Issues and Challenges in Managing Malaysia's Marine Spatial Information Sharing

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Abstract The integration between marine information management with the current marine management system is important for a sustainable marine management?. It will balance the impact of environmental, social and economic of marine ecosystem. In Malaysia, the management of marine area has been autonomous, heterogeneous and distributed scattered between each agencies, resulting in isolated marine spatial information. An interview to Malaysia's marine related organization was carried to 1) identify current practice in implementing GIS, 2) identify the cooperation related to information system management inside the organization and 3) obtain the views of cooperation between units, departments and related organizations, in order to improve the existing information system.. Result indicates the need for close cooperation within the organization and collaboration between organizations to integrate marine spatial information. The integrated marine information management will enable accurate and precise decision making taking into consideration the environmental, social and economic impact. Ultimately, it will bring unity in the diverse communities that involved in marine management.

1 INTRODUCTION

Marine and coastal areas are complex in terms of biodiversity and highly dynamic, and consist of high marine resources, social interaction, and produce high economic planning and development (C Thia-Eng 2003, Rajabifard, Binns et al. 2005). In order to balance conflict between marine resource use, habitat recovery, and area development (Saharuddin 2001), sustainable, holistic and informed governance structure is needed (Nichols 2000, Rajabifard, Binns et al. 2005). Figure 1 shows the demands for coastal and marine resources including military users, recreation, nature and conservation, fisheries and aquaculture, waste disposal pollution control, shipping and navigation, mineral energy extraction, engineering work, agriculture, and coastal industry or settlements. In fulfilling the demands, several initiatives have been developed, including Integrated Coastal Zone Management, Integrated Shoreline Management Plan, Marine Protected Area, Marine Spatial Planning, Ecosystem Based Management, Marine Cadaster, Marine Spatial Data Infrastructure, and Marine Risk Management (Robertson 1999, Andrew Binns, Lisa Strain et al. 2005, Strain, Rajabifard et al. 2006, Ehler C 2007, Jentoft, van Son et al. 2007, Douvere 2008, Campbell 2009, Fletcher, Shaw et al. 2010, Wheeler and Peterson 2010, Liu, Wu et al. 2011)

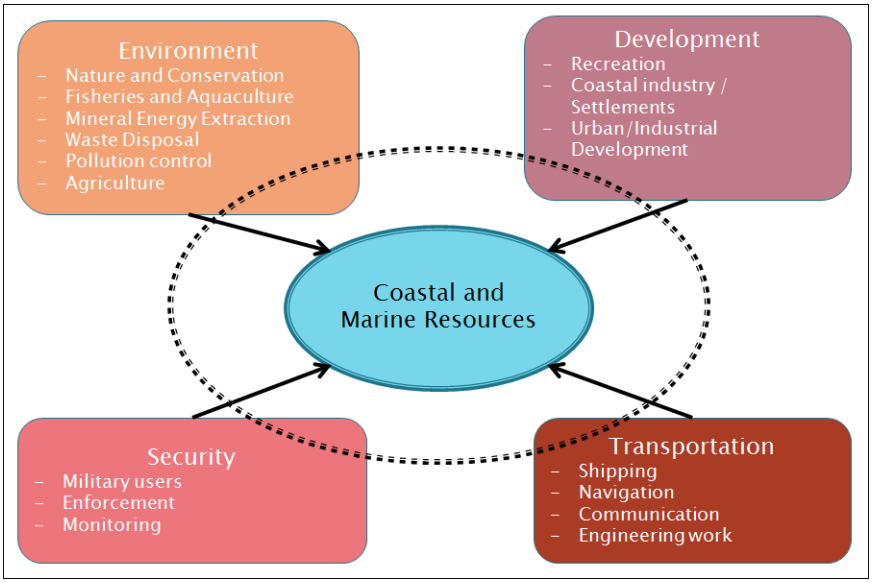

Figure 1: Various activities in marine environment (adapted from (Boateng 2006))

With isolation development in marine spatial information management, it has create an awareness for better marine spatial information. Marine spatial information is important in managing marine area, (Meiner 2011), figure 2 show the important balance of environmental resource management, planning

and control, marine and coastal commercialization and social jurisdiction claims and participation in marine and coastal management for sustainable marine management.

