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The Integration of Land and Marine Spatial Data Set As Part of Indonesian Spatial Data Infrastructure Development

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** Prepared by M. Arief Syafi'I, Centre for Marine Base Mapping and Aeronautical Charting, BAKOSURTANAL.

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As Part of Indonesian Spatial Data Infrastructure Development

M. Arief Syafi'i

Centre for Marine Base Mapping and Aeronautical Charting
National Coordination Agency for Surveys and Mapping
(BAKOSURTANAL)
http://www.bakosurtanal.go.id
email: arief@bakosurtanal.go.id

Introduction

Indonesia is an archipelagic country with about 17,548 islands and has more than 100 km length of coastline, the second longest coastline in the world after Canada. The total area of Indonesia is over 5.3 million square kilometers, where 63.7% of its area consists of water. The population of Indonesia is about 220 million. Twenty two percent (22%) of the population are living in the coast and rely on marine activities for their living sources, especially at coastal area which occupy about 80% of the activities.

In the last 2 years, several natural disaster hit some part of coastal area in Indonesia, causing hundreds thousands of peoples lost their lives, while those who survived had lost their properties. A devastating earthquake and tsunami hit Aceh and its surrounding area in December 2004, followed by Nias Earthquake in March 2005. The last earthquake and tsunami hit southern coast of Java Island in May 2006, causing more than 300 peoples died and thousands of the survivors lost their properties.

Learning from such kind of natural disasters, it is important to have a tsunami early warning system as well as an accurate and complete spatial information system of coastal area for tsunami modeling purposes and determine the evacuation routes. Moreover, such kind of database and information system is required to analyze and build a protection system of tsunami in the coastal area of Indonesia.

Sustainable development of Indonesia also requires the availability of spatial information throughout the country both land and marine area, that can easily be accessed for public. An accurate, complete and up-to-dated information is important for better development planning.

A national spatial data infrastructure of Indonesia is one solution to provide users with an integrated and comprehensive spatial information that can be found and accessed easily.

ISDI Development at a glance.

The development of National Spatial Data Infrastructure in Indonesia has been implemented since it is recommended by the National Coordination Meeting on Surveys and Mapping (Rakornas Surta) in 2000. Bakosurtanal is the coordinating agency for the development of Indonesian NSDI. The development covers 5 aspects of an NSDI:

- Institutional aspects,
- Legal aspects,
- Fundamental data set aspects,

- Technology research and development,
- Human resources aspects.

The complete report on the development of Indonesian NSDI is can be found on the country report of Indonesia.

Spatial Data Integration Issues

Spatial data integration is an interesting issue, especially for Indonesian case which is consists of thousands of islands. The integration should be carried out for both land and marine spatial data to build a seamless spatial data management throughout Indonesia. The integration of land and marine spatial data set is important since the seawater play role as a bridge connecting islands of Indonesia Archipelago and living sources for many people.

Sustainable development as mentioned in the national development program also requires the availability of an integrated spatial information system which provides built and natural environmental dataset that is available to public access. For this reason, Indonesia is also developing a national spatial information system as part of NSDI development program.
The spatial data integration at institutional or local level has been achieved to some degree. However, at national level, the integration of spatial data encounter several problems either technical or non-technical issues. The non-technical issues are the most difficult problems to overcome.

Technical Issues

Spatial data may come from various sources or data provider. Each data provider has its policies and ways on managing spatial data. The following are several technical issues that should be taken into consideration when merging spatial data from various data sources:

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- Differences in spatial reference system (horizontal datum, vertical datum, coordinate system).
- Differences in storage format.
- Differences in scale of data source (map scale).
- Differences in feature or object definition.
- Differences in spatial data quality due to the differences of resolution or data acquisition method.
- The differences in spatial data modeling (geometry, features name, attributes, field type, topology, etc)

The following table shows an example of the differences on several aspects of two main data sources that should be considered when integrating land and marine spatial data:

