Open Transport Net

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D2.1 CURRENT SITUATION ANALYSIS

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1 Executive Summary

OpenTransportNet's (OTN) ambitious goal is to develop a network of collaborative virtual service hubs that aggregate, harmonise and visualize open transport-related data to drive the rapid creation of innovative new applications and services.

To kick-start the project in the first months, the Consortium conducted a Current Situation Analysis to provide a quick snapshot of how GI is currently being published and used across Europe. Information was gathered from partner networks, a public sector survey as well as through desktop research. This subsequent report provides a useful reference guide for all project partners, especially those new to the GI domain, of the key considerations that need to be addressed when designing and developing the OTN hub solution.

The report begins by familiarizing readers with important GI initiatives by providing an overview of the cutting edge use and commercialization of Geospatial Information. The chapter outlines specific top-down initiatives and bottom-up approaches to GI before focusing on relevant standards. This complex chapter ends with the conclusion that OTN Hubs will go beyond the State-of-the-Art of existing initiatives by:

- Improving the accuracy of data insights by enhancing knowledge with Volunteered Geographic Information (VGI), and
- Deploying a sophisticated Access Control and Identity Management system that will manage privacy controls.

The next stage of the analysis focuses on helping Pilot partners to better understand the problems of data harmonization and to help them identify and describe suitable datasets. Key recommendations from initial data analysis include:

- Open Street Map should be the base map for OTN visualizations to meet VGI requirements
- Metadata should follow INSPIRE data and metadata profiles, and
- OTN should not just focus on open data but also on data that is published in a non-standard way with restricted use – meaning work focusing on licensing is necessary

Following on from data use, is a chapter outlining the results of the OTN Data Survey, used to get initial feedback from Public Sector managers who will be the most likely adopters of OTN from a sustainability (rather than broader end-user) point of view. The findings from the survey will help influence the communications and commercialization plan for OTN. Result highlights include:

- Only 22% of respondents today use linked open data
- 91% believe that the greatest benefit of open data is the stimulation of new service ideas
- The biggest barriers to GI use is access to high quality datasets, and lack of friendly data tools

Next, the Collaboration and Knowledge Sharing section describes 25 different best practice projects that technical partners, pilot partners, and communication partners may wish to explore further to identify possible tools and resources that could be useful to OTN. Finally the Climate chapter outlines some initial policy, economic, social and technical factors that could influence the OTN project moving forward. Factors to watch include differing pricing and legal requirements for licensing across various European countries.

The Current Situation Analysis Report concludes with a set of recommendations for specific OTN work packages, as well as the creation of OTN's first SWOT analysis. This SWOT analysis will be adopted by the Communications and Exploitation work package and will be kept updated on a regular basis so it can be used for helping to position OTN in the GI and transport services market.

Whilst not a traditional academic study, this first piece of research from OTN provides a comprehensive overview of GI use and its influences. Though long in length the structure means that OTN partners can either read the whole document end-to-end or select the chapters they deem most relevant to them.

2 Introduction

2.1 Objectives of OTN

OpenTransportNet's (OTN's) primary objective is to create an ambitious network of collaborative virtual service hubs that aggregate, harmonize and visualize open transport-related data to drive the rapid creation of innovative new applications and services. OTN specifically chose Transport as a cross border focus-area because it touches upon almost every facet of 21st century living, making it an ideal target for the creation of solutions that can be enhanced by location based services such as GNNS and VG resources such as OSM. [1]

OTN service delivery hubs will address the following challenges:

1) Need to better aggregate and harmonize data to improve accessibility and use,
2) Need to link spatial and non-spatial data to extract value and increase accuracy and,
3) Need to provide innovators with easier APIs and GUIs to stimulate the creation of new services and commercial opportunities.

OTN innovation hubs will overcome the above challenges by using an automated flexible dataset aggregator to integrate and harmonise transport related data. OTN hubs will combine spatial (GI), dynamic data streams and non-spatial (OD) data and derive insights from the data through visualisation tools and pattern detection algorithms. OTN Hubs will go beyond the State-of-the-Art by (a) improving the accuracy of data insights by enhancing knowledge with Volunteered Geographic Information (VGI) and (b) deploying a sophisticated Access Control and Identity Management system that will manage privacy controls.

OpenTransportNet will be validated in four pilot locations the UK, Belgium, France and the Liberec Region. The OTN solution will use a Social Enterprise Freemium business model. OTN Lite will be an open service that provides access to open data sets and an innovation environment. OTN Premium will be available for a fee that enables users access to business incubation.

2.2 Aim of this Report

The OpenTransportNet project kicked off in early February 2014, with a first task being the conduction of a rapid situation analysis of Open Data use across Europe focusing in particular on Geospatial information (GI), both generally and in the Transportation field. This report represents the findings of this snapshot. Whilst not claiming to be scientifically absolute, the information gathered has helped OTN to identify best practices in the use of GI and to understand problems that arise in its use. Specifically our report set out to identify:

- What kind of open GI data sets exist that can be used in the transport domain?
- What are the key similarities between the identified data sets?
- What are the key barriers to using open GI and data for innovation?
- Where are the gaps in existing standardization processes for using open GI?
- Which projects/organisations are currently using GI to deliver new services and business activities?

By leveraging networks of expertise available within the OTN Consortium, undertaking a literature review, and by consulting with stakeholders via an online survey, OTN has created this report outlining the current situation of open GI use in Europe, along with a set of practical recommendations to be further explored as the project moves forward towards achieving its goals. The OTN team hopes that the contents of this report will provide useful information for all OTN Partners, as well as other projects in the field.

[1] *The transport industry directly employs around 10 million people and accounts for about 5% GDP. The quality of transport services has a major impact on quality of everyday citizen lives. The average household* spends 13.2% of its budget on transport goods and services Source: http://europa.eu/pol/trans/

3 GI General Background Analysis

3.1 State-of-the-Art Use and Commercialisation of GI

"Spatial Data Infrastructures (SDIs) main goal is to provide access to geospatial data in a country, or across a given area or domain. Data is provided from several sources, and Spatial Data Infrastructures are distributed environments. The Internet could be now considered as enabler of new Spatial Data Infrastructures. The Internet allows making geospatial data available on a local level. More and more user centred information services are becoming available. Important is development of new technologies like smart phones, tablets GPS, and digital cameras." (Boes 2012) [2] SDI provides mechanisms for spatial data integration and sharing. Information coming from users, social network sites, sensors and other data providers can be made accessible and re-used for other purposes. Spatial data infrastructure (SDI), sometimes referred to as spatial information infrastructure, is generally understood as "a computerised environment for handling data that relate to a position on or near the surface of the earth." (CEN/TR 15449:2011). Spatial data, sometimes referred to as geographic data, geo-data or geospatial data, are defined by INSPIRE as "data with a direct or indirect reference to a specific location or geographic area." (European Commission 2010b)[3]. It has been estimated that over 80% of all data has spatial component. Spatial aspect is sometimes amended by temporal aspect. Spatial components enable to locate objects, processes and other phenomena, to model their shape and to analyse their relation to other data.[4] Spatial data as a model of real world represent a fundamental cornerstone of all geo-information technologies (GITs), spatial applications and spatial services.

Many public organisations produce and collect a broad range of different types of spatial data in order to perform their tasks. Spatial government data is progressively becoming more easily accessible and can be used in conjunction with information from other sources. Producing and updating geospatial data is expensive and resource intensive. Hence, it becomes crucial to be able to integrate, repurpose and extract added value from geospatial data to support decision making and management of local, national and global resources. Spatial Data Infrastructures (SDIs) and the standardisation efforts from the Open Geospatial Consortium (OGC) serve this goal, enabling geospatial data sharing, integration and reuse among Geographic Information Systems. Geospatial data is now, more than ever, truly syntactically interoperable. However, they remain largely isolated in the GIS realm and thus absent from the Web of Data and Linked data technologies enabling semantic[5] interoperability.

Spatial data openness improves the territorial decision making of both governments and individuals. In particular, the public is expected to be able to use spatial government data for better decision making specific databases easily accessible, through mobile apps, to better inform their choices; while governments are expected to be able to more easily access a wider range of datasets to foster evidence-based decision making.[6]

Open spatial public data resources for re-use is one of the key priorities of the Digital Agenda for Europe. Data available in public European organisations have an enormous potential economic growth.

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[2] *Boes, U., 2012. Building spatial data infrastructures in South-East Europe: Alternatives, bottom up and user oriented approaches. In SDI, Communities and Social Media. Prague: Czech Centre for Science and Society.*

[3] *Commission of the European Communities, 2005. COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: "i2010 – A European Information Society for growth and employment."*

[4] *Karel Charvát, Tomáš Mildorf, Otakar Čerba, Štěpán Kafka: SDI, INSPIRE & OTHER INITIATIVES, in INSPIRE and Social Empowerment for Environmental Sustainability, Results from the HABITATS project, edited by Mariano Navarro, Ana Sáez, Jesús Estrada, Published by: TRAGSA, 2013, ISBN-10: 84-616-3646-5*

[5] *John J O'Flaherty, D2.1 Requirements of the SmartOpenData Infrastructure, Linked Open Data for environment protection in Smart Regions, January 2014*

[6] *Barbara Ubaldi Open Government Data TOWARDS EMPIRICAL ANALYSIS OF OPEN GOVERNMENT DATA INITIATIVES, OECD Working Papers on Public Governance No. 22*

Nevertheless, finding and accessing environmental information is not always straightforward. There exists a strategy for Open Government Data generally, which could be adopted also for geospatial data. Open Government Working Group defined the following principles for Open Government:

1. Complete: All public data are made available. Public data are data that is not subject to valid privacy, security or privilege limitations.
2. Primary: Data are as collected at the source, with the highest possible level of granularity, not in aggregate or modified forms.
3. Timely: Data are made available as quickly as necessary to preserve the value of the data.
4. Accessible: Data are available to the widest range of users for the widest range of purposes.
5. Machine processable: Data are reasonably structured to allow automated processing.
6. Non-discriminatory: Data are available to anyone, with no requirement of registration.
7. Non-proprietary: Data are available in a format over which no entity has exclusive control.
8. License-free: Data are not subject to any copyright, patent, trademark or trade secret regulation. Reasonable privacy, security and privilege restrictions may be allowed.[7]

Probably the most advanced country in Europe with implementation of Open Governmental Data Policy is the UK. UK Public Data Principle's are as follows:

1. Public data policy and practice will be clearly driven by the public and businesses that want and use the data, including what data are released when and in what form.
2. Public data will be published in re-usable, machine-readable form.
3. Public data will be released under the same open licence, which enables free re-use, including commercial re-use.
4. Public data will be available and easy to find through a single, easy-to-use, online access point (www.data.gov.uk).
5. Public data will be published using open standards, and following relevant recommendations of the World Wide Web Consortium (W3C).
6. Public data from different departments about the same subject will be published in the same, standard formats and with the same definitions.
7. Public data underlying the Governments own websites will be published in re-usable form.
8. Public data will be timely and fine-grained.
9. Release data quickly, and then work to make sure that it is available in open standard formats, including linked data forms.
10. Public data will be freely available to use in any lawful way.
11. Public data will be available without application or registration, and without requiring details of the user.
12. Public bodies should actively encourage the re-use of their public data.
13. Public bodies should maintain and publish inventories of their data holdings.
14. Public bodies should publish relevant metadata about their datasets and this should be available through a single online access point; and they should publish supporting descriptions of the format provenance and meaning of the data.[8]

Public sector information is a strategic resource, holding great potential for a number of beneficiaries including public sector agencies, private businesses, the academia, citizens and civic organisations. It includes IT professionals, both small and large companies, and entrepreneurs as well as developers, government employees, civil society organisations and individual citizens active on the national or international level. Opening of governmental data does not guarantee economic development. It could be

[7] *http://resource.org/8_principles.html, adopted in December 2007.*

[8] *http://data.gov.uk/library/public-data-principles.*

guarantee by offering innovative value-added services on top of data, and providing opportunities for business start-ups. The next schemes coming from OECD document describe process of generating and re using of governmental data for commercial purposes.

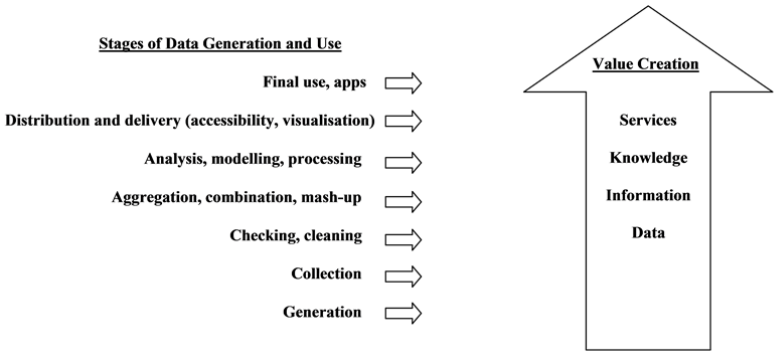

Figure 1 Stage of data generation and use

Currently geospatial datasets are not aggregated and are not easy to use for business issues: spatial data users are confronted to fragmented data sets, unable to create comparative analysis, monitoring and analysing spatial data, or developing inquiries and projects. Researchers, spatial data users and professionals from different disciplines, such a real estate, transport, the insurance industry, investors, agriculture or market-relevant activities related to territorial development have a growing stake in such capabilities.[9] A further stimulus for the commercial sector will be the possibility of adding value to information. Combining spatial data sets from different sources will grow the value of spatial data. New technologies of Linked Open are a good possibility for this new added value services. If spatial data are combined with statistical data and data from other registries the value of data will rapidly grow.

3.2 GI Initiatives

The review of current GI Initiatives is broken down for the purposes of this document into two key areas; (1) Policy, and (2) Voluntary initiatives, providing a comprehensive overview of each approach. This chapter is extremely useful for project partners new to the Geospatial Information domain.

3.2.1 Policy Initiatives or Top Down Approaches

INSPIRE

The Infrastructure for Spatial Information in the European Community (hereinafter referred to as INSPIRE) was established by the Directive 2007/2/EC of the European Parliament and of the Council of 14th March 2007 (hereinafter referred to as INSPIRE Directive). INSPIRE lays down general rules to establish an infrastructure for spatial information in Europe for the purposes of Community environmental policies, and policies or activities that may have an impact on the environment. The most significant general rules are summarised in the following INSPIRE principles:

- The infrastructures for spatial information in the Member States should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level;
- It is possible to combine spatial data from different sources across the Community in a consistent way and share them between several users and applications;

[9] *Didier Vancutsem, Pietro Elisei (ISOCARP); Joachim Rix (IGD); Tomas Mildorf (UWB); Karel Chavat (HSRS), Przemyslaw Turos (GEOSYSTEMS), A service platform for aggregation, processing and analysis of urban and regional planning data , Plan4business 2013*

- It is possible for spatial data collected at one level of public authority to be shared between all the different levels of public authorities;
- Spatial data are made available under conditions that do not restrict their extensive use;
- It is easy to discover available spatial data, to evaluate their fitness for purpose and to know the conditions applicable to their use. (INSPIRE 2012)[10]

INSPIRE should be based on existing spatial data and SDIs that are created by Member States. To ensure that the infrastructures are compatible and usable in a Community and trans-boundary context, the INSPIRE Directive requires that common Implementing Rules are adopted in a number of specific areas.

INSPIRE addresses mainly policy and activities that may have a direct or indirect impact on the environment. The INSPIRE Directive applies to spatial data sets and services held by or on behalf of public authorities and used in the performance of their public tasks. Data must be in electronic format and must relate to one or more of the themes listed in Annexes I, II or III of the INSPIRE Directive.

The development and implementation of INSPIRE follows a programme of work consisting of three phases. These are the Preparatory (2005-2006), the Transposition (2007-2009) and the Implementation (2009-2019) phases.

The Preparatory Phase (2005-2006) started with the Commission's proposal for INSPIRE and was successfully finished with its entry into force. The Implementing Rules begun to be drafted with the involvement of key stakeholders.

During the Transposition Phase (2007-2009) Member States focused on transposing the INSPIRE Directive's requirements into their own legislative systems. Member States are therefore engaged in implementing the technologies, policies and institutional arrangements that will form the basis for their INSPIRE compliant systems. The development of the draft Implementing Rules continued in this phase.

The Implementation Phase (2009-2019) covers the implementation of the Rules by Member States and the monitoring of the implementation through reporting according to the road map of the INSPIRE. The Implementing Rules are for the following INSPIRE elements:

- **Metadata** – Metadata are defined in the INSPIRE Directive as "information describing spatial data sets and spatial data services and making it possible to discover, inventory and use them". Discrete units of metadata are metadata elements (e.g. resource title, keyword, spatial resolution, responsible organisation). In order to have metadata compatible and usable in trans-boundary context, it is necessary to lay down rules for metadata (Kafka et al. 2010)[11]. INSPIRE metadata profiles for spatial datasets, spatial datasets series and for services are outlined through a set of metadata elements. It includes the minimum set of metadata elements necessary to comply with the INSPIRE Directive. It should ensure that all geospatial information resources and data produced and made available by Member States and their constituent organisations are catalogued in a standard way to support a consistent means of discovery, understanding and access across the Community.
- **Data Specifications –** Data Specifications pertain to the content of a basic set of data themes that each Member State is required to maintain and also the technological standards for communication of those data themes for use. The set of spatial data themes is listed in Annexes I, II and III to the INSPIRE Directive. These rules will enable full data use and interoperability across the INSPIRE network.

[10] *INSPIRE, 2012. INSPIRE. Available at: http://inspire.ec.europa.eu/.*

[11] *Kafka, Š., Fiala, R. & Mildorf, T., 2010. Plan4all Metadata Profile. Plan4all Newsletter, (3).*

- **Network Services –** Member States are required to establish and operate a network of services for the spatial data sets and services. In order to ensure the compatibility and usability of such services on the Community level, it is necessary to lay down the technical specifications and minimum performance criteria for those services with regard to the themes listed in Annexes I, II and III to the INSPIRE Directive. In order to ensure that public authorities and the third parties are given the technical possibility to link their spatial data sets and services to the Network Services, it is necessary to lay down the appropriate requirements for those services (including services that enable discovery, viewing, downloading and data transformation).
- **Data and Service Sharing** - The INSPIRE Directive requires the development of implementing rules to regulate the provision of access to spatial data sets and services from Member States to the institutions and bodies of the Community.
- **Monitoring and Reporting** - In order to have a solid basis for decision making related to the implementation of the INSPIRE Directive and to the future evolution of INSPIRE, continuous monitoring of the implementation of the Directive and regular reporting are taking place. Quantitative indicators for assessing the progress of SDI implementation in the EU Member States and the structure of qualitative reports are outlined. (Mildorf 2009)

The scope of INSPIRE is on data relevant to environment. The INSPIRE Directive includes spatial data themes divided into three annexes as depicted in Figure 2.

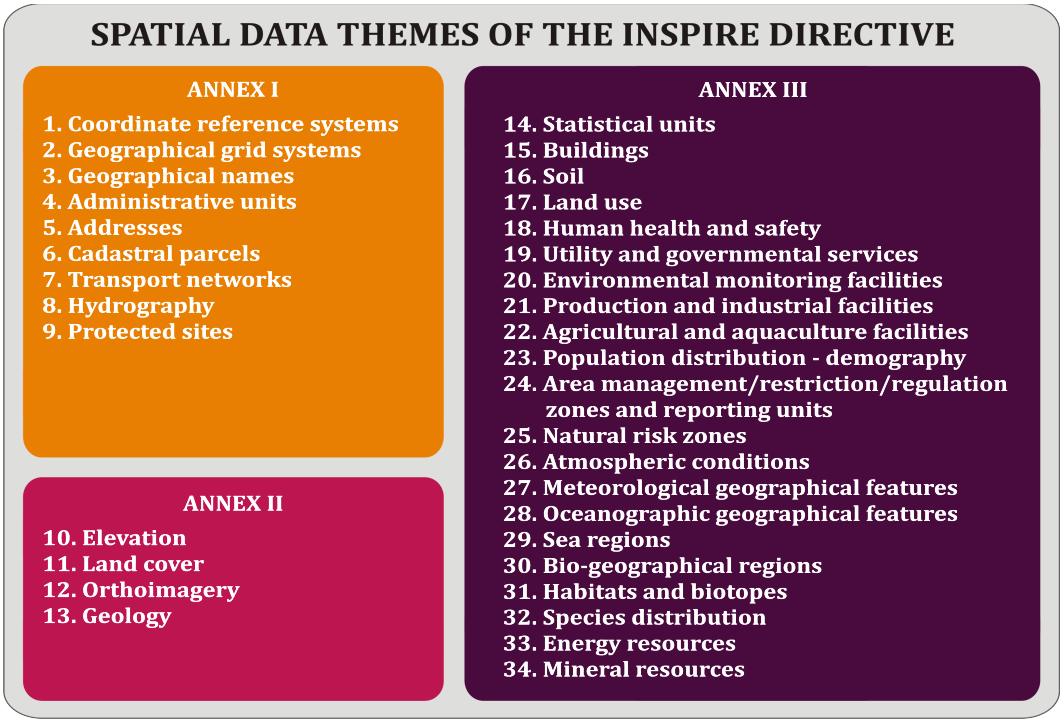

Figure 2 INSPIRE spatial data themes.

GEOSS

The vision for Global Earth Observation System of Systems (GEOSS) is to "realize that the originators of future decisions and activities for the benefit of humankind are well informed thanks to coordinated, comprehensive and sustained Earth observations." (Klien et al. 2009)[12]. GEOSS must provide access and improved interoperability both for the existing and future observation systems. GEOSS is based on voluntary contribution of governments and international organizations.

[12] *Klien, E., Annoni, A. & Marchetti, P.G., 2009. The GIGAS project – an action in support to GEOSS, INSPIRE, and GMES.*

The Global Earth Observation System of Systems (GEOSS) has been built by the Group on Earth Observations (GEO) and currently the implementation plan for the period 2005 to 2015 is being accomplished. The GEOSS is a user centric initiative, which is focused on better utilisation of environmental data and decision-support tools by users. The main focus is on Earth observations on global scale. The goal is to deploy global infrastructure, which will be able to supply near-real-time environmental data, information and analyses for a wide range of users. The focus of GEOSS is on nine areas called "Societal Benefit Areas". They include: (a) disasters, (b) health, (c) energy, (d) climate, (e) water, (f) weather, (g) ecosystems, (h) agriculture, (i) biodiversity.

Copernicus

Copernicus, previously known and hereinafter referred to as Global Monitoring for Environment and Security (GMES), is a European system for monitoring the Earth. The main objective of GMES is to monitor and better understand our environment. GMES serves decision-makers who rely on strategic information with regard to environmental and security issues with an independent and permanent access to reliable data. (European Commission 2012a)[13]

The purpose of GMES is to deliver information that corresponds to the user needs. The processing and dissemination of this information is carried out within the "GMES service component". The thematic areas within the GMES service component comprise:

- Land, marine and atmosphere information – ensuring systematic monitoring and forecasting the state of the Earth's subsystems at regional and global levels;
- Climate change information – helping to monitor the effects of climate change, assessing mitigation measures and contributing to the knowledge base for adaptation policies and investments;
- Emergency and security information – providing support in the event of emergencies and humanitarian aid needs, in particular to civil protection authorities, also to produce accurate information on security related aspects (e.g. maritime surveillance, border control, global stability, etc.)

The GMES service component depends on Earth observation data collected from space (satellites), air (e.g. airborne instruments, balloons to record stratosphere data), water (e.g. floats, shipboard instruments) or land (e.g. measuring stations, seismographs). These facilities are commonly referred to as GMES infrastructure component, while the non-space based installations in the GMES infrastructure component are generally referred to as "in situ component". The GMES architecture is portrayed in Figure 3. (HABITATS 2011)[14]

[13] *European Commission, 2012a. Copernicus. Copernicus, The European Earth Observation Programme. Available at: http://copernicus.eu [Accessed December 19, 2012].*

[14] *HABITATS, 2011. D4.1 State of the Art of existing SDI,*

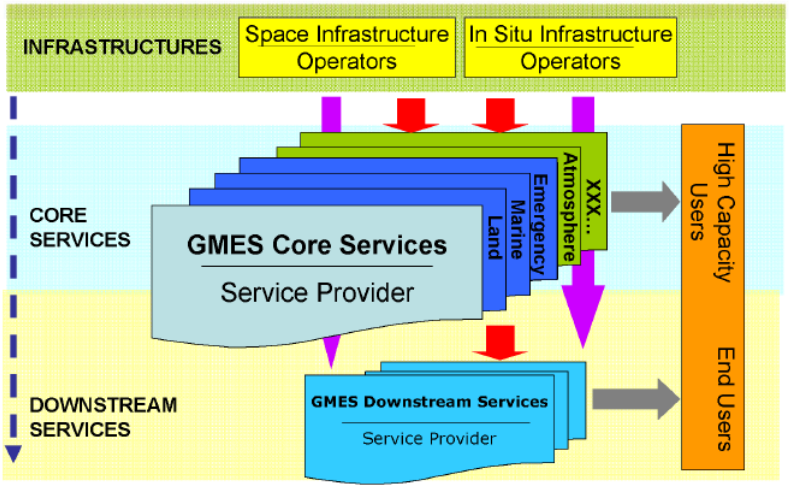

Figure 3 GMES architecture (ESA).

