

Assessing the need for an Australian Marine Cadastre

Jane E. Forse and Phil A. Collier

Department of Geomatics, The University of Melbourne, VIC 3010

Abstract

The Department of Geomatics at the University of Melbourne is leading a collaborative research project looking at defining the issues to be considered in the context of developing an Australian marine cadastre. The two year project is funded by the Australian Research Council and includes Geoscience Australia, Land Victoria, the Queensland Department of Natural Resources and Mines and GeoFix Pty Ltd as industry partners.

This paper will describe the incentive, objectives and principle tasks of the marine cadastre project. In particular, the results of a recently completed national questionnaire will be presented. This questionnaire was conducted in an attempt to evaluate the usage of and requirements for spatial data in the marine environment, and therefore to act as an aid in designing the features and capabilities of a future marine cadastre for Australia.

Introduction

Australia is a profoundly maritime nation. Encircled by the sea, the Australian coastline is almost 60,000 km in length and the area of the nation's maritime responsibility is over twice that of the Australian continental landmass (Kaye, 1995). The Australian Maritime Jurisdiction (AMJ) – the region to be covered by any future marine cadastre – is the second largest in the world and represents not only a vitally important national asset, but also a major national and international responsibility. Given the diversity and extent of Australia's ocean resources, there is a fundamental requirement to manage, explore and exploit the nation's ocean territories in a way that will maximise benefit to the nation, while at the same time protecting the delicate ocean environment (Collier et al, 2001).

In regard to ocean governance, Australia is bound by a number of international treaties and conventions. Furthermore, Australia is a federation of states and territories, each of which has enacted legislation governing activities in the marine environment. Such instruments of governance operate in tandem with the sovereign rights, responsibilities and legislative controls introduced by the Commonwealth.

In recent years there has been an increasing awareness of the importance of spatial data in the marine environment and the need for a structured and consistent approach to the definition, maintenance and management of offshore legal boundaries. It is in this context that the concept of a national marine cadastre has gained increasing prominence.

The *marine cadastre* is now being recognised as a fundamental layer of offshore spatial data infrastructure. In essence, the marine cadastre provides a means for delineating, managing and administering legally definable offshore boundaries. Examples of such boundaries include:

- International maritime boundaries
- Internal maritime boundaries
- The federal/state boundary at the 3 nautical mile limit of coastal waters
- Administrative and jurisdictional boundaries such as those used to define marine protected areas, restricted fishing zones and other areas where operational restrictions apply
- Tenure boundaries such as those delineating mariculture or aquaculture leases, petroleum exploration and mining leases, cable and pipeline locations and areas granted under native title claims

Status of Marine Cadastre Research in Australia

Initial support for marine cadastre research in Australia came in late 2001 with the awarding of an ARC Linkage-Projects grant to a team comprising the University of Melbourne, GeoFix Pty Ltd, Land Victoria (LV), Geoscience Australia (GA) and the Queensland Department of Natural Resources and Mines (NR&M). Throughout the remainder of this paper, this project will be referred to as the *ARC marine cadastre project*.

Interest and activity in Australia in relation to marine cadastre issues has grown steadily over the past two years. For example, the Intergovernmental Committee on Surveying and Mapping (ICSM) has established a Tidal Interface Working Group to look at rationalising the definition of the term *coastline*. The Australian National Marine Data

Group (ANMDG) has likewise established a Marine Cadastre Working Group with the objective of developing a data dictionary applicable to the marine cadastre.

As a collaborative initiative, two pilot project areas have been adopted to support the development and testing of research hypotheses and to demonstrate the concept and complexities of a future marine cadastre. The first area is located off Townsville on the Queensland coast, the second area includes Port Phillip Bay and extends eastward along the Victorian coast to the New South Wales border. The two pilot project areas are shown in Figure 1. More details can be found at <http://www.geom.unimelb.edu.au/maritime/index.htm>.



Figure 1 – Location of pilot project areas (Queensland and Victoria)

International Research Initiatives

Australia's move into marine cadastre research was not without precedent on the international scene, with relevant work being conducted in the United States and Canada. In the former case, the Coastal Services Center (CSC) of the National Oceanic and Atmospheric Administration (NOAA) has developed an *Ocean Planning Information System* (OPIS) for the states of Florida, Georgia and North and South Carolina (<http://www.csc.noaa.gov/opis>). A number of journal and on-line articles provide details about the project, including numerous references to the marine cadastre (e.g. Fowler and Treml, 2001; Neely et al., 1998; Treml et al., 1999; Lockwood and Fowler, 1999).

In July 2000, a research project incorporating four Canadian universities and five industry and government partners was commenced under the title: *Good Governance of Canada's Oceans: The Use, Value and Potential of Marine Boundary Data*. The project web-site (<http://gge.unb.ca/Research/OceanGov/>) contains more information about the aims and objectives of the project. An important aspect of the Canadian work is the emphasis placed on maritime boundaries and their accurate delimitation. Additional details can be found in Nichols and Monahan (1999) and Nichols et al. (2000).

Progress on the ARC Marine Cadastre Project

Objectives

The ARC funded marine cadastre project formally commenced in June 2002, with the awarding of two postgraduate scholarships and the appointment of a full-time research assistant. The project will run for two years and has as its principle objective the definition of issues currently hindering the development of an Australian marine cadastre and, in that context, the establishment of a direction for future research.

