IALA GUIDELINE

G1106
PRODUCING AN IALA S-200 SERIES PRODUCT SPECIFICATION

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DOCUMENT REVISION

Revisions to this document are to be noted in the table prior to the issue of a revised document.

Date	Details	Approval
December 2013	First issue.	Council 56
June 2017	Chapters 1, 2 and 3 Changes in procedures and approach. Removed Section 3 on domains management and amendments throughout the document.	Council 64
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1. INTRODUCTION

In January 2010, the International Hydrographic Organisation (IHO) adopted S-100, a framework geospatial standard for hydrographic and related data. IHO S-100 is aligned with the ISO 19100 series of geographic standards – thereby making the use of hydrographic and other geographic data more interoperable than using the present IHO S-57 data transfer standard.

The IHO S-100 document is underpinned by a Registry and component Registers based on *ISO 19135 Procedures for registration of items of geographic information*. The IHO owns and manages the Registry.

The IHO S-99 standard describes the roles, responsibilities and procedures for operating and managing the S-100 Geospatial Information Registry and its component Registers.

Within the IHO Registry, registers may be used by external Submitting Organisations.

IMO NAV at its 57th session agreed on the use of the IHO GI Registry as a baseline for the collection, exchange, and distribution of data. Supporting a greater variety of information and therefore supporting increased interoperability. This was the first step towards the Common Maritime Data Structure (CMDS), essential for e-navigation.

IALA Council has approved the participation of IALA in the IHO GI Registry as a Submitting Organisation, and as a domain owner (i.e., the IALA domains within the Registry).

The next step for IALA committees and contributors is to populate the IALA Domain within the registry. Where the development of product specifications comes first and then the required items are registered into the registry.

This Guideline is intended to provide an overview of the development process and be a step-by-step guideline from the data modelling to the actual production of a product specification.

1.1.   OBJECTIVES OF THE GUIDELINE

The objective of this Guideline is to:

- Give relevant background information on e-navigation and the IHO GI Registry.

- Provide information on what is needed to implement products in the registry.

- Explain the product specification development process in a step by step manner, aided by examples and formats.

- Provide a Product Specification template.

This Guideline is written for different users.

1   The intended developers of products and services, on the shore side, and in some extent the developers of the service receivers on-board or ashore. This Guideline provides these entities an understanding of what is to be developed and for what purpose.

2   The software developers of products and services in order that they develop a product specification which is fully S-100 compliant. The technical details and templates are specifically intended for software engineers who are developing the product specifications for the service.

The development of a product specification is a close co-operation between operational process experts, from the service providers and software developers.

1.2. e-NAVIGATION FROM CONCEPT TO REALITY

The definition of e-navigation is *"The harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment."*

To make this possible, e-navigation is based on the provision of services, founded on user needs. To have a common understanding of the services provided, the concept of Maritime Service Portfolios (MSP) was developed. The MSP consist of a collection of Services providing digital information from shore to ship. These Services are delivered through Technical Services and infrastructure.

A technical service facilitates an exchange of data described by data products. A service can consist of more than one product. In order to exchange information in a harmonized way and make it easily accessible and usable, there should be a common understanding about the product. This common product must be stored at a location which is accessible for all stakeholders who want to use it. This is the purpose of a register.

A registry is simply a dictionary where definitions / specifications are kept in organised locations known as registers. A registry eases the task of developing new functionality, by providing a centralised source for finding definitions / specifications.

1.3. THE IHO GI REGISTRY

Figure 1 describes the simplified generic structure of the IHO Geospatial Information (GI) Registry. The major features of the registry include registers for:

- Product Specifications – includes everything needed to fully describe and specify a product such as data exchange protocols and references to feature and portrayal catalogues from the GI Registry.

- Human-Machine Interface (HMI) – HMI definitions / specifications can also include references to Common Maritime Data Structure (CMDS) entities from the GI Registry.

  This register is named Portrayal by IHO.

- Feature Concepts.
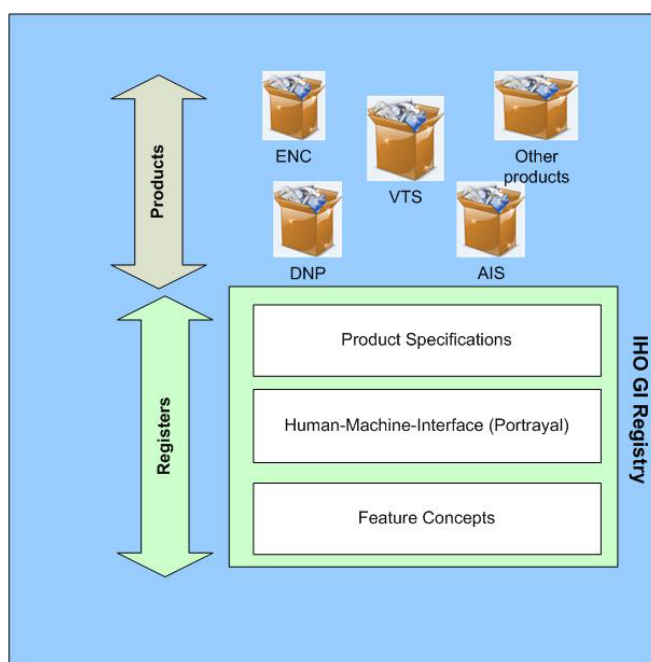
Figure 1   Simplified View of the IHO GI Registry

Note:

When building a product, it is recommended to reuse or extend previously created / existing entries within the registry (by reference) avoiding the need for creation of new entries as much as possible. When building a product specification for a product, it is up to the developing body to register information for new entries in the register and to make sure that the information conforms to the S-100 standard.

1.4. REGISTERS RELEVANT TO THE DEVELOPMENT OF PRODUCT SPECIFICATIONS

The S-100 GI Registry consists of five types of Registers:

1   Feature Concept Dictionary (FCD) register.

2   Portrayal Register (not yet available).

3   Metadata Register (not yet available).

4   Product Specifications Register.

5   Data Producer Code Register.
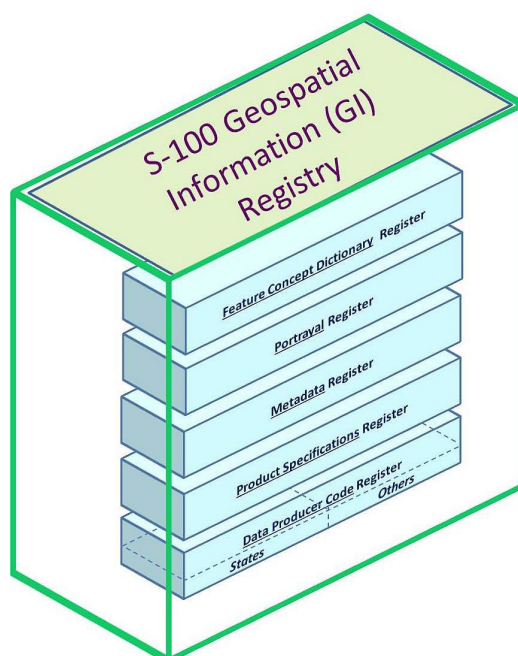
Figure 2   The IHO GI Registry

For the development of product specifications, the relevant registers are the Feature concept dictionary register and the products specification register. The purpose of these registers are:

The *Feature Concept,* are, in effect, managed lists or dictionaries of items. Selections from the Feature Concept dictionary are used in individual Product Specifications.

The *Product Specification Register* is a list of S-100 based Product Specifications created by recognized organisations describing meta information about the content, purpose, version, location and availability of those Product Specifications.

