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Special Section: INSPIRE (Note from the Field)

Open Data, VGI and Citizen Observatories INSPIRE Hackathon*

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Abstract

In 2016, the INSPIRE Conference hosted the first INSPIRE hackathon on volunteered geographic information and citizen observatories, also known as the INSPIRE Hackathon. The organisers, mostly representatives of European research and innovation projects, continued this activity with the next INSPIRE Conference in 2017. The INSPIRE Hackathon is a collaborative event for developers, researchers, designers and others interested in open data, volunteered geographic information and citizen observatories. The main driving force for the INSPIRE Hackathon is provided by experts from existing EU projects, and its primary objective is to share knowledge and experience between the participants and demonstrate to wider audiences the power of data and information supported by modern technologies and common standards, originating from INSPIRE, Copernicus, GEOSS and other initiatives. This paper describes the history and background of the INSPIRE Hackathon, the various INSPIRE-related hackathons already organised, supporting projects, the results of INSPIRE Hackathon 2017 and the authors' vision of future activities.

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1. INTRODUCTION

1.1. Motivation

Today's society requires easy, reliable and quick access to environmental information published by various organisations and initiatives. This information is collected by public and private actors covering a wide range of sectors, such as agriculture, forestry, fishery, environmental protection, landscape planning and natural risks and hazards management.

As part of community activities, local knowledge is captured through the use of multimedia tools in various formats, ranging from oral storytelling and video recordings to photography. These activities can also include the use of sensors capturing so-called "ground truth" data. The information collected in this way can contribute to up-to-date data. Volunteered geographic information (VGI) (Harris, 2013; Charvát, 2011; Charvát, 2013) is the harnessing of tools to create, assemble, and disseminate geographic data provided voluntarily by individuals. In the context of voluntary data collection, one important aspect is the way data are processed. Recent developments in sensors and sensor platforms (Kepka et al., 2017) have led to an approach involving 'do it yourself' sensors based on low-cost hardware, as well as the increasing availability of Bluetooth sensors that can be easily connected to a smartphone, and which together with existing smartphone sensors can provide a large amount of spatio-temporal sensor data.

The open data movement involves many issues around using existing datasets without limitation or restriction: "A piece of data is open if anyone is free to use, reuse, and redistribute it—subject only, at most, to the requirement to attribute and/or share-alike" (Open Knowledge International 2018). Open data activities mean open-source, open-content and open-access processes. These are focused primarily on technical solutions (open APIs, standardised formats etc.) or on legal issues. Open datasets are often provided by governmental bodies, scientists and international organisations and bodies (e.g. the European Commission and World Bank).

Open data are, and will continue to be, one of the driving factors of digital society in the EU. Many funding instruments have been put in place to support open data. However, the sustainability of actions triggered by hundreds of European projects is not guaranteed, and many results, including tools, data and methods, have disappeared. Too often, new projects and initiatives start over from scratch, often with little use made of the experience gained in past projects and initiatives. In order to support the long-term sustainability of project results, the current authors have used their experience of organising hackathons in the past to modify the organisational model of hackathons. This new structure ensures the sustainability of existing results and their better transfer into practice and further research.

The authors used the opportunity of the INSPIRE conference to host hackathons focused on spatial data, open data, VGI and citizen observatories. This initiative, which is supported by numerous EU projects and the INSPIRE team, aims to be a work in process and will evolve in the future.

The INSPIRE Hackathon is a playground for experts of all ages who want to fill the gap between results and efforts within European and international open data integration. The INSPIRE Hackathon supports the vision for Europe (and others) of open innovation, open science and being open to the world (European Commission Directorate-General for Research and Innovation, 2016). A special focus is on supporting open data policies, both in Europe and internationally. The INSPIRE Hackathon ensures the continuity of open data integrations as part of time-limited efforts such as those in EU-funded projects. The INSPIRE Hackathon contributes to capacity-building and education in terms of open data policy implementation and management, using INSPIRE as its platform. From this platform, a network of satellite hackathons will be supported to grow the community within Europe and beyond.

1.2. History

1.2.1. Sequence of Hackathons

The second INSPIRE Hackathon was a continuation of a longer educational process that started several years ago. A series of INSPIRE-related hackathons was organised, mainly by the SDI4Apps project in cooperation with other EU projects. A short overview of some previous events is given below. One of the major hackathons, the MedHack, is described in more detail in Section 1.2.2.

Jelgava Hackathon, September 2014 - The Open Data Hackathon was co-organised by the SDI4Apps project within the framework of the 18th International Conference on Information Systems for Agriculture and Forestry.

Open Data Hackathon in Dresden, September 2015 - SDI4Apps co-organised an open data hackathon within the framework of the 19th International Conference on Information Systems for Agriculture and Forestry.

Danube Open (Geo) Data Hackathon - SDI4Apps co-organised this hackathon in conjunction with the Danube Reference Data and Services Infrastructure initiative of the Joint Research Centre of the European Commission.