Research focus

Current research is focussed on two main areas. The first is a consideration of the similarities and differences between the existing land cadastre and a future marine cadastre and the suitability and extension of the Australian Spatial Data Infrastructure (ASDI) to the marine environment. The second research area focuses on issues of 3D and 4D parcel definition, the application of uncertainty in maritime boundary delimitation and coastline definition, and the integration of uncertainty within a multi-dimensional cadastral object model.

In parallel with these detailed areas of research, work is also being conducted to gain a broader understanding of the requirements of those individuals and organisations who use, manage and administer maritime spaces and marine spatial data. This is being achieved through the running of workshops, the conducting of a broadly based national questionnaire and the execution of detailed industry consultation.

Workshops

To date two workshops have been conducted and a third is planned for early in 2004, toward the end of the project. The first workshop was held in Townsville on 5-6 August 2002. The objective was to bring together

stakeholders with an interest in the marine environment and thereby gain cooperation and support for the Queensland component of the pilot project. To this end, the workshop was very successful, with more than a dozen organisations agreeing to be partners in the pilot project including fundamental players such as the Australian Hydrographic Office, the National Oceans Office, the Australian Institute of Marine Sciences and the Great Barrier Reef Marine Park Authority. Presentations from the workshop are available on CD from NR&M. The second workshop was held in Melbourne on 14-15 November 2002. The objective of this workshop was to explore and identify key issues in relation to the development and application of a marine cadastre from a diverse range of perspectives. An idea of the broad level of interest in the marine cadastre concept and the issues that must be considered as implementation of the marine cadastre progresses can be seen from the workshop presentations available at <http://www.geom.unimelb.edu.au/maritime/workshop.htm>.

Questionnaire

The national questionnaire, the results of which will be presented in the sections that follow, was intended to raise the issue of the marine cadastre with a broad audience and to gain feedback to enable a general picture to be formed on how spatial data is being used in the marine environment and what limitations are currently being faced in this context.

The questionnaire was made available on-line in September 2002 at <http://www.geom.unimelb.edu.au/maritime/questintro.htm>. Once the questionnaire was placed on the Web, over 260 emails were sent out to potential respondents with the request that the questionnaire be distributed as widely as possible. In the months that followed, a total of 110 responses were received, allowing the objectives of the questionnaire to be largely satisfied.

Industry consultation

While some preliminary discussions with key players have been carried out, a concerted process of industry consultation is yet to be undertaken. The questionnaire responses and the workshops have provided a broad overview of issues and a picture of how spatial data is being used offshore. However it remains necessary to get to a higher level of detail in order to fully understand the issues surrounding the implementation and operation of a marine cadastre from a user perspective. Thus in the coming months, a number of organisations will be selected for interview.

Any individual or organisation wishing to be a part of this consultation phase should contact Dr Philip Collier (p.collier@unimelb.edu.au).

Questionnaire Objectives

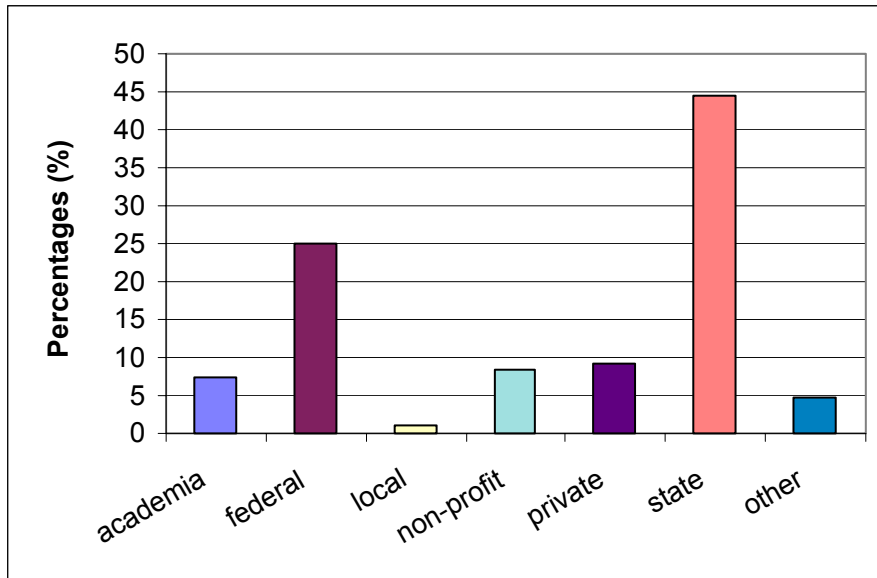
The aim of the questionnaire was to target as broad an audience as possible in order to:

- Identify major users, suppliers and producers of marine spatial data
- Identify the main categories of marine spatial data
- Understand the ways in which marine spatial data is being used
- Identify the limitations and shortcomings of currently available marine spatial data
- Identify the ways in which marine spatial data can better serve the needs of users

