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Paper for Consideration by HSSC

E-navigation developments

Restructuring of the IHO GI Registry

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Executive Summary:	This paper presents an outline for a possible future redefinition and enhancement of the GI registry to facilitate IMO´s adoption of the S-100 framework as the basis of the Common Marine Data Structure CMDS for the e-Navigation project.
Related Documents:	Report of e-Navigation correspondence Group to IMO NAV59 Jonas, M. Oltmann, J-H.: IMO e-Navigation Implementation Strategy – Challenge for Data Modeling, TRANSNAV2013, Gdynia, Poland, June 2013
Related Projects:	Development of S-100 and related tasks.

1 Introduction / Background

One of the underpinning principles of IMO´s e-navigation concept is to develop an overarching consistent e-Navigation data model on all navigation aspects related to the shipping and maritime domain. This so-called Common Maritime Data Structure (CMDS) is intended to cover the following elements:

(1) the overarching architecture of e-Navigation and generalities,

(2) shipboard equipment used to support e-Navigation,

(3) Maritime Service Portfolios (MSPs),

(4) Communication technologies,

(5) Resilient PNT (position, navigation and time data), and

(6) Shore-based Infrastructure.

The developing IMO e-Nav concept already proposes that the CMDS should be built on the basis of the S-100 Framework of IHO.

2. Analysis / Discussion

The S-100 registry concept as it is applied to the existing IHO GI-registry is designed to host hydrographic geospatial information in terms of features, attributes, portrayal and, finally, product specifications. IMO´s e-navigation concept, however, embraces a much wider scope. In order to cover all of the aspects intended to be addressed by the CMDS, a redefinition of the registered categories and enhancement of register themes is suggested. It is hereby proposed that the present registry concept, based on S-100 and its existent infrastructure be enhanced to and transformed into a universal “Marine Information Registry”, still being based on the S-100 framework.

For the purpose of the e-navigation concept the following categories could then be used within the Marine Information Registry:

- **Feature** (Objects classes and Attributes)
- **Exchange** (data exchange)
- **Portrayal** (Visualization)
- **Interaction** (Human Element)
- **Metadata** (Data about data)

These qualities may be grouped together by calling them a Basic Register. *Interaction* is a new element which addresses ergonomic requirements such as menus, icons and software buttons.

To achieve this, an additional **Product Register** would reference the above Basic Register categories. The Product Register hosts Product Specifications. In contrast to the existing arrangements within the IHO GI Registry, the term "Product" would be enlarged in scope. "Product" in the new context would not be limited to data exchange formats but would cover more complex models for services and physical devices. There might be a need for a sub-structure according to the domain structure, taking in the characteristics of the products:

- **Services**
- **Devices**

In this context ECDIS would become a Product Specification for a device, assigned to the Product Register. The former objects hosted under Product Specifications within the existent GI-Registry, i.e. the IHO S-10x data exchange format family (including S-101 ENC) would move to "Exchange" of the Basic Register and become entities of domain "Basic Register/Exchange/Environment/Hydrography".

Widening the scope to cover all aspects of the e-navigation concept requires further substructures within the different categories, which would then be called *top-level domains*. Each of the above categories, except Metadata, could therefore be subdivided into the following *top-level domains:*

- **Environment**
- **Infrastructure**
- **Construct**
- **Operation**
- **Load**

It is assumed, that these five top-level domains can effectively cover all topics and themes related to marine activities. However, each of these top-level domains would need to be broken down into entities which are subject to structuring by means of registry entries according to the S-100 construct. The following listed entities of domains are potential examples for first entries; however, in accordance with the principal design of a register; these lists could expand if the scope of the modeling requires it:

- **Environment**
  Hydrography, Oceanography, Meteorology …
- **Infrastructure**
  waterways, harbour facilities, WWRNS, AIS, LRIT, communication systems (all relevant frequency bands), …
- **Construct**
  Vessel, floating unit, group of units, offshore installation, aircraft, …
- **Operation**
  Voyage, Crew, ISM, Pilotage, Security, VTS, MIS, SAR, …
- **Load**

Cargo, Passenger, Fuel, Waste, …

The listed entities could be split up further, by elements, for example:

- **Vessel**

  Navigation, Voyage, Engine, Facilities, Spare parts, …

The granularity and the resulting level of complexity of the final domain entities are essentially dependent on the specific requirements of the modeling. In overlapping areas harmonization of entities should happen under the authority of a recognized body nominated to maintain specific themes within the Marine Information Registry. A good example would be "Hydrography" which would of course be maintained by IHO; another one – "Oceanography" could be under IOC. Aids to Navigation and VTS services would most likely be maintained by IALA. And so forth. IMO has asserted its governance role over the e-navigation process at large, and therefore would need to co-ordinate the assignment of the themes to relevant organizations.[1]

Diagram 1 shows the structure of a future "Maritime Information Registry", based on S-100, by giving an example for the description of the entity "Vessel".

