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INSPIRE – what if?

*Summary report from
the What if...? sessions
at the 2017 INSPIRE
Conference*

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Abstract

Following up from the successful *"What if we didn't have INSPIRE?"* workshop at the 2016 INSPIRE Conference in Barcelona and the *"INSPIRE - What if...?"* workshop at the OGC meeting in Delft¹ in March 2017, two *"INSPIRE - What if...?"* sessions took place at the INSPIRE Conference in Strasbourg on 8 September 2017.

This report explains the background to these sessions and provides a summary of the discussions in the break-out groups.

Even though the six group discussions focused on different topics, the conclusions converged around the following recommendations:

- Make INSPIRE easier to use for mainstream ICT professionals and developers
- Focus on data content and on creating (preferably open) national or pan-European data sets, which are quality-assured and of high-value to a broad user community
- Make INSPIRE more user-centric and user-driven
- Improve communication and promote INSPIRE's success stories
- Clarify the roles of the public and the private sectors, especially with respect to data offering(s), data integration and value adding services

¹ <https://inspire.ec.europa.eu/events/what-if-workshop>

1 Introduction

INSPIRE implementation is now progressing across the EU, and INSPIRE data, services and principles are being proposed for ensuring interoperability across sectors. At the same time, new digital technologies (smartphones, 5G mobile networks, cloud computing, internet of things, e-platforms ...) are transforming the economy and society and are imposing new policy challenges and opportunities. The *INSPIRE – What if...?* workshops therefore aimed at taking a step back and thinking about what the INSPIRE infrastructure could look like if we had to design it today, integrating new data sources and exploiting new ICT opportunities (with a time horizon for implementation by 2025-2030).

The *What if we didn't have INSPIRE?* workshop at the 2016 INSPIRE Conference in Barcelona confirmed that there would still be the need for a data infrastructure and data sharing arrangements very similar to INSPIRE, even if the legislation did not exist, but also made some recommendations of what issues could be improved (e.g. a stronger focus on users).

Also the workshop at the OGC meeting in March 2017 did not come up with revolutionary ideas, but stressed that

- no-one knows what will be the future will bring, and therefore the infrastructure needs to be flexible to allow for technological change;
- any changes in the infrastructure and its underlying rules should be based on experimentation; and
- it is important to define success factors for INSPIRE (and these should not be just about compliance).

Following up from these successful workshops, two "*INSPIRE - What if...?*" sessions took place at the INSPIRE Conference in Strasbourg on 8 September 2017, with the aim to investigate a number of these emerging issues in more depth.

This report explains the background to these sessions and provides a summary of the discussions in the break-out groups.

2 The *INSPIRE* – *What if...* sessions at the 2017 Conference

The sessions at the 2017 Conference aimed at investigating a number of these emerging issues in more depth, including

- **What if** INSPIRE needs to be future-proofed? With changing boundary conditions (e.g. new European policies), user requirements (e.g. in a national context), technologies and new data sources (sensors, IoT), how can we ensure that the infrastructure is resilient and flexible enough to embrace and benefit from change (whatever it may be) and allow changes to be implemented at reasonable costs?
- **What if** we wanted to more actively include non-administrative data providers into SDIs and INSPIRE (industry, citizens, researchers, NGOs etc.)? Who are the key actors (users, providers, intermediaries, initiatives), what are their specific assets, requirements and additions to SDIs, and what are the challenges and enablers (technical, organisational, legal, ...)?
- **What if** "success" in implementing INSPIRE has many faces? How should we define success factors for INSPIRE, ensuring that this is more than just legal or technical "compliance"? How should (degrees of) success be measured (methods and tools)?
- **What if** application developers didn't know our data existed or how to use it? How to make INSPIRE data more easily findable and usable through search engines and simple web applications? What roles could web standards play (e.g. dereferenceable http URIs, RESTful APIs and JSON) in addition to and on top of current SDI technologies and standards? How to create and publish good examples and reference implementations to make implementation easier?
- **What if** we wanted to base all future evolution of SDIS, especially INSPIRE, on experiments? How could we create an environment (organisational as well as technical) for such experiments that can help assessing benefits and impacts of the proposed changes?

We invited interested participants to submit short position papers addressing one or several of the questions mentioned above. These position papers could be moderate and radical ideas as well as mid-term and long-term visions or projections on SDIs. The selected position papers are included in Appendix B.

During the sessions, the authors of the position papers were invited to introduce their position and discussion topic in a 5' min speed presentations (three in each session). After these introductory presentations, the audience was invited to pick one of the presented topics and discuss in break-out groups (for around 45'):

- A vision for where INSPIRE should be in 5-10 years (or what should be possible then), at national (or sub-national) and/or European level.
- 2-3 recommendations on which activities should be reinforced ("we should do more of X"), given less importance ("we should do less of Y") or started ("we should do Z in addition"). Ideally, the recommendations should be based on existing experiences in MS or at least projects, i.e. they should be proven to be feasible and useful.
- Proposals for concrete next steps or quick wins for each recommendation. This could be around organising further workshops, pilots, testbeds or even suggesting an activity for the Commission expert group on INSPIRE Implementation and Maintenance (MIG) to discuss and include in the INSPIRE work programme. We are also interested in potential needs for further research or developments, i.e. are there recommendations where the current technical solutions are not up to the task?

The results of the discussion were then presented to all session participants. The main conclusions from these discussions are presented in the following section. Detailed summaries of the group discussions are included in Appendix A.

3 Main conclusions from the group discussions

Even though the six group discussions focused on different topics, the conclusions converged around the following recommendations:

- Make INSPIRE easier to use for mainstream ICT professionals and developers
- Focus on data content and on creating (preferably open) national or pan-European data sets, which are quality-assured and of high-value to a broad user community
- Make INSPIRE more user-centric and user-driven
- Improve communication and promote INSPIRE's success stories
- Clarify the roles of the public and the private sectors, especially with respect to data offering(s), data integration and value adding services

More specifically, the following main conclusions can be drawn for these five areas.

3.1 Make INSPIRE easier to use for mainstream ICT professionals

In order to make it easier to create value-added services on top of INSPIRE data and services, INSPIRE should offer a development environment that mainstream developers are more familiar with and which preferably can coexist with the current framework.

