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Policy Brief

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Linked Open Data for environment protection in Smart Regions

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Executive Summary

The SmartOpenData project has created a Linked Open Spatial Data infrastructure (including software tools and data) fed by public and freely available data resources, existing sources for biodiversity and environmental protection, and research in rural and European protected areas and its National Parks.

This Policy Brief explains the main benefits and advantages discovered during the implementation of this technological approach (Linked Open Data) in the context of spatial data regarding environmental information.

Similarly, a brief exposition about Open Government, Open Data and the links between those concepts and Linked Open Data will be shown. Accordingly, a brief exposition about Linked Open Data principles is given in the introduction.

The project results, which are presented in a descriptive and non-technical way, allow the definition of a set of recommendations for Data Providers that would like to process and publish their information as Geospatial Information/Linked Open Data (GI/LOD). The SmartOpenData approach is simple and logical; therefore, it can be implemented in any other scenario. It is important to know that generated GI/LOD and its supporting tools and applications should meet a number of general objectives that were presented in documents of Work Package 2 – Requirements and Architecture, and, again, are presented in a summarized way.

GI/LOD Publication involves a number of additional efforts. After the tasks carried out, SmartOpenData can offer a list of recommendations that facilitate the implementation of GI/LOD and could avoid some of the problems that the project has solved during its lifetime.

In conclusion, the question related to “Why Linked Open Data”, as a natural extension of Open Data, should be supported and enhanced in a general context, and specially, in the specific area of geospatial and environmental data is answered, developed and argued.

1 Introduction

"The Semantic Web is a web of data, in some ways like a global database" (Sir Tim Berners Lee)[1]

Hitherto, the web has been understood, basically, as a library full of human-readable information (web pages, texts, pdf files) supplemented by a varied range of services.

Nevertheless, currently, the web could be also depicted as a giant global database. In this sense, the number of available datasets related to a specific knowledge area could be, in the worst case, big and, generally, enormous.

In this new scenario, development of new applications that could integrate information from different sources is very desirable. Nevertheless, this approach mainly presents two problems [1]:

1. First of all, databases are still seen as **proprietary resources** and, consequently, people often do not want others to use the information for which they are responsible.
2. Moreover, information could be still **locked up in certain applications**.

One of the first consequences is that data cannot be re-used as easily as it should be. The architect or designer of a specific database knows not only the model, but also the specific application to be built on top. In this regards, the point is to stop emphasising which applications will use the data and focus instead on a meaningful description of the data itself.

Therefore, Linked Open Data is about information openness and how it can be offered to third parties to develop new and better services. In that sense, Linked Open Data is not completely a newcomer and it has very clear and strong links with other technological policies already present.

1.1 Open Government

Increasing information and knowledge exchange, enhanced connectivity, openness and transparency provide new opportunities for public administrations to become more efficient and effective provide user-friendly services, while reducing costs and administrative burden.

The **open government** "Open Data by Default" approach[2] can facilitate this transformation. This paradigm is driven by opening up public data and services and facilitating collaboration for the design, production and delivery of public service. It is also about making government processes and decisions open, in order to foster citizen participation and engagement.

The availability of open data can facilitate the creation of new services; stimulate new markets, businesses and jobs, by adding value to the original data provided by government.

[1] http://www.w3.org/DesignIssues/Semantic.html
[2] "G8 Open Data Charter and Technical Annex", 18 June 2013, www.gov.uk/government/publications/open-data-charter/g8-open-data-charter-and-technical-annex

The full use of LOD and big data in Europe's 23 largest governments could reduce administrative costs by 15% to 20%. **Open and modular public services** could be re-used by different administrations, but also by businesses and citizens, in order to create and deliver personalised, user-friendly and innovative services.