Baltic Open Data Hackathon in Latvia, March 2016 - This hackathon, organised by SDI4Apps, focused on tourist routes for e-vehicles, cultural heritage routes, attracting investment to brownfield areas, mapping of brownfield connectedness to major communications and TEN-T networks and models of land use data for investments.

Hackathon Conference Pilsen, October 2016 - This hackathon was part of the Joint Conference 2016, which focused on geo-science applications.

Hackathon in Kosice, November 2016 - SDI4Apps contributed to this event with a dedicated workshop presenting the main outcomes of the project to the T-systems Hackathon 2016.

Danube Hack, December 2016 - This focused on the collection of evidence for the possible added value generated on top of open (geo) data, related application programming interfaces (APIs) and software tools, identified within the Danube region.

Roadshow and FOODIE Hackathon Prague, January 2017 - This was a hackathon organised by the FOODIE project in cooperation with SDI4Apps.

MedHackathon - The main ambition of the MedHackathon was to create a space in which people could present what can be done with open (geo-) data resources, technologies, ideas and knowledge. Another, even more important, dimension of this event was the willingness to provide a space in which people representing various types of stakeholders (from producers to users) could meet and exchange their experience and knowledge.

The first INSPIRE Hackathon of 2016 is described in the following section.

1.2.2. INSPIRE Hackathon 2016

The "VGI & Citizens' Observatories INSPIRE Hackathon" was the very first hackathon that took place as part of the INSPIRE Conference 2016 in Barcelona. It sustained and developed the unique concept of European Citizens' Observatories as a forceful tool within environmental management and public participation. The hackathon transferred results from the EU projects FOODIE, SDI4Apps, OpenTransportNet and five citizen observatory projects (Citclops, CITI-SENSE, WeSenseIt, CobWeb, Omniscientis) to a new suite of citizen observatories (GROW, SCENT, Ground Truth 2.0, LandSense) so that they could benefit from this work and further develop the results.

In addition to making use of existing tools, the goal was to combine data from various sources, including those provided by the current citizen observatories of Copernicus, GEOSS, and INSPIRE, and data collected and produced by MyGEOSS apps.

The hackathon was divided into three groups, which addressed the following challenges:

Challenge 1 - How might future environmental management and public participation be improved by re-using already available data and tools? What can be learned from the experiences from existing projects, for new projects?

The team outlined the overall results from the pioneering citizen observatories. This formed the basis for several publications, including a white paper for the EC.

Challenge 2 - How can the four new citizen observatories and the next generation of observatories re-use and tailor the tools developed in the first five citizen observatories (and in particular, the imminently ending CITI-SENSE, WeSenseIt and CobWeb projects), and related projects like SDI4Apps, FOODIE and Open Transport Net?

Challenge 3 - Based on use cases from the citizen observatory projects, how can data from a variety of data sources be made interoperable and integrated as information answering concrete environmental issues?

Figure 1: Hackathon glimpse - Relaxed yet effective hackers during the INSPIRE Hackathon 2016 (photo: Bente Lilja Bye)

2. CONCEPT AND METHODS

2.1. Concept

The main focus of INSPIRE Hackathon 2017 was on the collaboration of experts and the transfer of results (datasets and tools from previously completed activities to new projects).

The hackathon exploited results from the completed SDI4Apps, OpenTransportNet and FOODIE projects. The main results in terms of open data included the Open Land Use Map, Smart Points of Interest and the Open Transport Map, currently managed by the Plan4all association. In terms of tools, Micka, INSPIRE CKAN, WebGLayer, HSLayers NG, SensLog and NiMMbus were the main tools for reuse.

The concept of this INSPIRE Hackathon is continued by other EU projects, including NextGEOSS, DataBio, PoliVisu, EUXDAT and SKIN.

2.2. Input from earlier projects

The potential of geographic information (GI) collected by various actors, ranging from public administration to voluntary initiatives of citizens, has not been fully exploited. Advancements in ICT technologies and a shift towards linked open data offer a basis for innovation.

OpenTransportNet was a project designed to revolutionise the way transport-related services are created across Europe, by bringing together open geo-spatial data within city data hubs and enabling it to be viewed in new easy-to-understand ways.

The FOODIE project focused on building an open and interoperable agricultural specialised platform hub in the cloud for the management of spatial and non-spatial data relevant to farming production, for the discovery of spatial and non-spatial agriculture-related data from heterogeneous sources, and for the integration of existing and valuable European open datasets related to agriculture.

Plan4all[1] is a non-profit association that sustains and further enhances the results of multiple research and innovation projects. It aggregates large open datasets related to planning activities in different areas of specialism, including transport, spatial and city planning, environment and tourism. Plan4all ensures that open data are easily accessible for reuse, and that they are maintained and their quality is improved.

