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INTEROPERABILITY MAP

MORTEN BORREBÆK - NORWEGIAN MAPPING AUTHORITY

GEOE3
A GEOSPATIALLY ENABLED ECOSYSTEM FOR EUROPE

INTEROPERABILITY

Interoperability is the ability of systems to exchange and make use of information. Improved interoperability in the public sector leads to more trust and better communication between public administrations and with citizens and businesses. It requires cooperation around semantic, legal, organisational and technical issues.

Interoperable Europe | Joinup (europa.eu)

"Improving public sector interoperability is key to Europe's digital success and essential to build a strong digital economy – trusted, safe, inclusive, and cooperative."

Johannes Hahn
Commissioner for Budget and administration
European commission

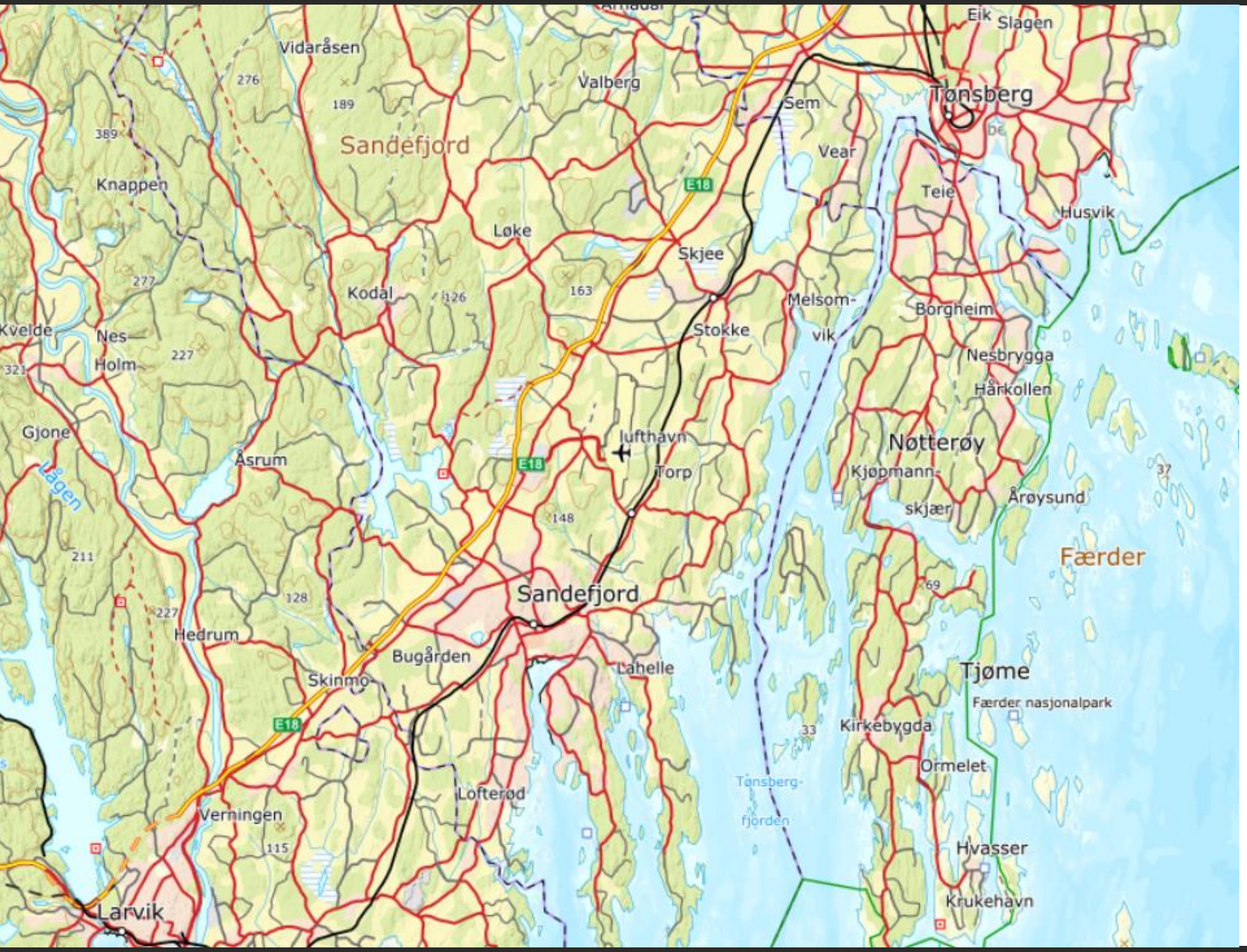
"The Interoperable Europe Act will fundamentally transform the way public administrations in Europe cooperate. There will be a time before and after the Act."

Veronica Gaffey
Director-General "Informatics"
DG DIGIT

"Through the Interoperable Europe Act, we want to create a stronger foundation for the interoperability of European public services. The proposal is the result of an innovative policy design process between the Member States and the European Commission."

Natalia Aristimuño Pérez
Director of Digital Services, DG DIGIT

MAP



INTEROPERABILITY MAP

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We know what a map is!

Describing interoperability in the context of a map does not provide a map in the classical sense, but a guidence document for establishing interoperable solutions. Drafted as an activity in the GeoE3 project with the intention on how data can be evaluated based upon a maturity model assessment.

The interoperability map will also be a guidence document for establishing cross domain spatial platforms and portal implementation in GeoE3, building an ecosystem enabling to build sustainable services that are interoperable.

INTEROPERABILITY IN OPEN DATA DIRECTIVE AND HVD

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High value data – Geospatial data

Scope; Adminstrative units, place names, addresses, buildings, cadastral parcels, agricultural parcels.

