

D3.1 Innovation Hub Technical Specification

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Responsibility for the information and views set out in this publication lies entirely with the authors.

Every effort has been made to ensure that all statements and information contained herein are accurate, however the PoliRural Project Partners accept no liability for any error or omission.

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List of Acronyms

AI = Artificial Intelligence
API = Application Programming Interface
CAP = Common Agricultural Policy
DIH = PoliRural Digital Innovation Hub
GIS = Geographical Information System
GUI = Graphical User Interface
ISO = International Organization for Standardization
LAG = Local action group
LOD = Linked Open Data
ML = Machine Learning
MOOC = Massive open online course
OGC = Open Geospatial Consortium
OLU = Open Land Use
OTM = Open Transport Map
PiH = PoliRural Innovation Hub
RDF = Resource Description Framework
SDI = Spatial data infrastructure
SPOI = Smart Point of Interest
UX = User Experience / Interaction Design
CSV = Comma Separated Variables
XML = eXtensible Markup Language
SWOT = Strengths Weaknesses Opportunities Threats analysis/assessment methodology

Executive Summary

The aim of the PoliRural Digital Innovation Hub (DiH) is to offer a public user interface and introduction to the *innovations* of the project. To this end, the DiH entry point is built on a content management system. Furthermore, the value of the DiH will be to provide four distinctive sections, or *spaces*, that cater for both internal and external users:

1. An interaction space with forums, dialogue and Wiki capabilities to support stakeholder interaction
2. A learning space for Massive Open Online Courses to facilitate dissemination and uptake of knowledge and methodology developed through the project
3. An experimentation space for testing analytics and visualization including text mining and system dynamics based on real data
4. A development and hosting space for creating virtual instances of the shared reference to be used by each pilot when developing their applications.

Below these high-level functional requirements there is a lot of implicit functionality that in some cases can be supplied by more than one technology component. In order to identify how the DiH can best serve the pilots, the deliverable starts off by a detailed analysis of pilots in terms of context, data availability and requirements, analytics requirements and pre-existing tools and technologies that the DiH must be capable of interfacing with.

Based on the joint and individual data requirements of each pilot, the DiH has selected common data sources with wide geographical coverage that is useful to most partners in a policy development and foresight context. These data sets will be made available in the DiH both as shared volumes for direct file access and through analytical and visualization services.

The DiH has well-defined interfaces to the two other systems in the PoliRural project and from the perspective of an external user will appear as a unity. Text mining and system dynamics applications will be linked from the menu system and test-applications will be made available as part of the DiH, to offer an introduction to these two technologies and how they may be applied in support of better policy development.

Based on these clarifications, the document then goes on to describe a reference architecture for a platform that will be used for three parallel deployment scenarios:

1. To serve as a back-end for the centralized DiH service provider node
2. To serve as a template for pilots who choose to host their applications in the DiH private cloud environment
3. To serve as a package repository and service provider for pilots who choose to host their applications on legacy infrastructures

PoliRural believes that a system that allows both options 2 and 3 for pilots will have a much greater chance of being successfully adopted and integrated than traditional *monolithic* alternatives.

The individual layers of the architecture are described, and candidate components are named for each requirement that is identified through the requirements analysis. Where suitable, more than one candidate technology is included for each purpose to allow flexible integration

with existing components and environments. Communications is in either case based on open standards supported by all alternate components.

A wireframe mock-up describes the principal functionality of the DiH user interface and the relationship between the hub interface and the interface and presentation of individual pilot innovations.

The deliverable rounds off by providing a plan for testing, recommendations for the first implementation stage and a conclusion that mirrors what is stated in this executive summary but with a more technical emphasis.

Since the project employs an agile and iterative development process, this is to be considered the first version of the DiH specification, as detail will be added for each monthly sprint and since extensions and minor changes may result from evolving user requirements as the pilot planning moves forward. At this stage, the specification is targeting the implementation of a reference and test lab that will be continuously developed in line with living lab methodology throughout the project life cycle

1 Introduction

The PoliRural Digital Innovation Hub (DiH) will be a central real and virtual space, where all stakeholders (policymakers, public servant, regional development agencies, NGO, citizens, scientists, developers, data experts, planners) will meet and share their needs and achievements to improve policy and decision making on local, regional and eventually national level. The core of the Innovation Hub will be the DiH platform. This DiH will also support the sharing of information with other projects and initiatives.

Innovation Hub objectives:

- Act as a gateway to PoliRural pilot activities, allowing users not only to check past achievements, ongoing developments and future events, but also get involved in building a better future for their region, for example by joining stakeholder panels, participating in online (forum) discussions
- Provide data that may not be readily available from other sources. This may include Earth Observation based maps showing land use (change) in each of the 12 participating regions. Such maps can be used for policy evaluation e.g. correlating changes in non-arable land with direct payments (CAP subsidies) for a given area
- Host the outputs of the PoliRural Semantic Explorer (text mining) and Policy Modeler (system dynamic modelling) for easy access by stakeholders in pilot locations and beyond
- Integrate an online learning course so that anyone with an interest in rural foresight could apply the PoliRural framework to deliver desired change in their region

2 Concept

The PoliRural Digital innovation Hub is an integration platform where all technologies, approaches and people meet. It is a central point for knowledge exchange and transfer. Strong involvement of pilots is one of key cornerstones supporting the overall project goal. There is a strong vision and tight position of the DIH within the project. The overall project progress in three phases is reflected in DIH development and new tools and outputs are continuously added in the DIH.

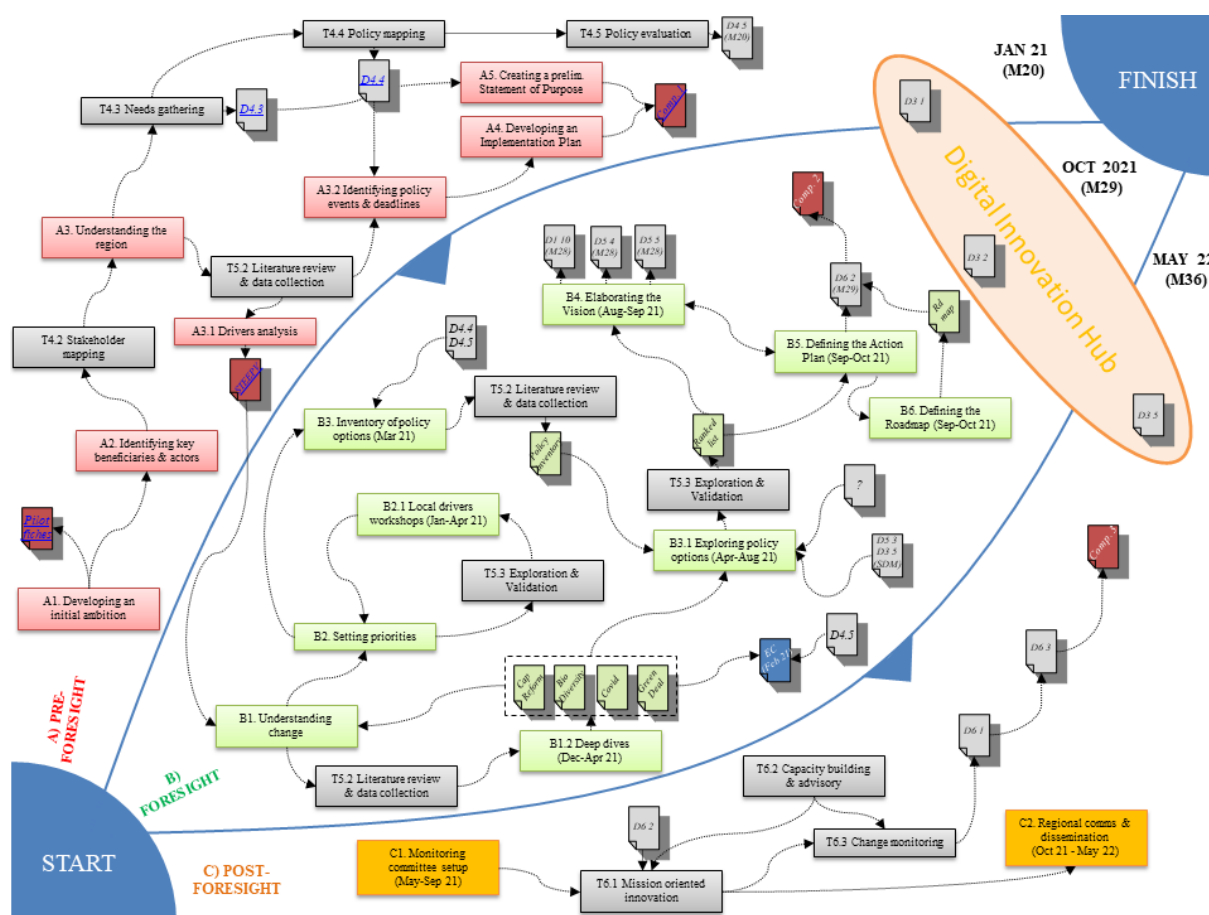


Figure 1 Polirural workflow

DIH is not only an isolated component of the PoliRural project, but its ambition is also to communicate with sister projects (RURALIZATION, DEMETER), exchanging methodologies, tools and knowledge, organizing cross-project seminars, and connecting project communities. Cooperation with related projects within the framework of Digital innovation Hubs (SmartAgriHubs, SIEUSOIL) is planned providing incubating environment for development of future tools and software, providing opensource components, reusable map services and data to build on.

Having technical tool is only a half of the success, the most important is to involve end users and assure their active participation. Pilots are key stakeholders involved in testing and help to steer the development of DIH, which is then better suit to their needs.

Extensive technical support to users including trainings and support is planned to assure active involvement of pilots in the DIH. Pilot localities will be given access to edit their own pilot subsite and benefit from all tools and information available on the DIH.

3 Digital Innovation Hub inside of PoliRural

The DIH will have four main components or *spaces*:

- **Interaction space** will be home to a Digital Science Shop as a communications platform, where users can look for researchers solving their problems and young researchers (bachelor, master and doctor studies) can look for topics for their thesis. It will also comprise components for interaction Wikis, dialogue etc.
- **Learning space** providing an environment and courses that permit training of partners, external stakeholders and early adopters.
- **Experimentation space**, where users will have the chance to test new analysis techniques and model simulations and visualization with real data from their own pilot regions.
- **Developer space**, with cloud hosting, shared components, tools, services, data and development environments for pilots wishing to run their own services.

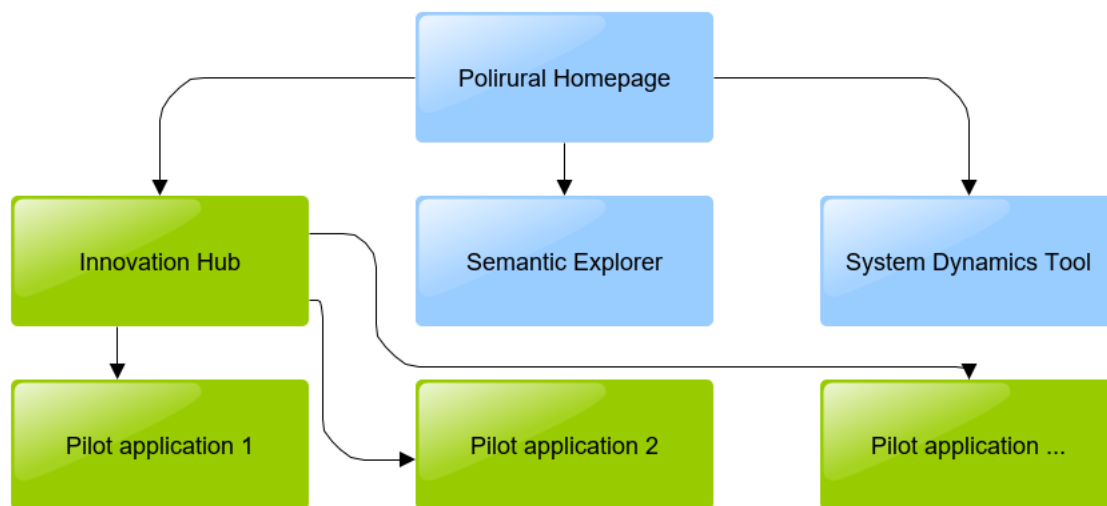


Figure 2a The relationship between the Innovation Hub and other PoliRural systems

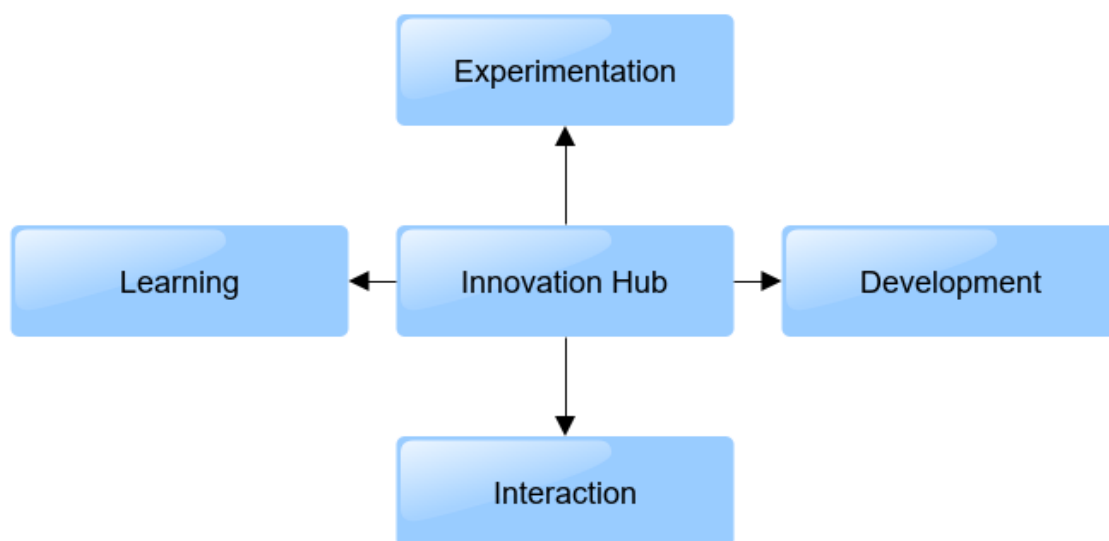


Figure 3 The four functional spaces of the DIH

4 User Needs

We surveyed pilots to collect information about their available data, data needs and analysis needs. This is the first round of survey, because analysis of pilots will continue, and we will provide regular updates of data and needs. This analysis will be used for the first round of implementation, which will continue with Agile methodology until the end of the project.

4.1 Pilot 1 Flanders, Belgium

4.1.1 Pilot background

In Flanders rural border communities attract new settlers who have various reasons for entering the community (interested in the farmhouse, temporarily renting land for growing crops etc.). Despite the increase in agri-environmental measures, small landscape elements disappear, and grasslands are being ploughed and relocated. At the policy level, measures have been activated to ensure that land maintenance is aimed at safeguarding the rural landscape. Regional governments and local communities engage in exercising pre-emptive rights, priority usage rights, active land acquisition, local land banking and financial compensation. Since maintenance of rural land, is the subject of a great debate, specific problems and solutions need to be addressed. The Flemish pilot will draw on the results of the project to develop (1) strategies for supporting citizen's investment and facilitating transfers of rural land, (2) more inclusive regulatory tools for land governance, (3) a better functioning system of market regulation.

4.1.2 Data availability and requirements

Most data in Flanders are free and can be queried using open source tools such as R, Python or in combination with Julia (Jupyter Notebooks). GitHub repositories have been created for all available data. Available data for this pilot includes statistical, geographical and climate data together with data from remote sensing. The list of data directly available on pilot is in Table 13.1 - A.1: Data directly available on pilot - Pilot 1 Flanders, Belgium in ANNEX A.

Also, all third parties have made their data available to the extent that they can share thereby abiding GDPR. All data are listed in the above table. The list of data available through third parties for this pilot is in Table 14.1 - B.1: Data available through third parties - Pilot 1 Flanders, Belgium in ANNEX B.

4.1.3 Analytical needs

The focus in the Flanders pilot is on mapping of changes in time. This will require multitemporal data geospatial and statistics. All analysis will need to be geo-located and distributed within Flanders. There will be a need to test different tools, which will support multi temporal analysis in regions. The full table of requirements is in Table 15.1 Analytical Needs - Pilot 1 Flanders, Belgium in ANNEX C Analytical needs.

4.1.4 Available tools

For analysis the Terrascope tool¹ is now available for analysis of Copernicus Remote sensing data.

4.2 Pilot 2 Monaghan, Ireland

4.2.1 Pilot background

The Monaghan County is a mainly rural county characterised by relatively small farm holdings but is well supported by a strong agri-food sector with major companies operating in the county and a strong emphasis on the export market. Monaghan attracts many new people from abroad because it is a pristine rural area with a strong community ethos, well-established farming support services and strong CAP subsidies. However, there are many negative factors: it is situated far from larger urban areas, land prices are high, new communities that settle in Monaghan often struggle to find suitable employment, there is lack of good-quality broadband and public services. Monaghan residents can avail of several support measures, some of which are national, some are specific to the county. However, there are currently no county-level services tailored to newcomers without a farming background. For that reason, the Irish pilot wants to introduce a new service called “I want to become a farmer” during mission orientation. The service will be targeted at (a) Irish people without a farming background, (b) new community members who may be interested in pursuing a career in farming, (c) people who have immigrated to Ireland from other countries, including CEEC.

4.2.2 Data availability and requirements

Most data in Monaghan are free, but usually not in a machine-readable form, i.e. in a textual/PDF form. Available data for this pilot includes a vast amount of descriptive data, as well as data from the social area and data from the field of farming. The list of data directly available on pilot is in Table 13.2 - A.2: Data directly available on pilot - Pilot 2 Monaghan, Ireland in ANNEX A.

Data sources relevant to the Monaghan Irish Pilot with links to policy documents from all levels are in **Error! Reference source not found.** in

¹ <https://terrascope.be/en>

ANNEX I to Pilot 2 Monaghan.

Data available through third parties for Monaghan are mostly open source. They are provided in various formats, including Linked Data, INSPIRE compliant data and so on. Such data for this pilot includes socio-economic statistical data, geospatial data and other official resources of Ireland. The list of data available through third parties for this pilot is in Table 14.2 - B.2:

Data available through third parties - Pilot 2 Monaghan, Ireland in ANNEX B. A further list of data sources relevant to the Monaghan Pilot, are listed in the ANNEX A and

ANNEX I to Pilot 2 Monaghan.

Specific data that the Irish pilot would like to obtain include information on

- Irish people – who have become farmers, with and without a farming background,
- Immigrants to Ireland – their demographics, backgrounds and profiles, identifying those with and without a farming background.

4.2.3 Analytical needs

The current geographical, socio-economic status, demographics, environmental, business, agricultural, financial, housing, policies and other issues that determine the attractiveness of Monaghan as a location for new farmers. The full table of requirements is in Table 15.2 Analytical Needs - Pilot 2 Monaghan, Ireland in ANNEX C Analytical needs.

4.2.4 Available tools

It is expected to use available Standard INSPIRE, Open Data and Linked Open Data Tools. It will be input for data dynamics, text mining and DiH analysis. The focus will be on Simulation of the Monaghan pilot and plans.

4.3 Pilot 3 Galicia-Castilla la Mancha, Spain

4.3.1 Pilot background

Nut trees can produce for decades, creating a dependable income for many years. Forestry activities include nut-fruit processing, planting strategies, wood and biomass, recycling, livestock feeding, tourism, mushrooms, etc. These varied economic activities have been built around remarkable research activity in agroforest areas around productivity enhancement, environmental and financial sustainability, cooperation or marketing. However, in many cases these lack policy support and broader adoption in analogous areas in Europe due to different value-chains and socio-economic conditions, resulting in a high valuable untapped knowledge and technology transfer. There are business opportunities available through the development of farming and forest species destined for non-wood products. In general, these products match the following characteristics: (1) they are present in all areas, but their use can be spread even further to increase socioeconomic and environmental benefits; (2) they are produced with too many heterogeneous reproductive materials and methods, which often leads to diverse results; (3) they are in high demand but its full potential remains untapped; (4) they create jobs in rural areas. This pilot will contribute to maintaining and increasing jobs in the field, by creating favourable regulatory conditions that support local agribusiness, which will help the region to retain and attract women and young people. TRAGSA will also provide a second PoliRural pilot based in Castilla la Mancha and related to fostering local economies using natural parks and historical heritage.

4.3.2 Data availability and requirements

Most data in Spain are public and in a format for geospatial data such as a spatial database. The list of data directly available on pilot is in Table 13.3 - A.3: Data directly available on pilot - Pilot 3 Galicia, Spain in ANNEX A.

Data available through public organizations or third parties for Spain are mostly available under CC-BY 4.0 license. They are provided mostly in geospatial-related formats such as LAZ, SHP, DBF or RDF. Such data for this pilot includes cadastre data, LiDAR data and various types of environmental data. The list of data available through third parties for this pilot is in Table 14.3 - B.3: Data available through third parties - Pilot 3 Galicia, Spain in ANNEX B.

Specific data that the pilot would like to obtain includes information on

- Economic impact of forest activities
- Statistics on visitors to Natural Parks, Archaeological Parks
- Economic impact of Visitors
- Downgraded conditions of rural life
- Demographic problems in Galicia and Castilla - La Mancha (They will be requested from INE – National Statistical Institute of Spain)

4.3.3 Analytical needs

The current and future socio-economic status, demographics, environmental, business, agricultural, and financial that determine the attractiveness of Galicia as a location for new forestry producers and farmer.

The future socio-economic status, demographics, business, financial, housing and other issues that determine the attractiveness of Castilla-La Mancha as a location for new inhabitants due to the impact of historical heritage.

Therefore, there are the following analytical needs:

- Collection and processing of data on rural attractiveness.
- Analysis of rural attractiveness as a factor for existing and / or potential entrepreneurs to develop their business of areas close to natural parks or historical parks.
- Analysis of the impact of Forestry Business.
- Analysis of rural space attractiveness as a factor for people to stay or to move elsewhere.

4.3.4 Available tools

It is expected to use available Standard INSPIRE, Open Data and Linked Open Data Tools. It will be input for data dynamics, social networks analysis and text mining.

4.4 Pilot 4 Vidzeme, Latvia

4.4.1 Pilot background

Due to strong out-migration, Vidzeme region's population experienced a significant decline since 2006. The demographic trend suggests that the region's inhabitants have lost much of their former interest in traditional fields such as agriculture, forestry and fishery. But there are opposite trends present: people want to move back to rural areas because of good quality of life or they want to start their own businesses. This is strengthened by high popularity and demand for products with specific certification (e.g. eco, bio, organic). Both newcomers and established farmers face multiple obstacles linked to the region itself. They include limited land availability, strict environmental regulations (due to large swathes of land being part of protected natural reserves), aging population and insufficient amount of skilled workforce, low quality of social services that can be provided for farmers and their families, as well as bad infrastructure (mainly roads). The pilot will introduce new regulatory measures and services with a special focus on newcomers. Pilot results will be embedded into the region's next long-term and mid-term planning documents and a comprehensive guide for farm diversification will be developed with the help of local stakeholders as a dynamic toolbox that is considering the newest and latest socioeconomic trends and agricultural and related industry foresight and analysis insights and findings.

4.4.2 Data availability and requirements

In the Vidzeme region data are only available through third parties. Data available through third parties for Vidzeme are mostly free to view. They are provided in various formats and data for this pilot includes different kinds of maps aimed at cadastre, forestry, culture as well as development or statistics. Data from the Latvian Geospatial Information Agency is also included. The list of data available through third parties for this pilot is in Table 14.4 - B.4: Data available through third parties - Pilot 4 Vidzeme, Latvia in ANNEX B.

4.4.3 Analytical needs

The analytical needs are as follows:

- Collection, processing and mapping of qualitative and quantitative data on rural attractiveness.
- Analysis of rural space attractiveness as a factor for people to stay or to move elsewhere.
- Analysis of rural attractiveness as a factor for existing and / or potential entrepreneurs to develop their businesses in rural areas.
- Modelling of Development Scenarios using data from the previous subsections.
- According to the scenarios define actions to be taken in each territory or set of territories.

