INSPIRE Guide 2.0

wetransform GmbH
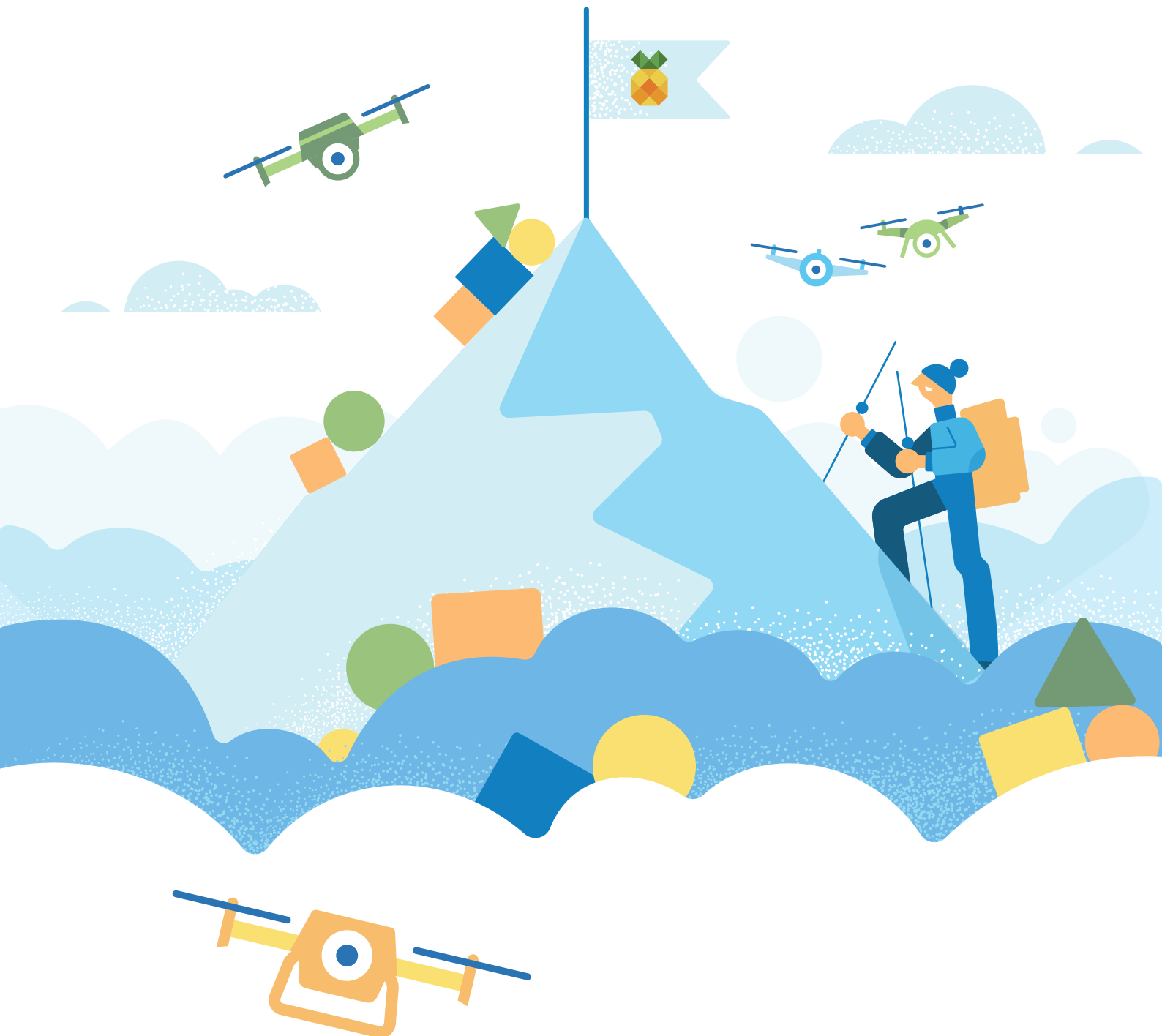
Contents

1 What is the INSPIRE directive, and why is it important?

Over the past years, we have seen an increase in the occurrence of natural disasters. The average number of floods, droughts and landslides has grown and continues to grow.

Landslide Damage on Chemin de Fer de la Mure near Grenoble, 2011. [1]

We must try to prevent, or at least mitigate, the effects of such natural disasters. The first step in tackling this problem is to collect geo-spatial data for preparation and prediction. The issue that arises in data collection is the lack of a common platform which allows successful management of data at an international level. To deal with this issue, the EU has introduced the [INSPIRE directive][2].

For geo-spatial data to be processed accurately, the data structure needs to be "harmonized." That is, the data needs to be in a format that ensures that it can be exchanged and edited between various platforms. The problem that exists currently is that most organizations and governments have different needs, and therefore have different requirements from their spatial data infrastructures. The INSPIRE directive aims to create a harmonized spatial data infrastructure. Each organization in the EU which deals with geo-spatial data has an obligation to standardize their data according to this directive.

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[1] Wikimedia Commons contributors, "File:Eboulement chemin de fer de la Mure - Monteynard.jpg," *Wikimedia Commons, the free media repository,* https://commons.wikimedia.org/w/index.php?title=File:Eboulement_chemin_de_fer_de_la_Mure_-_Monteynard.jpg&oldid=226402740 (accessed October 11, 2017).

[2] INSPIRE EU. "The INSPIRE Directive: a brief description." *Youtube.* Youtube. July 3 2015. Accessed September 26 2017.

1.1   What is the aim of this document?

This document aims to give you an overview of INSPIRE guidelines, challenges and solutions. By reading through it, you will learn about:

- Basic guidelines regarding the INSPIRE directive, such as technical components and legal specifications.
- The challenges which are faced when trying to implement the INSPIRE directive.
- Effective solutions and methodologies to implement them.

1.2   Who will this document be useful to?

This document will be of use to you if:

- You are part of an organization that is required to fulfil the obligations of the INSPIRE directive.
- You love to transform data according to INSPIRE Implementation standards and guidelines as a hobby, like we do ☺.

If you consider yourself to already be well-versed with INSPIRE implementation guidelines and challenges, and just need a solution, click here.

Why implement INSPIRE at all?

The INSPIRE directive aims for much more than just data interoperability. It aims for EU members states to have a homogenous ground for decision-making. It works towards better collaboration across borders through aggregated data models.

Interoperable geodata creates a ripple effect. The homogeneity of data formats leads to a drastic reduction in project times that are spent on harmonizing data to a specific standard, freeing up team members to perform other tasks. Moreover, the fact that open data is available across various member states means that cross-border policy making can shift to a data driven approach. A data-driven mechanism eases and fastens complex governmental decision-making, and it is ultimately the citizens that benefit from this. For example, if a river is flowing through two different countries, and there is a factory using the river's resources upstream in country A, then the downstream river users in country B need to be made aware of the effects of country A's usage.

INSPIRE Annexes cover data themes such as geographic features and transport networks. Interoperability with each of these features leads to improvement in many topics ranging from usage of resources to city planning and development. These improvements eventually trickle down towards enriching the lives of citizens.

