The use of GIS with regard to Marine Spatial Planning from a Safety of Navigation perspective

# General

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. A GIS can be thought of as a system: it digitally creates and "manipulates" spatial areas that may be jurisdictional, purpose, or application-oriented. GIS Applications are tools that allow users to create interactive queries (user-created searches), analyse spatial information, edit data in maps, and present the results of all these operations[[1]](#footnote-1). GIS is considered to be an essential tool for MSP.

# Considerations for the MSP Process

Note: Include some words from the MSP from Mike Hadley

## Aspects to consider for a methodology for an MSP Process

MSP is a step-by-step approach and should be inclusive of all relevant stakeholders from the very beginning of the process and take into account their various interests. It should also be iterative, always seeking to improve and refine. GIS plays an important and essential part of these processes.

The following paragraphs describe the minimum criteria that should be considered when developing GIS.

### Identification/description areas

* Vessel Traffic Separation Schemes (VTSSs)
* Deep Water Routes (DWRs)
* Anchorage areas
* Shallow waters
* Offshore structures (oil, gas) (incl. safety zones)
* Fish farms
* Windmill farms (incl. safety zones)
* Areas to be avoided (sensitive environment)
* Pipelines
* Communication and power cabling
* Restricted areas for certain activities

### Traffic

* Intensity
  + Mid-term traffic data (5 years) previous period
    - Trends
    - Growth etc.
* Diversity
  + Participants
    - Professional, non-professional (skills)
    - Merchant, Fishery, Pleasure, Ferries, Dredging etc.
* Scale enlargement
  + Maneuverability types of vessels
  + Needed space and Under Keel Clearance for maneuvering
* Mandatory, non-mandatory, expected on-board equipment

### Actual situation maneuverable space

* Detailed overview and full description of the use of the marine space
* Accurate mapping overall area and specific areas
* Specific areas
* Routing systems
* Offshore activities
* Up-to-date and accessible databases
* Recognizable Competent Authority/Authorities

### Identification present risk areas

* Incidents / Accidents
  + past mid-term figures (3-5 years)
    - type of incidents / accidents
    - causes
    - Types of vessels involved
    - nationality/flag of vessels involved
    - damages / losses
* Operational registrations
* Enforcement protocols
* Verdicts/decisions National Board of Transport Safety
  + - Validations
    - Conclusions
    - Proposed measures for improvement

### Identification/description service provision

* Detailed regional and local overview and description of the available (shore based) infrastructure and provided services
* Supporting **vessel traffic management instruments**, such as
  + Position, Navigation & Timing
  + Communications
  + Information provision, including MSI
  + Pilotage
  + **Aids to Navigation**
    - VTS
      * Areas responsibility and attention,
      * Coverage Radar, Communications
      * Provision INS, NAS, TOS
    - Maritime Buoyage System
    - Other marking (e.g. Racon, AIS, Lights)
    - Safety areas
    - Navigation related services provided (functional and technical)
    - Allied services (tugs, linesman etc.)
    - Incident/accident organizations (SAR)
* Transparency responsibilities and liabilities

### Identification short term measurements

Consequences: for each and every aspect

* Identification additional measures, potential solutions and services. In most cases **reactive**, such as:
  + Modification of existing routing
  + Modification of Marking
  + Additional provision of information
  + **GAP**-analysis (functional and technical)
  + What do we have?
  + What do we need?

NB: Use where appropriate 7-Pillar methodology (as for e-Navigation)

* + **RESULT**-analysis
  + What is the impact on
    - Legislation, regulations
    - Responsibilities
    - Organization(s)
    - Processes
    - Infrastructure (ashore, offshore)
    - Equipment (on board)
    - Human/Machine Interface
    - Training
  + **COST/BENEFIT**-Analysis
* Check national, regional, international policies
* Check national, regional, international legislation, regulations, guidelines
* Check decision and approval process, e.g. IMO

### Identification developments traffic and planned utilization of space

* Outlook
  + Mid-term expectations ( > 10 years)
  + Long-term expectations (> 20 years+)
  + Developments in shipping (all areas, trends, growth)
  + Growth expectations of ports
  + Evolvements of types of goods, transport of persons
  + Offshore developments
* Development **Vision** (*“What will be the picture then?”* )
  + Mid-term ( > 10 years)
    - Long-term (> 20 years+)
  + Tune where appropriate plans and Vision with neighboring administrations and Competent Authorities

### Identification future risk areas

* Risk Analyses
  + Use proven risk models, e.g. IWRAP/PAWSA, SAMSON and any additional instrument if needed
  + Use, where appropriate, a Route Topology Model

### Identification mid -and long-term measurements

Consequences: for each and every aspect

* Identification additional measures, potential solutions and services. On most cases **proactive**, such as
* Establishment/restructuring routing systems
* Establishment/restructuring MBS
* Additional/replacement infrastructure/systems (enhanced services, enlargement coverage)
* New concept of services based on user needs
* Enlargement areas of responsibility/attention,   
  e.g. VTS (beyond territorial waters), sea traffic management)
  + GAP-analysis (functional and technical)
  + What do we have?
  + What do we need?

NB: Use where appropriate 7-Pillar methodology (as for E-Navigation)

* + RESULT-analysis
  + What is the impact on
    - Legislation, regulations
    - Responsibilities
    - Organization(s)
    - Processes
    - Infrastructure (ashore, offshore)
    - Equipment (on board)
    - Human/Machine Interface
    - Training
  + COST/BENEFIT-Analysis
* Check national and regional policies
* Check national, regional, international legislation, regulations
* Check decision and approval process, e.g. IMO

# GIS Components

GIS layers maybe categorised into the following:

* General
* Present
* Future
* Variable Constraints
* Test Beds

Further details of the above categorisation is presented in Annex ???.