Questionnaire Results

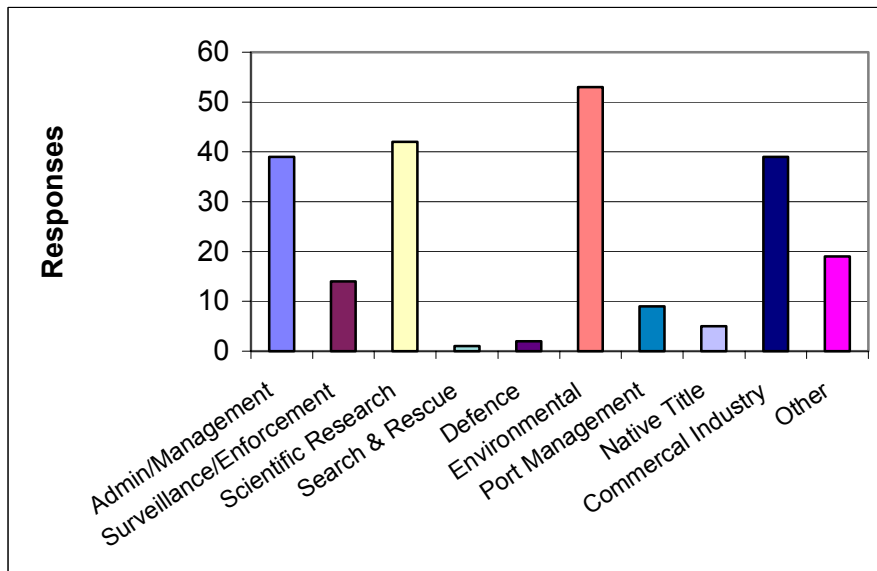
In the sections below a summary of responses to most of the questions is provided. Where appropriate, a graph showing the distribution of responses to each question is given, along with a brief comment on the interpretation of the results. For some questions a footnote is provided to define particular terms (such as *spatial information* and *marine cadastre*). These definitions are the same as those supplied to respondents to the questionnaire. It is important to see these definitions in their context when analysing the responses, as the answers given were (in some sense) correlated to the definitions.

Q1. Identify the industry sector to which your organisation belongs.



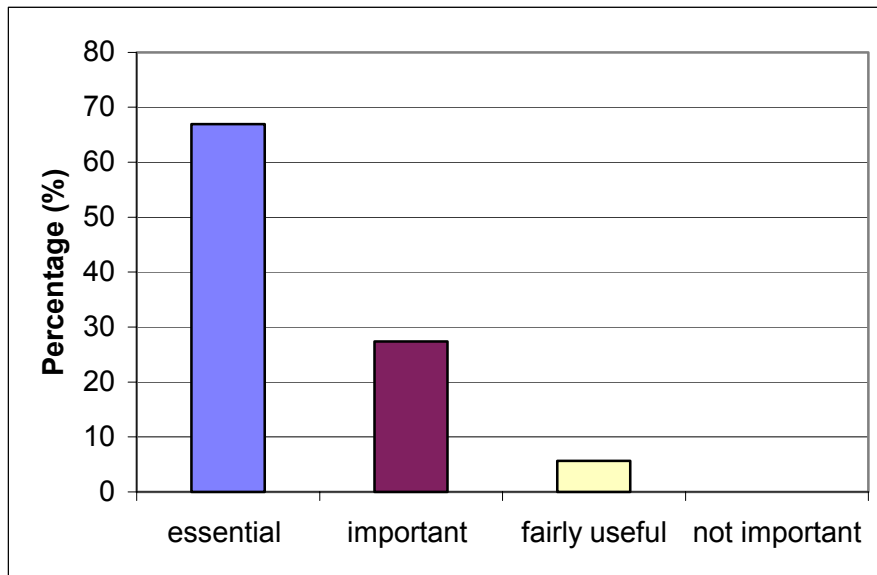
Most respondents came from the government sector, particularly state and territory government agencies and departments. The response from local government and the private sector was disappointing.

Q2. What is your organisation's core business? (You can select one or more options.)



Most respondents indicated a role in environmental issues offshore. Scientific research was also seen to be a major activity. Administration and management were key functions. Many respondents also played a role in commercial offshore activities.

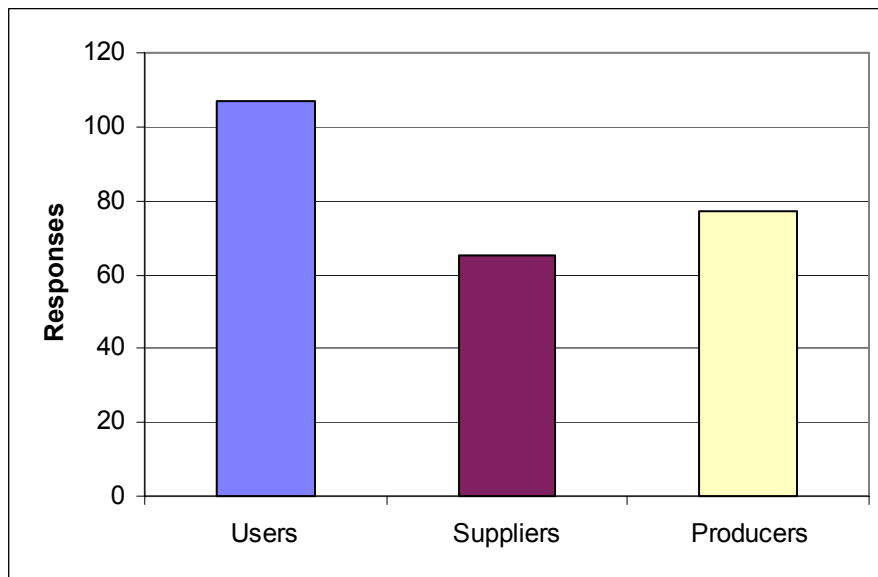
Q4. How important is spatial information¹ to your business operations?