The open government approach is expected to result in user-friendly, ubiquitous, personalised services; as they are designed, created and delivered in collaboration with others, combining information, data and services both from the public as well as the private sector. This approach will also improve the quality of decision-making and promote greater trust in public institutions.[3]

1.2 Open Data

The concept of Open Data is mainly assembled from availability, reuse and universal participation[4]. From this point of view, Data must be available as a whole, and at no more than a reasonable reproduction cost. Data should be provided to final users in a convenient and modifiable form. Similarly, Data must be provided under terms that permit reuse and redistribution including the intermixing with other datasets and it must be machine-readable. Those concepts are directly related to Linked Open Data.

Besides, final users must be able to use, reuse and redistribute it without considerations about restrictions, final purposes or specific uses.

Data should be open for the following reasons:

- Transparency. In a well-functioning, democratic society citizens need to know what their government is doing. To do that, they must be able to freely access government data and information and to share that information with other citizens.
- Releasing social and commercial value. In a digital age, data is a key resource for social and commercial activities. Everything from finding your local post office to building a search engine requires access to data, much of which is created or held by government.
- Participation and engagement – participatory governance or for business and organizations engaging with their users and audience. Much of the time citizens are only able to engage with their own governance sporadically — maybe just at an election every 4 or 5 years. By opening up data, citizens are enabled to be much more directly informed and involved in decision-making.

The European Commission (EC) has also put the issue high up on its agenda and is actively pushing Open Data forward in Europe. Neelie Krose, Vice-President of the European Commission responsible for the Digital Agenda, stated strong commitment to Open Government Data through her announcement of an EC data portal by early 2012 and for a Pan-European data portal acting as a single point of access for all European national data

[3] https://ec.europa.eu/digital-agenda/en/open-government
[4] https://okfn.org/opendata/

portals. Therefore, Open Data is an important part of both the Digital Agenda for Europe[5] and the European e-Government Action Plan 2011–2015[6].

As a result of this strategy, the European Union Open Data Portal[7] is already a reality and it is the single point of access to a growing range of data from the institutions and other bodies of the European Union. Following this philosophy, data are free for use and reuse for commercial or non-commercial purposes.

1.3 Next step: from Open Data to Linked Open Data

It is very important to publish information and Data in a specific way that can create new knowledge and enable new services and applications. As LOD facilitates innovation and knowledge creation from interlinked data, it is the natural mechanism for Information management and integration, to fully benefit from Open Data.

The path from Open (government) Data to Linked Open (government) Data was best described by Sir Tim Berners-Lee when he first presented his "five Stars Model" at the Gov 2.0 Expo in Washington DC in 2010. Since then, Berners-Lee's model has been adapted and explained in several ways; the following adaptation of the 5 Stars Model by Michael Hausenblas[8] explains the costs and benefits for both publishers and consumers of LOD.

★ Available on the web (whatever format), but with an open licence

★★ Available as machine-readable structured data (e.g. excel instead of image scan of a table)

★★★ as (2) plus non-proprietary format (e.g. CSV instead of excel)

★★★★ All the above plus, Use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff

★★★★★ All the above, plus: Link your data to other people's data to provide context

Figure 1 Five Stars Model

In the following paragraphs, the "Five Stars model" will be developed in order to explain the costs and benefits related to the different levels. Two different points of view will be analyzed, regarding final users and data consumers and with regards to data providers. Besides this, specific examples related to SmartOpenData and GI/LOD will be pointed out.

What are the costs & benefits of ★Web data?

As a consumer…

- You can look at it.
- You can print it.
- You can store it locally (on your hard drive or on an USB stick).
- You can enter the data into any other system.

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[5] Digital Agenda for Europe: http://ec.europa.eu/digital-agenda/
[6] eGovernment Action Plan Europe 2011–2015: http://ec.europa.eu/digital-agenda/en/european-egovernment-action-plan-2011-2015
[7] https://open-data.europa.eu/en/about
[8] Michael Hausenblas: http://semanticweb.org/wiki/Michael_Hausenblas

- Sometimes, you can change the data as you wish.
- You can share the data with anyone you like.

As a publisher…

- It's simple to publish.
- You do not have to explain repeatedly to others that they can use your data.

