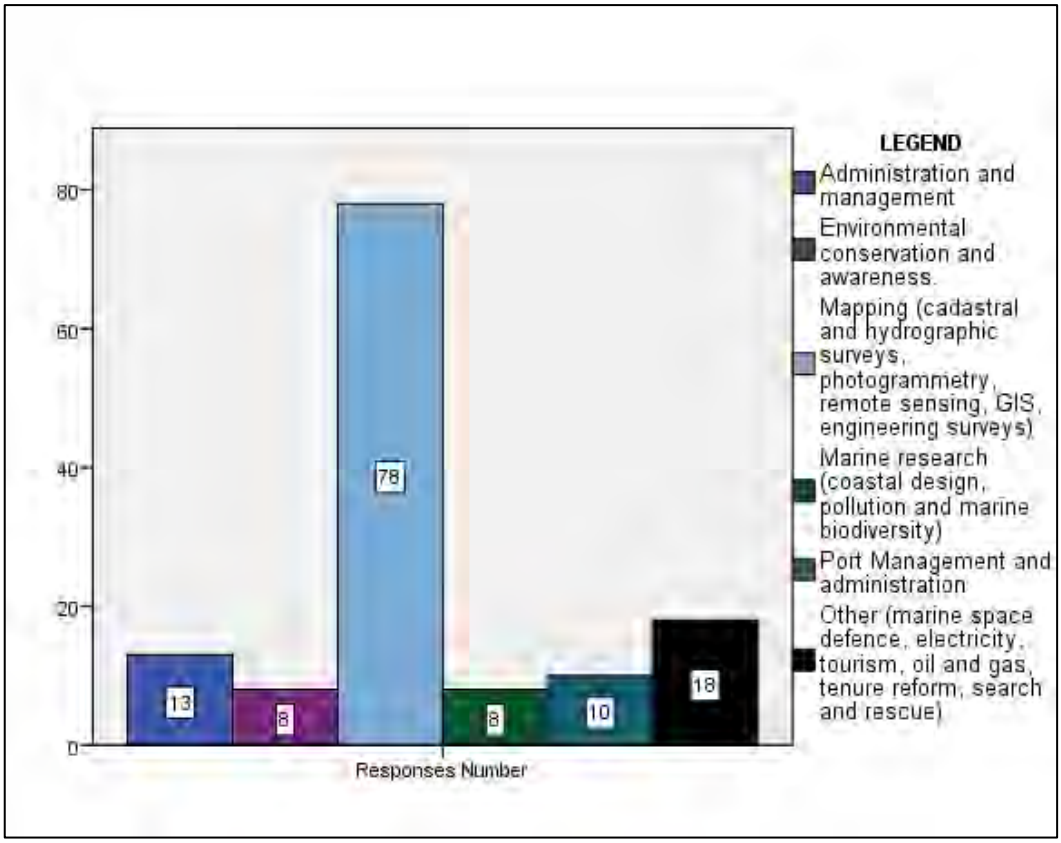


Figure 5.1. Main areas of business focus

The KW test of the organization categories with aggregated responses to the MRQ on business focus areas at a significance level of P=0.05, with six degrees of freedom, failed (Table 5.3).

Table 5.3. Kruskal-Wallis Test result for organization category and business focus areas

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Please select the main business focus of your organization is the same across categories of Which categories on the right does your organization belong to?	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is .05.				

The distributions of business focus areas differed between organizations with a calculated significance value of p = 0.00. Figure 5.2 shows organization categories and the associated boxplots indicates the range of all responses to business focus areas. The stars represent outliers in business focus selection by respondents yet are still valid responses. The values 0

to 25 on the y-axis correlates with the aggregated values of the MRQ for business focus areas (see Annexure 4). National government settles on the 7.5 value on the 0-25 range of aggregated business focus areas. This correlates with mapping, infrastructure development and land tenure being their area of focus. Provincial and local government focus on mapping, administration and management (value = 16) and academia on marine research and mapping (value = 21). The private industry's main business area is mapping (value = 5) although a significant range of responses which were not as frequently selected as others appear on the boxplot (Figure 5.2). Non-profit organizations showed an affinity to marine research (value = 20) while parastatals focused on port management and administration, import and export.

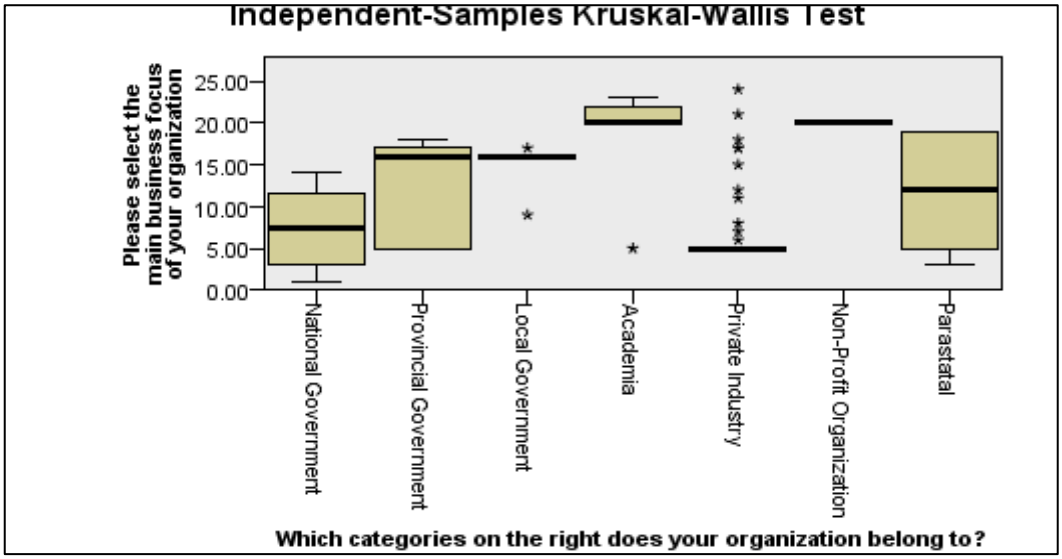


Figure 5.2. Boxplots showing the range of most frequent responses. Values 0 to 25 on vertical axis correlates to aggregated responses detailed in Annexure 4

Although there appears to be a bias of respondents towards private industry in the organization category, further breakdown into actual job title then, into business focus areas of respondents, resulted in respondent's having widespread professional responsibilities which covers all spheres of government and private industry where geospatial data and its application is concerned.

5.1.2. Access to spatial data – land versus marine environments

The KW test was performed at a significance level of 5% (p=0.05) to determine access to land and marine spatial data between respondents categorized by organization and job title. The job title group was reduced to four general groups [geospatial fraternity/surveyors (A), engineering (B), marine sciences, law and research (C), port and corporate management

(D)]. The groupings of respondents into these four general groups correlate with the most significant differences in their business focus areas:

i. Group A correlates with mapping the environment.
ii. Group B correlates with infrastructure design and development.
iii. Group C correlates with research and legislation.
iv. Group D correlates with management and subsequent decision-making.

Table 5.4. Kruskal-Wallis Test to show difficulties in accessing land versus marine spatial data between respondents categorized into groups.

GROUP CATEGORY	DIFFICULTIES ACCESSING LAND BASED SPATIAL DATA	DIFFICULTIES ACCESSING MARINE BASED SPATIAL DATA
By Organization	***p = 0.072*** Values across all groups = 2*	***p = 0.007*** Values: Academia, NGO, parastatals = 1* National Government = 2* Private industry, Provincial and local government = 3*
By Job Title	***p = 0.276*** Values across all groups = 2*	***p = 0*** Values : Groups A and B = 3* Groups C and D = 1*

**** The values 1, 2 and 3 correspond with Yes, No and Not Sure respectively.***

Although respondents were categorized into different groups and subjected to the KW test, there are generally, no difficulties in accessing land based spatial data as opposed to marine data (Table 5.4). Of note is the variation of responses in the difficulties in accessing marine based spatial data. Details on any difficulties accessing land and marine spatial data were requested in follow up questions and are detailed in the following two subsections.

5.1.2.1. Access to land based spatial data

The most significant disparity in responses in the grouping by organization was between private industry and the total of all three spheres of government (76% against 18.7% respectively, Table 5.5). Finding the data, format and cost implications were prominent difficulties experienced across both groups. In the organization group, this trend suggests that access and collaboration in data sharing are disparate between the Government and private sector. The job title group indicates that the geospatial fraternity experiences most difficulties. Although this is the case, the KW Test shows that access to land spatial data of all respondents is without serious difficulty (Value = 2, Table 5.4 above).

Table 5.5. Issues affecting access to land based spatial data

	GROUPING BY ORGANIZATION							GROUPING BY JOB TITLE			
Difficulties	**National Government**	**Provincial Government**	**Local Government**	**Private Industry**	**Non-Profit Organization**	**Parastatal**	**Total %**	**Geospatial**	**Marine science, law and research**	**Engineering**	**Total %**
Copyright issues	0.00	1.33	0.00	5.33	0.00	0.00	**6.67**	6.67	0.00	0.00	**6.67**
Finding the data	1.33	2.67	2.67	22.67	1.33	1.33	**32.00**	28.00	1.33	2.67	**32.00**
Format	1.33	2.67	0.00	14.67	0.00	1.33	**20.00**	17.33	1.33	1.33	**20.00**
Licence issues	0.00	1.33	0.00	5.33	0.00	0.00	**6.67**	6.67	0.00	0.00	**6.67**
Cost implications	0.00	2.67	1.33	16.00	1.33	0.00	**21.33**	20.00	1.33	0.00	**21.33**
Websites offline or broken links	1.33	0.00	0.00	12.00	0.00	0.00	**13.33**	13.33	0.00	0.00	**13.33**
TOTAL %	**4.00**	**10.67**	**4.00**	**76.00**	**2.67**	**2.67**	**100.00**	**92.00**	**4.00**	**4.00**	**100.00**

5.1.2.2. Access to marine based spatial data

National Government respondents did not report significant difficulties (Value = 2) while other groups within the Organization category fall into the Yes (Value =1) and Not sure (Value = 3) options (KW Test, Table 5.4).

Table 5.6 shows that amongst those who reported having difficulties in accessing marine data, the biggest hindrances were finding marine based spatial data (46.15%). National government experiences the least difficulty in accessing marine spatial data (2.56%). Of interest is that responses to the questionnaire from the geospatial fraternity greatly differed compared to the Marine science, law and research group and Port and corporate management group (78 versus 10 and 8 responses respectively) (Table 5.1). A significant cause for this disparity between these groups was the geospatial fraternity's core business area being mapping (with spatial data) while with other groups, spatial data is required as supporting evidence to their respective business focus areas. Nevertheless, finding marine based spatial data still poised the biggest difficulty for all respondents grouped by "Job Title".

Table 5.6. Responses to issues affecting access to marine based spatial data

	GROUPING BY ORGANIZATION							GROUPING BY JOB TITLE			
Difficulties	**National Government**	**Provincial Government**	**Academia**	**Private Industry**	**Non-Profit Organization**	**Parastatal**	**Total %**	**Geospatial**	**Marine science, law and research ?ort and corporate management**		**Total %**
The cost implications	0.00	2.56	2.56	5.13	5.13	2.56	**17.95**	5.13	10.26	2.56	**17.95**
Finding the data	2.56	2.56	10.26	17.95	5.13	7.69	**46.15**	15.38	17.95	12.82	**46.15**
Licence issues	0.00	2.56	0.00	5.13	0.00	2.56	**10.26**	2.56	2.56	5.13	**10.26**
Copyright issues	0.00	0.00	2.56	7.69	0.00	2.56	**12.82**	2.56	5.13	5.13	**12.82**
Format	0.00	2.56	2.56	7.69	0.00	0.00	**12.82**	7.69	5.13	0.00	**12.82**
TOTAL %	**2.56**	**10.26**	**17.95**	**43.59**	**10.26**	**15.38**	**100.00**	**33.33**	**41.03**	**25.64**	**100.00**

Although varying degrees of difficulties are experienced in accessing spatial data, Question 10 of the questionnaire asked whether the spatial data which respondents have access to, serves the purposes of their respective organizations. When categorized by organization, 80 respondents across all organizations answered "Yes", 18 responded "No" and 4 were not sure (Table 5.7). This indicates that once difficulties are overcome in acquiring spatial data, the data is sufficient to serve the organizations' purposes.

Table 5.7. Adequacy of spatial data to organizations

Organizational category	**10. Does the spatial data that you have serve the purposes of your organization adequately?**			**Total**
	Yes	**No**	**Not sure**	
National Government	7	1	0	**8**
Provincial Government	4	1	0	**5**
Local Government	6	0	0	**6**
Academia	2	3	0	**5**
Private Industry	57	10	4	**71**
Non-Profit Organization	0	2	0	**2**
Parastatal	4	1	0	**5**
Total	**80**	**18**	**4**	**102**

Further analysis by cross-tabulating the responses received from Question 10 with business focus areas shows that spatial data does in fact adequately meet respondents' requirements with only the marine research business focus area reporting otherwise (5 against 3 responses, Table 5.8).

Table 5.8. Adequacy of spatial data to business focus areas

	10. Does the spatial data that you have serve the purposes of your organization adequately?			
Business Focus Area	**Yes**	**No**	**Not sure**	**Total**
Administration and management	12	1	0	**13**
Defence	2	0	0	**2**
Electricity Utility	1	0	0	**1**
Environmental conservation and awareness	6	2	0	**8**
Fishing	1	0	0	**1**
GIS	2	0	0	**2**
Import and export	2	2	0	**4**
Infrastructure Development	2	0	0	**2**
Mapping	62	12	4	**78**
Marine research	3	5	0	**8**
Mining	1	0	0	**1**
Oil and gas	1	0	0	**1**
Port Management and administration	7	2	1	**10**
Search and rescue	2	0	0	**2**
Tenure reform	1	0	0	**1**
Tourism	0	1	0	**1**
Total	**105**	**25**	**5**	**135**

5.1.3. Importance of spatial data

The KW Test was performed to determine the distribution of responses for the importance of spatial data across organization categories at a significance level of P=0.05 and 6 degrees of freedom. All sources of spatial data, other than that derived from land surveys, were deemed of medium to high importance (Table 5.9). The response frequency for land surveys (93 responses) as opposed to hydrographic surveys (27 responses) and tidal records (22 responses) indicate that terrestrial spatial data is acquired significantly more often, by more persons and on larger scale than that of marine spatial data. Satellite imagery (66 responses) and aerial photography (84 responses) produce spatial data to include both terrestrial and marine jurisdictions but more so for land based applications. Geographic Information System (GIS) vector data and magnetic data were of high importance to 2 respondents.

Table 5.9. Importance rating of spatial data sources to organizations.

	IMPORTANCE RATING						
SOURCE OF SPATIAL DATA	LOW	MEDIUM	HIGH	TOTAL RATING RESPONSE	DID NOT RATE	GRAND TOTAL (REPONSES + NO RESPONSES)	KRUSKAL-WALIS TEST STATISTIC *p*
SATELLITE IMAGERY	14	18	34	66	36	102	0.543
AERIAL PHOTOGRAPHY	3	18	63	84	18	102	0.303
LAND SURVEYS	2	9	82	93	9	102	0.000
HYDROGRAPHIC SURVEYS	2	6	19	27	75	102	0.084
TIDAL RECORDS`	3	8	11	22	80	102	0.194

The test statistic p (last column, Table 5.9) are all above the significance level of P= 0.05 other than land surveys. Although land surveys has been rated the most important source of spatial data, it is not the case for all organizations. Post-hoc testing by Pairwise Comparisons and application of the Bonferroni correction indicates that land surveys are rated as significantly more important to the private industry compared to National Government when 21 pairs of groups by organization category are compared (p/21=0.001) at a significance level threshold of p = 0.024. One reason for this difference is that National Government provides the legislative framework regarding spatial data that the private industry must comply with.

When importance ratings were compared across the job title group using the KW test, the distribution of responses across all sources of data were similar, other than for land surveys

(tested at significance level $P = 0.05$ and calculated $p = 0$). The difference in distribution for spatial data derived from land surveys, as opposed to other sources of spatial data, is consistent for respondents grouped by organization category and job title. This suggests that the type of spatial data required for the objectives of organizations defines the relative importance of spatial data acquired by the organization's owners or employees.

5.1.4. Spatial data: its production, supply and use

The aim of querying whether respondents supplied, used or produced spatial data (or any combination thereof) was to:

i. ascertain the availability of spatial data for sharing (open-source or with cost).
ii. determine the use of spatial data to create more spatial data by modification and consolidation (e.g. data layers of composite interactive map from different data vendors)
iii. determine if there is an interaction between all three options (supply, use and produce) in organizations.

Table 5.10 shows responses from the organizational category. There are more users of spatial data across all organizational categories (92 responses) than producers (70 responses) and suppliers (52 responses).

Table 5.10. Spatial data handling by organization category

Organizational category	Produce, supply or use spatial data				Total
	Produce	Supply	Use	Don't know	
National Government	4	4	7	1	**16**
Provincial Government	4	4	3	0	**11**
Local Government	3	1	6	0	**10**
Academia	4	0	5	0	**9**
Private Industry	49	42	64	1	**156**
Non-Profit Organization	2	0	2	0	**4**
Parastatal	4	1	5	0	**10**
Total	**70**	**52**	**92**	**2**	**216**

Respondents were permitted to select one or all options between the production, supply and use of spatial data and the results show that there is a mixed selection (Table 5.10). Respondents are reliant on one another to perform their functions within organizations, indicating a community of professions and organizations that interact with one another to serve their purposes (Figure 5.3).

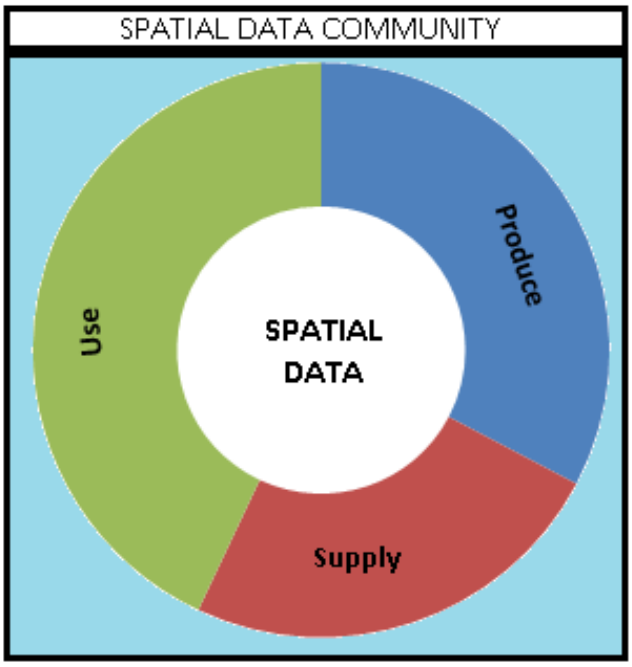


Figure 5.3. Interlinked community which shares spatial data

Although there appears a bias towards the use of spatial data compared to its production or supply, this correlates with fewer data producers or suppliers rendering services to a large and diverse community, which makes sound business sense. To gain a deeper understanding of the type of data used, produced or supplied by respondents, cross-tabulations were performed (Tables 5.11, 5.12 and 5.13).

Land survey outputs features as the prominent product (60 responses) and private industry being the dominant producer (48 responses) (Table 5.11). Although aerial photography and satellite imagery produce remote terrestrial surveys, they were offered as separate options to land survey outputs in the questionnaire as they also produce imagery of terrestrial water features and of the ocean.

Production of aerial photography and satellite imagery received 18 and 3 responses respectively in comparison to the 60 responses received for land survey outputs. Products centred on mapping water features and marine space received a poor response. Hydrographic surveys (12 responses), ocean maps (1 response), plans for off-shore rights (1 response) and 2 responses for marine bioregions, species movement, sediment type and coastal management data indicate fewer products being developed for mapping of SA's marine jurisdiction as compared to that of the terrestrial environment.

Table 5.11. Cross-tabulation of spatial data production and organizational category

Organizational category	Spatial Data: PRODUCE								
	Aerial photographs	Hydrographic surveys	Land survey outputs	Marine bioregions, species movement, sediment type and coastal management data	Ocean maps	Plans for off-shore rights	Satellite imagery	Not Sure	Total
National Government	1	3	1	0	0	0	0	0	**4**
Provincial Government	2	0	3	0	0	0	1	0	**4**
Local Government	2	1	3	0	0	0	0	0	**3**
Academia	0	1	1	0	1	0	0	0	**2**
Private Industry	9	4	48	0	0	1	1	1	**51**
Non-Profit Organization	0	0	0	2	0	0	0	0	**2**
Parastatal	4	3	4	0	0	0	1	0	**4**
Total	**18**	**12**	**60**	**2**	**1**	**1**	**3**	**1**	**70**

The supply of spatial data differs from that of its use in that suppliers usually are the vendors of data produced by others (Table 5.12). Again, land survey outputs features prominently with a total of 44 responses and mostly from the private industry (37 responses). Hydrographic surveys received 11 responses indicating fewer suppliers of spatial data regarding water bodies compared to land based data.

Table 5.12. Cross-tabulation of spatial data supply and organizational category

Organizational category	Spatial Data : SUPPLY						Total
	Aerial photographs	Hydrographic surveys	Land survey outputs	Satellite imagery	Socio-economic densification plans and zone/land use plans	Not Sure	
National Government	4	4	2	1	0	0	**11**
Provincial Government	1	0	3	1	0	0	**5**
Local Government	1	1	1	0	0	0	**3**
Private Industry	13	5	37	3	1	1	**60**
Parastatal	1	1	1	1	0	0	**4**
Total	**20**	**11**	**44**	**6**	**1**	**1**	**83**

The responses to Aerial photography (81), satellite imagery (61), hydrographic surveys (25) and land survey outputs (82) (Table 5.13) exceed corresponding responses for production (Table 5.11) and supply of spatial data (Table 5.12). This is indicative of a larger user base of data produced by fewer respondents to the questionnaire, although use, supply and production of spatial data overlaps amongst respondents.

Additionally, the larger user base suggests the procurement of spatial data from fewer producers and vendors and data sharing amongst users themselves (examples would be professional land surveyors using survey records already approved and archived at Surveyor-General offices, or an epoch survey for change detection analysis of sediment build-up of the uMvoti River of the KwaZulu-Natal north coast).

Table 5.13. Spatial data use by organizational categories

`	Spatial Data : USE							Total
	Aerial photographs	Bathymetry	Hydrographic surveys	Land survey outputs	Magnetic data	Satellite imagery	Not Sure	
National Government	5	0	5	6	1	5	0	**7**
Provincial Government	3	0	0	3	0	1	0	**3**
Local Government	6	0	2	6	0	2	0	**6**
Academia	3	1	3	3	0	4	0	**4**
Private Industry	57	0	11	59	0	44	1	**65**
Non-Profit Organization	2	0	2	0	0	1	0	**2**
Parastatal	5	0	2	5	0	4	0	**5**
Total	**81**	**1**	**25**	**82**	**1**	**61**	**1**	**92**

Spatial data pertaining to the marine environment is neither produced, supplied or used as much in comparison to terrestrial data. The use of bathymetric data garnered just one response (Table 5.13).

Although the use of spatial data exceeds that of is production and supply, Section 5.2 demonstrated the difficulties that respondents experience when accessing the data they require for both marine and terrestrial environments. There are issues in accessing both categories of spatial data, but accessing marine based data is more cumbersome and is compounded by the apparent lack of the production and supply of data relevant to marine space.

5.1.5. Land cadastre

The results shown thus far indicate a bias towards terrestrial spatial data where difficulties in its access are minimal and its production exceeds that in comparison to marine based spatial data. As a cadastre is a marriage of legal, institutional and spatial components, the questionnaire requested opinions on the efficiency of the South African land cadastre.