In response to Q3 (*Does your organisation use spatial information to conduct its business?*), it was found that the majority (97%) of respondents were users of spatial information. Responses to Q4 (as shown above) revealed how important spatial information was, with the majority of respondents (94%) regarding spatial information as either essential or important. Only 3% of respondents to Q3 did not currently use spatial information, but all of these agreed that spatial information would improve their operations.

¹ Spatial information is information that describes where things are. Coordinates such as latitudes, longitudes and depths/heights are typically used as the core component of any spatial information. Common examples include charts, maps, bathymetry, geographical information systems and navigation systems such as GPS.

Q6. Is your organisation a user, supplier or producer of spatial data?
(You can select one or more options.)



Nearly all respondents were users of spatial data, while roughly 70% were also producers and 60% were suppliers.

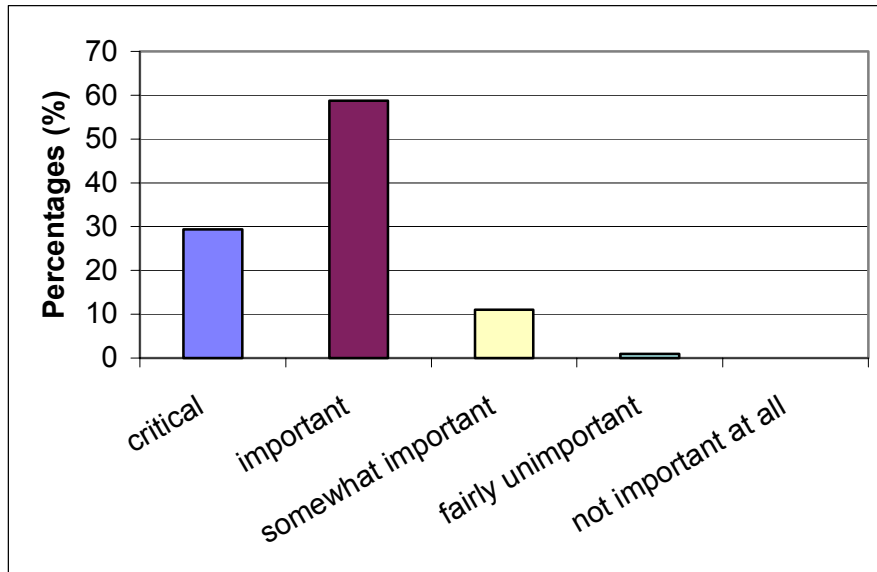
From the responses to Q7-Q10, the following conclusions can be drawn:

- The majority of offshore spatial data is supplied to users in digital form, though paper charts are still used by some organisations.
- Most users of spatial data require 3D information and many require knowledge of time variations as well.
- Data is generally supplied at large scale (typically 1:50,000 and 1:100,000).

Q11, which asked – *What would be the ideal accuracy² of the spatial information you use?* – was the cause of much confusion amongst respondents. It seems that the term accuracy means different things to different people and is very much context or application dependent. Because of this, no clear picture could be formed from the very limited number of responses to this question.

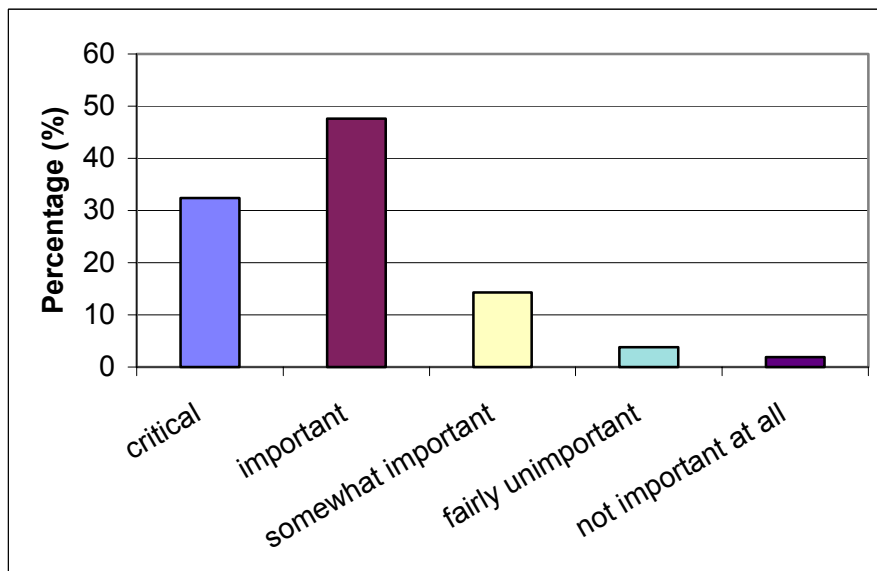
² Accuracy expresses how “close to the truth” the data is. Does it give a true representation of reality?

Q12. How important is the currency³ of the spatial information you use?



Thus users of offshore spatial information are generally very dependent on that information being kept up to date.

