GeoE3 Interoperability Checks

Project deliverable – Activity 6

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Appendices

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1. Introduction

1.1. Interoperability

Interoperability is a key factor in cross-border and cross-sector cooperation. It describes the ability of one system to communicate and interact with other systems. That ability involves the sharing of information and knowledge by means of data between different ICT systems and through business processes. Interoperability is a term that makes it possible to “talk” and “understand” between different kinds of systems, platforms, services, and organisations without effort from the end-user.

1.2. European Interoperability Framework

Interoperability can be managed and improved in many ways but since a single service can’t be interoperable alone, common principles are needed. To facilitate the interoperability between European public services, European Interoperability Framework (EIF) is published. It acts as a generic denominator of interoperability by providing guidelines in form of common principles, models, and recommendations. Its goal is to improve governance of their interoperability activities, establish cross-organisational relationships, streamline processes supporting end-to-end digital services, and ensure that existing and new legislation do not compromise interoperability efforts.

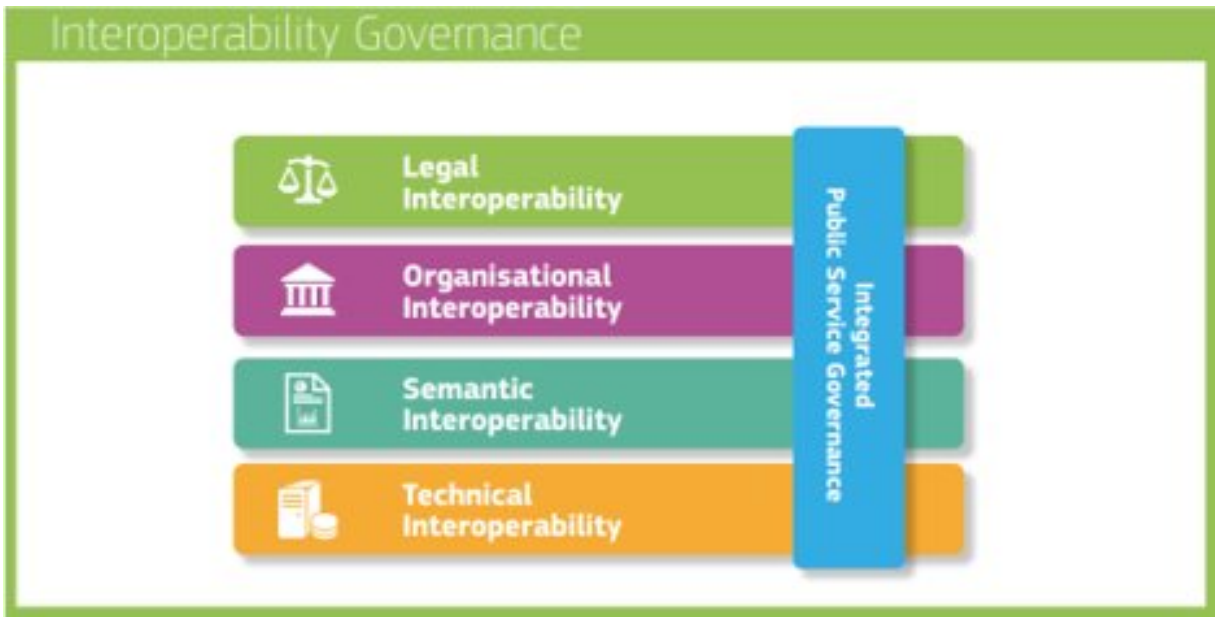


Figure 1. Interoperability layers by EIF

The EIF considers interoperability through interoperability governance, which is represented as a background layer of Figure 1. The term interoperability governance refers to decisions on interoperability frameworks, institutional arrangements, organisational structures, roles and responsibilities, policies, agreements and other aspects of ensuring and monitoring interoperability at national and EU levels.

The interoperability itself can be divided into four sub-categories according to same Figure 1: legal-, organisational-, semantic-, and technical interoperability. The definitions of these terms are opened in chapters 2.2, 2.3, 2.4 and 2.5.

