Paper for consideration by NIPWG

Use cases for association classes

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Executive Summary:	This paper describes use cases for association classes.
Related Documents:	(1) S-100 Edition 2.0.0; (2) TSMAD21-4.2.1; (3) TSMAD22/DIPWG3-03D
Related Projects:	

1   Introduction/Background

Following discussions within SNPWG about 2010, and a Jeppesen paper to TSMAD 21 arguing for the addition of UML association classes to the S-100 GFM, TSMAD updated the GFM to make associations "identifiable structures (like) feature and information types", and so that "associations can carry thematic attributes and have roles". The changes in essence added association classes to the S-100 GFM.

A UML association class is defined as "a declaration of a semantic relationship between classifiers, which has a set of features of its own. The features of an association class do not belong to any of the connected classes, but to the association itself. An association class is both an association and a class." (OMG Unified Modeling Language Superstructure, V. 2.0. http://www.omg.org/spec/UML/2.0/)

2   Overview

The use case for association classes is basically "whenever a relationship is characterized by one or more attributes." Examples are:

   i.   A specified set of vessels is COVERED by a regulation and another set of vessels is EXEMPT from the regulation.

   ii. Vessels with specified cargo & dimensions must use a specified pilot boarding place, vessels of smaller dimensions are recommended to use the boarding place, and warships are exempt from using the pilot boarding place.

Informally:-

   a)   **Applicability** describes the set of vessels: i.e., *who*.

   b)   **Regulations** provides the text of the regulation: i.e., *what*.

   c)   The association class **InclusionType** describes the relationship between *who* and *what*. That is, *who* must / need not / should / can do *what*.

   And -

   d)   A geographic feature defines a location or physical facility: i.e., *where*.

   e)   The association class **PermissionType** describes the relationship between *who* and *where*. That is, *who* can / must / should / need not use (or sail) *where*.

3   Use cases

Use case 1: Regulations applicable to vessels having certain characteristics

Sometimes the applicability of a regulation depends on vessel characteristics e.g., dimensions or cargo. At other times a regulation is generally applicable but certain types of vessels are explicitly exempted from it. The relationships between the operative part of the regulation (what must be done, or not done, or the restriction which must be obeyed) and different sets of vessels is thus one of the set {"mandatory", "exempt"}. These are distinct

categories of the concept "applicability of a regulation" and mutually exclusive (a vessel cannot be both "exempt from" and "mandatorily subject to" a requirement to carry a pilot).

Use case 2: Permissibility of location, or use of facility, depends on vessel characteristics

Whether the use of a facility (e.g. a pilot boarding place) by a vessel is required, recommended, permitted, or prohibited sometimes depends on vessel characteristics. That is, use of a pilot boarding place is mandatory for vessels of certain dimensions, recommended for other dimensions, and not needed for vessels below a certain tonnage or length. There are several examples of this in nautical publications, often concerning pilot boarding places and vessel dimensions or type of cargo. Here too the relationships are categories of a single concept and mutually exclusive (they are distinct categories of "use-requirement". The figure below depicts examples of both use cases in an UML application schema, in one diagram[1].
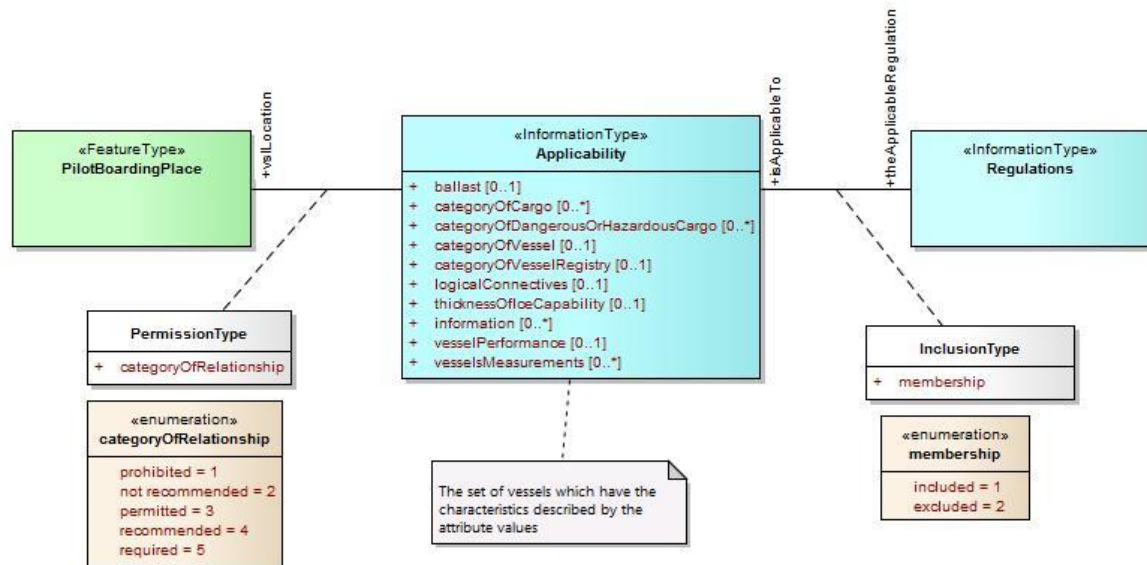

Figure 1. Use cases for modeling with association classes

Anti-Use case:

Without association classes, it would be necessary to define each relationship individually (Figure 2). We also have to define a constraint that prevents inconsistencies (e.g., a vessel being both included and exempt from a regulation – not shown in the figure). The problems with this are:

- It is complex and duplicative.

- It loses the semantics about the different relationships being related to one another. Practically, this means that the application schema would have to include a constraint saying that any single pair of PILBOP and APPLIC instances can have at most one of the 5 relationships.