As in standard LOD (No GI or Geospatial information), the classical example could be a PDF file containing some maps or images. The information is completely human readable, but it cannot be processed. In this sense, SmartOpenData has found several raw data-sources in PDF format that have been completely unusable for our purposes.

What are the costs & benefits of ★★Web data?

As a consumer, you can do all that you can do with ★ Web data and additionally:

- You can directly process it with proprietary software to aggregate it, perform calculations, visualise it, etc.
- You can export it into another (structured) format.

As a publisher…

- It's still simple to publish.

Despite being one of the most popular geospatial vector data format for GIS, and despite that it could be considered as a de facto standard, Shapefile[9] format is proprietary. Taking into account the second point, it is easily exportable to Keyhole Markup Language (KML)[10]. Those formats have been widely used in SmartOpenData as a source of vector geographic information.

What are the costs & benefits of ★★★Web data?

As a consumer, you can do all that you can do with ★★ Web data and additionally:

- You can manipulate the data in any way you like, without the need to own any proprietary software package.

As a publisher…

- Warning: You might need converters or plug-ins to export the data from the proprietary format.
- It's still rather simple to publish.

What are the costs & benefits of ★★★★Web data?

As a consumer, you can do all that you can do with ★★★ Web data and additionally:

[9] https://en.wikipedia.org/wiki/Shapefile

[10] KML is an XML notation for expressing geographic annotation and visualization within internet based, two dimensional maps and three dimensional earth browsers. KML became an international standard of the OGC in 2008. See https://en.wikipedia.org/wiki/Keyhole_Markup_Language

- You can link to it from any other place (on the Web or locally).
- You can bookmark it.
- You can reuse parts of the data.
- You may be able to reuse existing tools and libraries, even if they only understand parts of the pattern the publisher used.
- Warning: Understanding the structure of an RDF "Graph" of data can be more effort than tabular (Excel/CSV) or tree (XML/JSON) data.
- You can combine the data safely with other data. URIs are a global scheme so if two things have the same URI then it's intentional, and if so that's well on it's way to being 5-star data!

As a publisher…

- You have fine-granular control over the data items and can optimise their access (load balancing, caching, etc.)
- Other data publishers can now link into your data, promoting it to 5 stars!
- Warning: You typically invest some time slicing and dicing your data.
- Warning : You'll need to assign URIs to data items and think about how to represent the data.
- Warning : You need to either find existing patterns to reuse or create your own.

What are the costs & benefits of ★★★★★Web data?

As a consumer, you can do all that you can do with ★★★★ Web data and additionally:

- You can discover more (related) data while consuming the data.
- You can directly learn about the data schema.
- Warning: You now have to deal with broken data links, just like 404 errors in web pages.
- Warning: Presenting data from an arbitrary link as fact is as risky as letting people include content from any website in your pages. Caution, trust and common sense are all still necessary.

As a publisher…

- You make your data discoverable and increase the value of your data.
- Your own organisation will gain the same benefits from the links as the consumers.
- Warning: You'll need to invest resources to link your data to other data on the Web.
- Warning: You may need to repair broken or incorrect links.

SmartOpenData has mainly developed its tasks in the 4 and 5 stars levels, publishing geospatial information as GI/LOD. In some cases and pilots, this information could be considered as isolated, in the sense that there were no external datasets to be referenced. However, in many other situations, those connections have been successfully created.

Currently, it has been detected that majority of public environmental datasets are located in the third level: Data freely modifiable using open software and open formats [2].