Q13. For *users*, how important is metadata⁴ to your usage of marine spatial data?

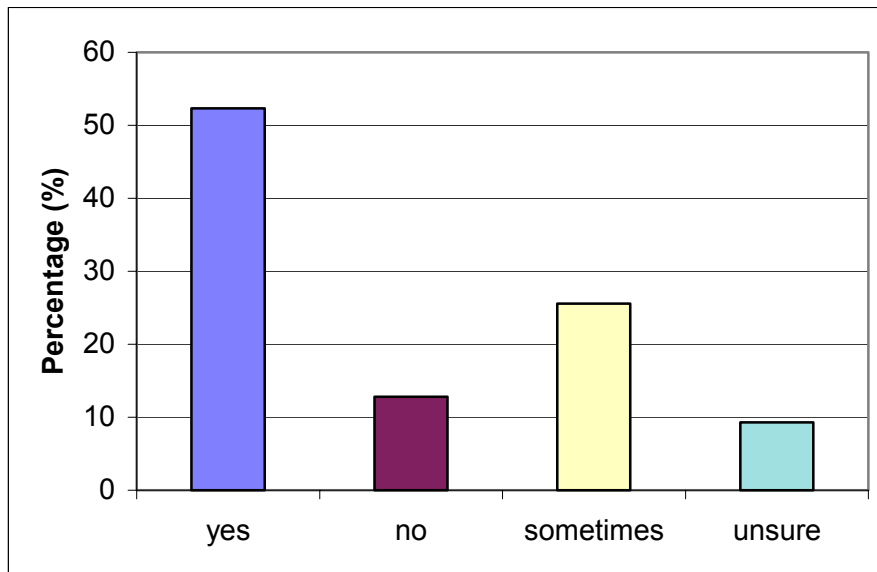


Metadata is seen to be a very important part of the correct usage and interpretation of spatial information.

³ Currency expresses how “up do date” the data is. Does it reflect recent changes in the marine environment?

⁴ Metadata is definitional data that provides information about or documentation of other data managed within an application or environment.

*Q14. For data **producers**, do you provide metadata along with the spatial data you supply?*

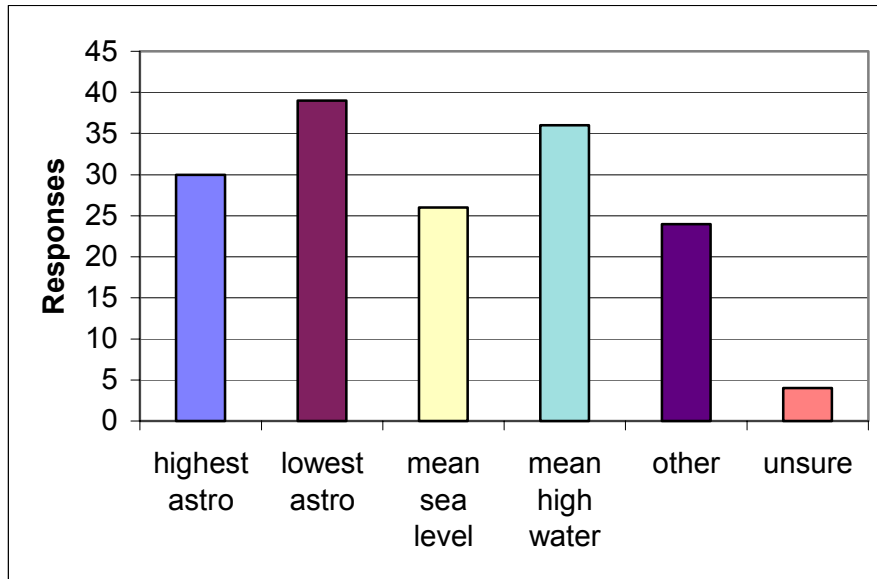


Somewhat surprisingly, not all suppliers consistently provide metadata and some are not even sure if they provide it.

From Q15 it was clear that most offshore spatial data is compiled from aerial photography and satellite imagery, while unsurprisingly Q16 showed that most offshore spatial data is being supplied to users by government agencies.

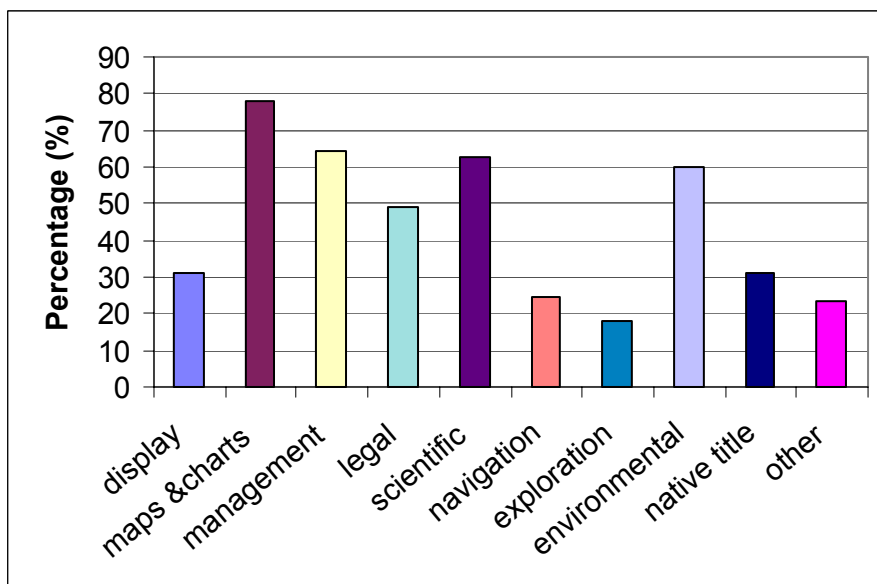
Answers to Q17 – *Does your work in the marine environment depend on a boundary which is defined by the intersection of a tidal plane with the land?* – demonstrated that the operations of almost 70% of respondents were in some way dependent on tidal plane definitions. Those who indicated this dependence were then asked to answer Q18.