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[1] http://www.plan4all.eu

2.3. Available Standardised and Open Datasets

An inevitable component of all hackathons is data. The INSPIRE hackathons aim to provide solutions in the form of apps and services that can serve people, helping them to make informed decisions, for example. The emphasis here is on the use of open data; in this way, the resulting apps and services are available to all without major restrictions hindering their wider uptake. This is why the INSPIRE hackathons support teams and projects that use common data specifications leading to interoperable environments.

The interoperability of data and services is a necessary step towards the sustainability of the results. However, sustainability cannot be achieved without a final (and in many cases overlooked) step, which is the further maintenance of the results. This is the point at which the Plan4all association steps in and takes care of the resulting open data and interoperable solutions. Three major datasets that were maintained from previous projects and further enhanced at the INSPIRE hackathons are described below. All of these are based on INSPIRE data specifications, and are shared using standardised and open interfaces.

The Open Land Use Map[2] (Figure 2) is an activity initiated by the Plan4business project and extended as part of the SDI4Apps project. This service aims to create an improved worldwide land use map. The initial map was prepared using CORINE Land Cover, the Global Cover dataset and OpenStreetMap. Contributors, who are mainly volunteers, are able to change the geometry and assign up-to-date land uses based on the HILUCS specification (the INSPIRE classification for land use). The Open Land Use Map is an open and seamless pan-European dataset that can serve multiple purposes, including specialisms such as spatial and urban planning, landscape planning, transport and the environment.

Figure 2: The Open Land Use Map

[2] http://sdi4apps.eu/open_land_use

The Smart Points of Interest[3] dataset is a seamless and open resource of Points Of Interest[4] (POI) that is available for other users to download, search or reuse in applications and services via the SPAFigure 3RQL endpoint. In comparison to other similar solutions, the added value of the smart approach consists of the implementation of linked data, use of standardised and respected datatype properties and a harmonised data model and common classification.

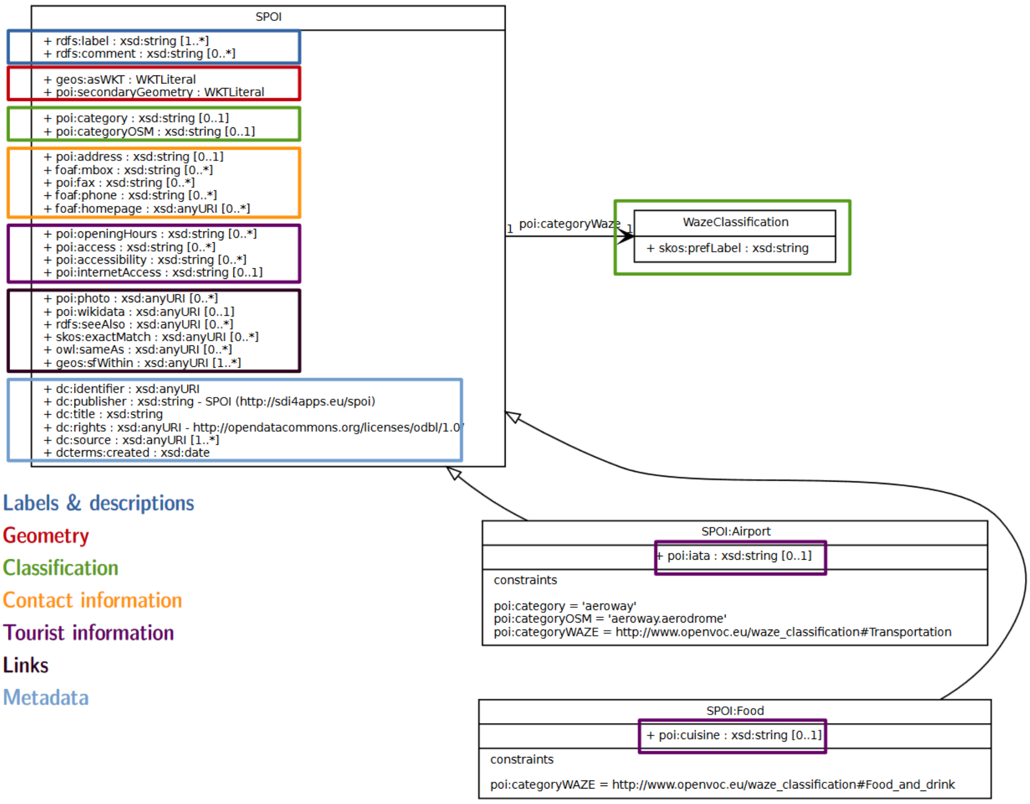
Figure 3: Smart Points of Interest

Smart Points of Interest is the largest harmonised open database in the world, providing detail information on location, geometry, classification (WAZE and OpenStreetMap) and further information including links to useful or interesting places. The current data model is shown in

[3] http://sdi4apps.eu/spoi
[4] A point of interest is a specific point location that someone may find useful or interesting.