All those layers share a cross-cutting component of 'Integrated Public Service Governance', which means the governance of multiple public agencies working under the same service. Its goal is to provide a single seamless experience for users, regardless of administrative complexity. That kind of cooperation boosts efficiency, improves data quality, avoids data redundancy, and makes usage of services easier.

1.3. EULF Blueprint

Even though the EIF is a very useful framework for providing a general understanding of interoperability, it doesn't put almost any emphasis on field-specific matters, such as location data.

To serve the needs of the geospatial domain, the ISA programme developed the fifth version the of European Union Location Framework (EULF) in the year 2021. It guides developers to use location information in policy and digital public services through several recommendations and implementation guidance. The EULF blueprint is fully aligned with the EIF principles, but it focuses on location interoperability instead of general interoperability of services.

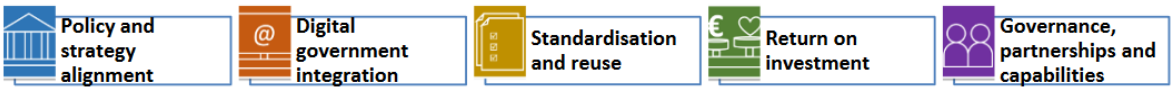


Figure 2. EULF Blueprint focus areas

The blueprint contains 19 upper-level recommendations, which are divided into five categories (see Figure 2). Every recommendation explains reasons (why?), recommended actions (how?), and potential problems (challenges). They also introduce references to best practices and other resources, such as EIF recommendations.

1.4. GeoE3 approach

The Geospatially Enabled Ecosystem for Europe, the GeoE3 project has been launched in 2020 to tackle the interoperability challenge. The project aims to create a data integration platform that enables data integration from various data providers. One goal is to improve the interoperability of data and digital services across Europe.

For the first data part, this project provided the document called the interoperability map. It focuses on four interoperability levels defined in the EIF, which were described in Figure 1. The interoperability map helps users to assess current interoperability maturity levels for their data sets and improve them further, especially in the context of data integration.

But the interoperability map doesn't solve the whole challenge of interoperability as it considers only data sets, not data services. Therefore, this document aims to perform interoperability checks for digital data services from our partner countries. These checks are key aspects towards interoperable services. They describe the basic principles of how public services should be designed, implemented and managed during their life cycle.

1.5. Evaluated Services

We evaluated the national geospatial services of our five partner countries: Norway, Finland, Netherlands, Spain and Estonia. Depending on the country, the term 'national geospatial service' can describe either a geospatial platform (NL, NO) or a geoportal (FI, ES, EE). By geoportals, we mean interfaces that allow users to use geospatial data and services, and by geospatial platforms, we mean digital platforms that are used for producing, distributing and analyzing spatial data by multiple participants. The boundary between these two definitions is not always clear.

In addition to national geoportals and geospatial platforms, we also evaluated the GeoE3 integration platform mainly for comparison purposes. The platform integrates data from all those five countries, so it is interesting to see how it differs.

In Finland, long efforts have been made towards a national geospatial platform, but at the moment, geospatial services are a bit dispersed. Therefore, we mainly evaluated services named Paikkatietoikkuna and Paikkatietohakemisto in addition to a few supporting services.

In the case of the Netherlands, geospatial services are centralized into one service called Publike Dienstverlening Op de Kaart (PDOK). It is a central distribution platform containing a large variety of (geospatial) data sets from multiple data providers, such as different ministries, Rijkswatersaat and Geonovum. The Kadaster has main technical and business responsibilities.

In Norway, there is Geonorge geoportal (or platform) that distributes spatial data provided by the Norge digital coalition. It is maintained and developed by Kartverket. Just like the PDOK, also Geonorge contains a large variety of services for users and over 400 data producers.

In Spain, there are multitude of geoportals and SDI nodes at state, regional and local levels, which are centralised through the geoportal of the Spatial Data Infrastructure of Spain (IDEE).

For Estonia, we mainly focused on Estonian geoportal. It publishes and made available spatial data owned by the Estonian state, local governments and other legal persons governed by public law. The Estonian geoportal is a part of the Estonian Spatial Data Infrastructure.