1.5.   IALA DOMAIN AND MANAGEMENT

IALA is a domain owner in the IHO GI registry. All product specifications developed by IALA are structured and managed by IALA.

In addition, IALA will need to co-operate and harmonize product specifications related to data used in VTS and AtoN with other IHO GI registry owners, especially together with IHO and vice versa.

IALA has developed procedures to manage the IALA domain and its role as a Submitting Organisation to the IHO GI Registry. The IALA Domains management and submission process for an IALA S-200 series product specification is described in detail in IALA Guideline *G1087 Procedures for the Management of the IALA Domain Under the IHO GI Registry* [3]. The responsible project and/or field manager responsible for product specification development should follow these procedures in order to get the product specification registered in the product specification register.

1.6.   IALA DOMAIN SPECIFIC REGISTRY INFORMATION

Some of the IHO S-100 parts will have to be interpreted in another context for use in the IALA domain.

Table 1 gives some additional information for the specific use in the IALA domain. This additional information is given to place the S-100 description of the different parts in a more IALA domain context.

Table 1   S-100 parts for IALA use

Part Title	Part Number	Specific guidance for IALA use
Conceptual Schema Language	S-100 Part 1	The use of UML is mandatory for describing the data-model of a product. The part will apply in full.
Management of IHO Geospatial Information Registers	S-100 Part 2	For the IALA Domain the management of the IALA registers will apply, these management procedures will be part of the register. Procedures on amending existing product specifications.
Feature Concept Dictionary Registers	S-100 Part 2a	The need for a register to store definitions applies for the IALA Domain. In the Feature concept dictionary for the IALA Domain the Features for the e-navigation/IALA domain are registered.
Portrayal register	S-100 part 2b	None, under development by IHO
General Feature Model and Rules for Application Schema	S-100 Part 3	This part applies in full for the IALA Domain. The General Feature Model and the Application Schema are the most important items.
Metadata	S-100 Part 4a	The knowledge about the quality of data is not limited to the hydrographic organisations but to every supplier of data. Therefore, this part is equally important for the IALA Domain.

Part Title	Part Number	Specific guidance for IALA use
Feature Catalogue	S-100 Part 5	The feature catalogue will be a part of the IALA product specification. When populating the IALA Domain of the registry it is possible that definitions of features are yet to be developed and be registered in the Feature Concept Dictionary. It is also possible to refer to an existing feature in the Main (IHO) domain of the register.
Co-ordinate Reference Systems	S-100 Part 6	WGS 84 as default but others can be applicable
Spatial Schema	S-100 Part 7	The usage of this part for the IALA Domain is not yet known, possibly referencing to the existing reference systems in the Main (IHO) domain of the register can be sufficient.
Imagery and Gridded Data	S-100 Part 8	Not yet applicable for IALA usage.
Portrayal	S-100 Part 9	The use of a portrayal register could lead to generic standards for portrayal and handling of information, providing familiarity and improving the training and enhanced usability. The portrayal catalogue is optional for IALA, but can be applicable depending on the use case of the product.
Encoding Formats	S-100 Part 10	The type of coding is also dependent on the type of carrier which will be used for the exchange of the data. Applies for IALA.
ISO/IEC 8211 Encoding Schema	S-110 part 10a	Binary encoding schema. May apply for IALA product speciation
Product Specifications	S-100 Part 11	The required structure for a product specification for the IALA domain is the same as for the IHO domain. However, the product does not have to be related to a geographic product. It can be any object which is intended to be exchanged and relates to the user need and goal of e-navigation.
S-100 Maintenance Procedures	S-100 Part 12	Specifically for maintenance of S-100 not applicable for IALA product specification development.

1.7. FROM USER NEED TO PRODUCT SPECIFICATION

The services in the e-navigation context are derived from user needs. These user needs, which are high level and functionally specified, must be transformed to service requirements in order to realise the required functionality. The development of service requirements drives the data model, which in turn generates a product specification and the items to be registered. This is the task of the product specification developer. n Figure 3 the global idea of the route from user need to product specification is shown.

In order to develop a product specification, it has to be clear what the product should be. For the provision of e-navigation this product is supposed to be a part of a Maritime Service Portfolio (MSP). The authority responsible for the relevant service creates a description of the desired product and the applicable user needs. Then it is up to the product specification developer to check the registry and investigate if the necessary features already exist. In cases where the feature does not exist, a new feature will need to be added to the feature concept dictionary (FCD) using the template referenced in annex B to IALA Guideline *G1106-2 Proposal for Additional S-100 Feature Concept* Dictionary item and submit this according to the Procedures for the Management of the IALA Domain under the GI Registry.

Next a data-model has to be produced, either by means of a conceptual schema language or by means of an encoding specific language. Finally, the previous and other information is captured in a document called a product specification. This document will then be registered, after an approval process, in the product specification register of the GI Registry.
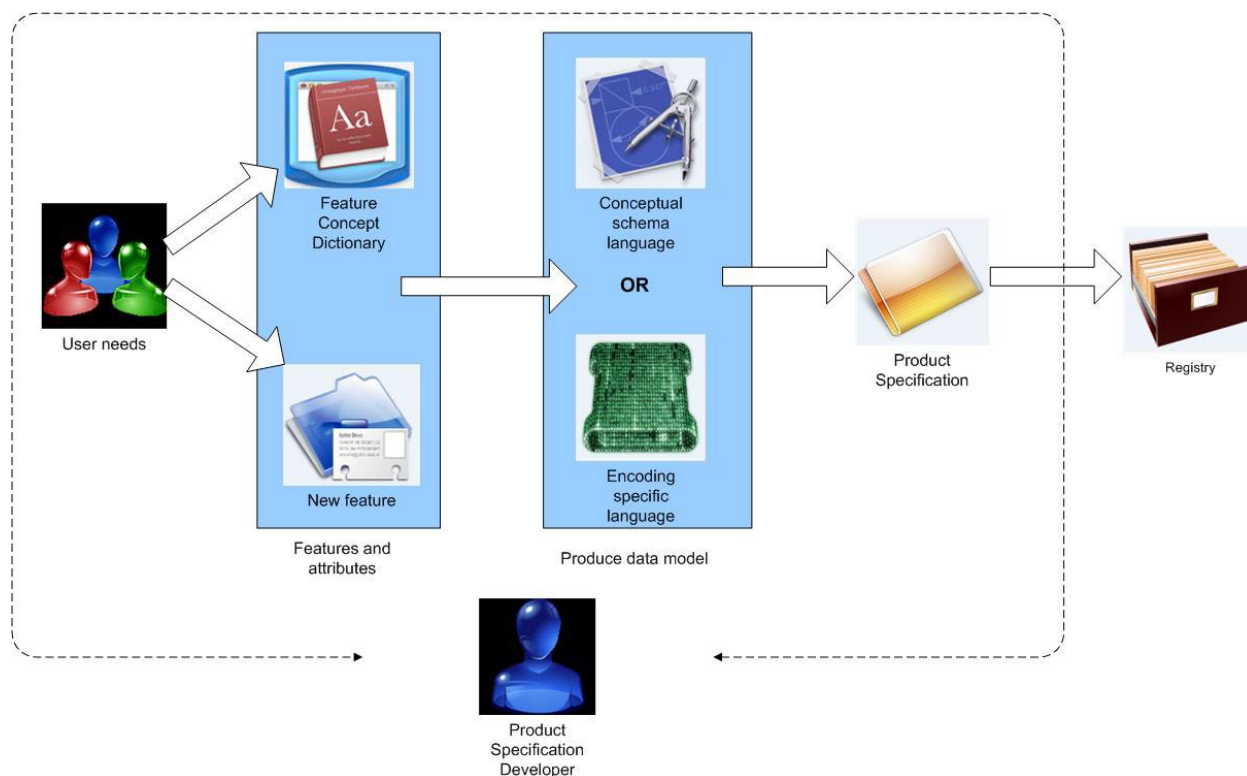
Figure 3   Transformation of a User Need into a Product Specification

For the development of a product specification a level of expertise is necessary. This level of expertise is not only necessary on the developer side but also the service provider needs to have some understanding of the process. The right mixture of expertise consists of S-100 experts and understanding of the product requirements and context of the product within the e-navigation scope.