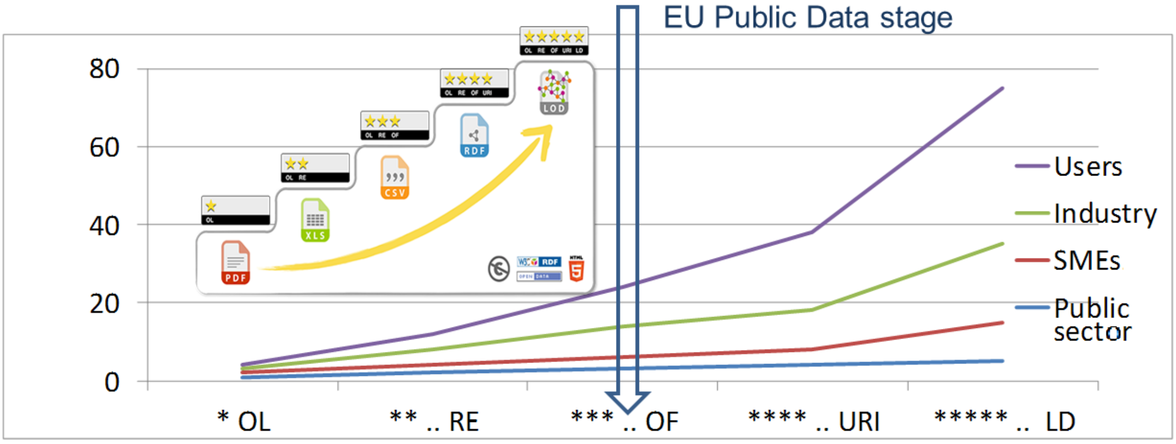

Figure 2 European environmental datasets, current situation

Nevertheless, it is easy to detect that, as stated previously, for Data providers (as Public Sector Administrations), Increase of Use of their own LOD datasets will be non-significant. On the other hand, the greatest benefits will be enjoyed by Industry and General Users. In other words, there has been detected an inversion of Costs-Benefits Ratio that should be assumed by Data Producers. In any case, Data Producers are eventually Data Consumers; therefore, they will enjoy also, at the end, the GI/LOD benefits.

In order to analyse this question and highlight what are some of advantages of LOD, the following table summarizes added value proposition and how they could be obtained[11]:

Value proposition	Description
Flexible data Integration	LOD facilitates data integration and enables the interconnection of previously disparate datasets.
Increase in data quality	The increased (re)use of LOD triggers increasing demands to improve data quality. Through crowd-sourcing and self-service mechanisms errors are progressively corrected.
New services	The availability of LOD gives rise to new services offered by the public and/or private sector.
Cost reduction	The reuse of LOD in Public Sector applications leads to considerable cost reductions.

11 https://joinup.ec.europa.eu/sites/default/files/85/31/25/Study_on_business_models_for_Linked_Open_Government_Data_BM4LOGD_v1.00.pdf

2 Approaches and Results

As described in the deliverables of work packages "Requirements and Architecture", "Data modeling and Linked Open Data alignment" and "Demonstration pilots", the tasks carried out in SmartOpenData can be summarized in a list of steps that follow, approximately, a logical order. However, certain steps and procedures can overlap in time.

1. The first task to be performed should be data, on public and environmental protected natural environments, **gathering and collection**. As a first approximation, the number of data may be limited; however, the experts and stakeholders can suggest new sources of data related to the first. Therefore, the use of Linked Data arises quite naturally.
2. After harvesting, a **modeling phase** takes place using existing models and vocabularies, whenever possible. If necessary, new models are generated. Modeling requires active participation of both data providers (active in the use case under consideration) and technological stakeholders.
3. After these phases of collection and adaptation, **Data Publication** using different technological platforms that allow third parties full and direct use of the data has to be carried out. This data usage by others may require some specific technical knowledge. In order to make data use and visualization easier for less technical profiles, maps and data viewers are added.

As shown, this process involves companies and organizations of every kind: data providers, technology providers and data experts.

It is important to note that each and every one of the parties are required and must participate in the final process and, particularly during the data modeling process.

Though the final result may seem conventional, the publication and data processing methods are completely different.

The benefits identified and obtained using GI/LOD are clear:

End users can visualize and process data no matter the final use. For example, the annoying circumstance of “Data tables in PDF files” visualization that cannot be processed is avoided. In fact, the extensive use of “text type PDF” is one of the features detected in this specific (environmental) context, such as scientific papers. Frequently, those tabular data cannot be exported to spreadsheets.