4.4.4 Available tools

No available tools currently.

4.5 Pilot 5 Mazowieckie, Poland

4.5.1 Pilot background

The region has a high positive migration balance every year. Despite the large influx of people of working age, it has one of the highest demographic load indicators in the country. There are 57 people of non-productive age per 100 working-age persons, and this problem is increasing in the peripheral areas. Trends in migration show strong population flows from villages to cities and from large agglomerations to suburbia. This is a challenge for the attractiveness of agriculture for rural newcomers. The current state policy favours rural newcomers, especially young farmers. The pilot will analyse existing policy instruments targeting young farmers and how they affect the broader rural ecosystem. It will then introduce concrete measures aimed at broadening the inclusion of farms (especially small farms) into existing food chains; chains that are local (e.g. purchasing initiatives) and based on new forms of market organisation (e.g. online platforms). The ambition is to go beyond the existing approaches and develop new, effective techniques to promote rural areas as a place of living and working for newcomers, in the context of a strong impact produced by the agglomeration of rural areas, as well as changing patterns in food consumption (demand), health awareness and lifestyles.

4.5.2 Data availability and requirements

Data for Mazowieckie are freely available. They are provided in various formats, but mainly in PDF format or as texts/HTML. Available data for this pilot includes data mostly about agricultural and statistics, then data about regional development. The list of data directly available on pilot is in Table 13.5 - A.5: Data directly available on pilot - Pilot 5 Mazowieckie, Poland in ANNEX A.

Data available through third parties for Mazowieckie are available without restrictions. They are provided in various formats, including database-related ones and data for this pilot includes different kinds of data related to rural development programmes. The list of data available through third parties for this pilot is in Table 14.5 - B.5: Data available through third parties - Pilot 5 Mazowieckie, Poland in ANNEX B.

The pilot would like to obtain data on the implementation of LEADER measures under the RDP in different years.

4.5.3 Analytical needs

The analytical needs are:

- Rural demographic evolution
- Rural Activities
- Collection, processing and mapping of qualitative and quantitative data on rural attractiveness and rural projects

The full table of requirements is in Table 15.3 Analytical Needs - Pilot 5 Mazowieckie, Poland in ANNEX C Analytical needs.

4.5.4 Available tools

No available tools currently.

4.6 Pilot 6 Central Bohemia, Czech Republic

4.6.1 Pilot background

Rural peripheral parts of the region are attractive places to live because of the beautiful landscape and relatively easy accessibility of the capital. But the generational renewal is coming along slowly across these areas. Existing local, regional and national interventions focus mainly on promoting environmental protection, boosting business competitiveness and supporting infrastructure redevelopment, but there are no stimuli for rural newcomers. To ensure the sustainable development of rural areas that also minimises intra-regional disparities, the pilot will seek to update existing strategies with a greater focus on new entrants and their needs.

4.6.2 Data availability and requirements

Most data for Central Bohemia are mostly freely available and in various formats. Available data for this pilot includes a vast amount of descriptive data, informative data for general public and data from agricultural areas as well as data related to tourism and LAG. The list of data directly available on pilot is in Table 13.6 - A.6: Data directly available on pilot - Pilot 6 Central Bohemia, Czech Republic in ANNEX A.

Data available through third parties for Central Bohemia are freely available. They are provided in various formats both geospatial and non-geospatial related, such as XLS, PDF, WMS etc. Such data for this pilot includes topics such as cadastre, statistics, tourism, SMEs, environment, agriculture, health or education. The list of data available through third parties for this pilot is in Table 14.6 - B.6: Data available through third parties - Pilot 6 Central Bohemia, Czech Republic in ANNEX B.

4.6.3 Analytical needs

The analytical needs are:

- Data evolution
- Information about attitudes
- Identification of main barriers and opportunities related to living in the countryside
- Evaluation of the performance of the local economy
- Identification of main barriers starting/ending of the entrepreneurship related to land

The full table of requirements is in Table 15.4 Analytical Needs - Pilot 6 Central Bohemia, Czech Republic in ANNEX C Analytical needs.

4.6.4 Available tools

It is expected to use external tools such as: Data analysis in different sectors of economics², ASP³, Legal information⁴

4.7 Pilot 7 Nitra, Slovakia

4.7.1 Pilot background

Nitra has a well-developed infrastructure (including broadband), the cost of resources is low, there is less pollution than in other regions of Slovakia, and it has good climate conditions. On the downside, Nitra lacks the full range of good-quality public services, because of that residents need to travel to regional centres for help. It is also losing human capital to metropolitan areas that have a stronger pull factor for the rural labour force and there are concerns about the environmental impact of excessive logging in and near the protected areas. The pilot will implement business-oriented measures focusing not only on farming but also entrepreneurship in fields like production of traditional goods, innovation in the agri-sector, historical, cultural or natural places of interest with touristic potential. One specific measure it would like to introduce is a start-up incubator which can encourage newcomers to move to the rural area and start businesses.

4.7.2 Data availability and requirements

Data of Nitra are freely available and in various formats. Available data for this pilot includes a vast amount of descriptive data, data from GIS platforms and statistical data. The list of data directly available on pilot is in Table 13.7 - A.7: Data directly available on pilot - Pilot 7 Nitra, Slovakia in ANNEX A.

Data available through third parties for Nitra are mostly freely available. They are provided in various formats such as text/HTML, xls or geospatial formats such as GML, SHP. Such data for this pilot includes cadastre data, data from local authorities, legislative, statistics, agriculture, LPIS or Rural Development Network data. The list of data available through third parties for this pilot is in Table 14.7 - B.7: Data available through third parties - Pilot 7 Nitra, Slovakia in ANNEX B.

The pilot would like to obtain data on

- SWOT analysis of specific rural areas - microregions
- Specific local development plans
- Specific planning for development in rural areas of Nitra region
- Opportunities for youth in the region e.g. jobs, free time, education, health services

² <https://www.bisnode.cz>

³ <https://www.noveaspi.cz>

⁴ <https://www.zakonyprolidi.cz>

4.7.3 Analytical needs

- Monitoring of demographic changes in rural areas
- Assessment of local development opportunities
- Infrastructure
- Job opportunities for people in rural areas
- Engaging youth in local policy
- Infrastructure

4.7.4 Available tools

There are no external tools expected.

4.8 Pilot 8 Häme, Finland

4.8.1 Pilot background

Häme Region has a great potential due to its location between Finland's biggest cities, however, the benefits of location have not been fully exploited and the population of the region has not increased recently. The reasons for this are being considered among citizens and authorities, but the solution remains unclear. Jobs are concentrated in large towns and employment in rural areas is challenging. However, it is possible to affect this reality. The pilot will use PoliRural results to boost the region's attractiveness for newcomers, by introducing business-friendly policies that can encourage tourism and digital services (e.g. bitcoin mining), which in the future may become a significant source of employment.

4.8.2 Data availability and requirements

Data from Häme are mostly statistical, based on various registers. The list of data directly available on the pilot is in Table 13.8 - A.8: Data directly available on pilot - Pilot 8 Häme, Finland in ANNEX A.

Data available through third parties for Häme are mostly freely available. They are provided in various formats. Such data for this pilot includes data from National land surveying, environmental data or data for farmers. The list of data available through third parties for this pilot is in Table 14.8 - B.8: Data available through third parties - Pilot 8 Häme, Finland in ANNEX B.

The pilot would like to obtain

- Statistics on repatriation to rural areas
- Statistics on two-placed living (both in urban and rural areas)

4.8.3 Analytical needs

There is a request for the following analysis

- municipal migration statistics
- reasons to move to the city queries (by cities or municipalities)

4.8.4 Available tools

It is expected to use the Futures platform - Foresight tool⁵

4.9 Pilot 9 Central Greece, Greece

4.9.1 Pilot background

The region's central location is seen both as an opportunity and as a challenge. On one hand, it has resulted in the accumulation of significant production units and the enhancement of regional employment rates. On the other, it led to the "virtual" increase of regional growth and economy indicators, which resulted in a marked inequality in income distribution. For both existing populations and potential newcomers, the increased agricultural activity accompanied by the excessive use of agrochemicals is one of the factors that negatively affects rural attractiveness. Other factors are the limited number and variety of private services, bad physical and broadband infrastructure, and employment opportunities. Challenges specific to newcomers also include the lack of necessary information and resources to access financing. Furthermore, the regulatory framework does not provide enough measures to support people without a rural background, which together with the amount of time, effort and initial investment required to migrate from the demand side (consumers) to the supply side (producers) acts as a significant barrier for newcomers. There is an urgent need for new solutions that go beyond what is currently available and effectively address existing service gaps and barriers. The pilot plans to introduce new interventions that improve training opportunities and digital skills, facilitate the adoption of new farm management practices (e.g. smart farming), develop social capital between newcomers and local populations, and facilitate access to the region's many resources (e.g. infrastructure, funding and financing).

4.9.2 Data availability and requirements

Data for Central Greece are available under the licence of library.aua.gr, under licenses of social media or they are freely/publicly available. They are provided in PDF format, as well as texts/HTML, as posts on social media, or as geodata (KML, json, RDF). Available data for this pilot includes bibliographical records of the AUA library, a vast amount of data about agricultural and rural development, together with related social media posts and GIS-related administrative and environment data. The list of data directly available on the pilot is in Table 13.9 - A.9: Data directly available on pilot - Pilot 9 Central Greece, Greece in ANNEX A.

Data available through third parties for Central Greece are mostly freely available, or under Creative Commons Attribution 3.0 license. They are provided mainly in formats such as text/HTML, xls or PDF. Such data for this pilot includes agricultural, environmental or population data, together with governmental and statistical data, data about tourism, economy or data from libraries. The list of data available through third parties for this pilot is in Table 14.9 - B.9: Data available through third parties - Pilot 9 Central Greece, Greece in ANNEX B.

The pilot would like to obtain data on

⁵ <https://www.futuresplatform.com>

- Demographic problem
- Lack of technologies
- High production costs
- Problem of competitiveness in its economy
- Delay in modernization and the mechanization of agriculture
- Lack of innovative solutions
- Absence of ICT tools related to land planning
- Subsidies
- *Brain drain*
- Poor economic conditions
- Small-sized farms
- Low and uncertain farm income
- Low productivity
- Downgraded conditions of rural life
- Mobility of young people to major urban centres
- Unfavourable age structure of the agricultural labour force
- Poor cultural level of rural society
- Inadequate infrastructure and training of the older farmers,
- Weak link between innovation and small-sized enterprises,
- Weak entrepreneurship
- Lack of access to finance, environmental and climatic limitations
- Specific forums on Twitter, Facebook and Instagram for farmers or other groups where they can exchange ideas
- Specific pages where a chat or discussion over specific issues could be organized
- Infrastructure facilities (roads, buildings, internet)
- Real estate data
- Quality of life indicators

4.9.3 Analytical needs

The analytical needs are:

- Statistics, historical information, economic data, demographic data.
- Positive, negative, neutral expressions/attitude in relation with agriculture sector (Utilized Agricultural Area, yield, indicators, etc.).
- Positive, negative, neutral expressions/attitude for each sector in relation with audience demographics (gender, age, education, location, etc.).
- Positive, negative, neutral expressions for each sector in relation with audience demographics (gender, age, education, location, etc.).

The full table of requirements is in Table 15.5 Analytical Needs - Pilot 9 Central Greece, Greece in ANNEX C Analytical needs.

4.9.4 Available tools

An open information dashboard and visualization interface for key indicators of the Region⁶

4.10 Pilot 10 Apulia, Italy

4.10.1 Pilot background

Apulia boasts a thriving SME community, and rich food and wine traditions that date back centuries. All this makes it attractive for local populations and newcomers. However, the region has its problems: excessive urbanisation of the coastal area threatens to undermine the scenic landscapes; employment opportunities are mostly seasonal, and poverty is growing in remote areas. The pilot will promote the enhancement of natural and social resources available in the area, by adopting measures that facilitate new business activities, including the provision of technical and financial assistance to established populations and those who consider making it their new home.

4.10.2 Data availability and requirements

Data in Apulia are in various formats and includes agricultural data together with data of LAG. The list of data directly available on the pilot is in Table 13.10 - A.10: Data directly available on pilot - Pilot 10 Apulia, Italy in ANNEX A.

Data available through third parties for Apulia are freely available. They are provided in mostly in CSV/XML data formats. Such data for this pilot includes agriculture and statistical data, data from local authorities or tourism data. The list of data available through third parties for this pilot is in Table 14.10 - B.10: Data available through third parties - Pilot 10 Apulia, Italy in ANNEX B.

The pilot would like to obtain data on

- The categories of workers employed in rural areas classified by competences
- Infrastructure facilities (roads, ports, airports, Internet)

4.10.3 Analytical needs

The analytical needs are

- Demographic evolution
- Evaluation of the performance of the local economy
- Market labour evolution

The full table of requirements is in Table 15.6 Analytical Needs - Pilot 10 Apulia, Italy in ANNEX C Analytical needs.

⁶ <http://hello.crowdapps.net/opendashboard-sterea-ellada/>

4.10.4 Available tools

It is expected to use the following external analytical tools:

- Cultural container of its kind activated in the area and created to raise awareness and promote the many gastronomic excellences of the LAG municipalities (Canosa di Puglia, Gravina in Puglia, Minervino Murge, Poggiorsini, Ruvo di Puglia and Spinazzola)⁷
- The Chambers of Commerce make the main statistical data and economic analyses organized by territory and by sector easily accessible
- ⁸The Index Unioncamere Price and Markets Observatory has been carrying out constant and articulated research and information activities in the field of prices since 1982, contributing to making the economic transactions taking place along the production-distribution-consumption process increasingly transparent. assets, for the benefit of all public and private operators who participate in these matters.⁹

The pilot is interested in the use of Orange Statistical tools

4.11 Pilot 11 Gevgelija-Strumica, FYROM

4.11.1 Pilot background

In FYROM in general and Gevgelija-Strumica in particular, a comprehensive extension service is lacking. The professional technical support of farming is very poor both in content and in the process of delivery. Also, like in other pilots, the young population is leaving rural areas, seeking a better future in towns or abroad. At the same time, FYROM is a transit point for migrants entering Europe, which presents both an opportunity and a challenge. Besides investigating the impact of third country nationals on FYROM's agricultural sector, the pilot will introduce new measures to update extension services so that communications with farmers and support delivery is carried out using modern ICTs.

4.11.2 Data availability and requirements

Data of Gevgelija-Strumica are freely available and provided in PDF format. Available data for this pilot is related to agriculture. The list of data directly available on the pilot is in Table 13.11 - A.11: Data directly available on pilot - Pilot 11 Gevgelija-Strumica, FYROM in ANNEX A. Data available through third parties for Gevgelija-Strumica are available freely without restrictions. They are provided mainly in formats such as text/HTML, xls or PDF. Such data for this pilot includes agricultural data, food production, rural development data, forestry or environmental data. The list of data available through third parties for this pilot is in

⁷ <https://www.facebook.com/altamurgia/>

⁸ <http://www.unioncamere.gov.it/P42A0C0S148/osservatori-e-analisi-dei-sistemi-locali.htm>

⁹ <http://www.unioncamere.gov.it/P42A0C0S148/osservatori-e-analisi-dei-sistemi-locali.htm>

Table 14.11 - B.11: Data available through third parties - Pilot 11 Gevgelija-Strumica, FYROM in ANNEX B.

4.11.3 Analytical needs

The analytical needs are as follows:

- Demographic evolution
- Evaluation of the performance of the local economy
- Market labour evolution

4.11.4 Available tools

No available tools currently.

4.12 Pilot 12 Galilee, Israel

4.12.1 Pilot background

The activities in the development of the Galilee are derived directly from the goals of the Ministry of Development of the Negev and Galilee peripheries to bring 300,000 new residents, along with strengthening the existing population in the Galilee. The Galilee pilot will integrate and accompany “change generating projects” along with examining the ongoing support to projects throughout the Galilee. Development of the region and strengthening of the Galilee settlement are a major goal for the Israeli governments in general and the Ministry of Development of the Negev and the Galilee in particular. The Galilee area offers a high quality of life, advanced education systems and diverse employment opportunities alongside the values of fulfilment of the land. These projects strengthen the Galilee population, the municipal authorities in the area and attract new populations. As part of its activities, the pilot will promote a variety of areas in which: economic and employment development, education and academia, tourism and culture, health and welfare, leisure and sports are in focus.

4.12.2 Data availability and requirements

Data for Galilee are freely available without restrictions. They are mainly provided as texts/HTML. Available data for this pilot includes mainly data about agricultural and rural development. The list of data directly available on the pilot is in Table 13.12 - A.12: Data directly available on pilot - Pilot 12 Galilee, Israel in ANNEX A.

Data available through third parties for Galilee are available freely without restrictions. They are provided mainly as text/HTML. Such data for this pilot includes mainly agricultural data.

Most of the data is in Hebrew, but official data by the Ministry of Agriculture and the Central Bureau of Statistics can be found in English. The list of data available through third parties for this pilot is in Table 14.12 - B.12: Data available through third parties - Pilot 12 Galilee, Israel in ANNEX B.

The pilot would like to obtain data on

- SWOT analysis of Galilee rural area
- Specific local development plans
- Information on digitization of agriculture in the Galilee, special methodologies, equipment, software and hardware
- Approaches of the Ministries to develop peripheral areas in Israel, and specifically budget allocation

4.12.3 Analytical needs

There are the following analytical needs:

- Rural demographic evolution
- Rural Activities
- Main changes in agriculture
- Analysis rural housing possibilities' attractiveness as a factor for people to stay or to move elsewhere.
- Analysis rural attractiveness as a factor for existing and / or potential SMEs to develop their businesses in rural areas.
- Engaging youth in regional policy and activities

The full table of requirements is in Table 15.7 Analytical Needs - Pilot 12 Galilee, Israel in ANNEX C Analytical needs.

4.12.4 Available tools

It is planned the use the following external tool:

- Foresight tool¹⁰

4.13 Analysis and Conclusions for the DiH

Due to the different geographical, geopolitical and historical conditions of the pilot regions, the availability and nature of data varies greatly. The DiH will need to accommodate a broad set of data formats for storage, retrieval and analysis.

Not all regions have open data; not all regions have data in machine readable form, significant data exist only as textual documents that will require text mining in order to be analysed automatically.

Some regions, on the other hand, are very well prepared for analytical work, starting with ready-to-use semantic Linked Data. This suggests that the *journey* from data to results will be quite different from pilot to pilot. The DiH architecture needs to observe this and offer a flexible solution that will be adapted to diverging pilot needs.

¹⁰ <https://www.futuresplatform.com>

The pilots see their requirements from the viewpoint of a policy development professional and add detail from that perspective. For the purpose of this document, it is necessary to abstract these requirements into broad technical requirements that can be satisfied by the inclusion of suitable components and tools as outlined in chapter 7 below. Analysing all pilots, we find the following common and recurring requirements:

- Analyse and visualize temporal changes
- Measure and visualize attractiveness of regions
- Identify barriers for regional development
- Monitor economic activities
- Find opportunities for, potential of regions
- Analysis of agriculture sector
- Analyse and promote culture, environmental and gastronomic excellence
- Analyse labour market
- Develop regional development plans

Some analysis can be executed successfully on a European-wide basis using shared high-resolution data sources that are available everywhere.

Others require local data that differ in structure and accessibility on a local level. Such data must be integrated and analysed semi-automatically or manually as a part of each pilot.

As a consequence of the variation, the DiH does not try to force all pilots into a single centralized platform but divides it into a central service provider node that will offer shared data and components as well as decentralized pilot nodes that may consume only such services and components as are required to satisfy local/regional needs as described in chapter 6.4

5 Available data sources

5.1 Plan4all data sets

Plan4all maintains a huge database of open data in collaboration with several EU projects including SDI4Apps, OpenTransportNet and FOODIE. These data are continuously being published through various interfaces. Currently, there are three key datasets published including [Open Land Use Map](#), [Smart Points of Interest](#) and [Open Transport Map](#) which are displayed below in the same order.



Figure 4 Open Land Use Map (OLU)



Figure 5 Smart Points of Interest (SPOI)



Figure 6 Open Transport Map (OTM)

Detailed information is in ANNEX D Plan4all data sets.

5.2 Copernicus data and services

The Copernicus programme is offering six services for monitoring of various phenomena - Atmosphere monitoring, Marine monitoring, Land monitoring, Climate Change monitoring and applications in Security and Emergency areas.

However not only pre-processed data products offered by Copernicus services are available, source images can also be obtained by accessing the ESA Copernicus Open Access Hub either web GUI or web services. OpenSearch and Open Data formats are available. Information about interfaces is in

ANNEX E ESA Copernicus Open Access Hub interfaces.

ESA Copernicus Open Access hub is not the only source of Copernicus imagery. Collaborative ground segment infrastructure is in place to allow alternative ways of accessing Copernicus data. There are national mirrors providing faster access to data within a respective country.¹¹

Copernicus does not offer only satellite data, but also different types of services. The most relevant are Climatic Services - **ERA5-Land hourly data from 2001 to present**. ERA5-Land is a reanalysis dataset providing a consistent view of the evolution of land variables over several decades at an enhanced resolution compared to ERA5. ERA5-Land has been produced by replaying the land component of the ECMWF ERA5 climate reanalysis. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset using the laws of physics. Reanalysis produces data that goes several decades back in time, providing an accurate description of the climate of the past¹².

The European Commission is financing the establishment of five competitive cloud platforms (Data and Information Access Services - DIAS), which are aiming at accessing Copernicus products - source satellite imagery and derived products. A list of DIAS platforms is in

¹¹ <https://sentinels.copernicus.eu/web/sentinel/missions/collaborative/existing-planned>

¹² <https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-land?tab=overview>

5.3 Available Linked Open Data (additional data to pilots' data)

Linked Open Data is becoming a source of unprecedented visibility for regional, agriculture environmental and other data that will enable the generation of policy analysis as well as a significant advance for research in the rural area. Linked Open Data are usually stored using so called **Resource Description Framework (RDF)**. The RDF data model^[2] is similar to classical conceptual modelling approaches. It is based on the idea of making statements about resources (web-components) in expressions of the subject–predicate–object, known as triples. The subject denotes the resource, and the predicate denotes traits or aspects of the resource and expresses a relationship between the subject and the object¹³. This scheme supports linkage data stored in different databases. During previous projects SmartOpenData, SDI4Apps, FOODIE, Open Transport Map and DataBio, several existing stores of linked Open Data were found, some relational data was transferred into RDF and completely new data sets were built. This will be an important source of semantic data for PoliRural analysis. The overview of available Link Open Data is in ANNEX G Other available data set.

5.4 Other available data set

During initial analysis other available Open Data Sources were detected, which are relevant for PoliRural analysis and which are available in machine readable form and which we plan to use. This data is in

¹³ https://en.wikipedia.org/wiki/Resource_Description_Framework

5.5 Analysis and Conclusions for the DiH

There are several Pan European and Global Data Sets that have broad relevance to most or all the pilots. These datasets must be integrated in the DiH and made available in the machine readable form through APIs as described in chapter 7.4.7 below.

For some data, like OLU, OTM and SPOI, it is necessary to guarantee regular updates and maintenance to ensure that downstream analysis processes have access to the latest and most up-to-date data.

It is also important to extend the shared data sources to ensure similar data quality for Israel and Macedonia as for the EU.

Since these shared data sources cover all regions, it will be useful to execute analysis in stages and on multiple levels of spatial resolution. The project will start with a Pan European comparison of analysis on the level of NUTS 3 regions and then gradually scale these to NUTS5 in pilot regions, augmenting the analysis with local specific data for each step. Where available data makes this feasible, analysis will finally be scaled to the level of individual parcels based on the OLU data set.

6 Integration with other WPs

6.1 Text Mining

Text mining has its own dedicated application system that will be linked from the Innovation Hub.