1.8. DATA MODELLING; A GENERAL EXAMPLE

In the Figure 4 a simple example is given about an everyday situation and how this would relate to features and types in Unified Modelling Language (UML) objects.

Suppose the objective is to provide a service intended to provide a car driver with information about the cheapest gas stations during his journey.

The service would require information about:

- the road;

- the location of petrol stations; and

- the price of fuel.

A data model could look like Figure 4.
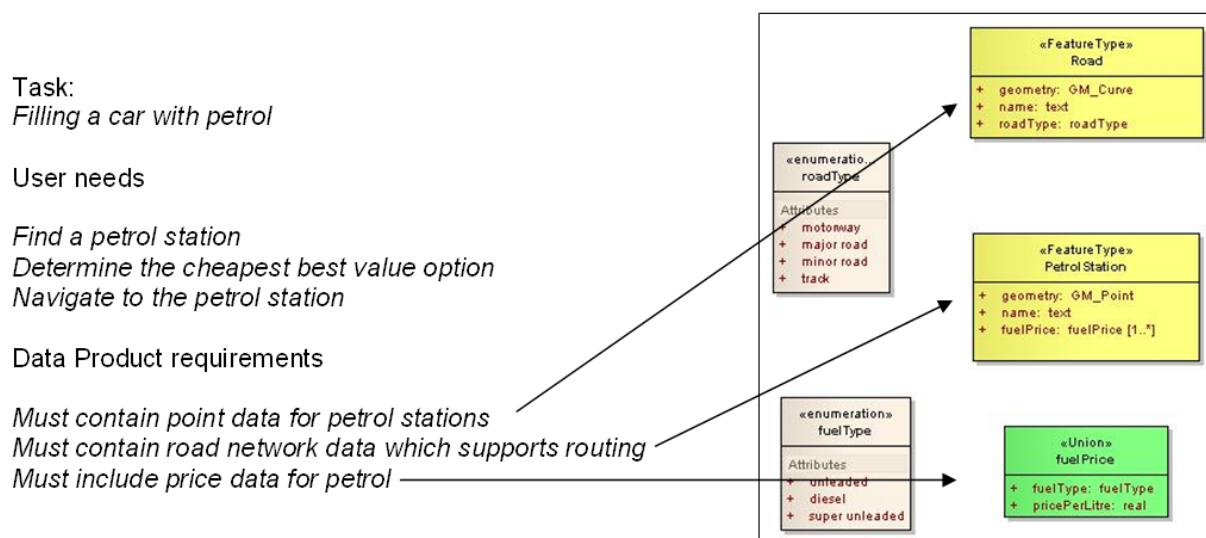
Figure 4   Data Modelling example – filling a car with petrol

1.9. PRODUCT SPECIFICATION E-NAVIGATION EXAMPLE

To explain the use of the registry and the need for a product specification in a semi technical way an example is used. Assume the following use case:

From the user needs it is derived that the wind speed in a given area is needed to be provided to the maritime stakeholder. The provision of the wind speed in advance for certain areas could be useful for decision support regarding navigation and berthing.

The first stakeholder who wants to provide the service will have to write a product specification. In this specification, all the relevant information is noted and, after an approval process, the product specification is added to the registry. Now the product specification can be used for the development of an application, either on the ship side or shore side.

Next there is a need for a shipboard system or application to have this information regarding the wind speed in a given area.

The developer of the shipboard system or application will search the registry to find out if this service is already provided and he will find the product specification. This will provide him, amongst other items, the following information:

- Extensible Mark-up Language (XML) is used for encoding.

- Wind speed is provided in metres per second.

With this information about the data the developer can build his application. The developer knows where the information can be retrieved and how the data must be handled, perhaps an extra calculation will be required if the program works with miles per hour.

The same applies for information providers. If another responsible body wants to provide a wind speed service, it can first search the registry to see if this service already exists. The product specification will be found in the registry as previously mentioned. Based on that information the developer knows how the data needs to be encoded and that the wind speed needs to be provided in meters per second. No new development is needed and this saves time and costs.

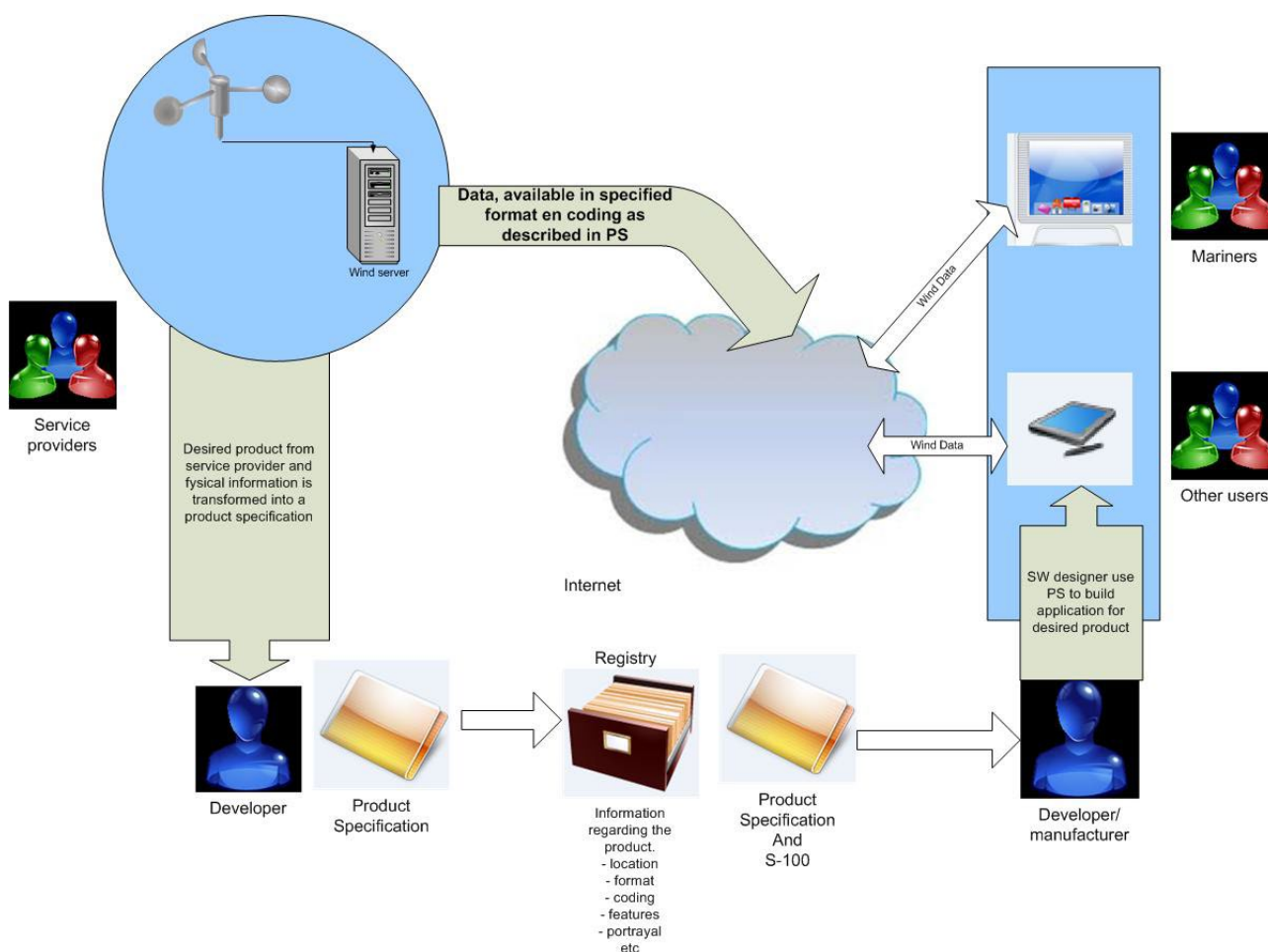Figure 5 shows the example in a graphical way.