The efficiency of land cadastre is highlighted by the 83% positive response frequency illustrated in Figure 5.4. In analysing the response rate to Question 15, no grouping into organizational, business focus area or job title categories were applied

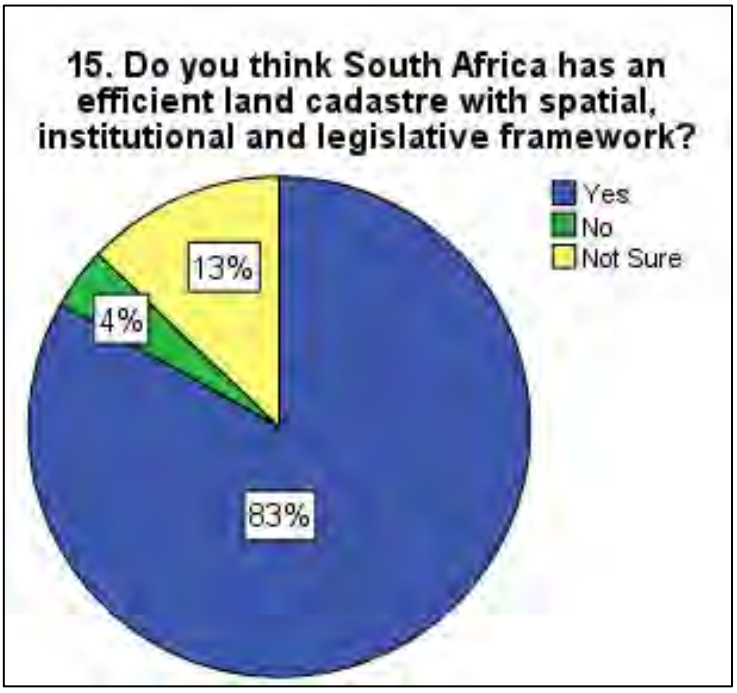


Figure 5.4. South Africa's land cadastre efficiency by organizational category

The null hypothesis was rejected after performing the KW test at a significance level of $P = 0.05$, to determine the distribution of responses to Question 15 by organizational category (Figure 5.5). The KW test determined a calculated significance value of $p = 0.04$. The numbers 1, 2 and 3 on the Y-axis correspond with the question values of "Yes", "No" and "Not Sure". Although responses range through all three options, the local government category is not certain of the land cadastre's efficiency (3 = Not Sure) and non-profit organizations indicating that land cadastre is not efficient. All other organizational categories lean strongly towards land cadastre being efficient.

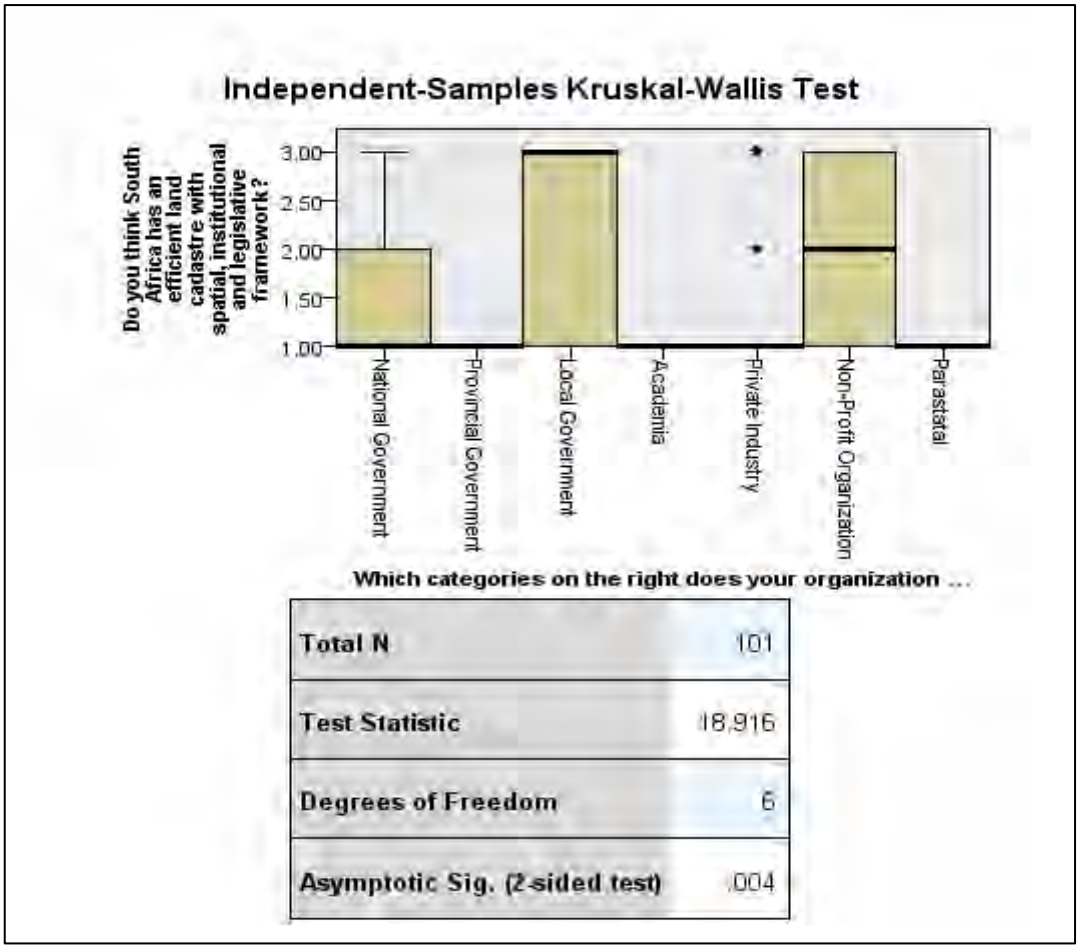


Figure 5.5. KW test to determine if distribution across organization category is the same

Post-hoc testing by Pairwise Comparisons and application of the Bonferroni correction shows the largest difference in opinion to Question 15 is between private industry and local government when 21 pairs of groups by organization category are compared (p/21=0) at a recalculated significance level threshold of p = 0.009. At this stage, it is relevant to note that the KW test does not determine a result based on different frequencies of responses from different groups as question responses are ranked and not scored. Professional land surveyors comprised the most respondents from the private industry group compared to local government and are responsible for undertaking land surveys that are strictly bound by legislation such as the LSA and the DRA. The LSA informs the spatial component, while the DRA informs on the accompanying registration component and together these acts form the cornerstone of land administration in SA. Local government is a public service entity encumbered by a magnitude of service delivery mandates while private industry are more self-serving and profit driven. The spatial data produced by land surveyors in the private industry group is significantly more than those from local government (Section 5.1.4, Table 5.11). As cadastral data is bound by a legislative framework, the output of the private

industry, which feeds directly into the South African cadastral system significantly influenced the positive response to Question 15.

When the KW test was performed against the job title grouping at a significance level of P = 0.05 for Question 15, the null hypothesis was rejected after a calculated significance value of p = 0.002 (Figure 5.6). Most respondents by job title grouping agreed with there being an efficient land cadastre (1 = Yes) other than managers and candidate professional land surveyors (2 = No) and engineers who were not sure (3 = Not sure). The managers who responded to the questionnaire were not from a geospatial background, or if they were, they were more involved in day to day running of the organization and dealing with finances and delegation. Candidate professional land surveyors are not yet experienced in cadastral systems being fresh out of university.

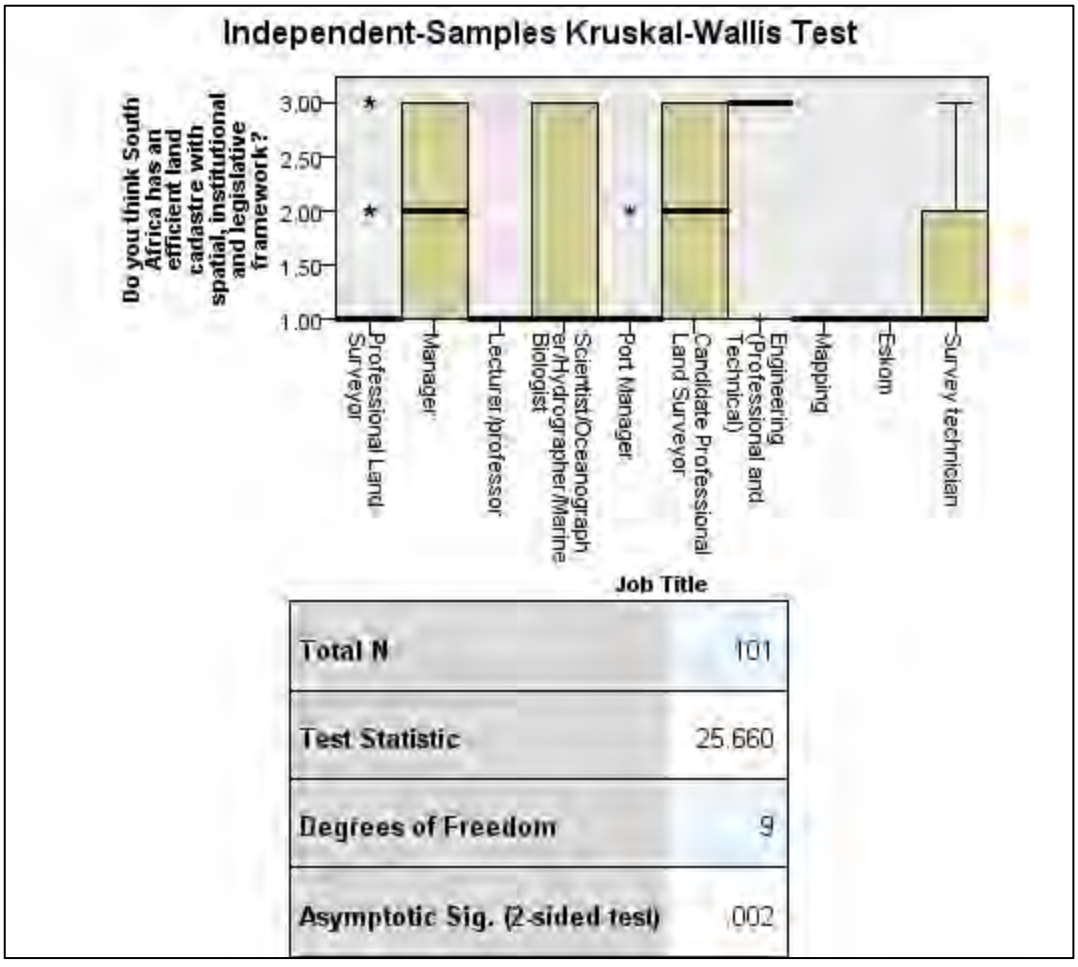


Figure 5.6. KW test to determine if distribution across organization category is the same

Engineers do not deal directly with cadastral data and their response shows that their field is not in boundary making, although they are aware of it and take consideration of boundaries. Responses to Question 16, from all respondents without any grouping, yielded the following result in Figure 5.7. Land based mapping (being the spatial component to a cadastral system) is extensive and rigorous enough in the view of 64% of respondents.

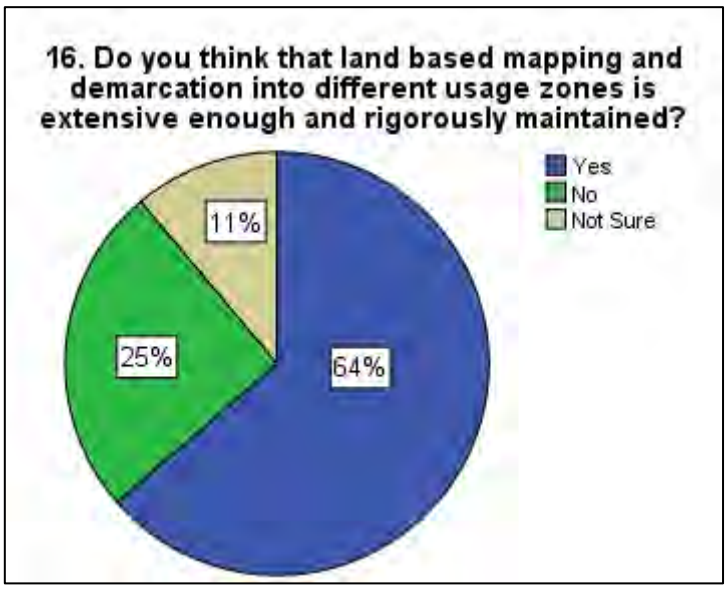


Figure 5.7. Extent and rigour of land based mapping

It is indicative from the favourable responses from a broad range of organizations, careers and professions to the efficiency, extensiveness and rigour of land cadastre that it is a well understood and supported land administration system in SA with the associated spatial, institutional and legislative framework.

5.1.6. Marine mapping

Those who responded favourably to there being rigorous and extensive mapping and demarcation into usage zones (Question 16, Section 5.1.5), were subsequently asked to make a comparison to the marine jurisdiction of SA. Of those who responded "Yes" to Question 16 (64% of all respondents, Figure 5.7), 60% (38 responses) feel that a similar degree of land based mapping should be applied to the South African marine jurisdiction (Figure 5.8). A significant proportion (38%, 20 responses) were not sure and 8% (5 responses) thought marine mapping should not be similar to that of land (Figure 5.8). Of 102 respondents, 39 did not respond.

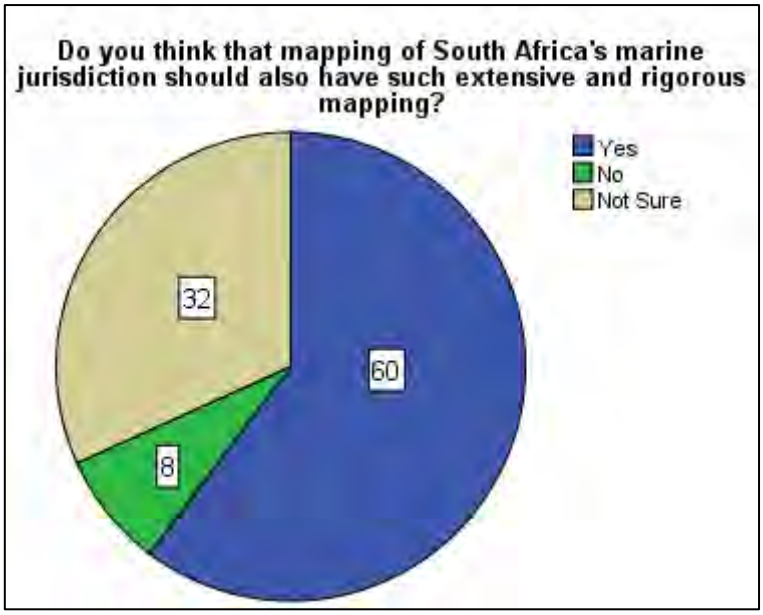


Figure 5.8. Mapping of South Africa's marine jurisdiction.

Further analysis showed all organization categories, who feel that SA's land delimiting system is efficient, also feel that marine mapping should be spatially on par to segregate different usages (Table 5.14)

Table 5.14. Organizational category responses to marine mapping.

	If you answered "Yes" to Question 16 above, do you think that mapping of South Africa's marine jurisdiction should also have such extensive and rigorous mapping?			
Organization Category	**Yes**	**No**	**Not Sure**	**Total**
National Government	2	0	1	**3**
Provincial Government	2	0	0	**2**
Local Government	3	0	0	**3**
Academia	4	1	0	**5**
Private Industry	25	3	18	**46**
Parastatal	2	1	1	**4**
Total	**38**	**5**	**20**	**63**

When asked for a motivation for similar mapping of land and the sea, respondents offered the following:

i. Most waters of SA coastline are surveyed but approximately 40% require updating with modern survey techniques.
ii. Increasingly accurate mapping is required to identify constantly diminishing resources.
iii. Updated maps would decrease shipping incidents and associated pollution.
iv. Cadastral mapping has different facets and one is associated with ownership rights. No one can own the sea or parts thereof.
v. Cost factors of creating a sufficient marine mapping system.
vi. Current legislation is land dominant and existing marine based legislation is target specific with overlapping agencies leaving users uncertain of jurisdiction of different authorities.
vii. Infrequent updates or updates performed when need arises (project specific updates).
viii. Respondents were not sure how marine mapping would benefit "the man on the street".
ix. Oil and gas reserve indicators in association with marine geology.
x. In and near tidal waters requires a more rigorous legal base.
xi. If tasked with a particular job, the data is collected to meet that specific requirement thereby creating temporally inconsistent and discrete datasets with different accuracies.
xii. No zoning and activity usage overlaps. Zoning and planning should be done in a similar fashion to terrestrial property.
xiii. General overlapping of rights as near shore, where most human activities occur, requires most clarity on RRRs.
xiv. Lacks input from spatial professionals in key decision areas.

The opinions above, thematically represented from 73 respondents, indicate differing views on marine mapping. The mapping of the sea lacks consistency and is seen as less important than terrestrial mapping. One theme prevalent was creating new data by survey when the need arises. This suggests that existing data is non-existent to serve a broad array of applications that may be development, economic or conservation oriented. The tidal area along the coastline of SA, immediately seaward from the land-sea interface, was identified as the most important area where marine activities require clearer definition, both spatially and legally.

5.1.7. Marine activities and restrictions

Very few of the respondents (16.03%) reported that they could practice their activity at will anywhere in the sea with most responses in the "No" (42.75%) to "Not Sure" (41.22%)

options (Table 5.15). Business areas that relate to management and are within the domain of government (like defence, environmental awareness and conservation, and mapping) show that government agencies do exercise their functions as custodians of the marine territory. Similarly, awareness of restrictions to activities trended towards "No" and "Not sure" options. This suggests that although there are restrictions defined in law, stakeholders did not fully comply due to lack of awareness

Table 5.15. Percentages of responses to business activities and restrictions

Business Focus	Business activity performance anywhere at sea			Total %	Awareness of restrictions			Total %
	Yes	No	Not Sure		Yes	No	Not Sure	
Administration and management	1.53	3.82	4.58	**9.92**	3.85	1.54	3.85	**9.23**
Defence	1.53	0.00	0.00	**1.53**	1.54	0.00	0.00	**1.54**
Electricity Utility	0.00	0.76	0.00	**0.76**	0.77	0.00	0.00	**0.77**
Environmental conservation and awareness	1.53	2.29	2.29	**6.11**	3.08	1.54	0.77	**5.38**
Fishing	0.00	0.76	0.00	**0.76**	0.00	0.77	0.00	**0.77**
GIS	0.76	0.76	0.00	**1.53**	0.77	0.77	0.00	**1.54**
Import and export	0.76	2.29	0.00	**3.05**	3.08	0.00	0.00	**3.08**
Infrastructure Development	0.00	1.53	0.00	**1.53**	0.00	0.00	1.54	**1.54**
Mapping	5.34	20.61	31.30	**57.25**	11.54	16.15	30.00	**57.69**
Marine research	0.00	3.05	2.29	**5.34**	0.77	1.54	3.85	**6.15**
Mining	0.00	0.76	0.00	**0.76**	0.00	0.00	0.77	**0.77**
Oil and gas	0.76	0.00	0.00	**0.76**	0.77	0.00	0.00	**0.77**
Port Management and administration	3.05	3.82	0.76	**7.63**	6.15	0.77	0.77	**7.69**
Search and rescue	0.76	0.76	0.00	**1.53**	1.54	0.00	0.00	**1.54**
Tenure reform	0.00	0.76	0.00	**0.76**	0.77	0.00	0.00	**0.77**
Tourism	0.00	0.76	0.00	**0.76**	0.77	0.00	0.00	**0.77**
TOTAL %	16.03	42.75	41.22	**100.00**	35.38	23.08	41.54	**100.00**

Of those who reported restrictions on their activities, the following themes prevailed:

i. Legal restrictions and law being uncertain.
ii. Man-made structures (coastal engineering, buoys)
iii. Marine conservation areas
iv. Unresolved maritime boundaries with Mozambique and Namibia.
v. Shipping channels, cables and pipelines.
vi. Fishing restrictions imposed by authorities and from coastal property owners who feel their rights are being depleted by anglers on their doorstep.
vii. Harbours, ports and navigation hazards and uncertainty of High and Low Water Marks.

Of concern to numerous respondents was the position of the High and Low Water Marks as this has direct implications on their land surveys. This indicates more interest of where land surveys should end rather that what occurs beyond the land termination line and into the sea. Some respondents, especially those in management, port authorities and in the survey profession for many years indicate that when offshore surveys were performed for any reason, existing restrictions (mining areas, waste disposal sumps, oil/gas platforms, ship mooring areas amongst others) were adhered to. Usually these charts were out-dated with other activities occurring where they should not. Marine conservation areas, shipping lanes and tourism related activities that can vary depending on time of year were infrequently reported by respondents. Many of the restrictions which respondents are aware of do not have spatial representation, or if they do, they are out-dated or detailed in legislation without enforcement or interpretation in the real world.

Boundaries are attached to restrictions (which respondents reported on above) whether or not people are aware of them. When queried on any physical boundaries, only 29 of 102 respondents provided the following:

i. High Water Mark (HWM)
ii. Shoreline debris
iii. Land-sea interface
iv. Rocky outcrops
v. Man-made features (buoys and walls within and out of ports).

The calibre of physical boundaries offered by respondents is vague and insufficient in managing numerous, often overlapping, activities and associated RRRs that occur near and

in the sea. The provision of the land-sea interface and HWM as boundaries relates more to where land surveys should end and not where marine surveys should begin. The lack of physical boundaries corresponds with physical monuments being nearly impossible to place at sea resulting in difficulty abiding and/or enforcing rules associated with different areas and activities.

5.1.8. Legal perspective

In determining the legal perspective, the questionnaire was designed to ascertain the awareness of legislation and whether particular legislation were being applied in day to day business of respondents (Table 5.16). The LSA was the most understood law amongst respondents. The LSA is central to land administration in SA as it is applied in demarcating rights on the ground by erection of monuments to mark the boundaries between properties. In comparison, the ICMA was applied less than the awareness levels of respondents. A similar scenario is evident with the MZA. The SSA, being an older Act was very well known but is hardly in use due to the ICMA replacing most of its provisions.

Table 5.16 Cross tabulation –Responses regarding awareness and use of South African Laws

Business focus	Integrated Coastal Management Act 24 of 2008		Maritime Zones Act 15 of 1994		Sea Shore Act 21 of 1935		Land Survey Act 8 of 1997		TOTAL	
	AWARE	USE	AWARE	USE	AWARE	USE	AWARE	USE	AWARE	USE
Administration and management	**7**	5	**5**	1	**9**	4	**12**	10	**33**	20
Defence	**2**	1	**2**	2	**2**	1	**2**	2	**8**	6
Electricity Utility	**0**	0	**0**	0	**1**	1	**1**	1	**2**	2
Environmental conservation and awareness	**7**	3	**7**	4	**6**	3	**5**	4	**25**	14
Fishing	**1**	1	**1**	1	**1**	0	**1**	0	**4**	2
GIS	**1**	1	**0**	0	**1**	1	**1**	1	**3**	3
Import and export	**4**	2	**4**	3	**4**	3	**3**	4	**15**	12
Infrastructure Development	**1**	1	**1**	0	**0**	0	**1**	1	**3**	2
Mapping	**43**	26	**17**	5	**58**	34	**73**	72	**191**	137
Marine research	**8**	6	**7**	4	**7**	1	**7**	2	**29**	13
Mining	**0**	0	**0**	0	**0**	0	**1**	0	**1**	0
Oil and gas	**1**	0	**1**	1	**1**	1	**1**	1	**4**	3
Port Management and administration	**10**	8	**9**	6	**10**	5	**9**	6	**38**	25
Search and rescue	**2**	0	**2**	1	**2**	2	**1**	2	**7**	5
Tourism	**1**	1	**1**	1	**0**	0	**0**	0	**2**	2
TOTAL	**88**	**55**	**57**	**29**	**102**	**56**	**118**	**106**	**365**	246

Table 5.16 highlights that respondents grouped by areas of business focus were aware of the main pieces of legislation that governed their day-to-day activities. The application of legislation lagged behind its awareness.