No	Items	Topographic Map (Bakosurtanal)	Nautical Chart (Hydrographic Office)
1	Coastline	Taken from aerial photograph (the meeting line of land and water at time of exposure)	High tide water level
2	Horizontal Datum	- Indonesian Datum 1974 (for map published prior to 1996) - WGS 84 (for map published from 1996 on)	- Bessel 1841 - WGS 84 (recent publication)

3	Vertical Datum	- Mean Sea Level (MSL) for land elevations. - no depth information.	- Mean Sea Level (MSL) for land elevations. - Chart Datum for depth information (e.g. Low tide water level).
4	Projection system	Universal Transverse Mercator (UTM).	Mercator
5	Digital Storage Format	Various format (DWG, ARC, SHP)	S57 files
6	Scale	Sistematically (1 to 10K, 25K, 50K, 100K, 250K).	Not Sistematically (range from large scale to small scale)

In technical point of view, the lack of spatial data standard that is implemented at national level is suspected to be the main problem of the above differences. Each institution or organization creates spatial data for their own purposes using their own technical specification without considering that the data may be shared or distributed to larger communities. The implementation of spatial standard at national level will assure that every institution and organization create spatial data in the same manner and it will ease the integration of spatial data from various sources as well as spatial data sharing and exchange. The adoption of ISO 19000 series or existing internationally accepted standard could be considered to accelerate the implementation of spatial standard at national level.

At certain level, the differences of spatial data that come from different sources could not be avoided. There are several communities that use the spatial data for different applications using different specifications. For instance, nautical chart that is used for safe navigation, uses chart datum (low water level) as depth reference level. Meanwhile, to show an integration of land and marine in coastal area, the depth information should be referenced to the same level to land elevation reference level (usually mean sea level). However, conversion from one system to another could be easily done as long as the required conversion factors or corrections are well documented. Fortunately, the emerging GIS software and technology has most of the required tools to convert one system to another as well as integrating spatial data from different sources.

Non-Technical Issues

Apart from the technical issues, there are several non-technical issues that should be overcome to integrate multi-sources spatial data. This problem occurs not only in Indonesia but it is believed that this problem happens in most countries all over the world. The following are several non-technical problems:

- Each institution or organization has different policies and rules on managing spatial data.
- Most of the data are still in hardcopy format or stored using formats that are not compatible for data sharing or exchange as well as integration.
- Each institution or organization has different understanding and knowledge about NSDI. More information and socialization about NSDI are required to have a better understanding.
- There is no regulation has been implemented to enforce that all spatial data providers should involve in and contribute to the development of NSDI. Such kind of regulation is still in the draft version and being processed by ministry of law.

- Most of spatial data providers do not publish enough information (spatial metadata) to enable users finding the spatial data easily.

However, it is believed that the above non-technical problems can be overcome by intents coordination and meet at regular basis.

Current Status of Spatial Data Integration in Indonesia

One objective of an NSDI is to facilitate users on finding, evaluating, accessing or obtaining spatial data to meet their requirements. An integrated spatial information would provide a comprehensive presentation of an area of interest. As the spatial data that represent a comprehensive information may come from various sources, the integration of spatial data is become very important. The NSDI can facilitate such kind of integration by implementing a set of standards, rules and technologies.

Indonesia, c.q. Bakosurtanal has conducting several spatial data integration project to build a seamless spatial data throughout Indonesia, stored in a database management system. There are two main integration activities:

- The integration of Indonesian topographic map series of scale 1 to 25K, 50K and 250K (published by Bakosurtanal). Each map series is stored in different schema of database.
- The integration of Indonesian coastal map of 1 to 50K scale (published by Bakosurtanal) that contain both land and marine information of the coastal area.