SISE and SEIS

In 2005 the European Commission launched the i2010 strategy: A European Information Society for Growth and Employment. The Commission defined three pillars for i2010 (Commission of the European Communities 2005):

- Single European Information Space;
- Innovation and Investment;
- Inclusive European Information Society.

The objectives of the Single European Information Space are to offer high-bandwidth communications, rich content and digital services with a market-oriented regulatory framework. The concept of **Single Information Space in Europe for the Environment (SISE)** was formulated for the first time in 2005 as part of the Single European Information Space defined in i2010. The idea was that environmental institutions, service providers and citizens can collaborate or use available information without technical restraints. The following schema defines the relation of SISE and other ongoing European initiatives.

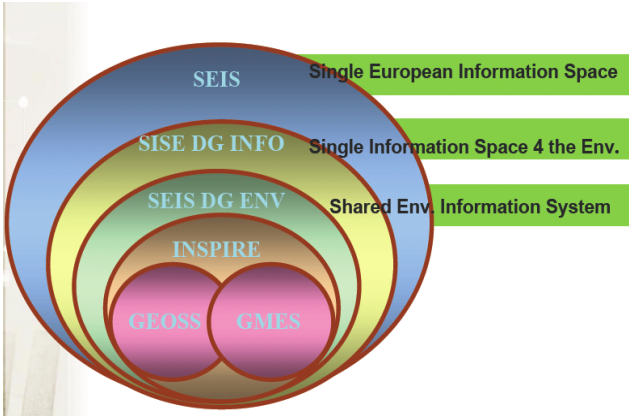

Figure 4 Shared Environmental Information Systems - peeling the onion (after Weets 2007).

The final vision of SISE was defined by the workshop of European experts in February 2008. The main objectives of SISE are as follows (O'Flaherty 2008):[15]

[15] *O'Flaherty, J., 2008. Towards a Single Information Space for the Environment in Europe., Brussels, Belgium. Available at: ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/sustainable-growth/sise-workshop-report-08_en.pdf.*

- SISE Context
  - Complexity Management;
  - Environmental Legislation in Europe;

- Application/Services
  - SISE Services;
  - Process Chaining & Uncertainties;
  - Real-time Mapping & Modelling;
  - Thesauri;
  - Open Standards & Open Source Software;

- SISE Open Semantics & Standards
  - Standardisation & Framework Projects;
  - Standardisation & Community Knowledge;
  - Semantic Web Technologies for the SISE;
  - Ontologies;
- Data Interoperability &Web Communities
  - Web 2.0 Technologies;
  - Data Provision in the Semantic Web;
  - SOA/Web Services & Model Driven Communities;
  - Social SISE;

- Data Visualisation & Modelling including Risk Assessment
  - Visualisation of Environmental Data;
  - SOA & Semantic Web Services;
  - Simulation & Modelling;
  - Complex 3D/4D Models;
  - Chained Web Services & Legacy Systems;

- SISE Deployment Models
  - From Framework Projects to Market Deployment;
  - Project's Knowledge Loss;
  - Regional Application of European Interoperability Standards;
  - SISE & Business Models;
  - Environmental Information Service Economy (EISE).

Shared Environmental Information System (SEIS) is based on the following principles (Hřebíček & Pillmann 2009)[16]:

- Managing all environmental information as closely as possible to its source.
- Collecting environmental information once, and sharing it with others.
- Making environmental information available to public authorities.
- Making environmental information readily accessible to end-users to enable them to assess the state of the environment in a timely fashion.

[16] *Hřebíček, J. & Pillmann, W., 2009. Shared Environmental Information System and Single Information Space in Europe for the Environment: Antipodes or Associates? In Proceedings of the European conference of the Czech Presidency of the Council of the EU: TOWARDS eENVIRONMENT. European conference of the Czech Presidency of the Council of the EU TOWARDS eENVIRONMENT. Prague, Czech Republic: Masaryk University. Available at: http://www.e-envi2009.org/proceedings.pdf.*

- Making environmental information accessible to enable comparisons at the appropriate geographical scale.
- Making environmental information fully available to the general public.

The concept of SEIS is based on information support for implementation of European Environmental Policies. The SEIS is mainly top-down driven and involves participation of mainly public organisations.
The authors consider as important to continue with the SISE vision as a complementary initiative to SEIS. This should ensure (Pillmann et al. 2009)[17]:

- Bottom up approach;
- Participation of public bodies, private initiatives, communities and social networks in SISE building;
- Sharing of information, its analysis and modelling;
- Education, participation access to information, protection, preparedness;
- Sharing not only data but also services.

European Union Location Framework[18]

The objective of this action is to create a European Union Location Framework (EULF) addressing the EU-wide, cross-sector interoperability framework for the exchange and sharing of location data and services. The EULF will consist of a package of legal acts, methodologies, specifications (and standards), guidelines, and training materials required by public administration and stakeholder communities to facilitate the implementation, use and the generalisation of the Infrastructure for Spatial Information in the European Community (INSPIRE) to a wider location context independently of the thematic sector (as part of e-government programmes).

The activities will contribute to the update of Reference Interoperability Agreements (RIA) and to the definition of a common vision for a European Interoperability Architecture (EIA) based on lessons learnt from sectoral projects or from large scale pilots, to monitoring the contribution of ISA interoperability actions and other projects, to the implementation of the common vision for the EIA. The activities might also include the development of tools, guidelines on how to use the RIA, pro-active participation in standardisation efforts, etc.

To work with the Member States and the concerned Commission services towards a joint vision on the EIA for a European Public Services (its scope, the articulation of the main architectural building blocks and the need for interface standards between such architectural building blocks). To assess the need and the relevance of having common infrastructure services. Drafting of the Framework through an iterative process based on workshops with standardization bodies and Member States' representatives.

What are the benefits:

- Increased awareness of the benefits of using geospatial data and interoperable location base services for innovation and growth.
- A recognized and coherent location framework facilitating the exchange and sharing of location data, as well as the development and interoperable location based services.
- Increased interoperability between public administrations and leverage of investments.
- Enhanced use of standards in Europe and of quality information contributing to the digital single market goals.
- Increased coherence and consistency in EU policies.

[17] *Pillmann, W. et al., 2009. Screening of Information Sources for an Integrated Environmental Information Space.*
[18] *http://ec.europa.eu/isa/actions/02-interoperability-architecture/2-13action_en.htm*

Open Data

Public sector information (PSI) is one of the largest sources of information in Europe. It is produced and collected by public bodies and includes digital maps and meteorological, legal, traffic, financial, economic and other data. Most of this raw data could be re-used or integrated into new products and services, which can be used on a daily basis, such as car navigation systems, weather forecasts, financial and insurance services. Re-use of public sector information means using it in new ways by adding value to it, combining information from different sources, making mash-ups and new applications, both for commercial and non-commercial purposes. (European Commission 2012b)[19]

The Commission's EU Open Data Strategy[20] asserts that opening up access and reuse of public sector data offers major opportunities not only for innovation and growth but also for more informed science, greater public participation, and for addressing societal and environmental challenges. The strategy is part of the Digital Agenda, one of seven flagships supporting the Europe 2020 strategy to achieve growth based on research and innovation, a low carbon-economy, jobs and poverty reduction. Another flagship initiative of relevance for this project is the Innovation Union, which argues for better use of existing investment in research and research infrastructures, pursuing a broad concept of innovation that is "involving all actors and all regions in the innovation cycle: not only major companies but also SMEs in all sectors, including the public sector, the social economy and citizens themselves ('social innovation')".

The Open Data movement covers many aspects of using existing data sets without any limits or restrictions – "A piece of data is open if anyone is free to use, reuse, and redistribute it — subject only, at most, to the requirement to attribute and/or share-alike." The Open Data activities mean open-source, open-content and open-access. They are focused above all on technical solutions (open APIs, standardised formats etc.) or on legal issues.

Open Linked Data[21] represent the highest level of Open Data according to the five-star rating. These data are available on the web (1st star), represented as a structured data (2nd star), stored in non-proprietary format (3rd star), described by URL (4th star) and linked with another data (5th star).

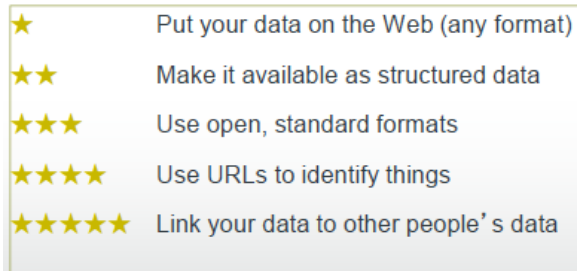

Figure 5 Five-star rating scheme (LATC project 2012)[22]

Open Linked Data Strategy is becoming a source of unprecedented visibility for any data that will enable the generation of new businesses, as well as a significant advance for research. Nevertheless, in order for this envisioned strategy to become a reality, it is necessary to advance the publication of existing data, usually owned by public bodies.

[19] *European Commission, 2012b. Public Sector Information - Raw Data for New Services and Products. Available at: http://ec.europa.eu/information_society/policy/psi/index_en.htm [Accessed December 19, 2012].*
[20] *http://europa.eu/rapid/press-release_MEMO-11-891_en.htm*
[21] *http://www.w3.org/DesignIssues/LinkedData.html*
[22] *LATC project, 2012. 5 star Open Data. Available at: http://5stardata.info/.*

3.2.2 Voluntary Initiatives or Bottom Up Approaches

INSPIRE is a politically driven top down approach. It is important to see how INSPIRE reflects local, regional and national needs. Currently, there is low awareness on regional level and the benefits for the local level are not clearly defined. During the JRC Cost benefit workshop in 2012 the schema depicted in Figure 6 was presented.

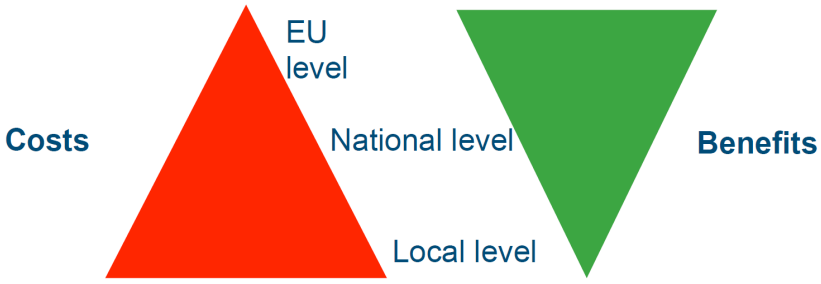

Figure 6 Reverse "pyramid" effect (Bregt 2012).[23]

Neogeography

There exist a large number of different voluntary or bottom-up initiatives supporting building of different parts of SDI. The SDI world is changing with development of new GPS devices, smartphones, mobile cameras and tablets. More and more localised information is collected by citizens. For this type of data collection the terms "people as sensors" or "human sensors" are often used. This means that "human observations" can be part of future real-time SDIs and serve as an input for spatial decision-making processes. Current use and collection of data by citizens is higher than collection of data by public bodies. Such process is depicted in Figure 7.

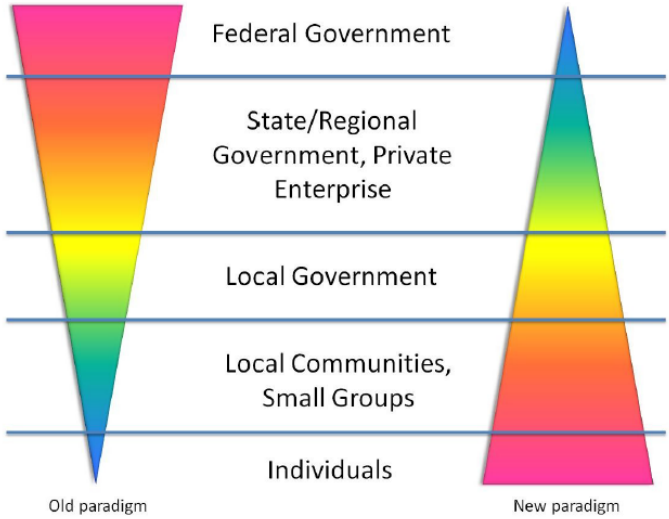

Figure 7 The changing sources of spatial data (Harris & Lafone).

Local and community activities capture local knowledge in multiple media forms including videos, photos or oral histories. The collected information can contribute to up-to-date data. The term neogeography is used for these methods. It is related to new Application Programming Interfaces (APIs), Web 2.0 and the mapping capabilities of the Geospatial Web. People can create "geotagged" information from mobile devices. This

[23] *Bregt, A., 2012. Cost-Benefit Analysis in Perspective.*

new technology opens new possibilities. Neogeography represents a new way of collection and geographic knowledge production using interactive technologies, interfaces and technical expertise. These methodologies bring serious challenges to SDIs and traditional forms of data acquisition, analysis, and publication. (Harris & Lafone) [24]

OpenStreetMap

OpenStreetMap (OSM) is a collaborative project aiming to create a free editable map of the world. The maps are created using data from portable GPS devices, aerial photography, other free sources or simply from local knowledge. The cartography in our map tiles, and our documentation, are licensed under the Creative Commons Attribution-Share-Alike 2.0 license (CC-BY-SA). OpenStreetMap is open data, licensed under the Open Data Commons Open Database License (OdbL). Registered users can upload GPS track logs and edit the vector data using the given editing tools.

OpenStreetMap can be considered as an example of neogeography. Citizens have an interest in sharing their findings within a community. Therefore, the architecture should foresee collaboration possibilities for people who are not employed by environmental agencies. Data reported by the general public need to be checked and validated before it may be published. Looking at this example, it is clear that the services used to build an Integrated Environmental Information Space need not only "access" functions but also "input" functions. (Pillmann et al. 2009)[25]

Geo-Wiki

The Geo-Wiki Project is a global network of volunteers who wish to help improve the quality of global land cover maps. Since large differences occur between existing global land cover maps, current ecosystem and land-use science lacks crucial accurate data. Volunteers are asked to review hotspot maps of global land cover disagreement and determine, based on what they actually see in Google Earth and their local knowledge, if the land cover maps are correct or incorrect. Their input is recorded in a database, along with uploaded photos, to be used in the future for the creation of a new and improved global land cover map. (Geo-Wiki Project 2012)[26]

Geo-Wiki, beyond simply improving land cover, include an application for helping to predict future deforestation in Central Africa (Nayar 2009) [27], and combining five existing cropland data sets from sub-Saharan Africa to create a new map which has higher accuracy than existing maps and should reduce uncertainty and improve predictions in land use, vegetation, climate change, and earth systems modelling. (Fritz et al. 2011)[28]

Plan4all Association

One of the results of the Plan4business project is an Open Platform, which will be Openly Accessible for any other volunteer initiative. These wide and varied scope of the platform's end users are granted with the opportunity of taking advantage of simplified and easier access to a comprehensive open data pool in order

[24] *Harris, T. & Lafone, F Toward an informal Spatial Data Infrastructure: Voluntary Geographic Information, Neogeography, and the role of citizen sensors. In O. Čerba & K. Čerbová, eds. SDI, Communities, and Social Media. Czech Centre for Science and Society 2013*

[25] *Pillmann, W. et al., 2009. Screening of Information Sources for an Integrated Environmental Information Space.*

[26] *Geo-Wiki Project, 2012. The Geo-Wiki Project. Available at: http://geo-wiki.org.*

[27] *Nayar, A., 2009. Model predicts future deforestation. Nature News. Available at: http://www.nature.com/news/2009/091120/full/news.2009.1100.html [Accessed December 19, 2012].*

[28] *Fritz, S. et al., 2011. Cropland for sub-Saharan Africa: A synergistic approach using five land cover data sets. Geophysical Research Letters, 38(4), p.L04404.*

to increase their effectiveness in everyday practice. Constantly growing, thanks to a unique co-operators network, this resource of freely accessible data, equipped with a powerful set of discovery, access, edition and analysis tools is called: the Open Data Platform (ODP). All the data in the hub are published as open data. All the tools provided by the ODP are available for free. Any party can access the data pool and create commercial or non-commercial apps based on these data. The use of the data must be in line with data licences provided in line with the conditions given by the data owners or data providers. Particular resources of ODP are accessible only for registered users, but still on non-profit rules. The Open Data Platform is expected to become an important part of future R&D projects. Existence of this kind of platform is in line with the European policy of opening access to public registers, but also is expected to stimulate the European companies competitiveness. It is obvious that this kind of initiatives require a long-term planning and constant development. That is why the idea of the Open Data Platform was decided to be initiated during the plan4business project and to be continued with a long time perspective. As a consequence to this approach and the necessity to harmonise non-profit operation with commercial one, it was decided to include the Open Data Platform in the business plan. For the managing of this open platform the association Plan4all was established.[29]

3.3 Standards

The standards important for OTN project could be divided into two main groups: (1) Industrial standards, and (2) Policy driven standards.

3.3.1 Industrial standards

Industrial standards relevant for OTN could be divided into three basis groups: (i) ISO standards, (ii) OGC standards, and (iii) W3C standards

ISO standards

ISO/TC 211 Geographic information/Geomatics is responsible for the ISO geographic information series of standards[30]. ISO/TC 211 provide standardisation in the field of digital geographic information. This work aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analysing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations. Many bodies are actively engaged in the work of ISO/TC 211. These include national standardization bodies, the OpenGIS Consortium (OGC), international professional bodies (such as FIG and ICA), UN agencies, and sectorial bodies (such as DGIWG and ICAO).

Project specification areas within the ISO/TC 211 technical committee include:

- Simple Features access
- Reference models
- Spatial and temporal schemas
- Location-based services
- Metadata
- Web feature and map services
- Classification systems

[29] *Przemysław Turos / GEOSYS, Didier Vancutsem / ISOCARP, Tomas Mildorf / UWB, Karel Charvat / HSRS, Tor Gunnar Overli / Avinet, Joachim Rix / Fraunhofer D2.4.2 Business Model final version, A service platform for aggregation, processing and analysis of urban and regional planning data, 2014*

[30] *http://www.isotc211.org/*

The ISO/TC 211 work is closely related to the efforts of the Open Geospatial Consortium. ISO/TC 211 have numerous liaisons with other organizations that often results in identical or nearly identical standards often being adopted by both organizations.[31]

OGC standards

The Open Geospatial Consortium (OGC), an international voluntary consensus standards organization, originated in 1994. In the OGC, more than 400 commercial, governmental, non-profit and research organizations worldwide collaborate in a consensus process encouraging development and implementation of open standards for geospatial content and services, GIS data processing and data sharing.[32]

OGC(R) standards are technical documents that detail interfaces or encodings. Software developers use these documents to build open interfaces and encodings into their products and services. These standards are the main "products" of the Open Geospatial Consortium and have been developed by the membership to address specific interoperability challenges. Ideally, when OGC standards are implemented in products or online services by two different software engineers working independently, the resulting components plug and play, that is, they work together without further debugging. OGC standards and supporting documents are available to the public at no cost. OGC Web Services (OWS) are OGC standards created for use in World Wide Web applications. Any Schemas (xsd, xslt, etc) that support an approved (that is, approved by the OGC membership) OGC standard can be found in the official OGC Schema Repository. All adopted OGC Implementation Standards can be found in this list: OGC Implementation Standards List. Many specifications are in the process of being advanced toward adoption by the OGC membership as official OGC standards.

The OGC Technical Committee (TC) has developed an architecture in support of its vision of geospatial technology and data interoperability called the OGC Abstract Specification. The Abstract Specification provides the conceptual foundation for most OGC standard development activities. OGC standards are built and referenced against the Abstract Specification, thus enabling interoperability between different brands and different kinds of spatial processing systems. The Abstract Specification provides a reference model for the development of OGC standards.

The OGC Reference Model (ORM) provides a framework for the ongoing work of the OGC. The ORM describes the OGC Standards Baseline (SB) focusing on the relationships between the OGC standards.[33]
The full list of standards is on http://www.opengeospatial.org/standards/is.

W3C standards

The World Wide Web Consortium (W3C) is the main international standards organization for the World Wide Web (abbreviated WWW or W3). W3C tries to enforce compatibility and agreement among industry members in the adoption of new standards defined by the W3C. Incompatible versions of HTML are offered by different vendors, causing inconsistency in how Web pages are displayed. Semantic Web aims at converting the current web, dominated by unstructured and semi-structured documents into a "web of data". The Semantic Web stack builds on the W3C's Resource Description Framework (RDF)[34]. According to the W3C, "The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.[35] The Semantic Web is a collaborative movement

[31] *http://en.wikipedia.org/wiki/ISO/TC_211*
[32] *http://en.wikipedia.org/wiki/Open_Geospatial_Consortium#Standards*
[33] *http://www.opengeospatial.org/standards*
[34] *W3C Semantic Web Activity". World Wide Web Consortium*
[35] *http://en.wikipedia.org/wiki/Semantic_Web*

led by international standards body the World Wide Web Consortium (W3C). The consortium tries to get all those vendors to implement a set of core principles and components, which are chosen by the consortium.[36] Tools and technologies emerging from the W3C's Data Activity are proving useful for data integration problems in information systems. Correspondingly, such technologies have been proposed as a means to facilitate interoperability and data reuse among GIS applications[37][38] and also to enable new analysis mechanisms[39]. The standard promotes common data formats on the World Wide Web. By encouraging the inclusion of semantic content in web pages, the

Ontologies are a key component of this semantic approach as they allow a formal, machine-readable specification of the concepts and relationships in a given domain. This in turn allows a GIS to focus on the intended meaning of data rather than its syntax or structure. For example, reasoning that a land cover type classified as deciduous needle leaf trees in one dataset is a specialization or subset of land cover type forest in another more roughly classified dataset can help a GIS automatically merge the two datasets under the more general land cover classification. Tentative ontologies have been developed in areas related to GIS applications, for example the hydrology ontology[40] developed by the Ordnance Survey in the United Kingdom and the SWEET ontologies[41] developed by NASA's Jet Propulsion Laboratory. In addition, simpler ontologies and semantic metadata standards are being proposed by the W3C Geo Incubator Group[42] to represent geospatial data on the web. GeoSPARQL is a standard developed by the Ordnance Survey, United States Geological Survey, Natural Resources Canada, Australia's Commonwealth Scientific and Industrial Research Organisation and others to support ontology creation and reasoning using well-understood OGC literals (GML, WKT), topological relationships (Simple Features, RCC8, DE-9IM), RDF and the SPARQL database query protocols.[43]

3.3.2 Policy driven standards

INSPIRE

To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans boundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting). These IRs are adopted as Commission Regulations/Decisions. The Commission is assisted in the process of adopting such rules by a regulatory committee composed by representatives of the Member States and chaired by a representative of the Commission (this is known as the Comitology procedure).[44] The INSPIRE implementation rules are based on ISO, OGC and partly W3C standards.

[36] *http://en.wikipedia.org/wiki/W3C*
[37] *Fonseca, Frederico; Sheth, Amit (2002). "The Geospatial Semantic Web" (PDF). UCGIS White Paper*
[38] *Fonseca, Frederico; Egenhofer, Max (1999). "Ontology-Driven Geographic Information Systems". Proc. ACM International Symposium on Geographic Information Systems. pp. 14–19*
[39] *Perry, Matthew; Hakimpour, Farshad; Sheth, Amit (2006). "Analyzing Theme, Space and Time: an Ontology-based Approach" (PDF). Proc. ACM International Symposium on Geographic Information Systems. pp. 147–154*
[40] *http://www.ordnancesurvey.co.uk/oswebsite/ontology/*
[41] *Semantic Web for Earth and Environmental Terminology*
[42] *W3C Geospatial Incubator Group".*
[43] *http://en.wikipedia.org/wiki/Geographic_information_system*
[44] *http://inspire.ec.europa.eu/index.cfm/pageid/3*

3.4 Summary

OpenTransportNet faces a complex challenge in terms of creating a new data platform that adheres to a wide range of rules and standards. In order to deliver a truly interoperable virtual hub network that will work with any type of geo-spatial information and tools the Hub must take account of the following best practices:

Top down GI initiatives:

- INSPIRE – rules for spatial information infrastructure for environmental policy
- GEOSS – earth observations interoperability
- COPERNICUS – global monitoring for environment and security
- SISE – single information space in Europe for the environment
- European Location Framework – exchange and sharing locations of data and services

Bottom up GI initiatives:

- Neogeography – localized information collected by citizens
- Open Street Map – free editable map of the world
- Geowiki – updating of global land cover maps
- Plan4all – open data pool and platform

OpenTransportNet will build on these initiatives by creating tools and approaches that:

- Better aggregate and harmonize data to improve accessibility and use,
- Link spatial and non-spatial data to extract value and increase accuracy and
- Provide innovators with easier APIs and GUIs to stimulate the creation of new services and commercial opportunities.