Such a framework should provide

1. simple APIs, which should provide easy-to-use access to parts of a dataset for mainstream ICT professionals, e.g. through faceted search with adjustable search parameters, and which could also be used to hide the perceived complexity of linked data encodings.
2. central access points caching data from the (highly) distributed INSPIRE service endpoints, which could also guarantee uninterrupted availability and good performance of services, and
3. support for the publication-subscription (pub-sub) messaging pattern, in order to provide better support for versioning of data sets, e.g. allowing to download only those objects that have changed since the last request or update.

Of these architectural measures, simple APIs were felt to likely have the highest impact².

The suggested APIs for mainstream ICT professionals could be established as a layer on top on the existing API offered by INSPIRE; however, some REST capabilities should be added, e.g. using a proxy approach. While this approach allows experimentation, it has some limits and cannot fix e.g. the lack of pub-sub support, inconsistent metadata etc.

For establishing such APIs, it will be crucial to engage with subject-matter experts and with mainstream ICT developers, to establish a credible (open source) community and a sustainable funding model. Government involvement will be important in order to give the community credibility and to encourage the necessary flow of funding (e.g. aimed at developers or start-ups). Finally, the framework should also include open source clients to facilitate user uptake.

Another architectural component to enable faceted or value-added services and APIs could be a well-managed ontology-structure linking INSPIRE data(sets) and also other data sources.

3.2 Focus on data content

The other crucial component for making INSPIRE and the proposed framework for creating value-added services a success will be a stronger focus on high-quality, up-to-date data. That is, the focus of INSPIRE implementation should move from the *how* to document and

² Since not all MS are implementing INSPIRE in the same way and following the same vision, in some cases of course other measure may have a higher impact on the implementation progress.

share data (metadata, network services, data structures and formats) to the *what* (the data content and the use of data for specific applications)³.

Currently, the data that is published in INSPIRE is the raw data used by domain experts for the business processes of the publishing organisation, while most users are really looking for is useful results of an analysis (maps, statistics, alerts, etc.).

The harmonisation (interoperability) of data is an important asset of INSPIRE - we have captured semantics from many data themes in 23 languages, but this unique body of knowledge is not really exploited so far.

Achieving nation-wide and pan-European coherent data sets or data centres could be a crucial step towards the success of INSPIRE. However, the development of such data sets could well take another decade and should therefore following a stepwise, topic-by-topic and be driven by clear user needs (which should determine the degree of coherence, consistency and harmonization aimed for). Clearly, the creation of such national or pan-European data sets requires effective governance structures and additional coordination efforts in the Member States and across Europe. It could be useful to analyse the existing coordination practices and governance structures in the Member States and evaluate whether powerful key responsible institutions in the Member States do (better/best) support the INSPIRE implementation.

There was a clear recommendation from most of the groups to strengthen the focus on open data, which is seen as a core success factor for the proposed framework for mainstream ICT professionals. Coordinated campaigns at country level could help promoting the Open Data idea more widely and help it become a mainstream pattern that includes data provision, user-driven evolution process and user feedback.

Generally, requiring user registration and authentication (e.g. for monitoring users and collecting user feedback) is seen critical, because it can keep users from accessing the data, even if it is free. An alternative could be a mixed licence model that provides free (unauthenticated) access to all users, but certain value-added functions to registered users.

3.3 Making INSPIRE more user-centric

As already stressed in the previous two *INSPIRE - What if...?* Workshops, it will be crucial to consider user centricity in any future evolution of INSPIRE, considering the flow of data from end (data provider) to end (end user) and the fact that also the business processes in the data provider organisations are currently changing in a lot of countries.

It is important to distinguish different categories of users, and at least end users (data users and map users) and developers (business developers and IT developers). Most participants felt the focus should be on the developers (see section 3.1), since most end users will access data through value-added services or applications and there will be very few direct users. Application developers and solution providers could also act as intermediaries, who could help to collect, interpret and channel the needs of end users, since they are in direct contact with them.

Participants also stressed the importance of EU-level users and of pan-European systems where INSPIRE data and services are being used, e.g. creating synergies with other reporting or planning obligations, where INSPIRE could provide a reference framework for connecting the diversity of environmental information in a coherent way.

Open Data initiatives were pointed out as one area to look at for lessons to be learnt for user engagement frameworks and strategies.

³ This has the added benefit that many problems related to data documentation and sharing only become apparent once one actually tries using the data.

3.4 Improve communication and promote INSPIRE's success stories

INSPIRE has a number of success stories of INSPIRE implementations for specific tasks, but we could do a better job in promoting them, including to a wider audience beyond the national coordination bodies and EC expert groups. In particular, it is important to show that the data is being used to justify implementation efforts to financing agents. Possible promotion channels include cookbooks, experiments, hackathons, simple data browsers, sharing practical examples, good practices, apps and other software or making your data crawlable (and thus more widely visible on the mainstream web). Platforms already exist for some of these channels at European⁴ or national level⁵, but these are not always widely (enough) known.

In addition, INSPIRE should investigate the use of "soft guidance" (e.g. good practices, conventions) in addition to the "hard" technical guidelines, which are the only endorsed implementation practices today. Furthermore, INSPIRE communication often gets lost in the technical details; it is therefore also important to communicate clearly about the big strategic directions (e.g. a stronger focus on data content).

Communication efforts should also try to explain INSPIRE and its benefits without using the specialised INSPIRE jargon. On the other hand, training and capacity building efforts like, among others, the large-scale training for public administrations in Poland, can have a considerable effect on increasing INSPIRE understanding and, more generally, geo-spatial literacy.

3.5 Clarify the roles of the public and the private sectors

Some discussions touched on the question of what should be the roles of the main stakeholders in the future, and in particular of the public and private sectors.

Both the private and the public sectors can be users of the INSPIRE infrastructure, in particular if it is made available through APIs for mainstream ICT professionals (see section 3.1). However, there are different models for implementing SDI-based solutions for government tasks or even basic SDI building blocks, ranging from relying strongly on public sector bodies to relying exclusively on the private sector (in particular SMEs).

Another discussion point was why not to simply rely on Google (or other big industry players) to make our data available? It was felt that, while sharing government data more widely on the web is useful, it is also important to know that (authoritative) data is up-to-date and has not been altered, and to have guarantees that government data is available in a standardized and non-proprietary environment.

