

**3<sup>rd</sup> S-100WG MEETING**  
**Singapore – 10-14 April 2018**

**Paper for Consideration by the S-100 Working Group (S-100WG)**  
**Review and Consolidation of IHO Geospatial Information (GI) Registry Content -**  
**Progress**

<b>Submitted by:</b>	IHO Secretariat (TSSO).
<b>Executive Summary:</b>	Progress report on the content review of the Feature Concept Dictionary (FCD) Register of the IHO GI Registry.
<b>Related Documents:</b>	<ol style="list-style-type: none"> <li>1. IHO Publication S-99 - <i>Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry</i>.</li> <li>2. S-100WG2-09.5A - <a href="#">Review and Consolidation of IHO Geospatial Information (GI) Registry Content</a>.</li> <li>3. S-100WG3-06.2.5 - <i>Register Item Review Spreadsheet</i>.</li> </ol>
<b>Related Projects:</b>	Development of the IHO Geospatial Information Registry; S-100 based Product Specification development.

### Introduction / Background

1. The S-100WG has approved full review of the content of the FCD Register of the IHO GI Registry so as to rationalize the content of the Register to conform to IHO guidelines and conventions for Register content (proposed Annex to S-99) (S-100WG2 Action 23 refers). This paper provides a summary of the progress made on the review so far; and suggests a way forward in facilitating the rationalization of the content of the FCD Register, to be implemented in the “new” IHO GI Registry structure (Concept Register).

### Analysis / Discussion

2. Paper S-100WG2-09.5A - [Review and Consolidation of IHO Geospatial Information \(GI\) Registry Content](#) reported the issues identified by the IHO GI Registry Manager/Feature Concept Dictionary (FCD) Register Manager with the content of the FCD Register. It was agreed at the S-100WG2 meeting that a Sub-WG should be formed to conduct a review of the FCD Register content (S-100WG2 Action 23), to be coordinated by the FCD Register Manager (TSSO at the IHO Secretariat).

3. An initial complete review of the content of the FCD Register was completed by the TSSO in December 2017, and the results summarized in a “Register Item Review” spreadsheet. This spreadsheet is a summary of all the items currently registered (as Valid items) in the FCD Register. Worksheets have been included in the spreadsheet for each Item Type in the Register, and the last Worksheet is a combined list of all items. Within the Worksheets, the items are listed in alphabetical order (items beginning with numerals listed first in numerical order and items beginning with non-alphanumeric characters listed last). The criteria (columns) used for assessment of the Register items is a concatenation of the metadata fields used across all the Item Types in the Register, with additional comments and decision/discussion columns added.

4. An indication of the suitability of an item in the FCD Register against each criteria is indicated using the “traffic light” (red, amber (yellow), green) system of colour highlights for the cells within the spreadsheet. [NOTE: For some criteria, this assessment has been done against the draft Conventions and Guidelines for the Content of the IHO GI Registry document (paper S-100WG3-06.2C refers), which is still in development.]

5. In December 2017, the first pass completed spreadsheet was circulated to the IHO GI Registry Project Team for review. It was decided within the IHO Secretariat that this was the best course of action, as the Project Team and those volunteering for the FCD Register Content Review Sub-WG were the same people, therefore it was considered that the formation of a separate Sub-WG consisting of the same people as the IHO GI Registry Project Team was not required. Feedback received so far from the Project Team has been included in the spreadsheet.

6. The Register Item Review Spreadsheet, updated to S-100WG3, is included as paper S-100WG3-06.2.5. It is important to note that only a very small percentage of items within the FCD Register are

considered to be suitable for inclusion directly into the Concept Register in the “new” IHO GI Registry structure. This is indicated by items carrying a green entry in the “Addressed” column (column G), noting the ongoing development for some criteria mentioned in paragraph 4 above. This may be indicative that a substantial amount of work will be required to standardize and rationalize the FCD content, which may have a significant impact on S-100 based Product Specifications in development. This spreadsheet will be maintained by the TSSO as an ongoing reference as changes are made to registered items in the FCD.