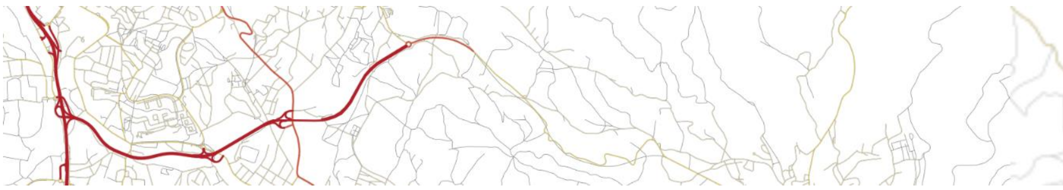
Figure 4.

Figure 4: Data model for Smart Points of Interest



The Open Transport Map[5] (Figure 5) allows the routing and visualisation of daily average traffic volumes for the entire EU and offers many other methods of innovative exploitation. The underlying data come from OpenStreetMap and are accessible using a scheme compatible with the INSPIRE Transport Network.

Figure 5: The Open Transport Map



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[5] http://opentransportmap.info

2.4. Available Tools

Two different metadata tools were used: the first was Open Micka[6], a web application for the management and discovery of geospatial metadata, and the second was the INSPIRE CKAN extension[7]. Two modules are part of INSPIRE CKAN extension: 1) the INSPIRE_harvester - this module extends the CSW_harvester and spatial_metadata extension to support harvesting of all INSPIRE required metadata elements from CSW 2.0.2 ISO AP 1.0, and 2) the INSPIRE_theme - this extension displays INSPIRE metadata in a user friendly form at the CKAN interface and exports INSPIRE metadata in an extended GeoDCAT-AP 1.0 RDF format.

Two tools were used for data visualisation: WebGlayer[8] and HSLayers NG[9]. WebGLayer is a JavaScript, WebGL-based library for the coordinated visualisation of multiple views. The library is focused on spatial data and large datasets (up to hundreds of thousands of features). HSlayers NG is a web mapping library written in Javascript, and is built in a modular way which enables the modules to be freely attached and removed as long as their dependencies are satisfied.

SensLog[10] was used as a web server for sensors and VGI data, which is a solution for static and mobile sensors and VGI. SensLog is web-based sensor data management system.

The final tool used was NiMMbus[11]. This is a solution for storing geospatial resources on the MiraMon cloud, and contributed to the hackathon as a geospatial user feedback storage tool. This system implements the Geospatial User Feedback standard developed in the OGC (and originating in the FP7 GeoViQua project).

2.5. Evolution of new projects

Three new cooperative projects emerged and support the collaborative process of INSPIRE Hackathons. The projects focus on GEOSS, agriculture and food chains.

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[6] http://micka.bnhelp.cz
[7] https://github.com/CCSS-CZ/ckan-ext-INSPIRE
[8] http://webglayer.org
[9] https://ng.hslayers.org
[10] http://www.senslog.org
[11] http://www.opengis.uab.cat/nimmbus

(1) The NextGEOSS[12] project implements a federated European data hub for access to and exploitation of earth observation data, including user-friendly tools for data mining, discovery, access and exploitation.

(2) The data intensive target sector selected for the DataBio13 project is the data-driven bioeconomy, focusing on the production of the best possible raw materials from agriculture, forestry and fishery/aquaculture for the bioeconomy industry to produce food, energy and biomaterials, taking into account various responsibility and sustainability issues. DataBio proposes the creation of a big data platform framework, where new components can be combined with open source and standards-based big data components and infrastructure, depending on the needs of an application system.

(3) SKIN14 is an ambitious initiative of 20 partners in 14 countries in the area of short food supply chains (SFSCs). Its aim is to systematise and bring knowledge to practitioners, promote collaboration within a demand-driven innovation logic and provide inputs to policymaking through links to the EIP-AGRI.

3. RESULTS OF THE HACKATHONS

3.1. Teams and results

The 2017 INSPIRE Hackathon had 11 teams in total, working on 11 projects, using open data, VGI and citizen observatories. The teams and their results are described in this section. The winning team is described in more detail in the next section.

Three teams focused their work on topics around metadata, which are defined by the ISO standard as data about data, and which play a crucial role in the everyday life of many professionals working in the field of data and information. Metadata help in discovering, evaluating and accessing the data necessary for a project. The primary focus of the three hackathon teams was on the availability of metadata and their interoperability between different systems using different metadata standards.

A team led by Stepan Kafka (Help Service Remote Sensing, Czech Republic) created a set of CKAN extensions to manage the importing, presentation and exporting of GeoDCAT AP metadata. These extensions enable the smooth

[12] http://nextgeoss.eu
[13] http://databio.eu
[14] http://www.shortfoodchain.eu

transfer of metadata across the geospatial world, including INSPIRE and GEOSS, and the open data world.

The main objective of the team under the leadership of Tomas Reznik (Lesprojekt, Czech Republic) was a simple and user-friendly visualisation of metadata. They made an attempt to make metadata more user-friendly for the final user, while trying to avoid complex structures based on the metadata standard.

The third metadata team, led by Dmitrij Kozuch (Lesprojekt, Czech Republic), created metadata for the Open Land Use Map; this is described above, and is a global initiative creating detailed land use maps based on public data and VGI.