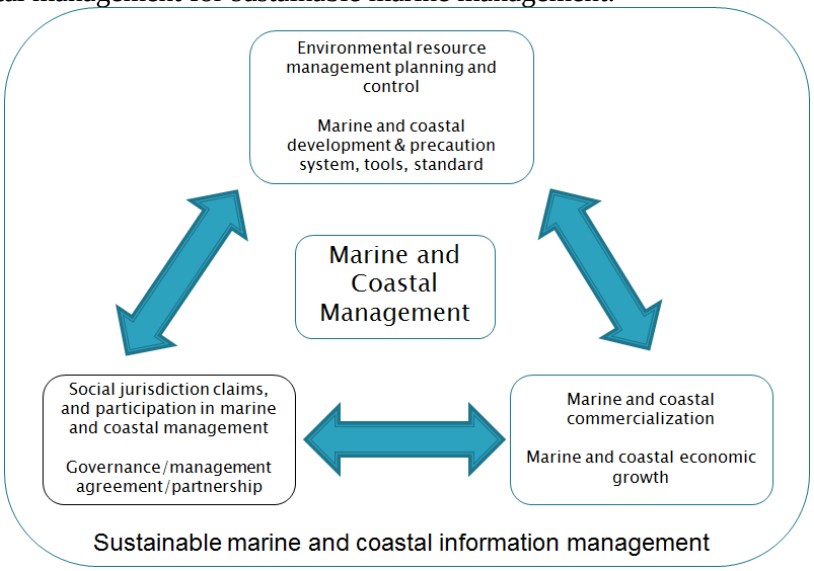

Figure 2: A sustainable marine and coastal spatial information management need the integration between environmental, economic and social aspects.

This paper will discuss issues in managing marine spatial information in Malaysia, within the pretext of the current practice in spatial information management in Malaysia, and the importance of collaboration and integration between marine and coastal organizations to improve marine spatial information management.

2 MALAYSIA'S MARINE MANAGEMENT

Malaysia is a country covered with coastal and marine area, and being managed by national, state and local organization. Table 1 show the Malaysia's marine and coastal areas. This area has been managed and sustain with various department and agencies all around Malaysia including government, private and education organizations. Table 2 show the Malaysia's national marine organizations.

Table 1: Malaysia maritime areas (adapted from (CheeHai Teo and Fauzi 2006), (Saharuddin 2001))

Malaysia Maritime Areas	**Area**
Total Land area	332,800 km²
Maritime areas	
- Exclusive Economic Zone	475,600 km²
- Malaysia's Territorial Waters	148,307 km²
- Total	623,907 km²
State Jurisdiction	
- Peninsular Malaysia	17950 km²
- East Malaysia	20250 km²
Federal Jurisdiction	
- Peninsular Malaysia	38800 km²
- East Malaysia	20300 km²
Length of Coastline	
- Peninsular Malaysia	1737 km
- East Malaysia	2753 km

Table 2: Malaysia's National Marine Department/Agencies (Adapted from (Saharuddin 2001, MoA 2013, MOSTI 2013, MoT 2013, NRE 2013))

Ministry	**Department/agencies**	**Division/Councils**

Ministry of Transport	Marine Department of Malaysia Penang Port Commission Port Authority of Johor Port Klang Authority Malacca Port Authority Port Kuantan/Kemaman Bintulu Port Authority Maritime Institute of Malaysia	National Shipping Council
Ministry of Agriculture and Agro-Based Industry	Department of Fisheries Fisheries Development Authority of Malaysia (LKIM)	National Advisory Council for Marine Park and Marine Reserve
Prime Minister's Department	Economic Planning Unit National Maritime Council Maritime Enforcement and Coordinating Centre Malaysia Maritime Enforcement Agency	National Petroleum Advisory Council
Ministry of Education		Universiti Teknologi Malaysia Universiti Malaysia Terengganu Universiti Malaysia Sabah Universiti Putra Malaysia Universiti Kebangsaan Malaysia Ungku Omar Polytechnic
Ministry of Culture, Arts and Tourism	Malaysia Tourism Board	
Ministry of Foreign Affairs	Economic Division Policy and Planning Division	Maritime Affairs Units
Attorney General's Chamber		Advisory and International Division
Ministry of Finance	Internal Tax Division	Secretariat for Cabinet Committee on Trade and Service
Ministry of Science and Technology	National Oceanographic Directorate (NOD) Malaysia Remote Sensing Agency (ARSM) Malaysian Meteorological Department Department of Standard Malaysia (STANDARDS MALAYSIA)	National Oil Spill Control Committee
Ministry of Defence	Royal Malaysian Navy Hydrographic National Center	
Ministry of Home Affairs	Royal Malaysian Police	Marine Unit
Ministry of Natural Resources and Environment	Department of Survey and Mapping Malaysia Department of Director General of Lands and Mines Department of Marine Park Malaysia Department of Environment Department of Irrigation and Drainage National Hydraulic Research Institute Research Institute of Malaysia (NAHRIM)	
Ministry of International Trade and Industry		Malaysian National Shipper's Council