Data are described using a public model. Proposed models follow the guidelines of the stakeholders involved and, simultaneously, they are as simple as possible. In addition, the use of ontologies[12] allows external users to access, analyze, criticize and improve models.

[12] An ontology is a specification of a conceptualization, it is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents, http://www-ksl.stanford.edu/kst/what-is-an-ontology.html http://www-ksl.stanford.edu/kst/what-is-an-ontology.htm, see also https://en.wikipedia.org/wiki/Ontology_(information_science)

Ontologies provide a worldview and, therefore, can be subjective. Henceforth, it should be open to third-party reviews.

The whole process, once completed, can be characterized as **moderately difficult**. That is, the inevitable learning steps suggest developing collaborative processes with companies and expert bodies on these technical issues. After that, depending on the skills developed by the data provider, it may maintain such collaboration for complex models and begin to develop simpler models.

In the Geographic Information System (GIS) environment, it has been found that point-type geometries offer no problems in their treatment as LOD. Even large areas (polygons), such as natural parks, can be properly treated. The main problem arises in the treatment and storage of small geographical units (cadastral parcels) and processing spatial queries (geometries that intersect, overlap or are included in, etc.).

In these cases, although technical tools and functionalities have been implemented, certain issues relating to deployment and performance improvements remain open. For technical aspects, deliverables [D21] and [D23] can help to complete this information.

Based on the previous sections and the experience of the whole project, a GI/LOD infrastructure should provide the following services [D21]:

Discovery Provides access to data and external metadata to users or to other system components. It implements search/discovery services, thus exposes catalogue services.

Display Performs the rendering of "generic data" (catalogue entry, map image…) into an output format delivered to the user through the "horizontal service" and then through the data services.

Data services Implements view and download services, thus exposing map/feature services.

- **View**: view services allow display, navigation, zoom in and out, pan or overlay viewable spatial data sets and display legend information and any relevant content of metadata.
- **Download**: download services allow the extraction of copies of spatial data sets, or parts of such sets, to be downloaded and, where practical, accessed directly.

Transformation Designed to carry out the mapping between the application schemas and the application schemas of the data provided by third parties. Implementing transformation services thus exposes map/feature transformation services.

Monitoring As basic tools will be established for monitoring based on logins of users. A full log analysis needs to be provided.

External services Discovery, view, data, transformation, analysis, authorization and authentication services can be implemented as internal, or can be used as external services coming from remote servers. Interfaces could be the same as for internal services.

Applications	A LOD geo-portal is not a tool for non-expert users. For most users there are important applications. The idea of a GI/LOD architecture is to ensure that Applications are not developed as independent proprietary solutions, but are based on existing services.

All those services should be oriented towards the accomplishment of the following requirements to make spatial data easier to discover and use, according to the Linked Open Data Strategy for environmental information [D23]:

1. Make environmental and geospatial data concerning rural and protected areas more readily available and re-usable, better linked with data without direct geospatial reference so different distributed data sources can be easily combined.
2. Make existing “INSPIRE based” relevant spatial data sets, services and appropriate metadata within the environmental research domain available through a Linked Data structure.
3. Harmonise geospatial metadata (ISO19115/19119 based) using the principles of the Semantic Web, provide spatial data fusion introducing principles of Linked Open Data, improve spatial data visualisation of Geospatial Linked Open Data and publish the resulting information according to user requirements and LOD principles. Allow geospatial and linked data specialists to communicate easily: RDF to describe a location or point of interest, GI to define where it is on the Earth's surface.
4. Enhance Linked Open Data with semantic support by integrating semantic technologies built on connected Linked Open Data catalogues aiming at building sustainable, profitable and standardised environment protection and climate change surveillance services, and contribute to standards development and maintenance, particularly through the W3C Community Groups mechanism and collaboration with the OGC.
5. Enable incremental sharing of information about the quality of Open Data to allow for offer and demand to meet, truly allowing pilot providers to exploit their results and prompting the commercial sector to create value added products and services, thus creating a new global environmental protection market with final user involvement.
6. Achieve real user engagement and trust to empower the further adoption of Open Data sharing and semantic services in GI, by enabling the implementation, meeting all functional requirements and validating the semantic technologies developed to be fully interoperable at data, metadata, semantic and legal levels, driven by strategic partners. Thus to demonstrate the impact of sharing and exploiting data and information from many varied resources, in rural and European protected areas by providing public access to the data and developing demonstrators to show how services can provide high quality results in regional development working with semantically integrated resources.