Figure 5   Graphical Representation of the Product Specification process and the technical data exchange process

2. DEVELOPING A PRODUCT SPECIFICATION

2.1. INTRODUCTION

The purpose of this chapter is to describe the process that can be followed to create IALA Domain S-200 series product specifications based on the S100 standard and the implementation of the product specifications in the Geospatial Information registers.

An explanation is provided in more detail regarding the purpose of a product specification, the applied concepts within a product specification, an overview of the GI Registry and a recommended process that can be followed to create a product specification.

2.2. PRODUCT SPECIFICATION

A product specification allows the standardisation of a data product according to the S-100 framework, in order to specify, implement and exchange a data product within the context of Maritime Service Portfolio (MSP) and e-navigation. The MSP for a given region consist of a collection of Operational Services, which are implemented as Technical Services. The services make use of 'data products' to exchange data. Examples of such IALA related data products are AtoN, Inter VTS Exchange Format (IVEF) service or Automatic Identification System (AIS) Application Specific messages.

A product specification can be summarized as a precise technical description, defining a data product within the S-100 framework. It describes the features, attributes and relationships of a given application and their mapping to a means of data exchange, such as exchange sets (AtoN) and dynamic data streams (IVEF).

For this purpose, it includes general information for data identification as well as information for data content and structure, reference system, data quality aspects, data capture, maintenance, delivery and metadata.

The applied methodology for product specifications is derived from the IHO profile of ISO 19131 and ensures a clear and consistent structure for data product specifications being consistent with the other standards that have been developed as part of the IHO S-100 framework.

2.3. PRODUCT SPECIFICATION TEMPLATE

For the development of a data product specification the form in IALA Guideline *G1106-1 IALA Product Specification Template* referenced in annex A shall be used as required by S-100 part 11.

The Product Specification Template proposes a standardised method to define and describe the product specifications. It contains all the relevant information that is necessary when developing a product specification. The template also includes clarifications for each information item of the product specification.

The product specification template in IALA Guideline *G1106-1* defines a standardised method to define and describe the product specifications. The template contains all the relevant information that is necessary when developing a product specification. The template in IALA Guideline *G1106-1* includes a clarification is included for each information item of the product specification.

2.4. CONCEPTS USED IN A PRODUCT SPECIFICATION

When developing a product specification, a developer will notice that there are some general concepts used in a product specification creation. In this section, the main concepts used in development of a product specification are presented in a step by step manner.

2.4.1. UNIFIED MODELLING LANGUAGE

UML is used as the modelling language in S-100. An understanding of UML class diagrams is needed to produce a product specification.

2.4.2. APPLICATION SCHEMA

An application schema is a *fundamental* element of any S-100 based product specification. The application schema serves two purposes:

1   It achieves a common and correct understanding of the content and structure of data within a particular application field.

2   Secondly, it may provide a computer readable schema for applying automated mechanisms for data management. This can be achieved in an XML document. The two roles imply a step by step process for creating an application schema. The steps can be briefly described as:

    a   Making a conceptual model of the application with concepts defined in the *General Feature Model*.

    b   This task consists of identifying feature types, their properties and constraints.

    c   Describing elements of the application schema in the *Conceptual Schema Language* used in S-100 and according to the rules for Application Schemas and the General Feature Model.

    d   Integrating the formal application schema with other standardised schema, (spatial schema, quality schema, etc.) into a complete application schema.

For the creation of an application schema several software tools can be used. For example, 'commercial of the shelf' software such as Enterprise Architect or freely available software such as Violet UML editor.

The application schema is subject to a number of rules:

1   All classes used within an application schema for data transfer shall be instantiable.

2   The identification of each application schema shall include a name and a version.

3   The inclusion of a version ensures that a supplier and a user agree on which version of the application schema describes the contents of a particular dataset. A system of defining unique names and versions for S-100 application schemas shall be defined.

4   In UML, an application schema shall be described within a PACKAGE, which shall carry the name of the application schema and the version stated in the documentation of the PACKAGE.

5   An application schema shall be documented.

6   A means of documenting application schemas for S-100 shall be defined to ensure consistency across S-100 product specifications. The insurance of the consistency of the application schema is a part of the responsibility of the Field Manager and is part of the overall development of a product specification.

7   The documentation of an application schema in UML may utilise the documentation facilities in the software tool that is used to create the application schema, if this information can be exported.

8   If a CLASS or other UML component corresponds to information in a *Feature Catalogue*, the reference to the catalogue shall be documented.

9   Documentation of feature types in an application schema shall be in a catalogue with a structure derived from the General Feature Model, such as in a *Feature Catalogue*.

10   This could be in text format or XML accompanied by a style sheet (XSLT) used to create a text version.

For a detailed description of Application Schemas see *S-100 Part 3.* [2]

2.4.3. GENERAL FEATURE MODEL

The content of a data product is structured in terms of objects. The general feature model has two concepts for objects.

1   *Features* defined together with their properties.

A feature is an abstract representation of real world phenomenon. Features have two aspects – feature type and feature instance. A feature type is class and is defined in a *Feature Catalogue*. A feature instance is a single occurrence of the feature type and represented as an object in a data set.

2   Information Types – An information type is a class of object that is defined in a *Feature Catalogue*.

An instance of an information type is an identifiable unit of information in a data set. Information types have only thematic attribute properties. An instance of an information type may be associated with one or more feature instances or other instances of information type.

An example of a feature could be a buoy and an example of an information type could be a maintenance report for a buoy.

See *S-100 Part 3*.

2.4.4. ATTRIBUTE TYPES

The class S100_GF_AttributeType is the S-100 realization of GF_Attribute Type. It is largely identical to the ISO 19109 class but differs in the following way: 1). The association attribute Of Attribute is not realised in the S-100 General Feature Model (GFM). S-100 introduces, instead, the concept of complex attributes. Complex attributes are described further in ISO 19109 sub clause 7.4.

2.4.5. GEOMETRY TYPES

S-100 includes definitions of 1D and 2D geometry types. If a geometry type is required that is not specified in S-100 Part 7 Spatial Component, an application shall be submitted to the Transfer Standard Maintenance and Application Development Working Group (TSMAD) for it to be added to the framework.

3.   EXAMPLES OF THE PRODUCT SPECIFICATION PROCESS

In the next sections some examples are given on how to develop the content for a product specification. Some real situations are given and the derivations of some of the main information items are explained. The information gained from this process can then be transformed into a product specification by using the Template.

