Marine Cadastre as an Application of MSDI

Peyton, Derrick R., John Conyon, Dr. David Dodd

IIC Technologies Inc.

Key Words: SDI, MSDI, Marine Cadastre, hydrography

Abstract Description

A Marine Spatial Data Infrastructure (MSDI) is a framework consisting of marine geographic data, associated metadata, and the information technology infrastructure to enable the discovery and use of this data by the wider community. An example of an MSDI is a Marine Cadastre.

A Marine Cadastre is a system of registries that allows for the systematic recording of all recognized legal rights, restrictions and responsibilities in the offshore area. On land, cadastral systems are an essential component in the land management structure and a pillar of economic development. They ensure the security of public and private interests and create a positive environment for investment. As a modified extension of the land cadastre, the marine cadastre is at the centre of the dynamics between usages and the ocean space. It requires accurate, up-to-date and complete information.

This paper presents some background information on MSDI and Marine Cadastre and discusses an idealized concept of how a multipurpose Marine Cadastre could operate.

Introduction to MSDI

Providing ease of data access is a major component of a Spatial Data Infrastructure (SDI). Such access is primarily dependent on a range of technology, policies and institutional arrangements. SDI emphasizes "unlocking" all of the geospatial information so it can be better utilized by all interested parties. The concept encompasses the hardware, software and system components required to support the integrated management and interoperability of spatial data, including the processes, standards, policies and structural relationships of all those involved. The custodian of the data that is supplied to the SDI is normally under the direction of approved authority. In this way supplied information is both legitimised and properly maintained.

A Marine Spatial Data Infrastructure (MSDI) can be considered a derivative of a SDI. A MSDI embraces the marine geographic component that includes traditional hydrographic information such as bathymetry, geology, infrastructure (e.g. pipelines, cables, wrecks, etc.), boundaries, and areas of conservation. In essence, ENC data made available online with searchable parameters (i.e. features, locations, metadata, etc) could be considered an application of a MSDI. It should be clear that a MSDI is not just a data storage system. It facilitates the access to the information stored by the group responsible for the information.

For a MSDI to function properly it must provide a web-based search engine whereby the information held is described by standards based metadata. Relevant metadata standards are governed by ISO 19115.   The web interface must be simple and uncluttered. It should only provide the information that a particular user is interested in, and not everything in the various databases that is represents. The key to making information usable is to ensure users can find it, access it and then use it as simply as possible. The web interface would use web mapping tools to present the geospatial information of interest to the user. The representation of the data could be taken directly from the database/s, or be from a pre-rendered database maintained by the

MSDI. The users of the MSDI could range from power users (e.g. chart production, database management, etc.) to casual users (e.g. grade 5 geography or science class), depending on the data sharing policies that are implemented.

The MSDI tracking component should:
- Track all actions within the MSDI
- Track all changes made to data, metadata and products
- Provide casual users with history of their queries and downloads
- Provide MSDI Management system with information on what data are used by the clients. These clients can then be notified of any updates or change.
- Provide managers with a record of all changes made to database information.

Responsibility of an MSDI

As discussed, a MSDI is made up of dispersed databases with associated metadata, a web interface and a management system that manages the links between the web interface and the databases.

One of the dilemmas of an MSDI is who has the responsibility for its existence and consequently its maintenance. This has been the focus of many discussions observed amongst national hydrographic organizations over the past several years whereby the sources of information for an MSDI can come from many number of governing agencies, each with a separate mandate. The idea that a national hydrographic authority is responsible for all data available through an MSDI is not necessarily a bad idea. That being said, the governance and policy of an MSDI is driven from the top down. That is, although each administration within a government is responsible for cataloging and supplying its data to the MSDI, the framework, policies and governance that must exist is normally allocated to an appointed and focused agency such as a national charting agency. Subsequently, full cooperation of all groups that have responsibility for marine geospatial information is essential for a functioning MSDI.