The OTN Hubs will go beyond the State-of-the-Art by:

(a) Improving the accuracy of data insights by enhancing knowledge with Volunteered Geographic Information (VGI) and

(b) Deploying a sophisticated Access Control and Identity Management system that will manage privacy controls.

The above objectives will be achieved by utilizing and advancing geo-data standards from ISO, OGC and W3C.

4 Data Analysis for OTN

This chapter includes a preliminary analysis of available data sets for the OTN project that will serve as an input for Task 4.1 Initial Pilot Dataset Identification. Apart from that, the chapter introduces the reader with basic terms such as data, geographic data or data sets, the interoperability components as defined by INSPIRE, Copernicus, ELF and the other initiatives outlined in the previous chapter.

This approach should help the pilot regions to better understand the problems of data harmonisation, to identify data sets suitable for the pilot applications, to describe them appropriately and made them available for the project purposes in an appropriate form.

4.1 Basic Terms

Is there any difference between spatial and geographic data? What about geodata, how is this term related to these? What is the difference between spatial data and geographic information? What is a dataset? Are you confident with your answers? If yes, then you can skip this section. If no, then please go through the basic terms explained below.

In order to have a common understanding about the project objectives, especially the problematic related to data, this section describes the main terms related to data and data interoperability. The project involves partners of various specialisms and knowledge about spatial or geographical data. The project members differ from managers and public servants to software developers and data experts. This section should clarify the basic terms related to data and set the basis for common understanding.

The main source of the terminology is the technical specification ISO/TS 19104:2008 Geographic Information – Terminology. This specification includes most of the terms from the ISO[45] standards 19100 series Geographic Information and related standards.

The general term **data** is defined as “reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing.” [ISO/IEC 2382-1:1993]

While **information** is defined as “knowledge concerning objects, such as facts, events, things, processes, or ideas, including concepts, that within a certain context has a particular meaning.” [ISO/IEC 2382-1:1993]

Information can be understood as a meaningful interpretation of data and relations between data.

Geographic data are “data with implicit or explicit reference to a location relative to the Earth.” [ISO 19109:2005]. And similarly, **geographic information** is “information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.” [ISO 19101:2002]

Spatial data, geographical data and geodata are synonyms. These terms can be used interchangeably. The same applies to spatial information, geographical information and geoinformation.

Another important term **dataset** is defined as “identifiable collection of data. Note: A dataset may be a smaller grouping of data which, though limited by some constraint such as spatial extent or feature type, is located physically within a larger dataset. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart may be considered a dataset.” [ISO 19115:2003]

Very often you will come across the term **service** which is defined as “distinct part of the functionality that is provided by an entity through interfaces”.

A crucial aspect for describing datasets and services is metadata. **Metadata** are “data about data” [ISO 19115:2003]. To be able to find spatial datasets and services and to decide whether they may be used for our purposes, spatial data sets and services providers secure their descriptions in the form of metadata. The

[45] *ISO stands for International Organization for Standardization (www.iso.org/)*

INSPIRE Directive defines metadata as information describing spatial datasets and services and making it possible to discover, inventory and use them.

Discrete units of metadata are **metadata elements** [EN ISO 19115:2003]. Metadata elements include resource title, keywords, spatial resolution or responsible organisation. These and many other elements will be collected for each dataset and service used within the OTN project.

4.2 Data Interoperability

Interoperability is defined as "capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units." (ISO/IEC 2382-1:1993)

Recent activity of the European Commission brought to an attention a document describing the European Interoperability Framework (EIF) for European public services. The document highlights the needs and benefits of interoperability. Interoperability enables (European Commission 2010)[46]:

- Cooperation among public administrations with the aim to establish public services,
- Exchanging information among public administrations to fulfil legal requirements or political commitments,
- Sharing and reusing information among public administrations to increase administrative efficiency and cut red tape for citizens and businesses.

EIF distinguishes four levels of interoperability including:

- **Legal aspects** - each public administration contributing to the provision of a European public service works within its own national legal framework. Sometimes, incompatibilities between legislation in different Member States make working together more complex or even impossible, even where such legislation is the result of transposing European directives into national law. Legal initiatives may be needed to remedy such situations. When information is exchanged between Member States to provide European public services, the legal validity of such information must be maintained across borders and data protection legislation in both originating and receiving countries must be respected.
- **Organisational aspects** - this aspect of interoperability is concerned with how organisations, such as public administrations in different Member States, cooperate to achieve their mutually agreed goals. In practice, organisational interoperability implies integrating business processes and related data exchange. Organisational interoperability also aims to meet the requirements of the user community by making services available, easily identifiable, accessible and user-focused.
- **Semantic aspects** - semantic interoperability enables organisations to process information from external sources in a meaningful manner. It ensures that the precise meaning of exchanged information is understood and preserved throughout exchanges between parties. In the context of the EIF, semantic interoperability encompasses the following aspects:
    - Semantic interoperability is about the meaning of data elements and the relationship between them. It includes developing vocabulary to describe data exchanges, and ensures that data elements are understood in the same way by communicating parties.
    - Syntactic interoperability is about describing the exact format of the information to be exchanged in terms of grammar, format and schemas.

[46] *European Commission, 2010. European Interoperability Framework (EIF) for European public services.*

- **Technical aspects** - This covers the technical aspects of linking information systems. It includes aspects such as interface specifications, interconnection services, data integration services, data presentation and exchange, etc.

Interoperability must be achieved not only through technical arrangements. Important roles play coordination between various actors (e.g. data providers and users) as well as legislation supporting interoperability and access to information.

The INSPIRE Drafting Team "Data Specifications" defined a set of data interoperability components which are mainly relevant to the semantic aspects of the EIF. These are the main aspects that should be into account while harmonising data from heterogeneous sources, which is the case for the OTN project.

Figure 8 provides an overview of the components relevant for data interoperability.

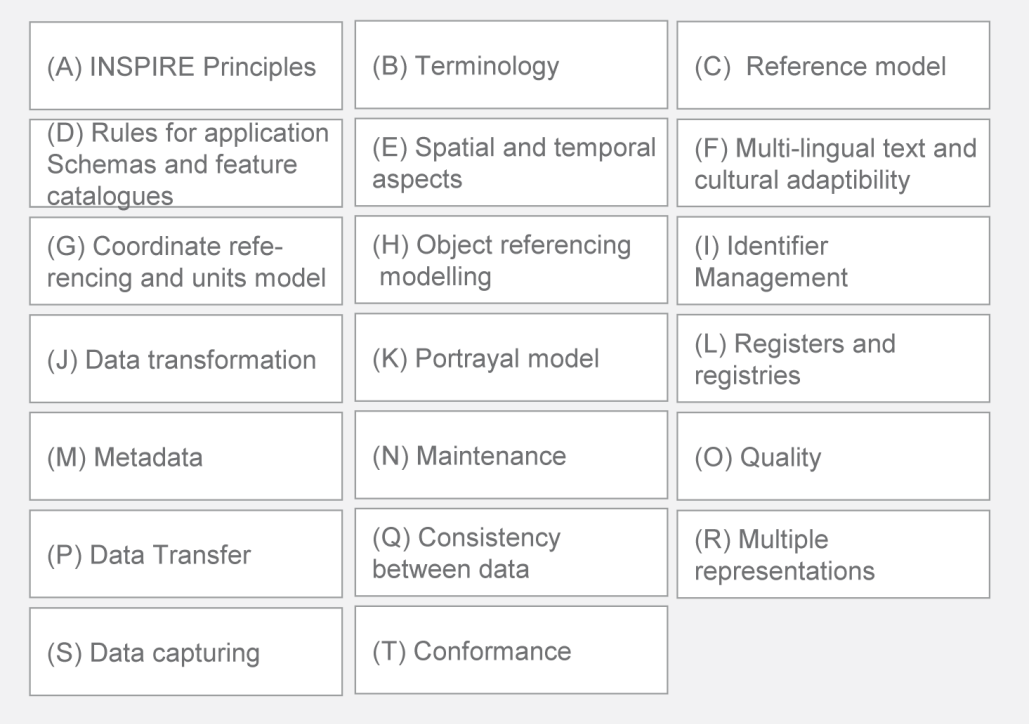

Figure 8: INSPIRE Data interoperability components (INSPIRE Drafting Team 'Data Specifications', 2008)[47]

The different components cover different aspects that need to be addressed in the process of enabling data interoperability. These components apply to all types of spatial objects including those with vector geometrical or topological properties as well as coverages (e.g. gridded raster data). However, for the different spatial representation types, the components will in general be different.

Figure 9 depicts different interoperability components defined by the authors (also other than those defined by INSPIRE) in the context of the EIF.

[47] *INSPIRE Drafting Team Data Specifications. D2.5: Generic Conceptual Model, Version 3.0. Available at http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.5_v3.0.pdf*

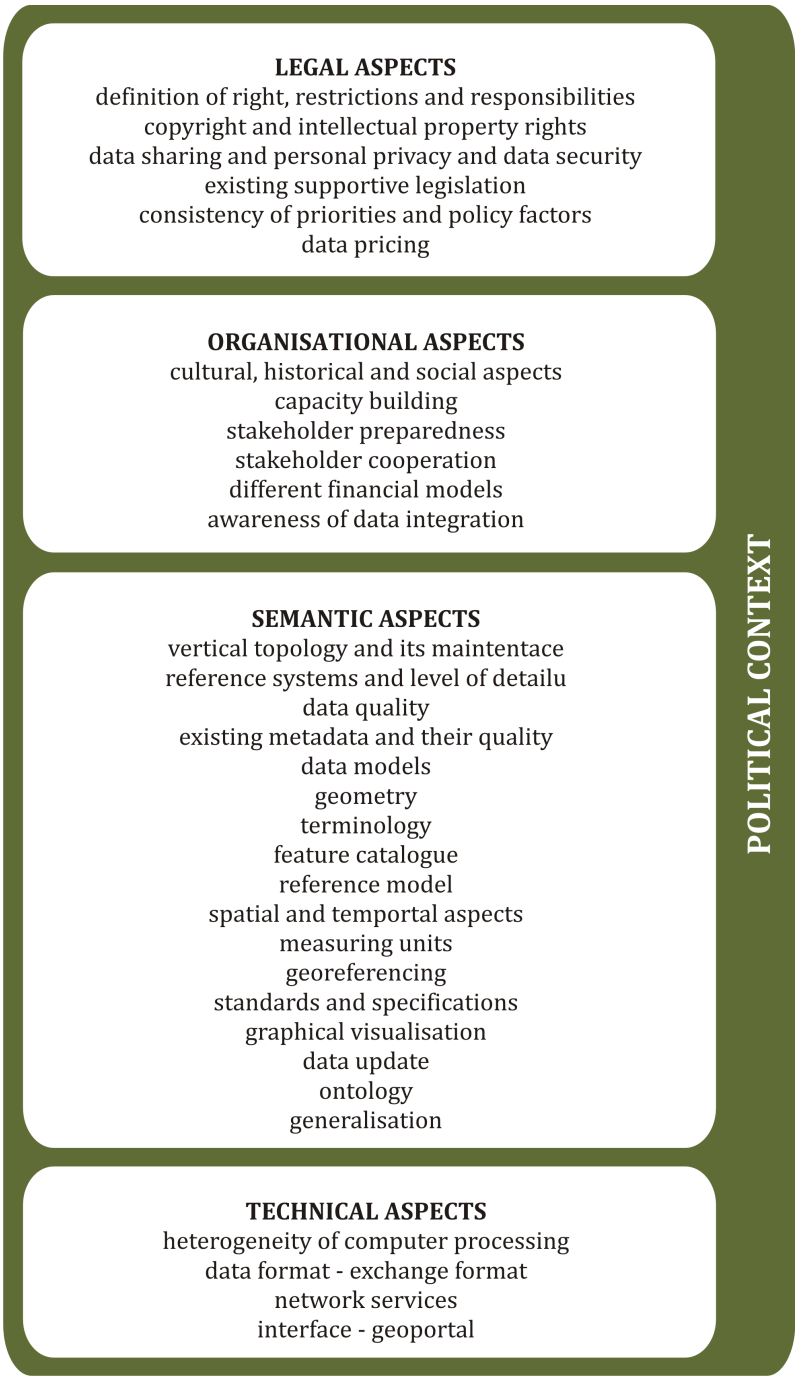

Figure 9 Interoperability components in the context of the European Interoperability Framework (EIF).

4.3 Available Datasets, Simplified Metadata and Implications for OTN

A preliminary list of available datasets is in Annex I of this document. The list includes the datasets identified during the project proposal writing and was amended by other datasets identified mainly in pilot areas. The identification of data is an ongoing process, which will continue under Task 4.1 of the OTN work plan.

The list of available datasets currently contains basic metadata elements (a subset of the INSPIRE metadata profile) including:

- Resource title - name by which the cited resource is known (e.g. Standardized Precipitation Index),
- Resource abstract - brief narrative summary of the content of the resource,
- Geographical coverage - linguistic transcriptions of the extent or location,
- Resource locator - "location (address) for on-line access using a Uniform Resource Locator (URL)",
- Spatial resolution - equivalent scale (e.g. 1:10,000),
- Responsible party - identification of and means of communication with person(s) and organisation associated with the resource,
- Restrictions/Licences - restrictions on the access and use,
- Format - file format, e.g. SHP, GML, JSON, KML, PDF, JPEG, TIFF.

Many of the data are already published as Open Data in non-proprietary formats (CSV, MKL, XML, JSON) which is easier to handle. Much further work on this complex topic, including analysis between pilot sites data sets will be provided within WP4 (Data Management) of the project.

4.4 Recommendations for OTN

The main challenge for the OTN project is to acquire data that can be used for user applications. Data is the core for the success of the project. All the datasets will be analysed in detail and complete metadata records created and placed in the metadata catalogue within WP4. From the preliminary list of datasets included in Annex I of this document and experience from other projects (e.g. Plan4business), we can make the following implications and recommendations for OTN:

- **Open Street Map** as a base map and street network. Open Street Map is freely available and covers the entire Europe. The Open Street map as a routable network has been prepared by the plan4business project and can be shared for the OTN purposes.
- **Data specifications and metadata** for the OTN project and its applications should follow as much as possible the INSPIRE data specifications and metadata profiles.
- **Data licences and data publication** - OTN should not only focus on data published as Open Data but also on data that are published in a non-standardised way and with restricted use (with data licence). The use of these data and especially their update is more complicated than in the case of Open Data. However, showing the potential of these data through the OTN hubs can influence the organizational and legal aspects for opening the data in an appropriate form. The attention should be also paid to standardization in the field of data licences. This is crucial when combining data from various sources with different data licences.
- **Data quality** – it is essential that data are of known and sufficient quality for the OTN applications. This includes completeness, logical consistency and positional, temporal and thematic accuracy.
- **Privacy and security** – privacy and security issues related with publishing data should be analysed.
- **Open Data Platform** – data collected within the plan4business project which are now managed under the umbrella of the Plan4all association should be reused and built upon. Close cooperation with the Plan4all association should take place.

5 Potential Customers

From the outset of our project OTN detailed a number of end users for the data platform from cities, to businesses, to developers and citizens. Whilst it is crucial for the success of the project that the whole value chain of stakeholders are engaged in platform development and piloting, for the purposes of sustainability it is Cities who will be key 'adopters' of the OTN platform long after the initial project funding ends.

To get a first-hand sense of how Cities are using GI data and the barriers they face in its use, the OTN Team created and distributed a short data survey across Europe. Project Partners promoted the survey through direct requests and social media for just over one week, which generated 35 high quality responses. The results from the survey are detailed in the sub sections below along with a summary of key findings and how they impact the direction of our project.

5.1 Respondents Background

Table 1: Survey Respondents Background

Name and Job Title	City and Country
Sandrine Mathon - chef de projet Open Data	Toulouse, France
Photios Zygoulis, eGov Coordinator	Athens, Greece
Geert Van Herbruggen, Account manager	Antwerp, Belgium
Jiri Kvapil, GIS administrator	Prague, Czech Republic
Atvars Guza, Liepaja City, Network administrator	Liepaja, Latvia
Christian Geiger, Key Questions 'ulm 2.0'	Ulm, Germany
Christian Burst (Dipl.-Ing.), Datenkoordination	Ulm, Germany
Francesc Aragall, President	Design for All Foundation
Neil Glendinning, ICT Enterprise Architect	Newcastle City Council, UK
Noël Van Herreweghe - Senior Advisor	Flemish Government, Belgium
Jiri Polacek, head of IT section	Prague, Czech Republic
Andreia Quintal, Public Transport Planning	Funchal, Portugal
Dr.-Ing. Dietmar Bosserhoff, Traffic engineer	Wiesbaden, Hessen, Germany
Eric Auquière, manager	Brussels Region, Belgium
Chris Griffin, Web Developer	City of Auburn, USA
johan denys, head of department ict	Roeselare, Belgium
Milica Projić, Project Manager	Zagreb, Croatia
Ing. Josef Fryml, Forest management institution	Brandýs nad labem , Czech Republic
John Keys, Digital Development Officer	Manchester City Council
martine tommis	Manchester, UK
Bart rosseau, eStrategy	Ghent, Belgium
Vincent de Roover - open data project manager	Antwerp Belgium
Marta Codinachs - GIS department	Diputació de Barcelona - Catalonia
Ing. Jaroslav Martinek, Czech cycling coordinator	Olomouc, Czech Republic
Albertine Harris, Contractor	Thomaston, Alabama, USA
Fouqueray - Open Data Manager	Région Île-de-France
Armelle Gilliard, project manager of digital services	Communauté urbaine de Bordeaux France
Laurent-Pierre Gilliard, Deputy Director	Aquitaine, France
Vladislav Rozsypal, traffic engineer	Liberec, Czech Republic

Pedro Lopez , Project Manager	Gijón City Council, Spain
Inga Berzina, Project manager	Jelgava/Latvia
François Salgé, Administrateur d'AFIGéO	France
François Du Mortier, Team support manager e-Gov	Brussels, Belgium
Eric LEGALE, General Manager Issy Media	Issy-les-Moulineaux, France
Gerrie Smits, Digital & Social Strategist	Antwerp, Belgium

Respondents represented 10 Member States across Europe as well as two states in the USA.

Figure 10: European Spread of Respondents

The majority of participants to respond to the survey work in Technology Management (45.7%) with the rest of the respondents split fairly equally between City Planning / Service Delivery, Communications and Engagement and Policy and Decision Making. The balance between technical and non-technical roles worked well for the analysis of the survey, so the respondents with advanced technical skills did not have an 'ICT' advantage that could skew the results.

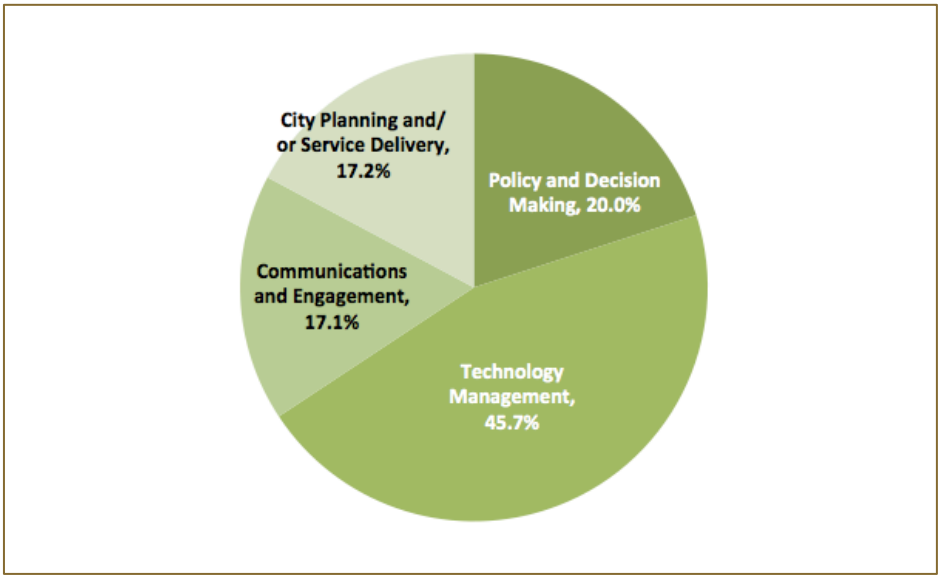

Figure 11: Work Categories of the Participants

5.2 Respondents Knowledge of Open Data

The survey asked participants if they had heard of three types of data initiatives (1) INSPIRE, (2) Open Data, and (3) Linked Open Data. An option for having heard of none of these was also given. The results showed that the majority of respondents (83%) had heard of Open Data, followed by INSPIRE (71%) and Linked Open Data (63%). Only a small percentage (6%) had heard of none of these terms.

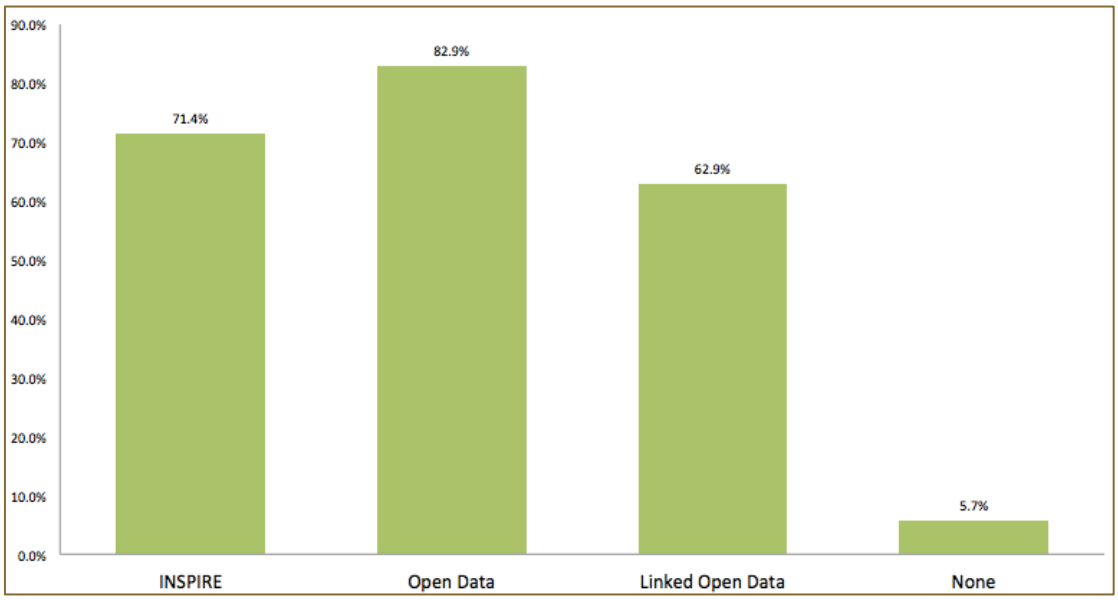

Figure 12: What types of data initiatives have you heard of?

The subsequent questions asked participants which of the data initiatives were their administration currently using. When compared against their knowledge of initiatives, the actual use percentage fell quite significantly. There was a 20% difference between knowledge of and use of INSPIRE, and a 17% gap between knowledge and use of Open Data. The most significant result was the drop between knowledge of and use of Linked Open Data at 40%.This highlights a significant impact from the lack of knowledge/understanding around Linked Open Data.