3.1.   CONCEPTUAL VIEWPOINT

Figure 6, taken from ISO 19109, illustrates the process of converting a real situation into a geographic data model:
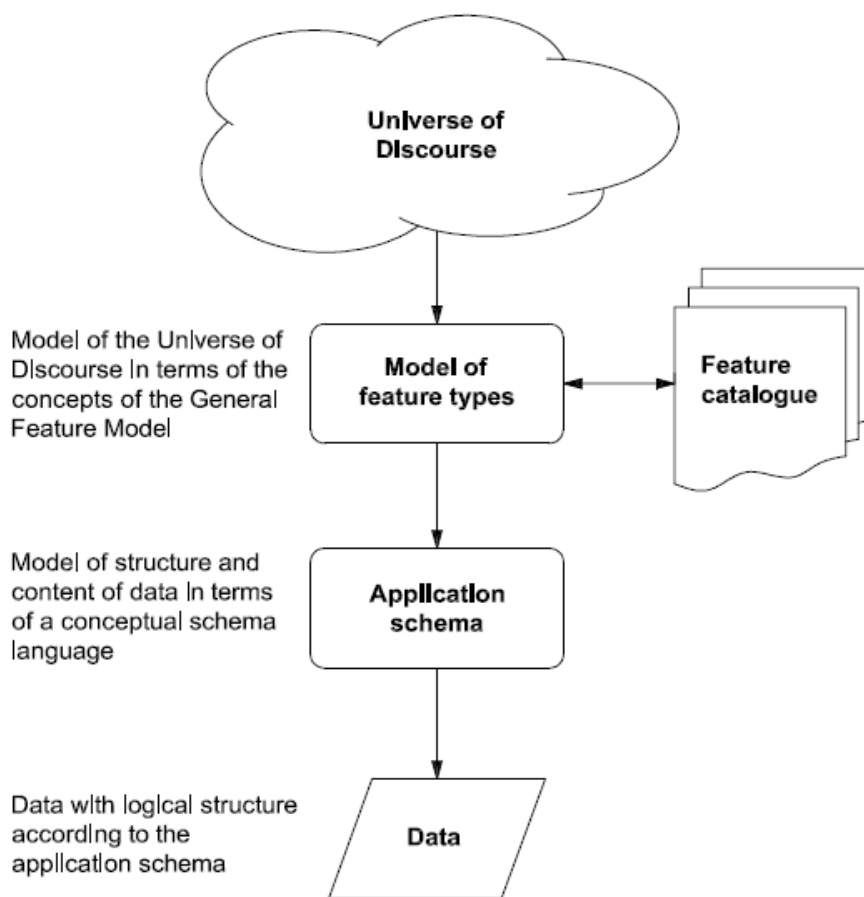
Figure 6   Process of converting a real situation into a geographic data model

Figure 6, shows how a defined view of the world in a given context or 'universe of discourse' is used as the basis for modelling features. These features can be represented in a conceptual schema language such as UML as an application schema and can be stored in documents called feature catalogues. Data then conforms to the structure and content of the application schema and consequently as reflected in the feature catalogue.

The flow diagram in Figure 7 is based on S-100 Appendix A and shows the process for a geospatial product, which could include vector and coverage data. In effect this is a more detailed view of Figure 6 showing the steps that the process follows.

Figure 7   Product specification process
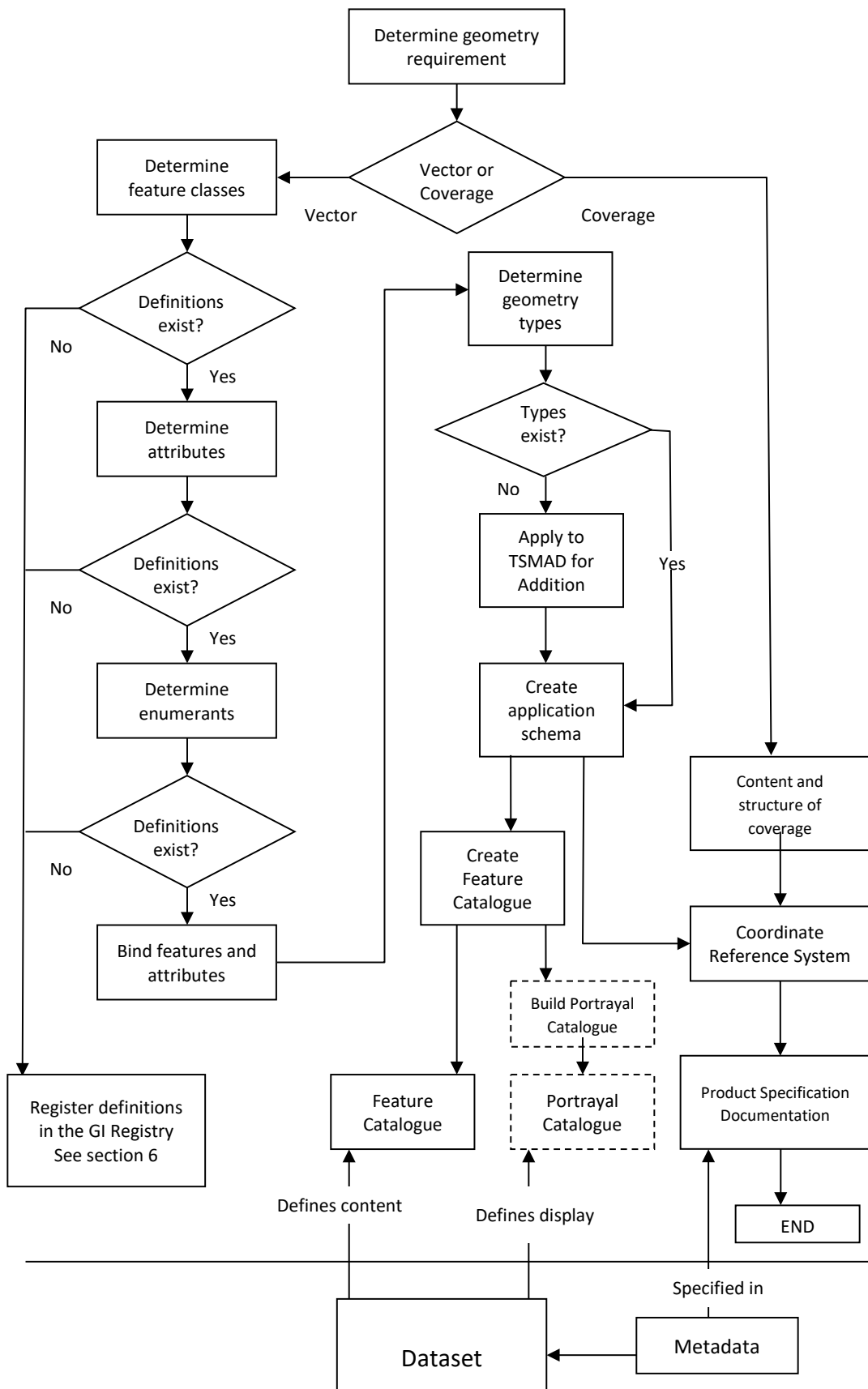
3.1.1. KEY STEPS

The following are key steps when developing S-100 based product specifications.

3.1.1.1. Determine geometry requirement

The first step in developing the specification is to determine whether the data will be discrete or continuous. A product specification may include both discrete and continuous data and these can be scoped separately.

Vector Geometry or Coverage-based

Geographic phenomena fall into two broad categories — discrete and continuous. Discrete phenomena are recognisable objects that have relatively well-defined boundaries or spatial extent. Examples could include buildings, or aids to navigation. Continuous phenomena, such as radio signal strength or ground elevation, vary over space and have no specific extent. A value or description of a continuous phenomenon is only meaningful at a particular position in space (and possibly time). Signal strength, for example, takes on specific values only at defined locations, whether measured or interpolated from other locations.