Generally and considering the various open issues in the discussion, the roles of the public sector/governments, the private sector and citizens could be the main topic of the next *INSPIRE – What if...?* edition.

⁴ e.g. the INSPIRE Thematic Clusters (<https://themes.jrc.ec.europa.eu/>) and INSPIRE in Practice (<https://inspire-reference.jrc.ec.europa.eu/>) platforms

⁵ e.g. the Dutch INSPIRE wiki (http://wiki.geonovum.nl/index.php?title=Aan_de_slag_met_INSPIRE)

List of abbreviations and definitions

AI	artificial intelligence
API	application programming interface
CSW	Catalog Service for the Web
GeoRSS	a specification for encoding location as part of a Web feed
HTTP	Hypertext Transport Protocol
ICT	information and communication technology
INSPIRE	Infrastructure for Spatial Information in Europe
ML	machine learning
OGC	Open Geospatial Consortium
OS	Ordnance Survey
OSM	OpenStreetMap
PDOK	Publieke Dienstverlening Op de Kaart, the Dutch national SDI
pub-sub	publish–subscribe messaging pattern
QGIS	QuantumGIS
REST	representational state transfer
SDI	spatial data infrastructure
W3C	World Wide Web Consortium
WMS	Web Map Service

Appendix A: Summaries of the group discussions

A.1 What if... our development environments would satisfy both geo-professionals and mainstream ICT developers?

Facilitator: Thorben Hansen, Head of Division, Danish Agency for Data Supply and Efficiency (SDFE)

The what-if-title for the discussion was 'What if application developers didn't know how to use our data?' with the subtitle 'Development environments that satisfy both geo-professionals and mainstream ICT developers'

The challenge to be discussed (as defined by me in my introduction) was outlined as follows:

- INSPIRE defines the web-services that must be available for data sharing, our traditional community of geo-professionals have no problem using these web-services when building applications, and the development environment to do so is both flexible and powerful.
- However, when you get outside the inner circle of the geo-domain, development against web-services is an issue, and we often hear objections about our web-services being too complex to handle. Mainstream ICT offers more approachable development environments for occasional and less geo-savvy developers (e.g. JavaScript APIs such as Google Maps API or OpenLayers API).
- INSPIRE (and other data sharing frameworks) must find a way to offer a development environment that mainstream developers are more familiar with – and preferably an environment that can coexist with the current.

The following is a wrap-up from the group discussion:

- The INSPIRE framework for data sharing should support 3 types of access:
 1. API access for the geo-savvy ICT professionals
 2. API access for the mainstream ICT professionals
 3. GUI access for geodata users

Type 1 is addressed via the web-services in the current INSPIRE implementation; type 3 is addressed via miscellaneous end-user applications. Type 2 access is missing a coherent approach – the group discussion focuses on this topic.

- Offering an API for mainstream ICT professionals is of critical importance for use of INSPIRE outside the geo-professional community.
- Establishing an API for mainstream ICT professionals is not a problem from a technology point-of-view – standard platforms are available to support this (e.g. OpenLayers).
- An API for mainstream ICT professionals can be established as a layer on top on the existing API offered by INSPIRE – however, some REST capabilities probably need to be added.
- Engage with subject-matter-domain-experts and with mainstream ICT developers when defining an API for mainstream ICT professionals – and provide good examples on how to use it when implemented.
- Users of the API for mainstream ICT professionals can be both government and private companies, including private companies offering their services to government.
- A discussion took place about the role of private companies when implementing solutions embedding data sources from the SDI to be used within government. Some participants/countries seem to favor that government itself develops such implementations, whereas others favor involvement of private companies, either

as sub-contractors to government or as providers of commercial products offered to government. This is a fundamental business model discussion that needs up-front clarification on a strategic level in order to avoid conflicts regarding roles amongst stakeholders.

- The API for mainstream ICT professionals must be open and free to use for all interested stakeholders
- Open Source seems to be the obvious choice for establishing the software platform supporting the API for mainstream ICT professionals layer (running on top of the existing INSPIRE API – probably extended with some REST capabilities as mentioned earlier).
- Critical success factors for this approach is establishing a credible open source community and a sustainable funding model
- The open source community must establish trust amongst the stakeholders and must be able and willing to take the lead, both in setting direction, in defining the platform and rules for engagement and in being the gatekeeper for development of the OS-environment.
- The funding model must encourage that the development environment is established with relevant content, and that this content is kept up-to-date as user-requirements, technology and the underlying INSPIRE API develops.
- Communities driven by private companies exist around existing OS developments – it is relevant to seek cooperation with some of these communities and anchor the new community in a similar setting.
- Government involvement/nursing is important in order to give the community credibility and to encourage the necessary flow of funding.

Two topics was mentioned as major caveats:

- Licensing – it will be a difficult to make the environment a success if it is not based on free data
- Service reliability – uninterrupted availability and good performance of services are critical

A separate discussion developed around a question about why we do not simply rely on Google to make our data available. This question must be answered from a strategic business perspective. For data associated with a cost at the point of use, the funding issue creates a competitive situation, whereas free data earns their value by being included as source everywhere – including in Google. However, even if Google (and others) embed our geodata, how do we then know that data is up to date and not altered? For this reason and for making sure that government data is available in a standardized and non-proprietary environment, government should (also) offer quality assured (authoritative) data in a controlled, standardized and easy to use environment.

A.2 What if... INSPIRE looked at the dataflow from end-to-end?

Facilitator: Clemens Portele, interactive instruments

The position paper was titled "What if ... INSPIRE would look at the dataflow from end-to-end?" and is complementary to the position paper in 1st "What If...?" workshop at the OGC TC meeting in Delft. That position paper focussed on architecture and the W3C/OGC Spatial Data on the Web Best Practices, which were presented in a separate presentation at the conference. One of the key statements was that architectural evolution like improvements to the "webbiness" of the spatial data should be based on experiments on top of the existing infrastructure where possible. Experimenting with the Best Practices on top of the current INSPIRE infrastructure

The additional discussion points for this workshop were:

- INSPIRE publishes data in two ways: download of a file with the data or full database access via HTTP. There is no middle ground supporting simple, easy to use access to parts of a dataset.
- For the bulk download, there is no mechanisms to download in the future just the changed objects.
- For the database access, the access to many distributed services adds practical challenges.
- The data that is published is the raw data used by domain experts for the business processes of the publishing organisation. It is in general not optimized for use.
- What most users are really looking for is useful results of an analysis (maps, statistics, alerts, etc.)
- That is, the current INSPIRE architecture implies that GIS experts build a layer of value-added services and tools on top of INSPIRE.
- At the same time, data providers express concerns about the required effort to meet the INSPIRE requirements to publish their datasets.
- Considering that, why not reduce expectations on data providers (that do not have the expertise and capacity to support the full interoperability and service requirements)?