Marine Cadastre

The Marine Cadastre can be defined as an integrated system of registries that allows for the systematic public recording of all recognized legal rights, responsibilities and restrictions related to the ocean space (legislative base, people, data infrastructure). (NRCan/DFO task group, 2010). Therefore a Marine Cadastre must also include the demarcation and administration of boundaries associated with those interests. These maritime boundaries can include oil and gas leases; local, national and international boundaries; marine protected areas, First Nations land and administrative boundaries. Figure 1 illustrates the various components of a multi-purpose Marine Cadastre:

- Geopolitical boundaries (international, national and local)
- Existing contiguous ownership (e.g. high-water line for real property rights)
- Intertidal zone
- UNCLOS zones and boundaries:
  - Baseline (coastline)
  - Territorial sea
  - Extended Economic Zone (EEZ)
- First Nations
- Marine Protected areas
- Marine navigation (shipping routes, anchorages)
- Habitats of concern
- Offshore Oil and Gas exploration and production
- Offshore construction (oil and gas, tidal energy and wind energy)
- Heritage protection (i.e. shipwrecks)
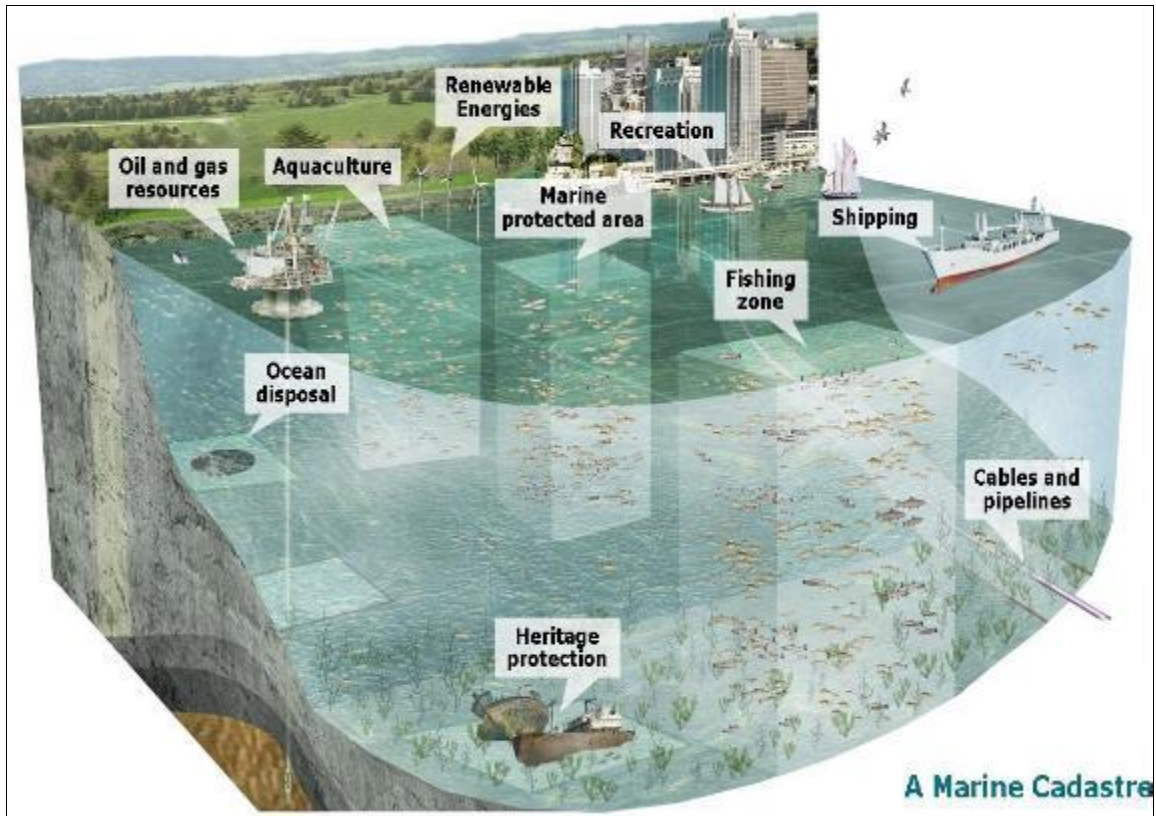- Pipelines and cables
- Aquaculture
- Fishing
- Military

Figure 1: Concept of a marine cadastre (Taken from M'Bala, 2016)

How does a Marine Cadastre fit within a MSDI?

What then of maritime boundaries? One of the primary responsibilities of an HO is to provide safe navigation for both national and international shipping. However, in establishing a nautical chart the HO provides maritime boundaries such as the coastline. Yet, as illustrated in Figure 1, coastline information is used by many different administrative groups at all levels of government; including local, national and international organizations.