6.1.1 Request for functionality

6.1.1.1 Geovisualization

To make a better presentation of textual analysis it will be necessary to implement geovisualization tools that guarantee the following minimum functionality:

- custom point(s) on map with assignable actions (on click)
- custom heatmap(s) overlay w/ parametrization (UI) and animation

6.1.1.2 Content Repository

A Content Repository preserves clean (plain) text substance of information acquired over time across regional and global sources of interest. The idea of a Content Repository is introduced in order to assure reliable and efficient access to all relevant inputs in the future, to allow:

- inquiry and reference (for online users needs and convenience)

- input context resilience (i.e. manual insertion of relevant documents into the system or automatic mirroring of selected 3rd-party resources)
- vindication and improvement (for process / decision verification)
- processing iteration (as contexts and processing chains evolve in time and need to be reapplied)

A Content Repository File has a unique identifier (such as normalized URI of origin) and variable set of attributes, such as content, title, time of acquisition, etc.). Content Repository API provides file (“Insert” / “Remove” / “Browse”) and file's attribute (“Get” / “Put” / “Rid”) operation.

A Content Repository may also serve as a Source Catalogue - any source referred from the Content Repository may get automatically crawled (where technically possible) to improve and update project inputs.

Technically, the Content Repository is using Storage for Indexed Data within text-mining framework as described in “D2.1 Text Mining Technical Specifications”.

6.1.2 Request for input data/services/interfaces

6.1.2.1 Geovisualization API (incl. map data)

While the Innovation Hub shared components include *professional* APIs including OGC services (WMS/WFS etc), there is a need for a simplified API for accessing and querying data based on simple JSON messages.

This API will leverage the threshold of including spatial functionality into applications for policy development, text-mining, semantic exploration and system dynamics.

The API will be implemented as a RESTful Web Service API and accompanied by a client-side JavaScript library to ease its inclusion into external applications.

6.1.2.2 Content Repository API

A Content Repository API is provided by the Text Mining framework and supports basic file (insert / remove / browse) and file attribute (set / get) operations, as well as full text indexing and search

6.1.3 Outputs data/services/interfaces

6.1.3.1 Pre-processing

Pre-processing is a set of automated services, focused on data:

- acquisition
- cleaning
- metadata extraction

6.1.3.2 Processing

Processing is a set of automated and semi-automated services, focused on machine interpretation:

- labelling, i.e. entities recognition, geolocation
- validation, i.e. fraud detection
- classification, i.e. topic detection
- semantic evaluation, i.e. emotional response

6.1.4 Needs of tools for developers

Aside from the Content Repository, the tool chain from WP2 is expected for text-mining features:

- crawlers (to acquire static content from the web)
- external service connectors (to acquire dynamic content from databases, social networks, etc.)
- central library (named entities, topics, etc.)
- machine learning (supervised and unsupervised)

6.2 System dynamics

Similar as for text-mining, system dynamics has its own application system that will be linked from the hub. The intended workflow is to develop models using the proprietary software suite Stella¹⁴ from Isee systems and then to publish them using one of three ways:

1. The simplest option is to publish interfaces, models and causal loop diagrams to Stella Exchange, a public cloud environment offered by Isee systems. Exchange offers both free and paid publishing options. The cost depends on the licensing model of the models. Models published under Creative Commons License would be free of charge
2. Models may also be published to private servers using two licensing options: Stella Server Enterprise and Stella Server Unlimited. Both options are paid and require a dedicated server. This option offers the simplest ease of use with the greatest privacy
3. Models built in Stella may be used as a 1:1 blueprint for reimplementing the model and its associated interfaces based on Open Source components.

The work of developing a system dynamics model is demanding both from the perspective of conceptualizing it, building it and fitting it with an interface that will allow people to use it effectively. However, the model being built, is a great deal easier to re-implement on another technology than to build it from scratch.

PoliRural has reserved a small resource for option 3, motivated by two objectives:

- Enable freedom of redistribution, replication and adoption of models based exclusively on the business model of PoliRural partners

¹⁴ Stella Architect and associated tools is one of the market leaders in System Dynamics modelling. This software is not part of the DiH but models developed using Stella may be run using one or more of the tools described in chapter 7.4.6 and 7.4.3

- Enable models to be modified, extended and customized without being explicitly linked to a proprietary software suite.

This will be done for 2-3 models deemed to be most promising for exploitation in the second half of the project.

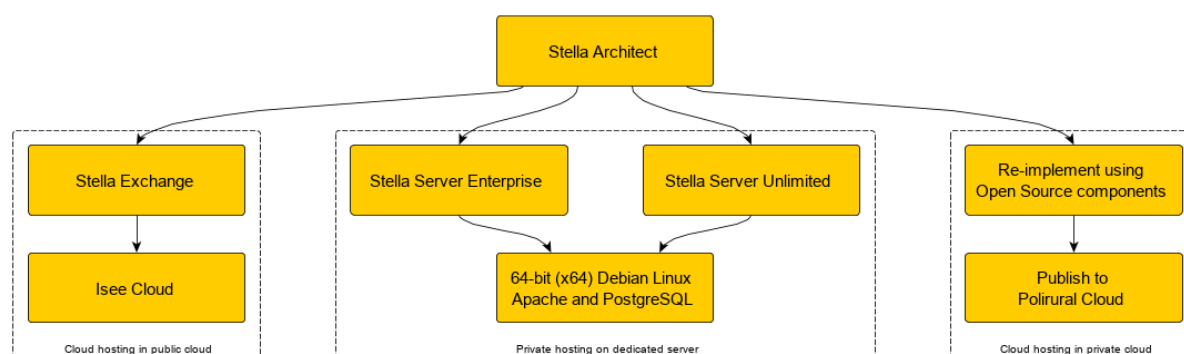


Figure 7 The authoring and publishing options for the Stella application system

6.2.1 Request for functionality

The authoring and publishing taking place in the Stella application eco-system does not have any functional demands for the DiH.

6.2.2 Request for input data/services/interfaces

Most input data to models will be specific to each pilot but the models will utilize shared data sets from DiH when these are needed in the simulations. This includes but is not limited to land-use, transportation network, land-form, geospatial statistics etc.

6.2.3 Outputs data/services/interfaces

Output data from the models may be published on the pilot applications that are instances of the DiH platform. This will use standard data management tools and data that are reduced to tabular outputs, charts and indicator figures may be also published as embedded tables/graphics within articles rather than as *data*.

6.2.4 Needs of tools for developers

In order to be able to realize option 3 in section 5.2 above, it is necessary to provide a suitable set of Open Source components to be able to implement system dynamics components. A set of candidate technologies are described in section 7.4.3

6.3 MOOC

6.3.1 Request for functionality

The PoliRural course will have 4 modules to be delivered in M30, M32, M34, M36. It must have all the basic features of an online learning tool. A non-exhaustive list is provided below

For “teachers” i.e. 21c and PoliRural partners:

- Simple interface with drag-and-drop functionality to create dynamic course material
- View registered participants, attendance, time spent studying, last login etc.
- Ability to participate in and respond to discussions, private emails
- Generate reports on usage statistics and export them if needed
- Possibly an option to publish content in languages other than English

For students:

- Free content
- Privacy policy
- Self-paced curriculum learning
- Some gamification to reward progress in completing modules, tasks, quizzes, as well as participation on the platform e.g. posting/replying to forum messages
- Certificate of completion (can be machine generated)

The PoliRural Tech team shall check the documentation of existing OS learning platforms to see which ones can work best with the DiH’s architecture. From the following shortlist, 21c will select the final option.

- Moodle <https://moodle.org/>
- Atutor <https://atutor.github.io/>
- Eliademy <https://eliademy.com>
- Forma LMS <http://www.formalms.org>
- ILIAS <https://www.ilias.de/en/>
- OPIGNO <https://www.opigno.org/en>
- OpenOLAT <https://www.openolat.com/?lang=en>

6.3.2 Request for input data/services/interfaces

The MOOC will not rely on any of the DiH data as content will be manually entered by 21c. Where cross-referencing is necessary, links/URLs to relevant DiH pages (text mining results, evaluation results, system models etc.) will also be added manually

6.3.3 Outputs data/services/interfaces

The main output is a certificate. 21c will create a template that will need to be updated with user information upon course completion. The platform will need to be able to collect and generate (anonymised) usage statistics for reporting purposes.

6.3.4 Needs of tools for developers

N/A

6.4 Analysis and Conclusions for the DiH

The following summarizes the findings from the analysis of these three related systems:

- It is necessary to establish a mechanism for bi-lateral communication between the text-mining system and the DiH. The text-mining system must get access to shared project-area-wide data sources; the DiH must get access to resulting data from text mining processes. The DiH must further get access to a geoparser instance exposed from the text mining system. The integration is envisioned as an API of microservices
- With regards to the system dynamics system, it is necessary to integrate models published from Stella Architect with the DiH through soft-linking and embedding within the DiH CMS. Towards the latter stage of the PoliRural project, a selection of promising models will be ported to an Open Source based platform in order to facilitate further development, community contribution and ease of embedding within existing business processes and applications seamlessly
- It is necessary to select an Open Source learning platform and to build components that will allow e.g. dynamic maps and system dynamics models to be displayed along traditional learning content.

The components required to realize these integration requirements are described in chapter 7.4.6 and 7.5.3 below.

7 Basic architecture

This chapter describes the basic architecture of the DiH and places it relative to other components implemented by the project.

7.1 Context of Innovation Hub in PoliRural

The DiH is distinctive from three other components in the PoliRural digital ecosystem:

- The home page (a website with a content management system)
- The semantic explorer (a ready-made application for exploring semantic graphs)
- The system dynamics tool (a commercial off the shelf authoring tool and a number of published, configurable models)

The hub will be accessed via a link from the homepage and will consume services exposed by the APIs and embeddable applications/models exposed by the semantic explorer and system dynamics tools.

Furthermore, the DiH will consume data from selected third party data repositories as discussed extensively in this document. Such data sources include European-wide shared data sources as well as data sources specific to pilots.

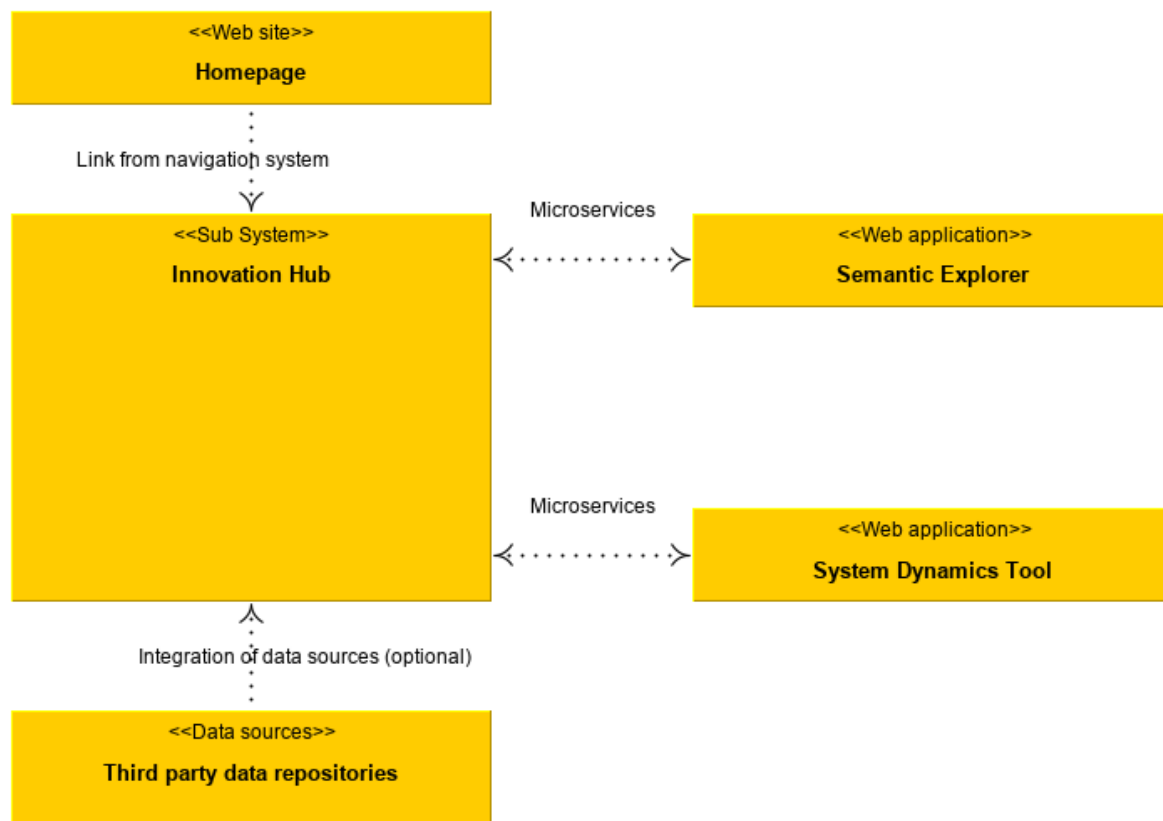


Figure 8 Context of Innovation Hub within PoliRural ecosystem of technical components

7.2 Innovation Hub Reference Architecture

The technical platform of the innovation hub is described as a reference architecture that can be realized in three different ways.

1. As a central service provider, shared data and components node
2. As a centralized pilot node hosted in the PoliRural private cloud
3. As a decentralized pilot node hosted in a legacy environment

This approach permits the innovation hub architecture to be applicable to both new and legacy IT environments. We believe this approach is superior to a make-or-break monolithic system that must be identical in every way, shape and form.

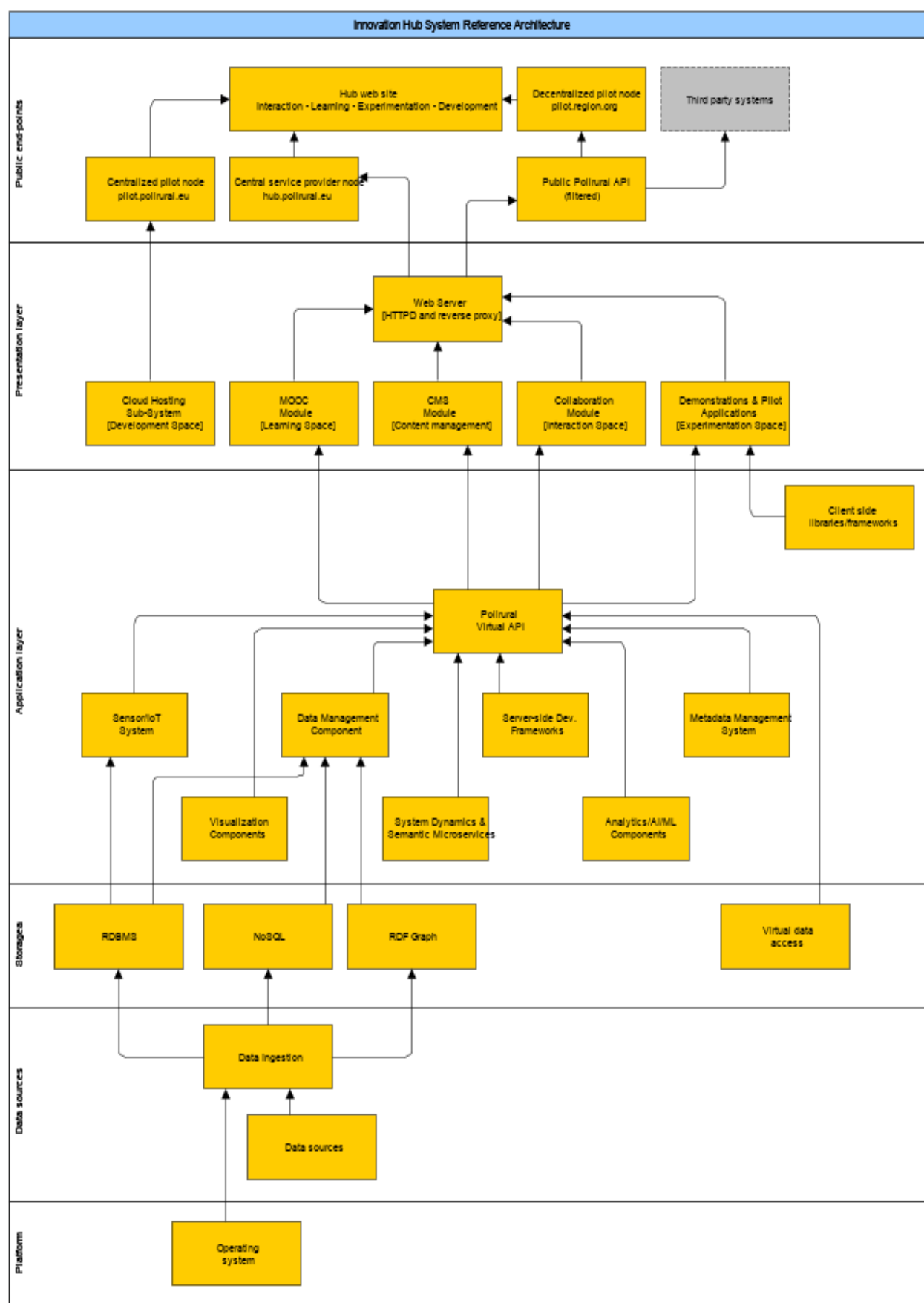


Figure 9 Innovation Hub Reference Architecture

- The box denoted [Development space] is a placeholder for the cloud hosting sub-system that is described in greater detail in the following chapter.
- The components shown as boxes in the diagram above will be available for inclusion in centrally hosted and decentralized pilot instances of the Innovation Hub platform as Docker images. The components included reflect common requirements identified through the analysis of the preliminary pilot descriptions and data requirements outlined in chapter 3 above. The specific functions provided by each component and how it resolves specific needs is described in chapter 7 below.
- Boxes shown in grey colour are external to the innovation hub application system and will be dealt with as third-party integrations as required.

7.3 Cloud hosting sub-system

In addition to offering an end-user service targeting the public and non-technical end users, the innovation hub will also be home to a cloud hosting environment targeting PoliRural pilots.

This environment will allow privileged users to create and manage virtual machines (PaaS) and add PoliRural components to them through a Docker repository that is populated with ready-made “images” for all PoliRural technical components.

The cloud management application, part of the OpenStack tools suite is shown in red. Persistent volumes and shared data are shown in pink. The centralized innovation hub service provider instance is shown in orange and the component library in the form of a Docker image repository is shown in yellow.

On top of the cloud hosting subsystem, there can sit two different types of pilot nodes that are discussed in the chapter below.

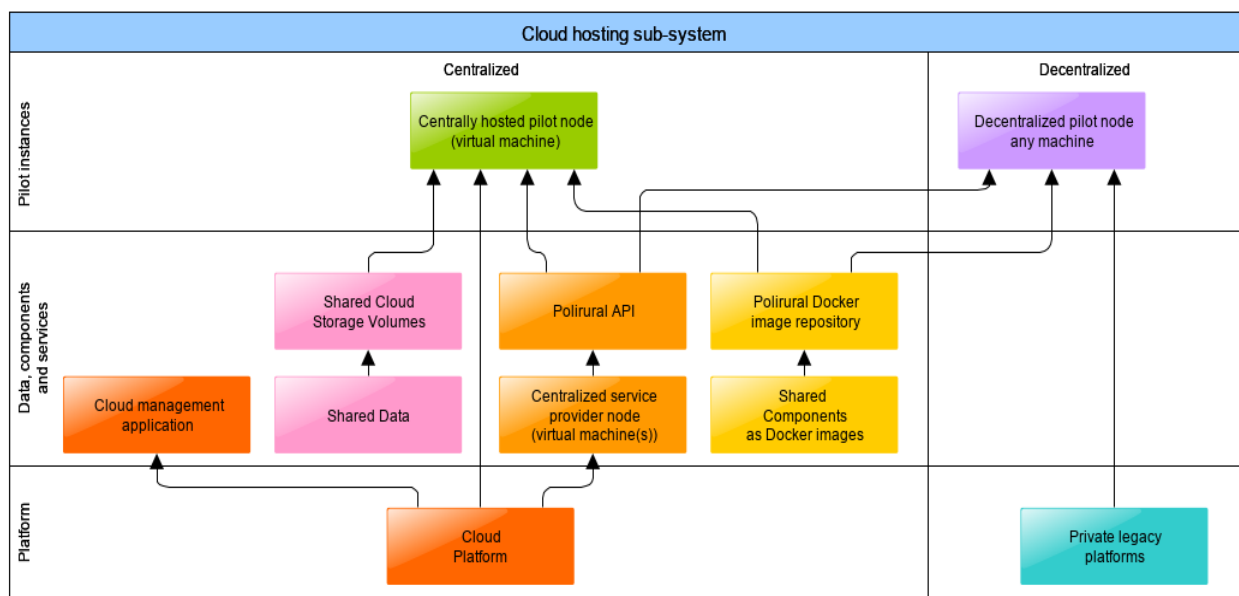


Figure 10 Cloud hosting subsystem

7.4 Innovation Hub Deployment Scenarios

Many platforms pose potential adopters with a problem; they constitute a very broad monolithic solution that if adopted will replace or duplicate the function of a lot of existing components that might - or might not - exist in a legacy IT infrastructure. Instead, PoliRural emphasizes easy customization and flexibility in integrating with legacy components.

The Innovation Hub architecture takes as a starting point that there is a set of broadly shared requirements. Not all instances but that individual instances may have need for customization. With the emergence of containers as the mainstream deployment scenario for platform components, a Docker image repository becomes a natural choice as a way of creating a reusable component library that can be deployed according to demand in each pilot node instance.

PoliRural envisions three different instantiations or deployments of the Innovation Hub technical platform.

1. A central service provider instance acting as the entry point for the end-user application and as an API and Docker image repository to be accessed by other nodes. This is shown in the first column in the diagram below
2. Centralized pilot instances, hosted as virtual machines in the PoliRural cloud hosting environment (shown in the second column)
3. Decentralized pilot instances, hosted in legacy environments but consuming shared components and data services from the central API and Docker image repository

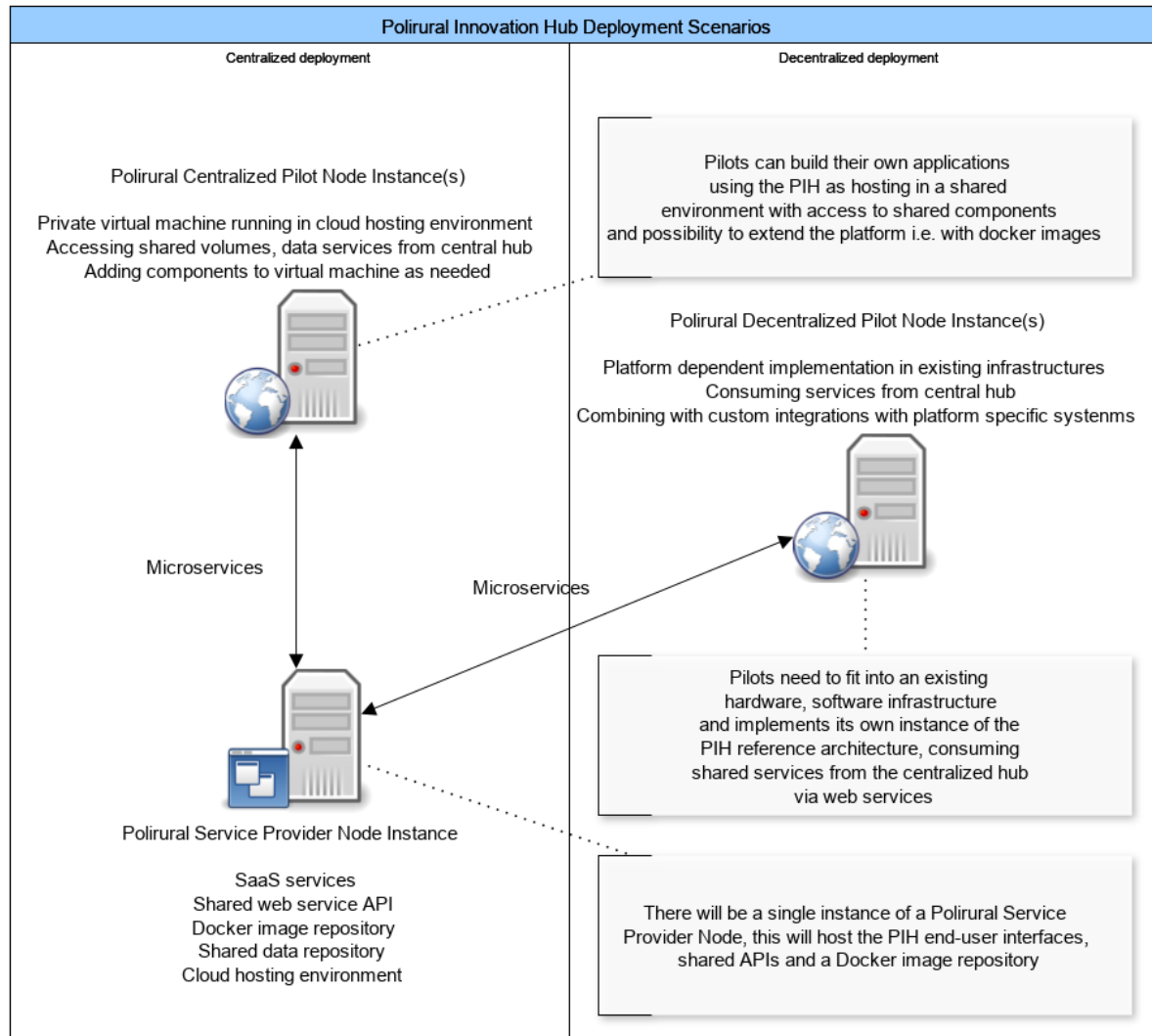


Figure 11 PoliRural Innovation Hub Deployment Scenarios

8 Layer description

This chapter describes, layer by layer, the reference architecture displayed in Chapter 6 Basic architecture above.