Most in the break-out group were interested in discussing what needs to be done to make it easier to create value-added services on top of INSPIRE.

In general, the analysis and the points raised in the position paper were supported.

Specific points raised in the discussion in the break-out group:

- Architecture
 - The proxy approach is a nice idea, and allows experimentation. In a way it is a value-added service, too, that provides an alternative publication channel. But there are limits, complex post-processing would result in a performance hit, other architectural issues cannot be addressed by a proxy (lack of pub-sub, inconsistent metadata etc.).
 - It is not clear which of the three architectural measures (simple API, central access points, pub-sub support) would have the biggest impact, but the API is the most likely candidate.
 - The usability of geoportals is a problem, also for specialists. This also relates to the metadata (metadata that a machine can derive should be derived by one and not edited by a human, relationships do not reflect the workflow: services

point to the dataset, but there is no clear link to the download services or other distributions of a dataset in the metadata, etc.).

- Semantics and data harmonization
 - The harmonization (interoperability) of data is considered important and should continue to be part of INSPIRE, but only where there is a clear user need.
 - What is not recognized enough is that with the interoperability regulation and the code lists we have captured semantics from many data themes in 23 languages, but this body of knowledge is not really exploited so far.
- Business and user needs:
 - There was agreement that evolution should be driven by businesses and uses of the data.
 - It was raised why business like Google use AI/ML to process the web, but do not harvest (open) WFSs.
 - We need to think about the workflows and the flow of data not just from the service or from the metadata, but we need to consider the flow from end-to-end.
 - We also need to take into account that the business processes in the data provider organisations are changing, too.

Through experiments we can learn what works and then go through the MIG to discuss the evolution of INSPIRE.

A.3 What if... one started thinking about an INSPIRE evolution

Facilitator: Lars Bernard, Chair of Geoinformatics, TU Dresden

The group discussions were stimulated by a position paper and a pitch talk listing a number of key successes and issues in today's INSPIRE implementation(s). The discussions were structured around the four INSPIRE revision topics as presented in the pitch talk. The discussions added the following aspects to these four topics. Even if several of the issues have already been raised elsewhere, the discussions showed that these issues do still exist and solutions are not yet at hand:

- 1) Rethink benefits vs. costs and efforts of the INSPIRE implementation
 - *Focus on creating synergies*
(Future) INSPIRE implementations should (more) clearly focus on creating synergies with other reporting or planning duties. The overall concept is to relate the diversity of environmental information in a coherent way via a common, semantically consistent spatial reference. Still, current INSPIRE implementations are too often felt as being mostly realized for the sake of achieving INSPIRE requirements and compliance.
 - *Funding follows success*
It was asked to more often focus and show the successes of INSPIRE implementations for specific tasks primarily on Member States' levels but also on the EU level to sustain interest, funding and future development capacities for the INSPIRE implementation. Resources not successfully acquired when starting with INSPIRE implementation can hardly be mobilized now unless needs and benefits are being pointed out convincingly.
 - *Rethink timeliness*
Keeping too strict to fulfilling the legally defined INSPIRE milestones may lead to situations where too much effort is being put in half-way solutions. The overall concept above is a long-term objective and can be only reached in an evolutionary process. Thus it was recommended to relax the timeline and/or the way of evaluating and judging whether INSPIRE requirements are met.
- 2) Prioritize by planning or reporting tasks
 - *Metadata has been the first step but is not the final goal*
Typically INSPIRE metadata currently describes the data sources being relevant for the INSPIRE topics. Thus, only now all the data being available in the INSPIRE context can be explored. However, this is just a first necessary effort and metadata is only an intermediate result to understand what is on offer by the public administrations as geodata describing the state of the environment.
 - *Consolidating the plethora of available data sets is the current main task*
Achieving nation-wide and pan-European coherent data sets has been identified as a crucial step towards the INSPIRE success. The group agreed on a stepwise, topic-by-topic and use-case driven approach – e.g. driven by applications in environmental reporting.
- 3) Empower key responsible institutions
 - *Look into best practices on INSPIRE implementation governance*
National examples on where and how the INSPIRE implementation is coordinated by only a few key responsible institutions were discussed (Poland, 11 coordinators for 32 nation-wide harmonization of topics; Denmark 6 coordinators for 32 nation-wide topics). It was also stated that less clear governance structures and steering efforts hamper the Member States INSPIRE implementations. It was proposed that EC could support the further INSPIRE implementation by providing an overview on existing coordination practices in the Member States, their governance structures and evaluating, whether powerful key responsible institutions in the Member States do (better/best) support the INSPIRE implementation.

4) Have a clear position on coherence, consistency and reliability

- *The answer is clearly user driven*

The group agreed – see also the topic *priorities* – that achieving coherent, consistent and reliable data sets (not only data models) on national levels and a pan-European level should be one of the future top targets for the INSPIRE implementations. Further, it was stated that the topics and the degree of coherence, consistency and harmonization should be driven and prioritized by user needs. It was estimated, that implementing successful harmonization and coherence processes and workflows might at least last another decade.

- *Refine and Refit Annex III Specifications*

It was also recommend to further gather the experiences gained in the ongoing INSPIRE implementations and consequently to refine and refit Annex III Specifications to better match with usage and application requirements.

A.4 What if... INSPIRE evolved into a Linked Data platform?