Q18. Which tidal plane (or planes) are relevant to your operations? (You can select one or more options.)



The response rate to this question was relatively poor, indicating that many respondents were unsure of which tidal plane (or planes) they were dependent upon. This is perhaps not surprising but is an important issue in the context of marine cadastre research.

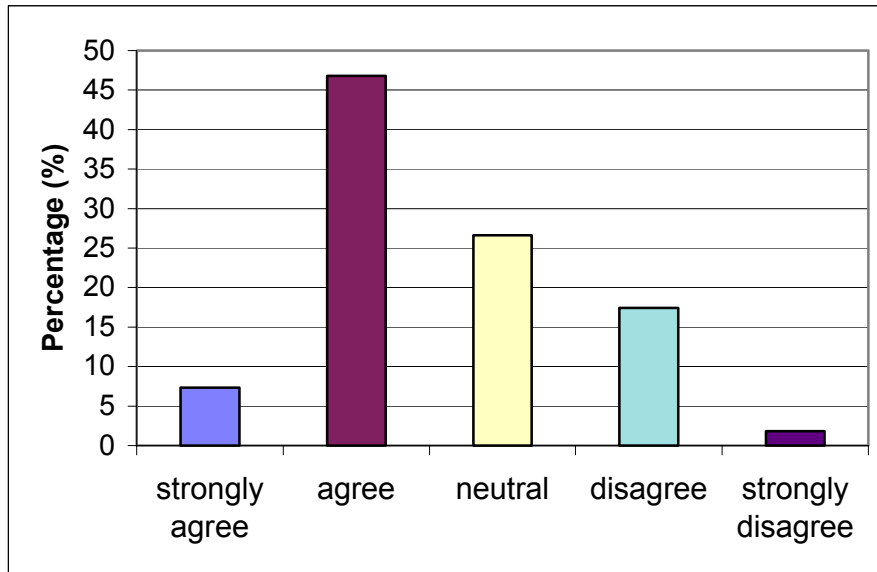
Q19. In what ways does your organisation use marine spatial data? (You can select one or more options.)



Maps and charts emerge as the most prominent product from marine spatial data, though management applications, scientific research and environmental applications are once again seen as key activities.

Q20 asked respondents to identify the legislative controls (*instruments of governance*⁵) under which they operate in the offshore environment. The poor response rate and incomplete responses to this question indicated that many were unsure about the legislation or treaties impacting on their offshore activities. Consequently no clear conclusions could be drawn from responses to this question.

Q21. Does the spatial data you have serve your purposes adequately⁶?

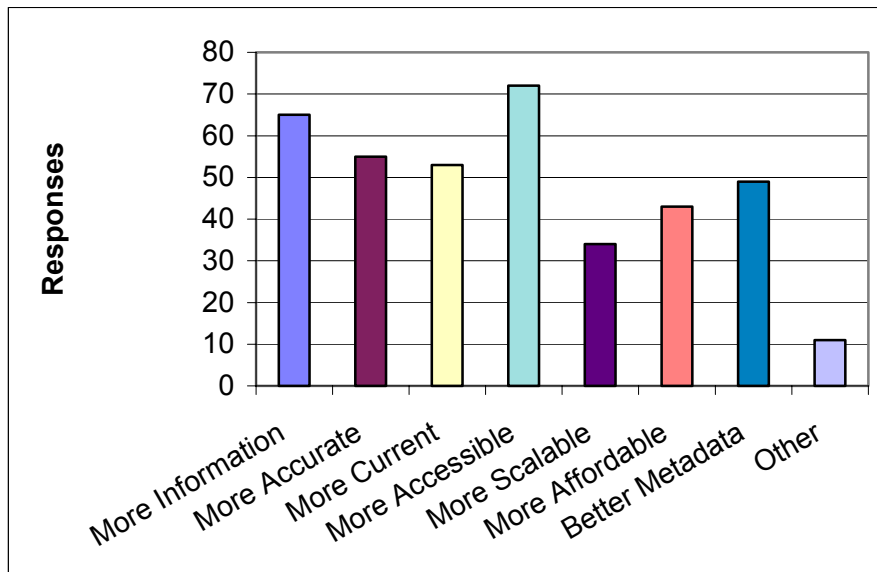


Somewhat surprisingly there was a high degree of satisfaction amongst respondents about the adequacy of marine spatial data.

⁵ *Instruments of governance* include such things acts of parliament (state or federal) as well as international treaties and conventions which impose rights, restrictions and responsibilities in the marine environment.