8.1 Platform

8.1.1 Operating system

CentOS will be used as an operating system platform. It is a Linux distribution with a long-term support suitable for a stable server deployment providing security updates backported to software packages in the versions as of CentOS release. CentOS is binary compatible with RedHat Enterprise Linux apart from a very few commercial packages that had to be removed from CentOS due to licensing issues.

CentOS introduces very good support of current hardware under many architectures (x64, ARM, etc.) and all major software tools support CentOS.

Within PoliRural CentOS is the operating system running directly on hardware servers, OpenStack is running on top of it. Pilot instances have the options of substituting CentOS for another OS. However, in order to benefit from the Docker image repository of shared components, a compatible Unix based OS is recommended.

8.1.2 Cloud platform

OpenStack is one of the most used cloud platforms. Completely open source it has gained a lot of popularity in the past years. From small to enterprise level deployments, many companies around the world are using OpenStack to manage their IT environment. OpenStack provides an additional abstraction layer between software applications and physical hardware virtually merging hardware resources into one cloud and providing all the managing services transparently to the user who doesn't need to know on which hardware machine an application or service is running. OpenStack does all the load balancing and even load distribution among hardware resources automatically, trying to find optimal usage of all available resources.

Thanks to very good support of infrastructure isolation by OpenStack, a standalone instance within OpenStack cloud with dedicated hardware resources will be created for PoliRural infrastructure allowing only authorized PoliRural staff to access it.

Within OpenStack there is a rich support not only for various formats of virtual images and format, but also for other services like e.g. compute services, storage services, etc. Docker is one of the supported environments natively supported by OpenStack. Docker images are run by OpenStack similarly to any other virtual server images, even multiple Docker images similarly to Docker Compose functionality are supported.

Docker provides support to running containers on top of the operating system. Several various environments can be set up on a single server, which is ideal for testing and development. Within Docker, containers of incompatible or various versions of the same software can live

next to each other which would never be possible in the physical operating system environment.

For the PoliRural project Docker is used as a flexible collaborative environment for rapid development, deployment and testing of a new software.

8.2 Data sources

The DiH will ingest and provide access to key shared data sets as described in chapter 4 above. There are two benefits to this:

1. Data are not stored redundantly, consuming unnecessary disk space from the cloud hosting environment
2. Services that facilitate access to data and analysis of data can be implemented once and consumed by any number of applications.

8.2.1 Data sources

The data sources that will be ingested into the platform include but are not limited to:

- Land use data (Open Land Use map)
- Land Cover data including historical data and changes
- Points of interest (Smart Points of Interest)
- Transportation network (OTN)
- Meteorological, climate data (various sources)
- Demographic data (Eurostat)
- The Farm Accountancy Data Network (FADN)

Data will be made available both as direct file access, through databases (RDBMS, NoSQL and RDF) and through a Web API communicating using JSON data structures. All data will be easy discoverable for every region through metadata

Data that are specific to each pilot will be ingested on a pilot by pilot basis. This will be done by each pilot, if required with assistance from PoliRural technical partners.

8.2.2 Data ingestion

The platform supports several parallel modes of data ingestion:

1. Ingestion of some file formats and data can be done through simplified user interfaces (e.g. LayMan for ESRI Shapefiles and other geospatial data sources)
2. Ingestion of data may be done through OGR/GDAL onto file servers or into RDBMS databases (e.g. GDAL and ogr2ogr for importing, converting raster data)
3. Ingestion of data may be done through manual processing and direct editing in GIS applications like QGIS
4. Ingestion may be done using product specific management tools, e.g. PostgreSQL pgAdmin, Virtuoso Data Explorer etc.
5. Ingestion may be done in the form of manually copying files from file system to filesystem

In addition to the data described in section 7.2.1 above, data will be ingested from the selected sources based on the needs of each pilot. I.e. data that are not used by more than one pilot and that are not deemed to have a re-use potential for future applications are handled on a pilot-by-pilot basis.

However, the platform has been dimensioned to handle the variety of data formats and models that are required to accommodate all data identified in Chapter 3 and Annexes A and B such as RDF data, tabular data, spatial data and “documents”.

8.3 Storage

The storage layer of the DiH reference architecture emphasizes the availability of a broad set of tools and technologies. The idea behind this is not indecision but the realization that different tools have different strengths and that depending on the needs of individual pilots one may be served best by e.g. a graph database whereas other deals in vast quantities of complex but static information that will perform best in a NoSQL database. The availability of alternative tools allows individual pilots to experiment with different technologies and choose the ones that most closely resemble their requirements. The objective is to arrive at the best possible cost/performance/complexity ratio.

8.3.1 Spatial RDBMS

They may not sound very exciting in 2019 but traditional RDBMS, a storage and information retrieval technology that has been in common use for most of the computing era, is still the preferred choice for most moderate scale applications.

While column databases, big table implementations and other NoSQL technologies have entered the market, they have not made the RDBMS obsolete. Simultaneously, the RDBMS technology providers have not been idle either, introducing XML and JSON storage and query capabilities as part of their relational models

In the DIH, the selected relational database management system is PostgreSQL 12 with PostGIS, optionally in cluster configuration under Citus Data to allow for greater horizontal scalability.

PostgreSQL also known as Postgres, is a free and open-source relational database management system (RDBMS) emphasizing extensibility and technical standards compliance. It is designed to handle a range of workloads, from single machines to data warehouses or Web services with many concurrent users.

Web site: <https://www.postgresql.org/>

PostGIS is an open source software program that adds support for geographical objects to the PostgreSQL object-relational database. PostGIS follows the Simple Features for SQL specification from the Open Geospatial Consortium (OGC)

Web site: <https://postgis.net/>

Citus is an extension to Postgres that distributes data and queries in a cluster of multiple machines. As an extension (rather than a fork), Citus supports new PostgreSQL releases, allowing users to benefit from new features while maintaining compatibility with existing PostgreSQL tools.

Citus horizontally scales PostgreSQL across multiple machines using *sharding* and replication. Its query engine parallelizes incoming SQL queries across these servers to enable human real-time (less than a second) responses on large datasets.

Web site: <https://www.citusdata.com/>

8.3.2 Graph

Graph databases typically power semantic applications, storing data in RDF graphs as triplets or quads. The DiH includes the OpenLink Virtuoso RDF Store as a graph database component. Graph databases are queried using SPARQL/GeoSPARQL.

Virtuoso RDF Store is a database that uses graph structures for semantic queries with nodes, edges, and properties to represent and store data. A key concept of the system is the graph (or edge or relationship). The graph relates the data items in the store to a collection of nodes and edges, the edges representing the relationships between the nodes. The relationships allow data in the store to be linked together directly and, in many cases, retrieved with one operation. Graph databases hold the relationships between data as a priority. Querying relationships within a graph database is fast because they are perpetually stored within the database itself. Relationships can be intuitively visualized using graph databases, making them useful for heavily interconnected data.

Web site: <http://virtuoso.openlinksw.com/>

8.3.3 NoSQL

For certain data storage and information retrieval tasks, RDBMS and graphs do not scale to the required volume of data. Enter NoSQL databases; systems that store data in a way that is optimized to respond lightning fast for specific queries. At the cost of not being able to conduct query time joins or complex selects, such storage systems provide unparalleled speeds when the database and keys are tuned to the specific type of query that is to be executed.

ElasticSearch is a search engine based on the Lucene library. It provides a distributed, multitenant-capable full-text search engine with an HTTP web interface and schema-free JSON documents. Elasticsearch is developed in Java. Following an open-core business model, parts of the software are licensed under various open-source licenses while other parts fall under the proprietary Elastic License.

Web site: <https://www.elastic.co/>

MongoDB is a cross-platform document-oriented database. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schema. MongoDB is licensed under the Server-Side Public License (SSPL).

Web site: <https://www.mongodb.com/>

PostgreSQL HStore data type provides a key-value store as a data type that may be used anywhere within the PostgreSQL RDBMS environment.

Web site: <https://www.postgresql.org/docs/11/hstore.html>

PostgreSQL JSON and JSONB data types PostgreSQL includes JSON data types for storing JSON (JavaScript Object Notation) data, as specified in RFC 7159. Such data can also be stored as text, but the JSON data types have the advantage of enforcing that each stored value is valid according to the JSON rules. There are also assorted JSON-specific functions and operators available for data stored in these data types. PostgreSQL offers two types for storing JSON data: json and jsonb. To implement efficient query mechanisms for these data types, PostgreSQL also provides the jsonpath data type.

Web site: <https://www.postgresql.org/docs/11/datatype-json.html>

8.3.4 Virtual data access

In addition to “physical” data sources that will be ingested to the DiH file-system and served as either files or through one of the three data servers, the platform will support several virtual data sources, i.e. data sources that are available through web accessible over network protocol, including but not limited to:

- File data sources read over the web
 - JSON including GeoJSON (RFC 7946) - to load remote data files accessible via a URL in real-time
 - OpenGIS® KML Encoding Standard (OGC KML) - see JSON above.
- Open GeoSpatial Consortium geospatial protocols
 - Web Map Service (WMS) - to access map images such as tiles and “fused” background maps and query attributes for single points
 - Web Feature Service (WFS) - to access to vector data as GML/XML or JSON and query spatial and attribute data.
- Map Sharing
 - JSON API of HSLayers NG
- Semantic end-points
 - SPARQL Protocol and RDF Query Language - to query graph databases (Virtuoso)
 - GeoSPARQL - to query spatial-enabled graph databases (Virtuoso)
- Common APIs
 - OpenSearch 1.1 - to support searches and parsing of results via common search engines
 - Smart Points of Interest - to retrieve and analyse area characteristics and potential
 - Mediawiki API - to retrieve contextual information
 - GDELT API - to retrieve sentiment and event information
 - SenseLog API - to connect with sensor data

8.4 Technical components

This sub chapter describes the shared technical components that will be made available to instances of the Innovation Hub platform.

8.4.1 Development environments

The platform includes development toolkits, compilers and execution environments for the following programming languages:

- C/C++ for low-level programs that require high performance and low memory footprint
- Java for Java servlets, executable files
- Python for server applications and scripts
- Mono / .NET Core / C# for server applications, executable files
- PHP dynamically compiled language as module in httpd server
- JavaScript/Node.js framework to develop server applications using JavaScript as a language
- Jupyter “sand-box” environment for experimentation

8.4.2 Data management component

A data management component is required to load data into the platforms data stores. For some well-known formats, this can be an automated process. For heterogeneous user data sources, data management might require creation of custom per-data-source scripts.

Layman (API user interface through HS Layers NG), depends on GeoServer

For easy management, access control and publishing of geodata, the LayMan server tool will be used. The server will enable publishing of geospatial data. The server offers REST API. Two models are available:

- **layer**: visual representation of single vector dataset (i.e. Shapefile or GeoJSON)
- **map**: collection of layers

Accepts data in GeoJSON, Shapefile, Styled Layer Descriptor, Symbology Encoding, or HSLayers Map Composition format

- Even large files can be uploaded from a browser
- Asynchronous upload and processing
- Each vector dataset is automatically imported into PostGIS database
- Provides URL endpoints
 - Web Map Service (WMS)
 - Web Feature Service
 - thumbnail image

Web site: <https://github.com/CCSS-CZ/layman>

PgAdmin, regular data I/O

pgAdmin is an open-source administration tool for PostgreSQL, which is supported Windows, Linux and iOS. It provides SQL and bulk data loading access to PostgreSQL instances running on local or remote machines.

Web site: <https://www.pgadmin.org/>

QGIS and plugins for DIH

Freeware GIS software QGIS is used for creating and processing maps. QGIS is a multiplatform geographic information system that mainly allows analysing, viewing, creating, editing vector and raster geodata, among other functions. This functionality can be extended by plugins written in Python. Plugin for uploading maps prepared environment for working with map composites. The main idea is getting composites from a local computer to the server environment and make it easily accessible for users. The plugin follows functions implemented in the layman server. It uses layman's rest API and provides functions mainly for creating map compositions. The plugin can load existing compositions from the server or create a new empty composition in a local computer, edit, delete them and save back to the layman server. The plugin can also store vector layers without saving to composition to layman server. Every layer, whether it is in the composition or not, is sent as a vector layer in json format to layman server and then is available as a WMS service. The plugin also supports symbology. It generates an SLD file, that stores symbology of QGIS layer and sends it together with the layer to layman. Files bigger than 1MB are uploaded by parts. It allows to continue uploading if it fails. There is a restriction for layers to be uploaded. Only EPSG: 4326 and EPSG:3857 are allowed. Minimum QGIS version for running this plugin is 3.0.

Web site: <https://qgis.org/en/site/>

Virtuoso Conductor is the graphical user interface for management of data in Virtuoso. It has a broader functionality than RDF.

Web site: <http://virtuoso.openlinksw.com/>

SensLog is web-based sensor data management system. SensLog can receive, store, pre-process and publish sensor data from various sources. This solution uses its own data model implemented in PostgreSQL RDBMS with a PostGIS extension for spatial data. It can store any sensor data producing numerical values or VGI with multimedia contents. SensLog is suitable to store observations from static in-situ sensors as well as from mobile devices. SensLog uses several communications interfaces to receive and publish data. The most flexible interface is REST API with data JSON encoding, this interface covers most of the functionality. Standardized interface is represented by OGC Sensor Observations Service 1.0.0 core methods. Its ability to receive or publish data from/to different sources can be extended by a system of Connectors that are transforming data from various interfaces that can't be influenced to the common SensLog API and vice versa. SensLog is a modular solution than can be extended by different modules. One of the modules is VGI modules that is capable to receive VGI data with variable amounts of attributes and optionally added multimedia files. This module adds an additional profile to the core data model and extends common interface by web-services for receiving and publishing VGI data. SensLog can be deployed as a WAR file in a container web server (mainly Apache Tomcat or Jetty are used) or can be deployed using Docker.

Web site: <http://www.senslog.org/>

8.4.3 Analytics components

In addition to being able to read, create and ingest data from a variety of sources, it is also necessary to provide some tools that allow analysis and processing of data to derive knowledge or answers of some kind.

These components are grouped under the title *analytics* and will in part comprise libraries that enable analytics functionality through programming language bindings to one or more of the development environments described in chapter 7.4.1 above.

Analytics is here broadly defined and includes mathematical and statistical processing; artificial intelligence and machine learning; text mining and natural language processing as well as system dynamics and modelling technologies.

The technologies identified below are enough to realize all mathematical, statistical, geostatistical, artificial intelligence and machine learning requirements implied by the pilot requirements described in Chapter 3 above.

The components will include but may not be limited to¹⁵:

TensorFlow is an open source artificial intelligence library, using data flow graphs to build models. It allows developers to create large-scale neural networks with many layers. TensorFlow is mainly used for: Classification, Perception, Understanding, Discovering, Prediction and Creation

Web site: <https://www.tensorflow.org/>

Keras is an open-source neural-network library written in Python. It can run on top of TensorFlow, Microsoft Cognitive Toolkit, Theano, or PlaidML. Keras is designed to enable fast experimentation with deep neural networks.

Web site: <http://keras.io/>

R is a suite of software facilities for data manipulation, calculation and visualization. R has bindings for Python, Java, C# etc. It includes

- data handling and storage facility,
- operators for calculations on arrays, matrices,
- collection of intermediate tools for data analysis,
- graphical facilities for visualization
- programming language which includes conditionals, loops, user-defined recursive functions and input and output facilities.

Web site: <https://www.r-project.org/>

¹⁵ The decision will sit with each pilot. From the perspective of the DiH there must merely be a menu that includes all that is required. Most pilots will not need more than 1 or 2 of these

GRASS Geographic Resources Analysis Support System, commonly referred to as GRASS GIS, is a Geographic Information System used for data management, image processing, graphics production, spatial modelling, and visualization of many types of data. GRASS contains over 350 modules to render maps and images; manipulate raster, and vector data including vector networks; process multispectral image data; and create, manage, and store spatial data. GRASS GIS offers both a graphical user interface as well as a command line syntax.

Orfeo Toolbox is a library for remote sensing image processing. The project was initiated by the French space agency. The software is released under a free licence. It can process high resolution optical, multispectral and radar images at the terabyte scale. Applications include: ortho-rectification, pan sharpening, to classification, SAR processing. All OTB's algorithms are accessible from Monteverdi, QGIS, Python, the command line or C++.

Web site: <https://www.orfeo-toolbox.org/>

GDAL/OGR is a translator library for raster and vector geospatial data formats that is released under an X/MIT style Open Source License by the Open Source Geospatial Foundation. It presents a single raster abstract data model and single vector abstract data model to the calling application for all supported formats. It also comes with a variety of useful command line utilities for data translation and processing.

GDAL and OGR has bindings for C/C++, Java, Python and C#

Web site: <https://gdal.org/>

Business Prototyping Toolkit for Python (BPTK PY) is a framework to build and run simulation models using System Dynamics and/or agent-based modelling. It makes it possible to build simulation models in Python and create plots of the simulation results in Jupyter Notebooks – or run the simulation in Python.

The framework also includes the sdcc parser for *transpiling* System Dynamics models, conforming to the XMILE standard, into Python code. This means that models built in an XMILE environment (such as isee systems Stella, used by the System Dynamics activity in PoliRural) can be compiled to Python code and used for experimentation in Jupyter. BPTK-Py is licensed under the MIT license.

Web site: <https://www.transentis.com/products/business-prototyping-toolkit/>

PySD - *Simulating System Dynamics Models in Python* - is a simple library for running System Dynamics models in python, with the purpose of improving integration of Big Data and Machine Learning into the SD workflow. PySD translates Vensim or XMILE model files into python modules, and provides methods to modify, simulate, and observe those translated models.

Web site: <https://pysd.readthedocs.io/en/master/>

SimPy - *Discrete event simulation for Python* - is a process-based discrete-event simulation framework based on standard Python.

Processes in SimPy are defined by Python generator functions and may, for example, be used to model active components like customers, vehicles or agents. SimPy also provides various types of shared resources to model limited capacity congestion points (like servers, checkout counters and tunnels).

Web site: <https://simpy.readthedocs.io/en/latest/>

8.4.4 Metadata management system

Without proper documentation on the data offered, they have little application in analysis. Thus, the Innovation Hub platform includes a component to manage metadata.

MICKA (Any SQL based RDBMS + Virtuoso), PHP

MICKA is a complex metadata system. It includes a spatial metadata editor, metadata catalogue and metadata harvester. It supports the CSW 2.0.2 / INSPIRE discovery service. In addition to the CSW 2.0.2 / ISO-AP 1.0 profile it supports many output formats including HTML, PDF, JSON, GeoRSS, Atom, KML, OAI_PMH and OAI_MARC21. MICKA is responsible for storing meta-information about available data and supporting discovery of existing geospatial data and services. MICKA is a bridge to the current INSPIRE geoportal and services. MICKA supports internal management of geospatial data. It helps to keep certain consistency of data. Since the metadata profile is compliant with international standards, it is much easier to search data. In addition, if metadata are stored as RDF then it is possible to query datasets from many sources (for example “show all datasets that were published by Eurostat”, or more complicated query “show all datasets that were published in 2013 by Eurostat and are related to demographics”).

Functions:

- Spatial data metadata (ISO 19115)
- Spatial services metadata (ISO 19119)
- Dublin Core metadata (ISO 15836)
- Feature catalogue support (ISO 19110)
- OGC CSW 2.0.2 support (catalogue service)
- User defined metadata profiles
- INSPIRE metadata profile
- Web interface for metadata editing
- Multilingual (both user interface and metadata records). Currently 16 languages supported. It is possible to dynamically extend the system for other languages.
- Context help (multilingual)
- Import from the following metadata formats are supported:
 - FGDC CSDGM,
 - ISO 19139,
 - OGC services (WMS, WFS, WCS, CSW)
 - Feature catalogue XML
- Export – ISO 19139, GeoRSS, HTML, PDF, JSON, GeoRSS, Atom, KML, OAI_PMH and OAI_MARC2
- Support of thesauri and gazetteers.
- Display of changes with GeoRSS

- Template base interface with possibilities to change according to user requirements
- Possibility of deep cooperation with any of map clients for display of online map services

The MICKA instance provides the following functionality:

- editing and validation of INSPIRE metadata,
- import metadata from existing services like WMS, WFS, CSW, SOS and their editing and validation against the INSPIRE profile,
- advanced metadata search by several criteria,
- full discovery catalogue, supporting multi catalogue search.

Web site: <http://micka.bnhelp.cz/>

8.4.5 Visualization components

MapServer is an Open Source geographic data rendering engine written in C supported by OSGeo. Beyond browsing GIS data, MapServer allows you create “geographic image maps”, that is, maps that can direct users to content.

Most important features of MapServer:

- Advanced cartographic output
 - Scale dependent feature drawing and application execution
 - Feature labelling including label collision mediation
 - Fully customizable, template driven output
 - TrueType fonts
 - Map element automation (scale bar, reference map, and legend)
 - Thematic mapping using logical- or regular expression-based classes
- Support for popular scripting and development environments
 - PHP, Python, Perl, Ruby, Java, and .NET
- Cross-platform support
 - Linux, Windows, Mac OS X, Solaris, and more
- Support of numerous Open Geospatial Consortium (OGC) standards
 - WMS (client/server), non-transactional WFS (client/server), WMC, WCS, Filter Encoding, SLD, GML, SOS, OM
- A multitude of raster and vector data formats
 - TIFF/GeoTIFF, EPPL7, and many others via GDAL
 - ESRI shapefiles, PostGIS, ESRI ArcSDE, Oracle Spatial, MySQL and many others via OGR
- Map projection support
 - On-the-fly map projection with 1000s of projections through the Proj.4 library

GeoServer is an open source software server written in Java that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. Being a community-driven project, GeoServer is developed, tested, and supported by a diverse group of individuals and organizations from around the world.

GeoServer is the reference implementation of the Open Geospatial Consortium (OGC) Web Feature Service (WFS) and Web Coverage Service (WCS) standards, as well as a high performance certified compliant Web Map Service (WMS). GeoServer forms a core component of the Geospatial Web.