Arrangements for the publication and re-use;

Licence and terms of use	CC-BY 4.0 or equivalent or less restrictive open licence
Format	Open and widely used machine-readable format
Machine-readability	
Availability of API, bulk download	APIs
Metadata (dataset content description) and documentation (incl. structure and semantics)	At least INSPIRE elements
Update frequency and timeliness	Most up-to-date data available

European Commission

DIRECTIVE (EU) 2019/1024 on open data and the re-use of public sector information (31):
Public sector bodies are increasingly making their documents available for re-use in a proactive manner, by ensuring online discoverability and actual availability of documents and associated metadata in an open format that can be machine-readable and that **ensure interoperability**, re-use and accessibility.

Interoperability is a key factor in making the digital transformation possible. It allows administrative entities to electronically exchange, amongst themselves and with citizens and businesses, meaningful information in ways that are understood by all parties. It addresses all layers that impact the delivery of digital public services in the European Union.

Is the Open Data Directive and the HVD regulation sufficient to ensure interoperability?

SEMANTIC STRUCTURES – ONTOLOGIES AND TAXONOMIES

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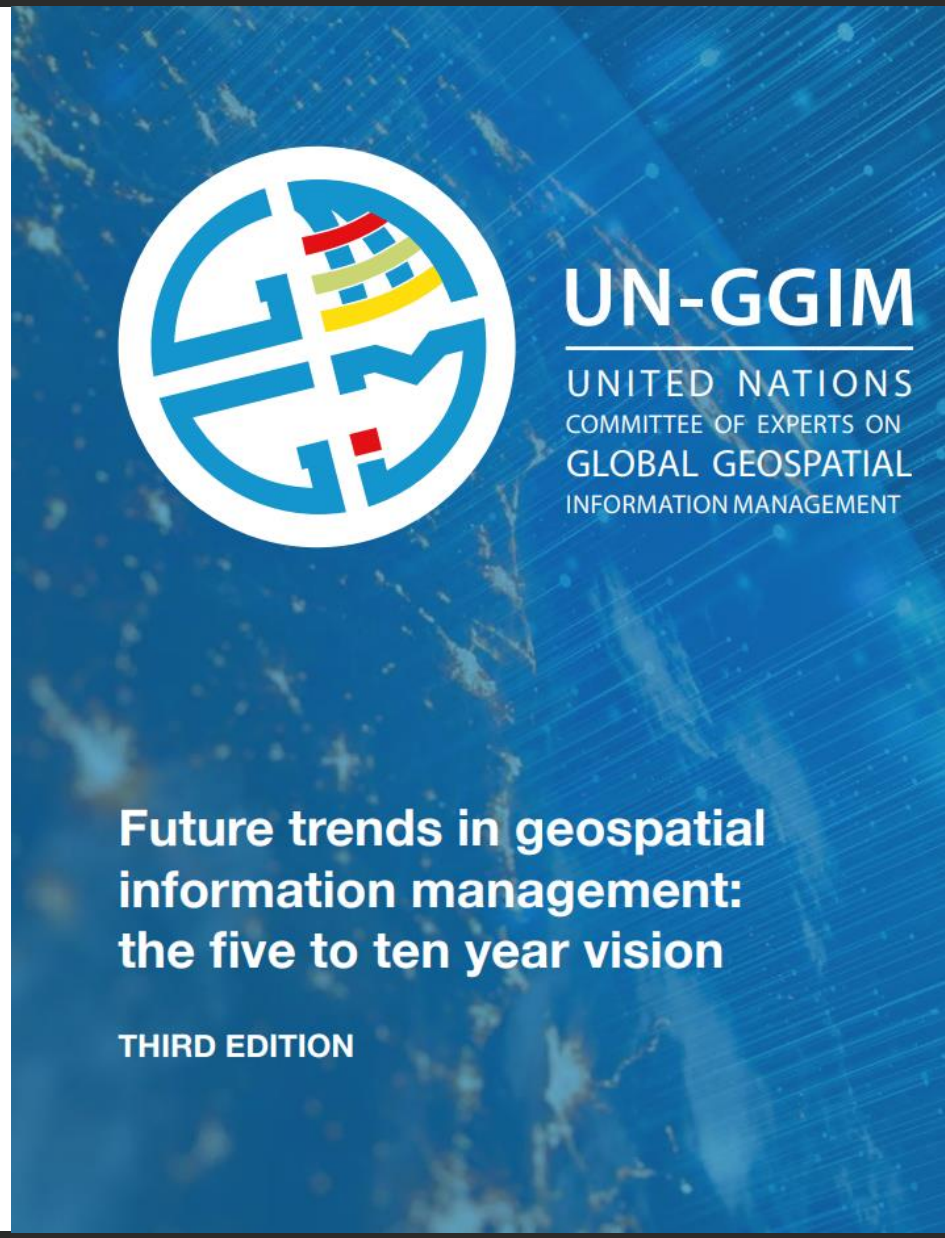
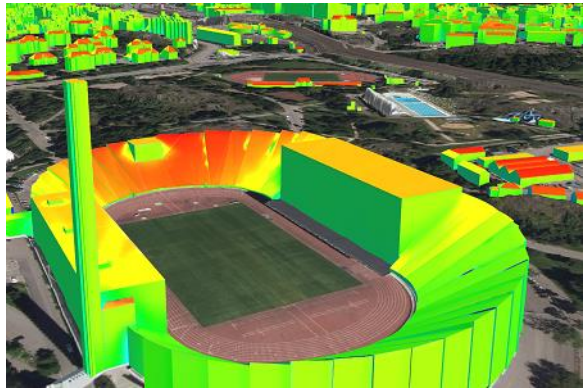
The concepts and languages used by stakeholders to describe the features and processes relevant to the domain has an impact on aspects such as the semantic structures – for instance ontologies and taxonomies – used to give meaning of the data, as well as the design and implementation of the tools for creating and storing data. Between different stakeholders and especially between different domains, even small differences can result in significant difficulties making data sharing or exchanging almost impossible or at best, not without some loss of information or changes to the structures or meaning of the data.