2   An overview of INSPIRE specifications

The INSPIRE directive aims to achieve a harmonized dataset by specifying legal and technical specifications. The legal guidelines are binding specifications, whereas the technical specifications deal with the how-to of the process. The legal guidelines, therefore, identify a framework. The technical specifications describe how to operate within this framework.

2.1 Legal and Technical Specifications

The Directive uses a set of implementing rules as the legal foundation to ensure that the spatial data infrastructure is applicable across boundaries. The following section provides a brief description of the specifications. If you would like to get more information on a certain topic, just click on the heading that will direct you to the INSPIRE Knowledge Base section.

[Technical Guidance](#)[3]

These documents provide information on how Implementing Rules may be transposed into working, technical solutions. Using these guidelines is extremely beneficial as it would maximize the interoperability of INSPIRE services. A flow chart that explains the relationship between Implementing Rules and Technical Guidance can be found [here](#)[4].

2.1.1 Metadata[5]

Metadata describes a data set, in particular its content, the license under which it is release, contact information for its maintainers and technical compatibility information. Metadata needs to be entered manually or generated automatically.

2.1.2 Data Specifications[6]

To make data interoperable, Data Specifications describe the data model and the encoding to use. They also contain additional information such as code lists and map layers. A full list of the data themes is available in the Annex to this document.

2.1.3 Network Services[7]

Network services identify common interfaces of web services. Network services provide a common way to do multiple things such as viewing, downloading, publishing and transforming data. The development of client applications can then be based on these interfaces.

2.1.4 Data and Service Sharing[8]

Access and sharing of spatial data and services on a common platform is what the INSPIRE directive is trying to achieve. This section specifies rights regarding the sharing of spatial information and services between all levels of government. Part of this process is to register the data set registration with an INSPIRE geoportal.

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[3] INSPRIE Knowledge Base. "INSPIRE Techincial Guidance." https://inspire.ec.europa.eu/inspire-technical-guidance/57753

[4] INSPIRE Knowledge Base. "Technical Guidance.." *INSPIRE Knowledge Base.* 02.10.2017. https://inspire.ec.europa.eu/inspire-technical-guidance/57753

[5] INSPIRE Knowledge Base. "Metadata." *INSPIRE Knowledge Base.* 22.09.2017. https://inspire.ec.europa.eu/metadata/6541

[6] INSPIRE Knowledge Base. "Data Specifications. *INSPIRE Knowledge Base.* 22.09.2017. https://inspire.ec.europa.eu/data-specifications/2892

[7] INSPIRE Knowledge Base. "Network Services." *INSPIRE Knowledge Base.* 22.09.2017. https://inspire.ec.europa.eu/network-services/41

[8] INSPIRE Knowledge Base. "Data and Service Sharing." *INSPIRE Knowledge Base.* 22.09.2017. https://inspire.ec.europa.eu/data-and-service-sharing/62

2.1.5 Spatial Data Service[9]

For the data to be interoperable, spatial data sets should possess the ability to exchange and execute data amongst them. These are the regulations which are concerned with the core services and interoperability of data sets.

2.1.6 Monitoring and Reporting[10]

EU member states are required to annually report a number of indicators for the monitoring the implementation and use of their infrastructures for spatial information.

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[9] SNPIRE Knowledge Base. "Spatial Data Services." *INSPIRE Knowledge Base*. 22.09.2017.
https://inspire.ec.europa.eu/spatial-data-services/580
[10] INSPIRE Knowledge Base. "Monitoring and Reporting." *INSPIRE Knowledge Base.* 22.09.2017.
https://inspire.ec.europa.eu/monitoring-and-reporting/69

3   What are the challenges to INSPIRE Implementation?

With many organizations and datasets involved, achieving a harmonized structure can be a challenge without the right tools. A wide variety of existing systems manage data in the organizations wishing to implement INSPIRE regulations, using different formats, models and languages. A few other challenges are represented below:

3.1   Costs

3.1.1   Monetary Costs

INSPIRE Implementation isn't free, but what you do have control over is how much it will cost. It depends on which kind of solution you use (a custom-built or out of the box solution), how it is operated and the size and complexity of data sets. The costs per data set can range from 120 to 5.000 € annually.
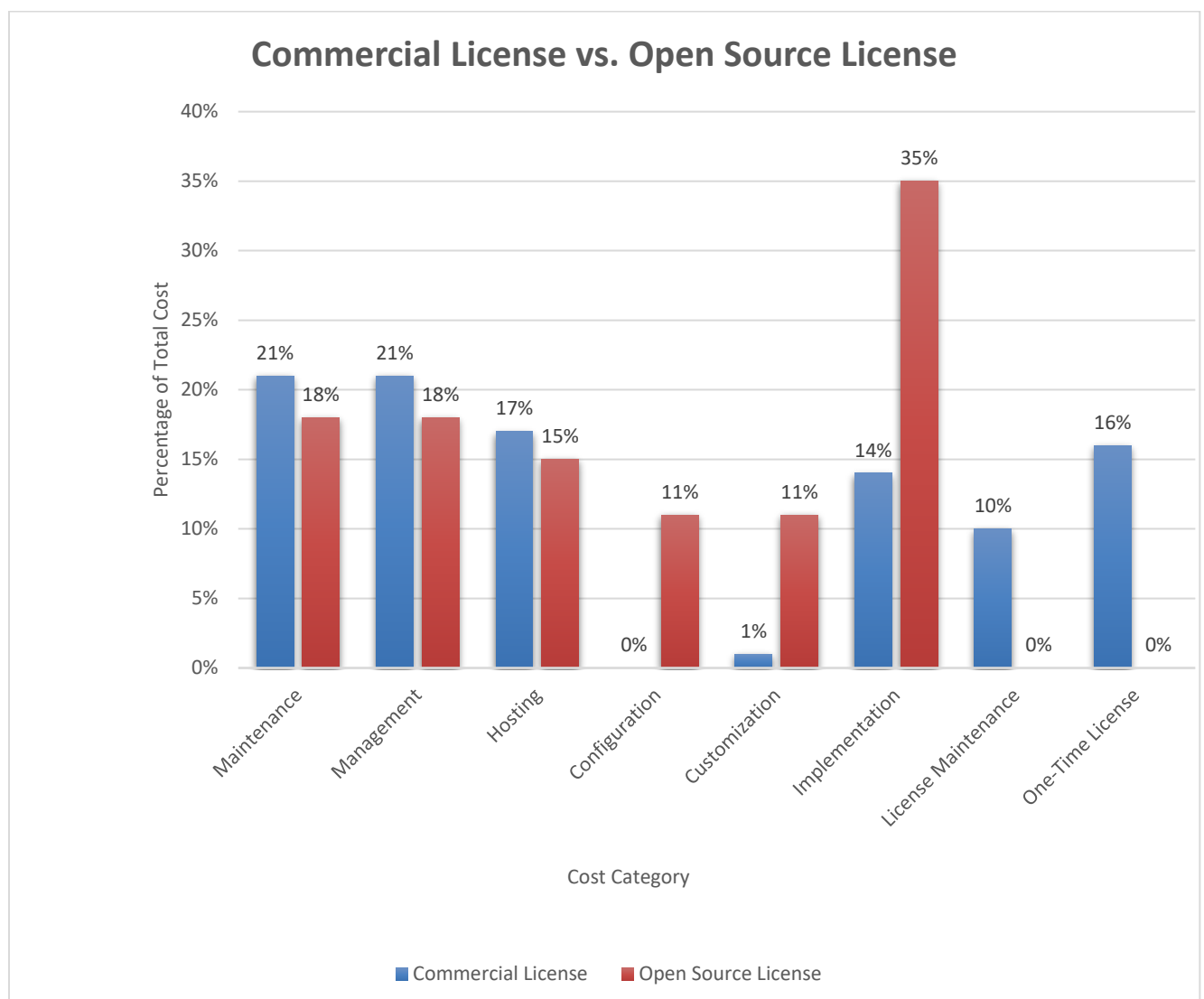
3.1.2 Scope and Form Procurement