Facilitator: Esa Tiainen, National Land Survey of Finland

1. Semantics & linked data
 - Data should be simple and easy to discover or search as fit for purpose whereas semantics and linked data seem a complicated and not a user friendly approach. Therefore semantics need to be hidden and linked data facilitated.
 - Provide simple linked data user interfaces, services and APIs, faceted searches with adjustable search parameters on code list values, sets of algorithms with user friendly guidance etc.
 - Provide open source clients to motivate and facilitate users (feedback on user experience)
 - Include JSON encoding
 - Use semantics as an integration layer across diverse platforms and disciplines - linked data as a means of deployment
 - Use semantics to curate decentralized data as "virtually centralized" data
 - Semantic layer is necessary for data management with a lot of data available to provide, update and deliver
 - Use place names (e.g. INSPIRE geographical names, OSM, geonames.org) to integrate geospatial data and link geospatial data to non-spatial data
2. Promotion
 - Linked data is not sufficiently known to users. It must be better sold to users and developers. And the same applies much to spatial data in general
 - Initiate a cookbook on INSPIRE, SDI, Linked data
 - Provide practical examples
 - Promote and encourage experiments
 - Set up hackathons
 - Make your data crawlable
 - Develop visual representation of spatial data analysis and characteristics (graphs for linked data)
3. Initiate and promote user communities
 - User communities are indispensable to create a sustainable platform ecosystem. Co-creative user communities explore and innovate perpetually new benefits out of data, support their members and develop practices and new methods to foster and stimulate use of data.
 - Provide a platform to share apps and other software and good practices
 - Development of new cross-border applications (e.g. for all emergency services) will push improve the services provided: it has been demonstrated that these new applications levers better integrated spatial datasets, improvement of update and quality of spatial data services and more flexible redesign of data collection (e.g. integration of crowd-sourced data).

A.5 What if... we wanted to more actively involve users in the evolution of INSPIRE?

Facilitator: Michael Lutz, European Commission, Joint Research Centre (JRC)

The position paper addressed the question what could be done in order to involve user communities more closely and actively in the discussion about how INSPIRE should develop and evolve in the future, and more specifically what types of users to focus on, how to communicate or engage with them (including simple(r) feedback channels or mechanisms), how to showcase INSPIRE benefits to attract users.

The following points were raised during the discussion:

1. Which types of users are there and who to focus on?
 - The following categories were proposed: end users (data users and map users) and developers (business developers and IT developers).
 - Most participants felt that it is important to focus on the developers, since most end users will access data through value-added services or applications and there will be very few direct users. This was supported e.g. by the experience of PDOK in the NL, where services were not much used, and user numbers significantly increased only once a QGIS plugin was developed.
 - Some participants underlined the importance of EU-level users and of pan-European systems where INSPIRE data and services are being used.
2. How to keep track of users?
 - Several participants felt that end users will be attracted to the infrastructure when the data sets are being made (openly) available. Some experience also shows that, while this is true, many users also leave again and do not come back. It is important to analyse why.
 - There was no agreement in the group on whether to require authentication or similar mechanisms to keep track of users (to understand who is doing what) or whether to remove all possible barriers to accessing the data (in order to make data access as easy as possible).
 - Some participants proposed a mixed model that provides free (unauthenticated) access to all users, but certain value-added functions to registered users.
3. How to communicate or engage with users and what feedback channels/mechanisms to use?
 - There was agreement on the importance of communication, but different opinions on whether there is a need for targeted communication measures and channels for specific user communities.
 - Training and capacity building can be an alternative to translating INSPIRE requirements into the language of different user communities. For example, in Poland, a dedicated training programme has been set up targeting 4500 people working in public administrations, resulting in a much bigger community that is now familiar with INSPIRE concepts and terminology.
 - Training programmes, like the OS Master classes on Open data⁶, or funding schemes aimed at developers or start-ups, like the UK geovation programme⁷, can help set up communities. More generally, there are many lessons to be learnt from user engagement frameworks for open data.
 - On technologies or approaches for collecting user feedback, there was mixed feedback. Some participants warned against using a platform model requiring user registration, in order not to create additional access barriers. Others pointed to successful use of social media platforms involving geo-ICT professionals.

⁶ <https://www.ordnancesurvey.co.uk/innovate/masterclasses/>

⁷ <https://geovation.uk/programme/>

- It is important to distinguish different types of feedback, which may require different approaches. E.g. feedback could be simple (e.g. 5-star) user ratings or more detailed feedback to fix bugs/errors or improve products.
 - In order to actually receive end user feedback, it is important to have feedback mechanisms built directly into the end user applications and not in separate tools (e.g. geoportals).
 - Application developers and solution providers could act as intermediaries, who could help to collect, interpret and channel user needs, since they are in direct contact with end users.
4. How to showcase INSPIRE benefits to attract users?
- Showing that the data is being used is important to justify implementation efforts to financing agents.
 - Having simple data browsers⁸ (rather than just geoportals showing dataset metadata) could help showcasing what is actually available and usable in the INSPIRE infrastructure.
 - Making data available as open data, at least at the beginning, will encourage their use for applications.

⁸ See e.g. the map with address data points on <https://openaddresses.io/>

A.6 What if... success looks like adoption and use?

Facilitator: Roberto Lucchi, ESRI, Redlands CA, USA

Discussion notes

- "INSPIRE forgets about communities"
 - Find resources without having to "crack" a CSW catalog
 - Listen to the users
 - Pay attention to practitioners (normally they want to download the data, or a OGC WMS service, or a developer-friendly format)
- Open data is a mainstream pattern that includes data provision, user-driven evolution process, user feedback
- Campaigns on open data at country level
- Apply more than academic exercise
- Technology has evolved

Recommendations for INSPIRE coordination groups:

- Be Agile, avoid waterfalls process and top-down approach, which complicate discussing benefits (that should be at all levels of government)
- Listen to community needs
- Focus on the what and not the how
- Focus on legally binding INSPIRE requirements; the complexity is often in the non-legally binding parts
- Soft guidance, "conventions" instead of rules (like OSM), remove technical guidance as they are today
- Open standards (including the new OGC Community Standards, see GeoRSS and 3D scenes)

Appendix B: Position papers

B.1 INSPIRE – What if...?

Author: Thorben Hansen, Head of Division, Danish Agency for Data Supply and Efficiency (SDFE)

What if INSPIRE needs to be future-proofed?

INSPIRE is based on the national spatial data infrastructures (NSDI) in the member states and establishes a framework for sharing relevant spatial data within the European Community for users and applications in the environmental domain.

But where are all the other domains that need a (spatial) data sharing framework for their users and applications? And how does the INSPIRE data sharing framework fit into the (spatial) data infrastructures ecosystem along with such other data sharing frameworks?