R might also be considered as a visualization component but is described above under chapter 7.4.3

8.4.6 System Dynamics and Semantic Microservices

There are dedicated applications in the PoliRural project for a Semantic Explorer and an authoring application for the creation of system dynamics models as well as a public cloud environment for publishing of finished models. These will be linked from individual pilots as well as from the Innovation Hub.

However, a critical threshold to the adoption of system dynamics and text-mining into a professional domain where these concepts at current may be said to be *foreign*, is to understand the potential benefits.

A few simple applications demonstrating key concepts of text-mining, named entity extraction, natural language processing, system dynamics and agent-based models will be included as part of the Innovation Hub. System dynamics models will only be included once

8.4.7 PoliRural virtual API

Rather than provide a new monolithic API, PoliRural will expose a *virtual API* that largely equals the sum of APIs exposed by underlying components in the reference architecture. There will be some custom extensions to this API that will be programmed solely for the purpose of PoliRural. These extensions will be utility methods that chain one or more of the underlying components in a tool chain for improved efficiency or simplified end-user experiences.

The API will be subject to restricted access as it has the potential to *bring down* the service provider instance if used indiscriminately or exceeding the dimensioning envisaged usage volume.

It will include but not be limited to:

- OGC services (WMS/WFS/C-SW)
- Map composition API
- MongoDB REST API
- Database access ODBC or native drivers over TCP/IP
- MapServer API
- GeoServer API
- R API

8.4.8 Client-side libraries and frameworks

To provide visualization UI and UX for end-user applications, the Innovation Hub platform includes a selection of client-side JavaScript libraries that are centered on user interfaces, visualization and data retrieval.

HSLayers NG is a JavaScript library which provides a foundation to build 2D and 3D web map user interfaces and components for managing map layers, searching and navigating maps, sharing, styling of vector features, adding and displaying OpenGIS® Web Map Service Interface Standard (WMS) layers etc. Together with Layman it can be used to add, store and visualize various data formats and display predefined analyses provided by backend services supporting OGC, Vega and other standards. It is integrated with Micka metadata catalogue, CKAN and Layman for listing and storing metadata and data about various data sources and map compositions.

Web site: <https://ng.hslayers.org>

WebGLayer is a JavaScript library focused on fast interactive visualization of big multidimensional spatial data through linked views. The library is based on WebGL and uses GPU for fast rendering and filtering. Using commodity hardware, the library can visualize hundreds of thousands of features with several attributes through heatmap, point symbol map. The library can render the data on the map provided by third party libraries (e.g. OpenLayers, Leaflet, Google Maps API).

The supported visualization techniques in v1.2.0 are:

- Histograms (rendered by d3.js)
- Point Symbol map (rendered by WebGL)
- Heat map (rendered by WebGL)
- Parallel coordinates (rendered by WebGL)

The library supports interactions:

- Filter by attribute (brush and link)
- Filter by polygon (polybrush)
- Filter by colour of a heatmap (in order to select a hotspot)

Web site: <http://webglayer.org/>

Vega is a declarative language for creating, saving, and sharing interactive visualization designs. It is used to describe the data, visual appearance and interactive behaviour of a visualization in a JSON format, and with the help of libraries supporting Vega syntax generate web-based interactive charts and export them as images. Vega chart descriptions can be generated by backend microservices in an independent way from the platform where the visualization will later be integrated into.

Web site: <https://vega.github.io/vega/>

D3 (also known as D3, short for Data-Driven Documents) is a JavaScript library for producing dynamic, interactive data visualizations in web browsers. It makes use of Scalable Vector Graphics (SVG), HTML5, and Cascading Style Sheets (CSS) standards. D3 sits under the hood of Vega

Web site: <https://d3js.org>

Crossfilter is a JavaScript library for exploring large multivariate datasets in the browser. Crossfilter supports extremely fast (<30ms) interaction with coordinated views, even with datasets containing a million or more records. It is built to power analytics for Square Register, allowing merchants to slice and dice their payment history fluidly. Since most interactions only involve a single dimension, and then only small adjustments are made to the filter values, incremental filtering and reducing is significantly faster than starting from scratch. Crossfilter uses sorted indexes (and a few bit-twiddling hacks) to make this possible, dramatically increasing the performance of live histograms and top-K lists.

Web site: <https://crossfilter.github.io/crossfilter/>

Turf is an advanced geospatial JavaScript open source library that allows you to do spatial operations in the browser or in server-side applications built using *node.js* environment. Turf helps you analyse, aggregate, and transform data to visualize it in new ways and answer advanced questions.

Web site: <https://turfjs.org>

Angular is a client-side web application development framework that provides an abstraction layer between barebones JavaScript and the developer. The most recent versions of Angular are based on Typescript. Originally introduced by Google, Angular was completely rewritten by a large community of users.

Web site: <https://angular.io>

React is a JavaScript library for building user interfaces and can be used as a base in the development of *single-page* applications, as it is optimal for fetching and displaying rapidly changing data. It is maintained by Facebook and a community of individual developers and companies. It is in some ways comparable to Angular.

Web site: <https://reactjs.org>

8.5 Presentation layer

The presentation layer is where all components that expose a public user interface are placed in the reference architecture.

8.5.1 CMS module

Liferay Portal is an open source full featured enterprise Java portal, enabling deployment of Java portlets, management of users and plenty of other user tools and applications. Liferay Portal uses Java SDK as its runtime environment, PostgreSQL as a database and is using Apache

Tomcat as a servlet container. Liferay Portal offers strong and rich CMS offering fine tuning of user access rights, integrates simple yet powerful WYSIWYG editor that everyone can edit news, articles or other content even without knowledge of HTML. Liferay Portal integrates Document gallery where documents, images and other files can be uploaded for linking in the CMS. Liferay Portal is highly customisable using templates and scripting. Deployment of portlets on each page is managed using a web browser without any need of coding. Security and user management is one of key functionalities of Liferay Portal and is essential to fine tuning of user access rights across the whole Liferay Portal components. Users after self-registration have only the very minimum level of access, they need to work with the component they need. Raised access rights need to be approved by the administrator. This is very essential for the overall portal security. Having editing rights for one component does not mean that user can edit all components. This is allowing for having the Liferay Portal under full control.

8.5.2 Collaboration module

Wiki (Liferay Wiki) is a Liferay Portal portlet aimed at providing services of wiki information publication. It contains a simple HTML editor that everyone with respective rights can add wiki content - short article, message, etc. Wiki portlet supports subscription function, users can subscribe and get notifications on updates in the areas they are interested in. Wiki articles can also be shared using social networks and accessed using RSS/ATOM feed.

Forum/Discussion board (Liferay Message Board) is another Liferay Portal portlet providing discussion functionality. It is structured in topics and threads. Its structure of topics and threads is defined and maintained by the administrator. Users after registration (and optional verification by portal administrator) can subscribe to a thread they are interested in and can also add a new message or reply to an existing one. Authors of threads are notified by email about any update of the thread they have created. Linking to social networks and access via RSS/ATOM are also available.

8.5.3 MOOC module

Dissemination of knowledge and training forms an important part of securing the adoption of PoliRural methodologies and technologies. As a vessel for online training, the project has chosen to emphasize Massive Open Online Courses (MOOC).

A MOOC is an online course aimed at unlimited participation and open access via the web. In addition to traditional course materials, such as filmed lectures, readings, and problem sets, MOOCs may provide interactive courses with user forums to support community interactions among learners and trainers. A MOOC platform typically also provides features like immediate feedback to quick quizzes and assignments. The MOOC platform that has been chosen by PoliRural is Moodle.

Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments. This is an Open Source environment that is distributed under the GNU General Public License. It provides a complete user experience and tools targeted both at trainers/learners etc.

8.5.4 Development space of demonstration and pilot applications

Each of the pilots has slightly different policy challenges as described in Chapter 3 above. They will however be implemented according to a shared methodology and will take as a starting point a shared set of building blocks that they will use to put together their solutions. Each pilot will create its own instance of the Innovation Hub shared platform with such components as they require (selecting from the reference architecture) to power their interaction, analytical and visualization needs. At the time of designing the individual pilots, a mapping from each pilot to the components included in the DiH will be made.

8.5.5 Cloud hosting module

OpenStack is the leading open source technology for building and managing cloud services. It supports integration of various HW infrastructure into a single virtual environment with a single management interface. It supports many types of services that can be deployed across the physical infrastructure, virtual servers are just one of them. OpenStack supports high scalability of infrastructure, grouping and isolation of all its parts and full control over all the components. OpenStack integrates all the HW resources available, balancing them equally loaded, however is always leaving full control to administrators should they request to adjust anything manually.

For the PoliRural infrastructure OpenStack is used and special management group for PoliRural is created that the rest of OpenStack infrastructure is fully isolated and only PoliRural staff can access the PoliRural stack.

8.5.6 Web server

Apache Tomcat Servlet Container server as an application server for Liferay Portal. It is a simple yet full featured and highly customisable reference implementation of JSP technology, widely used by Java developers who need to provide web interface to their applications. Tomcat is the most spread servlet container with millions of users worldwide.

In the PoliRural deployment stack Tomcat is running on top of OpenJDK 11 and is hidden behind an Apache Web Server reverse proxy which is responsible for port translation and TLS termination.

Apache Web Server is the most used web server worldwide. It supports all kinds of deployments from a single installation to huge load balancing environment with dozens of installations. Apache Web server is very robust and regularly updated by its open source community.

For PoliRural deployment the Apache Web Server is the very first frontend. The Apache server as a reverse proxy and is also responsible for TLS termination. All other web servers are hidden behind the Apache reverse proxy and the traffic to the backend servers is driven by the reverse proxy according to the rules defined. The reverse proxy concept also helps in optimised use of IP addresses pool as only one public IP address is needed for the whole infrastructure, the rest of the infrastructure is hidden behind NAT on a local network. The Apache Web Server is in version 2.4 compiled with OpenSSL 1.1.1 and nghttp2 enabled to support HTTP/2 and TLS 1.3

protocols. These new protocols enable faster connection establishment, lower overhead of traffic and higher security.

8.6 Public end-points

The upper layer drawn in the reference architecture is home to the public end-points that may be reached by users on the Internet.

8.6.1 Central service provider node

The most visible component of the Innovation Hub will be the content management system and web site that sits in the central service provider node. A mock-up of the principal functions of this end-point is described in chapter 8 Wireframe below.

8.6.2 Public PoliRural API

The PoliRural virtual API is described above in chapter 7.4.7 PoliRural virtual API. A portion of this API will be exposed over public Internet so that it is reachable from pilot instances that run from legacy data centres outside the PoliRural Cloud provider.

8.6.3 Pilot instances

Finally, public end-points include the pilot instances of the innovation hub platform. The exact content of these is not known at this stage since the elaboration of pilots is taking place in parallel and is due for a deliverable later.

The most important aspects of pilots from the perspective of the Innovation hub is to capture their technical requirements to ensure that the platform is flexible enough to accommodate any detailed pilot plan that may result from the specialization of the high-level pilot descriptions.

9 Wireframe mockup

The following is a non-designed wireframe mock-up of the Innovation Hub web site and the relationship between the hub web site and the individual pilot applications that will result from the project. These sketches will be subject to graphical design, interaction design and will also be embedded within a content management system that will provide identity, navigation and content authoring capabilities to the system.

9.1 Home page

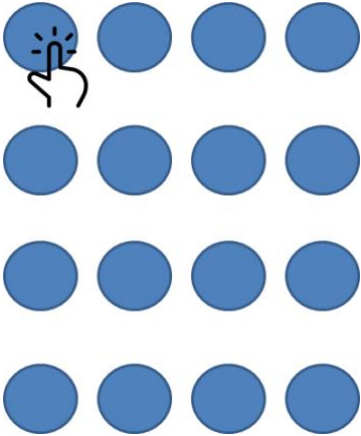
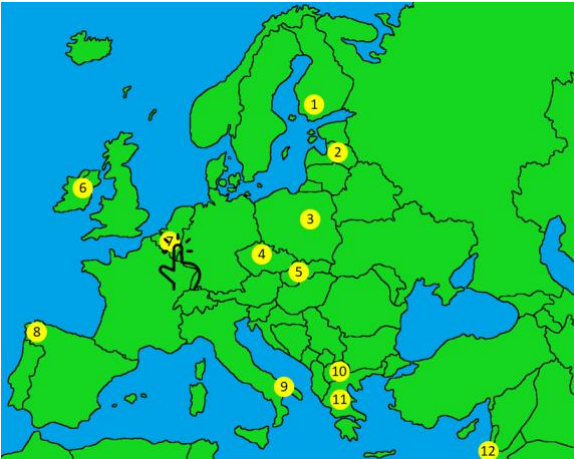
Option A: 12 study areas are presented as a block	Option B: 12 study areas are displayed on a map
	

Figure 12 Study areas as a bloc and on a map

9.2 Pilot page

1) A gallery showing each region's landscapes. Pilots to provide 5-10 images that capture their rural assets. The question is - do we want to show only 'nice' visuals or 'bad' ones too e.g. derelict houses, flooding, drought, abandoned villages, pollution? Perhaps the initial gallery can contain only nice visuals. Then, as soon as needs gathering is complete, pilots may wish to add some visual examples of the problems they face.



Figure 13 Region landscape

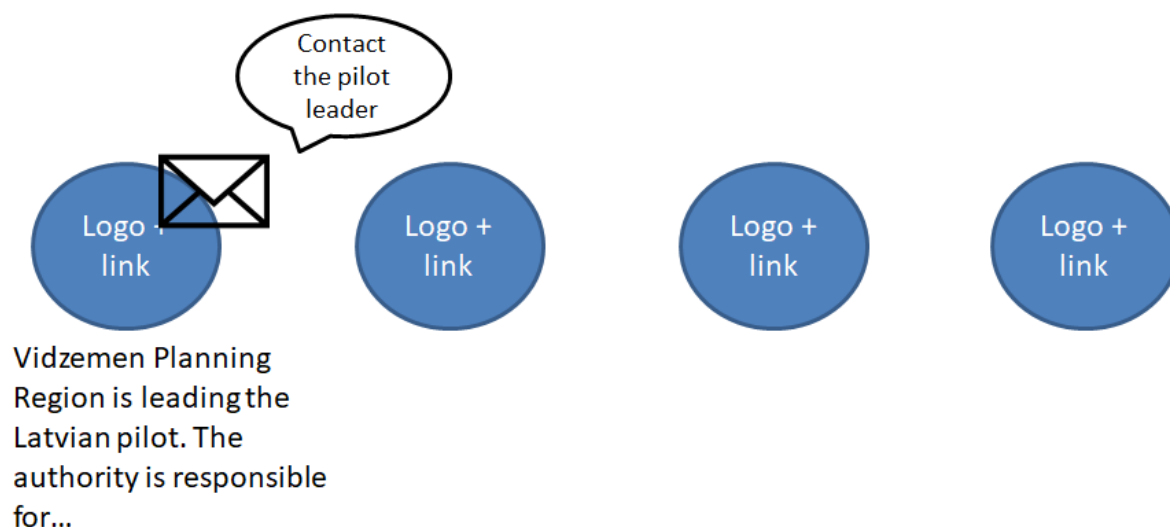
2) One paragraph to set the context. Pilots to review descriptions provided in DoA and send updated version if necessary. Below is an Irish example that needs to be reviewed.

“Monaghan County is a mainly rural Irish county characterised by relatively small farm holdings but is well supported by a strong agri-food sector with major companies operating in the county and a strong emphasis on the export market. Monaghan attracts many new people from abroad because it is a pristine rural area with a strong community ethos, well-established farming support services and strong CAP subsidies. However, there are many negative factors: it is situated far from larger urban areas, land prices are high, new communities that settle in Monaghan often struggle to find suitable employment, there is a lack of good-quality broadband and public services. Monaghan residents can avail of several support measures, some of which are national, some are specific to the county. However, there are currently no county-level services tailored to newcomers without a farming background. For that reason, the Irish pilot aims to introduce a new service called “I want to become a farmer” during mission orientation. The service will be targeted at (a) Irish people without a farming background, (b) new community members who may be interested in pursuing a career in farming, (c) people who have immigrated to Ireland from other countries, including from Central and Eastern Europe.”

3) Pilot team showing a lead partner and other beneficiaries. All pilots must provide high-res logo and a 3-5 sentence description of their organisation plus role in the project. Links to partner websites and contact information (for lead partner only) are important. Additionally, supporting organisations can be mentioned as per DoA i.e. those who signed the LoS. Pilots to

confirm with these 'third parties' if they want to be mentioned on the Innovation Hub. Then we can insert their logos and links.

Pilot team



Supporting organisations



Figure 14 Pilot team and Supporting organisations

4) Pilot stakeholder panels are created for the duration of the project and it would be good to reflect them on each pilot site. The panel's role should be briefly described (to provide input to PoliRural research, evaluation, foresight and modelling activities). Statistics on current composition should be provided. An option to become a member should be made available.



Policy makers

16



Long-term farmers

157



New entrants

36



Experts

25

Want to join Vidzeme
panel? [Click here](#)

Figure 15 Pilot Stakeholder panels

5) Forum where registered users can discuss issues relevant to the pilot. This can be a place to crowdsource information from users e.g. on things that worry them most? On issues they would like to see addressed first? Discussions in a native / regional language are welcome.

6) Progress bar can help orient the user in terms of what the pilot was doing, what is happening now and what will happen in the future. While the structure of the bar will be the same for all pilots, its content will differ from pilot to pilot. A dynamic front end with a pre-determined colour scheme can be used to differentiate past, present and future, like in the graphic below.

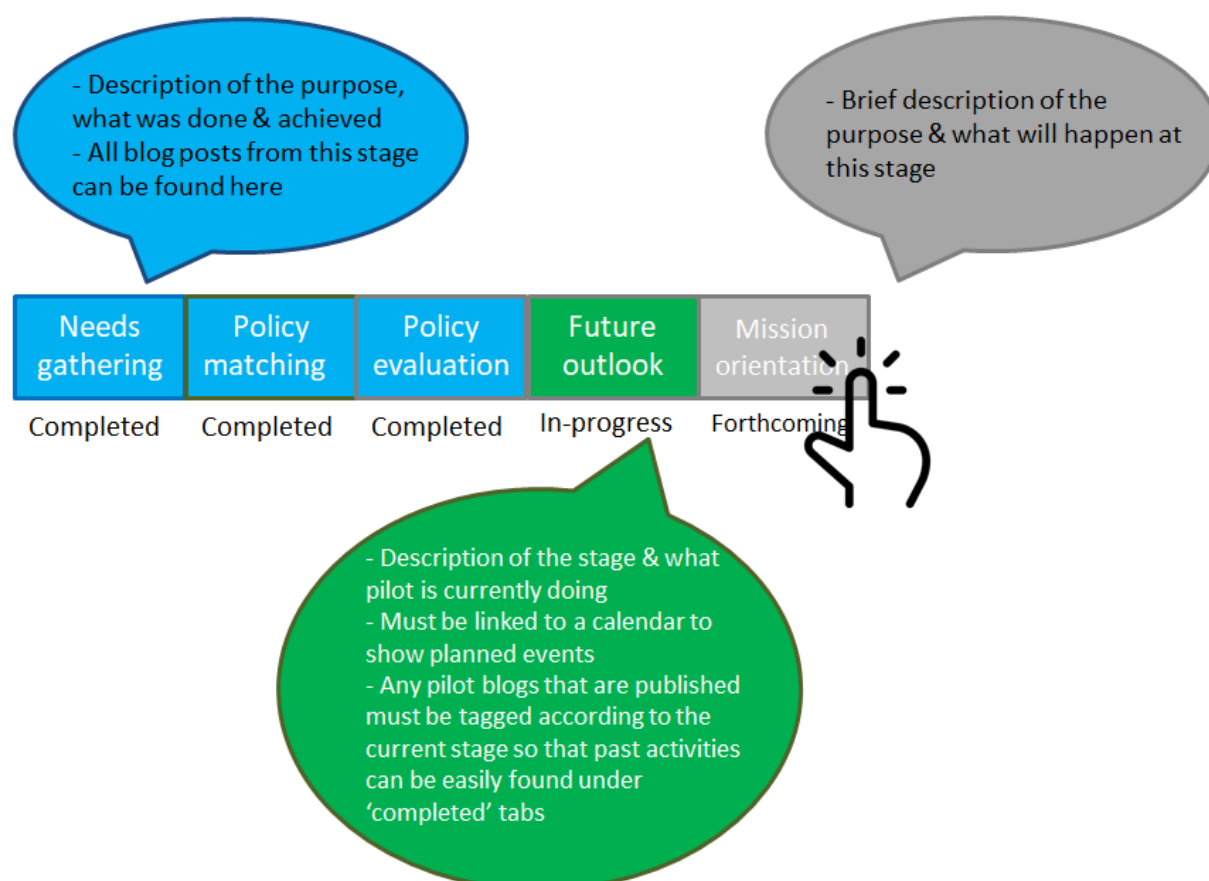


Figure 16 Progress bar

7) Calendar showing all forthcoming pilot activities (focus groups, foresight workshops etc.). The calendar is to be updated regularly by site administrators / pilot leaders.

10 Testing

Because finding representative users may be too time-consuming and expensive, the initial testing to be undertaken will be done internally. This will allow the PoliRural Tech Team to obtain quick feedback on the Innovation Hub's usability without spending too much effort on recruiting testers that closely resemble PoliRural end users. Having said that, PoliRural acknowledges that while internal testing has its uses, the second round of usability testing must focus more on external validity and that is something that can only be obtained by involving people who are valid approximations of real users.

PoliRural will consider both moderated and unmoderated approaches. Typically, moderated tests are only necessary for incomplete interfaces or in instances where security is a primary concern. Unmoderated tests, on the other hand, are more flexible, as the user needs only to log in and perform the designated tasks at their convenience. In both cases, the focus will be on people and their experiences with the Innovation Hub rather than technology per se.

As the name suggests, moderated testing refers to activities involving a moderator who assists the tester by answering questions, giving instructions, showing a demo etc. This puts more control in the hands of the Tech Team, but it adds significant logistical challenges for both the testers and the users, especially if the tests are conducted in-person.

Moderated tests could be organised at the project's General Assemblies or other events when all or most partners are present. Alternatively, the Tech Team may wish to conduct such testing over Skype or Adobe Connect. This option is particularly appealing given that PoliRural partners are spread across multiple countries in Europe and beyond.

PoliRural will record moderated tests with end users whenever possible and in accordance to all applicable ethical and privacy requirements.

Once the tests have been conducted and initial results processed, the process of review and implementation will start. The way in which this will be done may vary depending on what type of data was gathered and what the initial objectives were.

At this stage, a user journey map could be used. A journey map provides a visual overview of the different steps user testers took throughout their journey while browsing the hub. It will include emotional parameters as well as usability issues encountered by testers.

Journey maps are especially useful at the conclusion of usability tests because they help unveil hidden insights. After creating a few journey maps, the trends will start to become more apparent and areas of potential improvement easier to visualize.

11 Recommendation for implementation

The DiH Specification was defined:

- On the base of previous experiences of the technical team
- On the base of questioners of pilots, where pilots expressed their preliminary needs

The DiH development will be based on Agile methodology with strong feedback from pilots, but it will also partly introduce principles of stimulated demand, where new approaches and methods will be demonstrated. It is also necessary to consider the questionnaires with preliminary information from the pilots, keeping in mind that the first complete user needs report will be available in M6. For this reason, the technical team recommends:

- To prepare an update of this plan for internal purposes in M9 to synchronize the preparation of pilots with the current state of the DiH
- Simultaneously, the first version of applications required by pilot partners will be published in accordance with this deliverable
- To update this plan in M12, M15 and M18 to reflect evolving pilots' requirements. these updates of the plan will be part of or reports D3.2 Innovation Hub: Second Release and D3.7 PoliRural GitHub Account

The proposed way forward is in line with AGILE development principles and will also support adaptation of the DiH to evolving needs throughout the design of the pilots through continuous interaction and feedback.