3.1.1.2. Determine classes and attributes and relationships

The next step is to identify groups or classes into which the data objects fall and their associated attributes and relationships. The data objects, classes and attributes may have already been defined for another application and those existing definitions should be used. If not, then new definitions will need to be created. S-100 uses two specific object types, the feature type for objects that have attributes and geometric properties and the information type which is an object with no geometric properties. Information types can be associated with feature types.

EXAMPLE: Aids to Navigation are discrete phenomena, which can be divided into two classes: fixed and floating. As they carry a position these would be feature types in S-100. Their properties would be defined as attributes, such as shape, colour and name.

An AtoN Report could be an information type carrying details of the report, date and the author.

Note: Attributes other than geometric properties are considered thematic attributes. These can be simple or complex. A simple attribute carries a descriptive characteristic usually a value of a given type e.g., text, date, Boolean integer. A complex attribute is a property composed of one or more simple attributes known as sub attributes.

3.1.1.3. Create application schema

The next step is to create a model (schema) of the application. This can either be a logical model or a physical model.

EXAMPLE: A logical (conceptual) model can be created in Unified Modelling Language (UML). A physical (encoded) model can be created in Extensible Mark-up Language (XML).
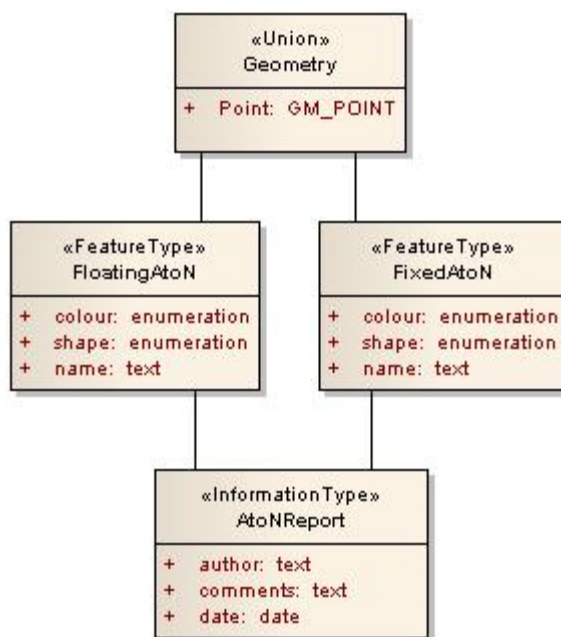
Figure 8   Example model in UML

If the application involves complex structures or relationships, these can more easily be visualised in UML and the resulting logical model should be included in the Product Specification. In some cases, it is possible to generate the physical model automatically from the logical model.

In S-100 application schemas are realised in a Feature Catalogue that is encoded in XML. This defines the features, information types and attributes used within a data product.

3.1.1.4.   Co-ordinate Reference System

The appropriate Co-ordinate Reference System (CRS) must be determined for the data product. It could be horizontal and vertical coordinate reference systems.

EXAMPLE:

WGS84 (World Geodetic System of 1984) should be used for the horizontal reference system for spatial data. WGS84 should be used as the reference ellipsoid. The data producer must undertake any conversion.

3.1.1.5.   Units of measure

Measurement units need to be specified.

EXAMPLE: metres (m), nautical miles (NM).

3.1.1.6.   Data Quality

Accuracy of data and validation procedures should be indicated.

EXAMPLE: +/- 1 m (95% probability) measured against a given reference system.

3.1.1.7.   Maintenance

The ownership of the specification and the revision arrangements should be shown.

EXAMPLE: IALA Committee XYZ is responsible for revising this Product Specification annually.

3.1.1.8. Portrayal

Portrayal is optional in S-100, but if included, provides the rules for display and symbology, which apply to the data defined in this specification and should be described in a Portrayal Catalogue.

EXAMPLE: Display and symbols should be in accordance with IMO *SN Circ. 243*.

3.1.1.9. Data format (encoding)

Encoding needs to be discussed, options include XML and GML (Geography Markup Language).

For some products a web service such as an OGC Web Feature Service (WFS) may replace traditional encoding formats.

The following example (Figure 9) shows an XML encoding for buoys, taken from a model produced by the General Lighthouse Authorities, put in a form of XML being developed by the UK Hydrographic Office for S-100 Product Specifications.

```
<?xml version="1.0" encoding="utf-8" ?>
<s100:FeatureCollection xmlns:s100="http://www.iho.int/S-100"
xmlns:a104="http://www.iala-aism.org/A-104"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xlink="http://www.w3.org/1999/xlink" xsi:schemaLocation="http://www.iala-
aism.org/A-104 A-104XMLSchema.xsd">
   <s100:featureMember>
    <a104:BuoySpecialPurposeGeneral s100:id="F1">
      <a104:featureName>AFAN OUTFALL INNER</a104:featureName>
      <a104:buoyShape>spherical</a104:buoyShape>
      <a104:categoryOfSpecialPurposeMark>pipeline
mark</a104:categoryOfSpecialPurposeMark>
      <a104:colour>yellow</a104:colour>
      <a104:depth>8.1</a104:depth>
      <a104:topmark>
              <a104:topmarkShape>x-shape (St. Andrew's cross)</a104:topmarkShape>
              <a104:topmarkColour>yellow</a104:topmarkColour>
      </a104:topmark>
      <s100:Point><s100:pos>-3.90093 51.58994</s100:pos></s100:Point>
    </a104:BuoySpecialPurposeGeneral>
   </s100:featureMember>
   <s100:featureMember>
    <a104:Lights s100:id="F2">
      <a104:signalPeriod>10</a104:signalPeriod>
      <a104:signalGroup>(1)</a104:signalGroup>
      <a104:colour>yellow</a104:colour>
      <a104:lightCharacteristic>flashing</a104:lightCharacteristic>
      <a104:lightDescription>Fl.Y.10s</a104:lightDescription>
      <s100:Point><s100:pos>-3.90093 51.58994</s100:pos></s100:Point>
    </a104:Lights>
   </s100:featureMember>
</s100:FeatureCollection>
```

Figure 9   Example of XML Schema for Buoys (GLA/UKHO)

3.2. EXAMPLE PRODUCT SPECIFICATION FOR ATON MANAGEMENT DATA

Development process of product specification and consideration for AtoN management data.

3.2.1. STEPS FOLLOWED

3.2.1.1. Determine the target domain

- Determine the target domain for developing Product Specification e.g.) AtoN, VTS, IVEF, etc.
- If there is not the target domain in the GI registry, propose a new domain (to the Hydrographic Services and Standards Committee (HSSC) [S-99]).

3.2.1.2. Determine geometry requirement

- Determine whether the scope will be feature based (i.e., use vector geometry) or coverage-based. [S-100 Part 11].
- According to the specification scope, development process of the product specification will be different. [S-100 Part 11].
- AtoN management data is feature based data.

3.2.1.3. Register Definitions in appropriate Feature Concept Dictionary (FCD) Register

Determine features, feature attributes, enumerated values in the product e.g., features and feature attributes related to AtoN.