The Open Land Use Map was also the topic of the other three teams. A group led by Dmitrii Kozuch were able to extend the Open Land Use Map to Africa. Simon Leitgeb (Lesprojekt, Czech Republic) and his team developed a crowdsourcing application for the Open Land Use Map, while the third project explored the visualisation of land use maps in combination with points of interest, using the WebGLayer library for coordinated multiple views.

An interesting project led by Raul Palma (Poznan Supercomputing and Networking Center, Poland) created a whole new range of datasets represented as linked data. Over 700 million triples were created, and these are now available as Sparql endpoint data.

A team led by Joan Masó (CREAF, Spain) focused its efforts on developing a feedback service for the INSPIRE Geoportal. This enables the user to see the comments submitted by previous users and to submit feedback to a particular dataset or data service. This might offer a method for data and service validation by portal users. This service can also help users to determine the quality and fitness for purpose of the geoportal content.

The next application was developed by the team led by Sarka Horakova (WirelessInfo, Czech Republic), and was entitled Find Your Farm Producer. This is an application for searching for farms, including their products and portfolio. The main data entries come from Smart Points of Interest, which are enhanced with further information from the farm.

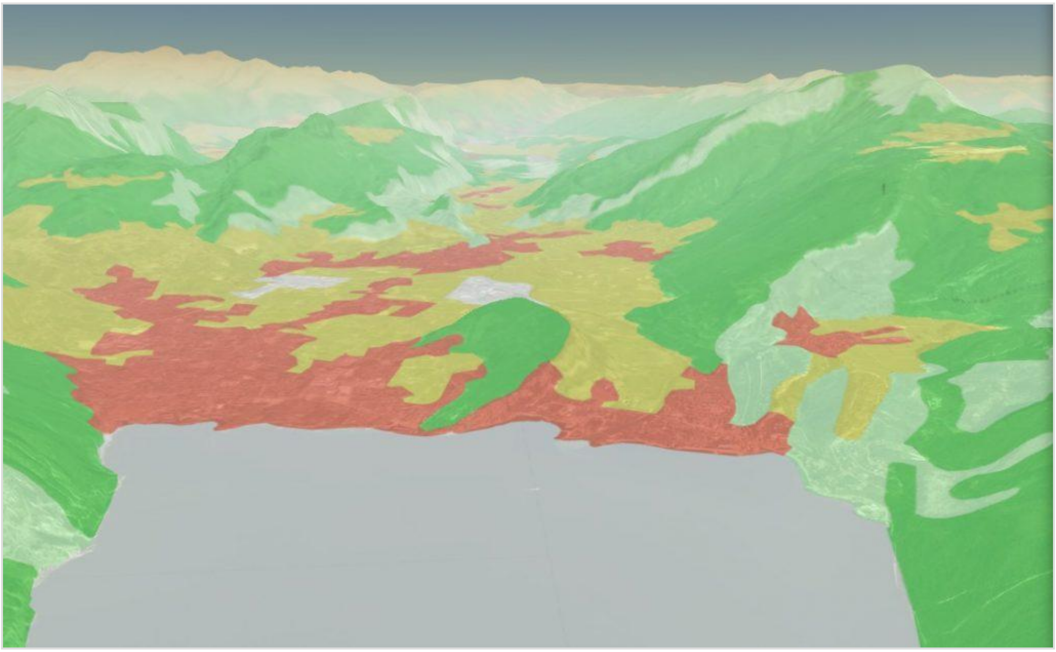
3.2. Winning Applications

3.2.1. Application prototypes

The winning team from the DataBio project developed two application prototypes, which were presented at the INSPIRE Hackathon 2017. The first was a global app (3D-OLU) visualising the Open Land Use Map (Section 2.3) in 3D. This 3D map can be combined with any web map service of the user's choice. The second app (Rostěnice Farm) illustrated the potential for 3D data visualisation in a local area of interest.

