

ISSUES IN DEVELOPING MARINE SDI

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INTRODUCTION

The world's oceans cover almost two thirds of the surface of the earth, regulating weather patterns and sustaining a huge variety of plant and animal life (UN, 2003). Given the diversity of this area, there is an economic, social and environmental need to effectively manage it. Current management is difficult with the ocean broken up into various national and international jurisdictions, all governed by a complex web of government legislation. Included in this is the United Nations Convention on the Law of the Sea (UNCLOS), which is the overarching law governing use of the ocean.

Underpinning this governance framework is the complex interaction between overlapping and sometimes competing rights, restrictions and responsibilities of various activities within the marine environment and at the coastal zone. It is now being accepted that the interests of a nation do not stop at the land sea interface, with competition for the vast array of natural resources ever increasing in the marine environment.

The ability to manage rights on land is well documented. The current system in place to manage the various rights, restrictions and responsibilities is the cadastre, with the advent of the Spatial Data Infrastructure (SDI) as a tool to help coordinate access to spatial data across a jurisdiction strengthening the management of such rights on land. SDI's have enabled a uniform approach for maximum integration and security of data, effective resource use and the development of comprehensive land information systems. The development of such SDI's however have concentrated on aspects of land, with the marine and coastal zone areas mostly missing from current SDI initiatives.

There has been a recent push by some countries to include the marine environment within the sphere of a nations SDI and is important to understand the factors driving the development of such SDIs in the marine environment. The current systems in place to manage marine boundaries and rights need to be assessed, in order to identify technical, legal and institutional issues and arrangements that are hindering the coordination and effective management of the marine environment. International perspectives also need to be considered, if the ability to create a marine SDI concept that crosses jurisdictional boundaries is to be successful.

The recent push by some countries to include the marine environment within the sphere of a nations SDI has led the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) to conduct an international workshop on “Administering the Marine Environment – the Spatial Dimensions”. The workshop aims to develop a better understanding of the spatial dimensions of the marine environment to the Asian and Pacific region. The Workshop will review national administration of marine environments of countries in Asia and the Pacific region based on a common template to identify problems, issues, similarities and differences in spatial data infrastructures; institutional arrangements; the administration of rights, restrictions and responsibilities; technology and human resource and capacity building in the marine environment.

KEY DEVELOPMENT FACTORS DRIVING MARINE SDI – WHY A MARINE SDI

Environmental

The world’s coastline is home to more than half of the earth’s population, with issues of pollution, depleted marine resources and increased threat by man to the health of the ocean forcing governments to implement sustainable development measures. According to the Food and Agricultural Organisation (FAO), nine of the world’s 17 fisheries are in serious decline with four depleted commercially (PANOS, 1995). This effects not only the environment, but also the commercial viability of the fishing industry. There is also international pressure to implement legal and institutional mechanisms to support sustainable development, through programs such as Agenda 21. This sets out guidelines for the protection of the oceans, all kinds of seas, and coastal areas and the protection, rational use and development of their living resources (UN, 1992). For this to become reality however, new approaches to marine and coastal area management are required (Robertson *et al.*, 1999).

Economic

The recognition of the marine environment as an economic resource is rapidly developing, with increased areas of ocean territory available to coastal States to exploit and explore. Oil and natural gas explorations are just one of the major sources of revenue for both government and private industry, with competition increasing for control over marine areas that are rich in natural resources. This makes the effective management and delimitation of coastal areas increasingly important.

Social

In recent times, there has also been growing pressure to recognize the rights of indigenous people to both the land and sea. This increased pressure has forced Governments to change the way in which land and ocean territories are governed. The ability to incorporate native title rights to land is only now beginning to be effectively managed within nations land administration systems (Brazenor et al., 1999). The ability for indigenous people to claim rights to areas of the sea and sea-bed has already occurred within countries such as Australia and Canada, driving the need to introduce a framework to facilitate more effective management of such areas.

Spatial Data

The ability to successfully manage such environmental, economic and social factors on land has been managed through the use of spatial data. In order to efficiently and effectively access and disseminate such spatial data however, there has been the need to develop SDIs, which aid in breaking down barriers between users and producers of spatial data. Within the marine environment however, the concept of an SDI is still in its infancy. Data management agencies continue to collect and disseminate data individually and without consultation amongst themselves. This encourages data to be held in various formats and at various accuracies within 'data silos'.

There has been a global recognition of the importance of issues such as sustainable development and indigenous rights to the marine environment. This has led to greater research into methods employed in the creation of marine SDIs and related systems throughout the international community. Such systems are discussed in the following section.