Table 5.17. Cross tabulation – Response numbers regarding awareness and use of policy categories and business focus

	POLICIES															
	Mining related		Communications related		Development related		Tourism related		Shipping related		Port related		Petroleum related		TOTAL	
Business focus	**AWARE**	USE	**AWARE**	USE	**AWARE**	USE	**AWARE**	USE	**AWARE**	USE	**AWARE**	USE	**AWARE**	USE	**AWARE**	USE
Administration and management	**5**	1	**3**	1	**7**	4	**3**	0	**4**	2	**5**	1	**0**	1	**31**	10
Defence	**1**	1	**1**	1	**1**	0	**1**	0	**2**	1	**2**	0	**0**	0	**8**	3
Electricity Utility	**0**	0	**1**	1	**1**	1	**0**	0	**0**	0	**0**	0	**0**	0	**2**	2
Environmental conservation and awareness	**5**	3	**4**	4	**6**	4	**4**	2	**6**	4	**6**	0	**0**	0	**33**	18
Fishing	**1**	1	**1**	1	**1**	1	**1**	1	**1**	1	**1**	0	**0**	0	**6**	5
GIS	**1**	0	**1**	0	**1**	0	**1**	0	**1**	0	**1**	0	**0**	0	**7**	1
Import /export	**3**	3	**4**	4	**4**	3	**3**	2	**4**	4	**4**	0	**0**	0	**22**	16
Infrastructure Development	**0**	0	**0**	0	**1**	1	**0**	0	**0**	0	**0**	0	**0**	0	**1**	1
Mapping	**31**	23	**5**	2	**28**	20	**6**	0	**11**	0	**12**	0	**1**	0	**129**	50
Marine research	**5**	5	**2**	2	**7**	4	**2**	3	**6**	3	**5**	0	**0**	0	**27**	17
Mining	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**1**	1
Oil and gas	**1**	1	**1**	1	**1**	0	**1**	0	**1**	1	**1**	0	**0**	0	**6**	3
Port Management and administration	**8**	7	**7**	9	**9**	6	**7**	4	**10**	9	**10**	1	**0**	1	**51**	36
Search and rescue	**1**	1	**2**	2	**2**	1	**1**	0	**2**	2	**2**	0	**0**	0	**10**	6
Tenure reform	**1**	1	**1**	0	**1**	1	**1**	0	**1**	0	**1**	0	**0**	0	**6**	2
Tourism	**1**	1	**0**	1	**1**	1	**1**	1	**1**	1	**1**	0	**0**	0	**5**	5
Total	**64**	48	**33**	29	**71**	47	**32**	13	**50**	28	**51**	2	**1**	2	**345**	176

Table 5.17 shows general policy categories. The use of policies (176 responses) significantly lags behind the awareness (345 responses). While it is not implied that every law a respondent is aware of should be used in their activities, the results on Table 5.16 and 5.17 indicates that land based management systems were better understood than marine based systems. This conclusion is drawn from the small difference between use and awareness of land based legislation and policies compared to wide difference in the marine counterpart.

It was made clear to respondents to the questionnaire that the sea is not static thereby implying that traditional boundary beaconing by monuments is not applicable. With intangible boundaries, respondents were asked if legislation, wherein boundaries are defined, is difficult to enforce for good ocean governance.

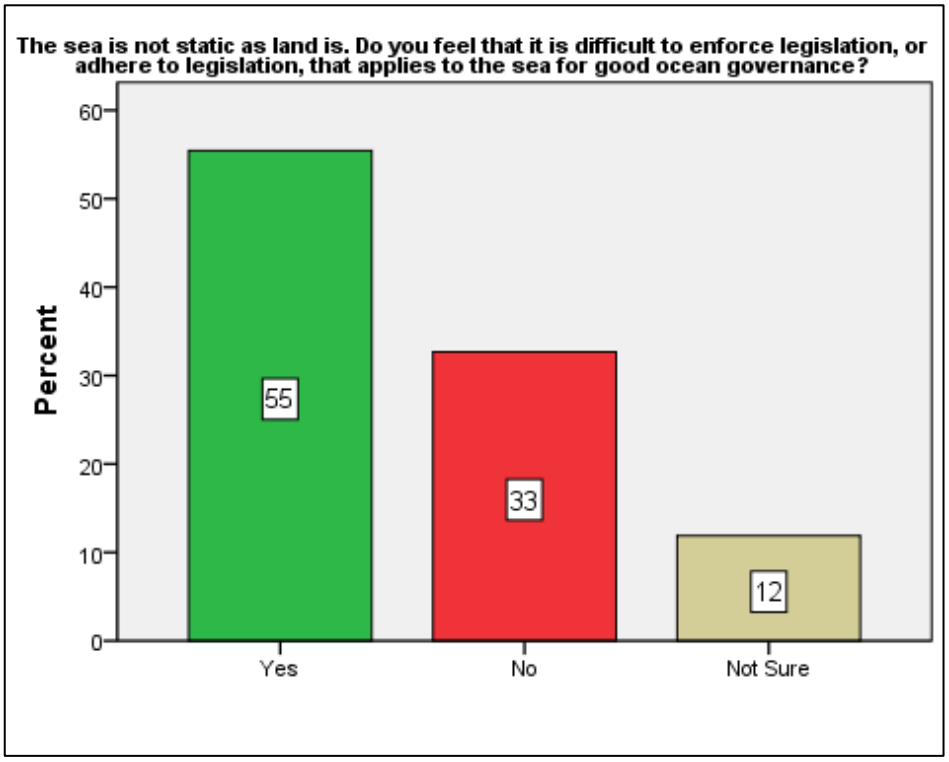


Figure 5.9. General response percentage to enforcing or adhering to marine legislation

Fifty-five percent of all respondents agree that legislation is difficult to enforce at sea (Figure 5.9). When further analysed all organizational categories "Yes" response exceeded the "No" (Table 5.18.). National and Provincial Government do not think it is difficult to enforce or adhere to marine legislation compared to Local Government. Although responses

received from all government spheres were low, the inconsistency between them regarding legislative enforcement would negatively affect ocean governance.

Table 5.18. Enforcing/adhering legislation applicable to the sea based on number of responses.

	The sea is not static as land is. Do you feel that it is difficult to enforce legislation, or adhere to legislation, that applies to the sea for good ocean governance?			
Organizational Category	**Yes**	**No**	**Not Sure**	**Total**
National Government	2	5	0	**7**
Provincial Government	2	3	0	**5**
Local Government	4	1	1	**6**
Academia	4	0	1	**5**
Private Industry	38	23	10	**71**
Non-Profit Organization	2	0	0	**2**
Parastatal	3	2	0	**5**
Total	**55**	**34**	**12**	**101**

Graphical representation of legal provisions would be useful to administration and management (8 positive responses), environmental conservation and awareness (6 positive responses), marine research (7 positive responses) and port management and administration (8 positive responses) (Table 5.19).

The mapping of legal provisions grouped by business focus areas received more negative and uncertain responses (35 and 21 responses respectively) as opposed to a positive response (22). This is indicative of a bias towards land legislative provisions as improved land based managements systems such a rigorous land cadastre would serve these respondents' businesses more favourably compared to marine boundaries.

Table 5.19. Cross tabulation of business focus areas with graphical representation of legislation in the marine environment.

Business focus area	Would graphical representation of the areas of the sea on maps and charts that legislation provides for be useful to your activities?			Total
	Yes	No	Not Sure	
Administration and management	8	2	3	13
Defence	1	1	0	2
Electricity Utility	0	0	1	1
Environmental conservation and awareness	6	1	1	8
Fishing	1	0	0	1
GIS	1	0	1	2
Import and export	2	1	1	4
Infrastructure Development	0	0	1	1
Mapping	22	35	21	78
Marine research	7	1	0	8
Mining	1	0	0	1
Oil and gas	0	1	0	1
Port Management and administration	8	1	1	10
Search and rescue	0	1	1	2
Tenure reform	1	0	0	1
Tourism	1	0	0	1
Total	**59**	**44**	**31**	**134**

The graphical depiction of marine boundaries received more positive than negative responses although a significant number of respondents were not sure (Table 5.19). A poorly responded to follow up open-ended question (which received 33 responses from 102 respondents) provided the following reasons to how graphic boundary description would benefit improving ocean governance:

i. HWM boundaries would be clarified instead of reliance on case law interpretations.
ii. Awareness of conflicting RRRs.
iii. Definition of overlapping boundaries (mineral rights areas, pipelines, shipping channels etc.) would clearly position exclusion zones of different activities of different stakeholders.
iv. Marine maps usually define existing features and are not consistent with legislation. A "judicial marine map" that is regularly updated with existing marine features shown would be beneficial.
v. Government obligations would be clearly defined spatially.

vi. All stakeholders would know all that should be happening (or not) at every location. Graphical representation would remove doubt and uncertainty of marine activities.

vii. Improved decision-making after easier information collection.

viii. May show redundancies in overlapping legislation i.e. when one piece of legislation supersedes another, all applicable laws on one system would ensure better legal interpretation.

ix. Temporal dimension would assist in showing changes in RRRs, as RRRs are not constant in time.

x. Similar to land cadastre, which promotes and protects land rights, rights to offshore property and resources, as opposed to *ownership rights at sea,* will be delimited.

xi. Can be linked to international conventions and policies to show SA's international role and position.

xii. It would offer another management dimension to all stakeholders.

xiii. Zoning maps would ensure reduced conflict as zoning correlates with a boundary making system.

5.1.9. UNCLOS and South Africa

SA signed and ratified the UNCLOS respectively in December 1984 and December 1997 (DIRC, 2006). The MZA drew provisions of maritime boundary limits from UNCLOS before ratification of UNCLOS so SA could conform to international standards (DIRC, 2006). As UNCLOS is an internationally recognized authority for standardization of ocean jurisdictions of coastal countries, the questionnaire requested its levels of awareness and that of SA being a signatory (Table 5.20).

In terms of awareness of UNCLOS, just 33 of 101 respondents gave a positive response, while the rest were either not aware or never heard of it. National Government, academia and parastatals are aware of UNCLOS and the private industry trending towards much lower levels of awareness.

Table 5.20. Awareness of UNCLOS and SA being a signatory amongst respondents

	Are you aware of the United Nations Convention on the Law of the Sea (UNCLOS)?				Are you aware that South Africa is a signatory to UNCLOS?			
Organization category	**Yes**	**No**	**Never heard of it**	**Total**	**Yes**	**No**	**Not sure**	**Total**
National Government	5	0	2	7	5	1	1	**7**
Provincial Government	2	2	1	5	2	2	1	**5**
Local Government	0	2	4	6	0	6	0	**6**
Academia	3	0	2	5	3	0	2	**5**
Private Industry	18	25	28	71	13	52	6	**71**
Non-Profit Organization	2	0	0	2	2	0	0	**2**
Parastatal	3	2	0	5	3	2	0	**5**
TOTAL	**33**	**31**	**37**	**101**	**28**	**63**	**10**	**101**

The positive responses to SA being a signatory of UNCLOS closely matched those of the awareness levels of the convention. There was a small decline between awareness of UNCLOS and SA being a signatory (33 versus 28 responses, Table 5.20). The responses received show that national government and academics at research institutions are most familiar with UNCLOS compared to other categories of respondents. Parastatals involved with maintaining ports and goods transport by sea are also familiar with UNCLOS due to the trading conditions and coastal state maritime zones imposed by the convention.

In terms of Article 76 of UNCLOS, SA has applied to the UN Commission on the Limits of Continental Shelf for an extension of its marine jurisdiction to the furthest extent of its continental shelf. Potentially, up to an additional 1.5 million square kilometres of ocean space can be added to SA's marine jurisdiction (Abbas, 2014). Only 29% of respondents who provided an answer were aware of this (Table 5.21. with 100 responses received).

Table 5.21. Awareness of South Africa's application to UN Commission on the Limits of the Continental Shelf cross-tabulated with organizational category.

Organizational category	Awareness of SA's Article 76 of the UNCLOS application for an extended continental shelf			Total
	Yes	No	Don't know	
National Government	5	1	1	**7**
Provincial Government	4	0	1	**5**
Local Government	0	6	0	**6**
Academia	4	0	1	**5**
Private Industry	12	48	10	**70**
Non-Profit Organization	2	0	0	**2**
Parastatal	2	3	0	**5**
TOTAL	**29**	**58**	**13**	**100**

If the extended continental shelf that SA applied for is granted, this will result in a significantly larger marine jurisdiction for SA and respondents felt that all implications offered to them (Question 33 of questionnaire) would be of significance (Table 5.22). All of the resultant implications of an extended marine jurisdiction for SA would require improved ocean governance, which ideally should begin with a spatial representation of all RRRs of all stakeholders. As no ownership rights are possible at sea more responsibility would lie with the South African government in ensuring sustainable management. This in turn requires a fit for purpose management system from which decisions can be made.

Table 5.22. Implications of an increased marine jurisdiction for SA.

Organizational category	Implications if continental shelf extension granted							TOTAL
	More untapped marine resources like oil and minerals	Expanded exclusive fishing areas	More responsibility for the State	Cost implications as a result of a bigger area	Exposure to piracy	Bigger area to ecologically protect and sustain	Don't know	
National Government	5	6	6	6	4	6	1	34
Provincial Government	5	5	5	4	3	5	0	27
Local Government	3	4	5	5	1	5	0	23
Academia	4	4	4	4	3	4	0	23
Private Industry	50	51	49	40	28	43	11	272
Non-Profit Organization	0	0	2	2	1	2	0	7
Parastatal	3	2	2	2	4	3	0	16
TOTAL	70	72	73	63	44	68	12	402

The Presidency of SA has shifted focus to extraction of marine benefits, especially oil and gas, to boost the ailing South African economy by declaration of Project Phakisa (Cropley, 2014). The implementation of Project Phakisa shows an intention for increased pressure exertion on the sea. This would stimulate a competitive atmosphere of maritime activities. Shipping, dumping of waste material and oil and gas exploration will compete with tourism and declared marine conservation areas. The prospects of addressing unemployment by Phakisa are documented by Abbas (2014) and the subsequent increase in coastal populations concurs with the 2025 projection by FIG (2006). The associated conflicting activities and their related RRRs would benefit from spatial segregation to aid in overarching sustainable governance that limits usage conflicts.

5.1.10. Marine cadastre

The prevailing definition from other countries for marine cadastre, presented in literature in Chapter Two, is that it is a spatial information system dealing with boundaries that are not physically fixed but rather referenced to points defining baselines on land (Collier *et al*, 2001; Nichols *et al*, 2000 and Robertson *et al*, 1999). As marine cadastre is a relatively new concept internationally, and respondents to this research questionnaire are predominantly familiar with land cadastre, 64 responses revealed that rights to the sea should be delimited, based on activity type, in a similar fashion to land rights (Table 5.23).

Table 5.23. Separation of marine rights similar to land rights

Job Title	Should the rights to the sea, based on activity type, be separated in a similar fashion as that of land rights which are separated by boundaries?			Total
	Yes	No	Not Sure	
Professional Land Surveyor	43	6	19	**68**
Manager	1	0	1	**2**
Lecturer/professor	2	0	0	**2**
Scientist/Oceanographer/ Hydrographer/Marine Biologist	7	0	2	**9**
Port Manager	4	1	0	**5**
Candidate Professional Land Surveyor	2	0	0	**2**
Engineering (Professional and Technical)	2	2	1	**5**
Mapping	0	0	1	**1**
Eskom	1	0	0	**1**
Survey technician	2	1	0	**3**
TOTAL	**64**	**10**	**24**	**98**

In light of the response frequencies shown above, respondents were asked to rate from "Strongly agree" to "Strongly disagree", if access to a marine cadastre would benefit their organization. Table 5.24 indicates that differences between groups occur mainly in the "Strongly agree" to "Neutral" options. Overall, respondents tended to agree that a marine cadastre would benefit their organizations.

Table 5.24. Percentage of responses to the benefits of having access to a marine cadastre

Business Focus	Benefits of a marine cadastre to your organization				
	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Administration and management	33.33	33.33	33.33	0.00	0.00
Defence	50.00	0.00	50.00	0.00	0.00
Electricity Utility	0.00	100.00	0.00	0.00	0.00
Environmental conservation and awareness	71.40	14.30	14.30	0.00	0.00
Fishing	100.00	0.00	0.00	0.00	0.00
GIS	100.00	0.00	0.00	0.00	0.00
Import and export	50.00	25.00	25.00	0.00	0.00
Infrastructure Development	0.00	0.00	100.00	0.00	0.00
Mapping	20.80	26.00	48.10	3.90	1.30
Marine research	62.50	12.50	25.00	0.00	0.00
Mining	0.00	0.00	100.00	0.00	0.00
Oil and gas	0.00	0.00	100.00	0.00	0.00
Port Management and administration	50.00	30.00	20.00	0.00	0.00
Search and rescue	0.00	50.00	50.00	0.00	0.00
Tourism	100.00	0.00	0.00	0.00	0.00
Total of 100%	**32.80**	**24.40**	**39.70**	**2.30**	**0.80**

The data above demonstrates that marine cadastre would be beneficial to a variety of organizations across many business focus areas. Because of this agreement between different stakeholders, Table 5.25 illustrates pooled results from all categories of respondents, giving the most favoured components for marine cadastre. Mining, pipelines, cables, MPAs, navigation hazards, shipping and fishing areas were viewed as necessary components. The last five components were volunteered by individual respondents as other components to consider. This data shows that sustainable development of marine space is of significance to respondents.

Table 5.25. Favoured features for a marine cadastre

Features	Number of responses	Percentage of Cases
Ecological information	58	59.80
Mining rights and mineral deposits	83	85.60
Bathymetry	45	46.40
Undersea cables	81	83.50
Pipelines	79	81.40
Shipping channels	71	73.20
Fishing areas	72	74.20
Marine conservation/park areas	84	86.60
Tourism information	45	46.40
Navigation hazards	69	71.10
Navy and defence	1	1.00
Submarine DEM	1	1.00
Fish farming	1	1.00
Exploration	1	1.00
Production rights	2	2.10

Figure 5.10 illustrates a scale of importance for marine cadastre features. All of the features for a marine cadastre suggested in the question were favourably rated in the "Medium" to "High" range. The non-response rate averaged 2.6% when all respondents are considered outside of groupings.

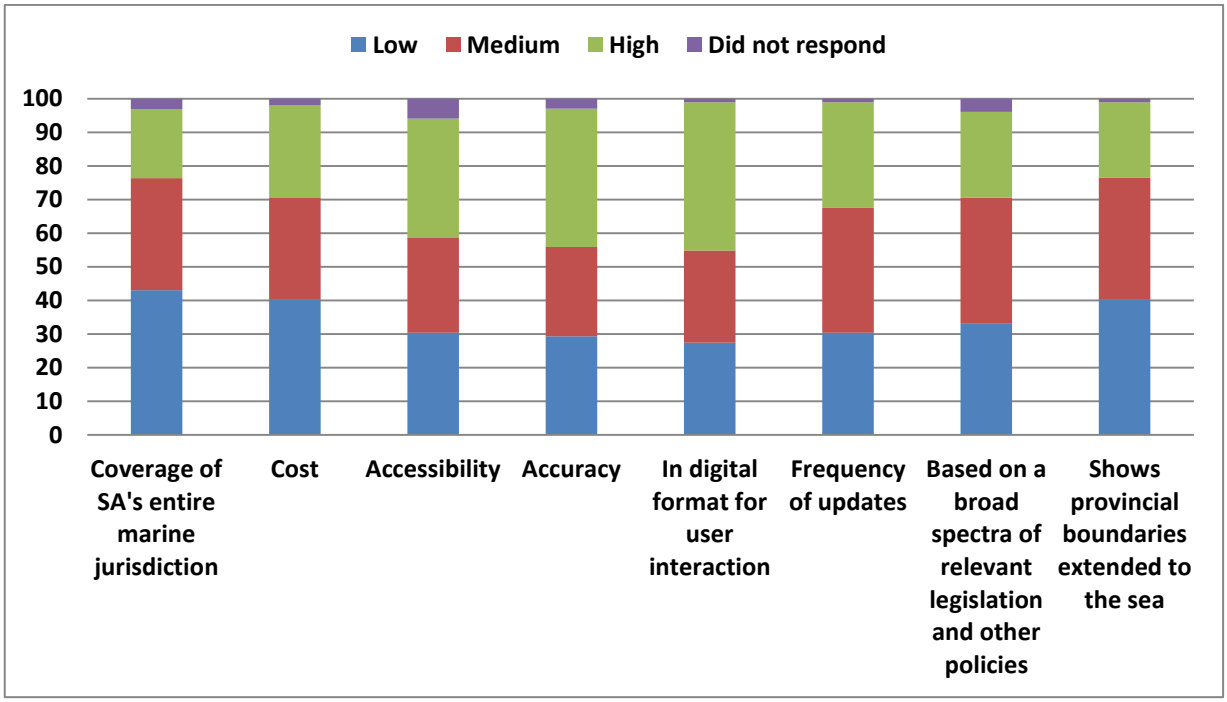


Figure 5.10. Rating the features of a marine cadastre

The favourable responses to different components and features of marine cadastre suggests that, irrespective of job title, business focus area or organization, information and tools lack in marine management systems. This in turn, indicates information gaps not yet filled by existing measures.

5.2. Findings from focus group meeting

Following on from the marine cadastre questionnaire, a focus group meeting was held in Stellenbosch, Western Cape. A brief scope of the study was presented to Cadastral Managers at provincial and national level after which interactive discussions were held. The aim of the group discussion was to enable an understanding of overlapping rights evident both on land and at sea and to create debate on the similarities and differences of land and marine cadastres (see discussion notes, Annexure 5). The managers present are custodians of the SA cadastral system. The key issues are presented and discussed below.

i. The Deeds Registrars suggested that, as they record ownership rights and are not involved in the spatial depiction of property enclosing rights, marine cadastre fell within the ambit of the survey and planning professions. Their role might be to create a register for marine rights.

ii. The meeting point between marine data custodians and the SDI of SA was uncertain. This indicated uncertainty of the whereabouts of marine spatial data.

iii. Clarification of international maritime boundaries with Namibia and Mozambique was needed to be recorded for SA's marine jurisdiction. Additionally, it was raised that SA has applied for an extended continental shelf under Article 76 of UNCLOS which may greatly increase SA's marine territory. The new territory will pose challenges which may need solutions for possible extraction of benefits.

iv. The positions of the HWM and LWM were noted to be ambiguous. Legal definitions will need clarification although case law exists which have set precedents as to their positions. Resolution of ambiguities will determine where coastal properties end, define the sea shore and the land-sea interface from which a possible marine cadastre could be referenced.

v. It was uncertain whether a possible marine cadastre should be managed by a new state agency or by coastal Surveyor-General offices. This suggested a linking of land cadastre to a possible marine cadastre across the land-sea interface.

vi. Legislation was noted to be required for a marine cadastre to be created and/or updated under one jurisdiction that includes both land and sea. This suggests an extension of the land cadastre to include the marine territory with associated changes to relevant legislation to support this end.

vii. Advancing survey techniques may be able to represent overlapping rights at sea. It was stated that overlapping rights do exist on land as well and similar methodology in their separation can be adapted to depict those found in the sea.

viii. Classic survey monuments used to define land based property extents is not practical at sea, but Global Navigation Satellite Systems (GNSS) that operate at high accuracy in real time could be used for referencing kinematic positions of vessels at sea in relation to pre-defined boundaries of RRRs of stakeholders. This would enable infringements to be shown as warnings and for ocean monitoring agencies (such as the Navy) to be warned, also in real time.