In an "ideal" world one authority could take on the responsibility to maintain and serve the coastline information to the MSDI for the Marine Cadastre. Responsibility for storing and maintaining the data and metadata could remain with each respective official authority. For example, the high water line could be administrated by the land cadastre

5

authority and the low water coastline by the HO. The MSDI would provide the links to the databases and monitor the metadata for any updates. The coastlines would be stored at the highest resolution possible, and the Marine Cadastre would provide the user with the tools to generalize the lines for their particular purpose. However, such is not always the case and we see several agencies stepping up to provide their version of the coastline that pertains to their requirements and user community (Dodd et al, 2016).

Unlike land based cadastral systems where the registry of property and its interests are recorded and managed by a designated government institution, a Marine Cadastre doesn't normally have a central registry and/or a governing authority to administer. A Marine Cadastre becomes even more complex than the land parcel in that the geometry of a Marine Cadastre can become geometrically multidimensional to include the surface, the water column, the seabed and sub-seabed. It can also include overlapping interests such as fishing zones, oil and gas, and shipping routes.

In all likelihood the databases are not centrally stored as part of the MSDI. They are most likely to be maintained, along with the relevant metadata, by the relevant governing agency or agencies. Any updates to the data are recorded in the metadata, which are monitored by the agencies management system. Databases could also include products, both unofficial and official. From a hydrographic perspective, for example, user access to charts could be managed through the MSDI. Any updates made to a chart would be recorded in the metadata and anyone who has downloaded that particular chart would receive notice of the update. The data in databases do not have to be S-100, but the data format and metadata must have enough information for the MSDI to be able to create S-100 objects for data transfer.

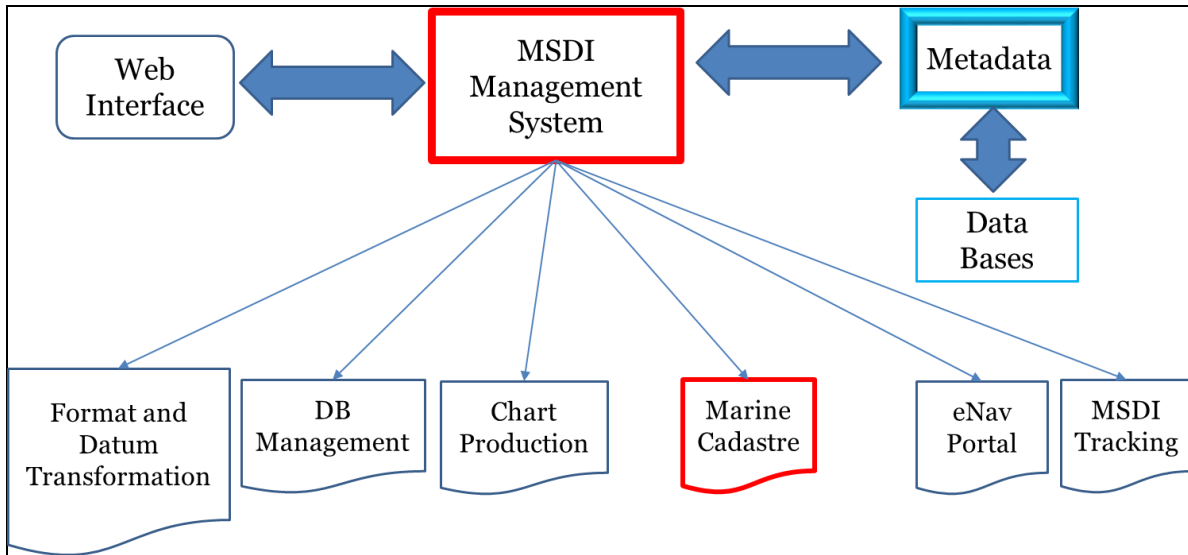Figure 2 illustrates the concept of having a Marine Cadastre integrated into a MSDI.