This is likely to **become one of the most crucial challenges** faced by municipalities working towards Smart Cities and Digital Twins and other contexts where collaboration, trust and transparency are necessary for removing the boundaries and fragmentation we see between domains today.



SHORT INTRODUCTION TO THE USE CASES IN GEOE3



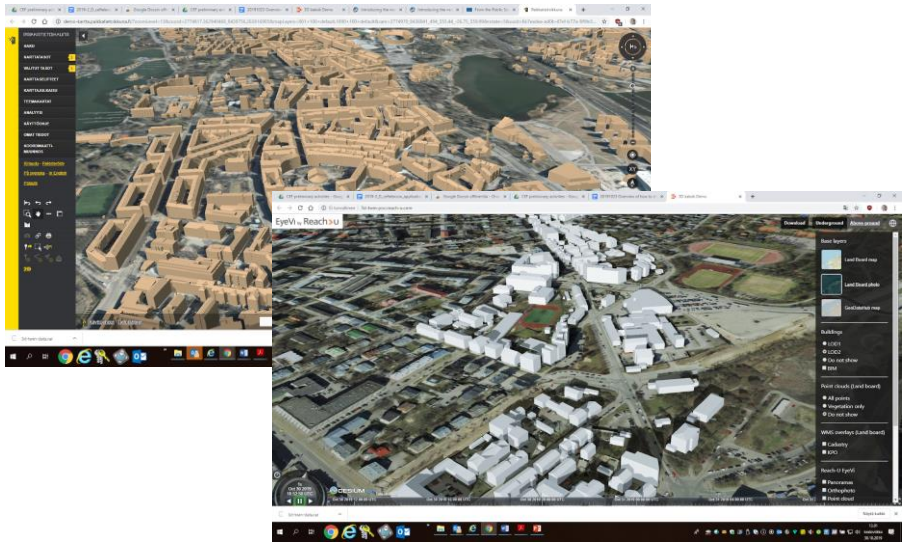
Solar energy potential and energy efficiency of buildings

Optimized use of solar energy

Energy efficiency of buildings

Co-operative Intelligent Transport Systems and Advancing map enhanced driver assistance systems leading to automated driving

Cleaner and safer transport



Cross border & Cross domain Smart City Finland Estonia

City planning for sustainable energy

Sustainable urbanization

DATA MANAGEMENT

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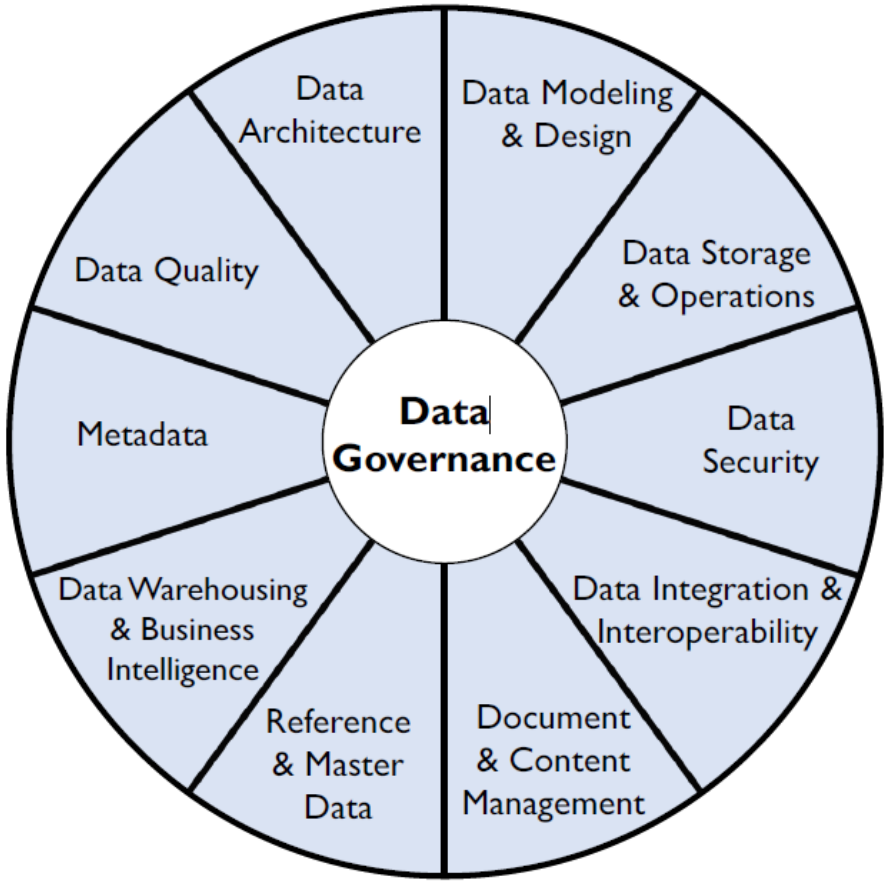
DAMA-DMBOK Guide is the data management associations international guide to the data management body of knowledge.