Naturally, the requirements and systems previously highlighted can be implemented using existing and openly available software tools.

3 Implications and Recommendations

As it has been pointed out in the introduction, the creation of the “4 and 5 stars” web of data means to data providers:

- Data are easily discoverable: it increases the value of data.
- Data providers gain the same benefits from the links as consumers.
- Data providers need to invest resources to link their data to other data on the Web.
- Data providers have to repair broken or incorrect links.

Clearly, the last two points directly involve more workload and investment. In the worst case, it could be found that the effort developed does not correspond to a higher or more intensive use of data by third parties. In order to match investments with the final results, a sequential and progressive process of GI/LOD implementation is suggested, as it has been carried out in the SmartOpenData pilots.

Throughout the value chain it can be seen that there are data providers for which the process of implementing GI/LOD could not bring great benefits. On the other hand, there are companies and SMEs with excellent technical skills (many of them part of the SmartOpenData consortium) that could facilitate the exporting, modeling and publishing process using semantic technologies. Therefore, generation of GI/LOD is itself an obvious business opportunity for SMEs and Public Administration providers.

On the other hand, if the generation of LOD remains linked only to organizations and isolated entities that do not collaborate and do not use their respective data sources, the use of LOD does not make much sense. The sequential and progressive utilization of LOD and GI/LOD by a larger number of actors will ratify the emergence of a large data ecosystem in a win-win scenario.

Finally, LOD is not the universal solution to all problems. In fact, its application could cause the occurrence of certain performance and speed issues. However its implementation, through a strong synergistic approach to define an interlinked data-sources web, is a very useful tool to promote the dissemination and use of data by third parties.

4 Conclusions

This Policy Brief summarizes best practice for linked open data implementation. Following the principles outlined in this document will enhance data discoverability and metadata, and encourage a standardized approach to data quality – which will make it easier for agencies to link their datasets to other open datasets.

In addition, this Policy also helps to maximize the opportunities of LOD and Big Data, by making larger datasets available for analysis by researchers, industry, and government agencies. Intelligence and insight gained can be used to support service delivery and evidence-based policymaking.

SmartOpenData, especially with regard to data providers and partners from the GIS world, has shown that the implementation of GI/LOD has certain technical complexities that can be addressed. It is recommended that the possible technical complexity of this process is not, in any case, a pretext to delay the implementation of GI/LOD systems, especially taking into account that we refer to a global movement and, particularly, driven by the European Commission.

However, it is suggested that this process is, at least in its early stages, guided by companies and experts in semantic web and (conventional, not GIS) LOD. For example, one of the main temptations, by inexperience, that may appear in early stages of learning is duplication of work already done. In particular, the generation of new vocabularies and ontologies, should build on existing international standards defined by reputable standards organisations, such as ISO, the European Commission, INSPIRE, W3C, IETF, OGC and OASIS. To facilitate LOD all Unique Identifiers for geospatial information should be defined in the format of Universal Resource Indicators (URIs) based on URI standards, naming conventions and persistent registries, building on the work of INSPIRE[13].

In the GIS environment it has been found that some geometries and features offer no problems in their treatment as LOD (points or even large areas such as Protected Sites). The main problems arise in the treatment and storage of small geographical units (cadastral parcels) and processing spatial queries. In these cases, certain technical questions remain open.

[13] http://inspire.ec.europa.eu/index.cfm/pageid/5120

5 The Palermo Declaration

The Palermo Declaration, presented and discussed during second and final SmartOpenData plenary meeting in Palermo on 8-9th July 2105, as a result of the SmartOpenData project fully agrees with the guidelines previously pointed out in this document.