One of the attendees pointed out that focus on the marine environment in SA and internationally is heightening as land-originating renewable and non-renewable resources are diminishing due to technological improvements and population growth. He further suggested that a multipurpose marine management system should not be piecemeal system that is left to evolve from different areas of need, only to leave gaps in management or create conflict that could be backed up legally from different consent giving authorities.

The analysis of the questionnaire revealed a bias towards land management systems that are supported by legal, institutional and SDI frameworks. It also showed the gaps evident in

marine management systems. The key findings of the focus group meeting were similar to those emerging from the questionnaire.

The general opinion of attendees appeared to be that a marine cadastre is quite similar to a land cadastre with ownership rights only being applicable to land. If ownership rights are ignored, then there are still strong linkages between existing terrestrial and proposed marine cadastres in terms of segregation and recording of RRRs by using spatial data, technology and aligned legislative provisions.

5.3. Stakeholder interview summaries

The general approach to interviews was to follow a semi-structured or open interview. Although some interviews were informal, some questions were pre-formulated, the interviews also explored any new ideas the person(s) being interviewed offered. The interviews were conducted at each stakeholder's respective office or when both interviewee and interviewer were attending a conference and it was convenient to hold the interview. Interviews were either digitally recorded or handwritten notes were taken in cases were requests to record were denied. The transcribed interviews and hand-written notes are in Appendices 4 to 8 and views of stakeholders interviewed are summarised below.

5.3.1. Interview 1 – SA Navy Captain Hydrographer

The selection of this particular individual offered insight into surveys of SA's marine jurisdiction by a State entity. The interview was held in Tokai, Western Cape in October 2013 (transcribed in Annexure 6 – Interview 1). Categorized below is a summary of the interviewees' views.

Spatial data perspectives

i. Navigation hazards are frequently updated and source data from marine surveys are kept in analogue format as a backup although the charts derived of the source data is digital.
ii. Difficult to obtain information across state and private sector.
iii. Differing datums used – introduces error.
iv. Marine mapping is linked to land based SDI as marine SDI begins at "Theoretical Zero" where land SDI ends. Matter on clearly linking the two systems properly by considering different datasets of different accuracies.
v. Complete survey of High Water Mark and its constant revision is needed.
vi. Shoreline surveys done by interviewee's office and is used in conjunction with those procured from Surveyor-General Offices.

vii. Surveyed baselines and zones defined in Schedule II of MZA.
viii. Involved in process for claim of extended continental shelf to UN in terms of Article 76 of UNCLOS.
ix. Incompatible datasets between state and private agencies or high cost factor involved.
x. Marine surveys are need based resulting in some areas, especially off-shore of coastal cities, being more recent and detailed than along less populated stretches of coastline.

Institutional perspectives

i. When maritime rights are allocated (like in the case of mining permits), the licence-issuing agency to be very specific and satisfied on positioning systems to avoid exploration in areas not allocated.
ii. State agencies, private sectors and other institutions are disparate. They operate alone or without sufficient collaboration. The business success comes first.
iii. Clear mandates of state entities are missing.

Legal perspectives

i. Coastal marine management agencies do not enforce the rules and regulations efficiently. Resources exist to do so. Positioning is important for prosecuting ocean use violations.
ii. Legal definition of HWM needs clarification.
iii. Application to UN for extended continental shelf was beset with meeting stringent requirements found in Article 76 of UNCLOS.
iv. Legal international maritime boundaries with Mozambique and Namibia not fully resolved.
v. Laws exist but are not fully enforced by relevant sectors.

Technical perspectives

i. A cadastral system, which is an accessible database and tool, is reliant on datasets and what its intended purpose is. If is in an open source system it would introduce limitations as not all data providers or producers would want to share data freely. Some information is also restricted or have some legal restrictions imposed – like title deeds and personal information of people.

5.3.2. Interview 2 – Maritime law professor

The interview centred on the perspectives of a maritime law professor on a marine cadastral system for SA. The interview was held at the Howard College Campus, UKZN in July 2013 (transcribed in Annexure 7, Interview 2).

i. Regulatory framework of SA's marine jurisdiction has a domestic component that fits into international conventions. The MZA is ratification of UNCLOS by SA. Ratification involves the SA National Assembly and President signing into domestic law derived of international conventions of which SA is signatory to. SA ratified, or is signatory to, many international conventions.
ii. Terrestrial applicable law, other than some laws applicable to land cadastre that requires land to enforce, extends to 12 NM out to sea with this being the Territorial Waters found in the MZA (defined in Section 4).
iii. Focus on maritime resources and, for example, depletion of fish stock will make current legislation applicable within SA's marine jurisdiction obsolete as fish stock moves into deeper waters (such as the MLRA).
iv. A marine cadastral system, if properly mapped, would partially assist maritime lawyers, as there is no existing clarity on rights conferred to individuals or attached liabilities. The RRRs can possibly be built into such a cadastral system as definition of an area with linked RRRs can assist in pursuing any infringements.
v. Marine reserves are well legislated and cannot see how demarcation on a marine cadastral system would assist any further but in areas not well legislated or explored, such a system would be beneficial.
vi. Precedent cases with associated outcomes/judgements are used for future rights and liabilities issues. Current law may be preventative of activities, but prosecution is always retrospective.
vii. SA is well legislated but its legal regime is not yet sufficiently tested due to offshore legislation not being as robust as in some other countries.
viii. Possible rights infringements are difficult to prosecute if infringer was never aware of his or her action affecting the rights of others. A marine cadastre can assist in depicting RRRs in advance.
ix. Disputes on position of HWM and LWM.

5.3.3. Interview 3 - Practising maritime lawyers and Parastatal official

A group interview was held with three maritime lawyers and a senior official from Transnet at the Maritime Law Association Conference held in Zimbali, KwaZulu-Natal in August

2013. The researcher explained the study being undertaken and the interview was handwritten (Annexure 8, Interview 3).

The lawyers are involved in salvage of wrecks, claims, pollution control and associated hazards and maritime negligence cases. It was made clear that the Government owns the sea and that everyone has rights to use the sea and that laws are in place to manage a variety of uses. Applicable maritime laws are wide-ranging and not always effectively used. Different government departments have different roles to play and laws are not enforced as is expected otherwise legal problems they handle would not persist.

The lawyers were not certain if a marine cadastre would help their cause as some cases are beyond territorial waters and involve international law, which SA prescribes to in part. Areas of law that interest them were:

i. MZA and the defined maritime zones and uses.
ii. Admiralty jurisdiction
iii. Transport of goods
iv. Oil and gas
v. Maritime insurance and claims
vi. Customs and excise
vii. Salvage
viii. Pollution

Business is high on the agenda and any legal infringements are handled afterwards. It seems that legal measures already in place are not preventative but are enforced after an issue arises.

The Transnet official presented on the future dig-out port south of Durban Harbour. It intends meeting increasing demands on shipping, cargo and storage capacities. The port would link to upgraded land road and rail transport infrastructure and better position SA as a gateway and major player in the Southern African Development Community. The official acknowledged constant rights abuses and the sometimes-difficult acquisition of tidal data, land/engineering surveys, aerial photos and regular EIAs. The use of GIS maps with out-dated data is a noted concern as they are relied on for showing port and near port activities. Data for updating such interactive GIS maps is collected by Transnet itself. The new port is envisaged to serve a bigger maritime industry and link the sea to land via the upgraded land transport network. The reverse of land reclamation would occur when large portions of Merebank, a mixed residential and industrial area, are expropriated, excavated and submerged.

5.3.4. Interview 4 – SA Research Chair in the Law of the Sea in Africa

The researcher met with an academic who specializes in laws of the sea at the Maritime Law Association Conference (Annexure 9, Interview 4). The interviewee's views are summarised below:

i. Lawyers are "translators of law" for the non-professional. They are tools to enforce, protect and question legislation.
ii. Laws protect and separate rights ultimately and rights separation at sea is complex.
iii. In the maritime industry, the different sectors within are not completely familiar with one another and externally related industries.
iv. Government should not legislate and thereafter forget about its enforcement. Government should anticipate future risks by looking internationally and build legal provisions to deal with such risks before waiting for problems to arise and realising gaps evident in legislation.
v. Competing activities evident in and on the sea is, if not more, important than land as its potential is not fully uncovered.
vi. A register for rights at sea can possibly be created but ownership rights disregarded, as the Government owns the sea.

5.3.5. Interview 5 – Marine academics

The interview with marine academics was undertaken at the UKZN Science Department, Westville Campus, Durban in May 2013 (Annexure 10, Interview 5). The purpose was to understand the complexity of the natural environment of the sea. On land, the cadastre is built on a bio-diverse environment that requires consideration for matters of conservation. The interview yielded the following summarised views:

i. SA has nine recognised marine bioregions and these significantly differ from one another. In addition, over 20 marine reserves are proclaimed by Government Gazette.
ii. Marine reserves or MPAs are areas of great significance for SA heritage. These areas have buffer zones around them and referenced to SA coastline to mark their boundaries on marine charts.
iii. Human interference by overfishing, pollution from offshore outflows and illegal dumping of waste by passing ships has ripple effects on food chains and in turn, the general bioregions the reserves are in.
iv. Marine cadastre would assist in graphically showing composite marine use areas, as geolocation is currently problematic.

v. Overlapping and conflicting uses/activities evident (waste discharge, deep sea dumping of waste, oil spills, echo sounds)
vi. Legislation is worded properly in most cases, but ineffective in reality as enforcement and understanding lacks.
vii. Research seems to be knowledge creation and preservation of information and not species and nature preservation.

5.4. Discussion of key findings

The results of the questionnaire and interviews created a broad picture of issues facing effective management of SA's marine jurisdiction. These results can be separated into four key areas (spatial data, technical, legislative, and institutional issues) and are discussed. Thereafter, a comparison between marine and land cadastre is presented.

5.4.1. Spatial data and technical issues

The industry consultation by questionnaire and interviews showed that marine spatial data is used by many different organizations with different business focus areas. The response rate to the questionnaire from all spheres of government was lower in comparison to the private sector and this was concerning as the sea is controlled entirely by the government. Access to land based spatial data is simpler than that pertaining to the sea (Table 5.4) and the most significant problem faced is finding the data (Table 5.6). The adequacy of spatial data, once the difficulties of its access are overcome, meets most respondent's requirements across organizational categories (Table 5.8 and Table 5.7 respectively).

Spatial data communities comprise those that use, supply and produce the data and can be defined as a "data sharing community". The results show that there are more spatial data users in comparison to data producers and suppliers (Table 5.10). This indicates that source data is available from fewer people compared to those who wish to use the data. Herein the cost factor of data arises as there is little competition for the producers and suppliers of spatial data.

The application for an extended continental shelf forced the SA government to undertake an expensive survey of its marine jurisdiction to meet requirements of Article 76 of UNCLOS. This is a case of creating data when needed and exposed a large gap in understanding the marine environment that the addition of new data was able to fill. Although data did exist, it did not cover the entire marine jurisdiction, was held by different State and private entities, and was at different standards and accuracies. SANHO is the State agency and national authority responsible for data collection, preparation, publication and distribution of nautical charts and marine related information. Such nautical charts must be updated regularly,

adequate in meeting its objectives, and freely available. They also form the background of other non-shipping activities such as depiction of port approaches, shipping lanes, radial zones for shipping vessels to report port approach, pipelines and cables, maritime zones amongst other necessary information (Figure 5.11). Although such data is available, it depicts the spatial dimension only. A cadastral system is determined by a spatial component that is supported by a legal component across all spheres of government.

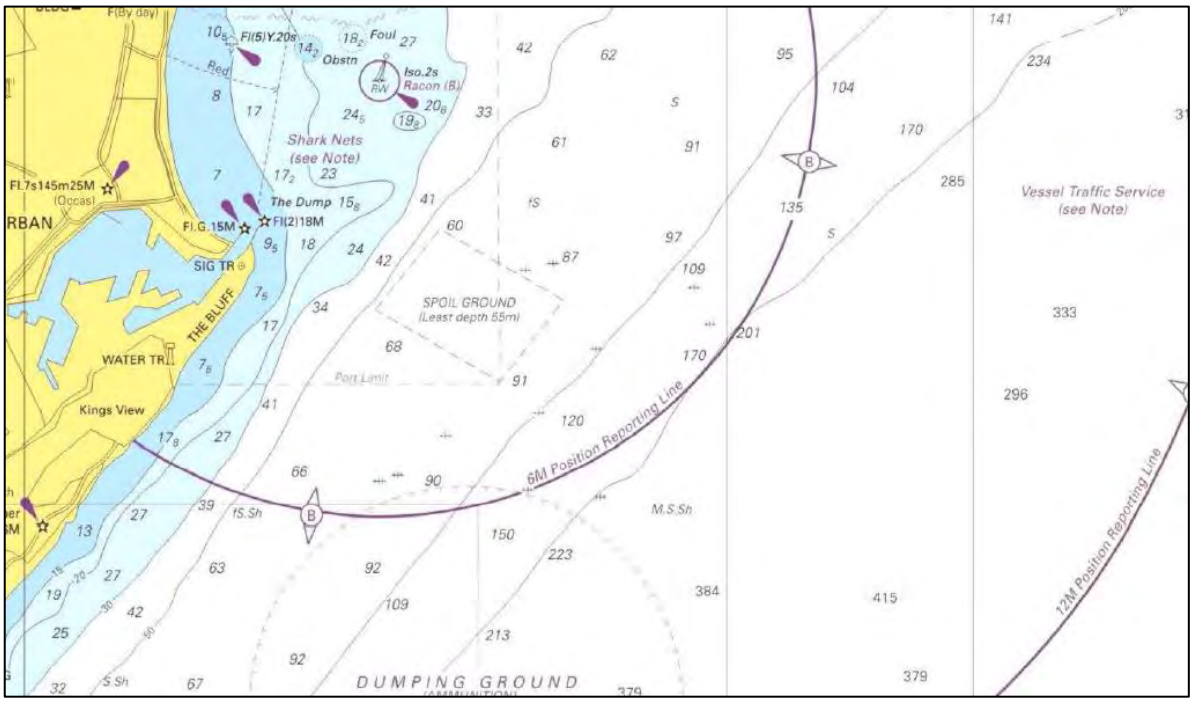


Figure 5.11. Excerpt of nautical chart of Durban, KwaZulu-Natal (used with permission from Navy Captain Hydrographer, SANHO)

The legal definitions of the HWM and LWM have an effect on spatial data as the land-sea interface lies here. The HWM and LWM fluctuates both in plane and height and are not contour lines. Yet, the LWM is the line from which provincial, national and international maritime zones, with their associated characteristics, are referenced. Standardization of legal definitions and the ability to consider the ambulatory nature of a curvilinear boundary into the spatial component of management systems such as a cadastre would enable confidence in decision-making. Legal clarity for reference lines such as the HWM and LWM, which tend to move over time, would aid in resolving discontinuity issues in spatial data between land and marine environments i.e. existing land cadastre would have clearer descriptions of its coastal extremities thus aiding in coastal land disputes. Simultaneously, the seaward spatial component would have a certain reference lines in the HWM or LWM. Clarity in the land-

sea interface would therefore permit simpler merging of land and marine spatial and legislative datasets.

Offshore, there are many different three-dimensional volumes with different activities and associated rights. Shown below are some examples:

i. *Seabed* – pipelines, cables, protected reefs, minerals, precious metals and stones etc.
ii. *Sub-strata* – mining of oil and gas
iii. *Water column* – Fishing, diving, movement of marine species, marine habitats.
iv. *Surface* – Marine tourism, shipping lanes, fishing

The introduction of time as an additional dimension resulting in, for example, fluctuation of regulated fishing periods, movement of marine wildlife that restricts some offshore activities and shipping intensity, the separation of RRRs becomes complex. To model a multidimensional space that is time dependent is a technical obstacle for true spatial representation of marine RRRs.

The overall trend of data collected by the questionnaire and interviews showed that marine spatial data is harder to procure than land based spatial data and has many associated issues, like those of not being continuous, different accuracy standards, infrequently updated, harder to access, licensing and copyright issues and cost implications. Appropriate spatial data is a necessary fundamental component of a marine cadastre and this appears not to be the case. The respondents to the questionnaire were mostly individuals involved in land cadastral systems but are interested in both marine and land based spatial data, and not only that which directly affects their own profession or organization. This is supported by the overlapping responses to the production, supply and use of spatial data that defines a community of spatial data users that are all interlinked and related. This demonstrates an overlapping interest in marine and land based spatial data.

5.4.2. Legislative issues

The legislative framework that governs SA's marine jurisdiction is complex. In addition to a plethora of domestic legislation, SA has ratified, or is signatory to, numerous international conventions. This permits SA to govern marine usage locally, while aligning to internationally accepted standards. The most significant convention is UNCLOS amongst numerous other conventions, treaties, protocols and domestic laws. The volume and complexity of legislation appears to be an impediment with many laws being written and amended over decades resulting in a piece-meal approach to ocean governance. The task specific manner of drafting and passing legislation, often written in isolation from other legislation and marine activities of stakeholders, introduces elements of overlapping marine

activities being governed by separate laws and legal provisions which may contradict one another . The applicable local and international policies were synthesized in the literature in Chapter Two where SA marine activities, land and marine cadastres were shown (Section 2.4 to 2.9) Disputes due to lack of understanding and application of the law create scenarios where the land-sea interface, best described as a littoral or fluid zone that changes with time, is still debatable. Ownership rights and municipal council planning zones (components of land cadastre) end at the land-sea interface where maritime zones begin (defined in domestic and international conventions such as MZA and UNCLOS respectively).

The legal boundary separating marine and land environments has a shadow of doubt and its clarification will spatially affect overlapping and conflicting ocean usage on and near the coast. Although numerous laws are geared towards governance of specific stakeholder activities, these too will need to be aligned. The ICMA is a relatively recent law that takes into account ocean diversity and usage in the coastal zone where human activity is greatest compared to deeper maritime zones.

The legal aspect, tested by the questionnaire, suggests application of legislation lags behind its awareness (Table 5.16 and Table 5.17). It is a positive indication that awareness levels are higher as actual application of legislation may not present itself in the course of day-to-day activities of stakeholders. Land based legislation awareness and application significantly exceeds that of the marine environment, primarily due to the distribution of respondents, but this scenario is indicatory of substantially more effort taken on land-based governance. Respondents to the questionnaire are mostly aware of some tangible physical boundaries and common restrictions at sea. The legal restrictions applicable to certain marine areas are not physically shown, neither are the boundaries within which they are enforceable marked for easier adherence. This creates an environment for knowingly or unknowingly breaking the law by stakeholders, both of which are rights infringements, resulting in the issue of liabilities arising. The proposition of graphically depicting boundaries and the RRRs they enclose provided for in legislation was welcomed by questionnaire respondents (Table 5.19). This has congruent properties of a title deed and survey diagram or municipal town planning schemes in land cadastre that graphically represents the spatial extent of terrestrial RRRs. The added benefit of depicting legal provisions graphically would enable legislative conflicts and redundancies to be exposed, thereby enabling a possible review for consistency across a complex set of laws. For an effective legislative framework for ocean usage to be harmonious in terms of conservation

and overlapping stakeholder activities in a multidimensional space, then the legal provisions emanating from this framework must be:

i. accurate, consistent and without ambiguity but taking into account legally published variation of precision as the land-sea interface is not fixed, but a littoral zone along the coast of SA.
ii. be geo-referenced to show applicability of legal provisions
iii. revised regularly
iv. considerate of the vast variety of marine activities and industry participation.
v. harmonious legislation that is enforceable
vi. Have interdisciplinary viewpoints considered i.e. the geospatial and legal fraternities across State and private sectors.

5.4.3. Institutional issues

Institutional issues are closely related to legislative issues. Legislation creates State institutions that are the "enforcers" of legal provisions. Private institutions are created mostly as businesses that must prescribe to present law. The piecemeal and target specific introduction of law resulted in institutions which were created to also follow a piecemeal and target specific approach to ocean governance. Although institutions may have clear mandates, the large number and variety of stakeholders negatively affect law enforcement. Stakeholder RRRs, that often overlap and are in conflict, further complicate governance tasked to State institutions. Stakeholders themselves may or may not be aware of their own RRRs and the spatial extent of those RRRs but, in reality, due to the overlapping nature of marine activities, may not have knowledge of other stakeholder RRRs. The stakeholder uncertainty is in itself problematic for institutions to manage resulting in poor law enforcement. Lack of co-operation and working in silos between institutions having different mandates must be overcome although they all operate in the same ocean space (Figure 5.12). Stakeholder education, aligned with co-operative institutions, will improve ocean governance.

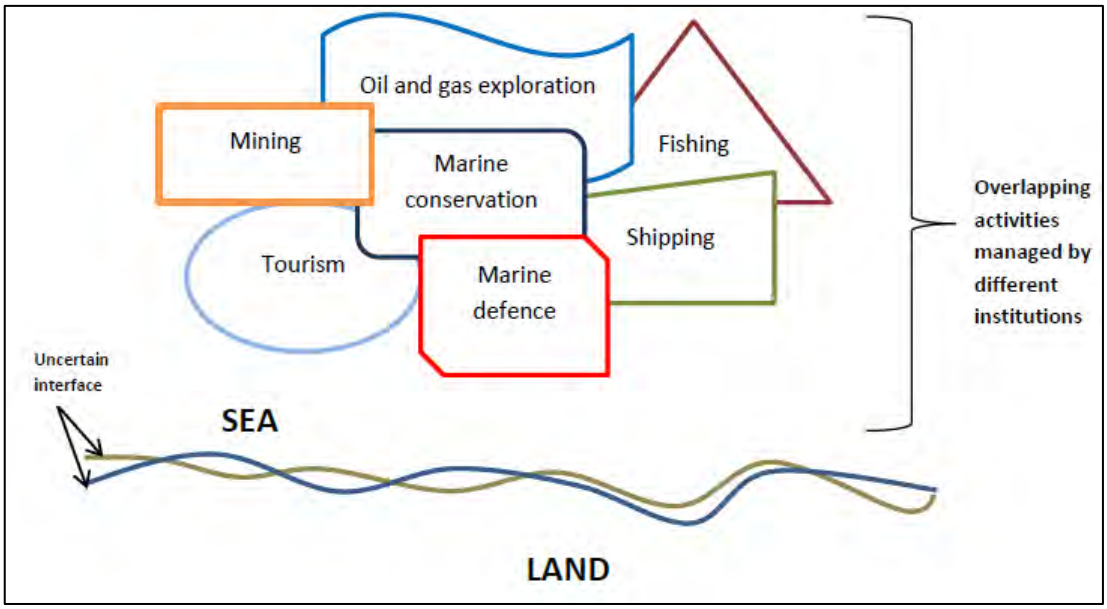


Figure 5.12. Overlapping institutional mandates referencing an uncertain land-sea interface.

Spatial data collected across different institutions can be duplicated, be at different accuracies or not updated regularly enough due to changing environmental circumstances. To demonstrate this, surveys of ports and approach routes by port authorities at a larger scale and on different datums to that of the SANHO indicates duplication of surveys and differing spatial datasets (Section 5.3.1). Referencing different lines separating land from sea adds to spatial inconsistency (Figure 5.12). Standardization of data accuracies and contributions to a single database for multi-institutional use involves co-operation between institutions that is difficult to achieve. A single overarching institution which collaborates with all institutions to develop such a database, therefore becoming a producer and supplier of spatial data that represents all legal aspects, would address all maritime governance issues as more informative decisions can be made. Data and legal convergence is a necessity.