DAMA-DMBOK introduces a model how in general data integration and interoperability can be achieved. It defines data integration and interoperability (DII) as processes related to the movement and consolidation of data within and between data stores, applications and organizations

One of the essential concepts in the DII process is the utilization of an ETL (Extract, Transfer, and Load) process, which is implemented in the GeoE3 data integration platform.



Data Management Framework

INTEROPERABILITY MAP – INTEROPERABILITY APPROACHES

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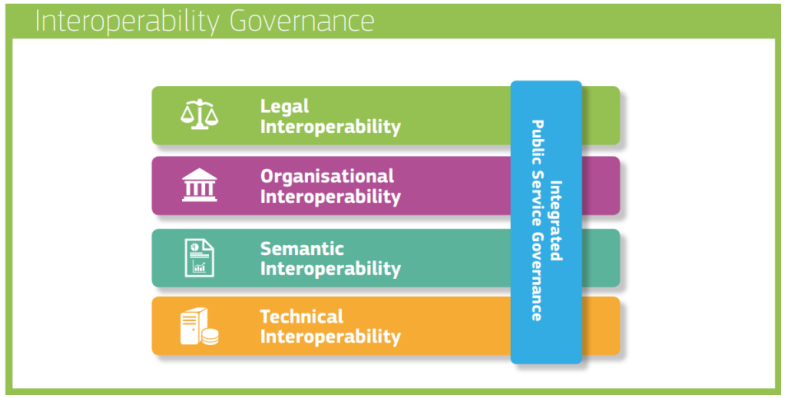
European Interoperability Framework



Interoperability layer	Description from EIF
Legal interoperability	Legal interoperability is about ensuring that organisations operating under different legal frameworks, policies and strategies are able to work together.
Organisational interoperability	This refers to the way in which public administrations align their business processes, responsibilities and expectations to achieve commonly agreed and mutually beneficial goals.
Semantic interoperability	Semantic interoperability ensures that the precise format and meaning of exchanged data and information is preserved and understood throughout exchanges between parties, in other words 'what is sent is what is understood'. In the EIF, semantic interoperability covers both semantic (meaning) and syntactic (format) aspects.
Technical interoperability	This covers the applications and infrastructures linking systems and services. Aspects of technical interoperability include interface specifications, interconnection services, data integration services, data presentation and exchange, and secure communication protocols

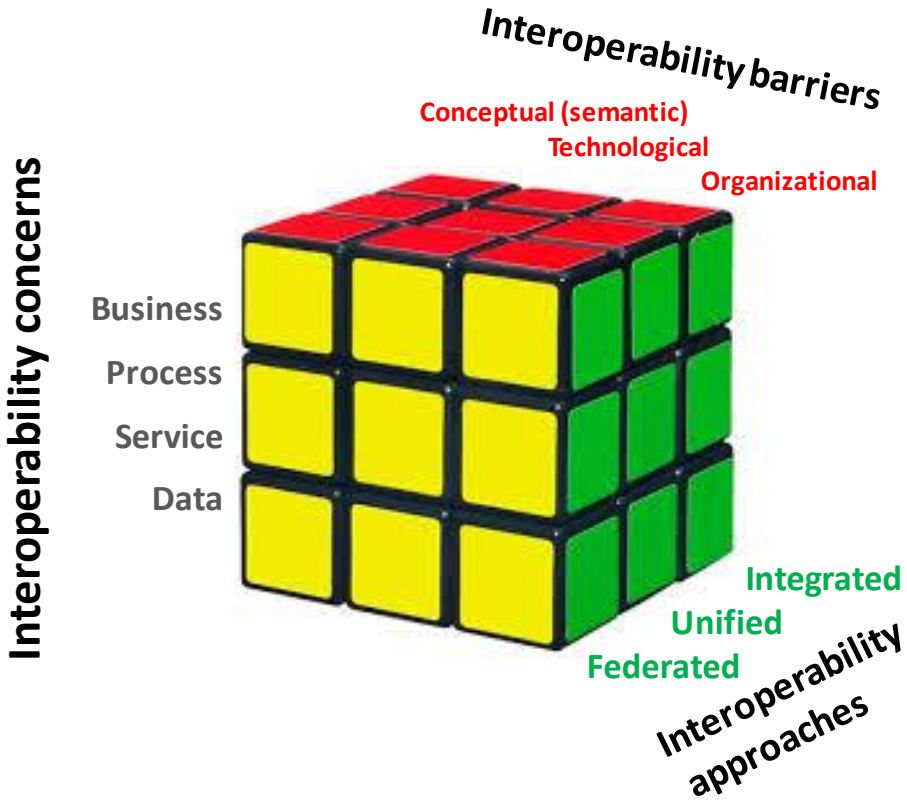
The European Interoperability Framwork has been further elaborated in the EULF Blueprint document from the ISA project and consists of the following focus areas:

- Policy and strategy alignment
- Digital government integration
- Standardization and reuse
- Return on investments
- Governance, partnerships and capabilities

19 recommendations

INTEROPERABILITY MAP – OTHER INTEROPERABILITY APPROACHES

"ISO 11354-1 Advanced automation technologies and their applications – Requirements for establishing manufacturing enterprise process interoperability – Part 1: Framework for enterprise interoperability"