All development will be managed using Redmine as a collaborative tool. Redmine will provide the following functions:

- Control the planning and execution of the implementation and manage and prioritize changes based on evolving projects needs
- Reporting of bugs in the system and supporting testing and communication between technical teams and users
- Effective management and overview from the perspective of the project coordinator

For the proposed development stage leading up to M9, a simplified development plan is proposed below. This document will be updated for internal purposes in M9 and extended with a plan for the coming 3 months reflecting planned sprints in the interim.

For the implementation of the first stage the following steps have been defined (detailed plans per component will be published internally on Redmine as it is principally of interest to developers and technical personnel¹⁶):

- M5: Monthly sprint 1
 - Platform is implemented in initial version
 - Storage is implemented in initial version
 - Internal Data Sets are integrated (OLU, SPOI, OTM and for NUTS3 are covering the whole Europe)
 - First detailed mock up for DiH is prepared

¹⁶ Access to Redmine is available for reviewers

- M6: Monthly sprint 2
 - OLU database will be updated at least for 10 countries
 - For at least 1 country OLU will be extended about additional parameters related to Land Use/Land Cover changes and climatic data
 - Additional NUTS parameters will be collected
 - Sensor Web, Metadata, Data Management Tools are implemented
 - LOD data from PSNC is connected
 - First Demo Apps will be released demonstrating utilisation of Exploratory visualization for comparison of EU NUTS3 regions
 - First release of CMS and Collaborative environment (English version only for the first year)
- M7: Monthly sprint 3
 - MOOC platform will be implemented (English version)
 - First APIs for accessing geospatial data implemented
 - API for text mining is implemented
 - Set of 20 maps demonstrating different parameters on European level are ready
 - Detailed maps for at least 3 countries based on OLU are prepared
 - OLU extension for 5 countries will continue
 - Update of OLU for pilot regions and build OLU in remaining countries
- M8: Monthly sprint 4
 - Start of analytical tools and tools for AI implementation
 - Development environment for pilots is implemented
 - Detailed exploratory visualization based on OLU data is prepared for at least 3 countries
 - Training camps for pilots is organised
- M9: Monthly sprint 5
 - Analysis of development is realised
 - First feedback from users is collected
 - Analysis of new requirements is done
 - Update of plan

This plan of monthly sprints guarantees, that pilots run their analysis in an early stage of the project. The detailed back-log for each sprint is prepared in cross-partner developer meetings and is distributed among developers as self-contained tasks (as far as possible).

12 Conclusion

This chapter summarizes the purpose and main conclusions of this deliverable as a base line for the subsequent implementation and release of the DIH.

This document sets out the context of the Innovation Hub within the project and in relation to other technical deliverables. Care has been taken to establish a clear divide between the functions of the different applications to avoid duplication and overlap.

D3.1 analyses each pilot to the degree that it is described at this stage, taking into consideration that the specific technical requirements of pilots may evolve in the design phase that continues beyond the finalization of this document.

At this stage it is more important to elicit the dimensioning requirements of the platform than it is to know the details of each individual pilot. Thus, great attention has been paid to type, nature and volume of data as well as explicitly mentioned and implicit requirements for storage, analytics and visualization.

In addition to serving the pilots, the Innovation Hub is a web site acting as an umbrella for four different information spaces:

1. An interaction space for communicating among stakeholders
2. A learning space for increased knowledge sharing through online courses
3. An experimentation space for trying out new things with real data
4. A development space for creating new virtual instances of the Innovation Hub platform for building independent pilot applications based on a set of shared building blocks consisting of components, services and data

The requirements of this centralized web site that have been analysed and determined by the authors of this deliverable, has been added to the requirements elicited from the pilots to arrive at a technical platform that can solve both scenarios.

Based on 20+ years of experience in international cooperation projects we are aware that monolithic solutions do not fit all purposes. For some, a new platform can be introduced - for others a legacy platform must be respected and extended in order to arrive at the desired functionality.

The Innovation Hub reference architecture can therefore be implemented by pilots in two different ways:

- Through virtual machines hosted in the PoliRural Private Cloud Hosting environment (based on OpenStack)
- Through their own decentralized servers (virtual/physical) communicating with the central service provider instance through a public end-point of the PoliRural API

Both implementations will be able to draw on the shared components that will be made available for ease of deployment as a Docker image repository.

When it comes to components, we have chosen to be inclusive and open rather than restrictive. Instead of forcing pilots to choose between e.g. one or the other map server applications, both are included as optional components. Instead of forcing everyone to convert their data into e.g. a graph structure, we offer three parallel data stores - one document oriented (MongoDB), one relation oriented (PostgreSQL) and one graph (Virtuoso).

Furthermore, we have emphasized that all components shall be free Open Source Software or otherwise be distributed under a license that does not propagate conditions that limits the use of products based on the platform for commercial purposes.



D3.1 Innovation Hub Technical Specification ANNEXES

13 ANNEX A

Table 13.1 - A.1: Data directly available on pilot - Pilot 1 Flanders, Belgium

Data directly available on pilot	Download or API address	License	Type of data/format
Statistics Belgium	https://github.com/weRbelgium/BelgiumStatistics	no	R data cubes
SDI Flanders	https://github.com/informatievlaanderen	no	Py compatible
GEO Flanders	https://github.com/DOV-Vlaanderen	no	R compatible
Remote Sensing Data	https://terrascope.be/en	Free registration	Jupyter compatible
Climate data	/geoserver/ows?service=wfs&version=2.0.0&request=GetCapabilities /geoserver/ows?service=wms&version=1.3.0&request=GetCapabilities	Free	WMF/WFS service Geoserver

Table 13.2 - A.2: Data directly available on pilot - Pilot 2 Monaghan, Ireland

Data directly available on pilot	Download or API address	License	Type of data/format
Monaghan Integrated Development programmes and work	www.midl.ie	Open source	Mainly textual.
Monaghan Integrated Development programmes based on Rural Community	www.midl.ie/index.php/programmes	Open Source	Textual/various

Development Principles			
Monaghan Local Development Strategy – Rural Development programme 2014 – 2020,	https://www.midl.ie/images/Documents/LEADER-LDS-for-Co-Monaghan-2014-2020---Amended-March-16th-2016.pdf	Open Source	Textual/PDF
Monaghan County Development Plan 2013 – 2019,	https://monaghan.ie/planning/monaghan-county-development-plan-2013-2019/	Open Source	Textual/PDF
County Monaghan Heritage Plan 2012 – 2017.	https://monaghan.ie/heritage/wp-content/uploads/sites/13/2016/11/County_Monaghan_Heritage_Plan_2012-2017.pdf	Open Source	Textual/PDF
Monaghan County Council web resources and statistics	https://monaghan.ie/communitydevelopment/monaghan-economic-community-monitor/	Open Source	Textual/various
County Monaghan Landscape Character Assessment	https://monaghan.ie/planning/landscape-character-assessment	Open Source	Textual/PDF
Monaghan Women in Business	http://www.monaghanwib.com/	Open Source	Textual/various
History of Agriculture in Monaghan,	https://monaghan.ie/museum/wp-content/uploads/sites/2/2016/11/2013Folklife72pagescorrected.pdf and https://www.cso.ie/en/releasesandpublications/ep/p-1916/1916irl/economy/ag/	Open Source	Textual/various
Co Monaghan Public Participation Network (PPN),	https://ppnmonaghan.ie	Open Source	Textual/various

NEWBIE project	http://www.newbie-academy.eu www.newbie-academy.eu/storytelling	Open Source	Textual/PDF/video/various
Irish Young Farmers Training programme	www.macra.ie/news-macra-launch-young-farmer-training-programme-211.html	Open Source	Textual/various
"Europe's new farmers Innovative ways to enter farming and access land"	https://www.accesstoland.eu/IMG/pdf/a2l_newentrants_handbook.pdf	Open Source	Textual/PDF
National Reserve funds for 'Young Farmer' and 'New Entrant to Farming' in Ireland.	https://www.agriculture.gov.ie/farmerschemes/payments/capentitlementsrelatedinformationandapplicationforms/2019nationalreserveandyoungfarmersscheme/	Open Source	Textual/various

Data sources relevant to the Monaghan Irish Pilot:

ANNEX I to Pilot 2 Monaghan

Table 13.3 - A.3: Data directly available on pilot - Pilot 3 Galicia, Spain

Data directly available on pilot	Download or API address	License	Type of data/format
Park Visitors	No	Private	DBF, RDF (?)
Use of apps (there will be different tools and apps... each one will have their specific Log)	No	Private	DBF, RDF (?)

Table 13.4 - A.4: Data directly available on pilot - Pilot 4 Vidzeme, Latvia

Data directly available on pilot	Download or API address	License	Type of data/format
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N/A

In Vidzeme region are only available data through third parties.

Table 13.5 - A.5: Data directly available on pilot - Pilot 5 Mazowieckie, Poland

Data directly available on pilot	Download or API address	License	Type of data/format
Information about voivodship (Statistics)	https://warszawa.stat.gov.pl/dane-o-wojewodztwie/wojewodztwo/informacje-o-wojewodztwie/	no	Textual/PDF
Demography (Statistics)	https://warszawa.stat.gov.pl/dane-o-wojewodztwie/wojewodztwo/ludnosc/	no	Textual/PDF
Labour market. Income of the population (Statistics)	https://warszawa.stat.gov.pl/dane-o-wojewodztwie/wojewodztwo/praca-dochody-ludnosci/	no	Textual/PDF
Regional Government	https://www.mazowieckie.pl/	no	Textual/PDF

NATIONAL AGRICULTURAL SUPPORT CENTRE	http://www.kowr.gov.pl/	no	Various formats
Mazovian Agricultural Advisory Centre	https://www.modr.mazowsze.pl/	no	Various formats

Table 13.6 - A.6: Data directly available on pilot - Pilot 6 Central Bohemia, Czech Republic

Data directly available on pilot	Download or API address	License	Type of data/format
Statistical Yearbook of Central Bohemian Region 2018 - Agricultural data	https://www.czso.cz/csu/czso/11-zemedelstvi-8ksclawere	Free	xls, pdf
Central Bohemian Region Authority	https://www.kr-stredocesky.cz	N/A	various formats
Ministry of Agriculture	http://eagri.cz/public/web/mze/	N/A	various formats
Ministry of the Environment	www.mzp.cz	N/A	various formats
Ministry of Education, Youth and Sports	www.msmt.cz	N/A	various formats
Ministry of Regional Development	www.mmr.cz	N/A	various formats
Regional Information Centre of the Central Bohemian Region	http://www.kis-stredocesky.cz/	N/A	various formats
Institute of Agricultural Economics and Information	https://www.uzei.cz/	N/A	various formats

Research Institute for Soil and Water Conservation	https://www.vumop.cz/en	N/A	various formats
Agricultural Association of the Czech Republic	https://www.zscr.cz/	N/A	various formats
Local Action Groups of the Central Bohemian Region	http://stredocesky.nsmascr.cz	N/A	various formats
Central Bohemia Tourist Board	https://www.centralbohemia.cz	N/A	various formats

Table 13.7 - A.7: Data directly available on pilot - Pilot 7 Nitra, Slovakia

Data directly available on pilot	Download or API address		License	Type of data/format
Portal of the Agricultural Advisory System	http://agroporadenstvo.sk/	Free	HTML	Agroinstitut Nitra
Land register	https://zbgis.skgeodesy.sk	Free	Various	Viediecky Parlament (VIPA SK)
Statistical survey in the SR	https://slovak.statistics.sk/	Free	HTML	Viediecky Parlament (VIPA SK)
Jobs opportunities in region Nitra	https://www.profesia.sk/praca/nitriansky-kraj/	Free	Various	Viediecky Parlament (VIPA SK)

Table 13.8 - A.8: Data directly available on pilot - Pilot 8 Hame, Finland

Data directly available on pilot	Download or API address	License	Type of data/format
Population reports	https://www.hameenliitto.fi/fi/tilastot		Statistics
HAMK's registers (student,..)			Register

Official statistics of Finland including Rural livelihoods (farming but also other source of income)	http://www.stat.fi/index_en.html		Statistics
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Table 13.9 - A.9: Data directly available on pilot - Pilot 9 Central Greece, Greece

Data directly available on pilot	Download or API address		License	Type of data/format
dspace.aua.gr (database)	http://dspace.aua.gr/xmlui/handle/10329/9	Copyright © 2019 library.aua.gr.	PDF	Agricultural University of Athens (AUA)
library.aua.gr (database)	http://library.aua.gr/index.php?option=com_content&view=article&id=83&Itemid=12&lang=en	Copyright © 2019 library.aua.gr.	PDF	Agricultural University of Athens (AUA)
News/ articles about agricultural and rural development issues	https://www.ypaithros.gr/en/		text	Neuropublic (NP)
News/ articles mainly for agricultural issues and rural development issues	https://agrotipos.gr/		text	Neuropublic (NP)
News/ articles about agricultural, rural development and related economic issues	https://www.agrocapital.gr/		text	Neuropublic (NP)
News/ Information/ Consulting about innovation in	https://www.agrotomi.gr		text	Neuropublic (NP)

agriculture and related subjects				
News/ articles about agricultural and rural development issues in the region of Central Greece	https://stilida.com/		text	Neuropublic (NP)
“Digital school” Information, training in related issues of agriculture and rural development	https://agronomist.gr/		text	Neuropublic (NP)
New about agriculture, innovation, EU/CAP, etc	http://agrotres.eu/		text	Neuropublic (NP)
Official page of Central Greece Municipality	https://pste.gov.gr/		text	Neuropublic (NP)
A twitter account posting about innovation in agriculture and related subjects (@agrotomi)	https://twitter.com/agrotomi Twitter API	Twitter license	JSON/text	Neuropublic (NP)
A twitter account posting about agriculture issues (EU requirements, (@agrosimvoulos)	https://twitter.com/agrosimvoulos Twitter API	Twitter license	JSON/text	Neuropublic (NP)
A facebook account posting relevant information for agriculture issues (problems in	FB API https://el-gr.facebook.com/neoiaagro/	FB license	JSON/text	Neuropublic (NP)

cultivation, warnings, crop protection, subsidies etc)				
Greek Agriculture (FB)	FB API https://el-gr.facebook.com/agroteselladas	FB license	JSON/text	Neuropublic (NP)
Region's municipalities boundaries	http://sterea.crowdapps.net/node/151?language=el	Public	kml	PERIFEREIA STEREAS ELLADAS (RSE)
Several environment datasets	http://sterea.crowdapps.net/group/perivallon?language=el	Public	Csv, json, rdf	PERIFEREIA STEREAS ELLADAS (RSE)

Table 13.10 - A.10: Data directly available on pilot - Pilot 10 Apulia, Italy

Data directly available on pilot	Download or API address	License	Type of data/format
LAG Murgia + 2007-2013 intervention database	NN	NN	Various
Confagricoltura associated databases	NN	NN	Various

Table 13.11 - A.11: Data directly available on pilot - Pilot 11 Gevgelija-Strumica, FYROM

Data directly available on pilot	Download or API address	License	Type of data/format
AgFutura Technologies	https://agfutura.com/	Free	PDF format
Green Growth Platform	https://greengrowth-platform.org/	Free	PDF format

Table 13.12 - A.12: Data directly available on pilot - Pilot 12 Galilee, Israel

Data directly available on pilot	Download or API address	License	Type of data/format
MIGAL's & Northern R&D's activities with farmers	www.migal.org.il http://www.mop-zafon.org.il/en	Free without restriction	Web
Galilee Agricultural Company	https://www.galil-elion.org.il/%D7%94%D7%97%D7%91%D7%A8%D7%94-%D7%9C%D7%97%D7%A7%D7%9C%D7%90%D7%95%D7%AA	Free without restriction	Web
Upper Galilee Regional Council	http://www.biowaste-scow.eu/Upper-Galilee-Regional-Council-Israel	Free without restriction	Web
Ministry of agriculture	https://www.moag.gov.il/en/Ministrys%20Units/Spokesmanship%20and%20Publicity%20Department/publications/Publications_18/Pages/farmings_young_generation-.aspx	Free without restriction	Web
Kirur Galil	https://www.youtube.com/watch?v=NP_h6R6zAlk	Free without restriction	Web

14 ANNEX B

Table 14.1 - B.1: Data available through third parties - Pilot 1 Flanders, Belgium

Data directly available on pilot	Download or API address	License	Type of data/format
Statistics Belgium	https://github.com/weRbelgium/BelgiumStatistics	no	R datacubes
SDI Flanders	https://github.com/informatievlaanderen	no	Py compatible

GEO Flanders	https://github.com/DOV-Vlaanderen	no	R compatible
Remote Sensing Data	https://terrascope.be/en	Free registra tion	Jupyter compatible
Climate data	/geoserver/ows?service=wfs&version=2.0.0 & request=GetCapabilities /geoserver/ows?service=wms&version=1.3.0 & request=GetCapabilities	Free	WMF/WFS service Geoserver

Table 14.2 - B.2: Data available through third parties - Pilot 2 Monaghan, Ireland

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
Official Government socio economic statistical data on Ireland	Irish Central Statistics Office (CSO)	https://www.cso.ie/en/index.html	Mainly open source	Various
Irish Population Census	CSO	http://data.cso.ie/ https://www.osi.ie/resources/osi-census-2016-open-data/ Settlements in Monaghan, http://census.cso.ie/sapmap2016/Results.aspx?Geog_Type=ST2016&Geog_Code=A835224B-B92B-4F96-BCA4-0A548751442B	Open Source	Linked Open Data
Irish Open Data portal of most official resources in Ireland.	Irish Government	https://data.gov.ie/	Open Source	Various

Ireland's public good mapping resources, information & tools, to help understand the dynamics of local areas, counties, regions and the cross-border area of Ireland.	Irish All-Island Research Observatory (AIRO)	http://airo.maynoothuniversity.ie/mapping-resources/overview -	Open Source	Various
Irish maps, townlands and data/services.	OSM Ireland	https://www.openstreetmap.ie https://www.townlands.ie	Open Source	OSM
GeoHive - Irish INSPIRE GeoPortal.	Ordnance Survey Ireland	https://geohive.ie/index.html	Mainly open source	INSPIRE compliant
Irish Spatial Data Exchange (ISDE)	Irish Marine Institute	http://www.isde.ie	Open Source	Open Data
EEA datasets on Ireland	European Environmental Agency (EEA)	https://www.eea.europa.eu/countries-and-regions/ireland	Open Source	INSPIRE compliant
Official Irish Place-names repository	Logainm.ie	https://www.logainm.ie/en/	Open Source	Linked Open Data
Generic socio-economic sources	Various	https://en.wikipedia.org/wiki/Ireland https://www.cia.gov/library/publications/the-world-factbook/geos/ei.html https://www.teagasc.ie/rural-economy/rural-economy/agri-food-business/agriculture-in-ireland/ https://www.britannica.com/place/Ireland	Open Source	Various

		https://data.worldbank.org/country/Ireland with specific rural population data at https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_census_in_Ireland http://www.askaboutireland.ie/enfo/irelands-environment/environment-overview/land-and-biodiversity/land-use/ http://www.askaboutireland.ie/reading-room/life-society/farming/farming-in-ireland-overvi/land-use-in-ireland/ https://ec.europa.eu/agriculture/sites/agriculture/files/rural-development-2014-2020/country-files/ie/factsheet.pdf		
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Table 14.3 - B.3: Data available through third parties - Pilot 3 Galicia, Spain

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
LiDAR	Spanish IGN	http://centrodedescargas.cnig.es/CentroDescargas/catalogo.do?Serie=LIDAR	CC-BY 4.0	LAZ
Cadaster	Castilla La Mancha Government	https://www.castillalamancha.es/gobierno/agriaguaydesrur/actuaciones/sigpac	Open	SHP

Protected Areas	MAPA	http://centrodedescargas.cnig.es/CentroDescargas/index.jsp	CC-BY 4.0	SHP, DBF
Red Natura 200	MAPA	http://centrodedescargas.cnig.es/CentroDescargas/index.jsp	CC-BY 4.0	SHP, DBF
Cross-Nature	MAPA	https://crossnature.eu/project-results/sparql-endpoint/	CC-BY 4.0	RDF
Cross-Forest	TRAGSA	Ongoing	Not yet defined	RDF

Table 14.4 - B.4: Data available through third parties - Pilot 4 Vidzeme, Latvia

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
Indicator module for regional development	Ministry of Environmental Protection and Regional Development	https://raim.gov.lv/temas	Free / For fee	Various
Nature data management system	Ministry of Environmental Protection and Regional Development	http://ozols.daba.gov.lv/pub/	Free limited / More detailed for users	Various
Land Service Cadastral Map	State Land Service of Latvia	https://www.kadastrs.lv/	Free to view	Various
State forest map and data service	Latvia's State Forests	https://www.lvmgeo.lv/dati	Mixed	Various
Cultural map	Ministry of Culture	https://kulturasdati.lv/lv/objekti	Free to view	Various

Envirotech data set	Envirotech	http://www.envirotech.lv/lv/aktualitates/gis-latvija-10-2/	Free	Various
State forest map	Latvia's State Forests	https://gis2.lvm.lv/map/#/tab-toc	Mixed	Various
Open data portal	Ministry of Environmental Protection and Regional Development	https://data.gov.lv/dati/lv/dataset	Free	Various
National Unified Geospatial Information Portal (Geoportal)	Ministry of Environmental Protection and Regional Development	https://geolatvija.lv/geo/search	Free limited / More detailed for users	Various
Central Bureau of Statistics	Central Bureau of Statistics	https://www.csb.gov.lv/lv/statistika/meklet?product_type[map_spatial]=map_spatial	Free	Various
Latvian Geospatial Information Agency map browser	Latvian Geospatial Information Agency	https://kartes.lgia.gov.lv/karte/	Free to view	Various
Map of the Groundwater Stocks Balance Sheet of the Latvian Center for Environment, Geology and Meteorology	Latvian Center for Environment, Geology and Meteorology	https://lvgmc.maps.arcgis.com/apps/webappviewer/index.html?id=1d7bdb0330f44214a4679c54d7f84afa	Free to view	Various
State Forest Statistics	State Forest Service	http://www.vmd.gov.lv/vals-ts-meza-dienests/statiskas-lapas/publikacijas-un-statistika/meza-statistikas-cd?nid=1809#jump	Free	Excel

Table 14.5 - B.5: Data available through third parties - Pilot 5 Mazowieckie, Poland

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
Data on RDP projects and expenditure	RDP Paying agency ARiMR	https://www.arimr.gov.pl/o-arimr/oddzialy-regionalne/mazowiecki-or07.html	No	Various formats, incl. database (eg xls, csv databases)

Table 14.6 - B.6: Data available through third parties - Pilot 6 Central Bohemia, Czech Republic

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
Farm Structure Survey 2019	CZSO	https://www.czso.cz/csu/czso/farm-structure-survey-2016	Free	xls, PDF
Registry of Organic Entrepreneurs	Ministry of Agriculture	https://eagri.cz/public/app/eagriapp/EKO/Prehled/	Free	xls
National Network of Local Action Groups in the Czech Republic	National Network of Local Action Groups in the Czech Republic	http://nsmascr.cz/en/	Free	various formats
National Institute of Education	National Institute of Education/CZSO	https://www.infoabsolvent.cz/Temata/ClankyAbsolventi/12	Free	PDF/xml
Czech Statistical Office	Czech Statistical Office	https://www.czso.cz/csu/czso/statistiky	Free	xls/PDF
State agricultural and conservation fund	State agricultural and conservation fund	www.szif.cz	Free	PDF

Institute of Health Information and Statistics of the Czech Republic - Health statistics yearbook of the Středočeský Region 2013, ...	Institute of Health Information and Statistics of the Czech Republic	http://www.uzis.cz/katalog/rocenky/zdravotnicka-rocenka-stredoceskeho-kraje	Free	PDF
Ministry of Health	Ministry of Health	https://www.mzcr.cz/	Free	various formats
Ministry of Labour and Social Affairs	Ministry of Labour and Social Affairs	https://www.mpsv.cz/cs/	Free	various formats
Ministry of Industry and Trade	Ministry of Industry and Trade	https://www.mpo.cz/	Free	various formats
CzechTourism	CzechTourism	https://www.czechtourism.cz/	Free	various formats
Státní pozemkový úřad	Státní pozemkový úřad	https://www.spucr.cz/	Free	various formats
CENIA, česká informační agentura životního prostředí	CENIA	https://www.cenia.cz	Free	various formats
Czech Agriculture and Food Inspection Authority	Czech Agriculture and Food Inspection Authority	https://www.szpi.gov.cz/	Free	various formats
Czech Chamber of Commerce	Czech Chamber of Commerce	https://www.komora.cz/	Free	various formats

