MSP & INSPIRE Data Model:
Harmonizing Maritime Spatial Plans within the Europe

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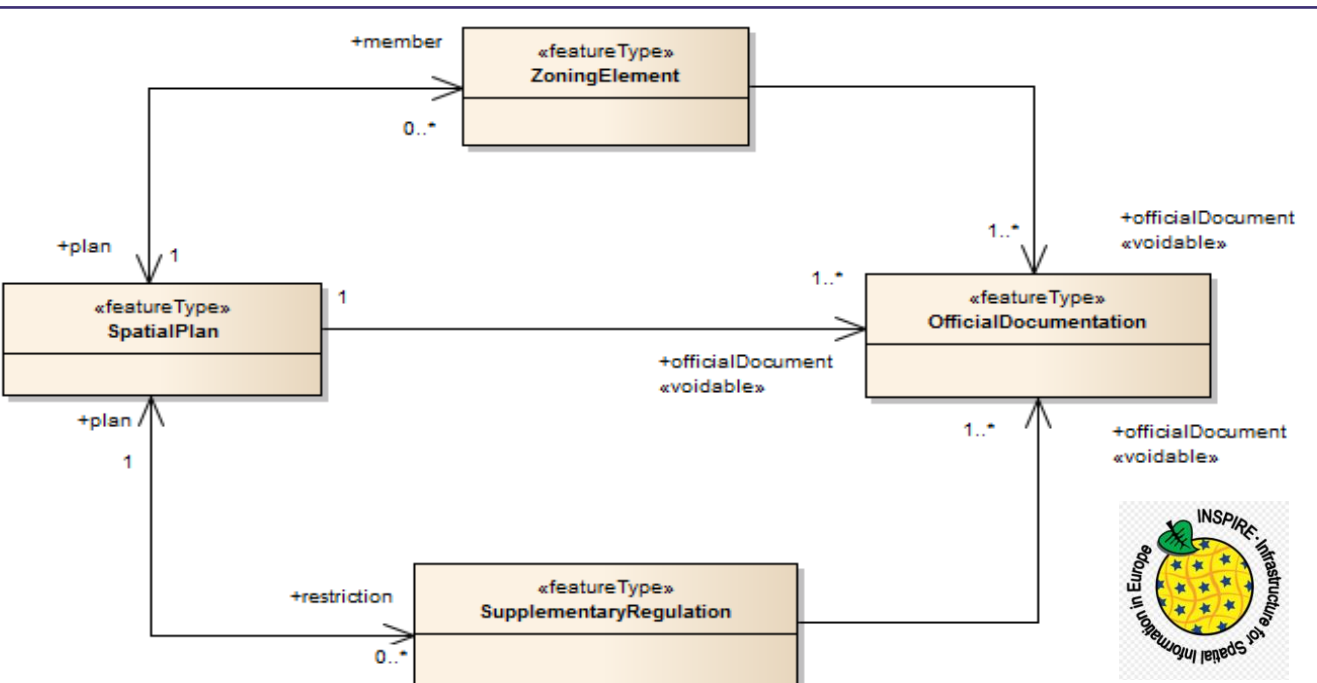
There are difficulties in harmonizing maps, spatial data and products of maritime spatial plans between countries (or regions) that share the same marine (sub) region. Different zoning elements across borders can have a great influence on each other. Cross-border governance needs optimal models and tools that provide an agile framework for spatial planning between countries, applying standards, plus a common symbology and data structure. Solution was developed (*) for harmonization of **Maritime Spatial Planning** (**MSP**), applying standards and principles of the European Directive on **Spatial Information Infrastructure in Europe** 2007/2/EC (**INSPIRE**).

Figure 1: UML (reduced) overview of the Planned Land Use application schema
Source: https://inspire.ec.europa.eu/id/document/tg/lu

Initially, the INSPIRE data model for terrestrial planning (Planned Land Use –Figure 1) was tested to see if it could be applied for Maritime Spatial Planning. Tests pointed out that the terrestrial data model is robust, and can map MSP's, but it tends to lose detail and specific information on marine uses.

Planned Land Use INSPIRE data model was adapted for Maritime Spatial Planning.

The **Planned Land Use** includes conceptual data model that consists of four features types (Figure 1).

Zoning Element were extended into the **MSP_Zoning Element** (Figure 4), including two additional attributes:

1. **hilucsMSP -** describing and classifying maritime zoning activity, applying values of **extended Hierarchical INSPIRE Land Use Classification System (HILUCS)**, for maritime zoning. Extended HILUCS is a code list on maritime uses (Figure 2), available as a register.
http://www.geoportal.ulpgc.es/registro/plannedLandUse/HilucsExt/

2. **verticalDistribution -** model was adapted to 3D introducing within the zoning **Vertical Distribution component,** that provides information where the maritime activity is taking part: surface and/or water column and/or seabed and/or subsoil (Figure 3).

HILUCS Extended register

Description: This is the HILUCS Extended register developed by Ecoaqua Institute in order to cover Marine Spatial Planning specific features. It includes original records referenced by original links and extended record clearly identified and explained.
Code list on maritime uses is still open for the data providers suggestions and it can be extended to required details. To propose new term for extended HILUCS, just mail us and we will include new term if appropriate, no later than a three days.

Childs:
primary production
secondary production
tertiary production
transport networks logistics and utilities
residential use
other uses

Throughout all the process, for the conceptual data modeling was used Unified Model Language (UML) is applied. Also the drafting of a data specification document that provides details on how to apply the MSP INSPIRE data model (**).