Figure 2: Marine Cadastre Integrated into a MSDI

Figure 3 illustrates an example of a Marine Cadastre whereby the various databases, including the authority for each of these different databases, would reside with the relevant government entities. In this example, the Marine Cadastre's component limits are defined in three spatial dimensions (horizontal position and depth) plus time. The rights, responsibilities and restrictions are recorded and registered by the Marine Cadastre.
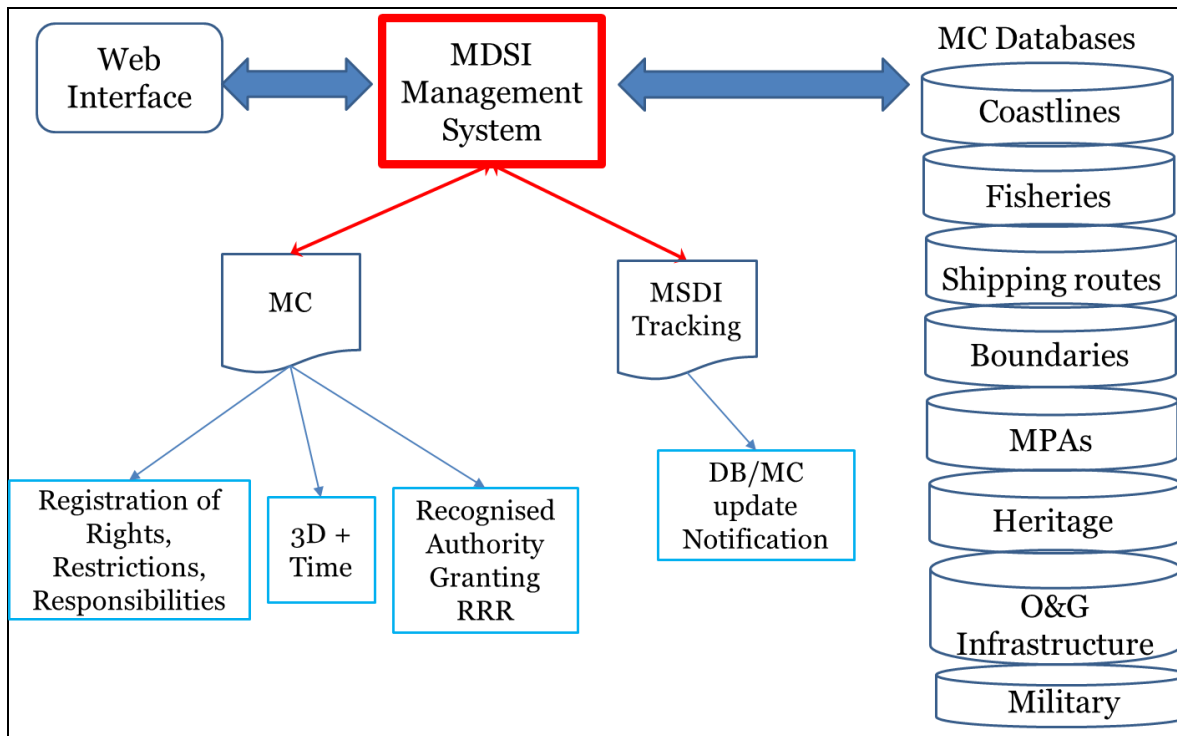
Figure 3: Marine Cadastre Schematic

Conclusions and Recommendations

This paper has attempted to address many of the issues that surround the implementation of a Marine Cadastre within the Marine Spatial Data Infrastructure Framework (MSDI). A MSDI needs to be fully supported from senior government.   Although a MSDI is not just for hydrography and involves interaction and cooperation across agencies, there is merit whereby a national charting agency could be the MSDI Manager and whether all MSDI data should be S-100 compliant. In the case of a Marine Cadastre there is the question of whether the Marine Cadastre ought to be a component of the MSDI and thus be the official registry of rights, responsibilities and restrictions placed on multi-dimensional geospatial interests. Of particular importance is if the web viewing and management tracking system of the MSDI system. The tracking system is essential for automated rendering and distribution, including updating, of agency products. In this instance interagency collaboration will be essential. Such a web based function will

also dictate as to whom the MSDI serves. That is, does it become a generalized representation of information held within a geospatial database and thus serve the general public, or does it become more flexible and provide specific products and thus serving a specific scientific and complex power user.

In any and all of these situations it is the author's belief that access to information must be made easy. MSDI and Marine Cadastre data must be stored and based on ISO 19115 metadata standards. The data must be comprehensive, kept up-to-date, and relevant. Given the legal and political aspects requiring the data be managed by the proper authority, is it practical for an HO to take over that responsibility? Will then, the HO become the registrar for Marine Cadastre information? With data stored in S-100, and with the rights, restrictions and responsibilities stored in the MSDI, can that be considered the "registry" for the Marine Cadastre?

References

M'Bala J. (2016). *A Marine Cadastre for Canada*. Surveyor General Branch Presentation at ACLS AGM 2016. Edmonton AB.

David Dodd, John Conyon and Jose M'Bala (2016). *Marine Cadastre Information as Part of a Functioning MSDI,* Canadian Hydrographic Conference, Halifax, Nova Scotia, 2016.