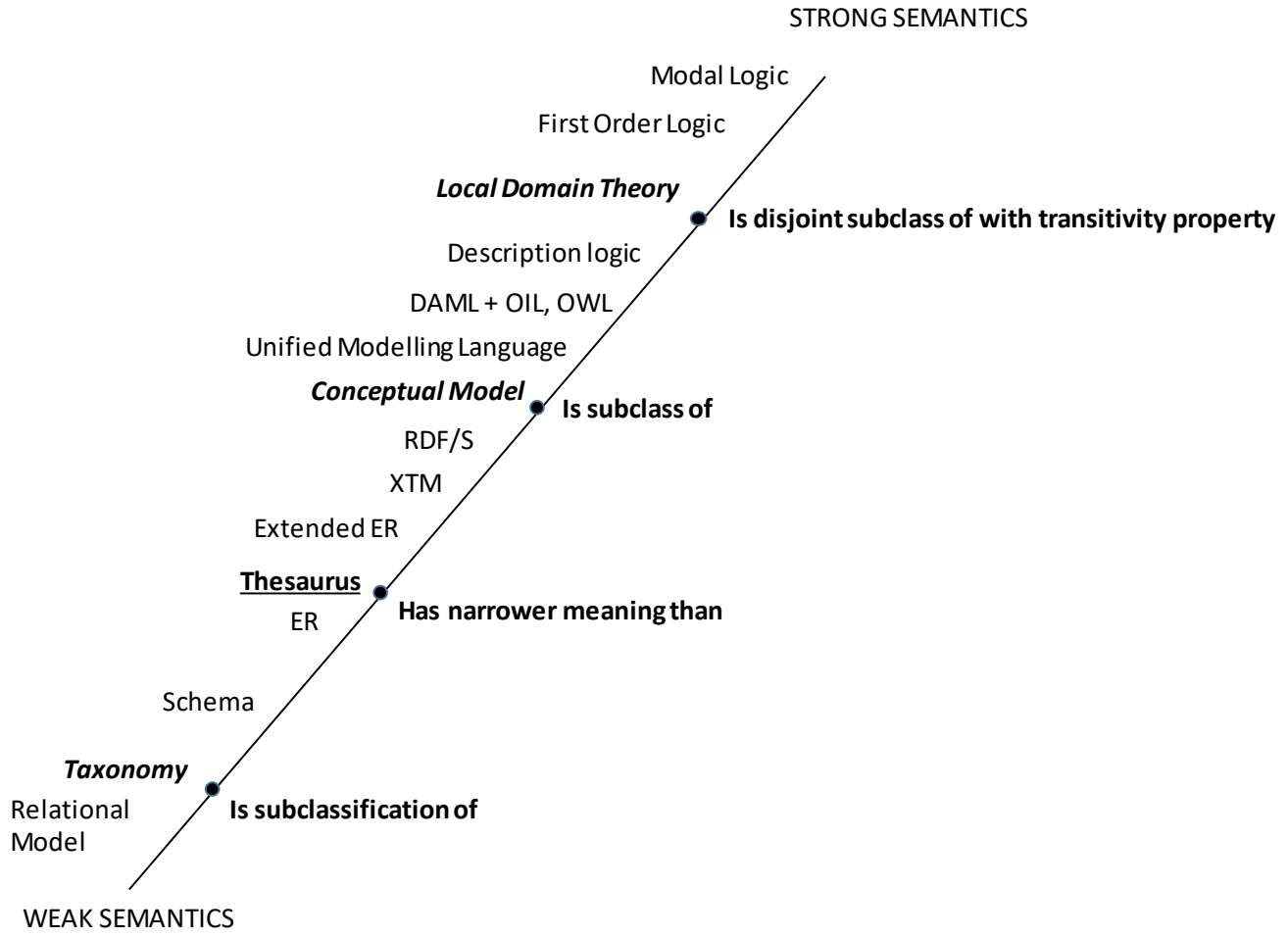
Interoperability approaches	Descriptions and examples on GeoE3.
Integrated	A common form shall be used to represent the exchanged entities. This common form shall be sufficiently expressive to capture those details and affect interoperability of the items to be exchanged. Example GeoE3 – INSPIRE buildings (flattened) is a common form (schema) applicable for the use case on solar energy and makes interoperability much easier.
Unified	A common metamodel , which is applicable for the participating entities and uses as a common reference to map existing models' syntax and semantics, shall be identified and detailed. Using this metamodel, a translation between the consituent entities is then possible. Example GeoE3 – General Feature Model (GFM) in ISO 19109 Rules for application schema constitutes a common metamodel for the specification of geospatial datasets. Data spesifications conformant to ISO 19109 General Feature Model. The datasets in the GeoE3 data sets inventory list that are conformant to the general feature model (for example all INSPIRE datasets) falls into this class.
Federated	There is no sufficient capable common form or meta-model to guide the interaction between enterprises that need to interoperate . This is more a case by case approach, and requires more resources to achieve interoperability (if possible at all). Example GeoE3 – are meteorological data available as INSPIRE data, or are they specified according to GFM.

INTEROPERABILITY MAP – LEVEL OF SEMANTICS

According to ISO/TC 211 standards most application schemas are modelled in UML. OWL (Web ontology Language) has slightly stronger semantic than UML and there are mapping rules from UML to OWL/RDF. But in our domain, vocabularies are not frequently applied.

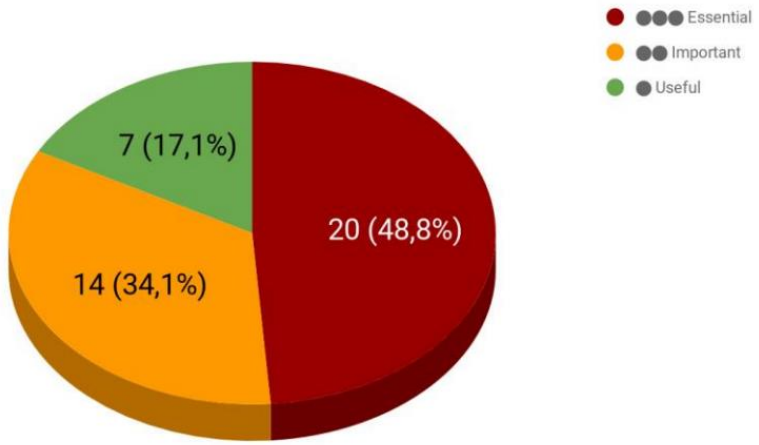
Even more important is that OWL/RDF is considered to be more knowledge oriented than UML in the form of ontologies/vocabularies and applicable for a long range of generic IT solutions (Linked open data).

