EnviroInfo 2011: Innovations in Sharing Environmental Observations and Information

Development of the reference model for the marine spatial data infrastructure Germany (MDI-DE)

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Abstract

Modelling is a necessity for the development of a spatial data infrastructure in particular when lots of partners are involved and many requirements should be met. The reference model for the marine spatial data infrastructure of Germany (MDI-DE) is the guideline for all developments inside this infrastructure and is based on the Reference Model for Open Distributed Processing (RM-ODP) and other reference models for federal states and Germany as a whole. The reference model is composed of several submodels which focus on different aspects of the marine data infrastructure. Because the undertaking is embedded in a series of regulations and developments this paper proposes two approaches on modelling scenarios for the Marine Strategy Framework Directive (MSFD) and the Water Framework Directive (WFD) using the Unified Modelling Language (UML).

1. Introduction to MDI-DE

Not only because of the INSPIRE (Infrastructure for Spatial Information in Europe) initiative the build-up of spatial data infrastructures (SDIs) is in full activity. But these SDI's are mainly created within a certain region and/or topic and thus we are faced with SDI's for federal states and administrative districts in Germany for instance. Yet these do not satisfy the needs of certain experts – in the marine domain for example. Scientific institutes, the public, politics and administration request specialized data and information of the coastal and marine domain which meet the specifications towards an integrated European maritime policy. That is why there is a need for thematic focussed SDI's which span over regional areas and are meeting the specialized requirements.

The Federal Ministry of Education and Research (BMBF) is currently funding the development of such a marine data infrastructure with the aim to integrate existing technical developments (NOKIS – a metadata database – and the spatial data infrastructure of the German Federal Maritime and Hydrographic Agency [GDI-BSH]) as well as merging information concerning the fields coastal engineering, hydrography and surveying, protection of the marine environment, maritime conservation, regional planning and coastal research. In figure 1 the structure, the participants and their affiliation to the subprojects is shown. The structure of MDI-DE was the result of the joint application of four participants. The applicants

- Federal Waterways Engineering and Research Institute (BAW, SP1 - "coastal engineering and coastal water protection"),
- German Federal Maritime and Hydrographic Agency (BSH, SP2 - "protection of the marine environment"),
- German Federal Agency for Nature Conservation (BfN, SP3 - "maritime conservation") and
- Professorship for Geodesy and Geoinformatics at Rostock University (GG, SP4 – "scientific accompanying research")

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are responsible for the subproject they applied for.