⁶ In other words, could your operations be improved (e.g. made more efficient) by having access to *better* spatial data?

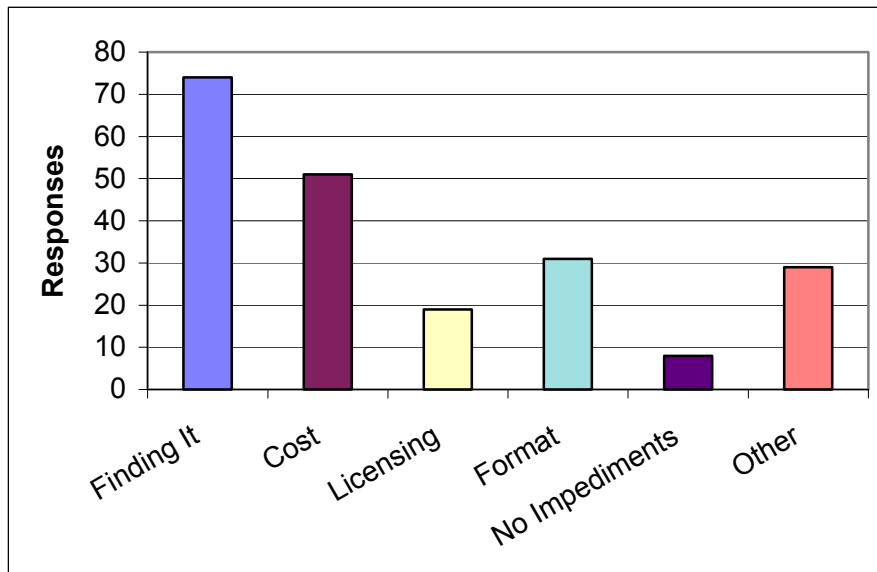
Q22. How could the spatial data you have be improved to better serve your purposes? (You can select one or more options.)



From this question, the issue of access to data emerged as a major concern for users.

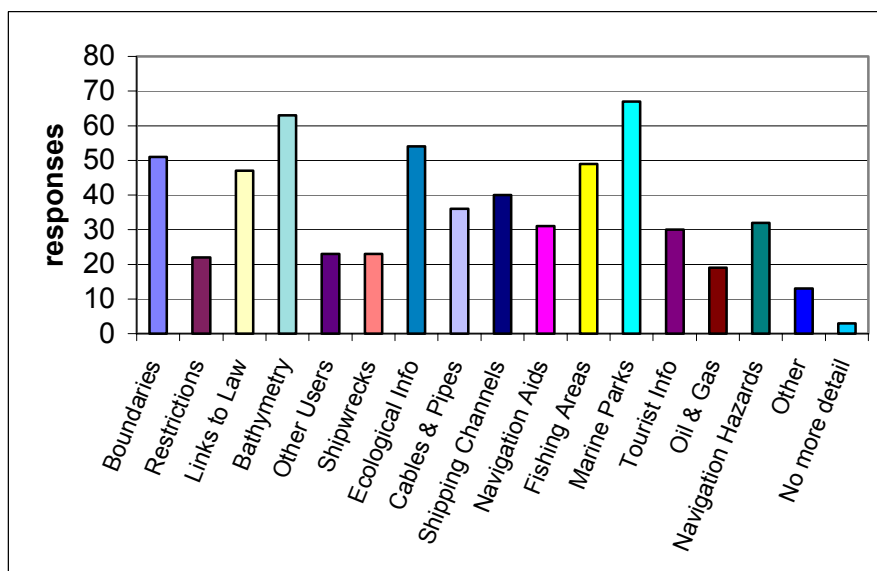
Responses to Q23 which asked – *Do you have trouble accessing the marine spatial data you require?* – supported the conclusion drawn from Q22, with half of the respondents indicating that they do face problems in accessing the data they need. Having access to *more data* was also identified as an area where improvements could be made in regard to the suitability of currently available marine spatial data.

Q24. What are the impediments to accessing data? (You can select one or more options).



Following on from Q22 and Q23, respondents identified reasons why problems were being experienced in accessing marine spatial data. The most common problem was simply finding the data that was needed, followed by the age-old issues of cost and format incompatibilities.

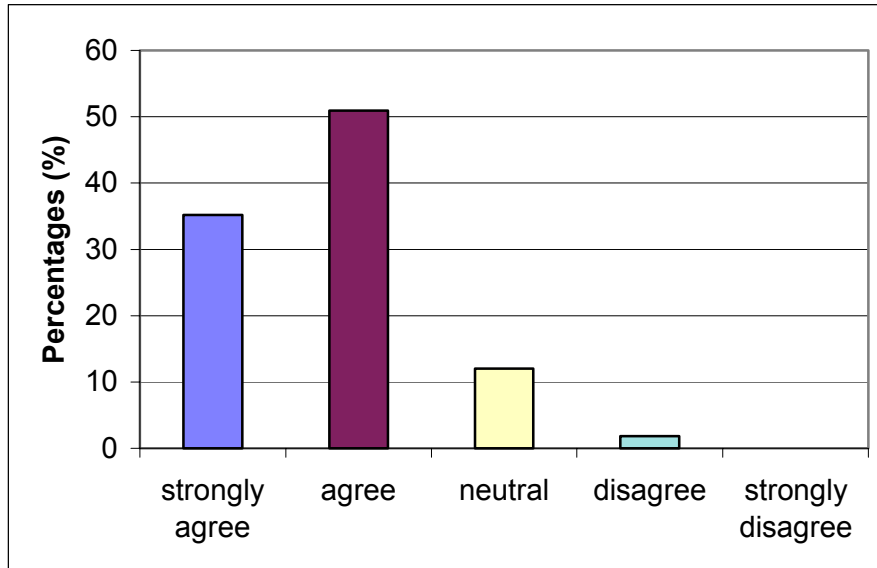
Q25. If your operations would benefit from more detail, what particular detail(s) would you like added? (You can select one or more options).