The availability of ontologies gives a higher score in our maturity model.



FAIR – FINDABLE, ACCESSIBLE, INTEROPERABLE AND REUSABLE

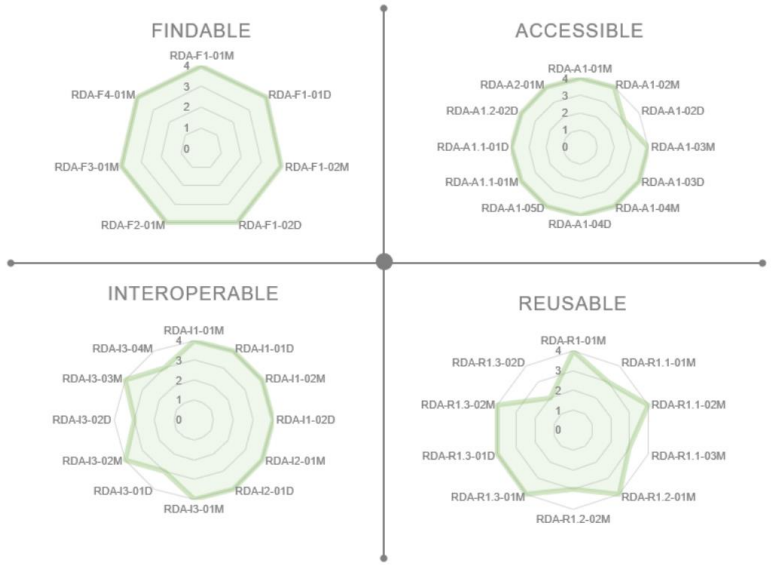
Among the set of indicators for FAIRness, 20 of the indicators are classified as Essential, 14 Important and 7 Useful.



Indicator maturity level

Priority	*Principle* Findable	Accessible	Interoperable	Reusable	Grand Total
Essential	7	8	0	5	20
Important	0	3	7	4	14
Useful	0	1	5	1	7
Grand Total	7	**12**	**12**	**10**	**41**

RDA FAIR data maturity model Working Group



	Essential	Important	Useful
Level 0	○		
Level 1	●		
Level 2	●	◐	
Level 3	●	●	
Level 4	●	●	◐
Level 5	●	●	●

○ None of the indicators are satisfied
◐ Half of the indicators are satisfied
● All indicators are satisfied

Complience levels

HTTPS://FAIR-ENOUGH.SEMANTICSCIENCE.ORG/

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Findable

- F1 - Resource identifier is persistent
- F1 - Resource metadata identifier is unique
- F2 - Metadata is grounded and machine-readable
- F2 - Metadata is structured
- F3 - Metadata identifier explicitly in metadata
- F4 - The resource is indexed in a searchable resource

https://www.geonorge.no/geonetwork/srv/spa/xml_iso19139Tooai_dc?id=82925&styleSheet=oai_dc.xsl

Identifier of this evaluation: https://w3id.org/fair-enough/evaluations/32f953a476b8b8af85b349058b84fbc32d14fe66

Evaluation score: 10/16
62.5%

Accessible

- A1.1 - Metadata uses an open free protocol for metadata retrieval
- A1.2 - Metadata authentication and authorization
- A2 - Metadata is persistent

Reusable

- R1 - Metadata includes a License
- R1 - Metadata includes a standard License

Interoperable

- I1 - Metadata uses a formal semantic knowledge representation language
- I1 - Metadata uses a formal structured knowledge representation language
- I2 - Metadata uses FAIR Vocabularies registered in known repositories
- I2 - Metadata uses resolvable FAIR Vocabularies
- I3 - Metadata contains outward references

INTEROPERABILITY MAP - MATURITY MODEL

We decided to base our maturity model on a simplified version the WMO stewardship maturity Matrix for Climate Data for national and regional purposes. This also aligns with the ideas behind MIM (Minimum Interoperability Mechanism) from Open & Agile Smart Cities.

Maturity levels			
Level 1 -> 0	Level 2 -> 1	Level 3 ->2	Highly desirable -> Level 3
Ad hoc	Medium	Highest	Level 3++
Not managed	Limited managed	Managed	Level 3++
Not implemented	Partially implemented	Fully implemented	Level 3++

WMO stewardship maturity Matrix for Climate Data for national and regional purposes

Level 0 – Not interoperable and cannot be integrated
Level 1 – Minimal interoperability and can be integrated with extra effort
Level 2 – Intermediate interoperability and can be integrated mostly automatically
Level 3 – Advances/Optimal interoperability and can be integrated automatically