Navguide2010			
Level1	**Level2**	**Level3**	**Comments**
AtoN			visual AtoN
	FixedAtoN		
		LightHouse	staffed facility/automated facility
		Beacon	
		Sector Light	
		Leading Line	pair of beacons
	FloatingAtoN		
		Buoy	minor floating aton
		LightVessel	major floating aton
		LightFloat	major floating aton
		LANBY	major floating aton large navigational buoy
	Racon		supplementary AtoN
	Light		supplementary AtoN
	DGPS		supplementary AtoN
	AtoNAIS		supplementary AtoN
	SoundSignal		supplementary AtoN

Figure 10   AtoN items in the IALA NAVGUIDE 2010

lateral mark	
	port hand mark
	starboard hand mark
	preffered channel to starboard
	preffered channel to port
cardinal mark	
	north
	east
	south
	west
isolated danger mark	
safe water mark	
special mark	
new danger mark	

name	Text
id	Text
code	Text
number	Integer
colour	Colour
colourpattern	ColourPattern
shape	Text
establishedDate	Date
surveyedDate	Date
daymark	Mark
position	Point
includelight	Light
includeAIS	AtoNAIS
includeRacon	Racon
includeDGPS	DGPS
includeSiren	SoundSignal

Figure 12   Attributes for AtoN items (Derived from the IALA NAVGUIDE 2010)

- If required definition is already in the existing FCD register, select the item.

- If required definitions do not exist in the existing FCD registers, register definitions in the most appropriate feature concept dictionary. S-99 is then applicable.

> **Sector light:** A light having sectors of different colours or the same colour in specific sectors separated by dark sectors.
> **Light sector** : As defined by bearings from seaward, the sector in which a navigational light is visible or in which it has a distinctive colour difference from that of adjoining sectors, or in which it is obscured.
> **Lighthouse**: A distinctive structure exhibiting a major navigation light.
> **Leading line**: On a nautical chart, a straight line, drawn through leading marks.

Figure 13   Examples of AtoN

- Feature Concept: AtoN, Light, Buoy, Mark, Beacon,,,,

- Attribute Concept: name, id, height, colour, shape, established_date, iala_region,,,,

- Enumerated value concept:

  Example) red, blue, orange, black, white,,, (enumerated_values for the attribute 'colour')

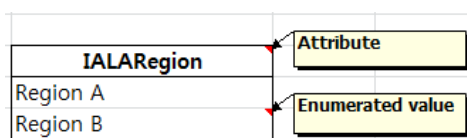 Example) region_A, region_B (for iala_region)

Figure 14   Regions

3.2.1.4.   Create Feature Catalogue

- Registered items in a feature concept dictionary are independent sets of definitions of features, attributes, enumerated values, and information types.

- Registered items drawn from one or more feature concept dictionaries are bound to describe characteristics of features in the AtoN domain.

- In a feature catalogue, item types, for example, features and attributes, are bound together.
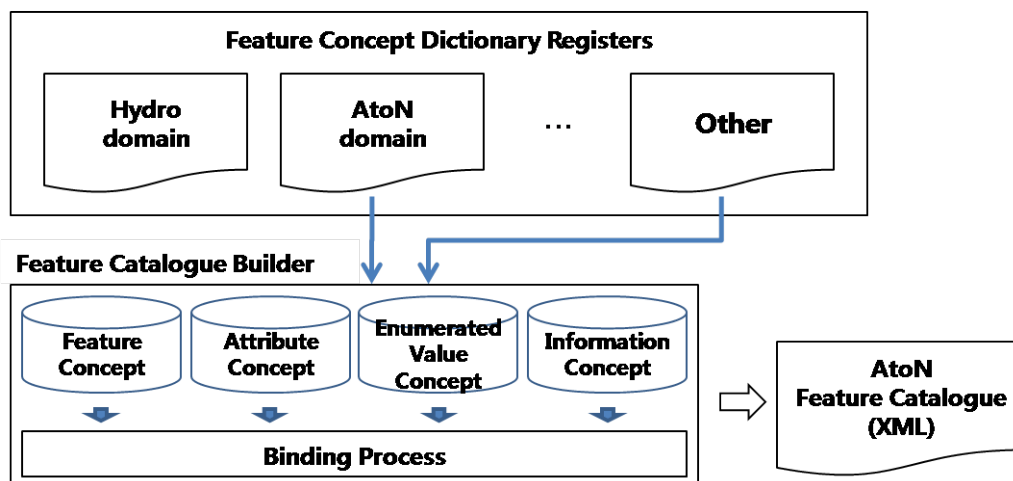

Figure 15   Concept diagram of feature catalogue builder

- In addition, constraints, units of measurement and format descriptions of attributes can be specified. [S-100 Part 2a].

- Feature concept, attributes concepts, and enumerated value concepts are bound together and described in the AtoN feature catalogue in XML.
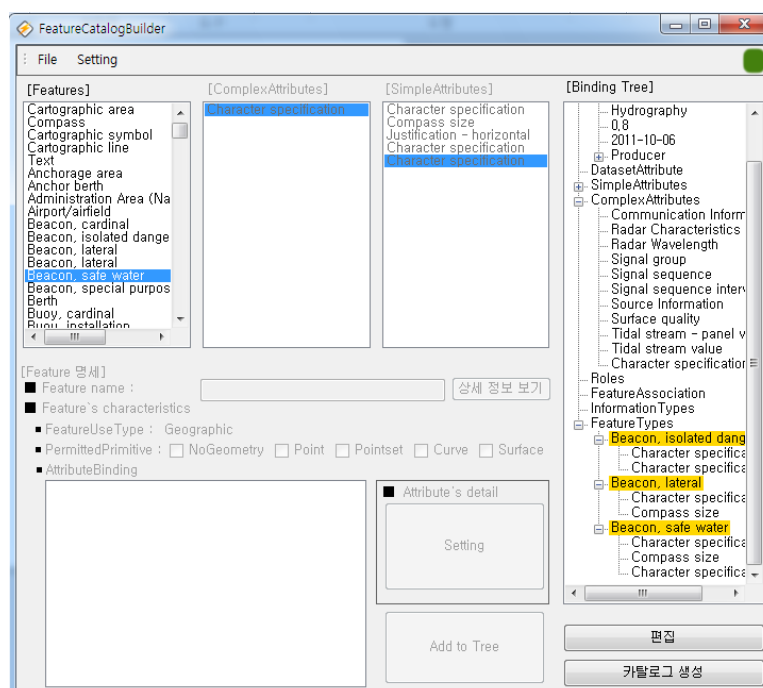

Figure 16   Examples of Feature Catalogue Builder (developed by Dongseo Univ)

A feature catalogue builder is a program that supports creation of a feature catalogue in XML.

3.2.1.5.   Create Portrayal Catalogue

- Create a portrayal catalogue that specifies symbology and presentation guideline of features in the feature catalogue.

- A Portrayal Catalogue Builder will support creation of a portrayal catalogue.

3.2.1.6.   Profile metadata model

- Profile metadata model for describing AtoN data set.

3.2.1.7.   Determine encoding format and delivery

- Determine encoding format and delivery of AtoN data set.

3.2.1.8.   Product Specification

- Based on all previous steps the information is complete and the template can be filled in.

  When the template is complete the product specification (PS) is finished and can be submitted.