NATIONAL MARINE MANAGEMENT INITIATIVES

In order to develop a system that enables effective management of the environmental, social and economic factors described above, countries such as the USA, Australia and Canada are developing spatial boundary management systems for their jurisdictions. The titles of such systems vary, from marine SDIs to marine cadastres and marine GIS, but the aims of each system are closely aligned.

All countries considering the development of such marine SDIs are facing similar problems in relation to how to effectively manage offshore boundaries. There are multiple and unclear jurisdictional limits, various co-management arrangements, no single agency managing offshore rights and boundaries, indigenous title and enormous maritime areas to manage.

USA

In the USA, the Coastal Centre of the National Oceanic and Atmospheric Administration (NOAA), in conjunction with various industry, government and academic collaborators has developed an Ocean Planning Information System (OPIS). The system has been classified as a GIS by the Coastal Services Centre, however it employs cadastral data toward integrated ocean planning. The system's major features include:

- an interactive mapping application;
- marine and coastal spatial data download tools;
- associated metadata; and
- legal summary pages.

The system draws together spatial components that can be of importance in balancing the conflicting uses or resources within the marine environment. Such a system is just one of the elements within a Coastal Spatial Data Infrastructure (CSDI) which NOAA is promoting.

Canada

At the same time, a project undertaken in Canada has focused on identifying marine limits and boundaries from which a framework for good ocean governance can be developed. According to Ng'ang'a et al., (2001) this framework has been given the title of a multipurpose marine

cadastre, from which other biological, economic and environmental information could be linked. Nichols et al., (2000) describe the marine cadastre as:

A marine information system, encompassing both the nature and spatial extent of interests and property rights, with respect to ownership and various rights and responsibilities in the marine jurisdiction.

There is also a project underway within Canada to develop a Marine Geospatial Data Infrastructure (MGDI) within the framework of the Canadian Geospatial Data Infrastructure (CGDI). The aim of the project is “to enable simple, third party access to data and information that will facilitate more effective decision-making (Gillespie et al., 2000). Progress on the project however is being hampered by a lack of resources and institutional barriers inherent in government at both local and national levels (Bartlett *et al.*, 2004).

Australia

Within Australia, a project under the title of Defining and Developing a Marine Cadastre for Australia began in early 2002. The major aim of this project is to provide a comprehensive spatial data infrastructure whereby rights, restrictions and responsibilities in the marine environment can be assessed, administered and managed.

A diagram and definition have been developed in order to define a marine cadastre in an Australian context. The first aim of the diagram (Figure 1) is to demonstrate the fact that for the marine cadastre to be efficient, it must not be developed in isolation from the terrestrial environment. The coastal zone straddles both land and sea and is the public access point to the marine environment. The linking of the marine and terrestrial environments will enable a more seamless integration of spatial data, facilitating a more integrated and effective approach to coastal zone management.

The diagram also shows the range of stakeholders and activities that occur within the ocean. The marine cadastre must take all of these into account, including activities that occur within different sections of the ocean, including on the surface, on and beneath the sea-bed and through the water column. It is not just the activities which need to be accounted for however, but also the legal and administrative boundaries which govern where and when such activities can occur.

The implementation of a marine cadastre also aims to address the issue of spatial data held in various formats and accuracies in ‘data silos’. There is a need for consistent and accurate spatial information on all activities to be made available to all marine users, reducing time and cost constraints. For this to occur however, an SDI must be in place to underpin the availability and reliability of spatial data. Within the context of this project, the marine cadastre is described as:

A spatial boundary management tool, which describes, visualizes and realizes legally defined boundaries and associated rights, restrictions and responsibilities in the marine environment, allowing them to be more effectively assessed, administered and managed (Binns et al., 2003).

The Marine Cadastre diagram (Figure 1) also shows the link between the terrestrial and marine environments through the utilization of the Australian SDI. It also aims to demonstrate the complex overlapping nature of uses within the marine environment.