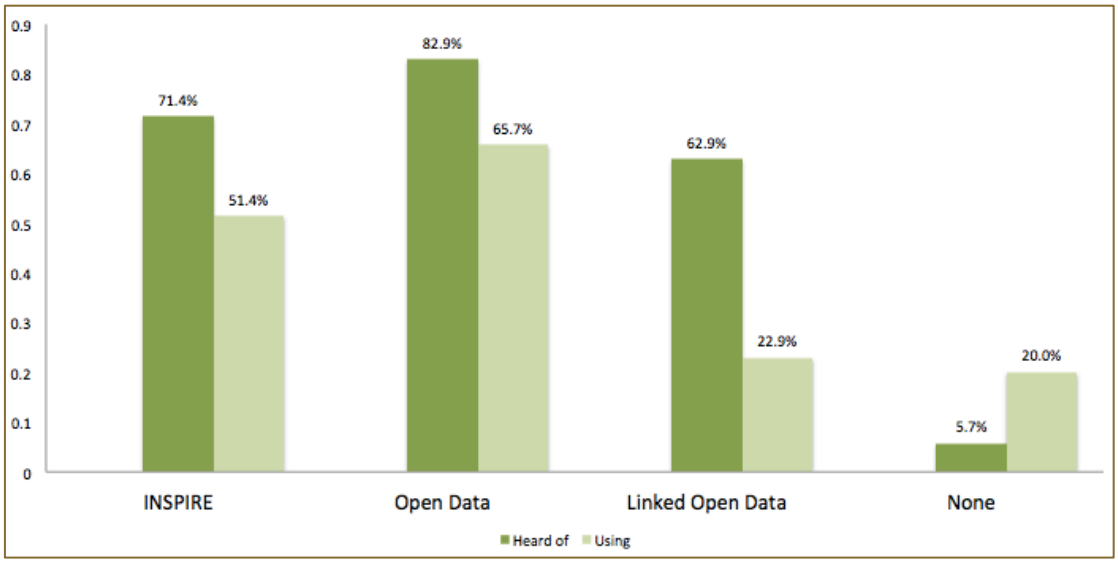

Figure 13: What types of data initiative are you using? Results shown against knowledge of Initiative

When asked about how participants currently publish their Open Data, over 80% of participants said they did so through their own catalogue or portal. With 11.4% using a shared National Portal. The high amounts of local publishing are an important finding for the OTN Team who need to understand where to access/find open data feeds into the OTN data platform.

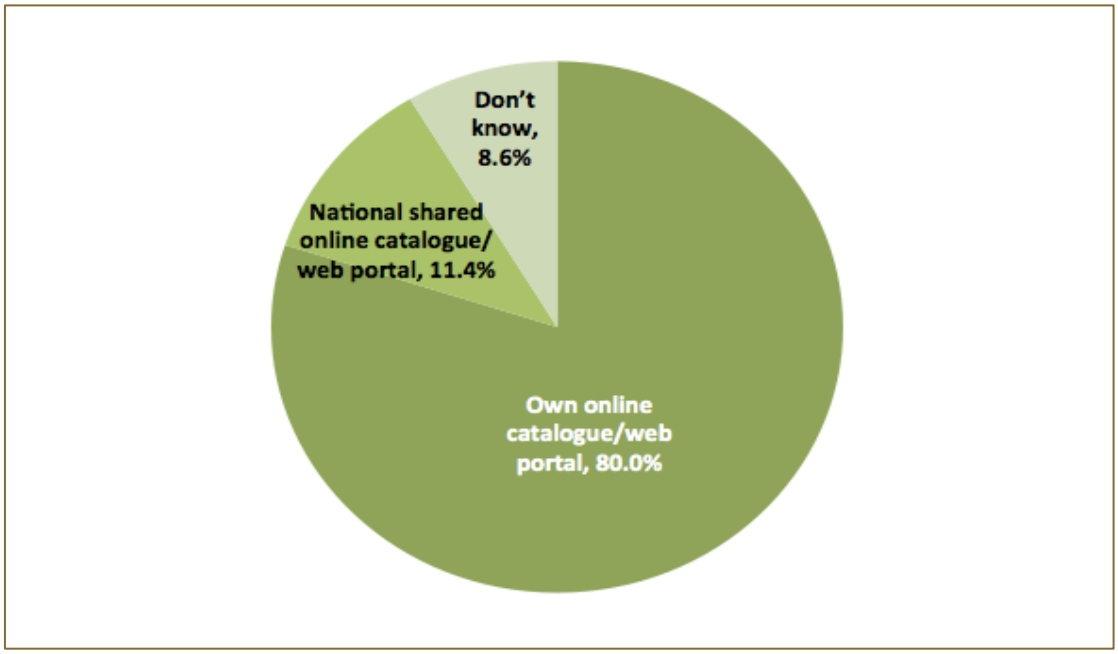

Figure 14: How do you publish/open your data?

5.3 Respondents Belief in Open Data

When respondents were asked about the value of publishing Open Data, a reassuring result was that 94% of respondents believed that publishing Open Data / Geospatial Information is useful to their administration, 0 people thought that it would not be useful and a small 6% were unsure.

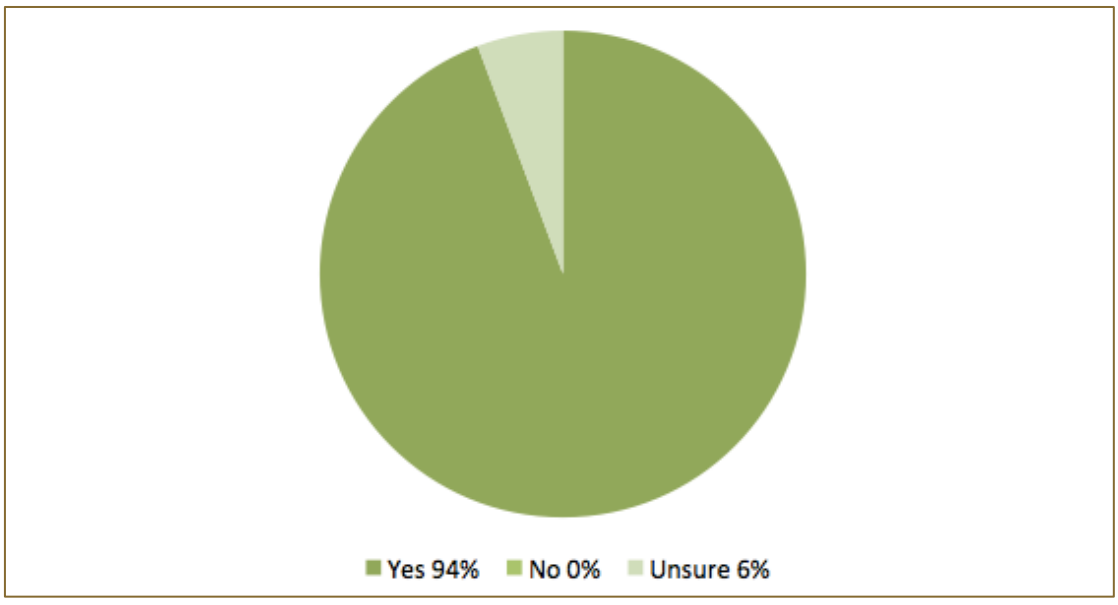

Figure 15: Do you believe publishing Open Data gives value to your administration?

When asked to weight the importance of specific benefits from making data open it was clear to see that the 'stimulation and creation of new ideas for services' was the most important benefit for nearly all participants (91%), followed by the 'greater transparency of administration operations' (71%). Surprisingly, considering the popularity of the highest rated benefit, the lowest rated benefit was the 'enablement of SME's to grow and develop new services' (43%), showing that administrations are not always linking the two benefits. There appears to be a gap between the generation of service ideas and service creation/partnerships with SME's.

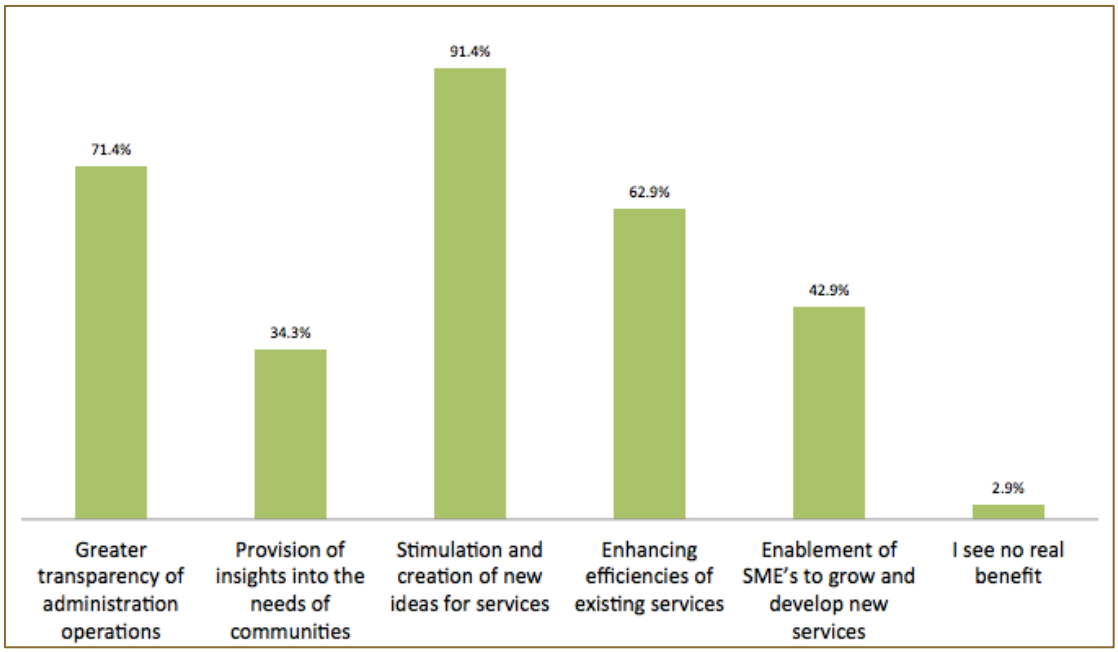

Figure 16: What are the most important benefits you see from making data available?

In contrast the respondents weighting of drivers (between 1-5) for opening data were all high and fairly even across the board, (between 3 – 4) with 'political' and 'social factors' just tipping into the lead.

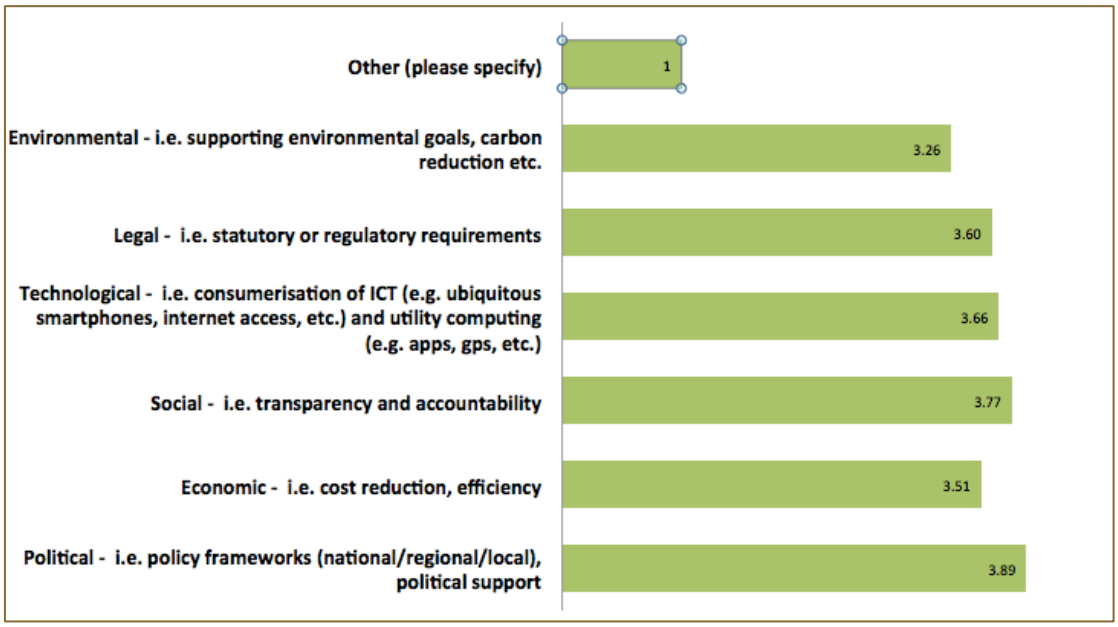

Figure 17: Importance of Drivers to Open Data on a scale 1 (low) to 5 (high)

5.4 Respondents Transport Data

All participants were asked what types of transport data their Authority holds. A selection of data types was offered. Unsurprisingly, information held on freight or maritime activities were low. However, other types of held transport data levels were surprisingly still only around the 50% mark. Points-of-Interest were the most widely held data set at 57%, followed by Infrastructure Planning info, 54%, and Parking Information, 51%.

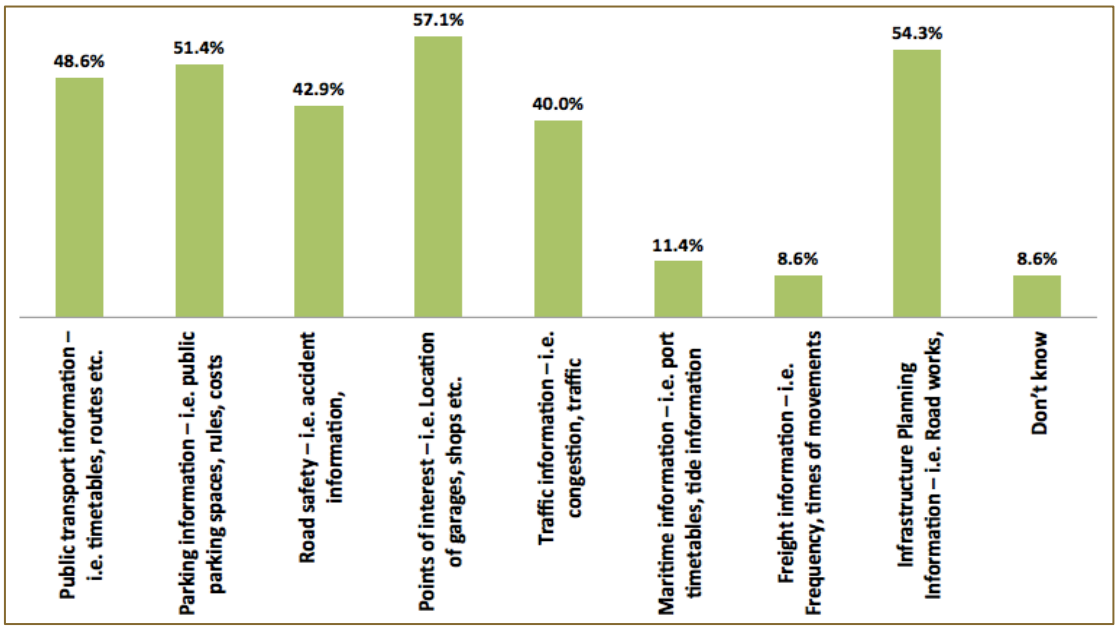

Figure 18: What types of transport data does your Authority hold?

When levels of data held were compared with levels of data published, it was clear to see that despite 54% of cities holding Infrastructure planning information, only 20% were making it open. For Points of Interest the gap was much less with only a 12% difference. The only dataset that was held and opened equally was traffic information, 40%.

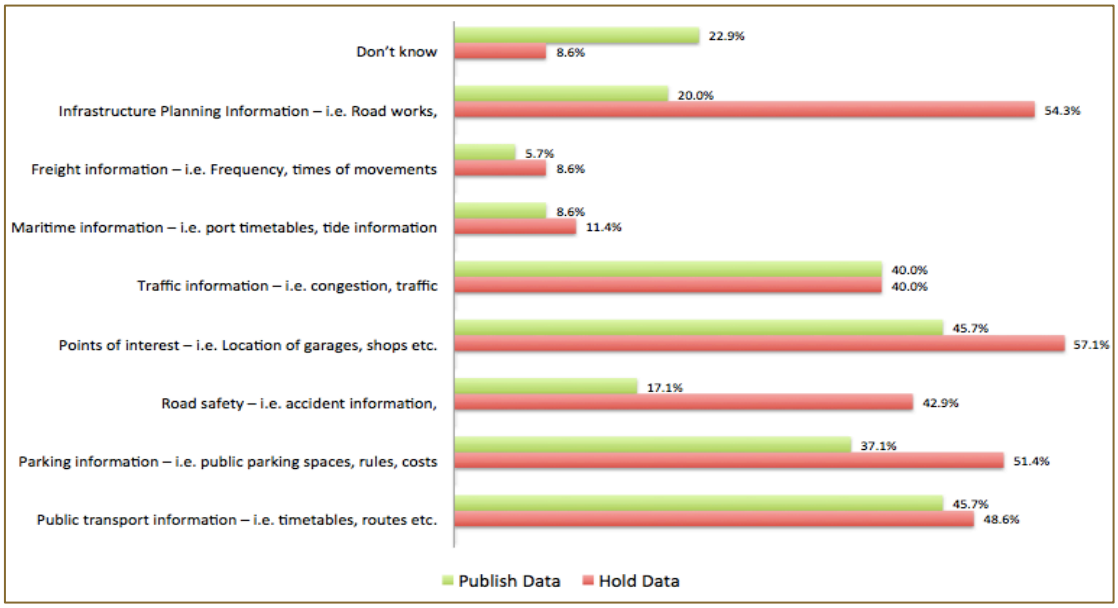

Figure 19: What types of transport data have you published? Shown here against held data.

5.5 Barriers Faced by Respondents

When asked to rate a set of barriers for opening data results found that 'privacy challenges' (3.34), 'access to useful datasets' (3.24), 'poor quality datasets' (3.21), 'risk of datasets being misused' (3.15), and 'lack of friendly tools for using data' (3.06) were deemed as important barriers. All the rest of the barriers scored below 3, deeming them less important.

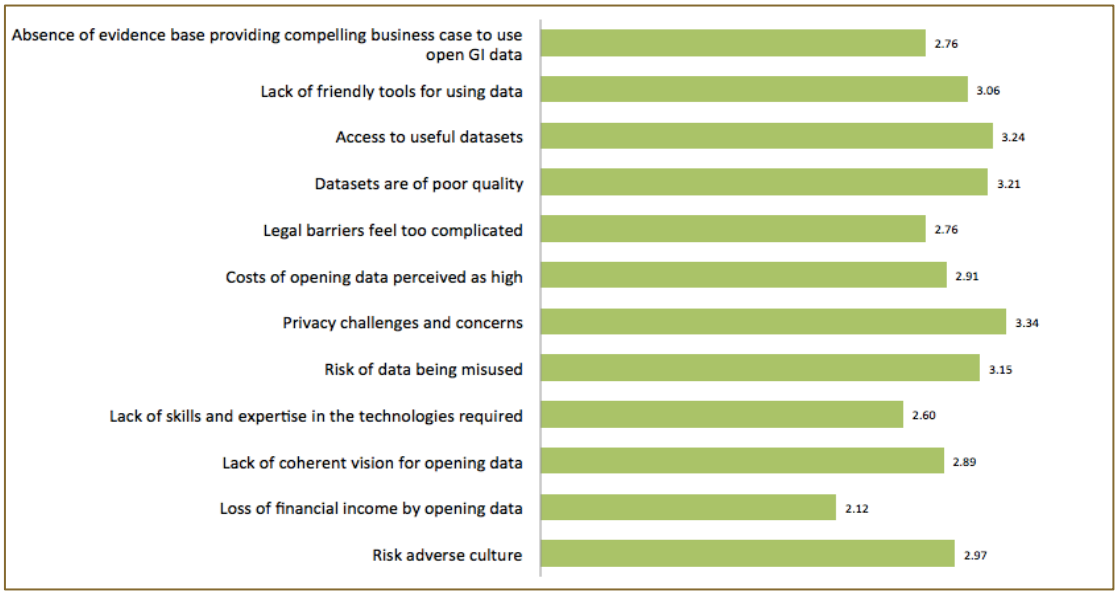

Figure 20: Please consider and rate barriers you face when opening data (1low - 5 high)

Participants were then asked what help they needed in order to publish and promote their data. 60% needed guidelines on how to publish information and 57% needed tools to help people understand and make sense of the opened data, as well as case studies to highlight the potential benefits and impact of opening data. These findings help to validate OTN's overarching project concept. Only 26% of respondents felt they needed a community of peers to provide informal support in opening data. A peer community was one of the outputs expected by OTN so the requirements for this feature will need to be analysed more closely during platform co-design workshops.

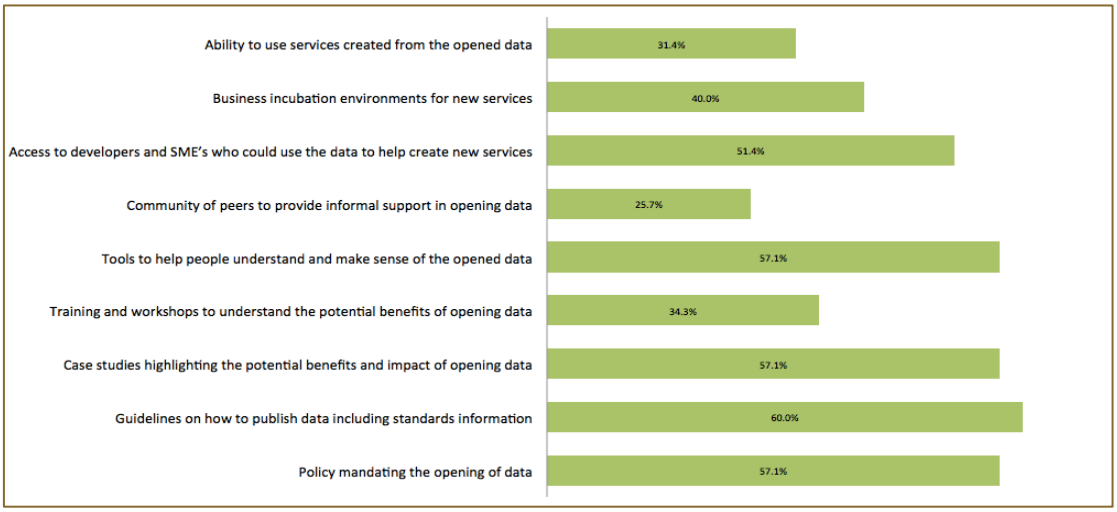

Figure 21: What help do you think you need to publish and promote the use of open/ GI data?

5.6 Summary

The survey results have enabled OTN to create an overview of the average Public Sector worker who could adopt the OTN solution. In keeping with the project theme of making data more easily understood through visuals, this overview is provided in the infographic below:

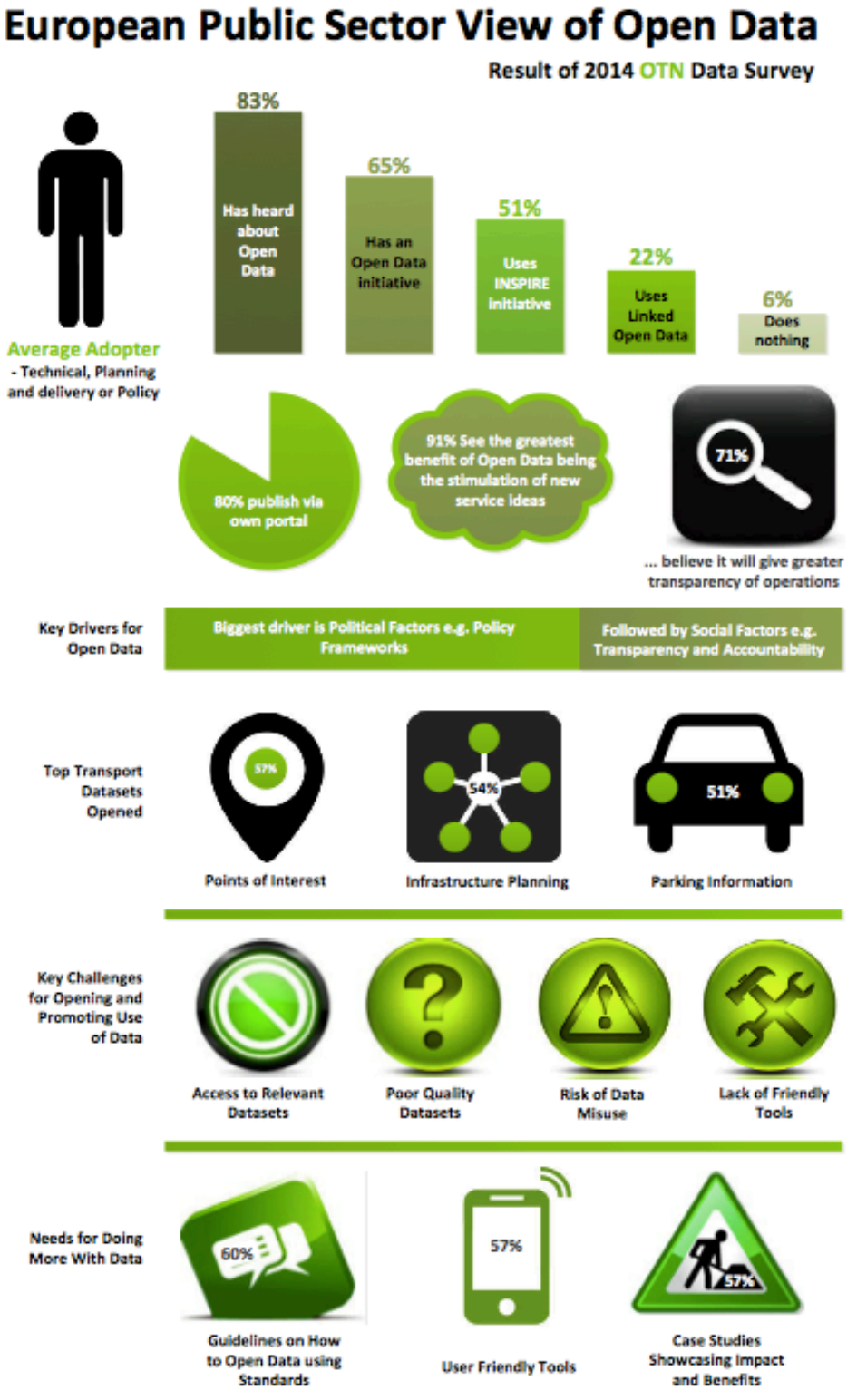

Figure 22: Infographic of Average Public Sector Adopter for OTN

6 Collaboration and Knowledge Sharing

A number of projects already exist that use GI including transport related initiatives. In order to build on work to data rather than reinvent the wheel, this section introduces the reader to a number of the most important projects in the field – some current, some already ended - with a brief overview of their key attributes. This section is of high importance to OTN's technical partners and communication partners. For ease of reading the chapter is split into (1) Geographic Information Projects and (2) Transport Related Projects, and (3) Linked Open data Projects.