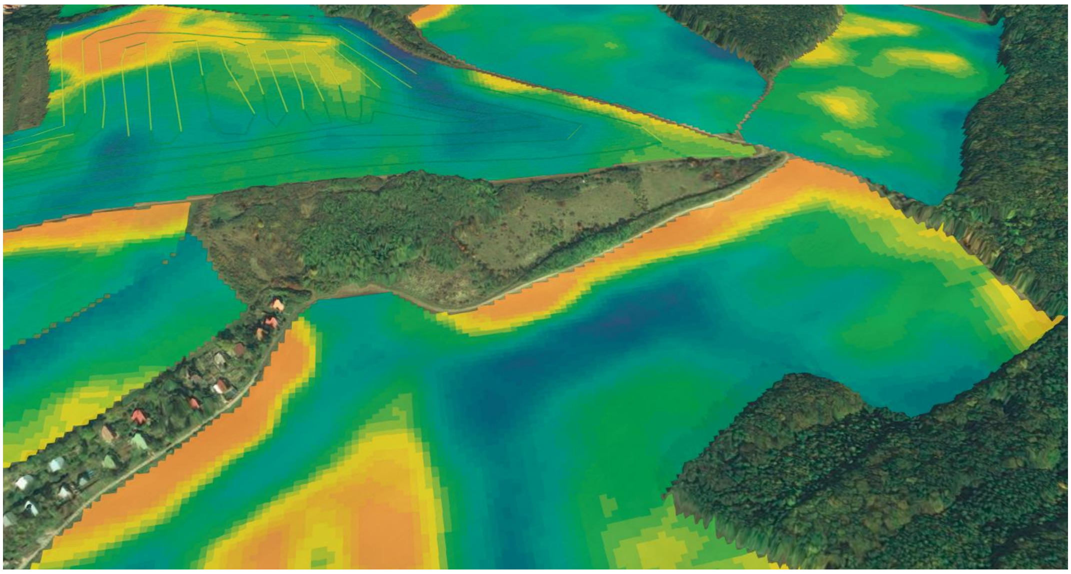
The 3D-OLU application developed by Jedlicka (2017a) visualises the Open Land Use Map on top of the EU-DEM terrain model (European Environment Agency, 2017) using a perspective view (see Figure 6). Displaying the data in a 3D environment helps the user to explore an area of interest in a more natural way than a traditional map. Moreover, users can add a web map service of their choice (as long as it uses the WGS84 coordinate system) to make custom 3D mash-ups.

Figure 6: The Open Land Use dataset on top of the EU-DEM terrain model, from a perspective view



The Rostěnice Farm application (Jedlicka (2017b) visualises geographical data in a 3D environment. This can help a farmer to better understand the fields within the farm, and to explore the relationships between the yield potential and the topography, slope, orientation and topography wetness index of the field (see Figure 7). The farmer can check those parts of the fields that have steep slopes and how the machinery deals with them (by checking the tracklogs of the machinery). The application uses a fifth-generation digital terrain model (CUZK, 2017a), a first-generation digital surface model (CUZK, 2013) and farm-related data produced by the Rostěnice farm, a joint-stock company.

Figure 7: Yield potential shown overlaying the topographical view



3.2.2. Technical progress

Integration of the Cesium plugin with HSLayers NG

The project was divided into three phases. Firstly, an integration of Cesium (Cesium Consortium, 2017) into HSLayers NG was realised; this can be tracked on Github (see folders examples/3d-olu and components/cesium at HSlayers-NG Github repository (HSRS, 2017)). A local copy of Cesium server was also created for better performance.

Visualisation of Open Land Use on top of EU-DEM

The second phase of the project consisted of a visualisation of the Open Land Use Map using a perspective view, to allow a 3D exploration of the dataset. When exploring the default Cesium terrain source, the team realised that the 30 m resolution EU-DEM (European Environment Agency, 2017) was already incorporated in AGI (2017), meaning that the terrain source issue was resolved, since the team were not aware of any other more detailed, open source terrain source that was available at the time. The remaining issue to solve was to visualise the Open Land Use Map WMS on top of the EU-DEM terrain. Since using only one WMS leads to slow response times, the following two optimisations were made:

- The land use was rendered from the CORINE data for less detailed views, where WMS tiles of a scale smaller than 1:200 000 were requested by Cesium. The detailed Open Land Use Map was displayed only in closer views.
- For these closer views, land use polygons of LAU2 municipalities that were just visible were shown. The technical implementation was as follows:
    - A visible spatial extent on Earth's surface is calculated from an actual view.
    - Bounding boxes[15] for LAU2 municipalities are then compared to the visible spatial extent.
    - Finally, displayed are the only LAU2 municipalities, whose bounding boxes intersected with the Earth's surface visible spatial extent.
    - These steps are done repeatedly each time when observer position nor line of sight is changed, as it influences the actual view.

Visualisation of yield potential on top of detailed terrain

The third phase of the 3D Open Land Use hackathon activity focused on visualisation in higher detail. A visualisation of the yield potential from a particular farm was chosen as a use case. Data for the yield potential were calculated for Rostěnice farm (the agriculture pilot area for the DataBio project). These data were then placed on top of the digital terrain; digital surface models were produced as services by CUZK (2017b), and a web application was created that showed the data on a digital surface model.

With regard to the BDVA Reference Model (see BDVA (2017)), the two applications used a set of components which are introduced in the text below. Figure 8 shows the mapping between the components (numbers 1 - 10) and the BDVA Reference Architecture.