On the national level INSPIRE is one of several drivers that support development of a national (spatial) data infrastructure supporting multiple domains. Examples of other drivers are initiatives within e-government, emergency management, and the military. Each of these initiatives have their own requirements for a data-sharing framework.

As INSPIRE in many areas is a front-runner for developing a NSDI, it sometimes comes across as the dominant requirement setter for NSDIs with only little awareness of how to coexist with and complement other (spatial) data sharing frameworks.

SDFE is currently implementing coexisting frameworks for data sharing as defined by a national e-government initiative, by INSPIRE, and by the military respectively – and has identified topics where INSPIRE recommendations could be improved.

Future-proofing INSPIRE calls for development of a solid approach and best practice recommendations for data sharing in a (spatial) data infrastructure that allow for multiple frameworks for data sharing to coexist in a cost-effective manner.

What if application developers didn't know how to use our data?

INSPIRE defines the web-services that must be available for data sharing, our traditional community of geo-professionals have no problem using these web-services when building applications, and the development environment to do so is both flexible and powerful.

However, when you get outside the inner circle of the geo-domain, development against web-services is an issue, and we often hear objections about our web-services being too complex to handle. Mainstream ICT offers more approachable development environments for occasional and less geo-savvy developers (e.g. JavaScript APIs such as Google Maps API or OpenLayers API).

INSPIRE (and other data sharing frameworks) must find a way to offer a development environment that mainstream developers are more familiar with – and preferably an environment that can coexist with the current.

SDFE is currently considering how to address this issue. Do we have to augment the current functionality of the data-sharing framework? – or can we make an out-of-the-box solution use for instance the OpenLayers API as a front end to the existing web-services? – or ... ?

Expanding the knowledge about how to use INSPIRE calls for a data sharing framework offering development environments that satisfy both the geo-professionals and the mainstream ICT developers.

B.2 What if... INSPIRE looked at the dataflow from end-to-end?

Author: Clemens Portele, interactive instruments

I had submitted a position paper already for the first workshop in Delft⁹. Work related to the topic of sharing data from INSPIRE on the Web has continued as part of the ELISE action in the framework of the ISA² programme and is presented at the INSPIRE conference. In this position paper, therefore, I want to take a different perspective and raise two topics for discussion, which are related, but complementary to the previous position paper.

1. INSPIRE with its download services shares the data in two ways - as a downloadable file ("pre-defined") and by providing access to the database via http ("direct access"). These options make the raw data that is typically used by domain experts available. In many cases, end-users will not be interested in that data itself, but in insights that are gained from analysing the data together with other data and/or by presenting it in ways that are immediately understandable by the targeted end-users: dashboards, statistical diagrams, maps, rule-based alerts, etc. It is in this additional layer of value-added services, tools and applications where value is created.

While the best practices discussed in the earlier position paper are helpful for developing such value-added services, the INSPIRE architecture based on the Directive has limitations in support the workflows to create and operate those¹⁰:

- a) In most cases, the data needs to be downloaded and processed by the developer of a value-added service or the user of a tool, but INSPIRE offers no mechanism to learn about or subscribe to changes in a dataset. As a result, it is difficult and requires active monitoring to keep the downloaded data up-to-date. To change this, pub-sub mechanisms and incremental updates would need to become part of INSPIRE, at least for datasets that change with time.
- b) In the other cases where data would be accessed "live" by a value-added service, a key requirement are reliable services with an appropriate service level. Services in INSPIRE sometimes do not seem to be on that level (yet). The distributed network of services may also be a challenge, when a value-added service accesses many datasets across Europe. One option to address this aspect could be to establish data holdings that cache data from INSPIRE and offer a service level that is sufficient for the targeted applications. Such offerings would not be part of INSPIRE itself, but are closely connected and require a mechanism for synchronisation with the source datasets, see item a above.

2. "Member States and stakeholders have repeatedly expressed concerns regarding the (perceived) complexity of the INSPIRE data models and guidelines [...] and the expected difficulty to have them implemented by the 2020 deadline"¹¹.

Considering the fact that the current INSPIRE architecture requires that experts build a layer of value-added services and tools on top of INSPIRE as discussed in item 1 above, where data providers find it (too) hard to meet the requirements of the data specifications, why not accept that datasets may continue to be published using their current schemas, also beyond 2017/2020? For open data, it could be discussed how to leverage the community, Member State and Commission efforts to publish that data in accordance with the data specifications, but only where there is sufficient user demand.

⁹

https://inspire.ec.europa.eu/documents/What_if_workshop/Portele%20INSPIRE%20What%20if...%20Position%20Paper.pdf

¹⁰ This aspect has been presented at the INSPIRE Conference 2013: http://inspire.ec.europa.eu/events/conferences/inspire_2013/pdfs/25-06-2013_ROOM-3_14.00%20-%2015.30_45-Clemens%20Portele_Clemens-Portele.pdf

¹¹ <https://ies-svn.jrc.ec.europa.eu/projects/2016-1>

Alternatively, for Annex III the requirements could be reduced to what is required by the Directive in Article 7(4): "the definition and classification of spatial objects [...] and the way in which those spatial data are geo-referenced". That is, the Directive only requires the information about the location of the spatial objects.

B.3 INSPIRE: What if one started thinking about an INSPIRE evolution?

Author: Lars Bernard, Chair of Geoinformatics, TU Dresden

Imagine you – an INSPIRE expert, being quite fluent in ISO and OGC and experienced in building and using SDI – would be asked today to start an undertaking similar to INSPIRE. *Similar* here would mean: Similar in its main goal – which could be (possibly over-)simplified as follows: Ease the sharing of geoinformation between users from public administration, industry and academia and provide them with a set of rules, tools and in the end data in such a way that they have better support to their different monitoring and planning duties and work on reliable, seamless and coherent information sources. Having more than a decade of pleasant and less pleasant INSPIRE experiences, you could start by listing related successes and failures, for instance:

INSPIRE Successes

- INSPIRE enabled an easy finding of administrative spatial data – metadata standards and catalogues established and improved transparency, and in a number of cases access to related map services is also possible.
- INSPIRE – not only but also – helped in establishing an Open Data attitude within public administrations and in the easing of restricted data access policies.
- INSPIRE is/was clearly one of the early movers (frontrunners?) in enabling data sharing and building frameworks for data infrastructures. INSPIRE experts today know about the complexity of such an undertaking, moreover a number of data providers and users today fully understand (in principle) why initiatives as INSPIRE are required – competence, knowledge and awareness gained in this context is an asset for establishing data infrastructures.