6.1 Geographic Information Projects

GIGAS

The objective of the GIGAS project was to ensure architectural coherence between INSPIRE, GMES and GEOSS based on analysis of services and standards. The focus was on full integration of the architectures of these three initiatives. All these initiatives are focused on interoperability of data, informatics and services with focus on environmental monitoring and management in the most open and interoperable way. INSPIRE, GEOSS and GMES apply open service-oriented architecture and software infrastructure using, whenever feasible, already established standards.[48]

GIGAS included not only analysis of these three initiatives, but also analysed, how different standardisation efforts were covered by these initiatives.

The analysis of GIGAS improved the mutual understanding (technical and procedural) of all these three initiatives. This analysis showed an explicit overlap of their objectives, missions and tasks, but also of the architectural principles, while benefiting from an interoperable approach. The initiatives have similar approaches, but so far a number of interoperability barriers impede the exploitation of synergies. On the base of this, GIGAS designed a multi-initiative enterprise context, in which interoperability between the different layers enables a common access across the initiatives. From the user's perspective, the multi-initiative enterprise context reveals the following advantages:

- Portals search resources over different initiatives and application domains
- Transparent and interoperable access to additional data
- Better reuse of services among different initiatives and application domains
- Development of applications using resources from different initiatives

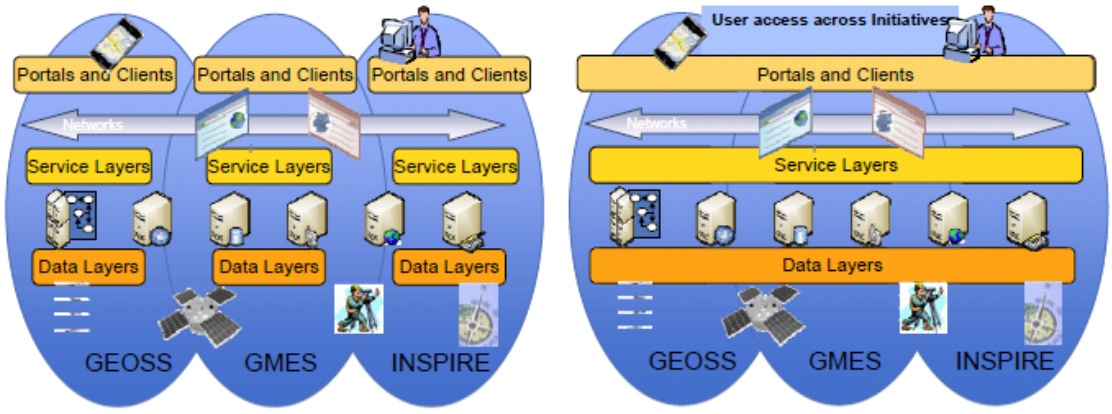

Figure 23: Overview of the GIGAS Project

[48] *GIGAS Technology Watch Report Architecture Technical Note, http://www.thegigasforum.eu/cgi-bin/download.pl?f=345.pdf*

Humboldt

The Humboldt project focus was on the integration of GMES and INSPIRE initiative. The Humboldt project aims at helping organisations to enable organisations to document, publish and harmonise their spatial information. The technical goal of Humboldt is to support Spatial Data Infrastructure (SDI) enablement by providing the functionalities for covering the data harmonization process as a whole. The Humboldt Tools and Services are built on current state of the art and standards, designed to provide solutions to all types of users, data custodians as well as private end-users. Humboldt enables the use of single functionalities as part of your own infrastructure. [49]

For the design of software architecture, Humboldt defines as mandatory Distributed Processing-Reference model-RM-ODP and Unified Modelling Language (UML 2).

On the base of scenarios need a common and shared infrastructure was defined

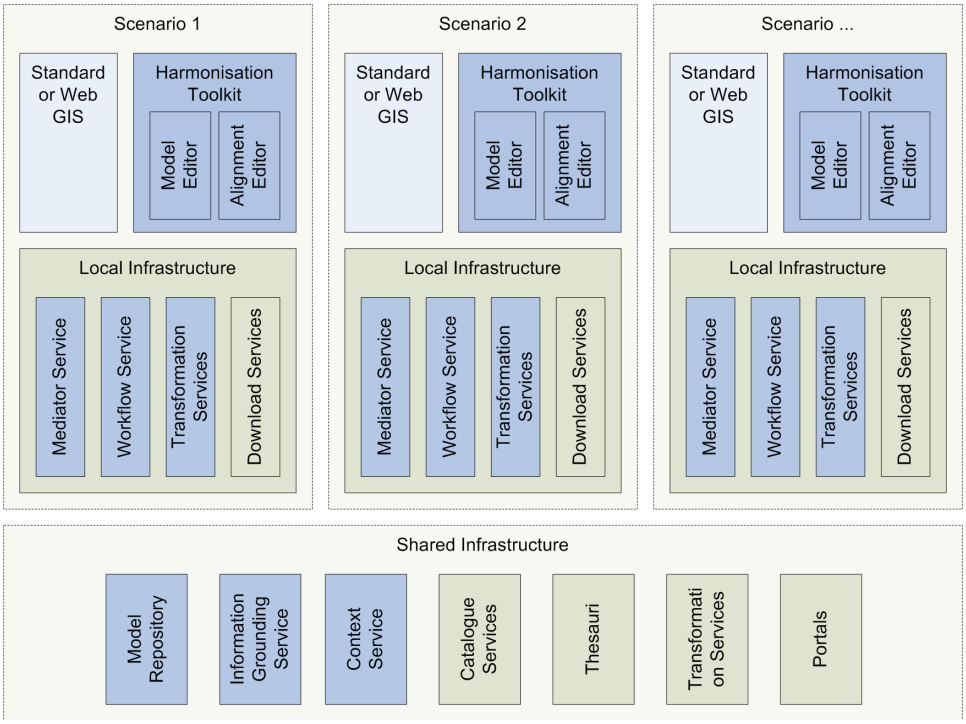

Figure 24: Humbolt Infrastructure

The first components of the Humboldt Framework have been published under the GNU Lesser General Public License version 3 (LGPL v3). They are available for free download at the Humboldt Community Website. This release includes the following software components:

- The Humboldt Model Editor, a UML editor that is specifically geared towards the creation of UML application schemas;
- The Humboldt Alignment Editor, a tool that allows to define conceptual schema transformations;
- The Humboldt Workflow Editor
- The Humboldt Mediator Service, a proxy service that executes transformation chains to provide harmonised geodata;
- The Humboldt Workflow Repository Service, a service that analyses data sets and decides which processing is required to match a target product description;
- The Humboldt Context Service, an easy to use-service that can be used to define transformation products;

[49] *http://www.esdi-humboldt.eu/home.html*

- Several transformation services exposed as OGC Web Processing Services, such as Coordinate Transformation Service and an Edge Matching Service.[50]

Plan4all

Plan4all in document Data Sharing Requirements[51] compares classification of services according ISO 19119 [52] with classification of services provided by INSPIRE. ISO19119 classification is much broader then the INSPIRE classification and for purposes of Habitats it will be necessary to also include additional services, then the services required by INPSIRE. Therefore, ISO19119 nomenclature of services could be useful for HABITATS architecture design. In the document Data Sharing Requirements the advantage of centralised and decentralised architecture is also compared. The advantages and disadvantages of centralised and decentralised infrastructure include:

- Centralised advantage: - Allows generalisation of content to take place at a higher level, whereby making the Plan4all infrastructure. Integration of data allows complex queries, analysis with high speed and performance. Fewer points to implement and maintain services and (custom) protocols
- Centralised disadvantage - Requires a solid server platform from the perspective of the aggregator. Might lead to issues related to intellectual property rights.
- Distributed advantage - All services will be working directly towards authoritative data sources without any time-lag. Allows for local autonomy and institutional involvement
- Distributed disadvantage - Content and schema will have to be generalised at the local level
- Requires skills, experience and resources in running distributed trusted infrastructures

Conclusion of Plan4all is, that future systems will be some way of coexistence of both models.

Plan4all Networking Architecture[53]design was based on RM-ODP methodology for design. The information viewpoint is put in the centre of spatial planning data. The spatial plan is considered as a composition of spatial data and documents while The information viewpoint describes all operations, which are provided with data. All these parts are described by metadata. The computational viewpoint defines a set of basic services and their relations and on the base of this scheme the Engineering viewpoint defines the generic platform independent from the architecture of the system.

[50] *http://www.esdi-humboldt.eu/open-source.html*

[51] *http://wiki.plan4all.eu/wk/images/3/34/Data_sharing_requirements.pdf*

[52] *International Organization for Standardization, Geographic information Services, ISO 19119:2005. July 8, 2005*

[53] *http://www.plan4all.eu/simplecms/?menuID=37&articleID=62&action=article&presenter=ArticleDetail*

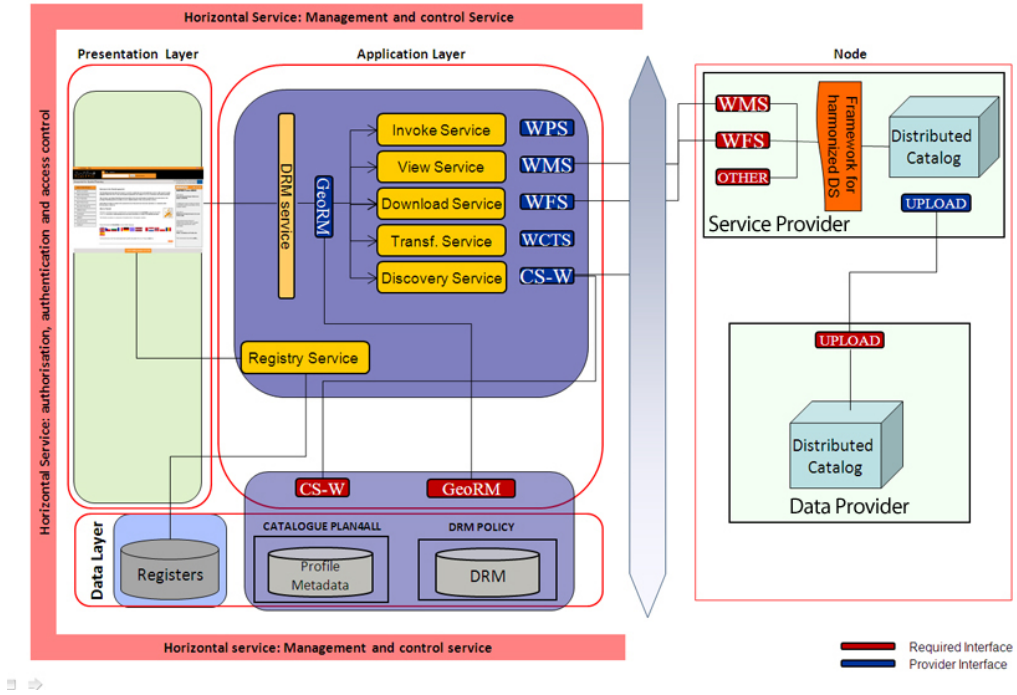

Figure 25: Plan4all Architecture

The Technology viewpoint provides recommendation for potential software tools, which could be used for the implementation of the Plan4all architecture. This recommendation is mainly based on previous documents.

Earthlook

Project EarthLookCZ (www.earthlook.cz) was one of the pilot projects developed in the Czech Republic in the ERA-STAR regions framework. The project undertaken by WIRELESSINFO association aimed at verifying the validity of spatial data infrastructure quality for GMES in the Czech Republic. Earthlook analysis of GMES describes present GMES activities at both European and national levels and in relation to the INSPIRE directive.

The proposed solution of the GMES national portal in the EarthLookCZ project that promotes better access to data. The prototype of the portal is aimed at sharing and publishing raster data (e.g. satellite images, orthophoto, geophysical measurements, climate data) and vector data including basic topographical layers (e.g. thematic environmental data). The main innovation of the project is the ability of users to publish their own data sources on the web and to integrate their own data together with external data into new compositions. Afterwards these map compositions may be published in the form of web services. Users can also integrate these new compositions into their own software solutions. This concept of the GMES portal allows not only the common data visualisation, but also a preparation of the new data composition by GIS specialist and its data accessibility to other users; all of it within the portal solution.

The National GMES Portal enables an integration of monitoring data that has been acquired using the space infrastructure (satellite images) and the In Situ infrastructure (ground measurements, aerial photographs) together with other data layers, such as general reference data (topographic maps) and thematic data (landscape planning data). In addition, sources of GMES Core Services built within the basic structure of the European GMES can be accessible from the portal via web services.

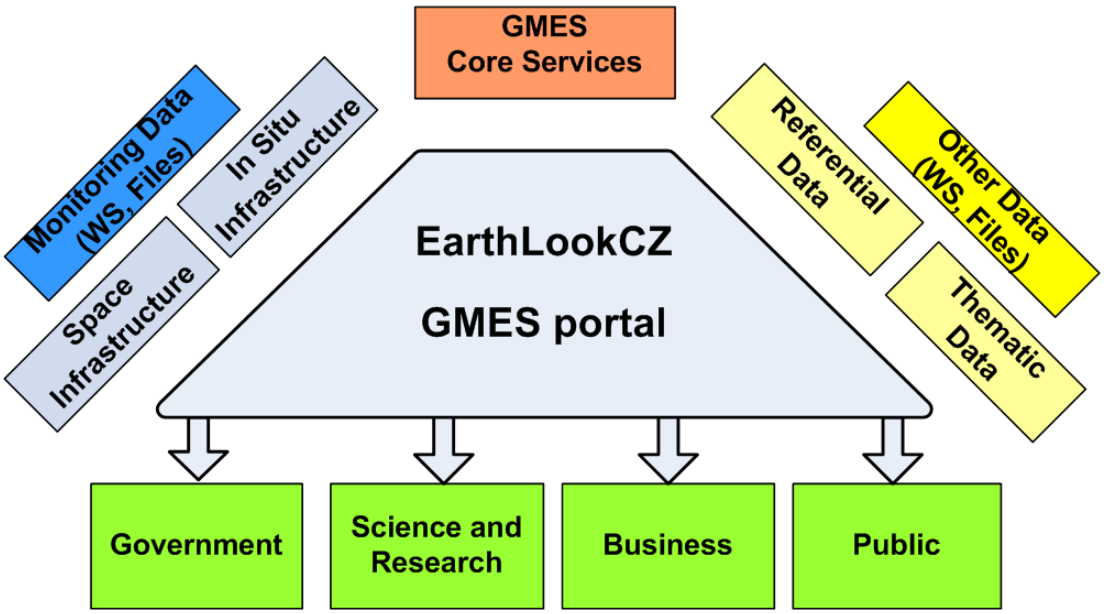

Figure 26: Project EarthLook Overview

Using the portal functionality, users are also able to upload their own data onto the server and publish it directly from the GMES portal. Users can combine different data sources, create new map compositions and make them available to other users. Availability of "data about data" and map compositions is ensured through metadata and catalogue systems.[54]

EnviroGRIDS BlackSea

EnviroGRIDS (Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development) addresses the subjects of ecologically unsustainable development and inadequate resource management in the Black Sea Catchment area. The goal is to make a large catalogue of environmental data sets (e.g. land use, hydrology, and climate) accessible and to provide distributed spatially-explicit simulations to build scenarios of key environmental changes.

The enviroGRIDS system provides Web applications for data management, hydrologic models calibration and execution, satellite image processing, report generation and visualization for large groups of users of five categories:

- Data providers,
- Earth science specialists,
- Decision makers,
- Citizens,
- System administrators.

EnviroGrids combine utilization of SDI tools with Grid technologies, the focus is on interoperability between the Geospatial and Grid platforms. EnviroGRIDS is a distributed system built up on Service Oriented Architecture (SOA) that allows the flexible usage of services over heterogeneous architectural components and technologies.

[54] *Petr Horák, Šárka Horáková, Karel Charvát, Martin Vlk EarthLookCZ - GMES data publication, combination and sharing on the web, in "INSPIRE, GMES and GEOSS Activities, Methods and Tools towards a Single Information Space in Europe for the Environment"edited by Karel Charvat, Maris Alberts, Sarka Horakova, ISBN 978-9934-8105-0-3, http://www.geoportal4everybody.eu/simplecms/?menuID=30&articleID=21&action=article&presenter=ArticleDetail*

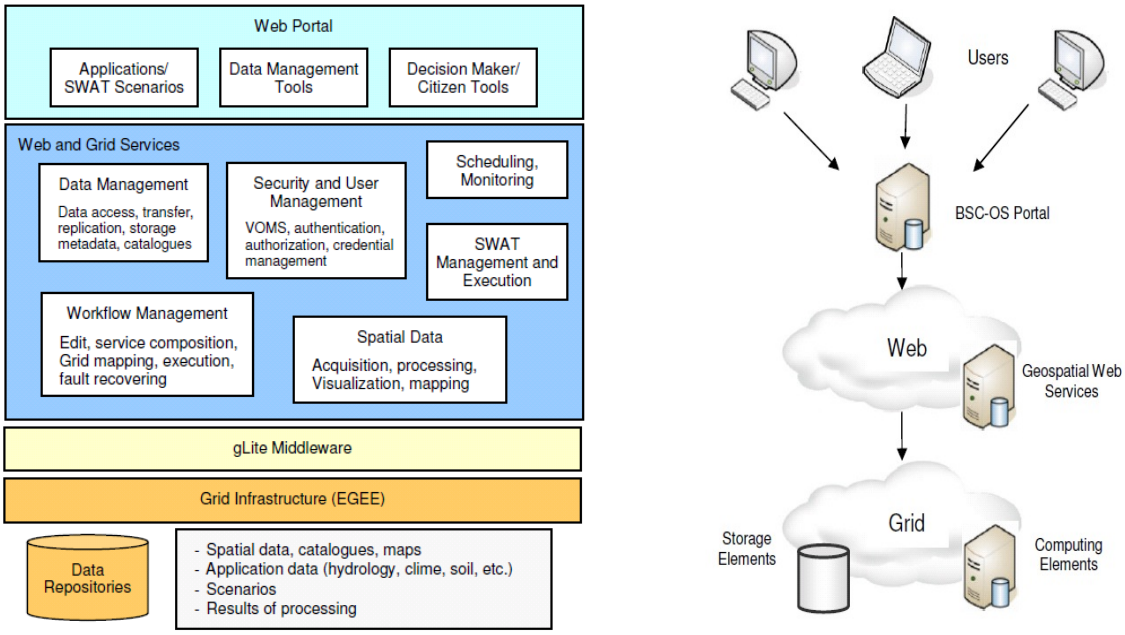

Figure 27: EnviroGrids Tools and Technologies

The GRID based technologies offers possibilities of resource management, resource sharing, data and processing distribution, and security. The Grid is based on the concept of service. The Grid architecture conforms generally the SOA architecture and particularly the OGSA framework.

An important part of the solution is Geospatial and Grid interoperability to guarantee, that OGC Web Services and the Grid gLite middleware will be able to interact.

GENESIS

GENESIS objective was to design and develop an application supporting the building of SISE allowing to:

- Provide all actors with an easier access to the various thematic data / services, and masking as much as possible the technical complexity,
- Provide a generic and comprehensive solution allowing to set-up a wide European information space, and to promote the collaboration between actors at regional, national and European level.

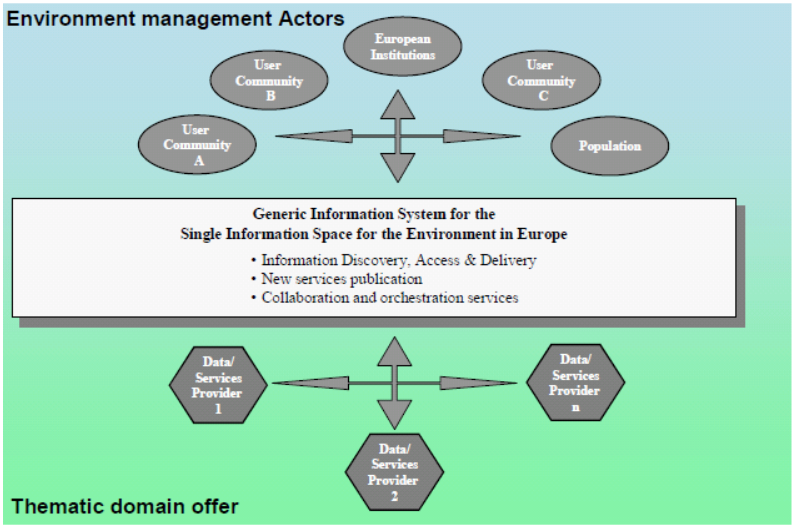

Figure 28: GENESIS Project Overview

The genesis focus is on:

- Making integrated Environment & Health information systems easily accessible through Web interfaces, with collaboration of remote information systems or actors (at all levels).
- Supporting environmental monitoring processes, and assessment of environment impact on health.
- Supporting the response process related to the management of pollution, through near-real time decision-making.
- Helping all actors to get enhanced access to the geo-spatial information or services available all over Europe, independently from their location.
- Helping data / services providers to upgrade their existing information systems, to promote standards and interoperability, in relation with INSPIRE and environment policy directives.
- Helping thematic communities to build for their own purposes new applications or services related to Environment & Health by chaining various services (data access, viewing, processing, …) or combining various data available all over Europe, with integration of their specific field of work items (data, models, algorithms, decision-support components,…).[55]

The architecture of GENESIS has been developed using the Open Distributed Processing and the Reference Model (RM-ODP) (ISO/IEC10746). An important aspect of GENESIS is the division on thematic and generic modelling. Thematic modelling is based on textual description of the scenario (Thematic Use Cases) and on graphical representation of the use cases that are used to help the formalisation process. Generic user requirements have to guarantee to design generic solution, which can be instantiated for any thematic pilot. The Generic Service Requirements are defined using this output, the Generic User Requirements and feedback from the IT teams in order to align whenever it was possible the requirements with already existing Service Technical Specifications, implementations or selected open source as it is one of the driver line of the Genesis project.[56]

Habitats Reference Laboratory[57]

[55] GENESIS D6100.6 - Technology Integration - Executive Summary,, http://www.genesis-fp7.eu/images/pdf/genesis_d4600.1_pu_tas_global_architecture_v1.3_public.pdf

[56] Genesis D4600.1 – Global Architecture Document http://www.genesis-fp7.eu/images/pdf/genesis_d4600.1_pu_tas_global_architecture_v1.3_public.pdf

[57] D-4.1 State of the Art of existing SDI, HABITATS, CIP- ICT-PSP-2009-3-250455, Social Validation of INSPIRE Annex III Data Structures in EU Habitats, 2010

HABITATS extends user-centric, co-design approaches into the arena of standards design and adoption processes, considering standards initiatives such as INSPIRE, OGC, UNSDI to be significant social, economic and institutional innovations. The elements of approach are maintained, applying the model at all levels from the global scale of the local and regional policies that frame many HABITATS validation pilots. Community building activities follow a Web 2.0 approach to capture the knowledge in active user communities with a strong interest in contributing to the standards development process. By inviting a broad multi-sectoral and inter-disciplinary range of concerned stakeholders to participate in the HABITATS network, a viral motivation spiral is set off. A peer-to-peer approach to opening up information sources and providing access to content ensure a rapid extension of the critical mass of environmental data established.