## Specific considerations

### Layer Properties

Layer properties should include easily understood information about the data presented to the user (for instance a legend) otherwise the information presented is useless.

### Sources of data and information for the GIS

The sources of information to be displayed on GIS are almost limitless; however, these should be presented to the GIS in a consistent and agreed manner.

### Metadata

Metadata can be described as “data about data.” It is important that metadata attributes are easily accessible and well defined. Metadata should be designed in order that the information is easily exchanged and presented consistently.

#### Maintenance of metadata

Data can consist of fixed or variable data. It is essential that these data are updated at regular frequencies. Data must be continually validated for currency, quality and accuracy. It is incumbent on the owner of the data source to ensure that the data is current and reliable.

#### GIS Data and the S-100 Registry

It is recommended that GIS data and their relevant product specifications are incorporated into the S-100 registry. IALA may consider co-ordinating the input into the relevant S-100 domain.

# Web-based viewer

A web-based GIS viewer is a simplified way to present geospatial information to non-specialist parties in a pre-defined structure. Web-based viewers are “read only” and the viewer cannot interact/change the GIS programme or parameters.

# Training

GIS systems are complex and as such, authorities should consider training programmes for personnel working with GIS. Hands on experience and current use are essential to maintain skill levels and get the most from GIS systems.

# Transparency

The process of MSP planning should be transparent and accessible to all stakeholders. This could include open access to GIS systems or web-based viewers.

# Conclusion and Recommendations

GIS is an essential tool for MSP.

Recommendations:

* Training
* Stakeholder engagement and information
* Transparency

Annex A – Categorisation of GIS layers for MSP

**General**

Relevant Sea area

* Overview of the Sea area with borderlines
* Parts of Continental Shelves
* 12 miles zones
* EEZ
* Traffic separation schemes (TSS)
* Deep Water Routes (DW)
* Ferry and RoRo lines (routes)
* Ports (geographic locations)

**Present**

* **Infrastructure and Operations**
  + VTS centers
  + VTS coverage
  + VTS areas of responsibility
  + VTS areas of attention
  + VHF coverage
  + Radar coverage
  + AIS base stations + coverage (shore- & offshore based)
  + DGNSS stations + coverage (shore- & offshore based), incl. accuracy DGPS IALA beacons, RTK stations where available, AIS stations providing message type 17
  + Terrestrial Loran stations plus coverage ( incl. accuracy)
  + d-Loran stations plus coverage, incl. accuracy
  + R-Mode, incl. accuracy
  + Coastguard Centers (MRCC/JRCC)
  + SAR areas
  + NAV areas
  + A1 + A2 + A3 areas for GMDSS
  + Stations providing Maritime Safety Information (MSI) + coverage
* **Offshore Constructions (present)**
  + Existing oil and gas platforms, inclusive safety areas
  + Existing windmill farms
  + Existing pipelines and cables
  + Existing Remote ports
  + Fish farms
* **Present Specific Areas**
  + Environmental protected areas
  + Anchorage areas
  + Military Practice areas
  + Dumping areas
  + Economical interest areas (Oil and Gas fields)
  + All other restricted areas relevant for accessibility and/or safety
* **Present Traffic** 
  + Density of present traffic (AIS and additional sources) on a year-to-year basis
  + Density of present traffic (Route Topology Model)
  + Density maps (varieties of types of ships)
  + Overall density map including general total of ship movements
  + Density maps cargo flows
  + Ports (incl. figures of incoming/outgoing traffic)
  + Ports and intermodality streams
  + Pleasure craft concentration areas
  + Main Fishing areas
* **Accidents**
  + Accidents and incidents
  + Accidents, distinguish types of accident and incidents
    - Collision
    - Grounding
    - Fire
    - Loss of cargo
    - Human factors
    - Reported near misses
    - Pollution
    - Types of vessels involved in accidents
  + Accidents and depth contours
  + Accidents and wind farms, oil platforms
* **Dangerous areas and hot spots**
  + Indication of present “dangerous areas”
  + Indication based on Route Topology Model

**Future**

* **Offshore constructions**
  + Foreseen oil and gas platforms inclusive foreseen safety areas
  + Foreseen windmill farms
  + Foreseen pipelines and cables
  + Foreseen remote ports
  + Foreseen fish farms
  + Foreseen Marine Spatial Planning plans/policies of country or ports
  + (Planned, under investigation or foreseen)
* **Future Traffic**
  + Density predictions
  + Density and limited space (oil platforms, wind farms, restricted areas etc.)
  + Ports growth expectations
* **Foreseen dangerous areas and hot spots**
  + Indication of foreseen “dangerous areas” and “traffic hotspots” based on increase of variables

**Variable constraints**

* **Constraints on accessibility and velocity of traffic** 
  + Time constraints (symbols of tidal windows for seaports and presence of locks)
  + Restrictions mandatory pilot services for ports
  + Wind force and directions in certain periods of the year

**Testbeds**

This list may not be exhaustive and food for further discussion

1. Clarke, K. C., 1986. Advances in geographic information systems, computers, environment and urban systems, Vol. 10, pp. 175–184 [↑](#footnote-ref-1)