7. An “Observations and Analysis” document has been prepared for by the TSSO. This document is very much a “work in progress” and is intended to summarize the opinions and recommendations of the IHO GI Registry Project Team. This document has been included as Annex A to this paper for information of the S-100WG.

8. Based on the work done so far on the content review, in conjunction with development of draft conventions and guidelines for FCD (Concept) Register content, it is considered that considerable further work is required, with as much input as possible from the Project Team; current Submitting Organization and DCB representatives; and other parties in the process of developing S-100 based Product Specifications. This input is considered vital as there is a likelihood that the resulting content of the IHO GI Registry will impact on all Product Specifications currently in development. This input may be facilitated by conducting an “IHO GI Registry Workshop”, and inviting all relevant representatives to attend. Further action regarding such a Workshop is incorporated in paper S-100WG3-06.2.3.

### **Conclusions**

9. The content of the FCD Register in the IHO GI Registry is inconsistent and in some cases may be considered to be inappropriate. The complete systematic review of the content of the FCD to rationalize the Register content and align all registered items in conformance with accepted IHO GI Registry content conventions and guidelines is ongoing.

### **Recommendations**

10. S-100WG to note the progress in the review of the FCD Register content to date, as indicated by the accompanying Register Item Review and Observations and Analysis documents, and endorse the continuation of this work.

11. S-100WG to approve the continuation of the review of the FCD content by the IHO GI Registry Project Team, rather than forming a separate Sub-WG consisting of substantially the same people.

### **Justification and Impacts**

12. Rationalized and standardized Register content will be a key enabler in ensuring consistency and interoperability in S-100 based products and services.

13. It is hoped that by completing such a content review at this early stage in the operation of the Registry, there will be a minimal impact on Product Specifications in development. However it is expected that there will be some impact on these Product Specifications as existing registered concepts are rationalized (for example many concept names are likely to change). The TSSO, as the FCD Register Manager, has assumed the bulk of the responsibility and work in conducting the content review as part of the “day to day” responsibility of the Register Manager, with input from the IHO GI Registry Project Team and the FCD Register Control Board as required.

### **Action required of S-100WG**

The S-100WG is invited to:

- a. **Note** progress of the FCD Register content review since S-100WG2.
- b. **Approve** the continuation of the review of the FCD content by the IHO GI Registry Project Team.
- c. **Discuss** further as required, noting discussion points raised in the Annex.

## IHO GI REGISTRY – FCD REGISTER REVIEW

### Observations and Analysis

#### Introduction:

This document is a summary of the observations and analysis of the review of the contents of the FCD (Feature Concept Dictionary) Register of the IHO GI Registry. The output from the review is contained in a “Register Item Review” spreadsheet compiled and maintained by the IHO Secretariat (TSSO). The intention of this review is to:

- Rationalize the content of the Register; and
- Utilize the outcomes of the observations and analysis to facilitate the compilation of an “IHO GI Registry Conventions and Guidelines” document for Registry administrators and Submitting Organizations to ensure concise, consistent and optimized Registry content.

#### Description of “Register Item Review” spreadsheet content:

The following is an explanation of the contents of the spreadsheet. Note that where an item (concept) has been duplicated within the Register, it has also been duplicated in the spreadsheet.

Item: The “name” of the item as registered in the FCD Register. The contents of this column are as the feature has been registered (including syntax and spelling).

Domain (FCD): The Domain within the FCD Register to which the registered item has been assigned. Currently items have been registered to: IHO Hydro; Inland ENC; WMO (World Meteorological Organization) Ice; WMO Weather; and IALA AtoNs.

Type: The registered Item Type (Feature; Information; Simple Attribute; Enumerate; Complex Attribute; Codelist; Codelist Value). Each Item Type has its own Worksheet within the spreadsheet; and a combined list of all Item Types is included in the “Combined” Worksheet.