5.5. Extending the SA land cadastre to include a possible marine cadastre

The opinion of stakeholders who responded to the questionnaire (Section 5.1.5 and legal perspectives in Section 5.1.8) and those interviewed (Section 5.3) indicate that the SA cadastral system is well-established and meets the purpose of its objective of being a major component of land administration.

Figure 5.13 shows the SA land cadastral system in simplistic form. Legislation forms the fundamental layer upon which any governance system is built. The legislative framework maps out exactly how different aspects of government duties are to be performed with constant revisions to meet changing needs. In SA, this entails creation of ministries, spheres

of government, state institutions and mandates. The top-down approach systematically filters down decisions taken at national level thereby separating government objectives and responsibilities for distribution amongst ministries and spheres for easier achievability. The results are, ideally, a well-oiled process of effective service delivery, accountability, transparency and good governance.

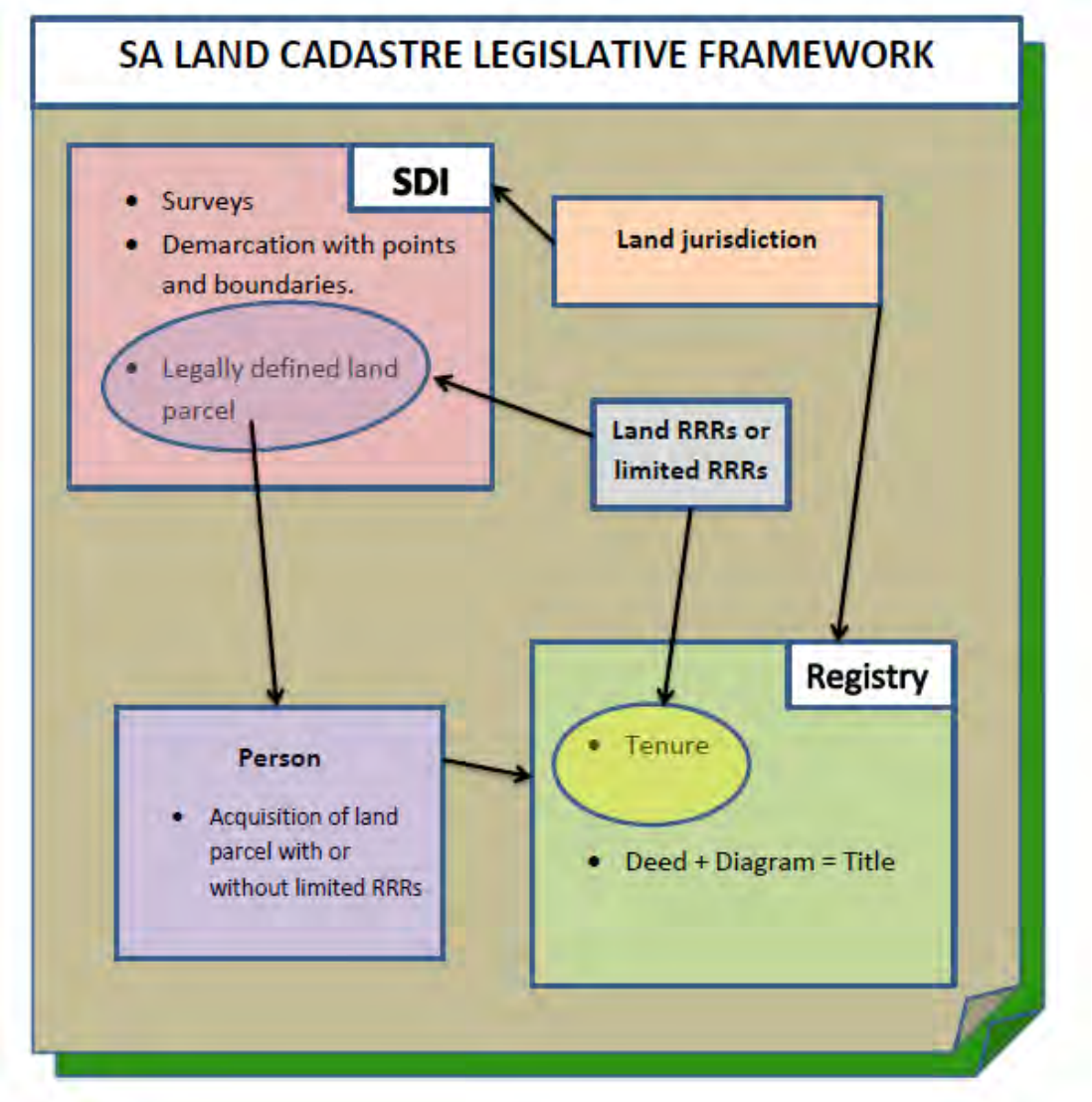


Figure 5.13. SA land cadastral system built on legislative framework.

Legislation passed at national level via all governance channels creates jurisdictions. In Figure 5.13, focus is on the "land jurisdiction" which informs RRRs and any limitations to RRRs. The SDI ideally created by and within legislative provisions legally defines land parcels by regulated surveys. Any interested person (juristic or otherwise, entitled to hold any form of land rights) may acquire rights or limited rights to the land parcel. This may

involve title registration that legally secures tenure. Title registration requires a deed and diagram.

Similar to the land cadastral system, that associates RRRs to persons using spatial data and a register within a legal setting, RRRs exist at sea. RRRs on land have superior management systems in place compared to marine RRRs and this is established by stakeholder views on land cadastre (Section 5.1). These systems include all spheres of government, industries and civil society. The temporal and ambulatory nature of water and the activities that occur therein are recognised management challenges. The RRRs at sea are simply found in different yet more complex medium of water that cannot be demarcated to show boundaries, therefore, can still be classified as requiring improved management systems that are, at the least, comparable to land cadastre.

Management of land RRRs ≠ Management of marine RRRs

yet, RRRs for both require effective management systems.

Marine cadastre has demonstrated its usefulness to improving ocean management systems abroad (Section 2.8.3). When local stakeholders were canvassed, their opinions showed that management of SA marine activities is lacking in comparison. However, similar challenges faced abroad are experienced in the SA marine jurisdiction (Sections 2.4, 2.5, 2.6 and 5.1). A cadastral system can simply be described as:

Cadastral system = SDI + Registry

There is no technical distinction between land and marine SDI as they both consist of mathematical data together with text attribute data. Land registration in SA is entrenched in land administration and forms a basis for securing tenure and describing RRRs. The offshore activities of SA have disparate registries for certain activities similar to land registers minus the ownership component as the sea vests with the Government. Therefore:

Land cadastral system = SDI + Registry

And

Marine cadastral system = SDI + *partial* Registry

The above demonstrates that a marine cadastral system is close to reality in SA despite the challenges of aligning legislation, enforcement agencies, uncertain boundaries etc. (Sections

5.4.1 to 5.4.3). Figure 5.14 shows salient points of the existing SA land cadastral system with additional markers to include a possible marine cadastre.

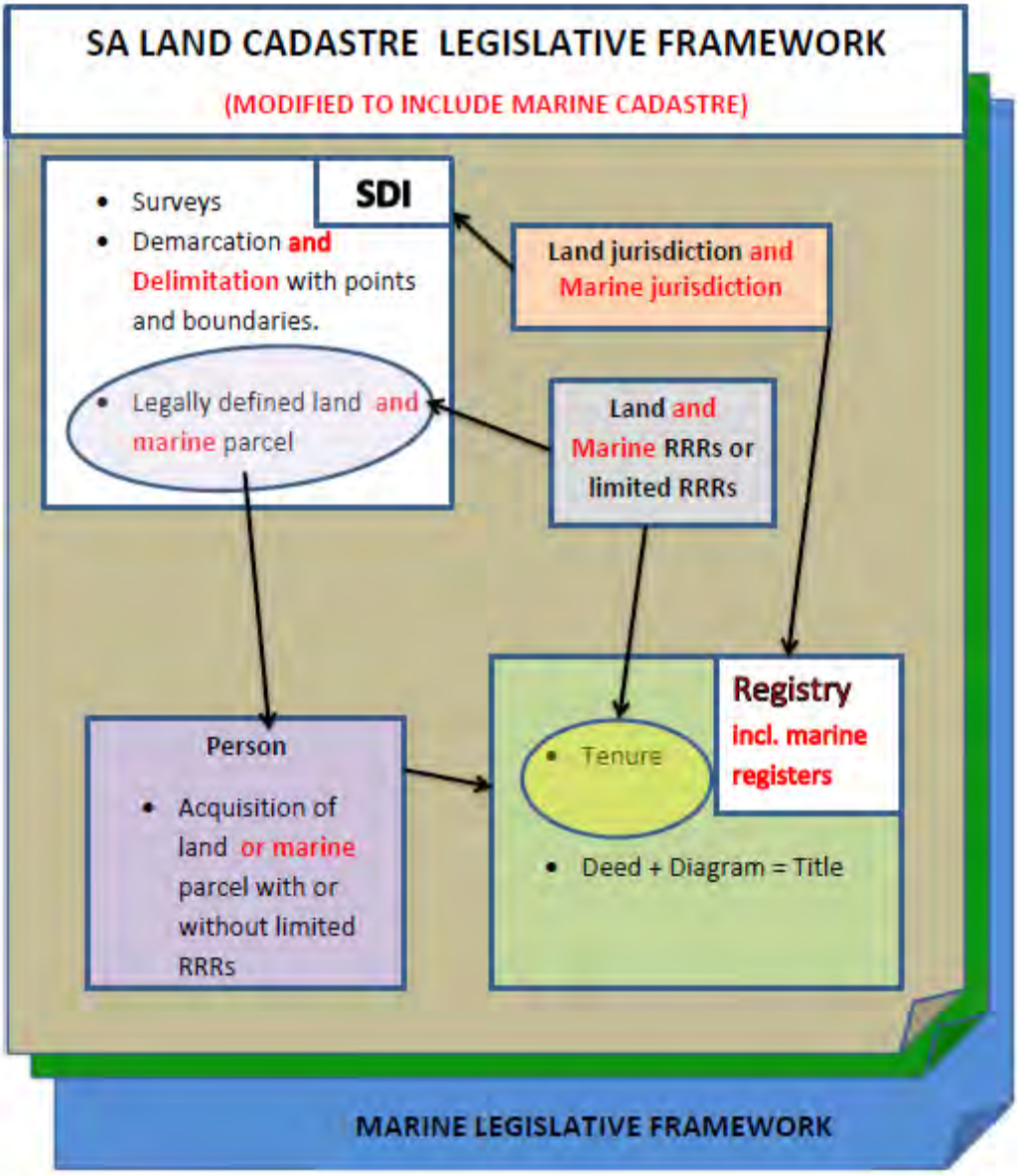


Figure 5.14. Salient points of SA land cadastre modified to include marine cadastre.

The reasoning behind using the existing cadastral system is that it incorporates an existing SDI and registration system that is in place for land administration. Duplication of the existing system to create an isolated marine cadastral system for SA would be counter-intuitive for alignment and standardization of datasets. The uncertain and littoral land-sea interface would become void and a continuous system would better inform decision making to aid sustainable development targets. A unified cadastral system model incorporating both land and sea SDI and registers is modelled in Figure 5.15.

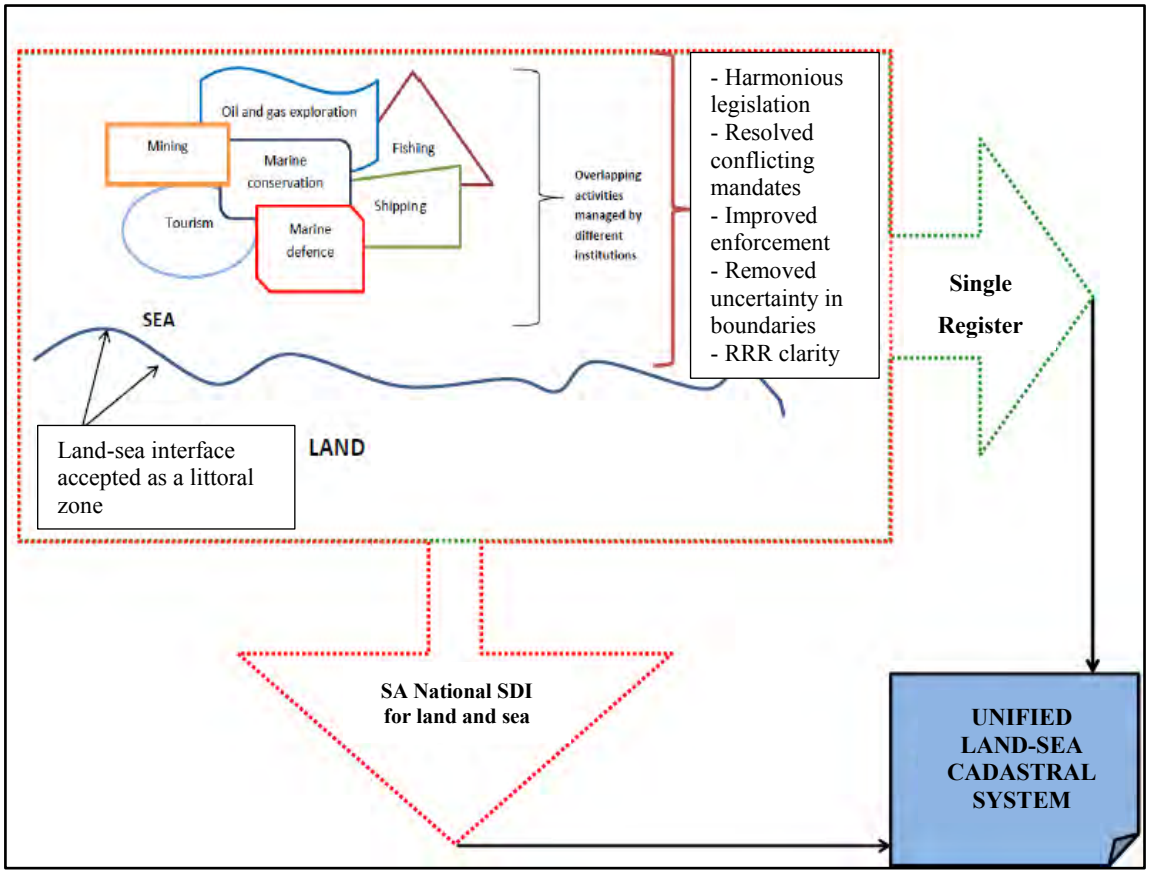


Figure 5.15. Unified cadastral system model

The unified (or seamless) land-sea cadastral system proposed above would be the result of a National SA SDI *and* register. Instead of trading ownership and other rights as on a land market, the register would serve as a means to better enable transfer of rights from one entity to another within the confines of appropriate legislation. The "title" that the register would facilitate in conferring would be the rights in addition to any other limited right, restriction and responsibility. Stakeholders exercising their rights responsibly within a spatially resolved environment would assist in improved ocean governance.

The seamless cadastre would further enable better management solutions in the transitional area from land to sea (coastal lands and waters) where all involved stakeholders can better understand intense competing activities.

5.6. Chapter summary

This chapter has presented feedback obtained from the marine cadastre questionnaire, interviews and a focus group discussion, which together created a broad view on spatial and legal management of SA's marine space while simultaneously comparing it to land cadastre. The use of descriptive and inferential statistics along with text analyses of open-ended questions when applied to the data collected primarily through the questionnaire, revealed

themes and opinions from a wide variety of stakeholders across government and private sectors.

The discussion of key findings (Section 5.4) summarized several issues facing marine management thus the implementation of a possible marine cadastre. Resolving these issues would pave the way to realising a marine cadastre that is very similar to land cadastre in SA. The overarching trend from participating stakeholders is that marine cadastre would benefit management of SA oceans and offshore activities and that valued land cadastre is an ideal framework upon which to extrapolate cadastral principles.

CHAPTER SIX

6.0. Conclusion and Recommendations

This chapter assesses to what degree the aim and objectives listed in Chapter One are met and recommends future research. This systematic approach would lead to a response to the research question.

6.1. Objectives

The objectives are met at different points of the study from the literature review, methodology, data analysis, results and discussion of key findings. This creates few instances of repetition under each objective listed below.

6.1.1. Objective 1

The first objective was stated as:

To investigate South Africa's history of marine property management

SA has a long history of marine management. SA marine management evolved from early hunter-gatherer philosophy, freedom of the seas (*Mare Liberum*), definition of marine jurisdictions and sustainable development goals. SA has tracked international developments closely with domestic legislation and management systems taking cognisance of international conventions, treaties and other policies. The evolution includes application for an extended continental shelf after the value of the sea to human needs and economies had risen sharply in the past few decades. However, fractured spatial surveys, uncertain marine boundaries, and other spatial, technical, legal and institutional issues mar SA marine management. Evidence of overlapping mandates and uncertainty of State, industry and civil society RRRs within unclear boundaries has led to target specific sectoral ocean management practice in SA. These challenges coalesce and lead to ocean management that falls short of the definition of good ocean governance. Shortcomings in management systems results in failure of meeting sustainable development targets. The reviewed literature of Chapter Two explores SA's history of marine management and the country's position relative to others.

6.1.2. Objective 2

The second objective was stated as:

To review the land based cadastral system of South Africa

The history of SA land management had significant influence on current land cadastre considering its nature of being a hybrid of Roman-Dutch law with increasing recognition of indigenous tenure types. Despite the volatile racial preoccupation by Apartheid leaders, the cadastral system is mature and well supported by the current democratic society. Literature in Chapter Two (Sections 2.8.1 and 2.8.2) outlines land cadastral concepts, components of a cadastre and its importance for tenure security, economic participation and as a reliable tax base. Research participants who represent the geospatial fraternity, cadastral managers and practitioners (professional land surveyors) support the efficiency of land cadastre (Chapter Five). The majority of responding stakeholders do not dispute the ease of access to updated land spatial data needed for decision-making and land transactions. The land SDI and Registry that together form the critical components of land cadastre is regulated in SA. Legally backed modification of boundaries leading to recognized land parcels approved at SGOs and title registration at Deeds offices secures tenure in land. Stakeholder views affirm the capability of SA's land cadastral system and in doing so confirm the underlying framework upon which it rests as one that is rigorous, scalable, reliable and capable of modification to react to changing socio-economic and other trends.

6.1.3. Objectives 3 and 4

These objectives were stated as:

Objective 3 – 3. To identify stakeholders and their interactions with the offshore property rights.

Objective 4 – To determine the rights, restrictions and responsibilities of identified stakeholders

These two objectives are synonymous as stakeholder interactions are subject to RRRs. In determining RRRs, the interactions between stakeholders in marine space can be better understood due to inherent complexities introduced by overlapping and competing activities in temporally variable, uncertain and multidimensional space. Stakeholders and their activities were identified in the literature review (Chapter Two) and subsequently in the methodology (Chapter Three, Section 3.2) and via the questionnaire analysis (Chapter Four, Section 4.3. Numerous pieces of legislation have different definitions of similar marine concepts that affect description or delimitation of marine boundaries meant to enclose RRRs. Numerous ministries, three government spheres, consequential institutions, enforcement entities and overlapping mandates all contribute in different ways towards an atmosphere of uncertainty of RRRs. The very nature of complex overlapping activities and stakeholder interactions results in sectoral approaches to marine management where some activities are

managed in isolation or with little to no regard of others. A holistic view to align management systems to avoid duplicities and gaps is lacking in SA.

The canvassing of stakeholders and derivation of results using a structured research strategy indicate spatial, legislative and knowledge shortcomings in marine management. Stakeholders identified in literature who responded to requests for research participation assisted in identifying other stakeholders. The questionnaire itself requested for leads or sharing with likeminded individuals and a "snowball" effect ensued. Some stakeholders are aware of their RRRs but not of others. Possibilities of having situations of stakeholders purposely or unintentionally ignoring legislative controls may arise. Not being aware of RRRs being permitted or prohibited while going about daily activities is a symptom of sectoral ocean management practice.

The identified stakeholders, their activities and interactions with the sea presented in the literature review and results chapters revealed many challenges to integrated marine management. Spatial, technical, legislative and institutional challenges were exposed in meeting the two objectives listed above. Expansive diversity of stakeholder interactions in SA's marine space supports the view of increasingly invasive extraction and usage of marine resources with growing management challenges. These show that existing marine management frameworks cannot keep pace with change. Alternative management systems, and one that is ideally multipurpose and adaptable, is found in marine cadastre. The stakeholder's general opinion is that marine cadastre can address many existing, discovered and acknowledged challenges,

6.1.4. Objective 5

The objective was stated as:

To conduct a comparative analysis of the design of marine cadastres and the design of the current SA cadastral system.

Land cadastre in SA and its country specific variations in other countries are relatively well established and accommodate many types of land transactions, land RRRs and form a substantial tax base to government treasuries. Land cadastre is a result of two components, namely, an efficient SDI and Registry that is well supported by an underlying legislative framework. In SA, land cadastre has been proven capable of adapting to social and legislative changes. The hunter-gather philosophy gave way to man staking property claims in places with stable food sources from newfound ability to practice farming. This developed later with indigenous and foreign tenure systems (introduced by colonialism or modelled on foreign land administration systems). The introduction of surveys and land

registers to SA formerly created a land "cadastral system" (Section 2.8.2). The spatial depiction of land to enclose RRRs conferred by title deeds through a Deeds Registry within a regulated environment ensures tenure security.

The cadastral components of SDI and a Registry are not without challenges on land. However, key land cadastral concepts may be applied at sea to improve ocean governance. This study proposes a South African marine cadastre, and any differences and similarities to land cadastre are presented in Sections 2.8 and 2.9. Land adjudication principles have parallels at sea. The SDI component of marine cadastre is subject to the same, if not *similar*, survey methods as on land which mathematically and graphically defines "space". A significant difference between land and sea space parcels is their depiction as it is possible to *demarcate* land boundaries opposed to mathematical *delimitation* of marine boundaries. Conflicting mathematical delimitation of marine boundaries in SA, mostly a result of differing legislative definitions (sectoral approach,) creates uncertain boundaries. Alignment of cross-legislative and cross-sector marine boundary definitions, target specific spatial data collection with varying accuracy standards is pertinent to resolving uncertain marine boundaries.

It is simpler to reduce land parcels to 2D although terrestrial 3D RRRs exist (e.g. sectional title and mining rights). The 3D nature of marine RRRs from the sub-strata, seabed, water column, surface and airspace above is a significant SDI challenge. In SA, and elsewhere, human activities conflict and interact and though general maritime boundaries exist, like those found in the MZA and UNCLOS, they do not adhere to natural fluctuation of movement and growth of ocean flora and fauna. The resolution of overlapping activities and uncertain boundaries in conjunction with the natural marine heritage is noted as a SDI challenge that can be addressed by modern technology.

The resolution of marine SDI is the first step to a marine cadastral system, as it would create recognised boundaries to enclose RRRs. RRRs would not exist unless it is legally provided for; very much like land subdivisions that is not acknowledged until registered. Registers for marine activities related to marine parcels do exist, albeit disparately, and not at the detail density of land registers (Section 2.41 to 2.4.3). Notably, the sea cannot be owned but marine parcels can be allocated with reduced rights linked RRRs, compared to that which is enjoyed on land. Ownership rights aside, a marine cadastral system, with its similarities and differences to land cadastre is possible. Study participants (Chapter Five) support that similarities and differences that exist between both cadastres unpacked in the literature (Chapter Two). Predominantly, the SDI and management capabilities are superior on land

compared to sea. A Register would enable recording and centralised access of RRRs for all stakeholders concerned. Order out of real and perceived marine management disorder could be addressed by marine cadastre.