Asociace malých a středních podniků a živnostníků ČR	Asociace malých a středních podniků a živnostníků ČR	http://amsp.cz/	Free	various formats

Table 14.7 - B.7: Data available through third parties - Pilot 7 Nitra, Slovakia

Data available through third parties	Owner of data	Download or API address	License	Type of data/format	Provider
National Rural Development Network	Agency for Rural Development	http://www.nsrv.sk/	Free	HTML	Agroinstitút Nitra
Cadastral portal	Public	https://www.katasterportal.sk	Free / Registered users	Various	Agroinstitút Nitra
Land Register	Office of Geodesy, Cartography and Cadastre	https://zbgis.skgeodesy.sk	Free	Various	Agroinstitút Nitra
Agricultural Paying Agency	Agricultural Paying Agency	https://www.apa.sk/	Free	HTML	Agroinstitút Nitra
Legislative and information portal	Ministry of Justice of the Slovak Republic	https://www.slov-lex.sk/domov	Free	HTML	Agroinstitút Nitra
Open data portal	National Agency for Network and Electronic Services	https://data.gov.sk/	Free	Various	Agroinstitút Nitra

Project support of RDP 2014-2020	Agricultural paying agency	https://data.gov.sk/dataset/projekt-ove-podpory-prv-2014-2020-06-2019	Free	xslx	Agroinstitut Nitra
Statistical survey on migration in the SR	Ministry of the Interior of the Slovak Republic	https://data.gov.sk/dataset/statisticky-prehľad-o-migracie-v-sr	Free	THML	Agroinstitut Nitra
Register of agricultural production areas (LPIS)	Ministry of Agriculture and Rural Development	https://data.gov.sk/dataset/register-polnohospodarskych-produkcnych-ploch-lpis	Free	Gml Shapefile	Agroinstitut Nitra
Database of Regional Accommodation Facilities	Tripgut, s.r.o.	https://www.ubytovanie.slovensku.eu/	Free	HTML	Agroinstitut Nitra
Enterprises by economic activity	Statistical Office of the Slovak Republic	link	Free	HTML	Agroinstitut Nitra
Capacity and performance of accommodation facilities	Statistical Office of the Slovak Republic	link	Free	HTML	Agroinstitut Nitra
Registered unemployment rate	Statistical Office of the Slovak Republic	link	Free	HTML	Agroinstitut Nitra
Regional gross domestic product per capita	Statistical Office of the Slovak Republic	link	Free	HTML	Agroinstitut Nitra
Legislative and information portal	Ministry of agriculture	http://www.mpsr.sk/	Free	HTML	VIPA SK
Cadastral portal	Public	https://www.katasterportal.sk	Free	Various	VIPA SK

Region Nitra	Region Nitra	https://www.unsk.sk/	Free	HTML	VIPA SK
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Table 14.8 - B.8: Data available through third parties - Pilot 8 Hame, Finland

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
Finnish farmer's association MTK member-register, young farmers	MTK			Register
National land survey of Finland		https://asiointi.maanmittauslaitos.fi/karttapaikka/?lang=en		The service offers you an access to the topographic maps, aerial images and background maps produced by the National Land. Survey of Finland. Intended for private persons.
Natural resource institute Finland		https://stat.luke.fi/en/uusi-etusivu		food and natural resources statistics

Table 14.9 - B.9: Data available through third parties - Pilot 9 Central Greece, Greece

Data directly available on pilot	Owner of data	Download or API address	License	Type of data/format	Provider
repository.kallipos.gr	Hellenic Academic Libraries-	https://repository.kallipos.gr/handle/11419/6?locale=en	Open Content License	PDF	AUA

	Link (Heal-Link)				
PEHOTEE - Environment, Civic & Landscape Art, New Technology, Energy (Provided via National Documentation Centre)	National Documentation Centre EKT's Databases	http://argo.ekt.gr/opa2/zConnectENU.html	Available free on the Internet		
Evonymos Ecological Library Nature and Neohellenic Culture (Provided via National Documentation Centre)	National Documentation Centre EKT's Databases		Available free on the Internet		
NAGREF: Greek Forestry & Natural Environment (Provided via National Documentation Centre)	National Documentation Centre EKT's Databases		Available free on the Internet		
DIMITRA: Phytogenic & Vital prod. Veterinary, Fishery, Foods (Provided via National Documentation Centre)	National Documentation Centre EKT's Databases		Available free on the Internet		

Web page of minagric about agriculture and R&D issues	Government	http://www.minagric.gr/index.php/en/		text	NP
Courses, Research, Projects on relevant to Agriculture issues Agriculture University of Athens (AUA)	AUA	dspace.aua.gr		text	NP
Library Information Center of Aristotle University of Thessaloniki (AUTH)	AUTH	http://search.lib.auth.gr/ http://ikee.lib.auth.gr/?ln=en		text	NP
Open access digital library of University of Thessaly (UTH)	UTH	http://ir.lib.uth.gr/?locale-attribute=en		text	NP
Organization of public interest related to agriculture subsidies	OPEKEPE	https://opekepe.gr/en/		text	NP
Population and Social Conditions	Hellenic Statistical Authority	http://www.statistics.gr/en/statistics/pop	open	xls	RSE
Agriculture, Livestock, Fishery	Hellenic Statistical Authority	http://www.statistics.gr/en/statistics/agr	open	xls	RSE
Economy, Indices	Hellenic Statistical Authority	http://www.statistics.gr/en/statistics/economy	open	xls	RSE

Environment and Energy	Hellenic Statistical Authority	http://www.statistics.gr/en/statistics/en	open	xls	RSE
2011 Population-Housing Census	Hellenic Statistical Authority	http://www.statistics.gr/en/2011-census-pop-hous	open	xls	RSE
Industry, Trade, Services, Transport	Hellenic Statistical Authority	http://www.statistics.gr/en/statistics/industry	open	xls	RSE
Tourism Insights	INSETE	http://www.insete.gr/en-gb/SETI-Intelligence/Statistics/Statistical-Data	open	xls	RSE
Aquatic areas of the mountain area	Ministry of Environment and Energy	http://geodata.gov.gr/dataset/udatikes-periphoreies-oreinou-khorou	Creative Commons Attribution 3.0	various	RSE
NATURA 2000 areas	Ministry of Environment and Energy	http://geodata.gov.gr/dataset/to-diktuo-natura-2000-kai-prostateuomenes-periokhes	Creative Commons Attribution 3.0	various	RSE
Atmospheric Pollution Measurement Stations	Ministry of Environment and Energy	http://geodata.gov.gr/dataset/stathmoi-metreses-atmospharikes-rupanses	Creative Commons Attribution 3.0	various	RSE

Table 14.10 - B.10: Data available through third parties - Pilot 10 Apulia, Italy

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
Tourist movements data	Puglia promozione	http://www.dataset.puglia.it/dataset/movimento-turistico	Open	Csv/xml

Offers proposed by the Accommodation Facilities	Puglia promozione	http://www.dataset.puglia.it/dataset/offerte-proposte-dalle-strutture-ricettive	Open	Csv/xml
List of Accommodation Facilities	ARET Pugliapromozione	http://www.dataset.puglia.it/dataset/elenco-strutture-ricettive	Open	Csv/xml
Services for tourism	ARET Pugliapromozione	http://www.dataset.puglia.it/dataset/servizi-per-il-turismo	Open	Csv/xml
Places of tourist, cultural and naturalistic interest	ARET Pugliapromozione	http://www.dataset.puglia.it/dataset/luoghi-di-interesse-turistico-culturale-naturalistico	Open	Csv/xml
List of operations funded by the POR Puglia 2014-2020 and beneficiaries	Autorità di Gestione del POR 2014-2020 - Sistema MIR	http://www.dataset.puglia.it/dataset/elenco-delle-operazioni-finanziate-con-il-por-puglia-2014-2020-e-dei-beneficiari	Open	Csv/xml
Use of Soil 2011 - UDS	InnovaPuglia Spa - Servizio Territorio e Ambiente info@sit.puglia.it	http://www.dataset.puglia.it/dataset/uso-del-suolo-2011-uds	Open	Csv/xml
Indicators of demographic aging of the resident population of the Apulian municipalities	Ufficio Statistico quale organo del Sistema Statistico Nazionale (SISTAN)	http://www.dataset.puglia.it/dataset/indicatori-di-invecchiamento-demografico-della-popolazione-residente-dei-comuni-pugliesi	Open	Csv/xml
Foreign population residing by sex and citizenship	Ufficio Statistico quale organo del Sistema Statistico Nazionale (SISTAN)	http://www.dataset.puglia.it/dataset/popolazione-straniera-residente-per-sesso-e-cittadinanza	Open	Csv/xml

Resident population in the Apulian municipalities by age and sex	Ufficio Statistico quale organo del Sistema Statistico NAzionale (SISTAN)	http://www.dataset.puglia.it/dataset/popolazione-residente-nei-comuni-pugliesi-per-eta-e-sesso	Open	Csv/xml
Housing density of the resident population	Ufficio Statistico quale organo del Sistema Statistico NAzionale (SISTAN)	http://www.dataset.puglia.it/dataset/densita-abitativa-della-popolazione-residente	Open	Csv/xml
Regional registers of authorized public and private social and welfare facilities and services	INNOVAPUGLIA S.P.A.	http://www.dataset.puglia.it/dataset/registri-regionali-delle-strutture-e-dei-servizi-socio-assistenziali-pubblici-e-privati-autorizzati	Open	Csv/xml
Companies by municipality and sector of economic activity	Ufficio Statistico quale organo del Sistema Statistico NAzionale (SISTAN)	http://www.dataset.puglia.it/dataset/impres-per-comune-e-settore-di-attivit-economica	Open	Csv/xml
Companies by municipality and legal form	Ufficio Statistico quale organo del Sistema Statistico NAzionale (SISTAN)	http://www.dataset.puglia.it/dataset/impres-per-comune-e-forma-giuridica	Open	Csv/xml
Local units of enterprises by municipality and sector of economic activity	Ufficio Statistico quale organo del Sistema Statistico NAzionale (SISTAN)	http://www.dataset.puglia.it/dataset/unita-locali-delle-impres-per-comune-e-settore-di-attivit-economica	Open	Csv/xml

Farms and classes of agricultural area used by municipality	Ufficio Statistico quale organo del Sistema Statistico NAZIONALE (SISTAN)	http://www.dataset.puglia.it/dataset/aziende-agricole-e-classi-di-superficie-agricola-utilizzata-per-comune	Open	Csv/xml
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Table 14.11 - B.11: Data available through third parties - Pilot 11 Gevgelija-Strumica, FYROM

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
North Macedonian National Agricultural Extension Agency	NMK-NEA	https://agencija.gov.mk/	Free without restriction	HTML and PDF
Ministry of Agriculture of North Macedonia	NMK-MZSV	http://mzsv.gov.mk/	Free without restriction	HTML and PDF
Agency for Financial support of Agriculture and Rural Development	IPARD agency	http://www.ipardpa.gov.mk/Root/default_eng.asp	Free without restriction	HTML and PDF
Macedonian Soil Information System	NMK_MZSV	http://www.maksoil.ukim.mk/masis/	Free without restriction	HTML
Agricultural Market Information System	NMK_MZSV	http://zpis.gov.mk/Default	Free without restriction	HTML
Agricultural Stock Market	Agricultural Stock Market	https://zelenaberza.com.mk/	Free without restriction	HTML
Economic accounts in agriculture	Statistical Office of North Macedonia	http://www.stat.gov.mk/OblastOpsto_en.aspx?id=10	Free without restriction	Excel, PDF format
Crop Production	Statistical Office of North Macedonia	http://www.stat.gov.mk/OblastOpsto_en.aspx?id=16	Free without restriction	Excel, PDF format

Animal Husbandry	Statistical Office of North Macedonia	http://www.stat.gov.mk/OblastOpsto_en.aspx?id=17	Free without restriction	Excel, PDF format
Forestry	Statistical Office of North Macedonia	http://www.stat.gov.mk/OblastOpsto_en.aspx?id=18	Free without restriction	Excel, PDF format
Structure of Agricultural Holdings	Statistical Office of North Macedonia	http://www.stat.gov.mk/OblastOpsto_en.aspx?id=38	Free without restriction	Excel, PDF format
Regional Rural Development Standing Working Group in South Eastern Europe	SWG	http://seerural.org/	Free without restriction	HTML, PDF format
National Federal Farm Agency	NFF	https://www.nff.org.mk/en/	Free without restriction	HTML
Faculty of Agriculture	University Cyril and Methodious	http://www.ukim.edu.mk/en_index.php	Free without restriction	HTML
Faculty of Agricultural Sciences and Food	University Goce Delchev	http://www.fzh.ukim.edu.mk/en/	Free without restriction	HTML
Institute of Agriculture	University Cyril and Methodious	http://zeminst.edu.mk/home/	Free without restriction	HTML
Macedonian Association of Processors (MAP)	Macedonian Association of Processors (MAP)	http://www.map.org.mk/index.php/en/	Free without restriction	HTML

Macedonian Chamber of Commerce- Association of wine producers	MASIT	https://www.chamber.mk/en/	Free without restriction	HTML
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Table 14.12 - B.12: Data available through third parties - Pilot 12 Galilee, Israel

Data available through third parties	Owner of data	Download or API address	License	Type of data/format
ISRAEL21		https://www.israel21c.org/the-israeli-tech-helping-farmers-worldwide-improve-their-crops/	Free without restriction	Web
Israel Innovation Authority	Ministry	https://innovationisrael.org.il/en/article/tomorrows-agriculture-begins-israel	Free without restriction	Web

15 ANNEX C Analytical needs

Table 15.1 Analytical Needs - Pilot 1 Flanders, Belgium

Description	Input data	Output data
Rural demographic evolution	Statistics Belgium	Evolution & Scenarios per age/gender category
Rural Activities	Current occupation & activities	Evolution & Scenarios
Farm typology	Type of farms and evolution (Size, animal/crop type, ...)	Evolution
Land tenure and access to land	DOV	Evolution

Land cover/use change	DOV, SDI	Evolution
Sustainable soil, land & water management	DOV, SDI	Evolution
Access to land	Land availability, land ownership, land listings, land prices	How easy it is for young people to access/purchase land
Climate impact & adaptation	VMM climate portal	Evolution of resilience

Table 15.2 Analytical Needs - Pilot 2 Monaghan, Ireland

Description	Input data	Output data
The current geographical, socio-economic status, demographics, environmental, business, agricultural, financial, housing, policies and other issues that determine the attractiveness of Monaghan as a location for new farmers.	The various sources listed above, in addition to others.	Inputs to the PoliRural Text Mining and System Dynamics Tools to explore and facilitate new plans and policies.

Table 15.3 Analytical Needs - Pilot 5 Mazowieckie, Poland

Description	Input data	Output data
Rural demographic evolution	Statistics Poland	Evolution & Scenarios per age/gender category
Rural Activities	Database of Rural Development Programme	Evolution & Scenarios
Collection, processing and mapping of qualitative and quantitative data on rural attractiveness and rural projects	Various sources (qualitative data)	Evolution & Scenarios

Table 15.4 Analytical Needs - Pilot 6 Central Bohemia, Czech Republic

Description	Input data	Output data
Number and statistical data about newcomers (on the level of municipalities?)	Regional demographic data	Data evolution
Attitudes towards living in the countryside, why to go to live in the countryside	Various data	Information about attitudes
Particular data about regional disparities	Various data	Identification of main barriers and opportunities related to living in the countryside
Economic data related to entrepreneurs and microenterprises in the field of agriculture	Gross domestic product, investments, added value, domestic consumption, domestic and foreign trade	Evaluation of the performance of the local economy
Main barriers of starting/ending of the entrepreneurship related to land	Land data (e.g. structure of land owners)	Identification of main barriers

Table 15.5 Analytical Needs - Pilot 9 Central Greece, Greece

Description	Input data	Output data
Digitalization	National websites'''	Statistics, historical information, economical data, demographic data
Supporting measures for entering in new agriculture or rural business	EU'''	
Public and private investments	Academic'''''	
In rural development	Electronic Library''	

<p>Effective protection and management of natural resources</p> <p>Small-sized farms</p> <p>Delay in modernization and the mechanization of agriculture</p>	<p>Region of Central Greece</p>	
<p>Statistics about land use, type of cultivation, varieties, agricultural production system (conventional, organic, integrated, and smart farming etc</p>	<p>Opinions expressed at documents (e.g. press releases, opinion articles, economic reports, academic articles, thesis, etc.) related with the current situation at the targeted area.</p>	<p>Positive, negative, neutral expressions/attitude in relation with agriculture sector (Utilized Agricultural Area, yield, indicators, etc)</p>
<p>Identify which economics sector (primary production, secondary production etc.) attracts the interest of the population (creates more internet buzz) in comparison with geographical and demographic parameters.</p>	<p>Opinions expressed at social media forums, documents (e.g. press releases, opinion articles, economic reports, academic articles, thesis, etc.) related with the current situation at the targeted area.</p>	<p>Positive, negative, neutral expressions/attitude for each sector in relation with audience demographics (gender, age, education, location, etc.).</p>
<p>Identify a hierarchy of the main issues that concern the population in relation with demographic characteristics. Discovery of potential (currently hidden) associations among different issues and/or demographics.</p>	<p>Opinions expressed as social media forums, documents (e.g. press articles, economical reports, academic articles, theses analyzing the current situation)</p>	<p>Positive, negative, neutral expressions for each sector in relation with audience demographics (gender, age, education, location, etc.).</p>

Table 15.6 Analytical Needs - Pilot 10 Apulia, Italy

Description	Input data	Output data
Demographic data	Demographic data	Demographic evolution
Economic data	Gross domestic product, investments, added value, domestic consumption, domestic and foreign trade	Evaluation of the performance of the local economy
Data on the evolution of the labor market structure	Assumptions, dismissals, skills,	Market labour evolution

Table 15.7 Analytical Needs - Pilot 12 Galilee, Israel

Description	Input data	Output data
Rural demographic evolution	Statistics Israel	Evolution & Scenarios per age/gender category
Rural Activities	Current occupation & activities as presented by authorities	Evolution & Scenarios
Main changes in agriculture	MIGAL's workshops	Evolution
Analyse rural housing possibilities' attractiveness as a factor for people to stay or to move elsewhere.	Information from municipalities	Data on changes in population in the periphery
Analyse rural attractiveness as a factor for existing and / or potential SMEs to develop their businesses in rural area.	Information from municipalities	Data on changes in establishing new businesses in the periphery
Engaging youth in regional policy and activities	Information from municipalities and workshops	Encourage youth to take leadership in the region

16 ANNEX D Plan4all data sets

Data set	Description	Download or API address	License	Type of data/format
Open Land Use Map (OLU)	The base European dataset is derived from the set of available datasources that are helping identify the landuse in particular locality.	https://sdi4apps.eu/open_land_use/download/	https://land.copernicus.eu/terms-of-use , ©ČÚZK (§62 zákon č. 111/2009 Sb., o základních registrech, v platném znění), Ministerstvo zemědělství ČR (zákon č. 252/1997 Sb., o zemědělství), Gratis Open Data Licentie Vlaamse Regering	Shapefile, WMS
Smart Points of Interest (SPOI)	The Smart Points of Interest data set is the seamless and open resource of POIs that is available for other users to download, search or reuse in applications and services.	http://data.plan4all.eu/sparql	ODbL	HTML, XML, JSON, CSV, RDF, Spreadsheet, Javascript, Turtle, TSV

Open Transport Map (OTM)	<p>The Open Transport Map displays a road network which is suitable for routing, visualizes average daily Traffic Volumes for the whole EU. It also visualizes daytime related Traffic Volumes in OTN Pilot Cities</p> <p>(Antwerp, Birmingham, Issy-le-Moulineaux, Liberec region)</p>	<p>http://opentransportmap.info/download/</p> <p>http://opentransportmap.info/wfs.html</p>	<p>ODbL</p>	<p>Shapefile, WFS</p>
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17 ANNEX E ESA Copernicus Open Access Hub interfaces

Interface type	Description	Owner of data	URI	License
Open Access Hub - Web GUI	GUI access to Sentinel-1, Sentinel-2, Sentinel-3 and Sentinel-5P data using map application	EC	https://scihub.copernicus.eu/dhus/	Open Data
OpenSearch API	Sentinel-1, Sentinel-2 and Sentinel-3 OpenSearch API access	EC	https://scihub.copernicus.eu/apihub/search	Open Data
OpenData API	Sentinel-1, Sentinel-2 and Sentinel-3 OpenData API access	EC	https://scihub.copernicus.eu/apihub/odata/v1	Open Data

18 ANNEX F List of DIAS platforms

DIAS platform name	Provided by	URI	License
CREODIAS	CloudFerro	https://creodias.eu/	Commercial
Sobloo	Airbus, Orange and Capgemini	https://sobloo.eu/	Open Data, Commercial
Mundi web services	Atos	https://mundiwebservices.com /	Open Data, Commercial
WEKEO	EUMETSAT, ECMWF and MERCATOR OCEAN	https://www.wekeo.eu/	Open Data, Commercial
ONDA	Serco italia	https://www.onda-dias.eu/cms/	Open Data

19 ANNEX G Other available data set

Data set	Description	Owner of data	URI	License
Open Land Use - OLU (EU*)	Land use data in Europe. NB:* Linked dataset has currently partial coverage: all agriculture related lands (hilucs_code<200) & main cities in Czech, Poland and Spain	PSNC, Plan4All	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/olu#	Open Data

Open Transport Map - OTM (EU*)	Transport map data in Europe. NB*: Linked dataset has currently partial coverage: all Czech, Poland and Spain, and RoadLinks for main roads, i.e., FunctionalRoadClassV alue: ('mainRoad', 'firstClass', 'secondClass', 'thirdClass', 'fourthClass')	PSNC, Plan4All	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/otm#	Open Data
Smart Points of Interest - SPOI (Global)	Open resource of points of interest (POIs) around the world.	Plan4All	https://www.foodie-cloud.org/sparql Graph: http://www.sdi4apps.eu/poi.rdf	Open Data
FADN - Farm Accountancy Data Network (EU)	Physical and structural data like location, crop areas, livestock numbers etc., as well as economic and financial data, like the value of production of the different crops, stocks, etc.	PSNC, EU commission	https://www.foodie-cloud.org/sparql Graph: http://ec.europa.eu/agriculture/FADN/{dataset}# where dataset is e.g., year-country-anc3	Open Data
LPIS - Land Parcel Information System (PL, CZ)	Land Parcel data generated from shapefiles structured according to FOODIE ontology for Poland and Czech Republic	PSNC, national data providers	https://www.foodie-cloud.org/sparql Graph: https://w3id.org/foodie/open/cz/pLPIS_180616_WGS#(CZ) http://w3id.org/foodie/open/pl/LPIS#(PL)	Open Data

Urban Atlas	Pan-European comparable land use and land cover data for Large Urban Zones with more than 100.000 inhabitants as defined by the Urban Audit as per European Environment Agency. NB:* Linked dataset has currently partial coverage: all EU agriculture related lands (hilucs_code<200) & main cities in Czech, Poland and Spain	PSNC, European Environment Agency	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/atlas#	Open Data
Corine Land Cover	Information on land cover status over the entire territory of the European Union. NB:* Linked dataset has currently partial coverage: all EU agriculture related lands (hilucs_code<200) & main cities in Czech, Poland and Spain	PSNC, Copernicus (EU)	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/corine#	Open Data
Hilucs - INSPIRE Land Use classification	INSPIRE Land Use classification dataset	PSNC, EU commission	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/hilucs#	Open Data