Issue: Initial observations of the TSSO when including the item entry in the spreadsheet. These observations are based on the initial review of the item only, and do not include any issues that may be identified through comparison between items, which will be included later in this document. **Other reviewers may add further comments in the spreadsheet as required.**

Comments: Recommendations of reviewers. Initial population of this column is by the TSSO. **Other reviewers may add further comments in the spreadsheet as required.**

Decision: Recommended decision of the Project Team. NOTE: For some items, the TSSO has included a decision that has been tentatively taken in order to ensure alignment between the FCD Register and the S-101 DCEG. These decisions are subject to approval of the other members of the Project Team.

Addressed: This column is intended to be indicative of the state of suitability of the registered item. Note that any instances of a cell in this column being coloured green is subject to approval of all members of the Project Team.

**Red:** If any Issue/Comment/Decision is listed and has yet to be addressed; or if any of the following columns (H-T) is red.

**Yellow:** If there are no listed Issues/Comments/Decisions (or these have been addressed and designated as such in the “Decision” column); and all columns H-T are green or yellow, but any of the yellow cells have an additional comment.

**Green:** All Issues/Comments/Decisions have been addressed; and all columns H-T are green or yellow.

**Clear:** There are no Issues/Comments/Decisions listed, however at least one of the cells in the columns H-T is red.

Columns H-T: These columns constitute a concatenation of the metadata provided for each of the Item Types present in the FCD Register. Hopefully the **red/yellow/green** colours are self-explanatory, however it is important to note that these are the opinions of the TSSO only and in many cases are subject to agreement of the conventions for the content of the Register. With the exception of the “Definition Source” column (please see below for further information), metadata fields that are considered non-mandatory have been coloured **yellow** (unsure if there is a value that could be populated) or **green** (considered OK that the field is not populated) where no value has been populated against the field

Additional information:

Item Name: Coloured and annotated in accordance with the draft Conventions and Guidelines document, which is subject to approval. This column is however indicative of inconsistencies in item naming and syntax.

camelCase: Indicates whether the camelCase exists and is consistent with current Register Conventions and the Item Name; does not exist; or exists but is inconsistent with current Register conventions or the Item Name.

Use Type: Note that this item metadata field is only present for the Feature Type (all other Types have a value of “NA” for this corresponding metadata field as this field is not present for these Types).

Definition: Is populated as OK (**green**) if considered to be suitable by the TSSO, and is therefore subject to review by the Project Team. Supporting comments are included either in the “Definition” column or the “Issues” column.

Definition Source: Has been populated as **red** if there is no value even though it is a non-mandatory field. TSSO considers that this field should be mandatory, as definitions should be supported by an authoritative source. **To be discussed.**

Reference: Has been indicated as **green** if a value has been populated (however the reference has not generally been checked); **red** if it is considered that an incorrect reference has been populated (the most common instance of this is where the Definition Source has been populated as the Reference); and **yellow** if no value has been populated.

Similarity to Source: **Green** and **red** have only been used based on comparison with S-57 and S-101 DCEG. **Yellow** indicates exclusively that no value has been populated.

Alpha Code: It is important to note that Alpha Code is not available for the Enumerated, Codelist and Codelist Value Types (noting that the Enumerated Type comprises approximately 80% of the FCD Register content). **Green** and **red** coloured cells are indicative only that a value has been populated, not on the suitability (or otherwise) of the value populated.

Alias: This Metadata field requires further discussion as to how it will be used in the Registry. **Green** and **red** coloured cells are indicative of possible values that may be applied to this field based on TSSO interpretation only. **To be discussed.**

INT1: **Green** values labelled “N/A” (not applicable) are indicative that no value has been populated and there is no reference to the concept in INT1.

S-4: As for INT1.

Distinctions: TSSO considers that this metadata field has been incorrectly labelled “Distinguishing Features” – **to be discussed.** It is important to note that this Metadata field is only available for the Feature Type. Values included (indicated by **green** and **red** coloured cells) have been taken from S-57 and S-101; or are interpretations of the TSSO.