Registration of on and offshore marine rights by a dedicated registration office, outside of the DROs, discussed in Section 2.8.3, makes it clear that a register does in fact exist for offshore limited real rights. However, the register is geared towards mining and petroleum resources only, although it takes consideration of effects on the environment. This register accommodates just one aspect of the complex RRRs that exist at sea. A more inclusive, single register of offshore property and other limited real rights would aid improving ocean governance as all stakeholder interactions, mandates and activities will have to be aligned. This suggests the need for legislative review and changes to merge registries. The main registries include the land-based registry of the DRO with that of the offshore MTRO that would have to merge.

Section 5.5 shows where the SA land cadastral system can be modified to include marine cadastre. The implications are that once identified legal, institutional, spatial data and technical issues are addressed at all levels and with all stakeholders, the land cadastre framework is adaptable to accommodate its own principles now applied to the sea.

6.2. Aim and Research Question

The stated aim of this study was to investigate the feasibility of extending the SA land-based cadastre offshore to provide similar property rights administration offshore. To achieve the aim, the objectives have had to first be met. All five objectives have been met and discussed (Sections 6.1 above).

Shortcomings of SA marine management systems are exposed by the history of marine management, stakeholder interactions, competing RRRs, the literature reviewed and results of data pertaining to land cadastre and its comparison with marine cadastre. Challenges to marine cadastre are common in many countries of differing political, social and economic ratings and SA is no different. Marine cadastre is lobbied as a viable tool to enhance marine management by many countries. However, country specific rationale gauged from marine related stakeholders only can identify country unique challenges for consideration for feature hierarchy of a marine cadastral system. The stakeholder opinions uncovered by this research suggest that marine cadastre is feasible for SA to address rising challenges and risks to meeting good ocean governance and sustainable development targets.

Marine cadastre is feasible in the opinion of stakeholders, but an infrastructure is needed from which it is to operate. The research question asked:

Can the existing South African land based cadastral system's framework be adapted to include marine cadastre?

A cadastral system has been reduced to having two critical components in this study i.e. land SDI with a Register. Review of the SA cadastral system's SDI and Registry, both in the literature review and results chapters, highlighted that the land cadastral system is proficient in securing tenure, separating and understanding RRRs. SDI exists for both land and sea, although skewed in favour of land, and similarly so for Registers. Relation of disparate SDI over the land sea-interface is possible with technology once spatial data issues are resolved, standardized and deposited into centralized data houses for easy access to all stakeholders. The Deeds Office is a complex registry of land title and the information registered there is a culmination of municipal systems (like zoning and planning), allocation of RRRs or limited RRRs, parcel designation and description by surveys. Rudimentary registers of some marine activities are recorded by different state entities (e.g. fishing and mining) and is, to a certain degree, comparable to the Land Deeds Registry. Although marine registers exist, they lack detail and are specific to a minority of marine activities.

The proposition of adapting established land cadastral systems to incorporate parallel cadastral components or features found in the marine environment is conceivable. In doing so, a seamless land-sea cadastre is a possibility. This can turn into reality information collected from both land and sea into a National SA SDI.

This research, by achieving the aim and objectives concludes that the existing South African land based cadastral system's framework can be adapted to include marine cadastre.

6.3. Recommendations for further research

The feasibility of establishing a marine cadastre has been established and concluded in this dissertation. Avoiding spatial data and legislative infrastructure duplication, key areas on the land cadastral system framework was identified onto which marine cadastre may be attached. At best, legislative alignment and SDI standardization together with a modified land cadastral system is needed. This seamless land-sea cadastral model needs refining and testing in the real world. Impediments facing possible implementation that were identified must be further investigated. These were the spatial, institutional, legal and technical issues.

Although this dissertation investigated international marine cadastre and uncovered the positive sentiment towards the feasibility of marine cadastre for SA by canvassing domestic stakeholders and showing complex marine activities, pilot studies are necessary. The limitations of the study regarding stakeholder participation are crucial for cross-sector buy-in. Possible beneficiaries to a marine cadastral system, like that of the offshore mining and

survey industries, must be included if an implementation study is undertaken. Similarly, research participation of related State departments, specifically the DME's Mining Titles Registration office, is necessary, as all the offshore RRRs will be attached by these participants. Future pilot studies conducted in coastal areas of SA that are identified as meeting the parameters of high intensity marine activities, dense coastal population and geographical diversity along the land-sea interface, will enable practical application of attempting to spatially separate and register marine RRRs.

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ANNEXURES

ANNEXURE 1 – MARINE CADASTRE QUESTIONNAIRE

University of KwaZulu-Natal
School of Engineering
Programme of Land Surveying

MARINE CADASTRE QUESTIONNAIRE

Introduction

Human interaction with the sea has increased in recent decades. This is due to increasing population in coastal areas, technological innovation, marked increase in the sea being a raw materials/food/energy source and the sea offering critical trade routes and transportation channels. Historically the focus has been on land development and its management. However, the increased focus on extracting benefits from the sea places emphasis on improving marine management systems.

The basic principle of marine cadastre is that it relates closely to land cadastre and the framework in place for land cadastre can be, with adjustments, applied to the marine environment.

This questionnaire forms part of my Masters degree research concerned with investigating the feasibility of establishing a marine cadastre for South Africa. The objective is to obtain a better understanding of stakeholders that deal with spatial data and their perceptions of a marine cadastre. The questionnaire will be in two parts i.e. part one being on spatial data and part two focusing on marine cadastre and associated tools of governance.

NB. The contact details provided below and data completed in this questionnaire will be used ONLY for ACADEMIC purposes.

Contact Details

Name	
Organization	
Designation	
E-Mail	

PART 1 - SPATIAL DATA AND PRODUCTS

This section aims to understand your organization's role and use of spatial data. Spatial data relates to maps and all associated data that is location based.

1. Which of the categories listed on the right does your organization belong to?

- ◯ National Government
- ◯ Provincial Government
- ◯ Local Government
- ◯ Academia
- ◯ Private Industry
- ◯ Non-profit organization
- ◯ Other (please specify) _____

2. Please select the main business focus of your organization? More than one option can be selected.

- ☐ Marine Research
- ☐ Administration and management
- ☐ Defence
- ☐ Port Management and administration
- ☐ Fishing
- ☐ Tourism
- ☐ Import and Export
- ☐ Environmental Conservation and awareness
- ☐ Search and Rescue
- ☐ Mapping
- ☐ Other (please specify) _____

3. What are the sources of spatial data that your organization deals with? You can select one or more options.

- ☐ Satellite imagery
- ☐ Aerial photographs
- ☐ Land Surveys (diagrams, general plans, topographical surveys, height surveys etc)
- ☐ Hydrographic surveys (sea charts, undersea maps etc)
- ☐ Tidal records
- ☐ Not Sure
- ☐ We do not use any spatial data
- ☐ Other (please specify) _____

4. How would you rate the importance of the data you indicated in Question 3 above to your organization?

	Low Importance	Medium Importance	High Importance
Satellite imagery	○	○	○
Aerial photographs	○	○	○
Land Surveys	○	○	○
Hydrographic surveys	○	○	○
Tidal records	○	○	○
Other (specified in Question 3)	○	○	○

5. Does your organization supply, use or produce spatial data? Select one or more options

- ☐ Supply
- ☐ Use
- ☐ Produce
- ☐ Don't Know

6. If you selected "supply" in Question 5 above, please list some of the spatial data your organization supplies. More than one option may be selected.

- ☐ Satellite Imagery
- ☐ Aerial photographs
- ☐ Land Survey outputs
- ☐ Hydrographic surveys
- ☐ Not sure
- ☐ Other (please specify) _____

7. If you selected "use" in Question 5 above, please list some of the spatial data your organization uses. More than one option may be selected.

- ☐ Satellite imagery
- ☐ Aerial photographs
- ☐ Land Survey outputs
- ☐ Hydrographic surveys
- ☐ Not sure
- ☐ Other (please specify) _____

8. If you selected "produce" in Question 5 above, please list some of the spatial data your organization produces. More than one option may be selected.

- ☐ Satellite imagery
- ☐ Aerial photographs
- ☐ Land Survey outputs
- ☐ Hydrographic surveys
- ☐ Not sure
- ☐ Other (please specify) ☐

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9. When dealing with spatial data, what dimension is of relevance to your organization?

- ☐ 1 Dimensional (height or depth only)
- ☐ 2 Dimensional (Horizontal position only)
- ☐ 3 Dimensional (Depth or height and horizontal position)
- ☐ Temporal variations (spatial data that is not fixed but shifts with time and other contributing factors like climate change, tidal forces, human interference etc).
- ☐ Not sure

10. Does the spatial data that you have serve the purposes of your organization adequately?

- ◯ Yes
- ◯ No
- ◯ Not sure

11. Do you encounter any difficulties in accessing **land based** spatial data?

- ◯ Yes
- ◯ No
- ◯ Not Sure

12. If you answered "Yes" to Question 10 above, please select one or more options from the attached list regarding difficulty in accessing **land based** spatial data.

- ☐ The cost implications
- ☐ Finding the data
- ☐ License issues
- ☐ Copyright issues
- ☐ Format
- ☐ Other (please specify) _____

13. Do you encounter any difficulties accessing spatial data that involves the **marine jurisdiction** of South Africa?

- ◯ Yes
- ◯ No
- ◯ Not Sure

14. If you answered "Yes" to Question 13 above, please select one or more options from the attached list regarding difficulty in accessing spatial data pertaining to the **marine jurisdiction** of South Africa.

- ☐ The cost implications
- ☐ Finding the data
- ☐ License issues
- ☐ Copyright issues
- ☐ Format
- ☐ Other (please specify) _____

PART 2 - Marine Cadastre and associated legislation, policies and conventions

This section of the questionnaire will cover marine cadastre. "Cadastre", in the simplest terms, refers to a boundary system and relevant laws. The basic principle of marine cadastre is that it relates closely to land cadastre and the framework in place for land cadastre can be, with adjustments, applied to the marine environment. The marine jurisdiction of South Africa is the area of sea beyond the land sea interface that South Africa has rights over and is expected to manage and derive benefits of.

15. Do you think South Africa has an efficient land cadastre with spatial, institutional and legislative framework?

- ◯ Yes
- ◯ No
- ◯ Not Sure

16. Do you think that land based mapping and demarcation into different usage zones is extensive enough and rigorously maintained?

- ◯ Yes
- ◯ No
- ◯ Not sure

17. If you answered "Yes" to Question 16 above, do you think that mapping of South Africa's marine jurisdiction should also have such extensive and rigorous mapping?

- ◯ Yes
- ◯ No
- ◯ Not Sure

18. Do you think that mapping of the marine jurisdiction of South Africa for various activities like shipping, tourism, mining etc. is comprehensive enough for good ocean governance?

- ◯ Yes
- ◯ No
- ◯ Not Sure

19, Briefly provide motivation for your response to Question 18 above.

19. Should the rights to the sea, based on activity type, be separated in a similar fashion as that of land rights which are separated by boundaries?

- ◯ Yes
- ◯ No
- ◯ Not sure

20. Choose one or more components you feel would be suitable for a marine cadastre.

- ☐ Ecological information
- ☐ Mining rights and mineral deposits
- ☐ Bathymetry
- ☐ Undersea cables
- ☐ Pipelines
- ☐ Shipping channels
- ☐ Fishing areas
- ☐ Marine conservation/park areas
- ☐ Tourism information
- ☐ Navigation hazards
- ☐ Other (please specify) ____

21. Are you allowed to conduct your business activities anywhere in the sea?

- ◯ Yes
- ◯ No
- ◯ Not Sure

22. Are you aware of any restrictions that may apply to your activities when dealing with the sea?

- ◯ Yes
- ◯ No
- ◯ Don't know of any

23. If you answered "Yes" to Question 22 above, please briefly state any restrictions you are aware of in the adjacent box

24. Are you aware of any physical boundaries that you encounter in your activities with the sea?

- ◯ Yes
- ◯ No
- ◯ Not sure

---

25. If you answered "Yes" in Question 24 above, please list any physical markers that may define those boundaries.

---

26. Are you aware of any the following Acts? Choose 1 or more options.

- ☐ Integrated Coastal Management Act 24 of 2008
- ☐ Maritime Zones Act 15 of 1994
- ☐ Sea Shore Act 21 of 1935
- ☐ Land Survey Act 8 of 1997
- ☐ None of the above

---

27. Are you aware of any of the following policy categories? Choose one or more options

- ☐ Mining related policies
- ☐ Communications related policies
- ☐ Development related policies
- ☐ Tourism related polices
- ☐ Shipping related polices
- ☐ Port related policies
- ☐ None of the above
- ☐ Other (Please specify)

---

28. In your activities, do you **USE** any of the following? Please select one or more from the adjacent list.

- ☐ Integrated Coastal Management Act 24 of 2008
- ☐ Maritime Zones Act 15 of 1994
- ☐ Sea Shore Act 21 of 1935
- ☐ Land Survey Act 8 of 1997
- ☐ Mining related policies
- ☐ Communications related policies
- ☐ Development related policies
- ☐ Tourism related policies
- ☐ Shipping related policies
- ☐ None of the above
- ☐ Other (please specify) _____

---

29. Are you aware of the United Nations Convention on the Law of the Sea (UNCLOS)?

- ◯ Yes
- ◯ No
- ◯ Never heard of it

---

30. Are you aware that South Africa is a signatory to UNCLOS?

- ◯ Yes
- ◯ No
- ◯ Not Sure

---

31. Are you aware that under Article 76 of the UNCLOS, South Africa has applied for an extension of the sea it controls? This will include up to 1.5 million square kilometres of marine space that will roughly be strips of ocean space running parallel to the existing marine jurisdiction of South Africa.

- ◯ Yes
- ◯ No
- ◯ Don't know

---

32. If the extension is granted by the United Nations, what implication(s) do you think this may have for South Africa?

- ☐ More untapped marine resources like oil and minerals
- ☐ Expanded exclusive fishing areas
- ☐ More responsibility of the State
- ☐ Cost implications as a result of a bigger area
- ☐ Exposure to piracy
- ☐ Bigger area to ecologically protect and sustain.
- ☐ Just more sea - no implications
- ☐ Don't know
- ☐ Other (please specify) _____

---

33. The sea is not static as land is. Do you feel that it is difficult to enforce legislation, or adhere to legislation, that applies to the sea for good ocean governance?

- ○ Yes
- ○ No
- ○ Not Sure

---

34. Would graphical representation of the areas of the sea on maps and charts that legislation provides for be useful to your activities?

- ○ Yes
- ○ No
- ○ Not Sure

---

35. If you answered "Yes" to Question 36 above, please briefly explain how such graphical representation would benefit improved ocean governance.

---

36. Please rate the importance of the following features of a marine cadastre to your organization.

	Low Importance	Medium Importance	High Importance
Coverage of South Africa's entire marine space jurisdiction	○	○	○
Cost	○	○	○
Accessibility	○	○	○
Accuracy	○	○	○
In digital format for user interaction	○	○	○
Frequency of updates	○	○	○
Based on a broad spectra of relevant legislation and other policies	○	○	○
Shows provincial boundaries extended to the sea	○	○	○

---

37. Do you think that having access to a marine cadastre for South Africa would have a positive impact on your organization?

- ○ Strongly agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly disagree

---

38. Do you have any additional comments to add?

---

39. If you would like to participate further in this research, please select one or more options listed here

- ☐ Focus group meetings
- ☐ Interviews
- ☐ Not Interested
- ☐ Keep me updated on this study

---

40 If you wish, please add the business contact details of persons who you feel may be able to contribute to this study. The details provided below will be used to further distribute this questionnaire and will be used ONLY for ACADEMIC purposes.

Name _____

Email _____

Contact Number _____

Name _____

Email _____

Contact Number _____

Name _____

Email _____

Contact Number _____

Name _____

Email _____

Contact Number _____

Name	
Email	
Contact Number	

Thank you for participating in this survey. Your input is highly appreciated.

Kovilen Reddy
BSc Land Surveying, 2008 (UKZN)
MSc Land Surveying (Current, UKZN)
Professional Land Surveyor (PLS 1250)
Mobile: 073 284 4040
Fax to email: 0866 641 493
email: 205507065@stu.ukzn.ac.za

END

ANNEXURE 2 – ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

4 February 2013

Mr Kovilen Reddy 205507065
School of Agriculture, Engineering And Science
Howard College Campus

Dear Mr Reddy

Protocol reference number: HSS/0033/013M
Project title: Investigating the Feasibility of established a South African Marine Cadastre

EXPEDITED APPROVAL

I wish to inform you that your application has been granted Full Approval through an expedited review process.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. Please note: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Professor Steven Collings (Chair)

/pm

cc Supervisor: Dr M Akombelwa & Mr Sm Chilufya
cc Academic Leader: Dr Leigh Jarvis
cc School Admin.: Mrs Kim Henery

Professor S Collings (Chair)
Humanities & Social Sc Research Ethics Committee
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 3587/8350 **Facsimile:** +27 (0)31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

ANNEXURE 3 – SPSS CODEBOOK

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JOBTTLE

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Valid Values	1	Professional Land ...
	2	Manager
	3	Lecturer/professor
	4	Scientist/Oceanographer/Hydrographer/Marine Biologist
	5	Port Manager
	6	Candidate Professional Land ...
	7	Engineering (Professional and Technical)
	8	Mapping
	9	Eskom
	10	Survey technician

Q1ORGCAT

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	Type	Numeric
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Valid Values	1	National Government
	2	Provincial Government
	3	Local Government
	4	Academia
	5	Private Industry
	6	Non-Profit Organization
	7	Parastatal
	8	Other2
	9	Other 3

Q2BFMARR

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Q2BFADM

		Value
Standard Attributes	Label	Administration and management
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFDEF

		Value
Standard Attributes	Label	Defence
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	Role	Input
Valid Values	1	Checked

Q2BFPMA

		Value
Standard Attributes	Label	Port Management and administration
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFFIS

		Value
Standard Attributes	Label	Fishing
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFTOUR

		Value
Standard Attributes	Label	Toursim
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFINEX

		Value
Standard Attributes	Label	Import and export
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFECA

		Value
Standard Attributes	Label	Environmental conservation and awareness
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFSRESC

		Value
Standard Attributes	Label	Search and rescue
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFMAP

		Value
Standard Attributes	Label	Mapping
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFINFRAD

		Value
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q2BFTENR

		Value
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

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	Measurement	Nominal
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Valid Values	1	Checked

Q2BF_OIL

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Valid Values	1	Checked

Q2BF_MINING

		Value
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	Role	Input
Valid Values	1	Checked

Q2BF_GIS

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Q3SSDSAT

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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q3SSDLS

		Value
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	Role	Input
Valid Values	1	Checked

Q3SSDHYD

		Value
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q3SSDTIDE

		Value
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q3SSDNOTS

		Value
Standard Attributes	Label	Not sure
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q3SSDNONE

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Standard Attributes	Label	We do not use any spatial data
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	Role	Input
Valid Values	1	Checked

Q3SSDGIS

		Value
Standard Attributes	Label	GIS Vector and Attribute data
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q3SSDMAG

		Value
Standard Attributes	Label	Magnetic Data
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	Role	Input
Valid Values	1	Checked

Q4RATE_SAT

		Value
Standard Attributes	Label	Satellite imagery.
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Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q4RATE_AER

		Value
Standard Attributes	Label	Aerial photographs.
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	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q4RATE_LS

		Value
Standard Attributes	Label	Land Surveys.
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q4RATE_HYD

		Value
Standard Attributes	Label	Hydrographic surveys.
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q4RATE_TIDE

		Value
Standard Attributes	Label	Tidal Records
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q4RATE_GIS

		Value
Standard Attributes	Label	GIS vector and attribute data
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	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q4RATE_MAG

		Value
Standard Attributes	Label	Magnetic data
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	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q5ORG_SUP

		Value
Standard Attributes	Label	Supply
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Valid Values	1	Supply

Q5ORG_USE

		Value
Standard Attributes	Label	Use
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Use

Q5ORG_PROD

		Value
Standard Attributes	Label	Produce
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	Measurement	Nominal
	Role	Input
Valid Values	1	Produce

Q5ORG_DKNW

		Value
Standard Attributes	Label	Don't know
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	Role	Input
Valid Values	1	Don't know

Q6SELSUP_SAT

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Standard Attributes	Label	Satellite imagery
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q6SELSUP_AER

		Value
Standard Attributes	Label	Aerial photographs
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q6SELSUP_LS

		Value
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q6SELSUP_HYD

		Value
Standard Attributes	Label	Hydrographic surveys
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q6SELSUP_NOTS

		Value
Standard Attributes	Label	Not Sure
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q6SELSUP_DENS

		Value
Standard Attributes	Label	Socio-economic densification plans and zone/land use plans
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q6SELSUP_OTH2

		Value
Standard Attributes	Label	Other 2 specify
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_SAT

		Value
Standard Attributes	Label	Satellite imagery
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_AER

		Value
Standard Attributes	Label	Aerial photographs
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_LS

		Value
Standard Attributes	Label	Land survey outputs
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_HYD

		Value
Standard Attributes	Label	Hydrographic surveys
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_NOTS

		Value
Standard Attributes	Label	Not Sure
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_BATH

		Value
Standard Attributes	Label	Bathymetry
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q7SELUSE_MAG

		Value
Standard Attributes	Label	Magnetic data
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_SAT

		Value
Standard Attributes	Label	Satellite imagery
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_AER

		Value
Standard Attributes	Label	Aerial photographs
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_LS

		Value
Standard Attributes	Label	Land survey outputs
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_HYD

		Value
Standard Attributes	Label	Hydrographic surveys
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_NOTS

		Value
Standard Attributes	Label	Not Sure
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_OCMAPS

		Value
Standard Attributes	Label	Ocean maps
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_BIOR

		Value
Standard Attributes	Label	Marine bioregions, species movement, sediment type and coastal management data
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	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q8SELPROD_OFMAPS

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Valid Values	1	Checked

Q9DIM_1D

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Standard Attributes	Label	1 Dimensional (Height or depth only)
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q9DIM_2D

		Value
Standard Attributes	Label	2 Dimensional (horizontal position only)
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q9DIM_3D

		Value
Standard Attributes	Label	3 Dimensional (depth or height and horizontal position)
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q9DIM_4D

		Value
Standard Attributes	Label	Temporal variations
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q9DIM_NOTS

		Value
Standard Attributes	Label	Not sure
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q10SD_SERVE

		Value
Standard Attributes	Label	Does the spatial data that you have serve the purposes of your organization adequately?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not sure

Q11ENC_LS

		Value
Standard Attributes	Label	Do you encounter any difficulties in accessing land based spatial data?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not sure

Q12YESQ11_COST

		Value
Standard Attributes	Label	The cost implications
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q12YESQ11_FIND

		Value
Standard Attributes	Label	Finding the data
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q12YESQ11_LIC

		Value
Standard Attributes	Label	Licence issues
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q12YESQ11_COPY

		Value
Standard Attributes	Label	Copyright issues
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q12YESQ11_FORM

		Value
Standard Attributes	Label	Format
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q12YESQ11_WEB

		Value
Standard Attributes	Label	Websites offline of broken links
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q12YESQ11_OTH2

		Value
Standard Attributes	Label	Other 2 specify
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q13ACC_MJ

		Value
Standard Attributes	Label	Do you encounter any difficulties accessing spatial data that involves the marine jurisdiction of South Africa?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q14YESQ13_COST

		Value
Standard Attributes	Label	The cost implications
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q14YESQ13_FIND

		Value
Standard Attributes	Label	Finding the data
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q14YESQ13_LIC

		Value
Standard Attributes	Label	Licence issues
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q14YESQ13_COPY

		Value
Standard Attributes	Label	Copyright issues
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q14YESQ13_FORM

		Value
Standard Attributes	Label	Format
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q14YESQ13_OTH1