The reference laboratory (RL) allows to deploy the current state of the art of technological solution, which will be tested and adopted by Habitats partners and user partners. It allows to test current existing technology and allows to generate further research tasks through a user driven process. Reference laboratory will also collect information coming from other projects, which will be important input for Habitats analysis and Habitats public discussion. Methods of social assessment will be an important part of the reference laboratory.

Habitats RL is based on principles of Geoportal4everybody. Habitats RL is designed and implemented as a virtual database. It uses principles of web services, URM, social network sites, Geoportal4everybody and semantic web. It integrates different technologies like GIS, e-learning, multimedia, and virtual reality. An important part is the integration of social networking tools supporting social assessment. These services are not implemented on the Habitats portal directly, but they are implemented as virtual services on different places in Europe.

Habitats extended this model and added l consists of several layers, which are (HABITATS D4.2.2 2011):

- Data layers – management data and files on storage, eventually guarantee access to external sensors
- Server (engine layer) – defines tools, which guarantee basic services on server side – supplying service
- Client layer – is client side of Web services, which guarantee access of users to services
- Application layer is some form of wrapping elementary client services into application or into such form, which could be used by other Web tools
- Presentation layer contain such web tools, which allow to combine and publish single objects from the application level as part of Web presentation

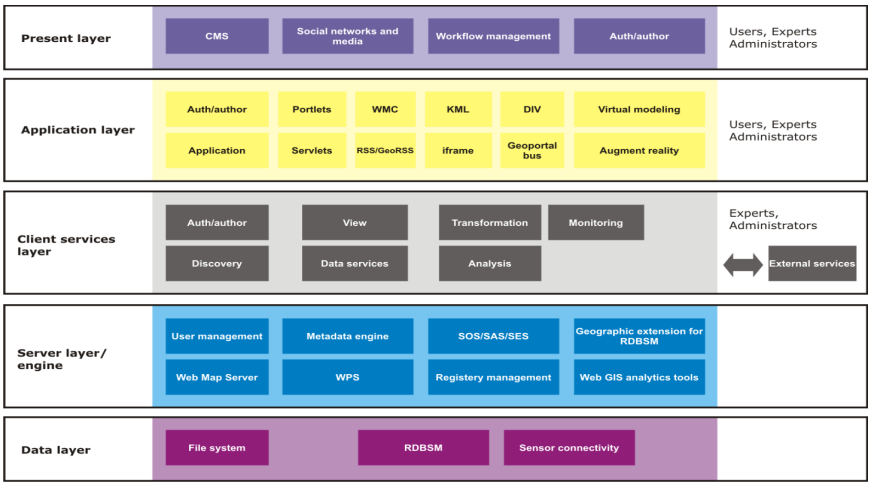

Figure 29: HABITATS Networking Architecture (taken from HABITATS D4.2.2 2011)

EuroGEOSS

EuroGEOSS demonstrated the added value to the scientific community and society of making existing systems and applications interoperable and used within the GEOSS and INSPIRE frameworks. The project

built an initial operating capacity for a European Environment Earth Observation. The extension of INSPIRE and GEOSS components with concepts emerging in the Web 2.0 communities in respect to user interactions and resource discovery, also supported the wider engagement of the scientific community with GEOSS as a powerful means to improve the scientific understanding of the complex mechanisms driving the changes that affect our planet. Ultimately, EuroGEOSS outcomes was extended to issues on a global scale.

The EuroGEOSS project adopted a Brokering Approach to implement multi-disciplinary interoperability and lower entry barriers for both Users and Data Providers. The introduction of the Broker component shifts the SOA binding architecture from a two-tier (User-Provider) to a three-tier (User-Broker-Producer) solution. Like an "application server," Brokers can do much more than just facilitate discovery and access of available resources: they may implement new capabilities for Users and Data/Information Providers. According to such an approach, Users and Data Providers are not asked to implement any specific interoperability technology but to continue using their tools and publishing their resources according their standards -as much as possible.

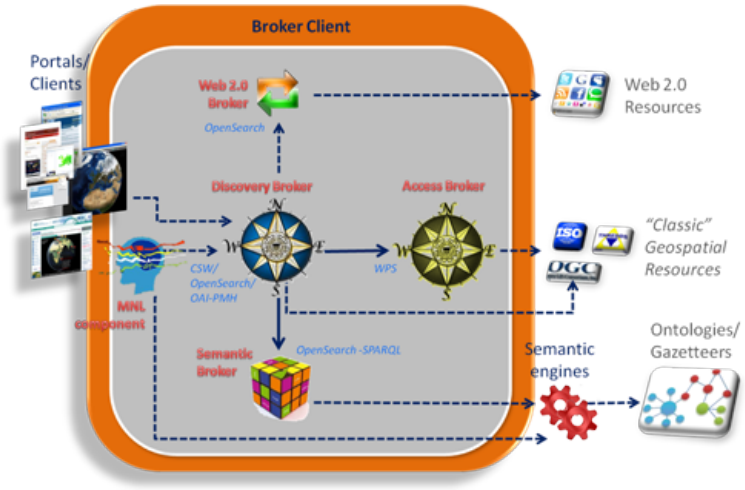

Figure 30: EuroGEOSS Brokerage Approach

In keeping with the Brokering Approach, EuroGEOSS has developed a Brokering framework (i.e. a set of Brokers) to bind the heterogeneous resources published by the Data Providers, adapting them to the tools commonly utilized by the Users. EuroGEOSS developed a Broker for each main interoperability functionality, namely: Discovery Broker, Access Broker, Semantic Broker. Actually, the EuroGEOSS Broker is a Brokering framework.

As a test for interlinked Open Linked data was design testing application, which tries to collect as much as possible data sets, process them to acquire relevant information and present the information in intelligible and simple way. The information are collected from many information resources (with open or free access to data) and transformed to the common data structure (with own schema taken account of metadata related to original source and time information) based on Extensible Markup Language (XML) format. The collected information is evaluated according to importance and reliability of particular resources. The original data are transformed to uniform data set with using XSLT (Extensible Stylesheet Language – Transformation) templates and open-source Saxon-HE processor. Users get the most relevant information, including links to original sources and a possibility to compare it with other collected data. Data is presented as the KML (Kyehole Markup Language) file of ski resorts and web pages in HTML (Hypertext Markup Language) 5 format connected to other features such as map or graph components. The application uses ECMA script libraries such as Google Chart Tools or RGraph.

Plan4business

Plan4business is a European project running from April 2012 until March 2014 and is co-financed by the 7th Framework Programme of the European Commission. The full title is plan4business – a Service Platform for

Aggregation, Processing and Analysing of Urban and Regional Planning Data. Plan4business develops a service platform for aggregation, processing and analysis of urban and regional planning data in Europe. Harmonised data will be integrated into seamless, homogenous, constantly growing and updated trans-border dataset. The platform will enable spatial analyses across European datasets. The platform should serve not only as a catalogue of planning data but also as their integrator enabling users to search, view, analyse and download spatial planning data on European and regional levels. The main project objectives are the automation of harmonisation processes and possibilities of complex analyses.

The design and development of the client side for the plan4business platform resulted in the design and development of the client side components of the plan4business service platform including the Authorisation, Authentication, Integration, Analysis and Plan hosting, API (Application Programming Interface) for integration of the Analysis Engine into other portals. The client components developed are based on existing tools and these tools are modified and extended on the basis of user requirements. For this purpose, a series of workshops aimed to different groups of stakeholders are being organised and a feedback on the development is tracked using a questionnaire for workshops' participants.

The first goal was to simplify the access to information for different types of users which are non-GI experts. The first pilot application that has been implemented is the Location Evaluator. The development of the application was focused on the integration of existing data sources. Data integration and building of data repositories was recognised as a key aspect for success of the plan4business platform. Other pilot applications include Thematic Map Atlas, Harmonise, Embed-Map and others. The complete list of applications is included in the extra document requested after the 1st project review - Business Model – Progress Report. A specific focus of these Service Levels is on a staged rollout of services to be offered by the *plan4business* platform. The five Service Levels are:

Service Level 1: This level includes examples of various components of the future platform which are not necessarily integrated but they show the basic functions that can be further elaborated and extended. This level includes:

- a data storage for disharmonised spatial and non-spatial data,
- a common data model for harmonised data based on the INSPIRE Directive,
- mechanisms for data integration into the common data model,
- features (platform prototype) for data display and simple navigation,
- utilisation of pan-European datasets related to spatial planning from scattered resources.

The developed components are used for showcases during workshops, presentations and other meetings in order to provide potential customers an idea of the future platform and its functions and get feedback from end users.

Service Level 2: The main goal for this level is to make the platform prototype publicly available and extend it by the following features:

- analysis of harmonised spatial data based on user requirements (this should include not only predefined queries but also a possibility for user defined queries),
- advanced visualisation tools,
- user customised data mining queries,
- retrieval of the data mining and analysis results for display,
- prototype management tools for data upload, download and publication using OGC Web Services,
- catalogue of spatial planning data,
- creation of user defined map compositions.

Service Level 3: This service level includes improvement of the features from previous service levels and in addition the following features will be utilised:

- mapping functions for maps' customisation based on identified use-cases,
- integration of the harmonisation tools into the platform,
- integrated metadata for analyses, map compositions and integration schemas,
- extended data management tools enabling maintenance of different versions of datasets,
- first releases of pilot applications – Location Evaluator and Thematic Map Viewer.

Service Level 4: This service level includes improvement of the features from previous service levels, their integration into the platform and in addition the following features will be utilised:

- new design of the user interface,
- advanced portrayal of the analysis result in a form of a table, chart or a report.
- support of most of the data formats defined by the users,
- tools for embedding maps into external applications,
- generation of a report from a selected area including information such as data availability, data quality, data source and non-spatial data that are integrated with spatial data.
- integration of single components into an integrated platform.

Service Level 5 – additionally, the Service Level 5 was designed. It includes:

- data download,
- tools for utilising feedback from users of spatial planning data,
- support of more complex queries by using the primary data storage as well as secondary storage,
- additional user applications for investors, design and implementation of a brownfield database,
- integration of advertisement into the portal,
- payment module,
- components' update.

The plan4business system is a comprehensive and complex system, built on flexible and scalable layers, interacting through a set of defined services, ensuring performance and security.

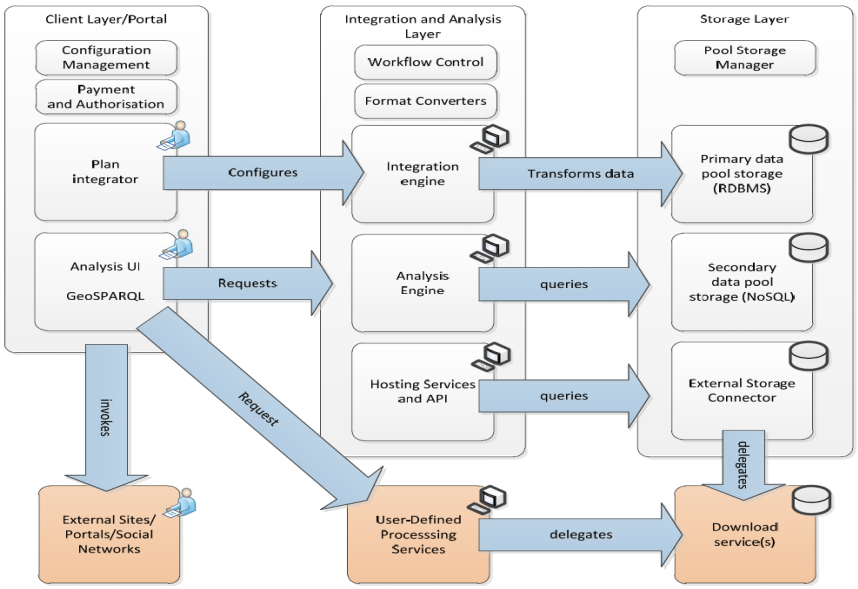

Figure 31: Plan4business Architecture

ARe[3]Na - A Reusable INSPIRE Reference Platform[58]

[58] *https://joinup.ec.europa.eu/community/are3na/description*

This open community aims to support access to common reusable software and other components for spatial data in European e-government. The Member States of the European Union are currently implementing the Infrastructure for Spatial Information for Europe (INSPIRE) Directive (2007/2/EC) and related regulations, a major European data-sharing policy helping to create a Spatial Data Infrastructure for the environment and related policy areas. Technical guidelines for INSPIRE implementation, based on existing international standards, are either in place or are currently under development. However, standards can be implemented in different ways, they can evolve and coordinating changes between standards can be a challenge. All these issues can limit the interoperability between systems and the way in which this European environmental Spatial Data Infrastructure (SDI) can operate.

In order to address these issues, as part of the Interoperability Solutions for European Public Administrations (ISA) Programme, the European Commission's Joint Research Centre (JRC) is establishing the Reusable INSPIRE Reference Platform (ARE3NA) which will identify and develop common components for the successful implementation of the INSPIRE Directive in relation to European e-government. ARE3NA will support collaboration, identification of best practices, guidance and the sharing of components relate to various aspects of INSPIRE (e.g. metadata-related tools, spatial data themes (as described in Annexes I, II, III of the Directive), spatial data services and technologies, including for testing conformity) through the following activities:

- Inventory of existing platforms and tools spanning multiple policy areas;
- Support existing or initiate new open source projects to address identified gaps;
- Produce extended multilingual documentation to help create an INSPIRE node based on existing Member States' relevant initiatives;

This site provides a major contribution to the last item by using JoinUp as part of ARE3NA's collaborative platform and a place to host, review and discuss these project outputs.

E.L.F - European Location Framework[59]

The goal of this project is to deliver the European Location Framework (ELF) required to provide up-to-date, authoritative, interoperable, cross-border, reference geo-information for use by the European public and private sectors. This versatile cloud-based and cascade-supporting architecture provides a platform of INSPIRE compliant geo-information, harmonised at a cross-border and pan-European level.

The three-year project is supported by a consortium of 30 partners across Europe, whose work is co-funded by the European Commission. It will foster the wider use of geo-information and enable the creation of innovative value-added services. The project's proactive stimulation of content markets involves the creation of sample applications using thematic communities to make user-led developments by SMEs (both inside and outside the consortium).

The consortium is committed to continue to provide the ELF Platform beyond the end of the project, thus enabling growth in the use and re-use of trustworthy, accurate and re-usable official reference geo-information. It therefore aims to create a sustainable framework for re-use of authoritative public sector reference geo-information at multiple levels of detail.

6.2 Transport Related Projects

BIKE INTERMODAL

[59] *http://www.elfproject.eu/content/overview*

The object of this work is to provide -by means of product and process innovations- an advanced compactable bicycle, making it practical to carry along a bicycle aboard public transportation, easily, safely and for a large number of passengers. The ultimate goal is a synergic, intermodal integration of public transport and cycling, expanding the share of both modalities in the urban mobility.

Bicycling, very efficient in the short range, but not so on longer distances, could be re-introduced into daily travel to handle the trip's end portions, enhancing the effectiveness of other modalities through an additive effect, re-balancing in a cost-effective way the modal mix in favour of micro-mobility and public transport. The state of the art does not allow a collective, pervasive use of the folding bikes in "intermodal duty", because of excessive weight and volume when collapsed -often exceeding the baggage limits of city bus and metros- discouraging their use out of practicality and safety on board.[60]

SPIDER PLUS - Sustainable Plan for Integrated Development through the European Rail network – Projecting Logistics & mobility for Urban Spatial design evolution

SPIDER PLUS objective is to provide a new 2050 mobility VISION through a Strategic Design & Plan, and a Road Map delivering Sustainable Solutions by then. In such Plan the electrified Rail has a central role both for passengers and freight. The productivity of the available resources supported by ICT and other technologies, is maximized by the combination of infrastructural nodes with spatial and urban planning integrating the missing links for sustainable mobility and city logistics. The combination of the Time with Space management generates seamless transport chains reducing aggravations and costs. E/Service, E/Freight, ICT technologies, satellite communications, Galileo are tools for achieving these objectives. Syncro-Mobility is the 2050 SPIDER PLUS MOBILITY motto.[61]

OPTICITIES

OPTICITIES' vision is to help European cities tackle complex mobility challenges. OPTICITIES' strategy focuses on the optimisation of transport networks through the development of public/private partnerships and the experimentation of innovative ITS services. OPTICITIES addresses both passenger and freight transport issues supporting a user-centred approach. OPTICITIES delivers significant innovation breakthroughs:

- New governance scheme between public and private stakeholders through a tractual architecture fostering data quality and implementing data access policy;
- European standard for urban multimodal data set including interfaces with information services;
- Decision support tools based on predictive data for proactive transport management and Multimodal Traffic trol Systems necting road traffic and public transport data in cities;
- Multimodal real-time urban navigator interfaced with in-car navigation systems as a first world trial;
- Urban freight navigator to support drivers and fleet operators in optimising their deliveries.[62]

CATS - City alternative transport system

The CATS project objective is the final development and experimentation of a new urban transport service based on a new generation vehicle. Its major innovation is the utilisation of a single type of vehicle for two different usages: individual use or collective transport. This new transport service is aimed at filling the gap between public mass transport and private individual vehicles. It is based on two operating principles: the self service except where small and clean urban vehicles are offered on a short term rental basis, and the flexible shuttle service where a variable length of vehicles voy, driven by a professional driver, operates at

[60] *http://cordis.europa.eu/projects/rcn/94358_en.html*
[61] *http://cordis.europa.eu/projects/rcn/106309_en.html*
[62] *http://cordis.europa.eu/projects/rcn/111158_en.html*

fixed hours along a line on a permanent basis or on a case by case basis. Both these principles are integrated in a single service (composed of vehicles and stations) called Cristal.

The final aim of this new service is a more efficient mobility in cities through a more balanced use of small clean vehicles and mass transport. This inclusive new transport system is well adapted to the needs of people with reduced mobility, young passengers and tourists. Four Cristal vehicles and two stations will be made available by Lohr Industrie to the project for experiments. The CATS project will investigate through an in depth mobility needs analysis, on-site demonstration and showcases, the impact of the introduction of such a new system in three different European cities (Strasbourg FR, Ploeisti, RO, Formello, IT).The impact on environment and especially on CO2 emissions, as well as the acceptance and the evaluation of market take-up of the system will be studied. CATS will complement the design and manufacture of the Cristal vehicle via a detailed definition of its operating principles and by a design of its urban settings (stations, infrastructures,) in accordance with cities and citizens needs. A full evaluation plan is then foreseen as well as transferability assessment.[63]

GIFT 2.0 – Greece Italy Facilities for Transport 2.0

GIFT 2.0 aims at demonstrating how to develop the Adriatic-Ionian geographical area, in Apulia and Greek Regions, with multipurpose approach through the joint coordinated management of existing infrastructures and common services, in order to **intercept new traffic flows** (short connections, neighbourhoods and long distances) and consolidate redistributing the existing ones in an optimized way, minimizing generalized costs. The main outputs are the following:

- **Integrated Information System** land-sea-air version 2.0 - created by public authorities and managed by private stakeholders (Trivago model);
- **pilot** cases aimed to overcome existing common bottlenecks for freights and passengers;
- **training** tools for qualified operators and change in skills;
- **positioning of Adriatic-Ionian** area with GIFT 2.0 as "fully facilities" Region;
- development of a joint **trans-border ticket system** (Ticketone);
- establishment of an **International Master** and cross border training courses.

Project outputs are linked to the concept of unique "virtual logistics" platform at three levels: CBC, intraregional and beyond borders. It aims to create an **informative hub centre**, focused on the improvement of accessibility to Ita-Gr transport areas towards belonging territories via integrated tickets and multimodal services both for passengers and goods.

EA SEA WAY

The general objective of EA SEA-WAY is to improve the accessibility and the mobility of passengers across the Adriatic area and its hinterland, through the development of new cross border(CB), sustainable and integrated transport services and the improvement of physical infrastructures related to those new services.

In particular, specific project objectives are to:

1. Integrate and upgrade existing and new collective passenger (tourists and residents) transport services to increase the accessibility across Adriatic basin and decrease CO2 emissions
2. Explore a better integration of urban and regional connections between ports, airports and main tourist destinations/urban areas
3. Develop new or renovate existing infrastructures in the Adriatic port system in order to promote and encourage a more sustainable and efficient passenger transport

[63] *http://cordis.europa.eu/projects/rcn/93669_en.html*

4. Foster the passenger sea transport and other collective transport means connected to port system
5. Test new governance models in the light of the forthcoming Adriatic Ionian Macro Region.

DANUBE – BLACK SEA CONNECTION OF EUROPEAN AND ASIAN ECONOMY,A STEP FOR SUBSTANTIAL GROWTH OF THE BLACK SEA AREA – DABS

Specific objectives are: 1. To improve the capacity of the stakeholders to develop improved or new freight eco-friendly water transport routes as a connection between European and Asian economy; 2. To advocate the use of the alternatives routes to connect Black Sea and Danube, as a contribution to the decreasing of the pollution caused by different type of transport coming to coastal areas; 3. To promote the maritime and inland water transport as a source for sustainable economic and social development of the area.

6.3 Linked Open Data Projects

SmartOpenData[64]

SmartOpenData creates a Linked Open Data infrastructure (including software tools and data) fed by public and freely available data resources, existing sources for biodiversity and environment protection and research in rural and European protected areas and its National Parks. This will provide opportunities for SMEs to generate new innovative products and services that can lead to new businesses in the environmental, regional decision-making and policy areas among others. The value of the data will be greatly enhanced by making it available through a common query language that gives access to related datasets available in the linked open data cloud. The commonality of data structure and query language will overcome the monolingual nature of typical datasets, making them available in multiple languages.

Linked Open Data is becoming a source of unprecedented visibility for environmental data that will enable the generation of new businesses as well as a significant advance for research in the environmental area. Nevertheless, in order for this envisioned strategy to become a reality, it is necessary to advance the publication of existing environmental data, most of which is owned by public bodies.

This project is focused on how Linked Open Data can be applied generally to spatial data resource and specifically to public open data portals, GEOSS Data-CORE, GMES, INSPIRE and voluntary data (OpenStreetMap, GEPWIKI, etc.), and how it can impact on the economic and sustainability progress in European Environment research and Biodiversity Protection.

There exist many different information sources for protecting biodiversity and environmental research in Europe -in coastal zones, agricultural areas, forestry, etc.-, mainly focused on the Natura 2000 network, and areas where environmental protection and activities like agriculture, forestry or tourism need to be balanced with the Habitats Directive and the European Charter for Sustainable Tourism in Protected Areas. Nevertheless, the economic value of these areas is still largely unknown.

SmartOpenData will define mechanisms for acquiring, adapting and using Open Data provided by existing sources directly involved in the project for biodiversity and environment protection in rural and European protected areas and its National Parks.

Through target pilots in these areas, the project will (i) harmonise geospatial metadata (ISO19115/19119 based) with principles of Semantic Web, (ii) provide spatial data fusion introducing principles of Linked Open Data, (iii) improve spatial data visualisation of Geospatial Linked Open Data and (iv) publish the resulting information according to user requirements and Linked Open Data principles to provide new opportunities for SMEs.

[64] *http://www.smartopendata.eu/*

The project will reuse existing European Spatial Data Infrastructures (SDI), based on INSPIRE, GMES and GEOSS (Free Pan European Data Sets like CLC, Natura 2000, Habitats, Plan4all, Plan4bussines, EnviroGRIDS, Brisedie, GEOSS registries, national INSPIRE portals, thematic portals like National Forestry portals together with local and regional data) and will extend it using Linked Open Data. Research and Development Partners will provide extension of current INPIRE/GMES/GEOS based Spatial Data Infrastructure.

The SMEs involved will develop new services based on this data and research on biodiversity. Environmental Agencies and National Parks will benefit by improving their knowledge of their biodiversity, maintenance and protection. Public bodies, researchers, companies and European citizens will take a central role in user-driven pilots developed to enhance the potential of protected areas. Innovation by third party SMEs will be encouraged by the promotion of royalty-free open standards and best practices generated, initiated or simply highlighted by SmartOpenData.

Open public data resources for re-use is one of the key priorities of the Digital Agenda for Europe. Data available in public European organisations have an enormous potential economic growth. The project will make spatial data easier to discover and use, having a positive impact on the public and standard availability of data according to the Linked Open Data Strategy for the purpose of environmental information.