2. Interoperability checks

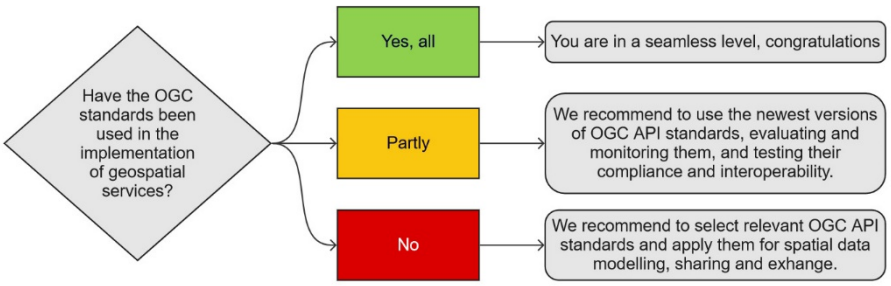
2.1. Background

To assess the interoperability levels of GeoE3 partner countries as geospatial data providers, we created interoperability checks. These checks are a set of criteria that indicate how interoperable geospatial services are in the context of cross-border and cross-sector data integration.

Our focus is on interoperability between geospatial services on a national level, instead of single application programming interfaces (APIs) or local platforms. Therefore, we excluded most criteria that are not suitable to cover geospatial services as a national entirety. Also, we excluded criteria that are difficult to measure comparably or don't have a direct impact on interoperability. For example, we didn't consider the interoperability of data sets that haven't been published yet.

Most interoperability checks are derived from the EIF recommendations and EULF blueprint, but part of them are self-made based on our previous experience with interoperability problems in data integration processes.

All interoperability checks of this project are formed into the question form, which makes them more understandable. For every question, there are pre-determined answering choices, which ensures consistent and comparable answers. To be easier to interpret, all answers are described with the corresponding colour (see **Error! Reference source not found.**). The green colour indicates seamless interoperability, the orange intermediate interoperability and the red weak interoperability. The higher number of green answers indicates service to have higher interoperability, which decreases the effort required for data integration.



One important part of our survey is to give recommendations in the case when the colour is red or orange. In most cases, recommendations are directly corresponding to the EIF recommendation, but we also included references to EULF recommendations and some recommendations from the perspective of the GeoE3 project.

2.2. Legal checks

Legal interoperability is about ensuring that different legal frameworks, policies, and strategies do not prevent organisations to work together. Multiple legal issues, such as copyright, licenses, and other intellectual property rights, as well as privacy and data protection laws (GDPR) may cause interoperability barriers, especially across country borders. In such situations, all partners should have clear agreements about how to deal with differences in legislation.

2.2.1. Q1: Does the national legislation cause any barriers to the international interoperability of data sets?

Examples: Data privacy or data protection laws (such as GDPR) may prevent data to be published freely, especially across borders. Other key examples are intellectual property rights, database rights or trade secrets.

Results: National legislation doesn't cause any big barriers to data sharing, except in Norway. Due to data policy issues, the Norwegian 2D buildings dataset currently covers only very limited subareas of the country. Legal interoperability will increase in the next 16 months when the EU High-Value Datasets implementing Act will be in force.

Recommendations: EIF No. 27 recommends ensuring that legislation is screened using 'interoperability checks', to identify any barriers to interoperability. When drafting legislation to establish a European public service, seek to make it consistent with relevant legislation, perform a 'digital check' and consider data protection requirements.

The third (3) EULF recommendation contains more information about legal requirements. For example, it reminds us that compliance with data privacy and protection laws is mandatory, and hence ignoring them might lead to severe consequences including penalties and a bad reputation. The recommendation also provides many useful approaches to help users meet legal policies.

The first (1) EULF recommendation recommends aligning digital and location strategies in all policy and legal instruments. Also, strategic engagement between service providers and legacy makers is important.

GeoE3 does not provide any extra recommendations.