When deciding on the form of INSPIRE related procurement, it is beneficial to focus on those features that will get you on your desired track. One of the first points to consider when purchasing software is whether to buy out-of-the-box software or have a customized solution. While ready to use, the out of the box solution is constantly being updated resulting with improvements of the solution. Customer support and community forums are available to help customers with an issues or questions they might have.

3.1.3 Time

The process of identifying, providing metadata, transforming, publishing and registering consumes time. Due to the approaching deadlines for Annex conformations, it's important to minimize the time taken for these processes to be completed. An average INSPIRE implementation project for an organisation with 10 medium sized data sets takes about 8 months to complete; more complex projects that include a lot of development work can take upwards of 48 months.

3.1.4 Open Source or not?

Open source tools are fundamentally **easy to access**. There is no need to fork out a credit card, and you can just download the software. You probably still need to convince IT that they will allow you to install the software, especially if it is to run on the server infrastructure, and access other parts of that infrastructure. Software as a Service can make life much simpler in some cases, since no local installation on a desktop or server in your own organisation is required. This makes Software as a Service projects faster and reduces efforts compared to Open Source projects, and is the reason why e.g. many people use hosted GitLab, when it's Open Source so they could also host it by themselves.

As there is no initial license cost, Open Source addresses budget constraints. Despite this, the **Total Cost of Ownership** (TCO) of an INSPIRE Open Source solution can be hundreds of thousands of euros higher than that of a proprietary solution. Thus, it's important to understand the underlying factors that contribute towards the TCO of any solution, as outlined in the next section of this document. There are a couple of points that you should pay special attention to when using open source components:

- **Integration**: Do you need to integrate multiple components, such as test suites, catalogue services, geodata servers, user management and others?
- **Hosting:** Do you have the infrastructure for high-availability hosting, ideally with on-demand scalability? Do you require any licenses such as Oracle/Windows Server?
- **Scaling**: Do you have the tools in place to scale up horizontally and vertically when your amount of data or users rises?
- **Monitoring**: Do you have monitoring infrastructure in place that helps you to fulfil the INSPIRE Quality of Service requirements?

- **Capacity**: Do you have sufficient capacity to maintain your deployment and to react quickly in emergency situations?
- **Customisation**: Do you need to customize or extend a component to match your requirements?

Based on our analysis of both our own projects and of published data on other projects, implementing the six points listed above can cost several hundred thousand Euros for a larger organisation.

You should also be aware that in the INSPIRE world, there aren't that many organisations that contribute financially or in-kind towards the development of open source tools, even when they are widely used. As an example, there are more than 5.000 hale studio users, but only about 40 paying customers that contribute directly (e.g. through support subscriptions) or indirectly (through project work and framework contracts) to its development. In other words, when you use an Open Source component, you should think about how you can give back – be it in a financial or in-kind way. In this way, you will ensure that the software will continue to evolve.

Open Source software does not rely on **security** by obscurity like some proprietary software does and is usually quite secure. What sometimes gets lost is that the actual deployments must be hardened, maintained and patched. To achieve this, the software and the deployments have to be made more robust at different levels. Management costs of secure operations can be high. Again software as a service is an alternative approach that can make life much easier, especially when the provider of such a cloud solution can prove that they maintain the system to the highest standards, such as ISO 27001 and C5, and that they can provide reports of security audits (e.g. penetration testing).

Open Source is often very **flexible**. With Open Source software, you can get access to the source code. You can and may change the program yourself, or outsource this work to a service provider. Proprietary products often offer open, powerful APIs that you or a third party can access to achieve the same, such as for developing a plug-in. If you would need to make changes to the core product you are probably better off using an open source component in your stack.

Open Source licenses also act as a type of **insurance** against being dependent on a single provider, e.g. when that provider goes out of business. You can also get comparable insurance from some vendors who provide access to the source code through source code licenses. These licenses give you continuous access to the current version of the product. They allow for changes and additions, but not for any redistribution. There is also the option of a source code escrow. The source code escrow provides you on-demand access of the source code from a third-party.

3.1.5 Total Cost of Ownership

When considering the cost of a solution, it is important to take into account all relevant costs. The following factors contribute to the total cost of ownership of your INSPIRE implementation:

- Initial Licensing: The one-time fee that is paid for a product license.

- License Maintenance: Yearly maintenance fee that is to be paid for updates for a product license.
- Customization and Configuration: Costs incurred when modifying a solution to match business needs as well as implement INSPIRE. These costs are especially high when a custom solution is built to support existing processes.
- Hosting: These are the costs relevant to hosting data and network services. Most organisations default to on premise hosting. In general, on premise hosting is ~5 times more expensive than cloud hosting.

Cost of Network Services
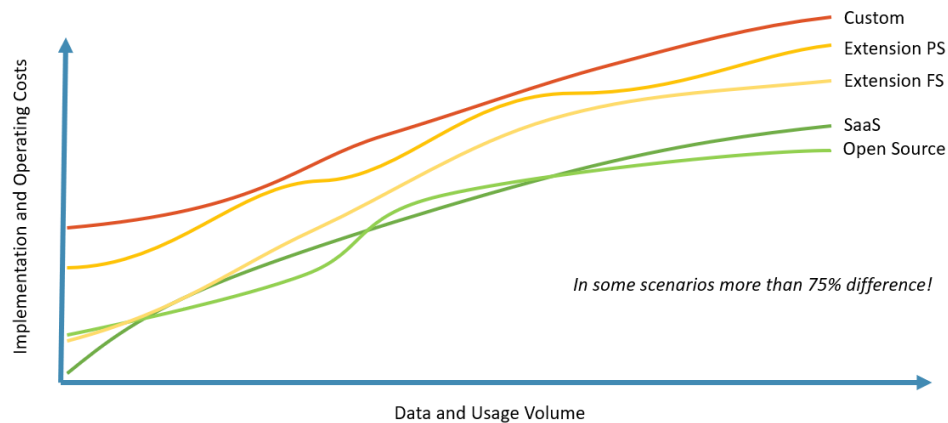
- Application Management: These are the costs that come along with managing the solution and ensuring that it is functioning correctly. Application management often causes significant personnel workloads, especially if your solution needs to have high availability. In case a small amount of resources is put towards application management, it increases the risk of major compliance issues.
- Training Costs: Consists of onboarding costs of staff to correctly use a toolset.