The target pilots will involve SMEs focusing on human activities (forestry, tourism, agriculture) in rural and protected areas such as National Parks and coastal zones. This availability will allow the addressing of globally environmental issues that are not affordable at this moment in terms of costs, efficiency and sustainability.

Data-and-Platform-as-a-Service (DaPaaS)

In the space of just a few years we have seen the transformational power of open data; both for transparency and accountability in public data, and efficiency and innovation with businesses in private data. In its first year, institutions and individuals throughout Europe have supported public sector bodies in releasing data and numerous start-ups, developers and SMEs in reusing this data for economic benefit.

However, we are still at the beginning of the open data movement, and there is still more that can be done to make open data simpler to use and to make it available to a wider audience.

The core goal of the DaPaaS project is to provide a Data- and Platform-as-a-Service environment, where 3rd parties (such as governmental organisations, SMEs, developers and larger companies) can publish and host both data sets and data-intensive applications, which can then be accessed by end-user applications in a cross-platform manner. You can find out more about DaPaaS on the detailed about page.

Essentially, DaPaaS aims to make publishing, consumption, and reuse of open data, as well as deploying open data applications, easier and cheaper for SMEs and small public bodies which otherwise may not have sufficient technical expertise, infrastructure and resources required to do so.

COSMODE[65]

The research and development project COMSODE has the following main objectives within its 24 months of duration:

(1) **Create a publication platform called Open Data Node** that builds on results of previous research and development in the linked data field. Its mission is to bring results from research environment into real-world for people, SMEs and other organizations to use and re-use.

[65] *http://www.comsode.eu/index.php/about/*

(2) **Create a methodology framework** for easy use of technology in operating conditions of typical public bodies and rigorously tested for traceability, usability and sustainability in a public body environment. This is going to be verified in three pilot implementations during the project. End user-communities will be involved EU-wide to set a use case framework within which the requirements of heterogeneous organisations can be clearly understood. Provided feedback will be processed into the final methodology and recommendations for re-use applications.

These two results will enable new applications to emerge – some of them will be directly created in the project by consortium members (search service by SPINQUE) or by associated bodies (Semantic Web Company, Austria).

SemaGrow[66]

SemaGrow envisages to develop the scalable, efficient, and robust data services needed to take full advantage of the data-intesive and inter-disciplinary Science of 2020 and to re-shape the way that data analysis techniques are applied to the heterogeneous data cloud.

But most of the low-hanging fruit has been picked and it is time to move on to the next step, combining, cross-indexing and, in general, making the best out of *all public data, regardless of their schema, size, and update rate*; accepting that some schemas might be better suited to a given dataset and application and that there is no consensus about a "universal" schema or vocabulary for any given application, let alone for the Semantic Web and related initiatives such as the LOD cloud. In other words, we need infrastructure that besides being efficient, real-time responsive and scalable is also *flexible and robust* enough to *allow data providers to publish in the manner and form that best suits their processes and purposes and data consumers to query in the manner and form that best suits theirs*.

This will be a decisive factor in maintaining the momentum of the linked open data movement by including in the cloud *large, live, constantly updated datasets and streams* that are published in formats that were not designed with linking across sources in mind. This will not only increase the value of all public data, but can also provide both the incentive and the opportunity to follow Semantic Web standards and linked data best practises for publishers that will not or cannot directly and immediately make this transition.

In order to achieve this ambitious vision and solve a difficult data management problem, we must address the following *key challenges*:

- Develop novel algorithms and methods for querying distributed triple stores that can overcome the problems stemming from *heterogeneity* and from the fact that the distribution of data over nodes is not determined by the needs of better load balancing and more efficient resource discovery, but by data providers.
- Develop scalable and robust semantic indexing algorithms that can serve detailed and accurate data summaries and other data source annotations about extremely large datasets. Such annotations are crucial for distributed querying, as they support the decomposition of queries and the selection of the data sources which each query component will be directed to.
- Since it is not possible to align schemas and vocabularies so perfectly that there is no loss of information, investigate how to *minimize losses* and how to *not accumulate* them over successive schema translations.

To *address these challenges,* SemaGrow carries out fundamental databases research and develops methods and infrastructure that will be *rigorously tested* on three *large-scale current use cases* as well as on their *projected data growth* beyond project's end: they are laying the foundations for the scalable, efficient, and robust data services to take full advantage of the data-intensive and inter-disciplinary Science of 2020.

[66] *http://www.semagrow.eu/?q=home*

GeoKnow - Geospatial Data and the Semantic Web[67]

Geospatial data or geographic information is the data that identifies a geographic location of natural or constructed features and boundaries on the Earth (e.g. oceans, buildings, countries, rivers, etc). Geographical knowledge bases are among the largest in existence and have high importance in a variety of everyday applications. The data can be mapped and often manipulated with Geographic Information Systems (GIS), however the integration of external data sets into these systems is time-consuming and complex. GeoKnow will provide the necessary tools and methods to easily integrate and process data across a wide range of data sources on the web of data.

Possibly one of the most interesting and promising outcomes of the activity surrounding the Web 2.0 evolution has been the large-scale adoption of Linked Data. Among the largest data sets are those with explicit geographic references, e.g. LinkedGeoData (2 billion triples), DBpedia (1 billion triples) and GeoNames (146 million triples). Other data sets carry implicit geographic references such as PubMed (797 million triples) or Freebase (1 billion triples). A problem GeoKnow aims to solve is the lack of rich geospatial links between the data.

SWITCH-ON[68]

The project SWITCH-ON addresses water concerns to thoroughly explore and exploit the significant and currently untapped potential of open data. Water information is highly sought after by many kinds of end-users, both within government and business as well as within civil society. Water touches virtually all societal and environmental domains and the knowledge domain is largely multidisciplinary. New water information and knowledge can thus lead to more efficient use of environmental services and better handling of environmental problems, including those induced by climate and environmental change. SWITCH-ON will show the benefits achieved through the whole process chain by re-purposing (re-using under different context) open data products into more dedicated and refined water products, which have high value and a broad impact on society. The vision is to improve public services, and to foster business opportunities and growth, by establishing new forms of water research and facilitating the development of new products and services based on principles of sharing. The SWITCH-ON objectives are to use open data for implementing:

- An innovative spatial information platform with open data tailored for direct water assessments.
- An entirely new form of collaborative research for water-related sciences.
- Fourteen new operational products and services dedicated to appointed end-users.
- New business and knowledge to inform individual and collective decisions in line with the Europe's smart
- Growth and environmental objectives..

While focusing on water, the project is expected to inspire a much broader environmental and societal knowledge domain and many different end-users. The SWITCH-ON project will be one trigger in a contemporary global movement to better address environmental and societal challenges through openness and collaboration.

MELODIES[69]

The MELODIES project (Maximizing the Exploitation of Linked Open Data In Enterprise and Science) is about using diverse sources of Open Data to develop new applications and technologies that benefit society in a variety of ways. Huge amounts of open data are now freely available and new data sources are appearing all the time. The MELODIES project will apply the latest technologies in cloud computing and data-handling to exploit these data to their best advantage.

[67] *http://geoknow.eu/Welcome.html*
[68] *http://www.water-switch-on.eu/?q=node/2*
[69] *http://www.melodiesproject.eu/*

6.4 Summary

In summary, projects that may provide interesting case studies, approaches and tools that could be leveraged by technical partners for OTN include:

- GIGAS – provide architectural coherence between INSPIRE, GMES and GEOSS
- Humboldt – integration of GMES and INSPIRE to harmonise spatial info
- Plan4All – data sharing using ISO standards
- Earthlook – verifying spatial data validity infrastructure for GMES activities
- EnviroGrids – web apps for data management using Geospatial Grid interoperability
- Genesis- application supporting the building of SISE
- Habitats – standards design and adoption using INSPIRE
- EurGEOSS – making existing systems and apps interoperable with GEOSS and INSPIRE frameworks
- Plan4business – platform enabling aggregation, processing and analysis of urban planning data
- AreNa – support reusable software for spatial data in European eGovernment
- E.L.F – provide up-to-date, interoperable, cross-border referenced geo-information

Technical partners may be particularly interested in looking at linked data projects which have already attempted to integrate and harmonise geospatial data from a variety of diverse sources:

- SmartOpenData – how linked open data can be applied generally to spatial data resources
- DaPaas – provide data and platform as a service environment for 3rd parties to publish data and apps
- COSMODE – bring results from research into the real world for re-use
- SemaGrow – develop scalable, efficient and robust data services that reshape analysis techniques
- Geoknow – provide tools and methods to easily integrate and process data from a variety of sources
- Switch-On – exploit significant and untapped potential of water data
- Melodies – maximise exploitation of linked open data in enterprise and science using diverse sources

Projects that would be useful for stimulating ideas with pilot partners and potential partnerships through the dissemination team include:

- Bike Intermodal – integration of cycling and transport
- Spider Plus – using Galileo tools to generate seamless transport chains
- OptiCities – cities tackle complex mobility challenges using governance and data standards
- CATS – more efficient mobility in cities through multi-use vehicles
- Gift 2.0 – intercept new traffic flowsa and redistribute exisiting ones
- EA SEA Way- improve mobility through cross border integrated transport services
- Danube – improve capacity of stakeholders to develop new freight eco-friendly water routes

7 Climate Analysis

This chapter provides a brief overview of broad climate factors that may affect the delivery of OTN. All project partners should take note of this section, as the content may raise some new risk areas that have not been previously thought of.

7.1 Political

Transport Domain

Transportation is a policy domain where data plays an increasingly central role. However, despite the maturity of transportation policy both at the European and national level, data policies and regulations in Transport are disparate and represent different levels of maturity. The introduction of this chapter will therefore not be transportation per se but rather the interaction between transportation systems. Such interaction is termed, by the 'Intelligent Transport Systems' directive 2010/40/EU, 'multi-modal transportation systems' and for the purposes of OTN represents the most relevant policy background for the project.

One of the main challenges faced by transportation is the integration of 'big' and ubiquitous data capture. The explosive increase in transportation data has three key drivers: 1) The increasing release of proprietary data by industry sectors 2) The rise in IoT[70] and other monitoring technologies that increase the potential for data harvest 3) Growth in the range of online channels through which data can be accessed and used. Together the three factors above have driven significant expansion in the data-driven business models in the transport domain.

In the European context, the drivers noted above have come under the aegis of the Commission's work through a white paper entitled "Roadmap to a Single European Transport Area - towards a competitive and resource efficient transport system"[71]. The paper proposes a roadmap of 40 concrete initiatives aiming to build a competitive transport system that will increase mobility, remove major barriers in key areas and foster growth and employment; while at the same time reducing Europe's dependency on imported oil and cut carbon emissions in transport by 60% by 2050. Despite its broad ambition and long term perspective, the white paper lacks a closer link to the Intelligent Transport Systems (ITS) Directive adopted on 7 July 2010, and leaves open how ITS can improve the transport modes.

The ITS programme recognises the role of ICTs to contribute to cleaner, safer and more efficient transportation system. A key aspect of the contribution offered by ICTs is the increased generation, harvest and availability of transportation data of the type on which OTN is focussed. ITS is an area that requires and has a long tradition of close collaboration with other DGs. It is supported by several Directorates-General: DG Move, DG CONNECT, DG Research, DG Enterprise, DG Environment and DG Regio.

- The current legal framework, EU Directive 2010/40/EU of 7 July 2010 on the framework for the deployment of intelligent transport systems in the field of road transport and for interfaces with other modes of transport[72] defines ITS as "*advanced applications which without embodying intelligence as such aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be* ***better informed and make safer, more coordinated and 'smarter' use*** *of transport networks*."

[70] *See Schindler et al (2013)*
[71] *http://ec.europa.eu/transport/themes/strategies/2011_white_paper_en.htm*
[72] *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:207:0001:0013:EN:PDF*

- The ITS Directive promotes *"advances in the field of the application of ICT to other modes of transport to be reflected in the developing in the road transport sector, in particular with a view to ensuring **higher levels of integration between road transport and other modes of transport***".

- The Directive requires the European Commission to adopt specifications to address **compatibility, interoperability and continuity** of ITS solutions across the EU by 2017. Priorities in the first years is the development of: traffic and travel information, the eCall emergency system and intelligent truck parking.

Beyond the explicit policy context of the ITS directive, there has been at least 20 years of cooperation between DG MOVE and DG CONNECT on transportation issues. Among the earliest examples was ERTICO[73], a joint effort between DGs 7, 12 and 13. The next major cooperation was the e-Call initiative[74] that began within DG INFSO but migrated to DG TRANSPORT as the focus shifted and specific transport applications of the scheme were developed. More recently, the joint space[75] has been linked to the evolution of the Intelligent Transport Systems (ITS) cluster of initiatives, and by Smart City initiatives, actions and programmes. These are not limited to direct policy actions, but also include strong research components, active links to other DGs and policy objectives, and extensive and complex external stakeholder engagement.

A Smart Transport Market[76] is a hybrid comprised of transportation and ICT value chains. OTN, as both a data-broker and an innovation environment, has the potential to benefit substantially from the advances that have been made in the area of Smart Transport Markets. STMs emphasises multi-modality and safe, interoperable connectivity between vehicles of all types, infrastructure and devices (V2X). Currently, Pike research estimates the site of STMs to Europe at 2 Billion Euros and this is poised to grow.

The record of policy engagement within transport *per se* and its linkages with other policy areas and actors shows a wide range of fragmented initiatives, many of which are – or could be linked on a common and consistent set of data. At present, the capture of data and even publication has far outstripped the capability or willingness of policymakers to integrate this information into their practices and regulations. Beyond this, many of the existing policy initiatives rest on highly simplistic models of how information affects transport behaviour that overlook many obvious opportunities for improvement of the uptake and use of transport data. There is therefore a need to lower barriers to inter-institutional information collection, communication, analysis and modelling in order better to understand how people's behaviour will change if they are

a) measured and monitored or asked to volunteer information;
b) provided with a range of relevant information to inform their short- and long-term decisions; and
c) provided with platforms on which to make new business models and connections.

OTN has been designed to become a primary catalyst for better sharing of information gathered within various transport sectors and the integration of this data into new applications and services that can benefit

[73] *ERTICO – ITS Europe was founded at the initiative of leading members of the European Commission, Ministries of Transport and the European Industry in 1991. Today, it represents the interests and expertise of around 100 Partners involved in providing Intelligent Transport Systems and Services (ITS). It facilitates the safe, secure, clean, efficient and comfortable mobility of people and goods in Europe through the widespread deployment of ITS. ERTICO's activities are carried out by its Brussels-based team after approval by its Supervisory Board. ERTICO's vision is to bring intelligence into mobility, working together in public private partnership towards: zero accidents, zero delays, reduced impact on the environment, fully informed people, where services are affordable and seamless, privacy is respected and security is ensured. To achieve this vision, all modes of transport should cooperate to achieve an optimal and sustainable use of all transport modes. Source: http://www.ertico.com/about-ertico*

[74] *http://ec.europa.eu/digital-agenda/en/ecall-time-saved-lives-saved*

[75] *There is no clear 'one or the other' rule, instead a case-by-case approach requiring close collaboration and coordination between DGs. ITS started at DG CONNECT, DG MOVE was involved early on, now a shared topic. Joint activities under Horizon 2020, with some parts managed by DG MOVE & RTD (Directorate H – Transport).*

[76] *See http://www.its.dot.gov/*

ITSs at the local level. Each hub has been designed to harvest data from a variety of sources connected to the transport. Currently, transportation data as understood by the policy process can be divided into 4 basic types. These types are summarised in the figure below:

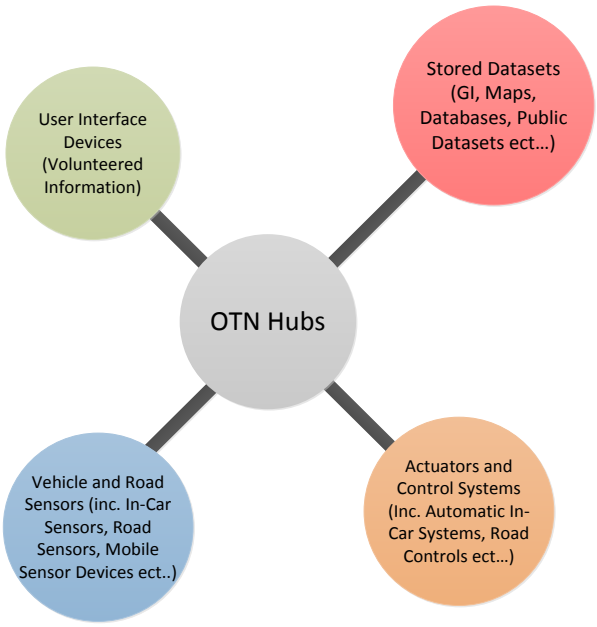

Figure 32: Broad Types of Transport Data

GI in General

Another basic factor that can affect the use of GI services is the multitude of public administrations that are involved in the generation and management of data, and the need for coordination between them. For example, in many countries GI data are maintained by a variety of institutions including statistical authorities, tax bureaus, and ministries. A consequence of this situation is that interested users will have to go to different public services, to negotiate and purchase usage rights for the needed data.

Additionally, lack of communication between those many data-generating or managing institutions can exacerbate this fragmentation and contribute in complicating the user's gathering sufficient GI data.

Moreover, difficulties faced by both the EU-member states and accession countries in implementing geographic information strategies and infrastructures include lack of awareness across different levels of the public sector, lack of management support and technical skills, varying policies in respect to access to data and pricing, weak motivation and coordination across agencies. In addition, these problems are exacerbated by limited financial resources [1].

A form of resistance to change can also come from public authorities and local governments, unwilling to divert from their established systems, thus holding up the adoption of new technologies or practices such as the aggregation of GI data onto the virtual hubs envisioned by the project. The resistance to change may come from a general lack of awareness of the benefits associated to opening GI data and improving access to it.

The issue of sharing 'sensitive' geospatial datasets (datasets concerning for example military, energy, water infrastructure) could also constitute a political barrier to the sharing of GI from local authorities and therefore the creation of new GI services. The heterogeneity in what is actually considered as 'sensitive' data

across Europe may also add up to the public authorities' reluctance in fully opening their datasets. In order to overcome this barrier, initiatives carrying clear regulations such as INSPIRE will be essential.

7.2 Economic

In respect to pricing of GI, there are significant variations among European countries [1] In some cases there is a distinction between essential data free of charge (i.e. data paid for through the general taxation), and value added data that is charged for.

In other countries, a policy has yet to emerge, and individual organisations act independently. Where a policy exists, a general principle that seems to emerge is that whatever the pricing policy, the price should be minimal and should not deter the use of data, but on the contrary should encourage it. For example, fees could be charged solely for purposes of updating and maintaining the databases, or different prices could be set according to the volume of requests. Thus, heavy users of data would increase revenue whereas the lighter use by individuals and small enterprises would be encouraged.

Apart from certain datasets that are necessary in order for citizens to fulfil their legal obligations, all other datasets can be charged on a case by case basis. Pricing differences can also exist between customers from broader government agencies and organisations (e.g. regions, municipalities), who may pay smaller amounts per volume of data and the private sector.

The desired EU policy to publish data so that it can be used without restrictions (Open Data), with the expectation of fostering innovation and growth also comes into conflict with the small benefits that have been achieved so far. Together with a very tight financial situation in the public sector, we have also a movement pushing in the opposite direction to Open Data, i.e. towards seeking economic returns from data sales.

Further, as users demand much higher data quality and documentation, opportunities are created for providing value-added services over "core data", which unavoidably have to be paid at higher prices. The reality is that the conditions and level of pricing, which in many European countries are not fully established, can be a major factor that affects the proliferation of GI services. As a result, a consistent framework should be developed that sets basic principles for pricing GI data in Europe, and stimulates use among the small and medium enterprises.

7.3 Socio-Cultural

GI is generally considered as public sector information, which means that it has a high societal involvement (i.e. citizens are already involved in the production of data) and interest. Since GI data can be used by citizens for everyday activities, conflicts may arise between economic and social objectives of GI services. This again highlights the need for charging such data at minimum prices, and for offering a minimum set of basic GI services for free. However, what constitutes a minimum set of services may differ from country to country, and can depend on cultural issues.

Moreover, the issue of personal data protection is an important social parameter. Some citizens are already concerned about the increasingly pervasive nature of technology and there is scepticism (and sometimes resistance) on issues such as opening-up and processing data, and increased monitoring for data collection. On the other hand many people are constantly using private apps and tool that offer personalized services because of efficiency and added value reasons, e.g. Google Maps. Following increasing attention on predictive analysis type tools that aim to make peoples life better, e.g. Google Now, Nest, Thermostat, etc, users will need to be convinced that data handled by government is different, 'safer' and less intrusive, with different ownership restrictions that that of private businesses. In addition, cities will have to decide to what extent they want to share information with third parties, such as application developers or commercial companies, without losing a competitive advantage, or worse, violating the privacy of their inhabitants [2].

Four factors are contributing both positively in the use of geospatial information for the creation of new services, in terms of efficiency and technological enhancements, and negatively in terms of the privacy risks associated. These four factors[77] are: the continuous and real time nature of the data flow being collected, the invisibility of the data-gathering process, the interconnected nature of Geospatial Information (GSI) services/devices and finally the ubiquity of devices and the richness of data these devices are able to produce.

In the same time, the rise of a 'Big Society', in which 'Big Data' is a cornerstone, as well as the increasing demand from citizens/businesses for greater transparency and accountability ('data democracy') of the public sector lead to a new approach in service delivery. The novelty of the approach resides in the larger space dedicated to a form of co-creation of services and a shift from consuming public services to collaborating in their production.

7.4 Technological

On the technological level, an important factor is the creation of metadata for GI, which will facilitate the indexing and search processes. In many countries, metadata do not exist or are insufficiently developed for GI.

A common focus of GIS development at a regional and pan-European level has been on producing Spatial Data Infrastructures (SDIs). An SDI is defined as a: "Framework of policies, institutional arrangements, technologies, data and people that enables sharing and effective usage of geographic information"[78]. Apart from rules for metadata, an SDI should allow for interoperability and sharing of spatial data sets and services, and have functionalities for monitoring and reporting. At the European level, INSPIRE[79] is a European Commission initiative to build a European SDI beyond national boundaries. INSPIRE touches on diverse domains such as addresses, transport networks, geology or natural hazards. Therefore, the success of OTN depends largely on the successful implementation of the INSPIRE directive, and should act complimentary to the work already done through in the context of INSPIRE.

A problem with sharing and maintaining geographic information systems-transportation data (GIS-T data) among applications is the diversity of formats that lead to inconsistencies, inaccuracies, and duplication. This diversity is due to differences among data models that make it difficult to achieve consistent representations of the transportation system[80]. In addition, the level of detail and spatial accuracy differs. The challenge is to establish means of data exchange among these disparate representations that lead to improvements in accuracy, consistency, and completeness.

Standards for data sharing are also difficult to develop because system requirements of advanced applications of GIS-T technology differ in spatial and temporal accuracy and details of road features. Attention must also be drawn on maintaining currency of databases of increasing detail and complexity, not just creating the initial database.

Finally, a problem is to cope with various licensing agreements, based on different legal frameworks and expressed in different languages, as well as to devise a process for importation and integration of the various purchased data sets into a common information data base, overcoming differences in coordinate systems, data models, etc. and possibly find ways to maintain this data base when purchasing updates from the data providers.