Remarks: **To be discussed.** Refer to the analysis section of this document.

Associated Attribute: Is provided for information only, and is only applicable to Enumerated and Codelist Value Types.

Enumerated Code Value: As for Associated Attribute.

In some cases, a cell has been coloured green, however it contains text that identifies an issue. These issues have been addressed as part of the activity to align the content of the FCD Register and the S-101 DCEG.

### **Some General Statistics (at March 2018):**

Total number of registered (Valid) items: **4610**

[321 Features]  
[17 Information]  
[577 Simple Attributes]  
[104 Complex Attributes]  
[3400 Enumerates]  
[19 Codelists]  
[172 Codelist Values]

Number of registered (Valid) items considered to have “no issues\*”: **57**

\* No identified Issues, Comments or red entries in columns H-T. Note however that this includes the Definition Source column being considered to be mandatory, which is not currently the case. It is also important to note that “no issues” is in relation to the draft guidelines and conventions which are yet to be approved.

Item Name considered suitable: **1065** [Based on draft conventions].

camelCase OK: **2508** [Majority of issues are missing camelCase].

Use Type: [A few issues only, noting that this is only allowable for Feature Types. Those issues identified are generally related to questions regarding modelling].

Definition considered OK: **1836** [Major issues are missing definitions; and repeat of (or almost repeat of) the name].

Definition Source provided: **115** [This Metadata field is a drop-down list of sources. In some cases, the Definition Source is entered as the Reference (assume this is because the option is not available in the drop-down list)].

Definition Reference provided: **252** [This does not include entries that are considered to be the Definition Source, which have been classified as Issues].

Similarity to Source provided: **141** [In many cases the definition is an adaptation (“Restyle” in drop-down list?) as indicated in S-57 or S-101, however this has not been populated].

Alpha Code provided: **638** [As has been stated above, this Metadata field is not available to all Types, and in many cases has not been populated if it is available. Note that for IEHG items, where provided the Alpha Code is lower case].

Alias: [Only a few Alias’s provided. Needs discussion as to purpose – refer to Guidelines and Conventions draft.].

INT1: Populated: **74** N/A: **3647** [The majority of INT1 references, where they are relevant, have not been populated. It is important to note the number of items that do not require INT1 references].

S-4: Populated: **81** N/A: **3610** [The majority of S-4 references, where they are relevant, have not been populated. It is important to note the number of items that do not require S-4 references].

Distinctions provided: **34** [Note that this field is currently labelled “Distinguishing Features in the FCD Register. The majority of distinctions identified in S-57 and S-101 have not been populated].

Remarks: [Relatively few items have remarks, and these tend to be specific to modelling or feature binding rather than remarks regarding the concept itself].

## **Analysis: Principle Observations of Note and Recommendations:**

1. **Repeated Concepts:** In general, this is a consequence of the current structure and interface of the FCD Register. A single concept cannot be registered once and then used as different Types (Feature, Attribute Enumerate, ...) in different Feature Catalogues across different Domains; or bound to different Features/Attributes within a Feature Catalogue, unless it is registered multiple times in accordance with its usage. In addition to non-conformance with a fundamental principle of a concept register (register once, use many times), this has also resulted in the following issues:

- a. Same concept registered more than once with more than one meaning and definition (example: Reed (Category of Vegetation); Reed (Category of Fog Signal));
- b. Concept that is essentially the same registered multiple times with different Item Names (example: Undefined; Undetermined or Unknown; Undetermined, Unknown, or No Form (used in ....); Undetermined/Unknown; Undetermined/Unknown – Ice Stage of Development (SS); Unknown; Unknown Coverage; Unknown Status; etc ...);

**Recommendation:** Establishment of a true “Concept Register”, containing single instances of uniquely defined concepts that are provided with context (assigned Type, binding, encoding rules, etc) within individual Domains in a Feature Data Dictionary Register. Refer to Registry Structure Diagram document.