NUTS - Nomenclature of territorial units for statistics	Nomenclature of territorial units for statistics is a classification defined by the Eurostat office of the EU. The NUTS classification is a hierarchical system for dividing up the economic territory of the EU, mainly for statistical and policy purposes.	EU commission	https://www.foodie-cloud.org/sparql Graph: http://nuts.geovocab.org/	Open Data
Czech geospatial open data (Erosion zones, Water bodies, Soil maps)	This is a combined dataset of Linked Open Data published from spatial data concerning Erosion Zones, water bodies and Soil maps over the landmass of Czech Republic. The raw data was supplied by various organizations of Czech republic, and transformed to RDF.	PSNC, Czech Republic national data providers	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/open/cz/{dataset}# Where dataset = e.g., Soil_maps_BPEJ_WGSc	Open Data
EMERGEL (subset)	Contains common knowledge and concepts related to emergencies and the stakeholders involved in a crisis situation. The current dataset includes: dangerous goods, grape varieties, standardization organisations, countries divisions.	CTIC	https://www.foodie-cloud.org/sparql Graph: http://foodie-cloud.org/emergel	Open Data

AGROVOC	Controlled vocabulary covering all areas of interest of the Food and Agriculture Organization (FAO) of the United Nations, including food, nutrition, agriculture, fisheries, forestry, environment etc.	FAO	https://www.foodie-cloud.org/sparql Graph: http://aims.fao.org/aos/agrovoc/	Open Data
YELP academic dataset	Subset of YELP dataset that includes businesses, reviews, and user data for use in personal, educational, and academic purposes.	YELP	https://www.foodie-cloud.org/sparql Graph: http://data.yelp.com/academic_dataset#	Open for use in personal, educational, and academic purposes
EUROVOC	Multilingual, multidisciplinary thesaurus covering the activities of the EU. It contains terms in 24 EU languages, plus in 3 languages of candidate countries for EU accession	EU publication office	https://www.foodie-cloud.org/sparql Graph: http://eurovoc.europa.eu/20180621/	Open Data
ASFIS List of Species for Fishery Statistics Purposes	Includes 12 771 species items selected according to their interest or relation to fisheries and aquaculture. For each species item stored in a record, codes (ISSCAAP group, taxonomic and 3-alpha) and taxonomic information (scientific	FAO Fisheries and Aquaculture Statistics and Information Branch (FIAS)	https://www.foodie-cloud.org/sparql Graph: http://www.fao.org/aims/aos/fi/taxonomic#	Open Data

	name, author(s), family, and higher taxonomic classification) are provided			
FAO Major Fishing Areas for Statistical Purposes	Arbitrary areas, the boundaries of which were determined in consultation with international fishery agencies on various considerations, including the boundary of natural regions and the natural divisions of oceans and seas, among others. It classifies them between inland and marine areas.	FAO	https://www.foodie-cloud.org/sparql Graph: http://www.fao.org/aims/aos/fi/water_FAO_areas/marine# http://www.fao.org/aims/aos/fi/water_FAO_areas/inland#	Open Data
NASA vocabularies	Set of controlled Earth Science keywords and related (platforms, instruments) vocabularies	NASA - Global Change Master Directory	https://www.foodie-cloud.org/sparql Graph: https://gcmdservices.gsfc.nasa.gov/kms/concepts/concept_scheme/{dataset} Where dataset = platforms, sciencekeywords, instruments	Open Data

GADM	Detailed spatial data for all countries and their sub-divisions.	PSNC, GADM	https://www.foodie-cloud.org/sparql Graph: http://w3id.org/foodie/open/gadm36/level{level}# Where level =1,2,3,4,5	Open Data
Spanish biodiversity	Spanish Nature Databank. Information according to Plinian-Core model.	MAPA (Spain)	https://crossnature.eu/project-results/sparql-endpoint/	Linked Open Data
Portuguese biodiversity	Portuguese Nature Databank. Information according to Plinian-Core model.	Open Data Portal (Portugal)	https://dados.gov.pt/pt/datasets/distribuicao-de-especies-2008-2012-artigo-12-diretiva-aves-versao-cross-nature-species-distribution-2008-2012-article-12-birds-directive-cross-nature-version/	Linked Open Data

20 ANNEX H Other available data set

Data set	Description	API	Owner of data	URI	License
CRU-10	10 minute gridded climate normals time series	Downloadable files	Climatic Research Unit, University of East Anglia	http://www.cru.uea.ac.uk/data	Open Database License
Who's On First	Global geographical names source	API and file downloads	Who's On First	https://www.whosonfirst.org/	CC-0
Natural Earth raster and vector data	Global scale vector and raster basemaps	Downloadable files	Natural Earth	https://www.naturalearthdata.com/	Public domain
GDELT	Global monitoring of news media for "human activity"	Google GDELT API + Downloadable files	GDELT project, Google Jigsaw	https://www.gdeltproject.org	GDELT license: https://www.gdeltproject.org/about.html#termsfuse
MODIS SST	Sea/water surface temperature time series	Downloadable files	NASA	https://modis.gsfc.nasa.gov/	Open Data

21 ANNEX I to Pilot 2 Monaghan

Links to policy documents from all levels (eu, national, regional, local):

- Monaghan Local Development Strategy – Rural Development programme 2014 – 2020, <https://www.midl.ie/images/Documents/LEADER-LDS-for-Co-Monaghan-2014-2020---Amended-March-16th-2016.pdf>
- Commission for the Economic Development of Rural Areas (CEDRA) Report & Recommendations, <https://www.teagasc.ie/rural-economy/cedra/>
- Realising our Rural Potential - Irish Action Plan for Rural Development www.chg.gov.ie/app/uploads/2017/01/162404-rural-ireland-action-plan-web-2-1.pdf
- 2014-2020 Rural Development Programme for Ireland, <https://ec.europa.eu/agriculture/sites/agriculture/files/rural-development-2014-2020/country-files/ie/factsheet.pdf>
- Rural Regeneration and Development Fund, <https://drcd.gov.ie/about/rural/rural-regeneration-development-fund/>
- Smart Villages – EU policy objective, https://enrd.ec.europa.eu/smart-and-competitive-rural-areas/smart-villages/smart-villages-portal_en
- Monaghan County Development Plan 2013 – 2019, <https://monaghan.ie/planning/monaghan-county-development-plan-2013-2019/>
- What is Europe doing for Monaghan, <https://ec.europa.eu/ireland/sites/ireland/files/monaghan.pdf>
- National statistical office-Census of Population 2016 - Profile 2 Population Distribution and Movements - www.cso.ie/en/releasesandpublications/ep/p-cp2tc/cp2pdm/pd/
- World Bank-Ireland - <https://data.worldbank.org/country/Ireland> Rural population - <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS>
- UN-Ireland - www.fao.org/countryprofiles/index/en/?iso3=IRL
- Ireland Family Farming Knowledge Platform - www.fao.org/family-farming/countries/irl/en/
- EU Open Data-Eurobarometer 473: Europeans, Agriculture and the CAP - https://data.europa.eu/euodp/en/data/dataset/S2161_88_4_473_ENG
- OECD-Ireland - Economic forecast summary - www.oecd.org/ireland/ireland-economic-forecast-summary.htm
- Eurostat-Agricultural census in Ireland - http://ec.europa.eu/eurostat/statistics-explained/index.php/Agricultural_census_in_Ireland
- data.gov.ie - Agriculture - <https://data.gov.ie/dataset?theme=Agriculture>
- National Rural Development Prog. 2014-2020 (LEADER) <https://drcd.gov.ie/about/rural/rural-development/leader/>
- Factsheet on 2014-2020 Rural Development Programme Ireland, <https://ec.europa.eu/agriculture/sites/agriculture/files/rural-development-2014-2020/country-files/ie/factsheet.pdf>
- UCD: Spatial Data & Other Datasets for Ireland - <http://libguides.ucd.ie/gisguide/FindSpatialData>
- Teagasc: Land Market Review 2018 - <https://www.teagasc.ie/media/website/publications/2018/Land-Review-and-Outlook-Report-2018.pdf>

- Rural Funding in Ireland, Department of Rural and Community Development, <https://www.gov.ie/en/service/c5849b-rural-funding/?section=rural-regeneration-and-development>
- European Innovation Partnership (EIP-AGRI), <https://ec.europa.eu/eip/agriculture/en>
- “Smart Villages: How to support Smart Villages strategies which effectively empower rural communities?”, European Network for Rural Development (ENRD), May 2019, https://enrd.ec.europa.eu/sites/enrd/files/enrd_publications/smart-villages_orientations_sv-strategies.pdf
- “Farm Business Innovation, Cooperation and Performance”, Rural Business Research (RBR), Paul Wilson, Mervyn Lewis and Joanne Ackroyd, July 2014, http://randd.defra.gov.uk/Document.aspx?Document=12288_RBRFarmBusinessInnovationreportFINALV2.pdf
- Teagasc Irish Agriculture and Food Development Authority - www.teagasc.ie/about/research--innovation
- Irish Journal of Agricultural and Food Research - www.teagasc.ie/publications/ijafr-journal/
- UCD Agriculture & Food Science: Journals & Databases - <https://libguides.ucd.ie/agriculture/databases>
- Rural Economic Development in Ireland - www.esri.ie/pubs/JACB201454.pdf
- Rural 3.0. A framework for rural development (OECD Policy Note 2018) <https://www.oecd.org/cfe/regional-policy/Rural-3.0-Policy-Note.pdf>
- Regions and Cities at a Glance 2018 – IRELAND (OECD 2019) <file:///U:/2019/Downloades/Interesting/IRELAND-Regions-and-Cities-2018.pdf>
- Ten Key Drivers of Rural Change (OECD 2019) <file:///U:/2018/Downloads/RDP/10-Key-Drivers-Rural-Change%20-%20OECD%20Conference%20April%2018.pdf>
- Edinburgh Policy Statement on Enhancing Rural Innovation. Rural areas are places of opportunities and are vital for inclusive growth. <file:///U:/2018/Downloads/RDP/Edinburgh-Policy-Statement-On-Enhancing-Rural-Innovation.pdf>
- The Future of Food and Farming – European Commission 2017 <file:///midlsrv01/RedirectedFolders/goconnell/My%20Documents/2018/Downloads/RDP/Future%20of%20CAP/LD-Net%20Docs/the-future-of-food-and-farming.pdf>
- European Commission proposal for CAP Regulation 2018 <file:///U:/2018/Downloads/RDP/Future%20of%20CAP/Proposed%20CAP%20Regulation%20-%20June%202018.pdf>
- Research for AGRI Committee – The CAP beyond 2020: appraisal of the EC legislative proposals [file:///U:/2018/Downloads/RDP/New%20CAP%20Proposals/IPOL_STU\(2018\)629174_EN.pdf](file:///U:/2018/Downloads/RDP/New%20CAP%20Proposals/IPOL_STU(2018)629174_EN.pdf)
- European Commission Fact Sheet - EU Budget: the Common Agricultural Policy beyond 2020 file:///U:/2018/Downloads/RDP/New%20CAP%20Proposals/MEMO-18-3974_EN%20-%20European%20Commission%20-%20Fact%20Sheet.pdf
- Modernising & Simplifying the CAP <file:///U:/2018/Downloads/RDP/New%20CAP%20Proposals/Modernising%20&%20Simplifying%20the%20CAP%20>

%20Economic%20challenges%20%20facing%20EU%20agriculture%20(Baskground%20Doc)%202017.pdf

- Draft OECD Principles on Rural Policy
file:///U:/2018/Downloads/RDP/New%20CAP%20Proposals/Draft%20Principles%20on%20Rural%20Policy%2021%20December%202018.pdf
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- Web resource relaunched by Monaghan County Council, with useful stats all in one place for the county, <https://monaghan.ie/communitydevelopment/monaghan-economic-community-monitor/>

Links to the Pilots' related websites:

- Monaghan Integrated Development programmes based on Rural Community Development Principles as described above (www.midl.ie/index.php/programmes)
- Irish National Reserve and Young Farmers Scheme (<https://www.agriculture.gov.ie/farmerschemespayments/capentitlementsrelatedinformationandapplicationforms/2018nationalreserveandyoungfarmersscheme/>)
- Farmers Knowledge Transfer Scheme (www.ifa.ie/knowledge-transfer/#.W1Cdr_ZFy00)
- Macra na Feirme Young Farmer Skillnet Ireland programme - www.macra.ie/skillnet
- Young Farmers Training programme (www.macra.ie/news-macra-launch-young-farmer-training-programme-211.html)
- Westmeath / Offaly / Cavan / Monaghan section of the Teagasc farm advisory services (www.teagasc.ie/about/farm-advisory/advisory-regions/westmeath--offaly--cavan--monaghan/)
- Irish Farmers Journal - www.farmersjournal.ie
- MID News - www.midl.ie/index.php
- Irish Cattle & Sheep Farmers Association - <https://icsaireland.ie>
- Farm Ireland - www.independent.ie/ad-test/farming/
- Agriland - www.agriland.ie/latest-farming-news/
- Irish Examiner farming - www.pressreader.com/ireland/irish-examiner-farming
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- ICMSA Irish Family Farm Association - <http://icmsa.ie/>
- Macra na Feirme - <http://www.macra.ie>
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[galway-researchers-to-support-rural-regeneration-in-new-eu-project-1.html](#),
[www.researchgate.net/project/RURALIZATION-The-opening-of-rural-areas-to-renew-rural-generations-jobs-and-farms](#)

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- National Rural Network (NRN) Ireland, <https://www.nationalruralnetwork.ie/leader-news/>
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- The Female Farmer Project, documenting the rise of women in agriculture, <http://www.femalefarmerproject.org>
- “Guidelines for Long-term Land Leasing”, Teagasc, October 2017, <https://www.teagasc.ie/media/website/publications/2018/Long-Term-Land-Leasing.pdf>
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- County Monaghan Landscape Character Assessment, Final Report, Monaghan County Council, August 2008, <https://monaghan.ie/planning/landscape-character-assessment>
- Agriland Top 10 tips on leasing out land <https://www.agriland.ie/farming-news/top-10-tips-leasing-out-your-land/>
- You may claim Income Tax (IT) relief on certain income that you earn from the long-term leasing of your farm land, <https://www.revenue.ie/en/personal-tax-credits-reliefs-and-exemptions/land-and-property/leasing-farm-land/index.aspx> And <https://www.revenue.ie/en/self-assessment-and-self-employment/guide-to-self-assessment/index.aspx>
- What’s involved in land leasing and what are the benefits? Advantages For Landowners - Enhanced Tax Relief Incentives for Land Leasing <https://www.agriland.ie/farming-news/whats-involved-in-land-leasing-and-what-are-the-benefits/>
- Guidelines for Long-term Land Leasing – Teagasc information document for farmers and landowners who are considering long-term land leasing. <https://www.teagasc.ie/media/website/publications/2018/Long-Term-Land-Leasing.pdf>
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- LeadFarm: International training programme for young farmers unveiled <https://www.agriland.ie/farming-news/leadfarm-international-training-programme-for-young-farmers-unveiled/>
- Land: Long-term lease options available with prices to level out in 2019 <https://www.agriland.ie/farming-news/land-long-term-lease-options-available-with-prices-to-level-out-in-2019/>
- Farming finance: Leasing out land may be financially attractive - but beware the pitfalls. <https://www.independent.ie/business/farming/agri-business/finance/farming->

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- Joint Committee on Arts, Heritage, Regional, Rural and Gaeltacht Affairs debate - Wednesday, 23 Nov 2016. Sustaining Viable Rural Communities: Discussion (Resumed), https://www.oireachtas.ie/en/debates/debate/joint_committee_on_arts_heritage_regional_rural_and_gaeltacht_affairs/2016-11-23/3/ and https://data.oireachtas.ie/ie/oireachtas/committee/dail/32/joint_committee_on_arts_heritage_regional_rural_and_gaeltacht_affairs/submissions/2016/2016-11-23_opening-statement-teagasc_en.pdf
- Local Enterprise Office Monaghan <https://www.localenterprise.ie/Monaghan>
- Taste of Monaghan, <https://www.tasteofmonaghan.com/> and [@tasteofmonaghan](https://www.instagram.com/p/B0EHVMViqOz/?igshid=y28e42ql73tz) and <https://www.instagram.com/p/B0EHVMViqOz/?igshid=y28e42ql73tz>
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- Monaghan Institute and Cavan & Monaghan Education and Training Board, <https://monaghaninstitute.ie/> and <http://cavanmonaghan.etb.ie/>
- History of Agriculture in Monaghan, <https://monaghan.ie/museum/wp-content/uploads/sites/2/2016/11/2013Folklife72pagescorrected.pdf> and <https://www.cso.ie/en/releasesandpublications/ep/p-1916/1916irl/economy/ag/>
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- Progressive farmer focus: Generating income for two families on a 70ac Monaghan farm, <https://www.agriland.ie/farming-news/progressive-farmer-focus-generating-income-for-two-families-on-a-70ac-monaghan-farm/> and <https://www.facebook.com/AgrilandIreland/videos/1542967452462464/?v=1542967452462464>
- Progressive farmer focus: Taking the reins and doubling production in Co. Cavan, <http://www.agriland.ie/farming-news/progressive-farmer-focus-taking-the-reins-and-doubling-production-in-co-cavan/> and <https://www.facebook.com/watch/?v=1535075433251666>
- Monaghan drystock farm hosts craft classes. A drystock farm near the village of Glaslough, Co. Monaghan is set to become a whole lot busier with craft classes taking place in renovated outbuildings, <https://www.agriland.ie/farming-news/monaghan-dry-stock-farm-hosts-craft-classes/>
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- Man dies in industrial accident on Co Monaghan farm, <https://www.agriland.ie/farming-news/man-dies-in-industrial-accident-on-co-monaghan-farm/>
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- Rainwater and wind turbines drive sustainability at Monaghan Mushrooms, <https://www.agriland.ie/farming-news/rainwater-and-wind-turbines-drive-sustainability-at-monaghan-mushrooms/>
- Young Monaghan farmers 'scoop' top enterprise award, <https://www.agriland.ie/farming-news/free-flow-bunkers-takes-third-prize-at-student-enterprise-final/>
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- Farmers to Market is Ireland's No.1 Free Range Chicken Supplier. The tradition of the Farmers to Market brand is rooted in the farming heritage of Counties Cavan and Monaghan, <http://www.farmerstomarket.ie/>
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<https://www.facebook.com/IrishFarmersAssociation/videos/10155203675516968/>
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<https://www.teagasc.ie/media/website/publications/2017/2016-NFS-Viability-Report.pdf>
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<https://www.rte.ie/news/2015/0713/714543-farm-households/>
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https://www.teagasc.ie/media/website/publications/2014/Off_Farm_Employment.pdf
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file:///L:/Ref%20Docs/Teagasc%20RD%20Conference%20Sepr%202014/Teagasc%20Farm_Viability_Analysis%20-%20Sept%2014.pdf
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 - Only 15% of farmers would consider leasing out their land, while only 4% would consider planting forestry within the next 3 years. Farmers were asked why they would not consider leasing out their land and an overwhelming majority reported that they would continue farming the land themselves. (p. 29)
<https://www.teagasc.ie/media/website/publications/2017/Small-Farms-Survey.pdf>
 - Dairy farm incomes drop by staggering 31% in 2018, <https://www.agriland.ie/farming-news/dairy-farm-incomes-drop-by-staggering-31-in-2018/>
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<https://www.irishtimes.com/business/work/two-out-of-five-jobs-in-republic-at-risk-of-being-lost-to-automation-1.3801703>
 - Which towns in rural Ireland are worth investing in? - A whole tier of Irish towns and villages need major investment. Can they be saved?, <https://www.irishtimes.com/life-and-style/which-towns-in-rural-ireland-are-worth-investing-in-1.3939487>
 - Presentation by Gabriel O'Connell on role of LEADER Programme in Smart Villages – July 2019, <https://www.midl.ie/index.php/downloads>
 - Series of Irish Times articles explores five challenges facing rural Ireland – diversity and migration, ; poverty; rapid growth; post-recession recovery; and depopulation – and ways to overcome them, <https://www.irishtimes.com/life-and-style/edgeworthstown-co-longford-new-communities-saved-this-town-1.3937048>, and <https://www.irishtimes.com/life-and-style/kilrush-would-be-a-lot-better-if-it-was-below-in-kerry-1.3939391>, and <https://www.irishtimes.com/life-and-style/life-in-a-commuter-town-they-call-sallins-dublin-28-1.3938187>, and <https://www.irishtimes.com/life-and-style/the-town-that-got-over-a-flood-a-recession-and-a-bypass-1.3939241>, and <https://www.irishtimes.com/life-and-style/the-carlow-village-that-wants-to-cancel-the-commute-1.3939592>

List of social media used and accounts/groups:

- Irish Farmers' Association (IFA) Farming Sector Blogs:
 - Forestry Blog <https://www.ifa.ie/sectors/forestry/>
 - Liquid Milk Blog <https://www.ifa.ie/sectors/liquid-milk/>
 - Sheep Blog <https://www.ifa.ie/sectors/sheep/>
 - Dairy Blog <https://www.ifa.ie/sectors/dairy/>
 - Beef Blog <https://www.ifa.ie/sectors/cattle/>
- Irish Cattle & Sheep Farmers Association - <https://icsaireland.ie>
- ICMSA Irish Family Farm Association - <http://icmsa.ie/>
- Macra na Feirme - www.macra.ie
- Irish Countrywomens Association – www.ica.ie
- Origin Green Ireland - www.origingreen.ie
- NUI Galway Rural Studies - https://m.facebook.com/story.php?story_fbid=976234829383672&id=554220964918396
- Teagasc Irish Agriculture and Food Development Authority - www.teagasc.ie
- Enterprising Monaghan, <https://enterprisingmonaghan.ie/blog/>
- *Irish Farmerette Blog*, <http://www.lornasixsmith.com>
- *Milk Maid Marian Blog*, <https://milkmaidmarian.com>
- *The Dairy Mom Blog*, <http://thedairymom.blogspot.ie>
- *Guernsey Dairy Mama Blog*, <http://www.guernseydairymama.com>
- *A Farm Wife Blog*, <https://www.afarmwife.com>
- Meeting to hear concerns of farmers in Cavan and Monaghan, <https://www.northernsound.ie/meeting-to-hear-concerns-of-farmers-in-cavan-and-monaghan>
- Social Farming Ireland, <https://www.socialfarmingireland.ie>
- Co Monaghan Public Participation Network (PPN), <https://ppnmonaghan.ie> and Member Groups, <https://ppnmonaghan.ie/meet-your-ppn/member-groups>
- Facebook: <https://www.facebook.com/Monaghan-Integrated-Development-1445713829016519/> and <https://www.volunteermonaghan.ie/>
- IFA Facebook home page <https://www.facebook.com/IrishFarmersAssociation/>

22 ANNEX J Responses to the monitors' comments

Comments made by the monitors	Explanation
<p>The interfaces for the PoliRural project will be integrated so that the end user will view everything as a unity</p> <p>The pilot user needs are not fully consistent e.g. the long, long list of data requirements do not align with the very short list for Italy or for Finland. It's recognised that different pilots will have different needs and it is good therefore to see that these have been abstracted into broader requirements on pp. 28-9. However some of these seem to have overlap e.g. monitor economic activities and analyse labour market? There seems to be a gap with respect to demographics and shifting nature of the rural population (to include youth exodus, ageing and immigration); rural entrepreneurship; social innovation; civic engagement. All of these are fundamental to successful rural development and rural attractiveness. I remain unconvinced that the statement on p. 69 stands: Thus, great attention has been paid to type, nature and volume of data as well as explicitly mentioned and implicit requirements for storage, analytics and visualization.</p> <p>What is the value of the DIH? How will the list on page 8 help to enhance the attractiveness of rural areas? The way this will contribute to the over- arching project objectives is not clear.</p> <p>Basic architecture of system is described and as such there is a lot of technical information.</p>	<p>Introduction of the Digital innovation Hub, its contribution to the enhancement of the rural areas attractiveness as well as its alignment with the overall PoliRural workflow were added into the section 2 Concept.</p>