2.3. Semantical Checks

Semantic interoperability ensures that different parties understand the format and meaning of exchanged data unambiguously in a similar way. Interoperability is not possible without a common language. In other words, ‘what is sent is what is understood’. In the EIF, semantic interoperability covers both semantic (meaning of data and relationships) and syntactic (grammar and format) aspects.

2.3.1. Q2: Do geospatial services allow users to download data in different resolutions or formats?

Example: Some users and applications require data in a specific format. When the geospatial service provides data in multiple formats and resolutions, users don’t have to do complex conversions or interpolations. That lowers the threshold to use data, especially for non-expert users.

Results: All countries allow users to select data in different resolutions or formats, at least for most data sets.

Recommendations: According to page 39 of the EIF brochure, open data publishing should allow data to be used in different ways and for various purposes. It also emphasizes the importance of machine-readable, open and non-propriety formats.

GeoE3 recommends that services should provide geospatial data in different resolutions and formats or transform data online to provide users the most preferable way to use data. Especially, the GeoJSON format is recommended.

2.3.2. Q3: Are there any data duplicates or overlapping services (more than regional)?

Examples: Sometimes same data/service may be produced by several authors, which can cause overlapping data/services or confuse users. When some authors produce similar data from overlapping geographical areas, it is not considered overlapping data if they have different objectives (e.g. local and national scope).

Results: All countries have some duplicate services. For example, cities can produce similar data from overlapping areas.

Recommendations: EIF No. 31 recommends implementing an information management strategy at the highest possible level to avoid (and fragmentation). Management of metadata, master data and reference data should be prioritised.

The first (1) EULF recommendation advises avoiding silo thinking, which can lead to duplication and inefficiency, poor value for money, confusion for stakeholders, and an overall reduction in policy effectiveness

The EULF recommendation No. 7 supports the first recommendation. It suggests to use spatial data infrastructures (SDIs) in digital public services and data across sectors, levels of government and borders, integrated with broader public data infrastructures and external data sources.

GeoE3 does not provide more recommendations.

2.4. Organisational checks

Organisational checks ensure that organisations can achieve their commonly agreed objectives of data production and sharing. This refers to how business processes, responsibilities and expectations are aligned, documented, and integrated. Organisational interoperability also aims to make services more available, accessible, easily identifiable, and user-focused with the help of requirements of user community.

2.4.1. Q4: Is data as freely available for use and reuse as possible?

Results: Accessibility checks have shown that most of the materials are openly available, but a few are not open. Also, some data sets require using API-KEYs to access data.

Recommendations: Recommendation 2 of EIF recommends that all data should be published with as few restrictions as possible and clear licences for its use to allow better scrutiny of administrations' decision-making processes and realise transparency in practice.

The EULF recommendation No. 16 adds that searching, finding, and accessing data and services should be as easy as possible. It also provided ten different examples, such as standardised metadata, open licensing, and merged data portals.

The EULF recommendation No. 2 promotes several data policies to increase data openness.

GeoE3 recommends delivering services with CC BY 4.0 license and through OGC APIs using flattened INSPIRE models, such as GeoJSON, when possible.

2.4.2. Q5: Are there alternative channels for users to find data (such as European Data Portal)?

Example: When (meta)data can be found from multiple channels, data is more available for different user groups. People who understand the national contexts may prefer national services, and international users may prefer cross-European platforms, such as European Data Portal (EDP). Similarly, non-expert users may prefer simple service download services, and more technical users may prefer machine-readable APIs.

Results: In most cases, metadata can be found from EDP. Countries might also have their own metadata catalogues.

Recommendations: EIF recommendation No. 10 suggests using multiple channels to provide the European public service, to ensure that users can select the channel that best suits their needs.

EULF: -

GeoE3 recommends sharing metadata with the European Data Portal. The metadata in EDP should be linked to national portals, which supports data availability.

2.4.3. Q6: Are geospatial services and their documentation available in multiple languages, especially in English?

Example: It is very difficult to assess, understand and use data if all documentation is written in a foreign language. Of course, there are some automatic translation services, but they do not work very well in all cases, especially when it comes to national or field-specific contexts.

Results: Yes, for all countries except the Netherlands. It provides only data in English (due to INSPIRE) but services are in Dutch.