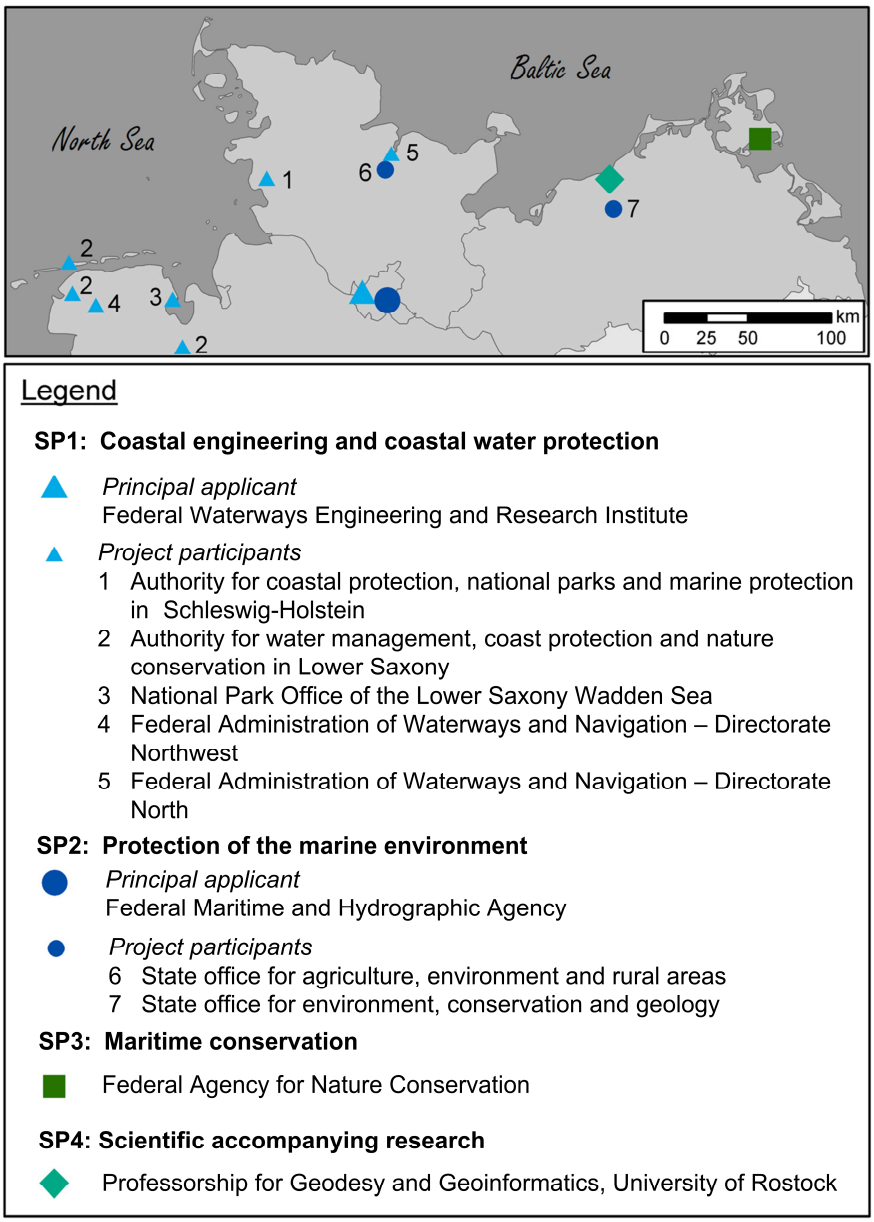

Figure 1
Project participants and their locations

As shown in figure 2 the undertaking is embedded in a series of regulations and developments on many administrative levels from which specifications and courses of action derive. On the European level it is – the already mentioned – INSPIRE initiative as well as the Marine Strategy Framework Directive (MSFD), the Water Framework Directive (WFD) and Natura2000 with their regulations counterparts for Germany and its federal states (MSRL, WRRL, FFH-RL, VS-RL).

To keep track of all the things mentioned and to give the marine data infrastructure (MDI-DE) a framework scientists at the Professorship for Geodesy and Geoinformatics at Rostock University are building a reference model, evaluating meta-information systems and developing models to map processes for the generation of reports for instance.

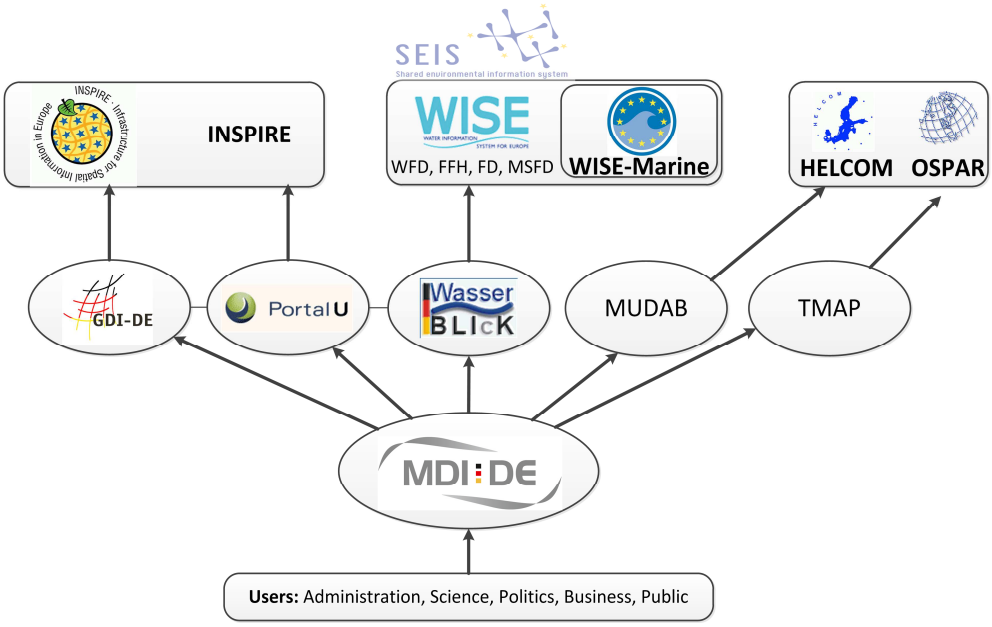

Figure 2
MDI-DE in the area of tension between German and European initiatives and infrastructures