INTEROPERABILITY MAP - MATURITY MODEL

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Categories	Level 0: Not interoperable and cannot be integrated	Level 1: minimal interoperability and can be integrated with extra effort	Level 2: Intermediate interoperability and can be integrated mostly automatically	Level 3: Advanced /Optimal interoperability and can be integrated automatically
LEGAL ASPECTS/ ORGANIZATIONAL ASPECTS				
National data accessibility and integration arrangements	Data cannot be provided due to legal requirements or is not considered as open data	Data accessible through different agencies, no national integration arrangements (data available without restrictions or minimum restrictions as defined in LIFO)	Data available mostly through national platform but some data missing. This could be for example attribute data.	Data available through national platform and data integration arrangements in place
TECHNICAL ASPECTS / DATA ACCESS				
metadata discoverability	No metadata available	Metadata available nationally	Metadata provided through APIs.	Metadata provided through DCAT AP 2.0 or OGC API records .
data accessibility	No data available	Data available with legacy APIs	Data available with OGC APIs.	Data available with OGC APIs.
SEMANTIC ASPECTS				
Vocabulary and data specifications	Vocabulary/ data descriptions not available and cannot be integrated	Vocabulary and data specifications including data content and data quality are described, but not according to any standards. Minimal definitions available and can be integrated with extra effort	Vocabulary and data specifications including data content and data quality are described, but not according to any standards. Intermediate interoperability Partly or full machine readable (MR) but automatic utilization not fully possible	Vocabulary and data specifications are fully machine readable in RDF/OWL. Advanced/Optimal vocabulary/definitions in machine readable format (MR) and can be utilized automatically
Data content and data quality	Data content and data quality are not described and cannot be integrated	Data content and data quality are described, but not according to any standards or in machine readable form.	Data content is sufficient for the expected usage in machine readable form.	Data content and quality are well described in machine readable form (e.g. UML).
Quality assessment	No quality assessment information available	Quality assessment done but not available through metadata	Quality goals defined and available through metadata	Quality assessment available through Data Quality Vocabulary (DQV)
Future criteria	Level 0 Not interoperable and cannot be integrated	Level 1 minimal interoperability and can be integrated with extra effort	Level 2 Intermediate interoperability and can be integrated mostly automatically	Level 3 Advanced /Optimal interoperability and can be integrated automatically

INTEROPERABILITY MAP

From service centric view (access point to data and metadata)--

Dataset	Provided by(organisation)	Available API's	Access points - data	Access point - metadata
Digital terrain model/Digital Elevation Model	Norwegian Mapping Authority	WMS WCS	https://wms.geonorge.no/skwms1/wms.hoyde-dtm-prosjekt-lokal-hoyde-graatone?request=GetCapabilities&service=WMS https://wms.geonorge.no/skwms1/wcs.hoyde-dtm1_33?request=GetCapabilities&service=WCS	https://www.geonorge.no/geonetwork/srv/nor/xml_iso19139?uuid=0f0a0f38-00c4-4213-a9e5-2d861dc4abb0

-- to also focus on the data centric view (access point to data specifications, model repositories and schemas/ontologies) --

Dame of dataset	Provided by	Access point data specification	Access point Model repository	Access point schema
Road network	Norwegian Mapping Authority and Norwegian Public Road Administration	https://data.transportportal.no/datasets/0d84c29a-a908-4ba4-9873-982c9d9af033	https://sosi.geonorge.no/SVNFAQ/EAP/SOSI_modellregister_JET40.eap Also available as XMI files at NVDB-Datakatalogen/SOSI-UML at master · vegvesen/NVDB-Datakatalogen (github.com)	**GML schema** at NVDB-Datakatalogen/GML at master · vegvesen/NVDB-Datakatalogen (github.com). **OWL ontologies available at:** NVDB-Datakatalogen/OWL at master · vegvesen/NVDB-Datakatalogen (github.com) and NVDB ontologier (vegvesen.no)

--is important to really enhance interoperability

INTEROPERABILITY MAP - MATURITY MODEL – BUILDINGS 2D/3D

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Country/Dataset	Legal aspects/Organizational aspects	Technical aspects/Data access		Semantic aspects		
	National data accessibility and integration arrangements	metadata discoverability	data accessibility	Vocabulary and data specifications	Data content and data quality	Quality assessment (QA)
Finland/Buildings, 2D	Level 1 (Open data, no national platform)	Level 1 (no DCAT AP)	Level 3 (OGC API)	Level 1 (definitions available but not MR)	Level 1 (national schema)	Level 1 (QA available but not published)
Finland/Buildings, 3D (test dataset)	Level 1 (Open data, no national platform)	Level 0 (no metadata)	Level 1 (no API)	Level 1 (definitions available but not MR)	Level 1 (data content limited)	Level 0 (no QA)
Norway/Buildings, 2D	Level 0 (not considered as open data)	Level 3 (DCAT AP)	Level 2 (WFS but not OGC API)	Level 2	Level 2	Level 1? (QA available but not published)
Norway/Buildings 3D (not available)	Level 0	Level 0	Level 0	Level 0	Level 0	Level 0
Netherlands/Buildings, 2D	Level 2 (Open data, national platform)	Level 2 (no DCAT AP)	Level 2 (WFS but not OGC API)	Level 2 (definitions available with RDF)	Level 1 (national schema)	Level 1 (QA available but not published)
Netherlands/Buildings, 3D	Level 2 (Open data, national platform)	Level 2 (no DCAT AP)	Level 1 (downloads, OGC API coming soon)	Level 1 (definitions available but not MR)	Level 1 (national schema)	Level 0 (No QA)
Spain/Buildings, 2D	Level 1 (Open data, no national platform)	Level 2 (DCAT AP)	Level 2 (WFS but not OGC API)	Level 1 (definitions available but not MR)	Level 2 (INSPIRE schema)	Level 1? (QA available but not published)
Spain/Buildings, 3D (not available)	Level 1 (Open data, no national platform)	Level 0 (no metadata)	Level 2 (national API with KLM format)	Level 1 (definitions available but not MR	Level 1 (national schema)	Level 0 (No QA)
Estonia/Buildings, 2D	Level 2 (Open data, national platform)	Level 2 (no DCAT AP)	Level 3 (OGC API)	Level 2 (INSPIRE schema)	Level 2 (INSPIRE schema)	Level 1 (QA available but not published)
Estonia/Buildings, 3D	Level 2 (Open data, national platform)	Level 2 (no DCAT AP)	Level 3 (OGC API)	Level 1	Level 1 (national schema)	Level 1