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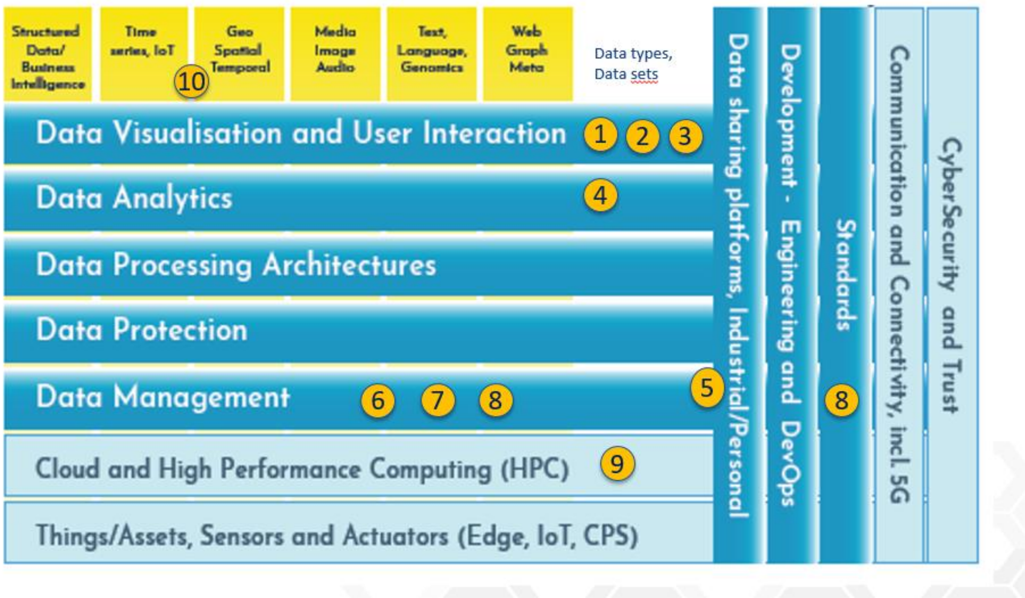
[15] Bounding box is an expression of the maximum extents of a 2-dimensional object (e.g. point, line, polygon) or set of objects within its (or their) 2-D (x, y) coordinate system, in other words min(x), max(x), min(y), max(y).

Figure 8: Hackathon components integrated into the BDV reference model (source: (BDVA, 2017))



Starting with the horizontal areas, the applications involve the following:

- *Data Visualisation and User Interaction* by using interactive perspective visualisation of 3D data for improved user experience (addressed by both applications). This includes components for WebGlayer (1) and HSLayers NG (2) integrated with Cesium (3).
- *Data Analytics* was done in the Rostěnice Farm application, which visualises an output from a yield potential analysis (4) performed on satellite data.
- *Data Processing Architectures* poses the future challenge of using an optimised and scalable architecture for the calculation of yield potential. The current solution is based on a semi-automatic approach involving mainly desktop software.
- *Data Management* - both applications handle spatial data (large volume data in the case of the 3D-OLU application). Data management components include an INSPIRE CKAN extension (5) and a SensLog (6) web server for sensors, and VGI data and NiMMbus (7) for storing geospatial resources. A web map service called WMS 8 (with WGS84 coordinates) was also used.

- *Cloud and High Performance Computing (HPC)* can be used to perform calculations of yield potential for large geographic areas. MiraMon (9) is a cloud solution for storing geospatial resources for NiMMbus (7).
- *IoT, CPS, Edge and Fog Computing* - sensor data can also be visualised and analysed, although only a small example of the visualisation of machinery tracklines was used in the Rostenice Farm application.

Vertical areas:

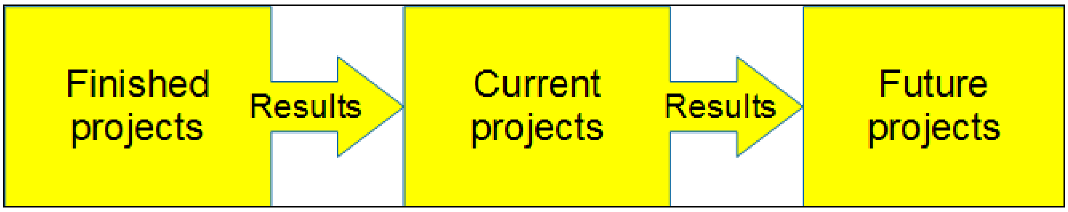
- *Big Data Types and Semantics* - Large geospatial datasets were used in the 3D-OLU application, and Earth Observations (EO) datasets were analysed during the preparation of the Rostenice Farm Application. In particular, the data sets included the EU-DEM terrain model, the Open Land Use Map, Smart Points of Interest, the Open Transport Map and CORINE data (10).
- *Standards* - The OGC WMS (7) standard was used for geospatial data publication in both applications.
- *Communication and Connectivity* - This was covered using standard data formats (OGC WMS).
- *Cybersecurity* – This was not addressed, and needs to be elaborated when incorporating sensor data in the future.
- *Engineering and DevOps for building Big Data Value systems* - Not elaborated.
- *Marketplaces, Industrial Data Platforms and Personal Data Platforms (IDPs/PDPs), Ecosystems for Data Sharing and Innovation Support* – This was supported by the INSPIRE CKAN component, also viewed as an industrial data platform (5).

4. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, there were four main outcomes from this series of hackathons:

1. Enhanced access to data and tools;
2. Improved interoperability of open data, volunteered geographical data, and data from citizen observatories;
3. Integrated capacity building;
4. An international community.

Figure 9: The INSPIRE hackathons make use of results from previous projects and initiatives, such as FP7/H2020 and national programs. These results are also being further developed and implemented

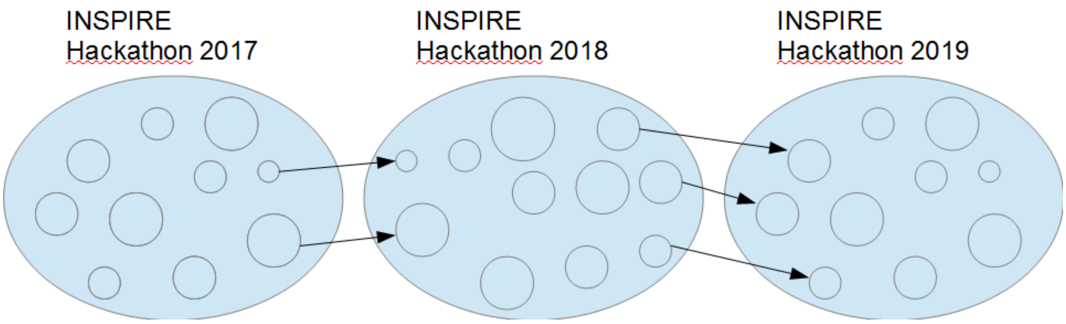


As part of the hackathons, data and tools from the projects were made available to the participants. By making these resources available, others will also benefit from improved access. Since the resources were listed in one place, it was also easy for others to find them, and the hackathon therefore allowed for the additional dissemination of the project results after the completion of the project itself.

Several projects and initiatives, including the INSPIRE directive, have contributed to the interoperability of inhomogeneous data from various sources. However, inconsistencies and gaps in data interoperability remain an issue, as not all interoperability aspects are covered by these projects and initiatives.

By bringing experts of all ages together and including students, capacity building was implicitly undertaken. In addition, some of the contributory hackathons were aimed directly at students.

Figure 10: Continuity: The INSPIRE Hackathons provide a framework for maintaining networks after the end of projects. Teams can be created freely and transferred to the next version of the INSPIRE hackathon, and the satellite INSPIRE hackathons facilitate the continuity of these teams. Teams can also regroup, depending on the problem that needs to be solved



The hackathons have also contributed to the sustainability of the networks and stakeholder groups engaged in various projects, since they provide a meeting place for interested individuals after projects have been completed.

Based on the experiences described above, an INSPIRE Hackathon concept has been developed, using the INSPIRE infrastructure as an umbrella or framework for the continuous inclusion of new contributions from European and international professional networks and projects such as the H2020, GEOSS etc. In addition to the main INSPIRE Hackathon included in the annual INSPIRE conference, several so-called satellite Hackathons will be organised. These serve two purposes: they provide continuity, and they allow new experts, groups and networks to join. These continuous satellite hacks will gradually grow the hackathon by involving increasing numbers of communities. This also ensures that attention is given to new challenges in a timely manner. Another aspect of the INSPIRE hackathon concept is capacity building; maintaining a hackathon network will result in transfer of knowledge and skills across the existing smaller focused groups and networks, and a growing network of experts will also enable some training of younger talents/experts.

A description of the vision for the INSPIRE hackathon is presented below. This vision is meant to be used in recruiting new organisations and individuals. The authors have identified several organisations that would benefit from taking part in the INSPIRE hackathons, such as OGC, EuroGeographics, GODAN, etc.

The INSPIRE Hackathon Vision: Making Open Data Policies Work!

The INSPIRE Hackathon is a playground for experts (of all ages) who want to fill the gaps between results and efforts in European and international open data integration.

The INSPIRE Hackathon ***supports*** the vision for Europe (and other areas of the world): Open Innovation, Open Science and Open to The World, with a particular focus on supporting open data policies within Europe and internationally.

The INSPIRE Hackathon ***provides*** a playground for seasoned experts of all ages and from all nations and organisations to work with the implementation of open data policies

The INSPIRE Hackathon ensures the continuity of open data integrations carried out in time-limited efforts such as those in EU-funded projects.

The INSPIRE Hackathon contributes to capacity building and education on open data policy implementation and management.

The INSPIRE Hackathon uses INSPIRE as its platform. Using this platform, a network of satellite hackathons will be supported to grow the community within Europe and beyond. In the future, we foresee being able to organise preparations before hackathon events (including coding) that could include input from problemathons, ideathons and datathons. We see the benefits of a continuous hackathon series in which datasets can be incrementally extended and sets of tools can be made available to the community before the hackathon event, so that the hackathon itself can be as productive as possible. A continuous series of hackathons can contribute to the sustainable coordination of old and new project results (data, interoperability solutions, tools etc.), and also support an engaged community with a momentum that will attract new generations.

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