This Declaration maintains that Open Data and Linked Open Data are a very useful tool for digital innovation. On the other hand, the Open Data communities are not speaking only about technical issues. Actually, Open Data and Linked Open Data have proven to be very powerful mechanisms for environment protection.

Indeed, the SmartOpenData project has defined mechanisms for acquiring, adapting and using Open Data provided by existing sources to facilitate biodiversity protection in European protected areas. Pilots in these areas have harmonized metadata, improved spatial data fusion and visualization and published the resulting information, providing new opportunities for use and reuse.

The Palermo Declaration also highlights the principal role of Universities as partnership builders.

Palermo Declaration

Presented and discussed at the public seminar of the SmartOpenData Project
Palazzo Cefalà, Palermo (IT), 09.07.2015

1. Human activities have an ever important impact on natural and environmental systems, with dynamics of an increasing complexity and thus increasingly difficult to understand and manage. Monitoring air and water pollution can no longer be considered a simple act of observation, but needs rather to be directly integrated with the evaluation of impacts upstream (natural phenomena and human activities with a negative impact on air and water quality) and downstream (negative impacts from pollution on natural and human systems).
2. Adequate reading, interpretation, and management of the effects of pollution require improved collaboration between different institutional actors and between them and other participants in the so-called “quadruple helix”: universities and research centres, industry and the private sector, in particular SMEs, and civil society as expressed by interest groups, NGOs, and individual citizens. Such collaboration needs to overcome stances of mutual confrontation, boundaries between sector responsibilities, and procedural obstacles, in order to address environmental concerns as a common challenge requiring a collective response.
3. At the basis of this approach is the open sharing of all information: in this context, this includes not only air and water pollution data but also information related to natural

phenomena and human activities up and downstream. Public authorities at all scales of governance and in all relevant sectors need to adopt Open Data policies that go far beyond mere compliance with legal requirements to configure an open infrastructure supporting community action. In parallel, different agencies and non-governmental and private sector actors, as well as individual citizens and businesses also need to identify information sources within their sphere of competence that can contribute to a richer understanding of environmental impacts.

4. Together, these different information sources constitute an Open Data Commons, namely the collective information space bringing together data from a variety of sources to form a common resource in the public sphere. Linked Open Data (LOD) codifies and operates on the logical relationships between the different sets of data to enable services based on the whole body of information. Local digital innovation communities, made up of individuals from across the quadruple helix with a specific interest in Open Data, provide an essential contribution to the coordination and governance of the Open Data Commons, as they constantly identify and align with emergent standards and methodologies.
5. In this collective vision, each of the components of the quadruple helix plays a specific role and can enjoy the benefits of participation:
    - The public sector shares the burden of environmental stewardship with local communities, while offering opportunities for local businesses to develop and test innovative services.
    - The private sector gains access to valuable public sector information in formats compliant with emergent standards, while locally validating innovation demand with end users.
    - Universities and research centres contribute to the governance of local partnerships, with new opportunities for co-creation of sustainable research paths.
    - Local citizens, NGOs and businesses gain access to improved environmental information and services, while benefiting from enhanced governance in the common interest.

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[D23] *Architecture of SmartOpenData Infrastructure, D2.2*. Published at the website of the project http://www.smartopendata.eu/public-deliverables

Annex A: List of Abbreviations

DAE - Digital Agenda for Europe

EC – European Commission

EU – European Union

FLOSS - Free/Libre and Open Source Software

FOI - Freedom of Information

GI/LOD – Geospatial Information Linked Open Data

GIS - Geographic/Geospatial Information Systems

IPR - Intellectual Property Rights

KML – Keyhole Markup Language

LD – Linked Data

LOD - Linked Open Data

LOGD – Linked Open Government Data

MDR - Metadata Registry of the Publications Office of the EU.

OD – Open Data

OGC – Open Geospatial Consortium

OGP – Open Government Programme

OSS - Open Source Software

PSI - Public Sector Information

SmOD – SmartOpenData

XML – Extensible Markup Language