4.   IALA PRODUCT SPECIFICATION PROCESS

In the previous sections, information was provided about the S-100 GI-Registry and how this will foster the e-navigation concept. Furthermore, an introduction was given regarding the development of product specifications. For the development of product specification within the IALA domain a flowchart was developed. The flowchart, as seen in Figure 17 on the next page, together with the product specification template can be used as a reference in the development of future product specifications.
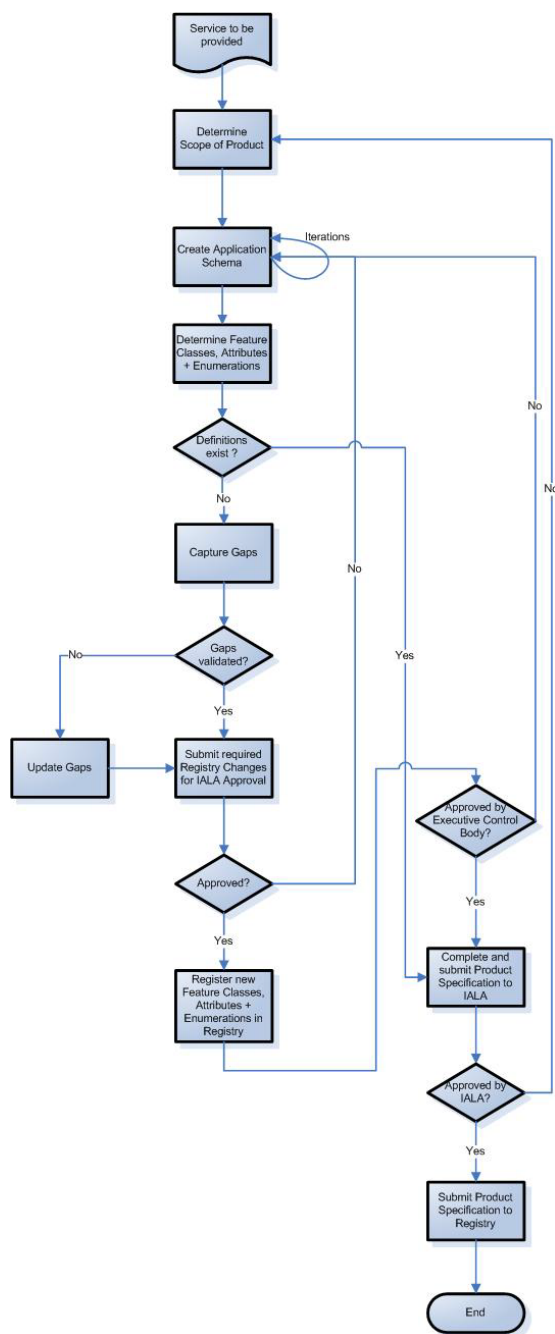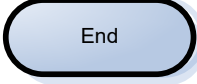
Figure 17   IALA Product Specification Process

Since a flowchart cannot contain the full context of the steps in de process. The steps of the process as seen in Figure 17 are briefly explained in 0.

Table 2   Elaboration on product specification process flow chart

Service to be provided	The entry point assumes there has been the necessary discussion within the IALA organisation, which has endorsed the action to create an S-200 series product specification. This action includes setting up the task group that will develop the product specification.
Determine Scope of Product	The task group refines the scope into the product specification, utilising the Product Specification Template. Procedures, item types etc. are a part of the scoping. What is the product supposed to do, is it for regional use or global use etc.
Create Application Schema	The task group develops the application schema using all required feature classes, attributes and enumerations. This process can lead to a revised list of needed feature classes, attributes and enumerations. Typically, the development process includes a number of iterations as the group refines the application schema. The outcome is a consensus S-100 compliant application schema.
Determine Feature Classes, Attributes + Enumerations	The task group makes an initial determination of the needed feature classes, attributes and enumerations. This process includes investigation of related domains for existing definitions and models that can be used for guidance.
Definitions exist ?	The task group checks for definitions of needed feature classes, attributes and enumerations in the GI registry. If all definitions exist, then the product specification can be finished and submitted.
Capture Gaps	Any gaps (missing/inadequate definitions) discovered in the search for definitions are captured for later reference.
Gaps validated?	The previously identified gaps (missing/inadequate definitions) are validated against the consensus application schema as there may be revisions introduced during the iteration process.
Update Gaps	If the previously identified gaps (missing/inadequate definitions) require revision (due to added gaps, eliminated gaps, changed gaps, etc.) these are captured for submission to the GI registry. For the submission of changes or creation of new item types a form is available, see Appendix 2.
Submit required Registry Changes for IALA Approval	Identified gaps are submitted to IALA Domain Control Body for approval of submission to the registry using the required form.
Approved?	If submission is approved, the new definitions can be registered as proposals on the GI registry, else the submission is sent back to the task group for further revisions.
Register new Feature Classes, Attributes + Enumerations in Registry	Registering the new proposals is done by the IALA Domain Control Body or by someone designated to do this task.

Approved by Executive Control Body?	The submitted proposals will be reviewed by the GI Registry register managers and possibly the Executive Control Body for validity. If rejected, the proposal is sent back to the task group for revision.
Submit Product Specification to IALA	With all needed definitions registered in the GI Registry, the product specification can be completed and submitted to IALA for review and approval.
Approved by IALA?	During the review and approval process as described in chapter 3 IALA can determine if the draft product specification needs further improvements or decide it is completed. If further improvements are needed, the draft product specification is sent back to the task group.
Submit Product Specification to Registry	Once complete, the task group can be requested by IALA to submit the finished product specification to the Product Specification Register manager.
End	All done.

5.   DEFINITIONS

The definitions of terms used in this IALA Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at http://www.iala-aism.org/wiki/dictionary and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

6.   ABBREVIATIONS

AIS	Automatic Identification System
AtoN	Aid(s) to Navigation
CMDS	Common Maritime Data Structure
CRS	Co-ordinate Reference System
DGPS	Differential Global Positioning System
DNP	Distributed Network Protocol
ENC	Electronic Navigation Chart
FCD	Feature Concept Dictionary (IHO)
GF	General Feature
GFM	General Feature Model (IHO)
GI	Geospatial Information *Registry* (IHO)
GLA	General Lighthouse Authority(ies)
GML	Geography Markup Language
HMI	Human-machine interface
HSSC	Hydrographic Services and Standards Committee (IHO)
IEC	International Electrotechnical Commission

IHO	International Hydrographic Organization
IMO	International Maritime Organization
ISO	International Organization for Standardisation
IVEF	Inter VTS Exchange Format
LANBY	Large Automatic Navigation BuoY
MSP	Maritime Service Portfolio
NAV	Sub-Committee on Safety-of-Navigation (IMO)
OGC	Open Geospatial Consortium
Racon	Radar beacon
SN Circ.	Safety of Navigation Circular (IMO)
S-57	IHO Transfer Standard for Digital Hydrographic Data
S-99	Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry (IHO)
S-100	Geospatial Information Registry (IHO
TSMAD	Transfer Standard Maintenance and Application Development Working Group (IHO)
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UML	Unified Modelling Language
VTS	Vessel traffic service(s)
WFS	Web Feature Service
WGS84	World Geodetic System 1984 (Reference co ordinate system used by GPS)
XML	Extensible Markup Language
XSLT	EXtensible Stylesheet Language
1D	One dimensional
2D	Two dimensional

7.   REFERENCES

[1]   IHO. S-99 Operational Procedures, version 1.1.0 November 2012

[2]   IHO. S-100 Universal Hydrographic Data Model, version 2.0.0. June 2015

[3]   IALA. Guideline G1087 Procedures for the Management of the IALA Domains under the IHO GI Registry

ANNEX A   IALA PRODUCT SPECIFICATION TEMPLATE

See IALA Guideline *G1106-1 IALA Product Specification Template.*

ANNEX B   PROPOSAL FOR ADDITIONAL S-100 FEATURE CONCEPT DICTIONARY ITEM - TEMPLATE NAME OF PROPOSED FCD ITEM

See IALA Guideline *G1106-2 Proposal for Additional S-100 Feature Concept Dictionary item – template.*

ANNEX C   PRODUCT SPECIFICATION UNDER DEVELOPMENT - TEMPLATE

See IALA Guideline *G1106-3 Product Specification under development - template.*