Recommendations: EIF recommendation No. 16 recommends to use information systems and technical architectures that cater for multilingualism when establishing a European public service. Decide on the level of multilingualism support based on the needs of the expected users. That shouldn't include only user interfaces, but available elements of data and services.

The EULF recommendation No. 13 emphasizes multilingualism for data quality, which improves communication and understanding.

The GeoE3 recommends that services and all related documentations are available at least in English.

2.4.4. Q7: Is it possible to use services without API-KEYs or other credentials?

Example: Different identification mechanisms may provide a lot of benefits but they hinder the usability of the service. Some users may feel uncertain if the service asks them to log in. That makes the use of API more complicated and decreases its usage and openness.

Results: Yes, for all countries but not for all data sets. Some countries have discussed the possibility to apply API-KEYS, but there are no specific plans to implement them.

Recommendations: EIF poses for the opposite opinion. Its recommendation No. 46 says that it would be good to consider security and privacy requirements and identify measures for the provision of each public service according to risk management plans. On the other hand, page 16 says that users should be asked to provide only the information that is absolutely necessary to obtain a given public service.

The GeoE3 doesn’t recommend API-KEYs or other log-in methods because they hinder usability. People are more likely to use the service when they don't have to log in or read instructions about API KEYs. Also, the open data directive recommends that data is freely available.

2.4.5. Q8: Is there a single point of contact available to users instead of multiple different contact points?

Example: Especially for foreign users, it might be difficult to find correct contact information in a national context. Therefore, all contact information should be organised and described clearly, or rather reduced to a single point of contact. Also, contact information should be available easily without language barriers, for example in the footer.

Results: Yes, for all countries.

Recommendations: According to EIF recommendation No. 11, a single point of contact should be made available to users, to hide internal administrative complexity and facilitate access to public services, e.g. when multiple bodies have to work together to provide a public service.

The EULF recommendation No. 16 encourages organisations to foster open data sharing. They give a lot of resources and guidance for that, including usability aspects.

GeoE3 does not provide more recommendations.

2.4.6. Q9: Does the geospatial service offer structured ways to give feedback about the service?

Example: In an optimal situation, users can give feedback easily and whenever they want. There should be a possibility to give feedback about the data and functionalities of the platform.

Results: Yes, for all countries, but in Norway and Estonia only email addresses were given.

Recommendations: EIF recommendation No. 12 recommends putting in place mechanisms to involve users in analysis, design, assessment and further development of European public services. Users' feedback should be systematically collected, assessed and used to design new public services and to further improve existing ones.

EULF recommendation No. 8 recommends services to ask for feedback continuously and as early as possible. That enables incremental improvement and reduces the risk of building a service that does not meet users' requirements.

EULF recommendation No. 17 emphasises that voice of users should be taken into account for example through communication events, consultation, or involving users to participate in development.

GeoE3 does not provide any recommendations.

2.4.7. Q10: Do geospatial services allow get support when needed?

Example: Support and assistance should be easily available for all users. For example, Q&A and email should be supported.

Results: In most countries, support is provided, but not in a dynamic way. For example, documentation and Q&A are supported, but help desks are not. Only Norway doesn't provide any kind of support.

Recommendations: EIF recommendation 14 resembles to ensure that public services are accessible to all citizens, including persons with disabilities, the elderly and other disadvantaged groups.

GeoE3 recommends providing support for users when they need it. Develop ways to improve supporting mechanisms based on previous experiences.

2.4.8. Q11: Have the service level agreements (SLAs) been established to ensure that services are working as promised?

Example: When service level agreements are published, they support the required use of APIs (e.g. availability, data quality, timeliness, response times). If services work reliably and fast enough according to SLA, users may dare to build their online application based on those services

Results: Yes, for most countries. In Spain and Estonia, SLAs were not easily findable, or they don't exist.

Recommendations: The EIF recommendation No. 26 recall to establish service level agreements (SLAs), if necessary. The relationship between service providers and service consumers must be clearly defined and detailed enough.