2. Composition of the reference model

The model which is currently in construction is based upon the ISO Reference Model of Open Distributed Processing [RM-ODP] and several other already existing reference models aiming at modeling spatial data infrastructures (such as the SDIs for the federal states North Rhine-Westphalia [**Fehler! Verweisquelle konnte nicht gefunden werden.**] and Brandenburg [GIB 2004]). As figure 3 shows it consists of several submodels offering different views on the system and is being modeled with the help of the unified modeling language (UML).

The aims, requirements and interests of the participants towards the infrastructure are defined in the business model which corresponds to the *enterprise viewpoint* of RM-ODP. Certain scenarios – which are part of the process model and are modeled as workflows – are the base for modeling the business processes. The participants (or actors) and their roles inside the system are collected in the role model so that one can see if a certain actor holds what types of data for example. The flow of the scenarios and the state of the data inside the processes is described in the process model which corresponds to the *engineering viewpoint* of RM-ODP. This model devides the process in activities and shows the course of actions and the state of data. It is being modeled by activity and sequence diagrams. The architecture model corresponding to the *informational* and *computational viewpoints* of RM-ODP characterizes the technical components (e.g. services, interfaces and clients) as well as their functions and the interrelation between them.

Since the architecture is service-oriented mainly service types and their roles inside the scenarios are of main importance in this model. The precise realization of the architecture model leads to implementation specifications for which the implementation model is responsible. The implementation model corresponds to the *technology viewpoint* of RM-ODP and basically uses existing specifications to come to the implementation specifications. The existing specifications are expanded with profiles to match the requirements of the marine domain.

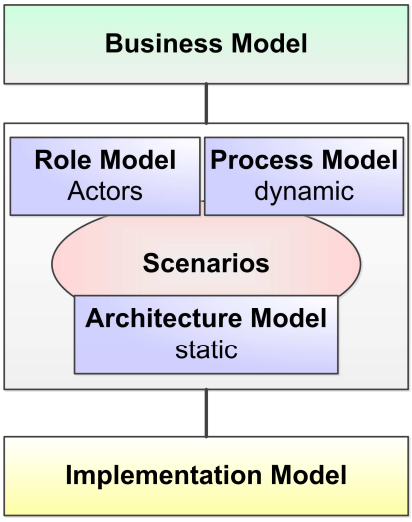

Figure 3
Components of the reference model (modified, see [BI10] and [GA03])

3. Modelling a scenario for the MSFD

This chapter models an exemplary scenario with UML diagrams, which are used to comply with the requirements of the MSFD. Because the modeling should be in step with actual practice as good as possible, an overview about the MSFD and the data this directive requires will be provided. Furthermore this chapter will model the flow enabling the actors to produce the reports the directive presupposes.

3.1 Outline MSFD

The marine strategy framework directive (MSFD) is a European directive and aims at achieving resp. maintaining a good environmental status (GES) for the seas. The directive calls in the member states to develop and implements strategies that protect and conserve marine environment, prevent its deterioration and – where applicable – restore damaged marine ecosystems. A first report described the current situation resp. condition, defined what a GES is and how the GES can be achieved and maintained. To measure the results on a regular cycle reports for the EU have to be prepared. For that purpose indicators were defined. These indicators will be evaluated and enter the evaluation of a superordinate descriptor. All eleven descriptors induce the total evaluation of the seas and the eleven descriptors are [MSFD-GES]:

1. Biological diversity
2. Non-indigenous species

3. Population of commercial fish / shell fish
4. Elements of marine food webs
5. Eutrophication
6. Sea floor integrity
7. Alteration of hydrographical conditions
8. Contaminants
9. Contaminants in fish and seafood for human consumption
10. Marine litter
11. Introduction of energy, including underwater noise