- If some future data product requires a relationship characterized by two independent enumeration attributes, the total number of associations required is literally multiplied – it will be the product of the number of allowed values for the two characteristics. E.g., if recommendations for use of boarding places are seasonal ("winter" and "not-winter"), a second attribute for "season" is required.

- Relationships characterized by numeric or date values either cannot be represented at all, or require a work-around (e.g., multiple co-located features with PERSTA/PEREND attributes, or periodic updates to datasets, which would have to be timed just right). Referring to the seasonal example above, if the season

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[1] Nautical publications applications schemas under development, especially S-122, are based on the same principles, but to reduce complexity the associations are made between **Applicability** and appropriate super-types and the sub-types inherit the associations. That is, **PermissionType** links **Applicability** and **FeatureType** which is the abstract super-type for all geographic features. **InclusionType** links **Applicability** and **AbstractRXN** which is the super-type for all four of **Regulations**, **Restrictions**, **Recommendations**, and **NauticalInformation**. The sub-types inherit the associations.

were characterized by dates (e.g., 1 NOV to 31 MAR every year for "winter", etc.) this would require use of a work-around.
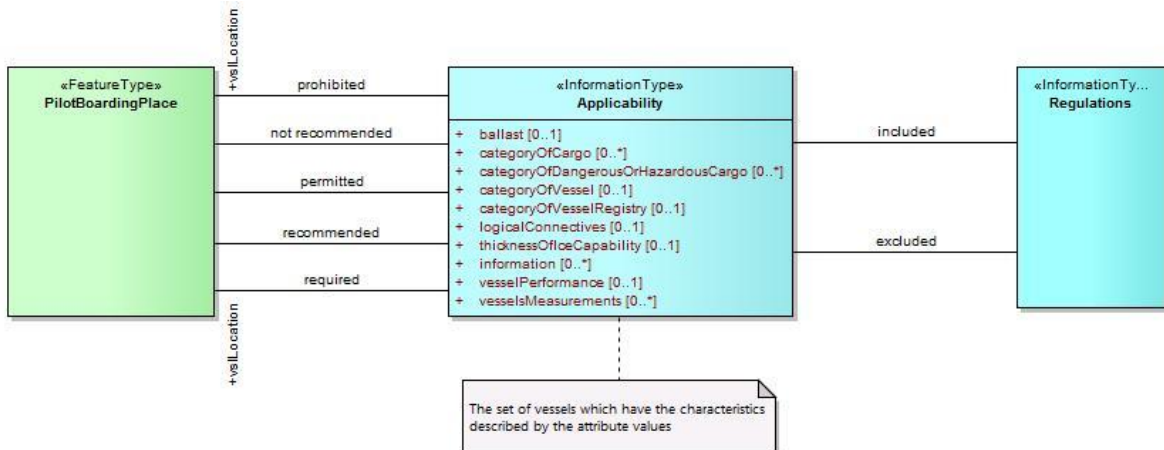

Figure 2. Application schema if association classes cannot be used

4   Examples

Examples of use are shown in the figure below.

Use of **PilotBoardingPlace PILBOP01** is required (*categoryOfRelationship*=5) for vessels carrying dangerous or hazardous cargo (**APPLIC01**/*categoryOfCargo*=7) but only recommended (*categoryOfRelationship*=4) for tankers not carrying hazardous cargo (**APPLIC02**/*categoryofVessel*=3 & *information*). No statement is made about vessels not falling into one of the sets described by **APPLIC01** and **APPLIC02**.

The regulation contained in **REGLTS01** applies to (**INCTYP02**/*membership*=1) vessels of LOA > 65 feet (**APPLIC04**/*vesselsMeasurements*) but warships (**APPLIC03**/*categoryOfVessel*=10) are excluded (**INCTYP01**/**membership**=2).
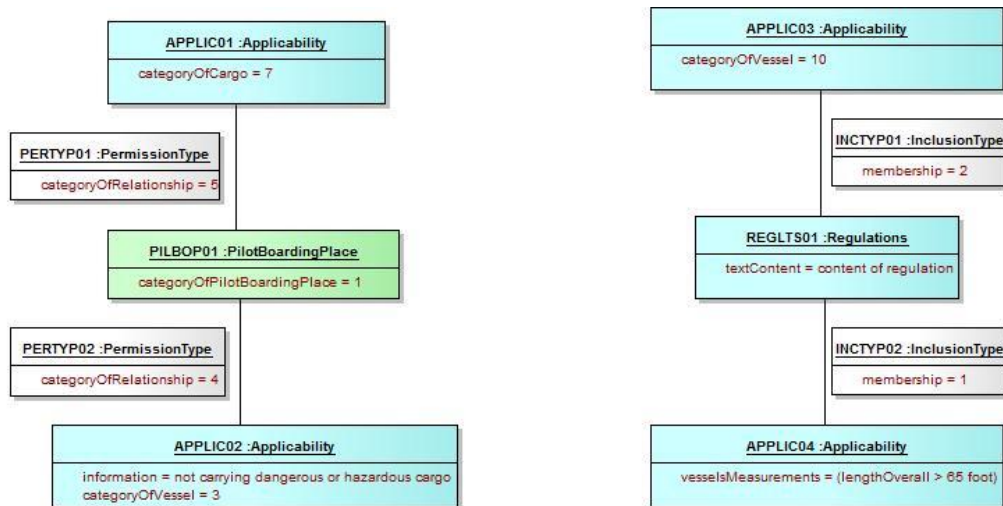

Figure 3. Examples of use in data

5   Actions Requested

NIPWG is invited to:

-    note this paper.