INTEROPERABILITY MAP - MATURITY MODEL – WIND CONDITION

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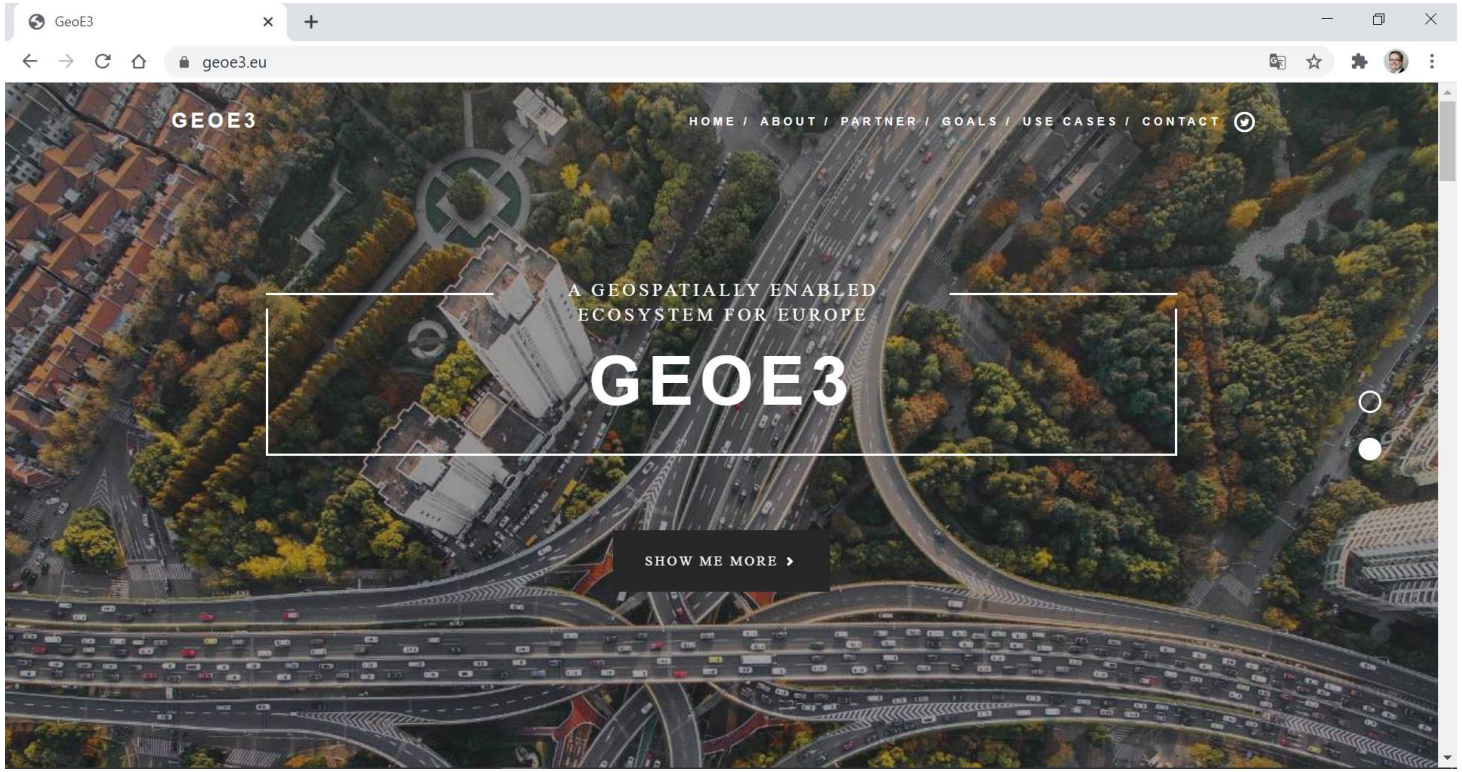
Country/Dataset	Legal aspects/Organizational aspects	Technical aspects/Data access		Semantic aspects		
	National data accessibility and integration arrangements	metadata discoverability	data accessibility	Vocabulary and data specifications	Data content and data quality	Quality assessment (Q A)
Finland	Level 1 (Open data, no national platform)	Level 3 (DCAT AP)	Level 3 (GeoE3 OGC API)	Level 0 - (No specification or vocabulary?)	Level 2 (INSPIRE schema)	Level 1 (QA done but not published)
Norway	Level 2 (Open data, national platform)	Level 3 (DCAT AP)	Level 1 (Non OGC REST API)	Level 2 – (The international CF Standard Name vocabulary)	Level 1 (data and quality described but not according to standards	Level 1 (QA done but not published)
Netherlands	Level 2 (Open data, national platform)	Level 2 (no DCAT AP)	Level 2 (WFS)	Level 1 (	Level 1	Level 0
Spain	Level 2 (Open data and national platform)	Level 3 (DCAT AP)	Level 2 (ATOM Feed but not OGC AP)	Level 1 (definitions available not according to INSPIRE)	Level 1 (data and quality described but not according to INSPIRE)	Level 1 (QA available, but not MR)
Estonia/	Level 2 (Open data, national platform)	Level 2 (API in dev)	Level 2 (WFS available, API in dev)	Level 2 (INSPIRE schema)	Level 2 (INSPIRE schema)	Level 2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