3 DATA COLLECTION AND ANALYSIS

The methodology for this research is qualitative method field survey case study, whereas case study is the precise description or reconstruction of a case (Flick 2009). Respondents consist of eleven organizations, using semi-structured interview with one or more personnel for each organization. The qualitative method used to obtain in-depth information on current practise, issues and challenges in implementing GIS and spatial data sharing in the organization. The objective of qualitative research is; 1) to identify the current practice in storing and managing spatial information in the organization, 2) to

identify the cooperation related to information system management inside the organization and 3) to observe the level of cooperation between units, departments and organizations related., All the information above is considered crucial to improve the current information system in the future.

Multiple case studies analysis has been adapted in this research (Figure 3). The information from each respondent is analysed using the combination of thematic and SWOT analysis. The thematic analysis is used to obtain list of issues for theme and sub-theme. To help analyzing the data, Atlas.ti software has been used to record and code the data into sub-theme and main themes. Subsequently, the information being analysed with SWOT analysis to differentiate between the internal and external factor that affects the GIS implementation and spatial data sharing within and between organizations.

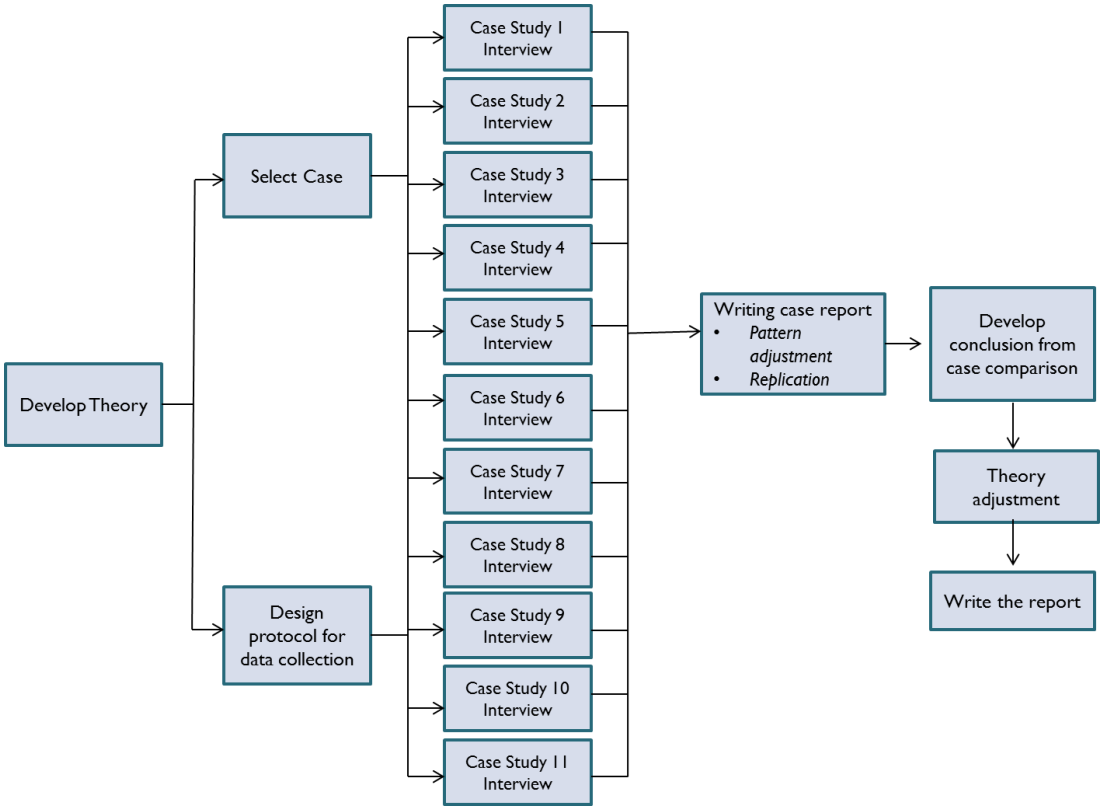

Figure 3: Schematic diagram for multiple case studies

4 RESULT AND DISCUSSION

From the thematic analysis, four main themes have been listed; technologies and access network, data and standard, policy and legal, and institutional issues. Issues from each theme then divided into internal strength and weakness, and external opportunities and threat.

Internal Strength and Weakness

The strength from technologies and network issues are; each organization has their own information system for management. These information systems have integration with Geographic Information System (GIS) with different level of integration, some with advance integration, some only small integration. The GIS hardware and software specification also vary for each organization. Most of the organizations have advance GIS hardware and software specification, and others have lower specifications. From the data and standard issues, the strength are most of the organization has main fundamental data including topographic, bathymetry and nautical chart. Other strength is each organization has the geospatial data, with different level of usage, some organization has catalogue to manage spatial data, and some of organizations collected, stored, inventory and have data analysis in-house.

The weakness from technological issues is; some organization has not enough hardware and also obsolete hardware for GIS. For the data issues, some organizations have data error, including human error in data entry. Other issues are insufficient data for internal use, data are not validated and data did not follow the standard. The institutional issues are the information and work flow didn't integrated in the organization, there are hidden information between units/division, personnel in-charge of GIS being change, didn't have enough knowledge of GIS, and not enough personnel to handle GIS. Besides that, most of the respondents didn't have knowledge about spatial data sharing activities in that has been implemented in Malaysia.