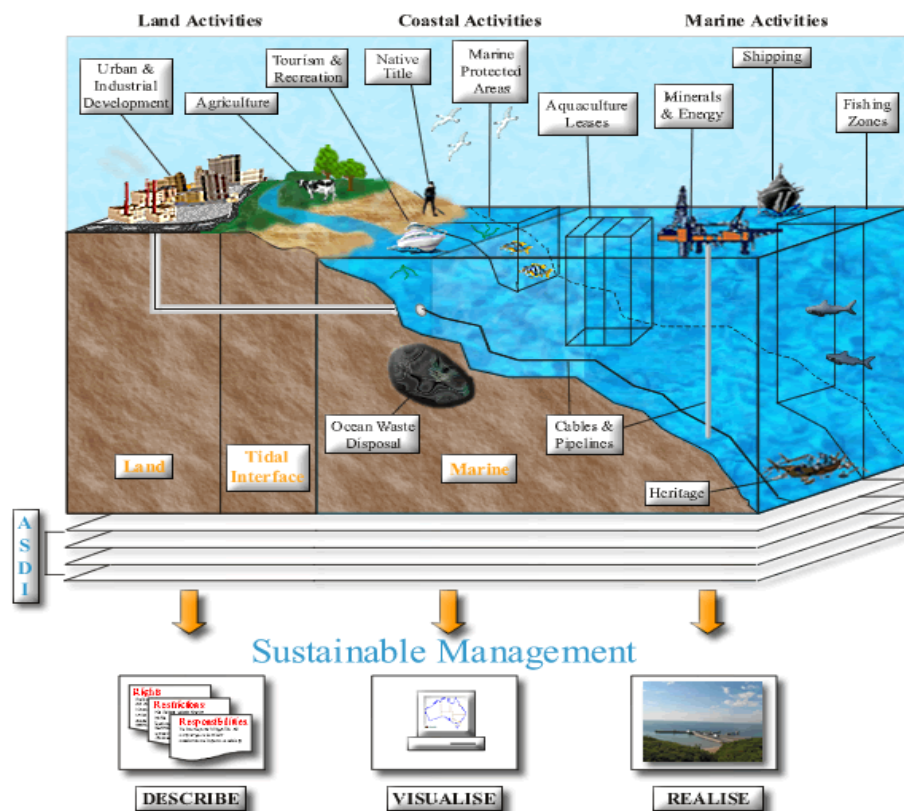


Figure 1 – Marine Cadastre Concept Diagram

The tangible outcome of a marine cadastre is the ability for users and stakeholders to “describe, visualise and realise” spatial information in the marine environment. This infrastructure will describe the location and spatial extent of rights, restrictions and responsibilities in the marine environment, including management boundaries, coastal planning guidelines, ocean parcels and legal definition. Such spatial extents should then be able to be visualised through the continual updating and maintenance of accurate and comprehensive digital spatial data. This ability to describe and visualize maritime boundaries will enable users to realise them physically at sea. This physical realisation will enable an integrated and practical approach to the management of a countries maritime extent.

CURRENT MARINE MANAGEMENT IN ASIA AND THE PACIFIC

The Asia and Pacific region is the largest region in the world with a vast geographic area of land and water, some 60 per cent of the world’s population and 55 countries as defined by the United Nations (Rajabifard and Williamson, 2003). It is recognized that such different nations are at different stages of development, in terms of the administration of the marine environment. This is especially so within the Asia and Pacific region, with nations ranging from archipelagos to almost entirely landlocked. This requires a solution which is unique, but also takes advantage of current international research, as described above.

To date most of the effort in administering the marine environment in the Asia and Pacific region has been on defining claim boundaries and establishing the basis for those claims. It is important however to demonstrate a capacity and intent to sustainably administer these areas and thus far, with the exception of a few special areas, competing rights and responsibilities in Asian and Pacific countries are handled in a somewhat ad hoc manner, with each responsible agency in the individual countries defining the spatial bounds of the given activity separately. The recent adoption of the WSSD commitments for the Seas of East Asia at the East Asian Seas Congress is a step forward in addressing such areas. However there has been no move to actively introduce a uniform and coherent infrastructure such as an SDI to support marine resource management.

Such an SDI would enable a more effective and efficient administration in support of marine resource management, especially in regards to rights, restrictions and responsibilities. The ability to clearly demarcate zones within the ocean, and access to accurate and relevant spatial

information would also be primary aims of the infrastructure. The management of the marine environment should also desirably be integrated with land-based information systems. This would aid in facilitating more integrated and effective approaches to coastal zone management, dealing with problems such as marine pollution from land based sources.