Out of the above, the cost of customization, configuration and application management are usually severely underestimated, since personnel costs and opportunity costs arising from this are not considered. Probing deeper into these costs, assessing different options, revising implementation strategies and generating a fair cost comparison can save hundreds of thousands of euros.

3.2 Organization

Implementing INSPIRE requires very specific competencies, which are not readily available in all but some very large INSPIRE implementing organizations. Thus the required knowledge represents one of the key constraints in implementation. In particular, you will need:

- **Standards Knowledge:** Standards such as ISO/GML are extremely complex, and it is hard to have sufficient working knowledge of such standards. A high amount of expertise is required to work with them.

- **Methodology Knowledge:** Methodology knowledge refers to the how-to of the organizational and technical steps that are needed to follow a successful implementation.
- **Technology Knowledge:** The knowledge of technology such as WFS/WMS, WCS and CSW is required to implement INSPIRE. The details of these technologies aren't readily available, and it is a challenge to procure the necessary information on these topics.

Question 2.17: Which challenges did you encounter when designing the data model?

35 responses

Source: http://inspire-extensions.wetransform.to/survey.html
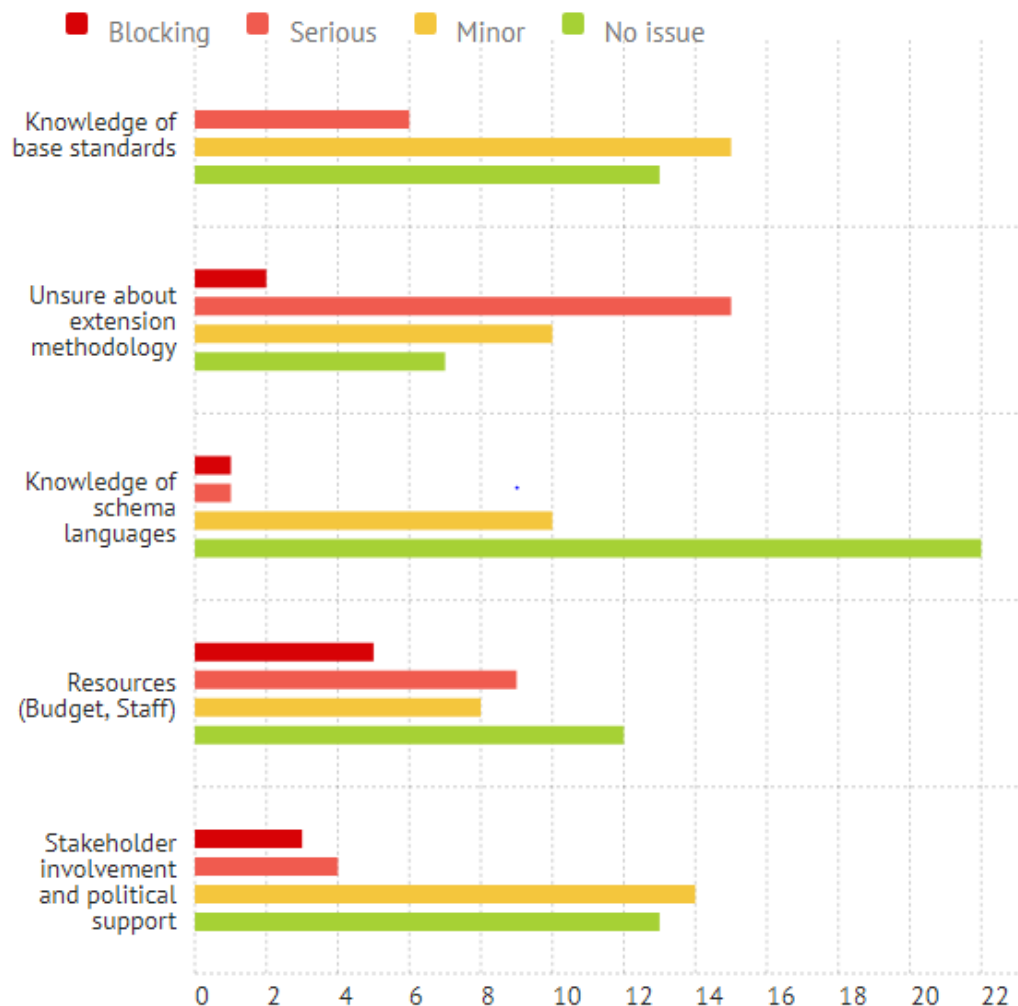
3.3 Personnel and tangible restrictions

These barriers are specific to the structure of an organization and include personnel, budget constraints and other resource constraints of an organization.

3.4   Technology

3.4.1   Model Transformation

Data models from different systems differ in structure and expressivity. The design of these models was approached without the concern of whether the model may have to be transformed. This makes it necessary to have a powerful tool to facilitate transformations.

3.4.2   Data Transformation

To get INSPIRE interoperable data, you transform it from its current format and data model to the INSPIRE data specifications. In most INSPIRE implementation projects, 50-80% of the time taken is used on such data transformation tasks.[11]

Most people dealing with these transformations are domain specialists, such as environmental policy analysts and micro-economists. Such domain specialists and less-technical users may not have sufficient knowledge to execute it themselves. As a result, important data may be left non-interoperable.[12]

3.4.3   Systems Integration

Systems integration refers to incorporating sub-systems into one standardized system. This ensures that each sub-system functions according to standardized specifications. Each addition to the sub-systems involved should conform to these standardized specifications. In the case of INSPIRE, each component needs to be compliant with INSPIRE guidelines and the standardized specifications.

3.4.4   Data Publishing

After the data has been transformed, it needs to be published. Sometimes the transformed data is not completely compliant with INSPIRE standards, and manual configuration of individual services is required. This process takes time and can also prove to be a problem if the organization does not have knowledge on how to manually configure data.

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[11] "Research Data Management." Wetransform gmbh. https://www.wetransform.to/services/research/
[12] Hollerstein, Joe and Jeff Heer. "Data Transformation." *O'Reilly Radar: Insight, analysis and research about existing technologies. http://radar.oreilly.com/2014/01/data-transformation.html*

Question 2.18: Which challenges did you encounter when implementing the data model?