**Recommendation:** The Concept Register and the rules/guidance for its use should be flexible enough to accommodate Product Specification development in different domains, while encouraging harmonization and a common conceptual framework for different Product Specifications. This suggests possible use or adaptation of an architecture based on lexical databases (for example introduction of “scopes” for items, utilizing namespaces) or ontologies.

- c. Items registered multiple times, and intended for the same purpose, during different iterations of the FCD Register. As a consequence, many of these instances have not been assigned to a Domain (example: First Stage Thin First Year Ice 30-50 cm (Enumerate)).

**Recommendation:** Retire instances of repeated item names that have not been assigned to a Domain; and retire duplicates of items that have identical Metadata that have been assigned to a single Domain.

2. **General Syntax/Format:** This is a common issue across all fields populated for items in the FCD Register, and impacts on almost all items in the Register. This is principally due to the lack of conventions and guidelines. Some of the most common issues identified include: Use of capitals; use of acronyms/abbreviations; length (item name); inconsistency between syntax in related concepts (for example “2 cones, base to base” v “2 cones (points downward)"); combination of full name and acronym/abbreviation as Item Name; multiple terms (principle term and alias’s?) included as Item Name (examples: “barrel (tun)”; “stake, pole, perch, post”).

On the other hand, it will be extremely difficult to define universal conventions and guidelines, which further are unlikely to be accepted by all Domains and Product Specifications. Any set of conventions or guidelines should therefore focus on local consistency – roughly speaking, ensuring that items that appear in juxtaposition (for example, different members of the same enumeration) are mutually consistent, instead of global consistency (universal rules applying to every item of the same kind).

**Recommendation:** A consolidated “Conventions and Guidelines” document is approved and published; and all concepts in the FCD Register assessed against this document and amended as appropriate before inclusion in the “Concept Register”. This assessment should focus on local consistency rather than universal consistency.

3. **Items not assigned to a Domain; and enumerates not assigned to an attribute:** Assume this is a result of bulk population of the Register in previous versions of the Registry. NOTE: Search conducted by Denise LaDue (utilizing Alpha Code) to identify likely bindings of enumerates to an enumerated type attribute where this binding is not identified in the Registry interface – this will need to be applied before the application of the recommendation below.

**Recommendation: Retire all items in the Register that have not been assigned to a Domain; and similarly retire all Enumerated items in the Register that have not been assigned to an Attribute.**

4. **Disparity between Item Name and Definition:** There are many such instances in the FCD Register, and in most cases these are instances of very specific terms having very generic definitions (although the opposite also occurs). Often, disparity arises from the definition depending on a particular context, which is set by the definition of the containing item (for instance, the definition of an enumeration sets the context for definitions of enumerates which are members of the enumeration). This has the potential to cause problems where concepts are used across multiple Product Specifications. The dilemma in resolving this issue is the level of specificity that is used. Is there a “one size fits all” that can be clearly defined in the Conventions and Guidelines; or should the guidance be more general in advising on the considerations for the use of a proposed item (and its definition) in other S-100 based Product Specifications?

**Recommendation: All identified instances of disparity between an Item Name and its definition must be resolved. In order to achieve this, there must be agreement on how a consistent approach is going to be reflected in the “Conventions and Guidelines” document. The principle of scopes utilizing namespaces is especially needed for enumerates (that is, literals, or listed values).**

5. **Non-Authoritative Definitions:** In association with resolving the above issue, there are many instances where the definition appears to be non-authoritative. In a large number of these instances, the definition is merely a repeat (or almost a repeat) of the Item Name. In some cases, the concept has been defined by a Working Group or Project Team to address specific modelling requirements in their domain.

**Recommendation: Review all definitions in the Register and amend as required to provide an “authoritative” definition. For the Concept Register, assign mandatory status to the “Definition Source” metadata field. Product specification developers should make every effort to research and use existing authoritative definitions and sources, but the working group may be cited as the source when it develops a new concept.**

6. **camelCase:** Varies from abbreviations of item names to examples so long that they are truncated (assumedly by the interface). There are items that have punctuation, acronyms, “special characters” or numbers. There are also items where the camelCase is missing. Also need to agree on basic syntax to be used in the (Type-neutral) Concept Register.