SDI IN ASIA AND THE PACIFIC

As a concept, an SDI is an initiative intended to create an environment that will enable a wide variety of users to access and retrieve complete and consistent spatial datasets in an easy and secure way. SDI is an integrated, multi-leveled hierarchy of interconnected SDIs based on partnerships at local, state/provincial, national, regional (multi-national) and global levels (Rajabifard and Williamson, 2003). This enables users to save time and money when attempting to acquire datasets by avoiding duplication of expenses associated with the generation and maintenance of data and their integration with other datasets

Within the Asia and Pacific region, the PCGIAP has been formed to provide a forum for nations across the region to cooperate in the development of the Asia-Pacific Spatial Data Infrastructure (APSDI) and contribute to the development of the global infrastructure. The PCGIAPs vision for the APSDI is of a network of databases, located throughout the region, that together provide the fundamental data needed to achieve the region's economic, social, human resources development and environmental objectives (Rajabifard and Williamson, 2003).

The PCGIAP has developed a conceptual model for its Regional SDI initiative that comprises the core components of:

- institutional framework;
- technical standards;
- fundamental datasets; and
- access networks.

The APSDI model is a network of fundamental spatial datasets, maintained by custodians and linked through the adoption of consistent standards, policies and administrative principles.

SDI IN THE MARINE ENVIRONMENT

The development of most SDI initiatives throughout the world has focused almost entirely on land. This is despite the fact that nearly half of the world's population lives within 200

kilometers of a coastline (with this number likely to double by 2025) and the marine environment provides half of the food source for countries within Asia and the Pacific (Creel, 2003). As human pressure on coastal areas increases, identifying ways to balance people's needs while sustaining coastal resources is becoming more important.

The need for an SDI to manage and administer the rights, restrictions and responsibilities of the world's oceans has only recently received international recognition (Ng'ang'a et al., 2001; Fowler and Treml, 2001; Williamson et al., 2001; Robertson et al., 1999). GIS and related technologies are becoming increasingly used to aid in the administration and management of the marine environment, and the development of an SDI would provide the foundation upon which such decision support tools can be based.

Within the PCGIAP, the 2002-2004 work-plan specifies the need for research into developing a marine dimension to the APSDI. Country specific initiatives such as the development of Australia's marine cadastre could be designed to tie in with any regional SDI. They would provide central registration, recording and monitoring of maritime rights, restrictions and responsibilities, integrate new and old leases and rights into a uniform spatial information system, and reconcile conflicts and incompatibilities in the management of spatial overlaps. The definition of a countries maritime zones and zone boundaries within a uniform national reference system could also be implemented.

Coordination between jurisdictions and agencies is important, especially so within the Asian region, given the large number and closeness of States maritime zones. The development of a regional SDI under the umbrella of the PCGIAP would aid in such coordination, providing interoperability of technologies and allowing better monitoring and enforcement of policies. The complex physical and institutional relationships that exist within the coastal zone make it impossible to develop a marine SDI in isolation from land based national SDI initiatives. Such land based initiatives would need to be expanded to include a marine SDI component due to the multiple physical and institutional spaces that exist within the coastal zone. In order to effectively develop a marine component to the APSDI however, an understanding of the current administration of the marine environment throughout the region is needed. Guidelines appropriate to the region for the development of a marine element to the APSDI can then be developed, concentrating on understanding the needs at a national level.

CONCLUSION

The need for a marine component to SDIs is increasing, being driven mainly by the need to address environmental, economic and social issues of sustainable development, along with the need to break down data silos, creating easier access to accurate and up-to-date spatial data. The concepts proposed within this paper aim to deal with such factors, creating solutions to the effective management of the marine environment.

It must be remembered that most ocean and coastal management problems are of a spatial nature. Therefore, the development of a marine component to national and regional SDIs is imperative to the effective management of the marine environment. It is also important to understand the link between the terrestrial and marine environments, recognizing that they cannot be treated as separate entities. The development of a marine SDI within the context of current national SDIs developed for land based management will enable a more seamless integration of spatial data at the land-sea interface.

The workshop on Administering the Marine Environment – the Spatial Dimensions aims to address the development of such SDIs, within the context of Asia and the Pacific. By reviewing the national administration of marine environments and identifying problems, issues, similarities and differences between them, appropriate guidelines can be developed to aid each nation in implementing a comprehensive spatial data infrastructure for their land and sea.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support of the University of Melbourne, the Department of Education, Science & Training Innovation Access Program for funding the research and the Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the University of Melbourne.

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Title:

Issues in Developing Marine SDI

Date:

2004

Citation:

WILLIAMSON, I. P., RAJABIFARD, A. & BINNS, A. J. (2004). Issues in Developing Marine SDI. Proceedings of International Workshop on Administering the Marine Environment - The Spatial Dimensions, pp.11-11. Dept of Survey and Mapping Malaysia.

Publication Status:

Published

Persistent Link:

<http://hdl.handle.net/11343/33866>

File Description:

Issues in developing marine SDI