35 responses
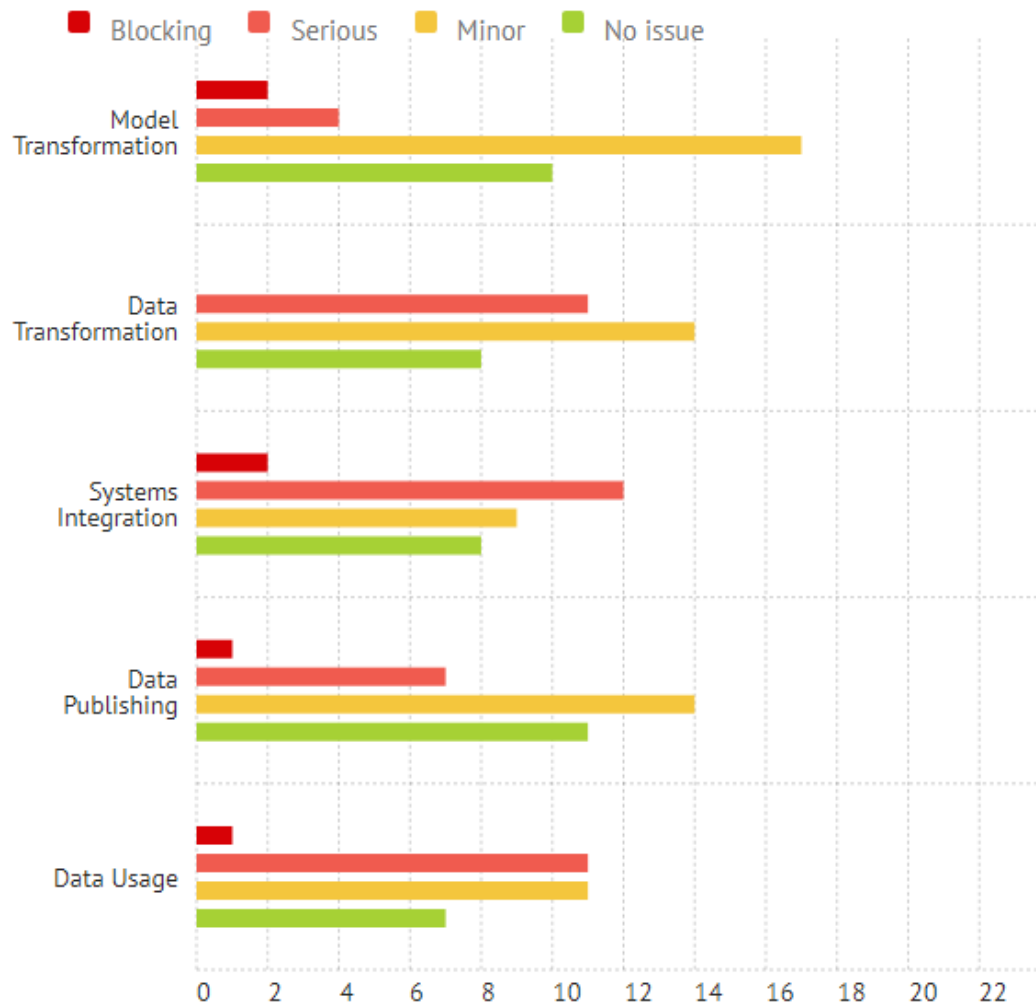
3.5   Data Usage

Datasets are often very diverse and complex, which can make them hard to analyze and share. For this purpose, the presence and quality of data, metadata and services, and standardization are very important. An overview of such issues and has been represented in table below.

Technical obstacles and licencing issues
Country reports, period 2010 - 2012

Type of barriers	Number of issues	Category
Diversity of existing information systems; duplication of data resources; difficult change to new technology	10	Technical (29.7%)
Additional (specific) technical and infrastructure resources are required; lack of appropriate tools	18	
Quality of data, metadata and services	7	
Level of standardisation; clarity of technical documentation is still low; high complexity of services and data specifications	8	
Heterogeneous licencing models and sharing arrangements (or lack of those); modernisation	6	Licencing and sharing (22.8%)
Restrictions are applied: charges and conditions for access and use (different user types, different conditions, etc.)	20	
Specific issues: resistance to open data, responsibility for use, protection of personal information	7	

Source: http://inspire.ec.europa.eu/events/conferences/inspire_2014/pdfs/18.06_1_16.00_Darja_Lihteneger.pdf

4   Typical Implementation Requirements

When deciding on using a tool on how to transform and publish data, it's a good idea to specify a benchmark. It can be a considered a baseline to compare the solutions provided by the tool. Here's a list of things to consider before deciding on a benchmark:

4.1   Priorities and value drivers

What are your priorities in accordance with national and international obligations?

- Is INSPIRE implementation a priority for you? If yes, to what extent? The different levels are represented below:
  - Fulfillment of minimum legal requirements only.
  - Fulfillment of new/additional legal requirements.
  - Achieve better collaboration with other authorities.
  - Move existing, reporting, production and publishing workflows to the infrastructure.

- Which are the risks and unknowns associated with your project? You can identify these by:
  - Creating a workflow design based on current production systems.
  - Identifying the risks that would arise with custom execution as opposed to an off-the-shelf or cloud solution.
  - Recognizing software components that are already in place and gauging if internal knowledge to implement a complete workflow is present.

4.2 Functional Requirements

This section lists some typical questions that allow you to identify functionality does your implementation needs to provide:

4.2.1 INSPIRE Implementation Scope

- Which INSPIRE themes can you map your source data to?

4.2.2 Data Modelling

- Do you intend to use INSPIRE extensions or non-INSPIRE data models, such as Reporting, in your INSPIRE infrastructure?
- Do you need to define additional quality and validation criteria to determine whether your source data is fit for transformation to an INSPIRE interoperable dataset?

4.2.3 Data Transformation

- Have you already created transformation projects or scripts to create INSPIRE interoperable GML from your primary data sources?
- Do you want to automatically update your INSPIRE interoperable data sets and published services if the data in one of the sources changes?
- How frequently do you need to update data sets, and how important is performance of the transformation?

4.2.4 Metadata Editing and Publishing

- Do you already have dataset metadata and intend to re-use that?
- Do you have your dataset metadata in an existing catalogue service?
- Do you want to generate your dataset and service metadata automatically?
- Do you want to automatically publish service and/or dataset metadata to a catalogue service?

4.2.5 Data Publishing

- How should your data be made accessible for publishing?
- What View services do you intend to provide – WMS and/or WMTS?
- What download services do you intend to provide – predefined (ATOM Feed) or direct access (WFS), or Coverage Services where applicable?
- Do you intend to allow edits to the data (requiring a WFS-T)?
- How do you ensure that you meet availability and performance criteria as defined in the INSPIRE Quality of Service criteria?

4.2.6 Data Validation

- Should metadata, services and data sets be validated automatically to ensure full compliance?

4.2.7 Data Usage

- In which portals, applications and downstream systems do you intend to use INSPIRE services, if any? What are their requirements? Can they work with INSPIRE GML?
- How should users find your INSPIRE data?

- What kind of loads do you expect on the INSPIRE services? How many parallel users will there be?

4.2.8 Authentication and Authorization, User Management
- Should your services be protected?
- Do you need to track individual user access, e.g. for billing or authorization?
- Do you already have a Single Sign On (e.g. CAS, OAuth) infrastructure in place that the INSPIRE system should tie into?
- Do you need advanced user management, e.g. based on roles and organisations?