**Recommendation: Develop standard format for camelCase for incorporation in the “Conventions and Guidelines” document and subsequent review within the Register. Assign the “default” camelCase (first letter of first word lower case, all following first letters upper case) as the format for the Concept Register. Develop guidance discouraging the use of long camelCase codes/names.**

7. **References or inferences to data modelling, or encoding guidance, included in Definitions and/or Remarks:** Given that the Concept Register is “generic”, there should be no information that relates to data modelling or encoding that is specific to a Product Specification included in the Metadata. If it is considered that such information should be included in the Registry, this should be done by additional remarks (additional Metadata field?) in the Feature Concept Dictionary Register Domains. However, given that this is provided in the Data Classification and Encoding Guide for each Product Specification, should this information also exist in the Registry?

**Recommendation: Remove references to data modelling and encoding from the Metadata. Investigate options for including such information, if considered it is required, in the Feature Data Dictionary Register.**

8. **INT1 and S-4 references:** As mentioned in the Register summary information above, it is important to note that the vast majority of registered items do not have any reference to INT1 or S-4. TSSO analysis to date indicates that there are about 900 items that have valid INT1 references and 950 items that have valid S-4 references. Consideration should also be given to those Organizations such as WMO and IALA for which the majority (or all) of their required items will have no relevance to INT1 or S-4. The question therefore is whether it is appropriate or necessary to include INT1 and S-4 references as Metadata fields for items

registered in the Concept Register? Perhaps this could be an additional Metadata field that can be included for items in the Feature Data Dictionary Register (such as within the S-101 Domain)?

**Recommendation: Consider the capability of including INT1 and S-4 references only within the required Domains within the Feature Data Dictionary Register.**

9. **“Distinctions”:** Within the current FCD Register interface, this Metadata field is labelled as “Distinguishing Features”. Consider this is an error in the interface, and this Metadata field should be labelled “Distinctions”. Consider this is perhaps a reason why this field is not populated for almost all items currently registered. Note also that this field is only currently available for Feature Types.

**Recommendation: Amend field name from “Distinguishing Features” to Distinctions and include as a Metadata field in the Concept Register. Request Submitting Organizations to conduct a review of all their registered items and submit proposals to add distinctions as required.**

10. **“Coded” Enumerate Lists:** Within the Enumerate Type, there are many items registered that are “Codes” that sub-divide a unique concept (some are lists maintained by other Organizations, such as IUCN Codes); or define “gradations” of a concept (examples: 0 Oktas, 1 Oktas, 2 Oktas, ....; 1/10, 2/10, 3/10, ....). Should these “Coded” (for want of a better word) enumerated lists of values be registered as “Concepts”? How can something like “1/10” be defined if it is considered to be a Concept, and what defines such a concept as “hydrographically relevant”? This needs careful consideration, as this may be extended to other enumerate lists (example: Topmark Shape). The European Commission INSPIRE Registry has included an “Enumeration Register” within its Registry structure; and perhaps this needs further investigation as a possible solution.

Different Product Specifications define different enumeration attributes which have different meanings but can still take the same set of values. At present S-100 assumes a 1/1 correlation between an enumeration attribute and its value space. The result is that each enumeration attribute implies a unique enumeration type.

**Recommendation: Include an “Enumeration Register” (and possibly a “Codelist Register” for open enumeration Codelists) as a hierarchical register(s) in the IHO GI Registry structure. Refer to Registry Structure Diagram document and INSPIRE Registry. Use enumerations defined in this Register(s) as datatypes for enumeration and Codelist attributes.**

11. **Metadata fields not available for different Types:** As stated in the review spreadsheet description above, the Use Type and Alpha Code Metadata fields are not valid fields for some Types. A decision needs to be made if these fields should be retained in the Metadata for items registered in the Concept Register. TSSO opinion is that the Use Type field is specific to modelling so should not be valid at the concept level, however it will need to be defined at the Feature Data Dictionary level. For Alpha Code, TSSO questions whether this field is required at all, given the implementation of camelCase. Is this just a legacy inherited from S-57 to be used for cross-referencing? Is there a requirement in ISO to include Alpha Codes?