External Opportunity and Threat

The opportunity from the technologies issues is some organization has already begun the spatial information exchange with other organizations, with formal and informal cooperation with each other. Some of the organizations also collaborate in MyGDI (Malaysia Geospatial Data Infrastructure); some organizations have followed the data standard. Besides that, some of personnel in the organizations have knowledge on spatial information sharing.

The threat in enabling spatial information sharing, in data issues are data security, ownership, availability and redundancy. The institutional threats are cross organization non integration, short term cooperation between organizations, insufficient planning on information collection and management, and bureaucracy issues that leads to refusal in sharing information to other organizations.

Table 3: Summary of SWOT Analysis

Issues	**Strength**	**Weakness**	**Opportunity**	**Threats**
Technologies/ Access Network	• Have information system inside the organization • Have integration with GIS	• Hardware not enough • The database not centralized, no connection with each other • Old hardware	• Need more integration from current information with GIS	
Data/Standard	• Organization collect GIS data in-house • Data enough for current purpose • Have GIS data • Have GIS data catalogue	• GIS data not complete • Data not updated • Data have human error • Data in hardcopy form • Have different data format • Not fully integrated with GIS	• Data get from other organizations • Distributed data to other organizations • Data follow standard from MaCGDI	• Data Ownership • Data security • Data availability • Data redundancy
Institutional	• Have long term cooperation with other organizations • Have short term cooperation with other organizations	• Not enough personnel to handle GIS • Staff don't have enough GIS knowledge • Not familiar with technologies • Don't have integration with other units/divisions	• Have formal cooperation • Have informal cooperation • Need steering committee for GIS data sharing • Need proper planning • Need frequent meeting • Need awareness program for GIS data sharing	• Weak communication with other organizations • Don't have strong lead agency in marine spatial data sharing • Low in budget • Time constraint • Bureaucracy between organizations • No political will
Policy/Legal	• Have good communication within organizations		• Need formal cooperation between organizations • Need to compliment with OSA	• Information protection

Improving Malaysia's Marine Spatial Information Sharing

Based on the qualitative analysis that has been done, to enable spatial data sharing, an improvement is needed in enhancing GIS strategies, cooperation in the organization and collaboration between organizations (figure 4). Spatial information sharing enablement will facilitate organization in planning and development for their data collection, maintenance, analysis and distribution. This will also reduce the

data redundancy, increase accuracy, expedite analysis and improve decision making speed and accuracy.