Responses to this question again relate back to Q22, where many respondents identified that they required additional information (details) in the marine spatial data that they used. The above chart shows the types

of information respondents were looking for, with marine parks, bathymetry, maritime boundaries and ecological data being areas where information was lacking.

Q26. Do you believe that access to a marine cadastre⁷ would assist the operations of your organisation?



In hindsight, the definition of the marine cadastre given to respondents probably biased the responses to this question. In fact the definition given overstates and generalises the basic purpose of a marine cadastre. The overwhelmingly positive response to the benefits of a marine cadastre must be interpreted in light of the definition given. However, it is not unreasonable to suggest that most respondents are in favour of the general marine cadastre concept.

⁷ A marine cadastre would provide ready access to a diverse range of spatial information of relevance and importance in the marine environment.

Where to from here?

The results from the questionnaire, the feedback from the two workshops held thus far and the findings from the forthcoming industry consultation process will be combined to identify fundamental design criteria for a future marine cadastre for Australia. The pilot project, with demonstration areas in Queensland and Victoria will provide a “laboratory” for testing research hypotheses and refining proposed solutions. Ultimately, the pilot project will become the means whereby the features and capabilities of an Australian marine cadastre can be illustrated and demonstrated to a wider audience. A final workshop, planned for early in 2004, will provide the forum for the presentation of results from the two year research program.

Another application for funding to the ARC has been recently submitted under the Linkage-Projects scheme, to allow marine cadastre research to continue beyond mid-2004 (when the current grant expires). The proposal has identified four key areas for future research:

- Resolving issues in the definition of the tidal interface
- The use of natural rather than artificial boundaries in a marine cadastre
- Extension and application of the ASDI to support a marine cadastre
- Marine policy, legal and security issues and the marine cadastre

The proposal, which seeks ARC funding for three years, brings together researchers from The University of Melbourne, The University of New South Wales and GeoFix Pty Ltd and includes four industry partners.

Conclusions

The ARC marine cadastre project formally commenced in June 2002. Since that time, a considerable amount of interest and discussion has been generated about the marine cadastre concept, the definition of the marine cadastre and the benefits and applications of a future marine cadastre for Australia. Results from the marine cadastre questionnaire, presented in this paper, highlight the importance of spatial information to the majority of individuals and organisations with responsibilities and interests in the marine environment. The marine cadastre will provide a means for defining, managing and administering legally definable offshore boundaries and in this context will form a fundamental component of marine spatial data and a layer in a future ASDI that covers both the terrestrial and marine environments.

References

- Collier, P.A., Leahy, F.J. and Williamson, I.P. 2001. Defining a Marine Cadastre for Australia. *2001 - A Spatial Odyssey: 42nd Australian Surveyors Congress*
- Fowler, C. and Treml, E. 2001. Building a Marine Cadastral Information System for the United States – A Case Study. *International Journal on Computers, Environment and Urban Systems, Special Issue: Cadastral Systems*.
- Kaye, S. 1995. Australia's Maritime Boundaries. *Wollongong Papers on Maritime Policy No. 4*. Published by the Centre for Maritime Policy, University of Wollongong, Australia.
- Lockwood, M. and Fowler, C. 1999. Significance of Coastal and Marine Data within the Context of the United States National Spatial Data Infrastructure. *Marine and Coastal Geographical Information Systems*. Ch.17; pp. 261-278. Edited: D. Wright and D. Bartlett. Taylor and Francis, London.
- Neely, E.M., Treml, E., LaVoi, T. and Fowler, C. 1998. Facilitating Integrated Regional Ocean Management Using A Web-based Geographic Information System. From: http://www.csc.noaa.gov/opis/html/occ_98.htm.
- Nichols, S. and Monahan, D. 1999. Fuzzy Boundaries in a Sea of Uncertainty. *The Coastal Cadastre – Onland, Offshore – Proceedings of the New Zealand Institute of Surveyors Conference (FIG Commission VII Conference)*, Bay of Islands, NZ, October 9-15, pp.33-43.
- Nichols, S., Monahan, D. and Sutherland, M. 2000. Good Governance of Canada's Offshore Coastal Zone: Towards and Understanding of the Marine Boundary Issues. *Geomatica* vol 54(4): pp. 415-424.
- Treml, E., Neely, R., Smillie, H., Fowler, C. and LaVoi, T. 1999. Spatial Policy: Geo-referencing the Legal and Statutory Framework for Integrated Regional Ocean Management. From: <http://www.csc.noaa.gov/opis/html/esri99.htm>.

Acknowledgments

The authors acknowledge the support of the Australian Research Council through the ARC Linkage-Projects Grant LP0211045.