**Recommendation: The Use Type field should not be a valid metadata field in the Concept Register, however it is required in the Feature Data Dictionary Register. Discussion is required as to the retention of the Alpha Code Metadata field.**

12. **General observations regarding S-57-based Register content:** There are a number of entries in the Register that have been taken from S-57 but are not being used in S-101 (or any other Product Specification). These need to be assessed to determine whether they are required in the Concept Register.

Also, while the benefits of basing the modelling for S-101 on the S-57 modelling are acknowledged, particularly in regard to converting S-57 datasets to S-101, this has to a certain extent restricted any extension or possible improvement to the modelling that experience with S-57 and additional functionality available in S-100 could provide. (Example: Category of Recommended Track is an enumerated attribute with 2 values – “based on fixed marks” and “not based on fixed marks”. This could be remodelled to a Boolean attribute “Based on Fixed Marks”.)



**Recommendation:** Review all Register entries that have been derived from S-57 that are not used in S-101 and, unless use cases can be found for retention, retire these items.

A possible action that can be taken, which is not directly related to the structure and operation of the Registry, is to recommend to the S-101PT that consideration be given to extending/refining the S-101 data model beyond the requirements to convert S-57 data.

13. **Enumeration and Codelist members:** There are many collisions between the names and definitions of enumerates (that is, literals, or members of enumerations/codelists) which were originally defined in different domains, or draw on different sources for their names/labels and definitions.

The enumerated value concepts draw on different sources, and their meanings, names/labels, and definitions depend on the context in which they are defined, a unified list will be extremely difficult to develop and require wholesale revision of all S-100-based Product Specifications currently under development.

**Recommendation:** Introduce the principle of scopes to the registers, especially the proposed Enumerations Register, as containers for enumerates. Define enumerates as being meaningful only in the context of their containing scope.

14. **Units:** Several product specifications need units of measure, either for metadata or to encode inside datasets. Some domains have defined units with varying spellings.

**Recommendation:** Define a separate register of units.

**Comments based on feedback from Raphael:** NOTE: Not all comments in Raphael's responses are listed here – only those comments that TSSO considers needs further clarification/discussion/ workshopping. Please refer to the commented/track-changed document submitted by Raphael for clearer indication of context.

**Comments included in Draft Guidelines and Conventions document:**

- General comments. This Annex should focus on the technical constraints and requirements of the registers, e.g., syntax, identifiers, required and recommended fields, documentation (references and sources), avoiding and resolving inconsistencies, guidance for writing definitions, etc.. Modelling guidelines should be addressed elsewhere, specifically, the Guidance for PS developers.

TSSO Comment: Agree.

- Since S-100 will be used for a family of standards in a variety of maritime information domains, it is unlikely that different product specifications will be able to use every concept "as-is". This is even true for a single product specification, e.g., RestrictedAreaNavigational and RestrictedAreaRegulatory.

The idea and use of the Concept Register should be flexible enough to allow Product Specifications to make the necessary distinctions. It should be like a thesaurus. Consider using the architecture of existing lexical databases e.g., Wordnet, or ontology (in RDF, OWL, or SKOS, specifications for which have been published by ISO or W3C).

TSSO Comment: Totally agree with this, however my area of expertise does not extend to database architecture – will need some sort of guidance/workshop on this. There has been discussion on using RDF, but again this is something that I require some education on.

- The rule in programming and modelling is that individual members (enumerates) are meaningful only in the context of their "container", which is a specific (named) enumeration. The context corresponds to an attribute concept. This can be elaborated with hierarchies and partitioning (subsets).