4.3 Deployment Models

Depending on your needs, your application can be hosted and managed publicly or privately. The costs and services provided vary along with the model deployment type. These models are elaborated on below:

- **Public Cloud Deployment:** A public cloud deployment uses shared resources. You either purchase virtual servers (also called "Platform as a Service") or a hosted solution ("Software as a Service"). Public cloud deployments tend to be far cheaper in their Total Cost of Ownership than the other options, except at very large scale (if you need at least hundreds of servers).
- **Private Cloud Deployment:** In this case, operations are hosted on a server that is selected by you and exclusively used by your organization, but operated by a service provider. Private Cloud deployment allow customization, but are more expensive than public cloud deployments.
- **On Premise Deployment:** If you wish to host the system on their own Infrastructure, On Premise deployment is used. This is the most complex type of deployment that typically requires customization and expert staff.

4.4 Integration or All-in-one?

When you implement your INSPIRE infrastructure, there are three architectural options. You can either deploy a standalone, all-in-one solution, you can extend your existing infrastructure, or you can do a shallow integration between an all-in-one solution and any existing infrastructure. All options have specific advantages and disadvantages.

- **All-In-One:** A fully integrated INSPIRE platform allows you to get started much faster, at significantly lower cost, especially when you use one of the existing Software as a Service solutions. The components for transformation, publishing and validation all work seamlessly together. On the downside, you will need to replicate users and data to the all-in-one-system.
- **Deep Integration:** A deep integration, where you add single new components to your existing environment is sometimes preferable, in particular when you already have many of the key components of a SDI and just need a specific capacity, such as Transformation or Download Service publishing. A deep integration always requires custom development and is usually more expensive, has higher risks and takes longer to complete.

- **Shallow Integration:** A compromise is a shallow integration, where the all-in-one system is fully deployed, but ties into some existing infrastructure, such as databases, Single-Sign-On tools such as OAuth or CAS or file/source code sharing infrastructure. This approach has few downsides, expect that it is usually not applicable for public cloud Software as a Service solutions, since these have tight limits on customization.

4.5   Common Errors to Avoid

There are a few common patterns that contribute to the complexity of INSPIRE Implementation. Here are a few things to avoid.

- **Data mapping errors**: The mappings between the source data and the target data need to be mapped well. It's best to have a visual representation of this process i.e. having a graphic representation of what the data initially looks like, how it will be mapped, and what exactly it should look like at the end. One issue that arises often is when there are two attributes with the same name but have different namespaces. In this case, make sure you use the right namespace.
- **Inefficient Software Combinations**: There are different parts of the implementation that include publishing original datasets, metadata generation, and validation, data transformation and publishing and viewing of services. There are various tools that you can use for each of these stages, but this doesn't confirm that the output from each tool will be extensible and guarantee a successful input for the next tool. There is a loss of data consistency if there are too many application breaks, which eventually must be dealt with manually. Ensure that you're using the right tools that have the right extensibility, or better yet, find a tool that can help you deal with all these steps in an integrated manner.
- **Lack of Documentation**: Documentation can give you the edge you need when you're running low on project times and deadlines are looming. Imagine having an internal go-to-repository of transformation projects to help you out whenever you seem to run into an issue, or already having a specific roadmap laid out for a complex transformation project. This documentation can exist in different forms, for example, a best practices sheet or a target data model prototype set, or even a list of five things to avoid when going about a project 😉.
- **Using an incompatible toolset**: Tools that are currently in place for INSPIRE workflows may need to be tweaked or changed. It's important to assess the capabilities of current tools and see if their capacity can match up to the task at hand. If it can't, it may be time to look into a new toolset that can better serve your needs and help you perform your tasks easily and efficiently.
- **Placing high manual efforts:** Even with the correct tools, knowledge, and documentation, project times and costs could still be high because of the amount of manual work that goes in. INSPIRE Implementation projects often have opportunities for automation; it's important to identify the parts of the project that don't need manual

intervention. These segments can then be capitalized on by looking into how the process can be automated.

5 Hale Connect as a solution

Spatial data infrastructures such as INSPIRE provide harmonised geospatial data to public organizations, enterprises and citizens. As mentioned earlier, there are a few key challenges to their implementation:

- A substantial amount of knowledge, technical tools and monetary resources is required to harmonize, migrate and convert data.
- Data publication requires server resources and staff expertise for hosting and application management.
- Data usage is riddled with technical problems and mismatches, which causes a loss of time and resources.

Hale Connect as integrated solution addresses the aforementioned challenges and enables the provision of INSPIRE compliant data. It ensures that the key components for design, metadata management, validation and publishing work together seamlessly and it fully automates workflows such as updating data sets and services. All 34 INSPIRE data specifications can be fully implemented, enabling data to be usable in other systems as well. Hale Connect also provides you with the option to publish reports in other formats such as FFH, WFD and Natura2000 so you don't have to use separate legacy tools.

Along with the **on-premise** deployment, it is also available as a **public cloud** or **private cloud** solution. For the cloud deployments, we guarantee to meet INSPIRE availability and performance criteria. Cloud deployment eliminates hosting and application costs and the need for custom development and maintenance.

In this section, you will learn how to use Hale Connect to complete each step of the INSPIRE implementation process. If you consider yourself to be more of a practical learner, a free demo account is available. Before jumping into the workflows, let's go over a few key concepts first.

There are three main roles in the system, each building on the scope of the others:

Data Manager: A data manager is someone is responsible for uploading and maintaining data, using pre-configured workflows for data transformation and publishing.

Theme Manager: A theme manager has sound knowledge of INSPIRE and of the related concepts and technology. The theme manager workflow is more complicated than the data manager workflow, but offers the benefit of more customizability.

Superusers: A superuser is an organisation administrator and can create other user accounts, set up suborganisations and change system settings.
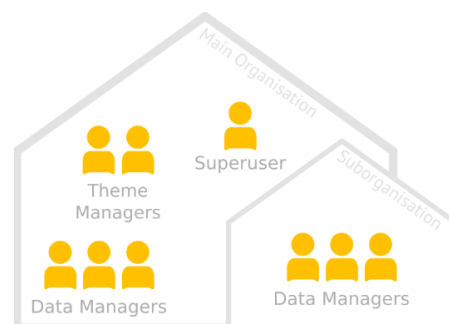
Hale Connect enables you to manage several different types of resources:

Data Set: A data set contains at least one file. All files in a dataset have the same schema, the same format and the spatial coordinate reference system. It's possible to create derived data sets by means of transformation projects.

Theme: A theme defines a workflow for data set processing and publication, such as View Service and Download Service configuration.

Schema: A data model defines what valid input data for processing and publication needs to look like, and is referenced from themes and transformation projects

Transformation Project: A transformation project is a hale"studio project using the formats *.hale or *.halez that has been uploaded to Hale Connect. The project contains references to source and target schemas, an alignment that maps elements from the schemas to each other, additional configuration for the loaded schemas and finally configuration options for the desired output.