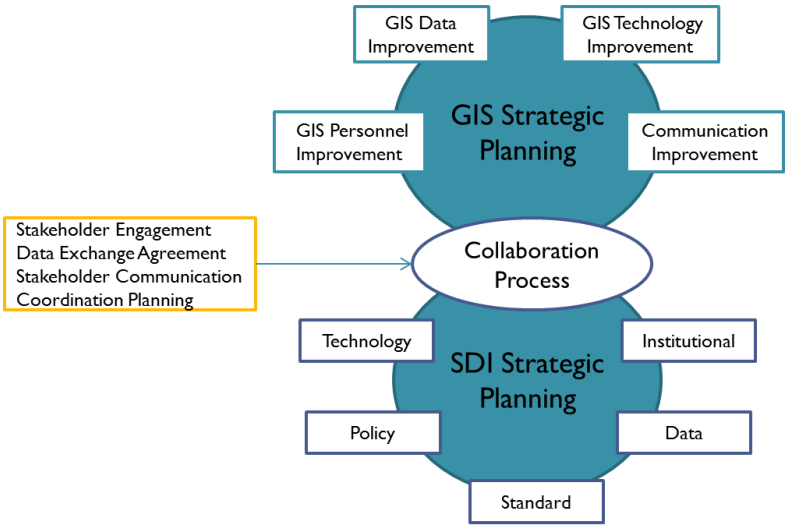

Figure 4: Improvement framework in enabling spatial information sharing for marine environment

Enhancing GIS Strategies

To improve marine spatial information sharing, firstly, the organization need to have proper GIS strategic planning. The planning should include top management awareness on the importance of GIS in marine management. Improved top management awareness will facilitate organization on GIS planning and implementation. Besides that, the improvement of GIS personnel, including GIS knowledge improvement, GIS skill and experience on using GIS for different purposes. GIS personnel are important to facilitate top management for GIS planning and implementation to facilitate in bottom up approach.. Furthermore, GIS personnel can improve the implementation of GIS data standardization, cataloguing and metadata.

For GIS data improvement, firstly, the fundamental data for marine area need to be standardized, either topographic, bathymetry or nautical chart. With standard fundamental data, the integration with other data is possible and easier. On top of that, the GIS data need to have the standard, catalogue and metadata. For GIS technology improvement, the software and hardware must be scalable to view the GIS data. Additionally, the networks such as intranet or internet with high security need to be established. Communication in the organization need to be improved, to enable proper instruction, improve data exchange within the organization, and improve system planning, development and implementation.

Improving Cooperation

One of the important aspects in enabling marine spatial information sharing is the cooperation within and between organizations. The cooperation within the organization including cooperation between units/divisions will help in planning and developing the big picture of marine spatial information. An enhanced cooperation between units/divisions, the GIS development can be integrated with the scope of work every units, improving spatial information specification from unified unit/divisions requirement, and it will facilitate the organization business process as a whole.

Collaboration with other organization will bring bigger benefit, such as improvement in communication and understanding of each organization, and how to improve the spatial information as a whole. This also improves the spatial information validation and verification. The collaboration process need to include stakeholder engagement, data exchange agreement, communication between stakeholder and coordination planning and implementation. A good collaboration between marine organizations

will improve not only spatial information sharing, but the decision making, risk management, marine and coastal planning and development for better sustainability.
Practice by Malaysia Centre of Geospatial Data Infrastructure (MaCGDI) can be implemented with some enhancement and integration to include marine spatial information as one of the important information in MyGDI.

6 CONCLUSION

With rapid development around coastal and marine area, good marine and coastal spatial information are needed for marine area planning, development and sustainability. With marine spatial information, an integration of marine spatial information will improve planning and development of marine area, resulting better contribution to economic, environment and social. Cooperation within the organization and collaboration between organizations will facilitate and improve marine spatial information sharing, which will lead to sustainable planning and development.
Future research will focus on the framework for marine spatial information sharing, including infrastructure for institutional cooperation, information management, network services, information sharing standard and policy enhancement. It is important to evaluate the current practice on information sharing to adapt marine spatial information sharing to the current management and improve marine management.

Acknowledgement
Our utmost gratitude to the Geospatial Information Science Research Group (GISRC), Universiti Putra Malaysia (UPM), Malaysian Centre for Geospatial Data Infrastructure (MaCGDI), and the anonymous reviewers of the earlier related topic of this paper for their encouragements, comments and suggestions.

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