INSPIRE Failures

- INSPIRE did hardly (or not yet?) succeed in providing a (nationwide or even pan-European) reliable, coherent and seamless access to spatial data for environmental monitoring and planning and in offering data providers or data users an easy entrance to spatial data sharing and data integration.
- INSPIRE today is (still?) often more seen as yet another burden than a helpful tool or undertaking and INSPIRE offerings have hardly been tightly coupled into reporting or planning applications.
- Since it often falls in-between the responsibilities of national mapping agencies and national environmental agencies, INSPIRE did rarely succeed in making the case for enabling cross-sectoral data infrastructure units/ministries/departments being sufficiently empowered to moderate developments, implement required common components and enforce the rules to achieve coherence.

Thinking on how to do better for a similar undertaking you would possibly come up with another list of priorities and another approach, than what we as the INSPIRE community developed more than ten years ago. Aspects of your today's *data infrastructure recipe* would cover organizational and technical aspects and possibly, you start doing a frank first draft of suggestions as:

- Be humble: Tackling the EU-wide harmonization of 32(+) data topics at almost no-cost might possibly not work – either you put substantial funding or you reduce significantly the number of topics for which you want to achieve coherence and consistency.
- Prioritize by topic and follow a spiral process: Start with a handful of fields (e.g. reporting about air quality, noise, water quality, traffic) and enable the infrastructure in such a way that all related reporting applications are running in the infrastructure, and then advance to other fields.

- Empower a key responsible (not only a contact point) for the infrastructure implementation. This responsible should be capable and mandated to mediate between all data providers, to enforce the provision of reliable services, and to improve the required capabilities and capacities.
- Take your stand towards coherence, consistency and reliability: Either you enforce the provision of (only) n datasets for n topics, such that a dataset is *the* reference for the given topic, consistent with the $n-1$ other data sets and access and updating mechanisms are well designed and implemented - or you put less burden on the data providers and leave this task to others. However, avoid staying in-between these two options.
- Offer access via easy to use mainstream technologies where ever possible, have as light-weight as possible data models and enforce identifiers and update mechanisms

Would these suggestions match with your suggestions? Do these suggestions also hold for a revision of approaches in INSPIRE or would they require an INSPIRE follow-up, or...?

B.4 Linked Data Deployment for Spatial Data Infrastructure

Author: Esa Tiainen, National Land Survey of Finland

Finland has initiated a program for a national spatial data platform, which is directed to connect data from different platforms and data sources. The work started with defining a master or overall architecture for some common reference data such as buildings, addresses and place names, land use plans and restrictions as well as satellite imagery and point cloud data together with the new topographic database. Connections to other data like INSPIRE data base on linked data principles and advanced semantic search capabilities so that data from different sources as well as INSPIRE data can be provided through the national spatial data platform.

Unique identifiers in HTTP URI format and their management methods (realisation of the linked data concept) form central parts of cross-administrative and more extensive interoperability. To this end the [national recommendation for unique identifiers](#) is taking a step further in interoperability and data integration introducing a framework for linked data infrastructure for spatial data and any other data, and within a scope of application wider than that of the INSPIRE Directive. The URI pattern in accordance with this recommendation must be applied to identification and linking of data within the entire field of public administration, and accordingly INSPIRE implementation is reviewed. This recommendation defines the structural model of URIs and practices for redirection in data retrieval.

In addition to the national infrastructure for spatial data, unique identifiers are also included in the geographic information reference architecture in the overall public administration architecture to enable linked data infrastructure and ecosystems regarding spatial data. To be live data links the simplest solution is to implement a RDF database which enables search by SPARQL as well as transformations to different popular formats like JSON-LD. Furthermore the national spatial data platform is targeting to enable and improve data combinations of spatial data and any other data deploying URIs of place names as well as OGC Table Joining Service (TJS) and towards nationwide linked data SDI.

Semantic search

The release of URIs for geographic feature types, i.e. concepts, in addition to geographic features enables an interface service in the infrastructure for spatial information to search for ontological concepts and their interrelations and, using concepts, for related geographic information. The concept source may be any vocabulary used by the data producer. For example, the vocabulary may be an ontology, data specification, schema, code list, taxonomy or thesaurus. This is the key to connect data from different platforms and data sources.

In order to be able to refer to concepts in a unique way, each concept included in the vocabulary must be provided with a unique URI. A redirection can be made from the URI of a concept to, for example, the (national) Finnish Thesaurus and Ontology Service (finto.fi) or a catalogue service including schemas.

Semantic search is usually wording used for data search on concept level. However it is not very smart management of semantics being able to locate for instance buildings i.e. within certain geographic area or 3D description. The essential semantics of data can only be achieved on attribute level i.e. by linking code lists of data assets with schemas or as linked data (RDF). Then questions like "Buildings with more than 3 floors and without elevator in a certain area" can be responded directly. To enable this also INSPIRE Register federation (MIWP6) is planned to be implemented to manage code lists and data linking.

The URIs for spatial data are all minted in nationally centralized domain with redirections to URI-services (service interfaces) of data providers. As a first stage the infrastructure is established with INSPIRE data - a critical mass and stepping stone. URIs for spatial objects shall be delivered through a spatial data platform. Unique ids are also employed to establish a URI-based production of national core location data (National Topographic Database).

B.5 What if... we wanted to more actively involve users in the evolution of INSPIRE?

Author: Michael Lutz, European Commission, Joint Research Centre (JRC)

The (main) aim of the INSPIRE Directive is to establish a European SDI "for the purposes of Community environmental policies and policies or activities which may have an impact on the environment" (Art. 1(1)). In addition, the data made available through INSPIRE, in particular the "reference data" under Annex I and II, can be used also for a number of other purposes. Hence, INSPIRE has always been understood as a cross-cutting and multi-sector/purpose infrastructure.

With this, however, come the problems that the potential user base for INSPIRE is very broad and has never been very precisely defined. Furthermore, while INSPIRE stakeholders have been actively involved in drafting the Implementing Rules (IRs) and Technical Guidelines (TGs) and in testing their fitness for purpose, user requirements were often captured mainly based on desk research (e.g. studies of existing legislation and national practices).