		Value
Standard Attributes	Label	Other 1 specify
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q14YESQ13_OTH2

		Value
Standard Attributes	Label	Other 2 specify
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q15EFF_LC

		Value
Standard Attributes	Label	Do you think South Africa has an efficient land cadastre with spatial, institutional and legislative framework?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q16LB_MAP

		Value
Standard Attributes	Label	Do you think that land based mapping and demarcation into different usage zones is extensive enough and rigorously maintained?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

		Value
Standard Attributes	Label	If you answered "Yes" to Question 16 above, do you think that mapping of South Africa's marine jurisdiction should also have such extensive and rigorous mapping?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q18MJ_ACTIV

		Value
Standard Attributes	Label	Do you think that mapping of the marine jurisdiction of South Africa for various activities like shipping, tourism, mining etc. is comprehensive enough for good ocean governance?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

		Value
Standard Attributes	Label	Briefly provide motivation for your response to Question 18 above. open ended
	Type	String
	Measurement	Nominal
	Role	Input

Q20SEP_RIGHTS

		Value
Standard Attributes	Label	Should the rights to the sea, based on activity type, be separated in a similar fashion as that of land rights which are separated by boundaries?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q21COMP_MC_ECO

		Value
Standard Attributes	Label	Ecological information
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_MR

		Value
Standard Attributes	Label	Mining rights and mineral deposits
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_BAT

		Value
Standard Attributes	Label	Bathymetry
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_UC

		Value
Standard Attributes	Label	Undersea cables
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_PIPE

		Value
Standard Attributes	Label	Pipelines
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_SHIP

		Value
Standard Attributes	Label	Shipping channels
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_FISH

		Value
Standard Attributes	Label	Fishing areas
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_MPA

		Value
Standard Attributes	Label	Marine conservation/ park areas
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_TOUR

		Value
Standard Attributes	Label	Toursim information
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_NAV

		Value
Standard Attributes	Label	Navigation hazards
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_NAVY

		Value
Standard Attributes	Label	Navy and defence
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_SUBM

		Value
Standard Attributes	Label	Submarine DEM
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_FARM

		Value
Standard Attributes	Label	Fish farming
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_EXPLOR

		Value
Standard Attributes	Label	Exploration
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q21COMP_MC_PROD

		Value
Standard Attributes	Label	Production rights
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q22ACTIVS_SEA

		Value
Standard Attributes	Label	Are you allowed to conduct your business activities anywhere in the sea?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q23RESTR_SEA

		Value
Standard Attributes	Label	Are you aware of any restrictions that may apply to your activities when dealing with the sea?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Don't know of any

Q24_OPEN_END

		Value
Standard Attributes	Label	If you answered "Yes" to Question 23 above, please briefly state any restrictions you are aware of in the adjacent box
	Type	String
	Measurement	Nominal
	Role	Input

Q25PHYS_BOUND

		Value
Standard Attributes	Label	Are you aware of any physical boundaries that you encounter in your activities with the sea?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q26_OPEN_END

		Value
Standard Attributes	Label	If you answered "Yes" in Question 25 above, please list any physical markers that may define those boundaries.
	Type	String
	Measurement	Nominal
	Role	Input

Q27ACTS_ICMA

		Value
Standard Attributes	Label	Integrated Coastal Management Act 24 of 2008
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q27ACTS_MZA

		Value
Standard Attributes	Label	Maritime Zones Act 15 of 1994
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q27ACTS_SSA

		Value
Standard Attributes	Label	Sea Shore Act 21 of 1935
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q27ACTS_LSA

		Value
Standard Attributes	Label	Land Survey Act 8 of 1997
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q27ACTS_NONE

		Value
Standard Attributes	Label	None of the above
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_MINE

		Value
Standard Attributes	Label	Mining related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_COMM

		Value
Standard Attributes	Label	Communications related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_DEV

		Value
Standard Attributes	Label	Development related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_TOUR

		Value
Standard Attributes	Label	Tourism related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_SHIP

		Value
Standard Attributes	Label	Shipping related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_PORT

		Value
Standard Attributes	Label	Port related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_NONE

		Value
Standard Attributes	Label	None of the above
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_PETROL

		Value
Standard Attributes	Label	Petroleum related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q28POL_CAT_OTH2

		Value
Standard Attributes	Label	Other 2 specify
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_ICMA

		Value
Standard Attributes	Label	Integrated Coastal Management Act 24 of 2008
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_MZA

		Value
Standard Attributes	Label	Maritime Zones Act 15 of 1994
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_SSA

		Value
Standard Attributes	Label	Sea Shore Act 21 of 1935
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_LSA

		Value
Standard Attributes	Label	Land Survey Act 8 of 1997
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_MINE

		Value
Standard Attributes	Label	Mining related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_COMM

		Value
Standard Attributes	Label	Communications related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_DEV

		Value
Standard Attributes	Label	Development related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_TOUR

		Value
Standard Attributes	Label	Tourism related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_SHIP

		Value
Standard Attributes	Label	Shipping related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_NONE

		Value
Standard Attributes	Label	None of the above
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_PORT

		Value
Standard Attributes	Label	Port related policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q29_USE_PETROL

		Value
Standard Attributes	Label	Petroleum related
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q30AWARE_UNCLOS

		Value
Standard Attributes	Label	Are you aware of the United Nations Convention on the Law of the Sea (UNCLOS)?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Never heard of it

Q31SA_UNCLOS

		Value
Standard Attributes	Label	Are you aware that South Africa is a signatory to UNCLOS?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not sure

Q32UNCLOS76_EXT

		Value
Standard Attributes	Label	Are you aware that under Article 76 of the UNCLOS, South Africa has applied for an extension of the area of sea it controls? This extension will add up to 1.5 million square kilometres of marine space that will roughly be strips of ocean space alongside t
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Don't know

Q33_UNTAP

		Value
Standard Attributes	Label	More untapped marine resources like oil and minerals
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_EXCLUSFISH

		Value
Standard Attributes	Label	Expanded exclusive fishing areas
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_RESP_RSA

		Value
Standard Attributes	Label	More responsibility of the State
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_COST

		Value
Standard Attributes	Label	Cost implications as a result of a bigger area
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_PIR

		Value
Standard Attributes	Label	Exposure to piracy
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_MORE_MPA

		Value
Standard Attributes	Label	Bigger area to ecologically protect and sustain
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_NO_IMPL

		Value
Standard Attributes	Label	Just more sea - no implications
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_DONTKNOW

		Value
Standard Attributes	Label	Don't know
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_OTH1

		Value
Standard Attributes	Label	Other 1 specify
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q33_OTH2

		Value
Standard Attributes	Label	Other 2 specify
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Checked

Q34SEA_ENF_LEGIS

		Value
Standard Attributes	Label	The sea is not static as land is. Do you feel that it is difficult to enforce legislation, or adhere to legislation, that applies to the sea for good ocean governance?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q35GRAPH_REP_LEGIS

		Value
Standard Attributes	Label	Would graphical representation of the areas of the sea on maps and charts that legislation provides for be useful to your activities?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Yes
	2	No
	3	Not Sure

Q36YESQ35_OPEN_END

		Value
Standard Attributes	Label	If you answered "Yes" to Question 35 above, please briefly explain how such graphical representation would benefit improved ocean governance.
	Type	String
	Measurement	Nominal
	Role	Input

Q37RATE_IMP_COV_SA

		Value
Standard Attributes	Label	Please rate the importance of the following features of a marine cadastre to your organization. Coverage of South Africa's entire marine space jurisdiction
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_COST

		Value
Standard Attributes	Label	Cost
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_ACCES

		Value
Standard Attributes	Label	Accessibility
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_ACCUR

		Value
Standard Attributes	Label	Accuracy
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_DIGF

		Value
Standard Attributes	Label	In digital format for user interaction
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_FREQ_UPDT

		Value
Standard Attributes	Label	Frequency of updates
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_SPECTRA_LEGIS

		Value
Standard Attributes	Label	Based on a broad spectra of relevant legislation and other policies
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q37RATE_IMP_PROV_BOUND

		Value
Standard Attributes	Label	Shows provincial boundaries extended to the sea
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Low Importance
	2	Medium Importance
	3	High Importance

Q38POS_IMPACT

		Value
Standard Attributes	Label	Do you think that having access to a marine cadastre for South Africa would have a positive impact on your organization?
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Strongly agree
	2	Agree
	3	Neutral
	4	Disagree
	5	Strongly Disagree

Q39_OPEN_END

		Value
Standard Attributes	Label	Do you have any additional comments to add
	Type	String
	Measurement	Nominal
	Role	Input

Q40TAKE_PART

		Value
Standard Attributes	Label	If you would like to participate further in this research, please select one or more options listed here
	Type	Numeric
	Measurement	Nominal
	Role	Input
Valid Values	1	Focus group meetings
	2	Interviews
	3	Not Interested
	4	Keep me updated on this study

ANNEXURE 4 – AGGREGATED RESPONSE SUMMARY

Aggregated response summary		
Allocated code for SPSS aggregated responses to MRQ (vertical axis)		Please select the main business focus of your organization
1		None
2		Mining
3		Electricity
4		Infrastructure and development
5		Mapping
6		Mapping and GIS
7		Mapping and land tenure
8		Mapping and infrastructure and development
9		Environmental conservation and awareness and GIS
10		Port management and administration
11		Port management and administration and mapping
12		Port management and administration, import and export
13		Port management and administration, import and export, environmental conservation and awareness, search and rescue
14		Defence and mapping
15		Defence, port administration, import and export, environmental conservation and awareness, search and rescue
16		Administration and management and mapping
17		Administration and management and mapping
18		Administration and management, environmental conservation and awareness and mapping
19		Administration and management, port administration and management
20		Marine research
21		Marine research and mapping
22		Marine research, environmental conservation and awareness and mapping
23		Marine research, tourism, environmental conservation and awareness
24		Marine research, tourism, port management and administration, fishing, environmental conservation and awareness
Total	N	24

ANNEXURE 5 – FOCUS GROUP

· Recording of proceedings not permitted.

· Research was presented and discussion began immediately thereafter. – (~~45~~ 35 min) presentation
– (45 min) discussion.

+ Laws may be needed / amended for a seamless l-s cad. or just for a MC for SA. (D.R)

+ e-Cad project to link different State + pvt entities together, basically one infamation centre. e-Cad framework scaleable (SG-WC)

+ HWM LWM positions uncertain. Legal def. to be clarified. Case law exists. Resolution will better define land-sea interface (SG-EC)

+ D.R record ownership rights etc. on paper. Not involved in Spatial representation - that info from SGOs. MC for Survey + planning professions. DRs could possibly create a register for M rights. (DR-CT)

* Resolution of maritime boundaries with Nam + Moz to fully define SA ocean space/juris. Art 76/UNCLOS was raised. More ocean space to manage as resources identified ~~for~~. (CD. CSG)

⊛ Tech. can be used to show overlapping rights which is evident on land as well. Tech is improving and adaptable and for more applications. (DR. JHB)

- A seperate state agency or coastal SGOs to deal with a possible MC ∴ Mr Reddy is proposing in this feasibility study (SG. - Limpopo).

+ Classic monumentation as found on land not possible.
  - GPS
  - Real time GPS
  - Kinematic positions of ships (as they move). Warning can be live if any infringements

Discussion point

?
Benefits of Sea resources (R + Non.R) increasing in importance. Countries looking to the ocean for food Security – land R + Non.R resources reaching critical points of shortage + expense (non-viable anymore)
– Supply + demand

Rights on land is secure thats the point of this Cad Conference (SG + EC).

S.G. EC provides explanation of HWM / LWM on tidal Rivers (Fish River). Tides change. But rights are not fixed as well. Doesn't matter if on land or sea, they can be backed up on paper. It is a planning concern? or the Cadastral Systems? Laws are too many and confusing to navigate. (SG. EC).

Discussion on above

- Laws are made by us and can be revised (DR.)
- Mr. Reddy's study + presentation is new to me but interesting in face of pop. growth and sea resource extraction. will we stand up to new but I think existing issues we not aware of as yet that is brought to us old managers by young minds?

discussion

Kovilen Reddy

- We are the people II bring together spare and laws on land. The same can be ~~done~~ done at sea in my opinion but with the angle that the State owns the sea - no prt. ownership. This can make it easier.
- Over legislation won't work in real life cases. ~~This~~ laws must be in laymans terms, its hard for us to understand as well at times.

I make it clear that my study is a feasibility study and thank them for entertaining my request of the presentation + discussion. Some persons want updates of research or the final dissertation

END.

Attendees. ← No Names to be recorded by order.

- Surveyor Generals (SG)
  - Gauteng
  - Eastern Cape
  - KZN
  - Western Cape
  - NWest
  - Limpopo
  - Mpumalanga
  - Free State

  ⊕ SG deputies

  ⊕ (other CSGO + SGO staff)

- Chief SG representatives.
  - Chief directors.

- Chief Registrar of Deeds + Provincial Deeds Registrars
  - All provinces

  ⊕ deputies

  ⊕ (other CRDO + DRO staff)

End of meeting.

ANNEXURE 6 – INTERVIEW 1

Transcript of interview with the Marine Navy Captain Hydrographer

Two in attendance (NCH and K Reddy)

Meeting: Navy Captain Hydrographer, South African NAVY Hydrographic Office, Tokai, Western Cape, South Africa. 31 October 2013

Greetings exchanged

KR: In addition to meeting with you, I am in Cape Town to present my research at the Department of Rural Development and Land Reform's (DRDLR) Cadastral Conference (CD) in Stellenbosch between offices of the Chief Registrar of Deeds and Chief Surveyor General. Technology is outpacing legislation at a faster pace than the past. The cadastral component is busy with digital migration and to develop a paperless system of document lodgement and archiving.

NCH. I can imagine that that will be a lot of pressure on them because of how complex the current system is.

KR. It is complex.

NCH. Maps which I am responsible for is not the same as cadastral diagrams which lies on the shelf for many years. Like, for us, information such as navigation hazards must be updated all the time and all source data be kept in case someone crashes their yachts, the first thing which they say is that the hazard hasn't been chartered.

KR. Have you had cases like that?

NCH. Yes of course. Most times, it is poor navigation. That is why it is important for us to keep source data and analogue data…they still are very important. As with survey records that is approved, source data is important for us. Digital data can be altered.

KR. Yesterday I presented on marine cadastre that seems it may be leaning towards a multi-purpose system, one question arose on extended classical demarcation of boundaries to the sea and I responded that it might be possible to a certain extent by digital means. Captain, how often do you deal with queries of unchartered features?

NCH. Not that often. However, it can be very costly for maritime insurances, but it does happen.

KR. What is your opinion of separation of overlapping rights at sea?

NCH. It is extremely difficult. Nevertheless, in what context do you mean as currently everything belongs to the State without any private ownership?

KR. In the context of lease blocks, pipelines for example and different overlapping uses?

NCH. Oh. Ok. The only way such things can be demarcated is by latitude and longitude and hopefully, in the case of lease blocks, the person would stick to the area allocated to him. I think in cases of mining when licences are issued, positioning and positioning systems must be strictly emphasized in advance, so he does not drift miles of. In the case of the majority marine reserves, they do have beacons where everything is perpendicular to the coast with the distances to marine reserve boundaries referenced to land beacons. Coastal marine management agencies should enforce the rules and regulations more efficiently, and if they want to prosecute someone inside the reserve, they need to know positioning.

KR. It is difficult to obtain information across agencies, especially as this topic is a new concept. There is a focus on land based mapping naturally.

NCH. Of course, as there is private land ownership.

KR. Yes, as there is also state land resulting in much more layers of required information.

NCH. As I had said, when it comes to mining areas etc. the licence-issuing agency must stipulate prior to issuing such leases and it must be specified in advance. The problem is what you measure from when offshore. Calibration from land beacons is difficult as to what type of projection to use. High Water Mark is easiest to use but it also easily changes.

KR. Of course it does.

NCH. High Water Mark is determined mostly by physically walking the coast and using debris washed in from the tide. Land Surveyors also survey the High Water Mark but some stretches of coastline has not been measured.

KR. I do not know if you remember the severe coastal floods in KwaZulu-Natal in 2006/2007.

NCH. I do. The problem is that everyone wants to build closer to the sea. We had a similar case in Cape St. Francis. People must also realise that when you start any type of construction on the coastline, it may not have an affect there but couple of miles away. That type of effects is not properly researched.

KR. The term I come across for this is “coastal engineering”. In Durban Municipality, Ballito and Umhlanga, we have cases like where the High Water Mark is encroached on, and

other properties may be affected by construction further up or down the coast and liabilities can shift in cases of disaster.

NCH. To stop this, High Water Mark must be surveyed properly and people should know where it is, and, it should be revised often enough. It is the only line we can draw on the sand.

KR. What do you think of land based SDI (Spatial Data Infrastructure) and how you deal with hydrographic surveys? Do you think there are any linking features between land SDI and marine SDI?

NCH. Everything we do is linked to the land datum. To merge land and sea data would be very easy in my view.

KR. Do you perhaps have any maps showing coastal land or the sea alienated prior to the 1935 Alienation of the Seashore Act?

NCH. Unfortunately not. This office was established in the 1950's to survey the sea and I was not even aware of that type of stuff even happening.

KR. The SGO's (Surveyor General Offices) may have that info.

NCH. The position of the shoreline is mostly important to us as we depict that on our charts, and where the coastline has not been surveyed, we made use of the coastline surveyed by the SGOs.

KR. The boundaries that radiate outwards from the...

NCH. Yes, we surveyed those.

KR. Is what is in the Maritime Zone's Act that is surveyed?

NCH. Yes. However, there were changes where we had to update for the application extension of the continental shelf.

KR. How is that coming along?

NCH. It was submitted in time and we had a meeting here earlier this year for a presentation to be made at the UN. The actual hearing has not been done yet.

KR. I have come across academic papers and media releases on the claim. Is what being claimed final?

NCH. Its provisional pending the hearing but our claim is less contentious than other countries. Antarctica is not an issue, but there may be issues with next-door neighbours as our maritime boundaries are currently provisional with them.

KR. With Mozambique and Namibia?

NCH. Strange enough, this office and the SGO with co-operation from Mozambique established the boundary, and was fairly a simple exercise and there was somewhat an agreement. With Namibia, although there was an agreement as to the boundary, but with minerals and natural resources the boundary became contentious. The historic boundary is the Northern bank of the Orange River. It does not really matter as you go further offshore due to scale, but our current maritime boundaries require it physically. However, the issue is political, as political will is needed. In addition, the shape of the land and where land boundaries between countries change is where maritime boundaries start as well.

KR. The claim in terms of Article 76 of UNCLOS will mean what for RSA?

NCH. We tried to get maximum property for SA. Some claim areas had depths of water up to 4000m, and no one has technology to mine at that depth, but maybe in future. However, that is how the claim was addressed as it is not for now but for the future, before the claim window period closed.

KR. Definitely, as I read that up to 1.5 million square Km may be added.

NCH. Yes, but that was a problem with the UN Commission as applying the juristic provisions of Article 76 became problematic. We reviewed other countries claims as an on-going process, and that resulted in our claim being revised, usually upwards, to maximise our area of claim. UNCLOS Article 76 has good intentions but is overly complicated. Most African countries have some survey system and hydrographic offices but it is very expensive to claim. It would have been very easy to use satellite data – but they in essence forced countries that wished to claim to perform very expensive marine surveys and it is very discouraging. This office is interested in navigational safety and saving lives and maybe up to 200Nm, not beyond that.

KR. Therefore, you say that you have gaps in data between countries depending on their political and economic position.

NCH. Yes, not only that. In SA, for example, you get private firms that do surveys and keep this data hidden, and it is very expensive to procure. Might as well do it yourself.

KR. How intense are surveys?

NCH. It varies, depending on where there is most need. Technology has increased the amounts of data like from multi-beam scanners. We may not use all data but it can be used for many other applications.

KR. The USA has their Integrated Ocean Observation System. I visited the website while researching marine cadastre. I was looking at a similar system where rights to the sea are built into the system to assist in decision-making. Legislation is on paper somewhere without much evidence of its spatial coverage. For example – the zones defined in the MZA, - it is defined in law and extends in the case of the territorial waters to 12Nm out to sea. The outer boundaries are not visible. This leaves room for people to wilfully or ignorantly break law. I am looking for clarity in law as we have the building blocks in place with law and spatial data, but they operate in silos.

NCH. Before the commencement of the shelf project, we had a project called MZ1 that used analogue data to show maritime zones, straight baselines, co-ordinates and so forth, and I went through that before the shelf project that showed a provisional claim area, but obviously, we could not use it as it could harm the whole claim process. We needed the data but despite that, it is easy to produce the data – but who is going to enforce the use of that data? Who is to take that role? For marine reserves, we have shown them on all rhumb charts and I do not even think the marine and coastal management agencies actively control those areas. I think only when their control boats are operating. They have probably done it in the past but currently I do not know. Those things are there, so the people that are responsible for monitoring and control, the tools are available. So it is not like there is nothing, they must just make use of it.

KR. That was one of the critical points for me in this research as legislation was not created to lie somewhere, or not fully used and I have come across Acts with many provisions – but it fizzles out in its enforcement. Like marine protected areas are created by law with specified exclusions and any permitted overlapping rights stated, then what? It is a very grey area for me.

NCH. Sometimes people write laws with major implications, usually for the better, but it is not really enforced.

KR. Have you been approached for input on drafting laws?

NCH. Yes, we are currently working on the Hydrographic Act, very similar to the Land Survey Act, because we do feel there is a vacuum there, and for many years, we have been trying to do this. I have been involved in that.

KR. That is very interesting. I never heard of this and that its actively being pursued.

NCH. The main thing in this is protection of life at sea and a big section specifically on hydrography and contracting to other suppliers and procedures. In SA, we are responsible for hydrographic services, but we have never really been mandated especially as you have to start battling for resources. The first thing people ask for is where our mandate is. We have nothing to fall back on.

KR. Yes.

NCH. Therefore, it is critical for clear mandates without too many grey areas. I worked on cases for SARS regarding tax issues that are affected by maritime zones. The info this office provided SARS be included in their tax systems.

KR. How often do people declare their positions and activities at sea?

NCH. It is easier now with VRS and live web tracking or post voyage GPS logging, or, using a log book which position must be recorded every 4 hours.

KR. I was going to ask on defence of the coast and piracy.

NCH. We are actively involved in anti-piracy along the Mozambique Channel. We currently have ships operating in our defence against piracy. We issue navigational warnings in real time if any reports of suspicious activity are logged. The furthest the Somali pirates came down was the Seychelles.

KR. That is good news.

NCH. It is also the western side of the African continent around Nigeria.

KR. The marine cadastre system this research is investigating- is it feasible in terms of converging spatial data, and legal provisions?

NCH. I hear what you say. A database depends on what you would want to use it for. If you want to have a system that is free and open access, you would introduce limitations and it will be the same for the Cadastral System where they would not put data up on a system for free as there are some restrictions on information. I think with small scale there is no problem. This office for instance supplies bathymetric data for free, same like SGO's in terms of Survey Records, but it depends on the use its intended for.

KR. I actually need your permission to use the maps you made available to me already.

NCH. Yes, ok. In your research? Provided you acknowledge.

KR. Of course, all info would duly be acknowledged.

NCH. You know, you as a Surveyor work landwards from Theoretical Zero (being along the coast), we work seawards. The data can be matched up. It is a mathematical process. The data is available, some inconsistent with one another. Like some harbours work on their own systems and its dangerous and silly as tidal datums are referenced from harbours and ports.

KR. Talking of harbours and of defence earlier, are there any offshore sumps for waste and ammunition disposal? I need to know where these are.

NCH. Yes. Many years there were absolutely no restrictions and people were dumping stuff all over the place. However, we have those areas chartered.

KR. Is it open source information?