A compendium of enumerates would need to include "scopes" (= "namespaces" in XML terms) in order to be workable. A global list of individual enumerates will quickly become unmanageable.

TSSO Comment: Need further information on this.

**Comments included in IHO GI Registry Structure document:**

- I am arriving at the realization that the concept register idea should be more flexible than this document and the diagram suggest. Either the CR should allow for "senses" or "scopes" like a lexical database or thesaurus, or the architecture and guidance documents should explicitly allow for product specifications and the data dictionaries to make different types of derivations from the concept register (especially refinements, and specializations or partitions). Use the concept register to link the derivations, and require derivations to describe the relationship to the entry in the concept register, e.g., which item (and which sense) it relates to and the nature of the derivation (refinement, specialization).

TSSO Comment: Agree. However, need assistance as to how this may be done.

- The tendency will be to reject anything that might have an impact, which would block development of new products or introduction of new maritime information domains. Adding senses or scopes would mitigate, though not avoid, this potential problem.

TSSO Comment: Requires further discussion.

- This [*one domain for each PS*] is likely to be very troublesome for implementers. It will also be troublesome for product specifications that share parts of their application schemas.

- Introduce scopes or namespaces? Need to develop a middle ground between total independence and total integration of different product specifications.

TSSO Comment: OK. However, will need to find some “middle ground” so as to avoid instances of concepts being modelled differently within the same Domain, which has caused a lot of problems with the current FCD Register. Further discussion required.

- The application schema (UML model) is developed first, then the feature catalogue. The project specification team cannot know which concepts are needed until the application schema is completed. It develops the application schema by a process of iterative refinement, referring to the concept register as a source (though not the sole source) of concepts within the scope of the data product. The feature catalogue is developed later. When the FDD is introduced, populating it will be an intermediate step between developing the application schema and feature catalogue.

TSSO Comment: Agree. The document will be reworded, however note that “Feature Catalogue Builder” is just a term that is used for the “tool” that will be used to implement the application schema in the FDD Register.

- The enumerate register should define literals (enumerates, listed values) in different scopes or namespaces, generally corresponding to attributes. Provision should be made for hierarchies (supersets/subsets).

Enumerations (and codelists) are actually different datatypes for the purposes of implementations, data formats, and modeling and their treatment in the registry should facilitate that.

TSSO Comment: Requires further understanding and discussion.

#### **Comments included in IHO GI Registry – FCD Register Review – Observations and Analysis document:**

- Adding the concept of a « datatype » should resolve this [*repeat entry of concepts*]. It separates <**AttributeX**> from <**The set of allowed values of Attribute X**>. Multiple attributes can then have the same datatype. The Enumerations register could fulfil the role of a Datatypes register if the Enums register idea is modified a little.

After going through the registry issues Excel file, I think the idea of scopes for enumerates is essential and introducing it will resolve half(?) the issues in the spreadsheet. This is normal in programming as well as modeling, a member of an enumeration type is defined only within the context of that enumeration and has no meaning anywhere else.

Also, in my experience product specification developers think first about the enumeration as a whole and then about the individual members it contains.

TSSO Comment: Agree. However, I (and others I think) need a much greater understanding of the concepts being suggested here – suggest a workshop is required.

- As I have written in other documents, I think the concept register and the rules/guidance for its use should be flexible enough to accommodate product specification development in different domains without unduly constraining them, and it should be structured like a lexical database or ontology. Consider using or adapting the architecture of existing lexical databases e.g., Wordnet, or ontology (in RDF, OWL, or SKOS, specifications for which have been published by ISO or W3C).

Wikipedia has an article on Wordnet.

TSSO Comment: Agree. I think this needs to be workshopped.

- I prefer short names and short camel case codes. Long names arise from the common belief (tradition ?) in IHO working groups and project teams that the camelCase should consist of exactly the words in the long descriptive name. I suggest developing guidance about this for S-100 Parts 1 and 3.

TSSO Comment: Agree.