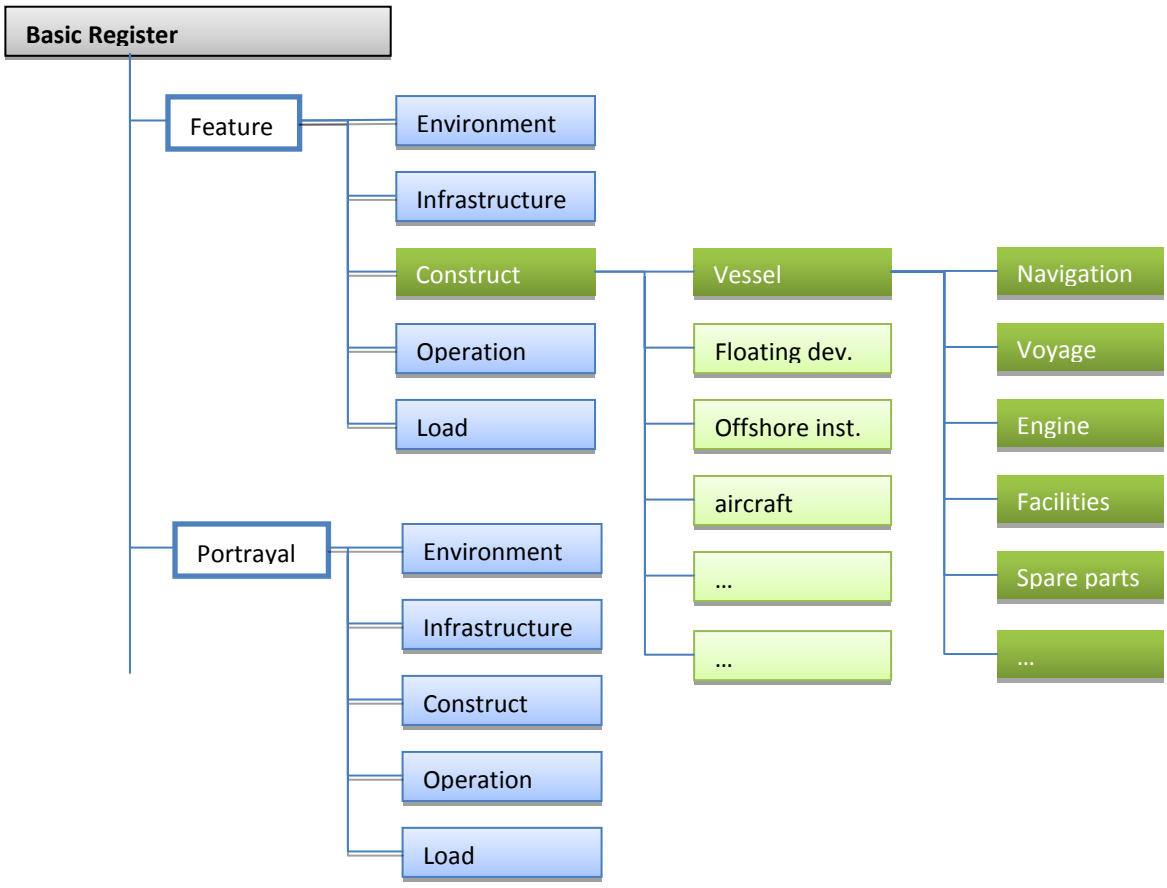

Figure 1: Example for part of the structure of the proposed future "Maritime Information Registry on the basis of S-100

[1] It should be noted, that IMO MSC has already established (but not activated) a dedicated group, the so called IMO/IHO Harmonization Group on Data Modelling (HGDM), to perform this task, amongst others. The HGDM is likely to be activated when the e-Navigation Strategic Implementation Plan (SIP) reaches maturity.

Basic Register Element: Metadata
The Metadata element would not have a specific domain structure. Instead, this element of the Basic Register would host a structured catalogue of metadata entries which can be combined with the particular entries under the different domains within the Basic Register.

Identifier
In seeking to provide a CMDS that potentially allows any element of the marine domain to be included, it becomes evident that avoidance of ambiguity and addressability of each of the elements is essential. It might therefore become necessary to introduce a system of unique identifiers at all levels of the Marine Information Registry which are ideally both human and machine readable. There is probably no need for a consistent system of identifiers across all domains. In order to adopt existing registers including their individual identifier arrangements, the following variable options could be applied as convenient to the particular domain/entity:

- alphanumerical, not meaningful
- alphanumerical, meaningful
- verbal (Camel-Case)

3. Conclusions
The ultimate goal of the e-navigation concept is to integrate ship borne and land based technology on a so far unseen level. The principal bridge between these two domains will, most likely, be broadband communication technology which is in increasing becoming available and affordable in commercial shipping. The constituting element for this integration, however, is a common maritime data model. The existing concept of the Geospatial Information Registry could be adapted to provide a future Marine Information Registry covering additional maritime domains by expansion, amendment and moderate redefinition. This includes options to adopt existing register-like structures including identifier systems.

4. Justification and impacts
The IMO e-Navigation correspondence group was tasked by IMO NAV59 to focus on five key topics and to work on developing a Strategic Implementation Plan (SIP). In order to fulfill the SIP, a CMDS will have to be available. This will require the support of IHO / HSSC. The scope of the proposed MI-Registry goes far beyond IHO´s existing GI-Registry concept. The management of the suggested MI-Registry would, require extra technical resources and specific expertise. A transfer of the existent GI-Registry into the proposed MI-Registry might not be required at this stage but would need to be managed once required. IHO/HSSC should be prepared to consider its role in developing and implementing the relevant proposals, in relation with the elaboration and adoption by IMO of the SIP for its e-Navigation concept.

5. Action required of HSSC

5.1 The HSSC is invited to:

- Note and discuss this paper with regard to
    - the necessity and conditions of such a transformation of the GI-Registry into the MI-Registry,
    - the organisational, technical and practical dimensions and impacts of such a transformation.