The above spatial databases use Oracle 9i with Spatial Data Option as the database engine, and have the following characteristics:

- *Seamless*, the spatial is stored continuously throughout Indonesia (not on map sheet basis).
- *Multi-purposes*, the same data can be used for different purposes.
- *Multi-users*, the same data can be accessed by different user concurrently.
- *Interoperable*, the data stored in the database can be accessed using different GIS software and applications.

The following diagram shows in general how the spatial database system works.

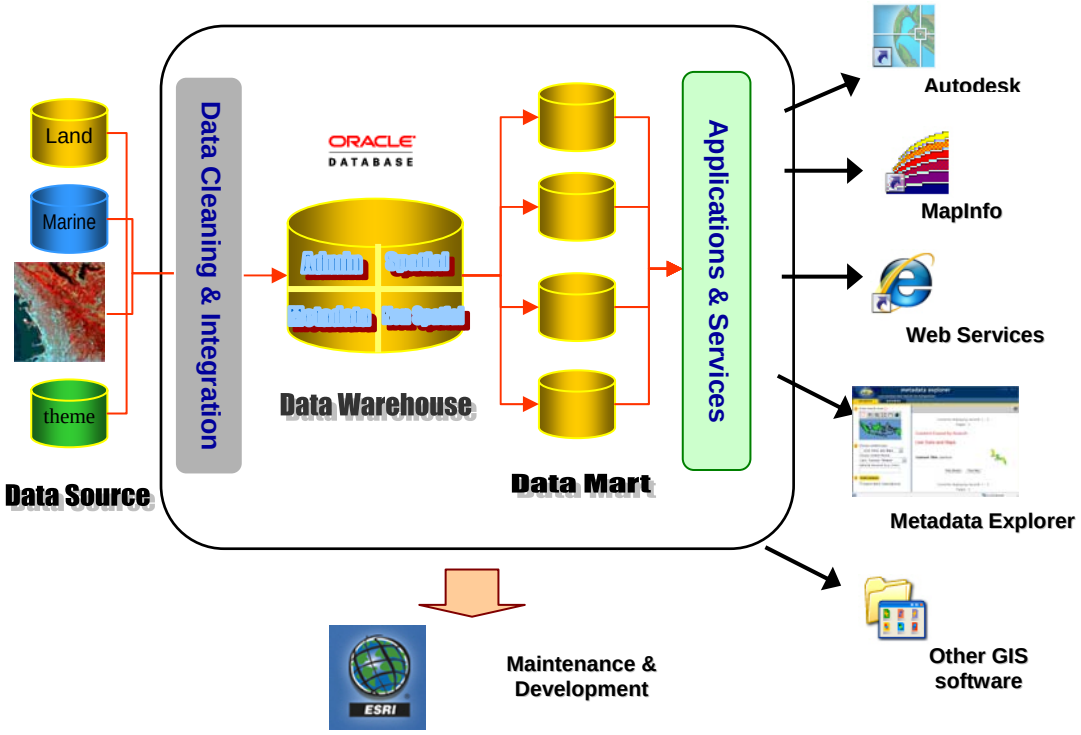

Fig 1. Spatial data warehouse architecture of Bakosutanal.

From year to year, more institution and organization who own spatial data in Indonesia realized that the integration of spatial data is very important and may benefit their own organization. For this reason, more organizations involved in the development of NSDI either at national or regional level as nodes to build inter-connected SDI. They also realize that spatial standard should be implemented at national level as soon as possible. It also required to encourage all spatial data providers to open their data for public access either on free or commercial basis.

Conclusion

Many institutions and organizations create and manage various spatial data in Indonesia. At present, each spatial data providers uses their own way on managing the spatial data, behave like islands of information that is not connected each other. Integration of these islands of information is very important to build an integrated and comprehensive spatial information system that covers the whole area of Indonesia. Efforts have been made by the Government of Indonesia by developing a national spatial data infrastructure (NSDI) and the progress is moving forward. More spatial data providers at national and regional level are joining the development of Indonesian NSDI to provide users with easy access to spatial data they need.

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