Only now that more and more INSPIRE implementations become available are we beginning to receive "real" feedback from users, e.g. from the environmental community (mainly related to using INSPIRE for the spatial data aspects of environmental reporting) or EU-funded projects (e.g. for developing cross-border or pan-European applications based on INSPIRE reference data, such as gazetteers or pan-European data layers). But even now such feedback or change proposals are still rare and ad-hoc, even though, with the MIG and platforms such as the *Thematic Clusters* or *INSPIRE in Practice*, both a governance structure and tools are in place to channel such proposals and discussions about them.

So what could we do to involve user communities more closely and actively in the discussion about how INSPIRE should develop and evolve in the future?

1. There are different types of users that have different requirements and speak different languages (than INSPIRE experts, but also than each other). These include (at least) *end users*, i.e. users of INSPIRE-based products or applications in public administrations in the MS, thematic units in the European Commission or EU agencies, or in the private sector; and *solution providers*, i.e. application developers or analysts using INSPIRE data or services to build "value-added solutions" that will be used by other solution providers or end users.
 - How to better understand who the INSPIRE users really are and characterise them?
 - Do we need to keep track of our users? If so, how can this be achieved (e.g. some INSPIRE services require authentication in order to keep track of users, but such information is not available at the level of the infrastructure)?
 - What are the appropriate communication channels and language to reach out and engage with these groups of users?
2. Users (of all kinds) often are not (and should not be) deeply involved in INSPIRE and do not know where to turn to have their issue fixed. While there already are platforms for this purpose, they still seem to be too difficult to use and/or too much oriented towards INSPIRE implementation and hence "awe-inspiring" that many "lay persons" do not dare to use them for fear of exposing themselves as "ignorant" or "saying something stupid". Also, the process from change proposal to actual change in the technical or legal framework is long and not clear to even many INSPIRE experts.
 - How to improve and simplify the feedback channels for users and reducing the fear of using them? Ideally, users should be able to provide feedback on issues, missing features, etc. directly in the tool(s) they use to access the infrastructure. One could even imagine soliciting feedback from them actively, in the way that e-Commerce platforms such as Amazon or booking.com do.

- What would need to change in the INSPIRE maintenance and implementation process to make it more flexible to react to proposed changes?
 - What sort of intermediaries can help to collect, interpret and channel user needs to the EU level? What roles could European umbrella organisations, EU-funded projects and private companies play in this context?
3. While in many countries, INSPIRE has triggered better national coordination or even the creation of national data sets, we often hear from national representatives that their national services and data are well accepted and used, while their INSPIRE implementations are not. The harmonised access to data and services through INSPIRE is particularly useful for creating pan-European or cross-border analyses, applications or data layers.
- But what other features could INSPIRE offer that national solutions cannot? Possible added value features could include pan-European data analytics of data sets and their usage, e.g. which data sets are similar or complementary, which data sets have been used for similar application areas, which tools have been used, ...
 - What can we learn from other platforms? What features attract users to platforms such as booking.com, Amazon, Google Maps or OpenStreetMap?
 - How could such additional features be implemented in INSPIRE? Would they work in the current architecture or would they require changes?
4. Many INSPIRE implementations and cross-border usage of INSPIRE is happening only in EU-funded projects, because these provide the necessary funds to do the "extra work".
- Are users actually willing to pay for the extra benefits they can get out of INSPIRE data and services, or should these costs be covered in some other ways (e.g. through "tax payer's money")?
 - Should the infrastructure provide standardized ways or re-usable tools for charging for and licencing data access and use (or value-added services)?
5. It is still difficult to showcase the benefits of INSPIRE in a simple application that can be understood by many different user communities.
- What could such a simple showcase application(s) look like? What areas should they address (environment, job market, migration, ...)? There could be different ones for showing the benefits of different levels of INSPIRE implementation (data inventory, data sharing, metadata, network services, data interoperability).
 - What are barriers that we still need to overcome? What could be quick wins?
 - How to best make the key users of a showcase the drivers of its implementation?

B.6 INSPIRE: what if success looks like adoption and use?

Authors: Roberto Lucchi & Satish Sankaran, ESRI, Redlands CA, USA

Over the last many years, GIS solutions have been transitioning to a web services based pattern using map, feature and tile services to provide data to end users. Many geospatial standards organizations like the ISO TC 211 and OGC have provided clear guidance on how to leverage these patterns. INSPIRE discovery, view and download services are good examples of how specific programs can make use of these available well-defined protocols for sharing geospatial content.

Esri has in the recent years, thought hard about improving the collaboration, sharing and exploitation aspects of Spatial Data Infrastructures. We have developed technology that allows organizations and governments to create a collective, interconnected "system of systems" across the web that can dynamically replicate and integrate information from all the parts of a government through a unified GIS portal. We call this pattern web GIS. This pattern builds on Open Data policies and the spirit of collaboration that has been pioneered in the GIS community for decades. It allows for distributed data management and dynamic integration of all the information across organizations. It uses shared information access to connect everyone—from the field worker to city management and operations centers. This pattern allows agile and cross cutting information to be continuously integrated and made available – Anytime, Anywhere and on Any Device.

We share the vision of INSPIRE and believe INSPIRE has done an excellent job in meeting its primary objectives: define common data models that can be implemented by each EU member state, and foster authoritative data sharing which in turn helped adopting open data licenses. Thanks to INSPIRE, participating members and users can better collaborate and share information across domain, organization and country borders. Lessons we have learnt from applying Web GIS principles could help meet the next round of INSPIRE goals – making data and service access easy and convenient at the point of use.

While technical guidance documents have been instrumental to provide evidence that INSPIRE can be implemented, the very strong compliance requirements associated with such specs have been a deterrent for widespread adoption and use.

Our strong recommendation would be to have INSPIRE continue to focus on a strong underlying framework (for example data models and synergies with other EU initiatives), while leaving enough room for the community to continuously improve the way data and GIS can be used, innovate and leverage new technologies.

In this presentation, we would like to share our experience about user needs, user expectations, technology and trends and how this can be put in the context of INSPIRE framework to move from 'compliance' to widespread adoption and use.

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