EULF recommendation No. 18 resembles that partnership agreements (such as SLAs) should be established as early as possible.

GeoE3 does not provide any recommendations.

2.4.9. Q12: Does the country have open data strategies (and roadmaps) that promote the use and sharing of public data?

Example: National open data strategies or roadmaps will encourage organisations to publish and use open data.

Results: Yes, in most countries but not always in English. For example, there are no English versions in Spain.

Recommendations: EIF recommendation No. 41 recommends establishing procedures and processes to integrate the opening of data in your common business processes, working routines, and the development of new information systems. The EIF recommendation No. 31 says that strategies should be put in place at the highest possible level.

EULF recommendation No. 16 suggests public administrations promote open data policy in government and brokering access to this data through hackathons, and open challenges to government, as an example.

GeoE3 doesn't provide extra recommendations.

2.5. Technical checks

Technical interoperability covers the applications and infrastructures linking systems and services. It includes interface specifications, interconnection services, data integration services, data presentation and exchange, and secure communication protocols. Technical interoperability aims to remove the undesirable effect of “fragmented ICT islands”.

2.5.1. Q13: Are geospatial services based on open-source solutions?

Example: Developing geospatial services is easier when open-source solutions (e.g. pygeoapi and geoserver) are used instead of commercial and propriety software.

Results: Yes, for all countries, except Estonia that uses ESRI.

Recommendations: According to EIF recommendation No. 3, the use of open-source software technologies and products can help save development costs, avoid a lock-in effect and allow fast adaptation to specific business needs because the developer communities that support them are constantly adapting them. Public administrations should also contribute to the pertinent developer communities.

EULF approves open solutions in multiple different recommendations. For example, recommendation No. 11 suggests reusing existing authentic data, data services and relevant technical solutions when possible.

2.5.2. Q14: Are geospatial services complying with the INSPIRE Technical Guidelines?

Example: INSPIRE Technical Guidelines provides multiple mandatory and recommended elements related to the implementation of INSPIRE Download Services.

Results: Yes, for all countries. Especially, if the INSPIRE covers the data theme.

Recommendations: EIF recommendation No. 22 recommends using a structured, transparent, objective and common approach to assessing and selecting standards and specifications. Consider relevant EU recommendations (e.g. INSPIRE) and seek to make the approach consistent across borders.

EULF recommendation No. 12 asks to apply relevant standards to develop a comprehensive approach for spatial data modelling, sharing, and exchange to facilitate integration in digital public services. It says that INSPIRE makes spatial data infrastructures to be cross-border compatible. In addition, also introduces many other standards.

GeoE3 recommends using INSPIRE Technical Guidelines including the following ones:

- Technical Guidance for the implementation of INSPIRE Download Services
- Technical Guidance for the implementation of INSPIRE Download Services using Web Coverage Services (WCS)
- Technical Guidance for the implementation of INSPIRE View Services

2.5.3. Q15: Is data available in multiple coordinate reference systems, especially in the WGS 84?

Example: In the most optimal situations, users can download data in many coordinate reference systems (CRS). Either data is directly available in different CRSs or it is converted into another CRS online.

Results: The Netherlands, Spain and Norway allow users to select data with different coordinate reference systems and provide data also in the WGS 84. Other countries don't support this or provide data only in WGS 84.

Recommendations: According to page 39 of the EIF brochure, open data publishing should allow data to be used in different ways and for various purposes. That also includes different CRSs, even though they don't mention it directly.

GeoE3 recommends using different coordinate reference systems (CRS) when delivering geospatial data. In addition to local CRSs, use some global systems, such as WGS 84 / Pseudo-Mercator.

2.5.4. Q16: Are OGC standards involved in the implementation of geospatial services?

Example: Geospatial services are more interoperable when their data-sharing services are based on similar and standardised methods, such as OGC APIs.

Results: Yes, in all services.

Recommendations: EIF recommendation No. 21 suggests putting in place processes to select relevant OGC standards and specifications, evaluate them, monitor their implementation, check compliance and test their interoperability.