Service: For every data set that has a valid theme configuration linked to it, services such as INSPIRE View and Download services can be published. Services are usually described through INSPIRE compliant metadata.

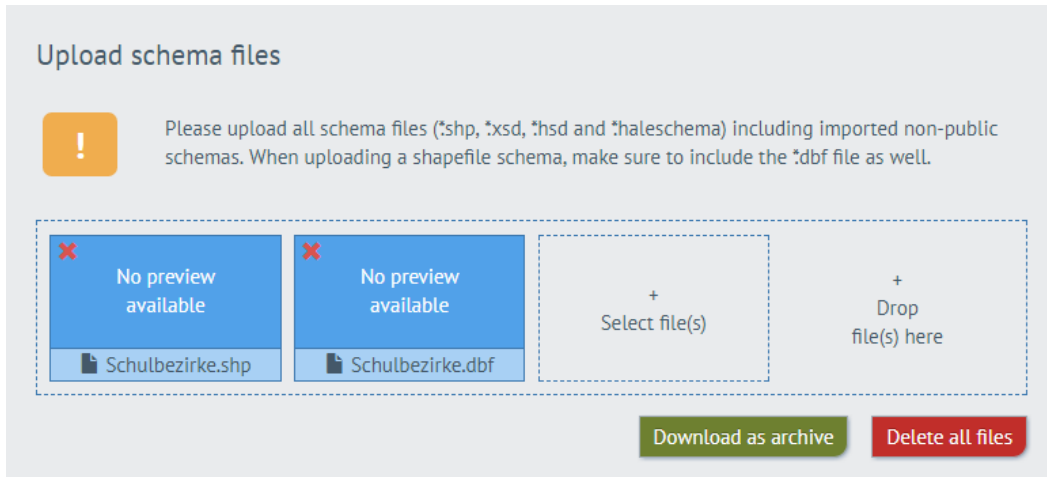The following figure shows the relations between the different resource types:
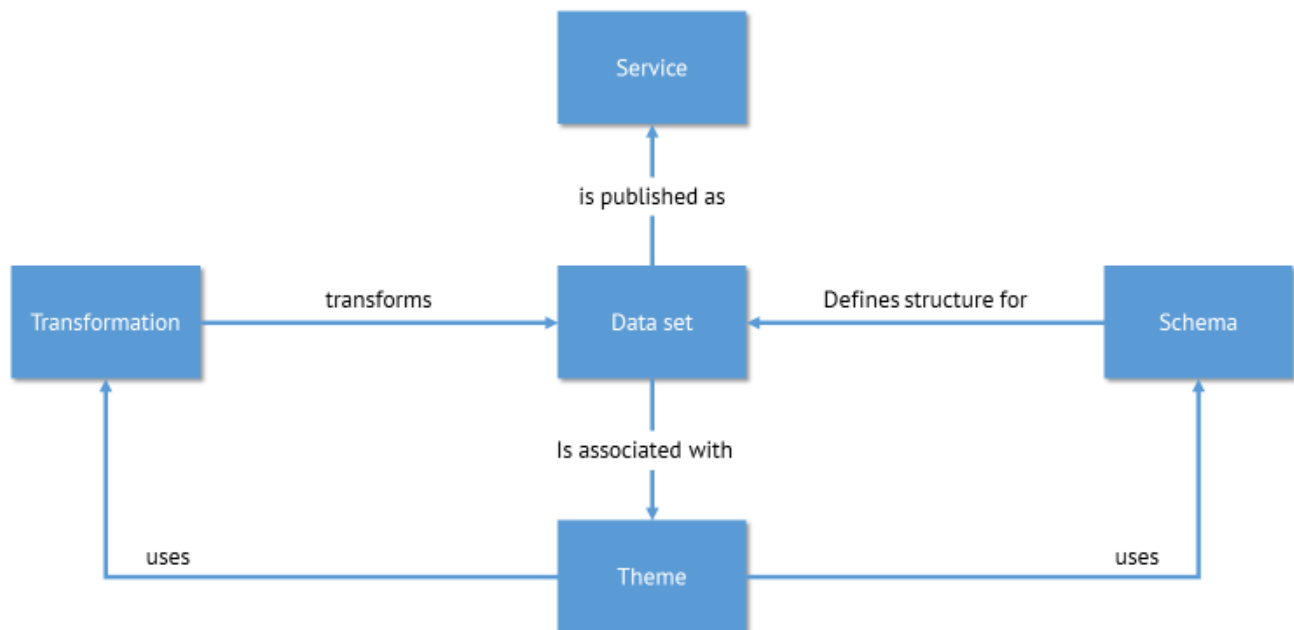
5.1 Setting up a Workflow: The Theme Manager's Process

If you require customizability for theme creation and schema creation and have a sufficient knowledge regarding those topics, use these guidelines.
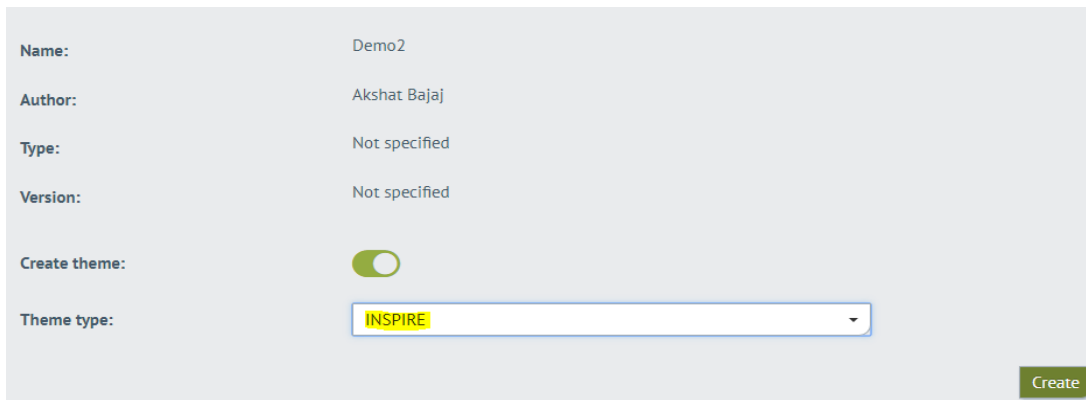
The first step is to set up a schema to define what valid input data for processing and publication needs to look like.

5.1.1 Set up a Schema

1. Click on "Schemas" on the main toolbar, then select "Create New Schema." Depending on your requirements, choose whether to create a schema from scratch or whether to upload an existing one, e.g. an XML Schema, a Shapefile or a database schema. For this workflow, we'll upload a schema to define its types and properties.
2. The next step is to upload the schema. If you are uploading a .shp file, make sure that you include the corresponding .dbf file too.

3. In the next section, give a name to the dataset so it is easily differentiable.
4. Now, toggle the "Create Theme" button so it is green, and select the "INSPIRE" theme type.

5.1.2   Transformation Project Creation

The next step is to create the transformation project. In this case, a .hale or .halez file has to be uploaded. The project specifies source and target schemas, an alignment that maps elements from the schemas to each other, additional configuration for the loaded schemas and configuration options for the desired output.