Figure 4: MSP_Zoning Element: Zoning Element extended with HILUCS MSP attribute. // Source: **

```
«featureType»
MSP_ZoningElement

+ inspireId: Identifier
+ geometry: GM_MultiSurface
+ hilucslandUse: HILUCSValue [1...*]
+ hilucsMSP: marineNarrowerHILUCSValue [1...*]
+ regulationNature: RegulationNatureValue
+ verticalDistribution: verticalDistributionValue [1..4]

Voidable
+ Valid from: Date [0..1]
+ Valid to: Date [0..1]
+ hilucsPresence: HILUCSPresence
+ specificLandUse: LandUseClassificationValue [1...*]
+ specificPresence: SpecificPresence
+ processStepGeneral: ProcessStepGeneralValue
+ backgroundMap: BackgroundMapValue
+ dimensioningIndication: DimensioningIndicationValue
```

```
«codeList»
VerticalDistributionValue

+ seaSurface
+ waterColumn
+ seaBed
+ subSoil

tags
asDictionary: True
extesibilty: Narrower
vocabulary: http://www.geoportal.ulpgc.es/registro/plannedLandUse/HilucsExt/
```

Figure 3: INSPIRE Data model adaptation for MSP: VerticalDistributionValue. // Source: **

Styled Layer Descriptor for the MSP INSPIRE Data Model:

In order to harmonize the portrayals, a SLD has been development. Once the symbology has been designed in QGIS (or imported to QGIS) (see Figure 5), it was necessary to export the XML format to the standard SLD format. The SLD is a profile of the Web Map Service (WMS) Encoding Standard, and both are OpenGIS® standards. A SLD defines an encoding to allow the users to define a symbolisation and colouring of geographic feature and coverage data. (https://www.ogc.org/standards/symbol). Finally, to apply the style to a map service in a web server must be used a SLD file with the "style manager" must be imported and will then be available for use (see Figure 6). MSP SLD and other resources and can be downloaded (http://www.geoportal.ulpgc.es/marsp/).

MSP INSPIRE Data model is successfully tested on Madeira MSP draft version, discussed with MSP and GIS experts, and currently published as tool for transboundary MSP. Data model has high potential to be used for the Land Sea interaction analysis and Cumulative Impact assessment, that will be studied, analyzed and tested within the new projects.

HILUCS Extended register (codelist values)

1_4_AquacultureAndFishing
  1_4_1_Aquaculture
    1_4_1_1_AquacultureSeaWater *
    1_4_1_2_AquacultureBrackishWater *
    1_4_1_3_AquacultureFreshWater *
  1_4_2_ProfessionalFishing
    1_4_2_1_FishingLine *
    1_4_2_2_HandLine *
    1_4_2_3_Trap *
    1_4_2_4_BeachTrawl *
    1_4_2_5_MorayTrap *
    1_4_2_6_TrammelNet *
    1_4_2_7_LiveBait *
    1_4_2_8_PoleLine *
    1_4_2_9_JiggerFishing *
    1_4_2_10_Others *
  1_4_3_SeaweedCultivation *
  1_4_4_RecreationalFishing *

2_4_EnergyProduction
  2_4_1_NuclearBasedEnergyProduction
  2_4_2_FossilFuelBasedEnergyProduction
  2_4_3_BiomassBasedEnergyProduction
  2_4_4_RenewableEnergyProduction
    2_4_4_1_RenewableEnergyProductionWind *
    2_4_4_2_RenewableEnergyProductionCurrent *
    2_4_4_3_RenewableEnergyProductionThermal *
    2_4_4_4_RenewableEnergyProductionWave *
    2_4_4_5_RenewableEnergyProductionTidal *
    2_4_4_6_RenewableEnergyProductionOsmotic *
2_5_OtherIndustry

Figure 2: HILUCS Extended register – new values (marked with asterisks):
a) on level 1, Aquaculture and Fishing types (1_4_x)
b) on level 4, maritime Renewable Energy Production types (2_4_4_x)

Styles for the layer "LandUse.ZoningElement"

Aquaculture Fresh Water
Seaweed Cultivation
Recreational Fishing
Renewable Energy Production Wind
Renewable Energy Production Current
Renewable Energy Production Thermal
Renewable Energy Production Wave
Renewable Energy Production Tidal
Renewable Energy Production Osmotic
Renewable Energy Production
BlueBio Tech
Desalation
Nautical Sports
Beaches
Coastal Tourism
Maritime Services
Natural
Wreck
Archeological
Underwater Cultural Heritage
Others
Port
FishPort
Commercial Port
Cruises Ferries Port
Recreational Port
Harbours
Anchorage Area
Water Transport
Marine Traffic Lanes
OffShore Suply
Oil Line
Gas Line
SolidWaste Treatment
Water Waste Treatment
Marine Litter Location

Figure 5: Styles for the layer "LandUse.ZoningElement"

These symbols were designed, based on the HILUCS values, assigning different colors, patterns and styles of geometric frames to each level within his hierarchical structure. Source: **

Madeira MSP
Spatial Plan
Zonning Element
Supplementary Regulation

Zonning Element
Primary Production: Aquaculture
Primary Production: Professional fishing
Primary Production: Seaweed Cultivation
Tertiary Production: Financial, professional and information ser...
Tertiary Production: Maritime Services. Sports
Tertiary Production: Maritime Services. Coastal Tourism

Figures 7 and 8: Madeira and Islas Canarias Viewers (screenshots). Source:
http://www.geoportal.ulpgc.es/visor2/?json=mspmadeira.json#   http://www.geoportal.ulpgc.es/visor2/?json=mspcanarias.json#

Figure 6: Creating and load a Styled Layer Descriptor for MSP INSPIRE Data Model.