NCH. Yes.

KR. Ok. Do you perhaps have any composite of sumps charts?

NCH. We do – but not as many. We have a couple for the Cape and for Durban. Anything that relates to navigational safety, we chart, so people do not anchor in them.

KR. Would it be possible to obtain charts electronically with different layers?

NCH. The problem is different scale and it would be difficult to show on one chart.

NCH describes a chart of the sea off Durban – and offers copies of charts via email.

KR. What other types of charts do you have?

NCH. We have navigational charts, showing (on the Durban chart) approach routes. The info here is also not really for public use, although they can access the data.

KR. A lot of other ocean uses I obtained from the SA National Biodiversity Institute annual report, although not shown here.

NCH brings in other scale maps of Durban and Port Elizabeth and indicates possible areas where hazardous material was dumped – but specific location not known.

NCH. Unfortunately, in the early days, these things were not properly controlled and same general dumping areas were specifically gazetted. Therefore, it was by law that dumping zones were prescribed. I think the 1980's was the last time things were dumped.

KR. I would like digital copies of these maps.

NCH. Of course. In addition, if you would look here – some underwater cables are shown, like communication cables. I will email them to you.

KR. Thank you Mr XXXXXXX I think you covered a lot of additional information and provided insight to certain areas on interest for me.

NCH. Thank you, it has been a pleasure to do my part. Nice meeting you.

END OF INTERVIEW

ANNEXURE 7 – INTERVIEW 2

Transcript of interview with the Maritime Law Professor

Two in attendance (MLP1 and K Reddy)

Meeting: Maritime Law Professor, School of Maritime Studies, UKZN, Howard College Campus, KwaZulu-Natal, South Africa. 29 July 2013

Greetings exchanged

MLP1: You have an interesting topic but what I need to know is why you want to see me about and what you are looking for or

KR: I spoke to Mr YYYY (a marine economist) and he said that you would be a better person to speak to.

MLP1: What are you looking for from him and from us?

KR: More the law aspect and in administrating the marine space and from the conservation perspective as well.

MLP1: From your email, requesting this interview there is really three or four things that possibly we need to explore. The first is to obviously understand the legislative framework that governs the marine environment, I presume you have got access to all of those acts

KR: Yes

MLP1: So, let us quickly run through them. There is domestic legislation and international convention law. Then what you are looking at is you wanting from us are some guidance on how developing a marine cadastral system would enhance future legislation policies, sustainable development decision making etc.

KR: Yes

MLP1: That kind of thing and I am sure it is something we can probably bounce around with you but it is not something that our department has done any specific investigation on: it is not something where I have those answers at my fingertips. Let us first look at the marine framework and make sure you have all those acts. I see from your paper referred quite closely to the maritime zones act, which is fine I think but I would suggest you cross-reference that to the UNCLOS convention.

KR: Okay

MLP1: Internal waters obviously pose a problem and the territorial waters up to 12 NM.

KR: Yes

MLP1: From the baseline, the laws of South Africa applies directly. Both the seabed and the sea are owned directly by the state, you have the Seashore Act?

KR: Yes

MLP1: 1935? Right, there are obviously crossovers there that we can look at in terms of all of the rights that the states can lease or approve on conditions that it sees fit through the national assembly under the Seashore Act, but then you've also got one added element, I see you looking at it as sort of a 3D perspective

KR: Yes I am

MLP1: Because I thought initially you just mapping the seabed but you looking at actually a 4D dimension because you looking at time so just bear in mind that within the territorial zone although it forms part of the territory of South Africa and our domestic law applies wholly and directly and its fully part of our courts jurisdiction, it is subject under UNCLOS for innocent passenger vessels.

So that's UNCLOS article 17, 18 and 19 so you got to bear those rights in mind. The Merchant Shipping Act section 32(7) (1) would also confirm the law that applies. The Contiguous Zone article 33 and the maritime cultural zone, I do not know if you are looking at those so that extends from 12 to 24 NMs.

KR: Yes, I am as its legally defined maritime boundaries.

MLP1: Maritime laws are applied in that zone, I do not know if you also interested in looking at ownership of the moveable property on the sea floor or if land surveyors are involved in immovable property

KR: We are.

MLP1: Real rights in property? Of course

MLP1: But are you interested in also looking at ownership of things like wreck and treasure on the sea floor?

KR: I think that I might…

MLP1: Might just be worthy of a little side mention

MLP1: If that comes involved, it gets a little bit complicated as our jurisdiction deals with the wrecks outside of our territorial sea in terms of our rights. Essentially he can declare exclusive rights to salve the property but he never becomes the owner of the wreck and then we have got our common law (Roman-Dutch law) on ownership which would say that if the property is abandoned - truly abandoned and not just forsaken on the sea bed for a long time- then you can acquire ownership so the salver could possibly acquire ownership of abandoned property, but generally speaking as well as in legislation and case law, interesting case law in the US in particularly around all those Spanish wrecks they found around the Boston and coast of West Virginia in Spain they are saying its 300 hundred years ago we still own the gold we never abandoned it

KR: So….

MLP1: So that is a slightly different aspect

KR: How we have prescription, does it apply to the sea?

MLP1: Prescription in the sense of acquisitive prescription?

KR: Yes

MLP1: No because the Seashore Act specifically says that it doesn't apply and in terms of property that you own acquisitive prescription only starts to run once you are in possession of that property so on land you take possession of an abandoned piece of land and if you're in undisturbed possession of that for 30 years then you can acquire ownership if the owner has never intervened

KR: So in the case there is no possession?

MLP1: But in a sea bed there's no possession, the salver then finds the wreck obviously if he is salving it undisturbed for 40 years possibly it would apply there's no reason why it wouldn't but of course Spain for example in the American cases has leaked in within a years or whatever to say no no no we still own that property there's got to be some act of abandonment by the original owner some indication they intended to forsake the property

KR: That's a technically I think a lot of people overlook regarding possession

MLP1: Yes, exactly and I mean possession has to have a physical element which is quite different to establish in the sea compared to land. I mean you got people who have gone down and have tried to tie buoys onto wrecks or they have tried to put a court order into a plastic bottle and tie it to the wreck with a cable line.

KR: Has that really happened?

MLP1: Yes, I can show you some stuff on the Titanic because there has been Titanic struggles over the rights to salve the vessel, the right to photograph the vessel, the right to massive revenue that has been earned off the photographic and video footage of the vessel, the original salvers have tried to get the court interjections, how we would get court interdicts in this country to prevent anyone else coming within a particular area of the vessel. The American courts are much more aggressive than ours, I mean the vessel lies in the actual high seas and there of course you know no state can never exercise sovereignty which would mean no state has exclusive court jurisdiction and in fact doesn't have jurisdiction to deal with it, but the Americans have developed this concept of jurisdiction to say their courts can make orders about who can go onto the Titanic wreck, quite how that would work I've got another student looking at how that whole thing works, but it's nothing to do with me. You've got Articles 56 and 57 of UNCLOS, you've got to look particularly at fishing rights, Marine Living Resources Act of 1998, then the continental shelf Article 76 of UNCLOS and where we're at with our extended continental shelf

KR: Yes, we have lodged a claim and it is still pending

MLP1: Looking at the thing you came to speak to me about today, I think the two would be probably the key things for the focus of better management both of them support sustainable exploration of resources and the 1st key one is obviously fishing because of all the statements you can find on marine sources on the UN websites about mankind's dependence on fishes as a food source. A presentation by the Director General of the Environmental Affairs Department said in essence that the current focus of South Africa in respect of fishing is misplaced and we are currently focused heavily through the Marine Living Resources Act on regulating the rights of substance fishing but it's going to become effectively obsolete with the effect of global warming as is pushing fish stocks into deeper waters where it will be unreachable with the kinds of vessels they are operating and in fact, unless we protect the now extended continental shelf and protect those fishing stocks effectively, which is another issue all together, the inadequacy of our Naval controls is amazing, we are going to be compromising South Africa's security and our access to the fishing source so I think within that context absolutely you can make a great case with the new permanent Cadastral system and its obviously one of the reasons why a whole lot of other countries , I mean Australia, has done very much about it

KR: Yes, I researched Australia, Canada, and the United States

MLP1: I imagine everyone is working on something similar for that reason.

KR: Yes because they moving towards protecting the offshore rights now as they are seeing the increasing importance

MLP1: Absolutely. The other thing which I think you have to look at closely is going to be mineral exploration of the coastline

KR: Yes

MLP1: So I do not know whom I can put you in contact with but there are many resources available on the web. I've got a student who's looking at the liability regimens in place for in respect for specifically offshore oil drilling outside of our territorial waters but along our continental shelf that's quite a complex area but it's not really relevant to your studies but he's managed to find a lot of information on all of the currently active exploration site. Presumably, you have all that at your fingertips?

KR: I do have some of it

MLP1: Okay

KR: In terms of what my area of interest is, there would be the blocks allocated, to show this block has been leased and whatever rights are associated with it that has been given by the State to these companies that are doing the exploration. You know I was also looking at 4D rights that fishing can overlap. Between a fishing company and an oil exploration company they can overlap and conflict can arise somewhere down the line.

MLP1: One of the obvious areas of conflict would be when we have spills and in scope of broader horizons when you know it's one thing to have an oil tanker leak oil all over the coastline but at least it's on the surface and we can deal with

KR: You mean the recent Gulf of Mexico oil spill?

MLP1: Well it's not so recent I think it was in 2010 but yes.

KR: It's still in the news as of late due to civil cases.

MLP1: South Africa has very, very recently caught up with the world in terms of protection from oil spills, from tankers, there's a series of international conventions and for an international convention to become part of South African law it's not enough that we signed the treaty it must be approved by the National Assembly and enacted into South African law. So you are probably aware of that, that in relation to the International Pollution from Oil Tankers Convention we have signed it was but never enacted at all and as recently as June 24 this year the Council of Provinces referred it to the National Assembly to get those draft Bills in place. On the SAMSA (The South African Maritime Safety Authority) website,

there is nothing effective in place if the spill is from an offshore drilling installation and those spills actually are much harder to stop, much harder to cap because of the depth at which they are drilling. So it creates a great problem in determining who is liable and it effects fishing operations and that obviously has a direct economic impact to the fishing company concerned. Where you have these over lapping rights, so are those kinds of issues you are trying to explore?

KR: Yes

MLP1: Ok now you are asking how it would help a lawyer to solve that problem?

KR: Separation of rights

MLP1: If the marine cadastral map had been properly mapped out and as far as the answer is that it wouldn't entirely help us to solve the problem but it would be a key aspect to it because at least we can define the area in which the right can be exercised and obviously as a lawyer we would need to know a whole lot of other things such as the nature of the rights been conferred and the nature of the liabilities that attach to that activity and then in any event the rights that Parliament confers on, let's say a company exploring oil of South Africa's coastline creates a legal relationship between the State and that company but now the State is given rights to a fishing company there's no legal relationship between those two entities the question would arise in law on legal duty owed to other entities exploring or pursuing other economic activities within that zone. Obviously, it has never been tested. Presumably, one would apply the same principals we would apply to land based liability issues. A legal duty is determined by asking whether you should foresee the possibility of harm to a certain category of people, whether it is reasonable to expect you to take steps to prevent that harm or whether the category of people is too wide or too far removed from your activity to reasonably expect you to have a duty towards them. That's how we would probably try and resolve that issue. A marine cadastral system frankly is not going help us in that at all but its will define the area within which you have a right to pursue.

KR: I think so far my research is not looking more towards the fixed kind of system as its not tangible the boundaries as the sea is not as fixed as land is it and moves all the time, it changes all the time, it's quite impossible to demonstrate in terms of physical boundaries so lean more towards…

MLP1: How do they do it? I mean with GPS coordinates?

KR: Possibly a live GIS system that you can programme into a system that would demarcate an area and if you have an on board computer and you made the links to that system it will

show you within which area you are in and whether you can do certain things in that particular area.

MLP1: What is in place currently? What systems do they use?

KR: There was a major hydrographic and bathymetric survey when there was an application for extension for…

MLP1: the continental shelf claim?

KR: Yes and they do have bathymetric maps of the country and its basically an elevation model of the sea bed, but what they have is mostly nautical charts and I think it degenerates in detail from beyond the territorial waters and prominent coastal cities and I think further outwards as interest is lost.

MLP1: You opened the point relevant for your thesis as the area of the territorial waters is almost valueless to us as there's almost nothing happening in the immediate seas zone. Apart from obvious environmental protection of estuaries and fish stocks, which I think those are pretty much already an effective system with the Marine Resources Act, I don't see how a marine cadastral system could be aligned with the demarcations. Other than that, I don't think it can add much to it as there's already an effective demarcation of marine reserves and we are already protecting those reserves and fish stocks but the key is to the areas that are yet to be explored, that is why everyone is so interested. That is why we actually do need the cadastral system as you propose in this research. Chat to me, what can I as a lawyer assist in?

KR: The perspective of a lawyer who has a speciality in maritime law to cover the legal aspects of this study.

MLP1: The legal field is huge, I wasn't sure if you were looking at the basic guidelines or more detailed, but I see you have got the basics in place. So that's fine. The legal aspects…we've mentioned conservation.

KR: Your views on offshore pipelines, ammunition and waste sumps of the coast have associated rights and restrictions and whether you think marine management in terms of the legal aspect is robust enough in SA, whether its target specific and when lawyers are faced with new or unique situations, do you scramble around to find a solution to it? Is there any prescribed way lawyers resolve issues that arise?

MLP1: There is no clarity on the liability to one another for damages their respective activities might cause beside precedence cases locally and internationally – like the Gulf of

Mexico and other oil spills. So you want to brainstorm the worst likely legal problems that would arise so that you can look at whether a marine cadastral system would assist in resolving those disputes? Right, so one would be the conflictor of rights between different people, exploiting the seabed or sea for economic gain…those would firstly be private law issues. In other words rights or liabilities between different private individuals, individuals could also be companies.

KR: Yes

MLP1: The second would obviously be public law issues in terms of the regulation of how conducting that activities as I say, for example, all pollution from offshore installations, is going to lead to wider environmental damage. It is going to affect the State and its citizens as a whole but there isn't currently a very affective regime in place as there isn't much current exploration occurring. But there is a lot of current interest in exploration. SA has better regulations than other countries, but it hasn't been tested as yet. For instance, every year in the Niger Delta, more oil is spilt that in the Gulf of Mexico case and we hardly hear about it. Bribery and corruption can lead to massive economic and environmental disasters and no law can protect against that.

KR: In the cases of vessel discharge of waste at sea?

MLP1: That is very difficult to manage. Look, on land all pipes and pipelines for waste and sewerage are not mapped. I dealt with a case where a poor guy had a pipe burst under his home and he didn't know of its existence. People have no idea where these things are. So is your proposed system going to dig down to that level of detail in mapping all these offshore pipeline installations etc.? Is that the idea?

KR: Yes

MLP1: Well there's going to be a direct impact on legal issues because if someone damages that pipeline, the question becomes "Who has to pay for the loss and/or repair?" They can't be expected to pay for it if they weren't expected to know it was there. So a marine cadastre will assist there as it's a spatial system with linked rights and law etc. as you say.

KR: Yes, people and companies may not know if something is down there and what implications there may be in case of rights infringement.

MLP1: Is that how the data cable was pulled out of Egypt?

KR: Yes.

MLP1: They were without the internet for a long time

-MLP1speaks of accessing data bases for laws and case laws at length-

KR: One question I've had was how does the HWM and the definitions of HWM and its variation in case law affect maritime lawyers? We have the HWM and Low WM and between these two is where the land-sea interface is?

MLP1: The strange thing is that we learn of the HWM and LWM at varsity and then it never comes up again as there is hardly anything that comes up again in the practise of maritime law in SA because there is almost never anything happening on that interface what we need to deal with so it means I've never ever come across it as an issue.

KR: I think I meant more in perspective of my research.

MLP1: From your perspective, it's more difficult as you have a shifting line.

KR: And development along the coast, how problematic is that then?

MLP1: Now maritime lawyers is never going to deal with those kind of disputes if, for example, perhaps there is a dispute about the construction of a downtown Point water sports club or a proposed hotel or pier, then they actually going to go to a property lawyer, conveyancer or property law expert because at that interface the SA system for registration of land rights is applicable and maritime lawyers know nothing about that. We deal with what happens out on water, not the beach, and having said that, my understanding of the HWM is that it fluctuates but is legally fixed.

KR: In terms of?

MLP1: The highest point the sea reaches during the stormy period or whatever so in reality it fluctuates but the legal HWM is a fixed line. I always assumed the Surveyor-General fixed it.

KR: It is a surveyed line, but not completely.

MLP1: I know there has been disputes on whether it has been correctly plotted or not.

KR: It is not revised as often as one may like.

MLP1: Okay.

-MLP1 indicates that she has to leave and thanks KR for an interesting interdisciplinary meeting and that we should not work in silos and meetings such as these give better insight in each profession

END OF INTERVIEW

ANNEXURE 8 – INTERVIEW 3

Infamal interview with 3 layers @ MLA conf. (1)

Note Sheet for "LIVING THE LAW OF THE SEA CONFERENCE" hosted by the Maritime Law Association of South Africa, Zimbali Lodge, Ballito. 03 August 2013

Conference deals mostly with marine insurance.

Infamal Interview with L① L② L③ } L = Lawyer. No recording of names by request.

⊗ detailed notes after.

KR. Explains research scope and requests their perspectives. (law especially).

(L①) – I deal with maritime claims due to maritime incidents. So Salvage of wrecks.
Includes : pollution control + cleaning up
: Enviro. hazards as a result.
: Negligence
: Wrecks sometimes avoidable, sometimes not.

Everyone has right to use sea for whatever it is, laws are in place

KR. Are laws used eff? (⊗effatively).

(L①) Yes and No. Yes 'cos it's there and we as lawyers are fully aware. others not so much. The different gov. depts. themselves not aware or don't enforce, otherwise there wont be legal problems.

(L②) Sometimes I have to go thru law and double check its applicability in a case.

KR Would spatial depiction of laws help?

(L①) What? (⊗do what you mean?)

K-R I explain. (Laws on paper, their spatial coverage explained but its not visually shown overlaps shown as well)

(L①) Yes I suppose.
(L③) It would.

Kovilen Reddy

(2)

@maritime

K.R. What laws interest you or you apply? (regulaly).
(L2) Admiriality Jurisdiction, MZA, ICMA, Salvage, wreckage,
(L3) And pollution of the sea. Oil and gas permit applications. Transpat. Customs and Excise
(L1) Ship law, security, Admirality Act. Goods. Insurance and Claims.

KR. MPA's?

(L3) Not so much. (@commercial) We are more interested in Comm. side of the law. MPA for state and consorvation (agencies)

KR. ok. Effluent clischarge from land, pipelines etc?

(L1) Unless they need representation, yes. It happens undetected, but it happens.

After IInteriour Notes + Pay Conference

Seems as the conference is more applicable to commercial needs. Lawyers spoken to and presentations attend, suggest more how laws should be applied or cases handled after precedents set. Certain rights like shipping permits are registered with applicable parts. Shipping, bulk cargo transportations, tax revenue, money are high on agenda with rights infringements via ship wrecks, pollution, no go zones etc. handled afterwards. Seems that legal measures are not preventative but are instigated post-event.

ANNEXURE 9 – INTERVIEW 4

Informal interview with Prof. P. Vrancken, SA research chair in the Law of the Sea in Africa

Presentation key points "AU 2050 Africa's Integrated Maritime Strategy"

- Proposed Directorate of Maritime Affairs for African Union
  - potential for better local, regional and on Pan-African maritime activities.
  - Improved bi-lateral trade - keep Africa's resources in and for Africa.
  - Knowledge / skills sharing
  - More resources from sea to boost African economies
  - Resolution of Maritime Boundaries
  - Art. 76, UNCLOS - extension of continental Shelves and future benefit potential.

* KR + P. PV

KR - Explain research on MC feasibility for SA.

PPV - MLA conf. has many lawyer present and they needed ~~for~~ as "translators" of law for laymen and to enforce or protect and question laws. It's all about rights and what people use the sea for. Rights seperation is important, but complex.

KR - Cross-Sectoral awareness?

PPV - Maritime industry, and the Sectors within, are not familiar with 1 another and other related industries. (* Maritime industries) (* vice-versa)
- Gov. does not communicate with MI and VV. Gov. "owns" the sea so must regulate, enforce law and be more proactive. Not legislate then forget about it, or no legislate only when something new happens - must anticipate and look internationally.
- Less red tape

KR Competing MA (* Maritime Activities)

PPV. Yes. Reserves, pipelines, ships, bio-regions. Sea is as, if not more valuable, than land as we don't know whats there yet fully.

KR Explain land cad. + possible registerable rights @ Sea.

PPV It's possible. Nothing impossible. May be easier as ga. "owns" sea. Can be something like leases or existing. lease blocks for mining + exploration.

KR Awareness of restrictions?

PPV Yes. Laws in place. Restrictions abound.

KR Are they obvious restrictions?

PPV Not really. Need to be aware of them first plus it's similar internationally.

KR So are laws retrospective? like learn from mistakes?

PPV I believe so.

KR Thanks for your time (* Asked to use name in research - PPV responded that it was too informal - so no.)

later contact with PPV failed for a more formal interview.

ANNEXURE 10 – INTERVIEW 5

General note Sheet for digitally unrecorded meetings and interviews

Attendants: K Reddy (researcher) and MR. [redacted] (lecturer @ UKZN Westville) + Doctoral student. ([redacted])

(Recording of interview digitally, not permitted after requested)

KR - Explain research of MC for SA. Input on SA bioregions and MPA.

Vos - Yes we do have MPA and naturally occuring bioregions which are recognised. Nine SA bioregions, over 20 MPA's.

KR - B.Reg. includes all of Sea around (characteristics) SA which ~~has~~ each have unique ch. whats diff. with MPAs

Vos - MPAs are "more" unique and contribute to our nat. her. (natural heritage)

KR - Are they then declared?

Vos - Yes by gov gazettes

KR - I'm a p|s. how are the MPA's referenced; allocated ~~the~~ bandaies

Vos. Buffer area around MPA, ref. to coastlines (at 90°?)

KR. They are protected for reasons. (Global Warming) what are they?

SN. Mostly human, but GW - nat factors

KR. Expand on HF. (Human factors)

SN. - overfishing affects entire food chain + has affects all over
- Pollution from vessels dumping at sea, coastal runoff and marine pipelines of to sea.

K.R. Would a MC assist? In rights definition, uses, overlapping RR's

SN. Yes. Would give composite, view on uses.

Date: May 2013 Page 1 of 2 Kovilen Reddy

General note Sheet for digitally unrecorded meetings and interviews

Attendants: K Reddy (researcher) and Mr [redacted] ecturer @ UKZN W)
+ Doctoral Student. ([redacted])

continued...

SN. Problem is laws and positioning. People don't know what is at sea or the imp. role of sea.

Yes. It may assist to an extent. Finer details will be excluded. Though rights may be seperated (right direction), it can still be abused. Step in →.

K.R. In yor research, do, did you find overlapping and conflicting uses?

Yes All the time

S.N. Yes. Waste discharge at outfalls into sensitive areas Ships dumping onboard waste. Mining on shore, off-shore in protected areas. Even if in prescribed areas, mining has pollution affects and ripple affects elsewhere.

K.R. Legislation?

Yes Yes there are. For MPA proclamation, allocation of mining permits, Ocean use, fishing timetables etc.

K.R. Is the law effective?

Yes In words they are. In reality, No.

K.R. why is that so?

Yes Enfacement lacks. Understanding lacks. Real type. Research is like preservation of info, not of natual resources. Although we recomend.

K.R. -Mentions time running out.

Yes -All the best.

END

Date: May 2013 Page 2 of 2 Kovilen Reddy