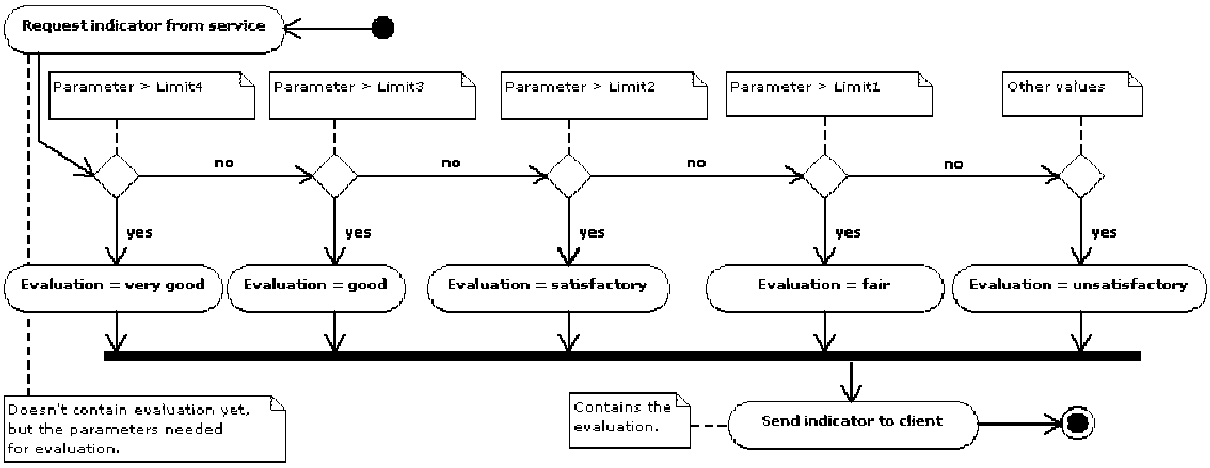

Figure 4
UML-activity diagram to evaluate an indicator (MSFD)

3.2 Modelling the construction resp. evaluation of indicators and descriptors

How the different submodels of the reference model interact with the connected UML diagrams is outlined by means of an exemplary scenario. In this scenario an actor has to evaluate indicators resp. descriptors to prepare a report to the EU for the MSFD.

The business model defined that the topic “MSFD” should have a high priority and the role model specified that the federal agency for nature conservation for instance has to deal with the MSFD in the sense that it records data needed for the reports to the EU. It gathers data about the population of sea birds (descriptor 1 of the MSFD) for example. The different roles of the role model can be recognized in the use-case diagrams. In figure 5 the federal agency for nature conservation could be principal or reviewer as well as both. The process model describes the operations of the scenario, inter alia, with activity diagrams. The activity diagram shown in figure 4 takes the use-case “Evaluation of indicators” off the use-case diagram (figure 5) and characterizes its course of actions. Firstly an indicator is requested from a service which contains the limits for evaluation. The parameter recorded then gets compared to the limits and if

it's under "limit4" but above" limit3" the indicator will be evaluated with "good" and sent back to the service. Figure 4 shows as well that the provision of indicators resp. descriptors uses services. This is a link to the architecture model which constituted the orientation towards the usage of services.