1. Go to "Transformation Projects"
2. Click on "Create Transformation Project."
3. Upload the transformation project.
4. Name the transformation project and confirm creation.
5. Click on "Theme" on the top bar. Select the theme you've created before, and go to the "Transformation" section.

6. Click on "Select Project" and choose the applicable transformation project from the list.
7. Click "Select Target Theme" to choose a theme that the data sets produced by the transformation should be associated with.

5.1.3   Theme Creation

After the schema and transformation project have been created, follow these steps:

1. Go to "Themes."
2. Go to "Create New Theme" at the bottom of the theme list.
3. Now, decide if you would like to use an existing theme configuration. This can be done by deriving your new theme from the selected one. Each part of this configuration can be edited later on.
4. Name your theme for easy identification.
5. Provide additional information, such as version number, author name and a description.
6. Click "Create" to save the theme.

5.1.4   Adding Feature Types to Themes

To validate whether an uploaded file's content matches a theme's definition, you have to assign feature types from previously uploaded schemas to the theme. This step is necessary to configure display properties and to enable certain autofill rules. There is no limit to how many feature types are assigned to a theme, and a single feature type can be associated with multiple themes.

1. Go to "Themes"
2. Select the theme you'd like to assign a feature to.
3. Go to "Feature types, and click on "Add New Type".
4. Choose a schema from the list by clicking on the "»" button.
5. Choose a single feature type from the list of features by clicking on the "»" button.

5.1.5   Editing Display Properties

To provide well-usable view services, you can define display properties which are then used for legends and GetFeatureInfo popups. To set display properties, follow these steps:

1. Go to "Themes" and pick the theme you'd like to change the configuration for.
2. Go to "Feature Types"
3. Click on the properties of the feature type for which you'd like to edit the display properties.
4. In the table that appears, decide which fields you want to be visible in a popup by setting the "Display" property to "Yes", and then pick an Alias for those that should be visible.
5. Save your configuration by clicking on the "Save" button.

5.1.6   Editing Metadata Configuration

The metadata configuration defines which metadata needs to be provided for all data sets associated with a theme. The metadata configuration also contains autofill rules and default values, which you can use to automate metadata entry almost entirely.

1. Go to "Themes"
2. Pick the theme you'd like to edit the metadata configuration for
3. Go to "Metadata"
4. Modify the configuration in the text editor. Metadata category objects can be found here.

5.1.7 Configure View Services

In the View Service configuration, you can adjust aspects such as the type of service, the coordinate reference systems and the cartographic styling.

1. Go to "Themes"
2. Pick the theme you'd like to change the configuration for
3. Go to "View Services"
4. Pick the type of service you'd like to publish.
5. Choose at least one coordinate reference system (CRS) that should be supported. You can add additional CRS by clicking the "+" button.
6. Decide whether GetFeatureInfo should be enabled or not.
7. Upload a Styled Layer Descriptor to define the cartographic configuration for the view service.

5.1.8 Configure Download Services

All data sets linked to a theme share a common configuration for the creation of download services, such as OGC Web Feature Services or INSPIRE Predefined Dataset Download Services. In the Download Service configuration, you can adjust aspects such as the type of service and the supported file formats and coordinate reference systems.

1. Go to "Themes"
2. Pick the theme you'd like to change the configuration for
3. Go to "Download Services"
4. Pick the type of service you'd like to publish.
5. Choose at least one coordinate reference system (CRS) that should be supported. You can add additional CRS by clicking the "+" button.
6. Choose at least one file format that should be supported. You can add additional formats by clicking the "+" button.

5.2 Publishing a Data set: The Data Managers' Process

If you're responsible for uploading and maintaining data, then follow these steps.

5.2.1 Data Set Creation

1. Select "Data" on the main toolbar
2. Select "Create Data Set" at the bottom of the data set list.
3. Decide which theme to link the data to.
4. Upload the files making up the data set.

Is your upload taking too long? Compress your data into a zip file before uploading it. This ensures a quick upload and no data is left behind.

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5. Name your dataset for easy identification.
6. Now it's time to provide optional and mandatory metadata. The mandatory input fields are marked by red circles. The number inside these circles refer to how many fields must be filled. When the red badges have disappeared, you can click on "Continue" move onto the next step.

7. Review all desired steps and transformation processes. You'll also notice five toggle switches which allow you to Download and View Services, Transform, and Publish the Data.

8. Download your dataset by clicking on the "Transformed Data" button.

5.2.2 Publishing Services

Services can be published immediately at the final step of creating a dataset. It can also be published manually by using the following steps:

1. Go to "Data" on the main toolbar.
2. Select the dataset for which you would like to publish services.
3. Go to "Download Services" or "View Services."
4. Select "Create." This process runs in the back and may take a few minutes.
5. With each completed step, you will receive additional information such as link to dataset for metadata, link to service metadata and a preview link for viewing services.

6   Conclusion

As the importance of environmental regulations is increasing, the need for harmonized geo-spatial data systems is increasing too. We are transcending language barriers, and have created common currencies. The next step is to transcend data barriers to ensure that data can be exchanged easily.

The EU has made INSPIRE implementation mandatory for its members. Even though it is not mandatory for others, a few countries such as India are already pushing for INSPIRE implementation due to the conveniences provided by a harmonized data infrastructure.

The path to a harmonized data infrastructure is, however, paved with challenges. These range from unclear requirements, difficult harmonisation, missing expertise and non-compliant software components to budget constraints. Thankfully, none of these challenges is unsolvable. With the right tools at your disposal, all challenges can be addressed and INSPIRE implementation can be achieved.

Want to learn how to use Hale Connect? Book a free online demo session today!

Want to try it out on your own? Create a 30-day trial account.

Have any questions or comments regarding the guide and INSPIRE Implementation practices? Reach out to us at info@wetransform.to or visit our Hale Connect page.

7 Annex I: INSPIRE Themes

INSPIRE identifies three specific annexes to work along, which contain a total of 34 themes. Each theme corresponds to a specific annex. These annexes refer to different kinds of data, and each annex has different deadlines.

These are represented in the table of Annexes below.

Annex 1: Basic Reference Data	Annex 2: Topographic Data	Annex 3: Sociographic, Nature and Statistical Data
- Addresses - Cadastral Parcels - Geographical Grid Systems - Hydrography - Transport Networks - Administrative Units - Coordinate Reference Systems - Geographical Names - Protected Sites	- Elevation - Land Cover - Geology - Orthoimagery	- Agricultural and Aquaculture Facilities - Atmospheric Conditions - Bio-geographical Regions - Buildings - Energy Resources - Environmental Monitoring Facilities - Habitats and Biotopes - Human Health and Safety - Meteorological Geographical Features - Mineral Resources - Oceanological Geographical Features - Natural Risk Zones - Population Distribution and Demographics - Production and Industrial Facilities - Sea Regions - Statistical Units - Soil - Species Distributions - Land Use - Utility and Governmental Services