EULF recommendation No. 12 recommends applying relevant standards to develop a comprehensive approach for spatial data modelling, sharing, and exchange to facilitate integration in digital public services. It says that OGC API standards have a huge potential for modernising SDIs.

GeoE3 recommends all data providers use the newest versions of OGC API standards, such as OGC API Features.

2.5.5. Q17: Are data extents (bbox) defined in service metadata?

Example: If data extent is defined by using bounding boxes (bbox), users can't query features outside of the given area.

Results: Yes, in all services. Mostly because the INSPIRE directive requires using bounding boxes.

Recommendations: GeoE3 recommends defining data extent in the service metadata as accurately as possible.

2.5.6. Q18: Do services allow to download data as a single nation-wide entity (e.g. ATOM feed)?

Results: In most cases, services allow users to download data as a single nationwide entity. Only the GeoE3 platform doesn't allow that directly. Some services support this only for some data categories.

Recommendations: GeoE3 recommends providing data in different sizes, to ensure that users can select the channel that best suits their needs

2.5.7. Q19: Do geospatial services support the newest versions of the OGC Web Services? (see https://www.ogc.org/docs/is)

Example: Using the newest versions of OGC Web Services ensures that all functionalities and abilities are available. For example, WFS2.0 can handle GML3 and it supports joins via a GetFeature request. However, OGC APIs are recommended more than OGC Web Services.

Results: Most geospatial services support the newest versions of OGC Web Services, but for Estonian climate data, they are not supported.

Recommendations: EULF recommendation No. 12 resembles that OGC API standards (e.g. OGC API Features) are already considered as possible INSPIRE Download Services. They also have a huge potential for modernising SDIs.

GeoE3 recommends using the newest versions of OGC APIs because they allow more functionalities for users. See the newest versions: https://www.ogc.org/docs/is

2.5.8. Q20: Do APIs support for most common error messages (HTTP error messages)?

Example: HTTP status codes can give you an idea of what was going on when you made your API call. The standardized status codes go from 100 to 511, and all have different meanings, but only the status codes from 400 to 511 reflect an error response.

Results: Most APIs support the most common error messages. However, more precise and thorough error messages would not be a bad idea.

Recommendations: GeoE3 recommends developing APIs in a way that considers the most common error codes and status messages (100-511).

2.5.9. Do geospatial services include data also out of the defined country borders?

Example: When integrating data sets from different countries, it may cause duplicate features if some features are located outside of country borders. In most cases, bounding boxes don't provide limits that are accurate enough.

Results: Most data sets are fine, but the Norwegian building data set has some buildings located on the Finnish side of the border. Therefore, the error is also visible in the GeoE3 platform.

Recommendations: GeoE3 recommends that data sets contain only features inside the defined borders.

3. Conclusion and Future Work

Our study found that while most countries make geospatial data available as open data, there is still a lot of variation in legal interoperability. This is likely to improve as countries adopt the principles of high-value data (HVD) sets outlined in the EU's Open Data Directive. However, semantic interoperability is still underdeveloped, with data sets often published in varying resolutions and across multiple platforms. Organizational interoperability is generally good, but there are still areas for improvement, such as multilingual accessibility, feedback mechanisms, and support services. For example, the PDOK is currently only available in Dutch. Technical interoperability is well-managed for standard usage and metadata, but there are challenges when it comes to integrating data across country borders due to variations in coordinate systems.

The interoperability between geospatial data and services is only the first step. We need to consider also other data services. We believe that meeting the interoperability at the national level is the only way to ensure good quality base data, which is needed in many use cases.

The next step of our project is to create an implementation plan to support all countries to emphasize interoperability even more. We will provide help for implementing OGC APIs and EU-based tools, such as eTranslate services to add multilingualism for national platforms and geo-enabled CEF context Brokers to facilitate data integration. Our next step is to create an implementation plan to guide countries to make their services more interoperable.

The International Data Spaces Association (IDSA) is on a mission to create the future of the global, digital economy with International Data Spaces (IDS), a secure, sovereign data sharing system in which all participants realize the full value of their data. GeoE3 services can be used in the future as a fuel into Data Spaces, especially Green Deal Data Space.

4. Appendices

None