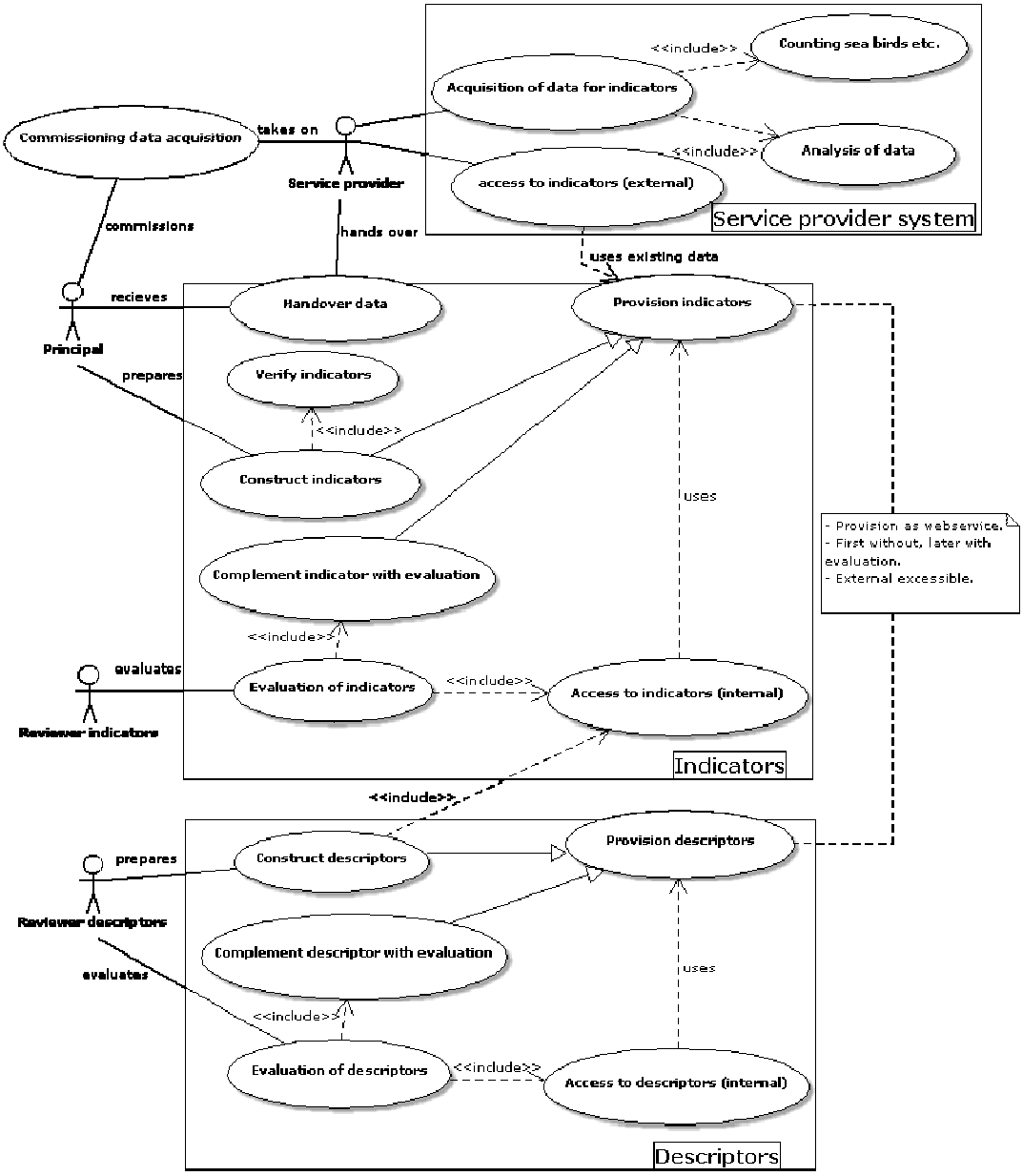

Figure 5
UML use-case diagram to construct resp. evaluate indicators and descriptors (MSFD)

4. Prospect on future activities

Regarding the reference model the works on the business model is completed thus the other submodels will be further refined and expanded e.g. with more models for other descriptors of the MSFD in the process model. Furthermore the implementation resp. architecture will be expanded by specifications on how to transform data to comply with INSPIRE specification of Annex III data themes. In the INSPIRE context test criteria will be defined and tests will be executed regarding performance and compliance of web services which expands the implementation model further.

Bibliography

AGILE11: Bauer, M., Wosniok, C., Lehfeldt, R.: Marine Modeling as a Service, AGILE Workshop: Integrating Sensor-Web and Web-based Geoprocessing, 28.04.2011

BI10: Bill, R.: Grundlagen der Geo-Informationssysteme. Wichmann Verlag. Berlin-Offenbach. 804 pages.

GA03: Greve, K., Altmaier, A., Fitzke, J., Petersen, K.: Referenzmodell Version 3.1. der Initiative Geodateninfrastruktur NRW, www.gdi-nrw.org

GIB 2004: Geodaten-Infrastruktur Brandenburg (GIB) – Referenzmodell, Version 1.0, from 26.04.2004.

MSFD-GES: Good Environmental Status (GES) of the Marine Environment, European Commission Environment, http://ec.europa.eu/environment/water/marine/ges.htm

RM-ODP: Information technology – Open Distributed Processing – Reference Model: Architecture. International Standard ISO/IEC 10746-3 vom 15.09.1996.