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8 Conclusion

Whilst the OTN Current Situation Analysis is not intended to be a thorough academic piece of research it does provide a comprehensive high-level snapshot of how Open Geospatial Information is published and used use across Europe.. The report has far exceeded the original objectives of the current situation analysis task and is in-itself a useful reference documents for all OTN project partners, especially those who are new to the GI domain. The answers to the initial questions outlined at the start of this document are as follows:

- What kind of open GI data sets exist that can be used in the transport domain?
  - OpenStreetMap as a routable network is recommended as the base map for visualizations
  - Countries have wide varieties in number and type of data sets made open
  - An initial list of available data sets for pilot areas can be found in Annex 1

- What are the key similarities between the identified data sets?
  - Many data sets are published in common formats which helps with interoperability
  - A full metadata review needs to be undertaken in WP4 to address this question

- What are the key barriers to using open GI and data for innovation?
  - Difficulty in accessing high quality and relevant GI data sets
  - Lack of user friendly tools for analyzing the data – practical rather than academic
  - Not knowing how to minimize the risk of data misuse
  - How to ensure interoperability through consideration of all standards and GI initiatives

- Where are the gaps in existing standardization processes for using open GI?
  - How to access relevant data – a lot of information is not yet opened.
  - How to harmonise and link GI transport data sets from a wide variety of sources
  - How to present linked information in an easy-to-understand way
  - How to package the approach in a way that is easy for users to understand and follow

- Which projects/organisations are currently using GI to deliver new services and business activities?
  - Initial list of projects identified for all Partners to explore and build on
  - GI for business and transport list will be expanded as part of the coms and exploitation plan

On a more practical level, the findings from this document can be used to stimulate further thinking and direction within specific OTN work packages

- WP2 Open Innovation, User Requirements and Design
  - Need the co-design process to provide strong usability guidance as there is a strong perception of a lack of friendly data tools in the market
  - Need to understand if other stakeholders (other than the public sector) see the peer community as being important and how this should operate
  - SWOT review existing GI platforms with business support such as Plan4business

- WP3 Adaptation of Hub Components
  - Review relevant projects to identify best practices tools and approaches to use for publishing and hosting tools
  - Understand how ISO standards may affect the adaptation of web apps for using GI

- WP4 Management of Data: Formats, Interoperability and Security
  - The project will need to create guidelines on how to publish data to common standards

- Biggest challenge will be how to overcome access barriers to transportation datasets
- Easiest datasets to access at first may be POI, Parking, Traffic Info and Public Transport Info
- Need to have a high focus on data quality!

- WP5 Hub Integration
  - Need to ensure Hub can access and harmonise a range of data from different sources
  - Need to ensure the resulting Hub will be simple to use

- WP8 Communications and Commercialisation
  - Need to educate stakeholders about linked open data
  - Stakeholders are looking for case studies about positive impact from opening data
  - Need to differentiate OTN from existing projects as being practical rather than research focused – initial SWOT for OTN is provided below:

Table 2: OTN Initial SWOT Analysis

STRENGTHS	WEAKNESSES
New data sources • Geo-positioning data: GPS, GSM, WLAN, RFID, etc. • Web content • High resolution vector data **New business models** • Free data, paid by advertisers • Volunteered geographic information (VGI) **New networks** • OGC, INSPIRE • Semantic web • VGI, Web 2.0, "Neogeography"	**Access to relevant and accurate data** • Difficulty accessing enough different data sets to create value • Massive amounts of data that is growing and needing to be updated real-time • Often unstructured or semi-structured (e.g. web documents, news archives), often heterogeneous • Often with little or no metadata
OPPORTUNITIES	**THREATS**
New methods: • (Geographic) Information Retrieval (GIR) • Spatio-temporal data mining and geographic knowledge discovery • (Geo)Visual analytics, etc. **New applications:** • Vernacular geography • Moving object analysis • Geographic association mining, etc. **New technologies:** • LBS, map engines, Google Maps/Earth etc. • Mash-ups • An increasing number of spatial apps and maps generated and used by non-geo people • Increasing life tracking tools / VGI • New audience and new "competitors"	• Lack of interest to GIS community – may prefer more academic type approaches • Lack of awareness across different levels of the public sector regarding the implementation of linked GIS and infrastructures • Varying policies in respect to access to data and pricing

9 References

Please note all the references below are included as footnotes throughout the document.

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[56] Genesis D4600.1 – Global Architecture Document http://www.genesis-fp7.eu/images/pdf/genesis_d4600.1_pu_tas_global_architecture_v1.3_public.pdf
[57] D-4.1 State of the Art of existing SDI, HABITATS, CIP- ICT-PSP-2009-3-250455, Social Validation of INSPIRE Annex III Data Structures in EU Habitats, 2010
[58] https://joinup.ec.europa.eu/community/are3na/description
[59] http://www.elfproject.eu/content/overview
[60]http://cordis.europa.eu/projects/rcn/94358_en.html
[61] http://cordis.europa.eu/projects/rcn/106309_en.html
[62] http://cordis.europa.eu/projects/rcn/111158_en.html
[63] http://cordis.europa.eu/projects/rcn/93669_en.html
[64] http://www.smartopendata.eu/
[65] http://www.comsode.eu/index.php/about/
[66] http://www.semagrow.eu/?q=home
[67] http://geoknow.eu/Welcome.html
[68] http://www.water-switch-on.eu/?q=node/2
[69] http://www.melodiesproject.eu/
[70] See Schindler et al (2013)
[71] http://ec.europa.eu/transport/themes/strategies/2011_white_paper_en.htm
[72]http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:207:0001:0013:EN:PDF
[73] ERTICO – ITS Europe was founded at the initiative of leading members of the European Commission, Ministries of Transport and the European Industry in 1991. Today, it represents the interests and expertise of around 100 Partners involved in providing Intelligent Transport Systems and Services (ITS). It facilitates the safe, secure, clean, efficient and comfortable mobility of people and goods in Europe through the widespread deployment of ITS. ERTICO's activities are carried out by its Brussels-based team after approval by its Supervisory Board. ERTICO's vision is to bring intelligence into mobility, working together in public private partnership towards: zero accidents, zero delays, reduced impact on the environment, fully informed people, where services are affordable and seamless, privacy is respected and security is ensured. To achieve this vision, all modes of transport should cooperate to achieve an optimal and sustainable use of all transport modes. Source: http://www.ertico.com/about-ertico
[74] http://ec.europa.eu/digital-agenda/en/ecall-time-saved-lives-saved

[75] There is no clear 'one or the other' rule, instead a case-by-case approach requiring close collaboration and coordination between DGs. ITS started at DG CONNECT, DG MOVE was involved early on, now a shared topic. Joint activities under Horizon 2020, with some parts managed by DG MOVE & RTD (Directorate H – Transport).

[76] See http://www.its.dot.gov/

[77] Gleicher, N.J., Hwang, J.S. (2010). "Geospatial Information Services: Balancing Privacy and Innovation", in AAAI Spring Symposium: Intelligent Information Privacy Management.

[78] Craglia, M., et al (2003). SDI Developments in Western Europe. GI in the Wider Europe

[79]http://inspire.jrc.ec.europa.eu/

[80] Kenneth J Dueker, J.Allison Butler, "A geographic information system framework for transportation data sharing", Transportation Research Part C: Emerging Technologies, Volume 8, Issues 1–6, pp.13-36.

10 Annex 1: Initial Data Sets

This list of available data sets will be updated and managed during WP4.

Table 3: Initial List of Project Datasets

Resource title	Resource abstract	Geography	Resource locator	Responsible party	Restrictions/ Licences	Format
Name by which the cited resource is known (e.g. Standardized Precipitation Index)	Brief narrative summary of the content of the resource	Linguistic transcriptions of the extent or location	Location (address) for on-line access using a Uniform Resource Locator (URL)	Identification of and means of communication with person(s) and organisation associated with the resource	Restrictions on the access and use	Indicate the file format, e.g. SHP, GML, JSON, KML, PDF, JPEG, TIFF
Dogwalking areas	Location and sizes of dog walking areas in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/hondenloopzone	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Glass recycling containers	Location and sizes of glass recycling containes in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/glascontainers	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Recycling centres - points	Location and sizes of recycling centres in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/containerparken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Recycling centres - Shapes	Location and sizes of recycling centres in Antwerp, as polygon shapes	City of Antwerp	http://opendata.antwerpen.be/datasets/containerpark-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_E	CSV/KML/XML/JSON

					NG.pdf	
Recycling Streets	Location of the 'recycling Streets', a project where residents recycle their garbage in a local area.	City of Antwerp	http://opendata.antwerpen.be/datasets/sorteerstraten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Bins	Location of bins in Antwerp.	City of Antwerp	http://opendata.antwerpen.be/datasets/papiermanden	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Public toilets	Location of public toilets in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/openbare-toiletten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Playgrounds	Location of playgrounds in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/speelterreinen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Playgrounds - Shapes	Location of playgrounds in Antwerp, as polygon shapes	City of Antwerp	http://opendata.antwerpen.be/datasets/speelterreinen-vlak-0	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Admin centres - Points	Location of city admin centres in Antwerp.	City of Antwerp	http://opendata.antwerpen.be/datasets/districtshuizen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Admin centres - Shapes	Location of city admin centres in Antwerp, as polygon shapes	City of Antwerp	http://opendata.antwerpen.be/datasets/districtshuizen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Hospitals	Location of hospitals in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/ziekenhuizen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
District borders	Precise borders of the 9 Antwerp areas (called Districten)	City of Antwerp	http://opendata.antwerpen.be/datasets/grenzen-districten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Local neighbourhood borders	Borders of local neighborhoods. These are used by the Districts to define areas for participation.	City of Antwerp	http://opendata.antwerpen.be/datasets/wijken-stedelijk-wijkoverleg	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Statistical sector borders	These sectors are the smallest clustering level for demographic,	City of Antwerp	http://opendata.antwerpen.be/datasets/statistische-sectoren	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

	… data.				pendataforum.info/files/Modellicenties_ENG.pdf	
Police offices	Location of police offices in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/politiekantoren	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Sports infrastructure	Location and usage of sports infrastructure in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/sportinfrastructuur	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Culture infrastructure	Location of musea and cultural centres in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/cultuur	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Childcare	Location of all childcare initiatives (for kids 0-12)	City of Antwerp	http://opendata.antwerpen.be/datasets/kinderopvang	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Housing advice offices	Location of all housing advice offices in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/woonkantoor	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Green areas	Location of all parks and public green spaces.	City of Antwerp	http://opendata.antwerpen.be/datasets/groenzones	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Schools	Location of all schools in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/scholen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
A-card	The A-card is a city loyalty card. You can earn points by visiting cultural centres, using the library, sports infrastructure, … This dataset has all the locations of the A-card-readers where you can earn points.	City of Antwerp	http://opendata.antwerpen.be/datasets/kaart	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Reports of dumped garbage per statistical sector	Amount of reports of dumped garbage per statistical sector (2006-2012)	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-sluikstortmeldingen-statistische-sector	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Reports of dumped garbage per District	Amount of reports of dumped garbage per District (2006-2012)	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-sluikstortmeldingen-district	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_E	CSV/JSON/XML

					NG.pdf	
Students in primary school according to address (per statistical sector)	Students in primary school according to address (per statistical sector)	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-leerlingen-het-basisonderwijs-volgens-woonplaats-statistische-sector	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Students in secondary school according to address (per statistical sector)	Students in secondary school according to address (per statistical sector)	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-leerlingen-het-secundair-onderwijs-volgens-woonplaats-statistische-sector	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Income per statistical sector	Income per statistical sector	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-inkomens-volgens-woonplaats-statistische-sector	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Income per district	Income per district	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-inkomens-volgens-woonplaats-district	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Demographics per District	Age, nationality, ethnicity,…	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-bevolkingsgegevens-district	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML

Students in primary school according to address (per District)	Students in primary school according to address (per District)	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-leerlingen-het-basisonderwijs-volgens-woonplaats-district	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Students in secondary school according to address (per District)	Students in secondary school according to address (per District)	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-leerlingen-het-secundair-onderwijs-volgens-woonplaats-district	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Fire stations	Location of fire stations in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/brandweerkazernes	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Postal zones	Exact borders of the postal zones in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/postzone	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Area definition for Market Research	Exact borders for the areas that our Market Research team uses.	City of Antwerp	http://opendata.antwerpen.be/datasets/buurtmonitor-wijken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Approved urban planning projects	Shapes and borders of the approved urban planning projects (BPA	City of Antwerp	http://opendata.antwerpen.be/datasets/bpas-begrenzingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

	+ RUP)				pendataforum .info/files/Modellicenties_ENG.pdf	
Approved urban planning projects - points	Point mapping of the approved urban planning projects (BPA + RUP)	City of Antwerp	http://opendata.antwerpen.be/datasets/bpas-en-rups-puntvormige-planelementen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Approved urban planning projects - lines	Line-shaped planning elements of the approved urban planning projects (BPA + RUP)	City of Antwerp	http://opendata.antwerpen.be/datasets/bpas-en-rups-lijnvormige-planelementen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Approved urban planning projects - shapes	Plane-shaped planning elements of the approved urban planning projects (BPA + RUP)	City of Antwerp	http://opendata.antwerpen.be/datasets/bpas-en-rups-grondvlakken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Approved urban planning projects - subareas	Subareas (that have a certain spatial or thematic connection) of the approved urban planning projects (BPA + RUP)	City of Antwerp	http://opendata.antwerpen.be/datasets/bpas-en-rups-deelgebieden	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Employment statistics city of Antwerp administration	Aggregated data on sex, fulltime/parttime, level, age,… of employees of the city administration	City of Antwerp	http://opendata.antwerpen.be/datasets/personeelsbezetting-stad-antwerpen-0	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML

Public tenders	live update from public tenders for city of Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/aanbestedingen-gemeenschappelijke-aankoopcentrale-0	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/JSON/XML
Archeological advice map	Overview of archaeological zones of Antwerp. Each zone is based on historic, geological,… data.	City of Antwerp	http://opendata.antwerpen.be/datasets/archeologische-advieskaart	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Barbecues	Location of public barbecues in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/barbecues	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Area covered by buildings	Adjacent buildings form one building blocks	City of Antwerp	http://opendata.antwerpen.be/datasets/bebouwing	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Cemeteries - Shape	All cemeteries in Antwerp, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/begraafplaats-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Cemeteries - Points	All cemeteries in Antwerp, shown points	City of Antwerp	http://opendata.antwerpen.be/datasets/begraafplaatsen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
Access zone primary schools	Each service has an access zone, based on walking distance. Access zone for schools is 400m and 5 mins walking.	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-basisonderwijs	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone libaries	Each service has an access zone, based on walking distance. Access zone for libraries is 800m + 10m walking on local level, 1600m + 20m walk/8m bike on city level)	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-bibliotheken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone public open space	Each service has an access zone, based on walking distance. Access zone for public open space is 400m and 5 mins walking.	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-buurt-open-ruimte	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone public green areas	Each service has an access zone, based on walking distance. Access zone for public green areas is 400m and 5 mins walking.	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-buurtgoen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone sports infrastructure	Each service has an access zone, based on walking distance. Access zone for sports infrastruture is 400m and 5	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-buurtsportterreinen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_E	CSV/KML/XML/JSON

	mins walking.				NG.pdf	
Cinemas - Shapes	All cinemas in Antwerp, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/bioscopen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Cinemas - Points	All cinemas in Antwerp, point coordinates.	City of Antwerp	http://opendata.antwerpen.be/datasets/bioscopen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Guidelines for the blind	Streets where it is required that there should be physical changes in the street to help the blind.	City of Antwerp	http://opendata.antwerpen.be/datasets/blindegeleidelijnen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Building blocks	A building blocks is a selection of adjacent sites surrounded by infrastructure	City of Antwerp	http://opendata.antwerpen.be/datasets/bouwblokken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone cultural centres	Each service has an access zone, based on walking distance. Access zone for cultural infrastructure is 1600m + 20m walk/8m bike on city	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-cultuurcentra	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

	level)					
Access zone community centres	Each service has an access zone, based on walking distance. Access zone for community centres is 1600m + 20m walk/8m bike on city level)	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-dienstencentra	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone administration centres	Each service has an access zone, based on walking distance. Access zone for admin centres is 1600m + 20m walk/8m bike on city level)	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-districtshuizen-en-stadskantoren	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone art academies	Each service has an access zone, based on walking distance. Access zone for art academies is 1600m + 20m walk/8m bike on city level)	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-beeldende-kunstacademies	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone music academies	Access zone music academies	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-muziekacademies	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Access zone party venues	Each service has an access zone, based on walking distance. Access zone for party venues (<300 people) is 1600m + 20m walk/8m bike. >300 people is 2400m + 30m walk/12m bike)	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-fuifzalen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone dog walking areas	Each service has an access zone, based on walking distance. Access zone for dog walking areas is 800m/10m walk.	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-hondenloopzones	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone youth support centres	Each service has an access zone, based on walking distance. Access zone for youth support centres is 400m/5m walk.	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-vrijwillige-jeugdwerkingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone public transport stops	Each service has an access zone, based on walking distance. Access zone for public transport stops is 400m/5m walk.	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-haltes-openbaar-vervoer	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone polices offices	Each service has an access zone, based on walking distance. Access zone for police offices is 1600m + 20m	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-politiekantoren	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_E	CSV/KML/XML/JSON

	walk/8m bike				NG.pdf	
Access zone secondary school (first 2 years)	Each service has an access zone, based on walking distance. Access zone for police offices is 1600m + 20m walk/8m bike	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-middenscholen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone play areas	Each service has an access zone, based on walking distance. Access zone for play areas is 400m + 5m walk	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-speelruimtes	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone playgrounds	Each service has an access zone, based on walking distance. Access zone for playgrounds is 400m + 5m walk	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-speelterreinen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone sport halls	Access zone for sport halls is 800m + 10m walk on local level; 1600m + 20m walk/8m bike on city level	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-sporthallen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone supermarkets	800m + 10m walk	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-supermarkten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Access zone community gardens	1600m walk + 20m walk/8m bike	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-volkstuinen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone shopping streets	Access zone shopping streets	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-winkelstraat	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Access zone swimming pools	Access zone swimming pools	City of Antwerp	http://opendata.antwerpen.be/datasets/bereikzone-zwembaden	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Libraries - Shapes	Location of libraries, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/bibliotheken-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Libraries	Location of libraries, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/bibliotheken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Bridges	Location of all bridges in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/brugdek	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
Campings - Shape	Location of campings, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/campings-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Campings - Points	Location of campings, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/campings	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Concert venues - Shape	Location of concert venues, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/concertzalen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Concert venues - Point	Location of concert venues, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/concertzalen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Cultural centres - Shape	Location of cultural centres, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/culturele-centra-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Cultural centres - Points	Location of cultural centres, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/culturele-centra	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Fitness centres - Shape	Location of fitness centres, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/fitnesszalen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Fitness centres - Points	Location of fitness centres, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/fitnesszalen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Fairs - Shape	Location of fairs, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/foren-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Fairs - Points	Location of fairs, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/foren	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Ditches	Location of ditches in Antwerp (min 2m wide), excluding waterways in	City of Antwerp	http://opendata.antwerpen.be/datasets/grachten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

	the port area.				pendataforum.info/files/Modellicenties_ENG.pdf	
Groundwater measure points	Location of 193 points where monthly groundwater level is measured	City of Antwerp	http://opendata.antwerpen.be/datasets/grondwatermeetpunten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Port of Antwerp	Borders of port area	City of Antwerp	http://opendata.antwerpen.be/datasets/havengebied	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Main roads	Overview of all main roads	City of Antwerp	http://opendata.antwerpen.be/datasets/hoofdweg	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Hospitality Industry	Areas with sufficient presence of hotel, restaurants, bars	City of Antwerp	http://opendata.antwerpen.be/datasets/horecakern	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth centres - Shape	Location of youth centres, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdcentra-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Youth centres - Points	Location of youth centres, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdcentra	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth advice centres - Shape	Location of youth advice centres, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugddiensten-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth advice centres - Point	Location of youth advice centres, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugddiensten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth Hostels - Shape	Location of youth hostels, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdhotels-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth Hostels - Point	Location of youth hostels, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdhotels	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth clubs - Shape	Location of youth clubs, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdhuizen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
Youth clubs - Point	Location of youth clubs, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdhuizen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth work - Shape	Includes professional (youth centres, party venues,…) as well as voluntary orbs (scouts,…)	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdwerkingen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Youth work - Point	Includes professional (youth centres, party venues,…) as well as voluntary orbs (scouts,…)	City of Antwerp	http://opendata.antwerpen.be/datasets/jeugdwerkingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Traffic light cables	Location of cables used for traffic light control, maintained by the city of Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/kabels-en-leidingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Religious venues - Shape	Location of religious venues, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/locaties-levensbeschouwingen-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Religious venues - Points	Location of religious venues, points coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/locaties-levensbeschouwingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Aiport	Area of Antwerp airport	City of Antwerp	http://opendata.antwerpen.be/datasets/luchthaven	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Disused buildings	Location of disused buildings	City of Antwerp	http://opendata.antwerpen.be/datasets/legstandregister	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Markets - Shape	Location of all outdoor markets - shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/markt-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Markets - Points	Location of all outdoor markets - point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/markt	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Archeological zones and monuments	Location of protected archeological zones and mu-onuments	City of Antwerp	http://opendata.antwerpen.be/datasets/archeologische-zones-en-monumenten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
Protected landscape areas	Protected landscape areas. Borders are defined by Flemish Heritage organisation.	City of Antwerp	http://opendata.antwerpen.be/datasets/beschermde-landschappen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Protected monuments & landscapes	Protected monuments & landscapes	City of Antwerp	http://opendata.antwerpen.be/datasets/beschermde-monumenten-landschappen-stads-en-dorpsgezichten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
UNESCO World Heritage	Location of UNESCO World Heritage spots in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/unesco-werelderfgoed	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Museums	Location of museums (run by the city of Anwerp)	City of Antwerp	http://opendata.antwerpen.be/datasets/musea	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Uninhabitable buildings	List of buildings (address) that have been qualified as uninhabitable	City of Antwerp	http://opendata.antwerpen.be/datasets/ongeschikt-enof-onbewoonbaar-verklaarde-woningen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Public forest	Areas that are defined (and protected) as forest.	City of Antwerp	http://opendata.antwerpen.be/datasets/openbaar-bosgebied	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Public space	All public space	City of Antwerp	http://opendata.antwerpen.be/datasets/open-ruimte	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Parking zones	Location of the different parking tariff zones in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/parkeertariefzones	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Stages - Shape	Location of all stage infrastructure (music, theatre,…)	City of Antwerp	http://opendata.antwerpen.be/datasets/podia-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Stages - Points	Location of all stage infrastructure (music, theatre,…) - point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/podia	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Post offices - Shape	Location of post offices - shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/postkantoren-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
Post offices - Points	Location of post offices - point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/postkantoren	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Courts - Shape	Location of courts - shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/rechtbanken-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Courts - Points	Location of courts - point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/rechtbanken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Rehearsal venues - Shape	Location of rehearsal rooms, shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/repetitieruimtes-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Rehearsal venues - Points	Location of rehearsal rooms, point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/repetitieruimtes	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Driving directions	Overview of driving directions (one-way/two-way) for cyclists and cars.	City of Antwerp	http://opendata.antwerpen.be/datasets/rijrichtingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Water filtering installations	Location of water filtering installations in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/waterzuiveringsinstallaties	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Water filtering installations - Shape	Location of water filtering installations in Antwerp - shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/waterzuiveringsinstallaties-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Schools taking part in School Imrpovement projects	Every year the project 'School aan de beurt' works together with local schools to improve the quality of live in the vicinity of the school. This is a list of schools that have taken part.	City of Antwerp	http://opendata.antwerpen.be/datasets/school-aan-de-beurt	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Road segments	A segment is a piece of road between junctions. This datasets lists all segments on Antwerp roads	City of Antwerp	http://opendata.antwerpen.be/datasets/wegsegmenten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Maximum speed	Maximum speed	City of Antwerp	http://opendata.antwerpen.be/datasets/toegelaten-snelheid	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Percentage of social housing per statistical sector	Amount of social housing, compared to total households.	City of Antwerp	http://opendata.antwerpen.be/datasets/sociale-huisvesting-sector	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Existing and planned Recycling streets above street level	Existing and planned Recycling streets above street level	City of Antwerp	http://opendata.antwerpen.be/datasets/bovengrondse-sorteerstraten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Existing and planned Recycling streets below street level	Existing and planned Recycling streets below street level	City of Antwerp	http://opendata.antwerpen.be/datasets/ondergrondse-sorteerstraten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Rail tracks	All rail tracks (train, tram cranes)	City of Antwerp	http://opendata.antwerpen.be/datasets/spoorrails	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
City borders	Borders of the city of Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/begrenzing-stad	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
City parts - postcodes	Outlines of city parts, which are defined by the different postcodes	City of Antwerp	http://opendata.antwerpen.be/datasets/stadsdeel	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Landfill	Outlines of the Hooge Maay landfill	City of Antwerp	http://opendata.antwerpen.be/datasets/stortplaats	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Amount of student homes per block	Amount of student homes per block	City of Antwerp	http://opendata.antwerpen.be/datasets/studentenhuizen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Functional areas	The functional index of the city of Antwerp: agricultural zones, roads, rail, industrial zones,…	City of Antwerp	http://opendata.antwerpen.be/datasets/indeling-terrein	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Theaters - shape	Location of theaters in Antwerp - shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/theaters-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Theaters - point	Location of theaters in Antwerp - point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/theaters	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Building entrances	Location of entrances, access points on streetlevel that allow access under a building or provide shelter	City of Antwerp	http://opendata.antwerpen.be/datasets/toegangen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Train stations	Location of train stations in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/treinstations	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Tunnels	Location of tunnels in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/tunnels	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Velo stations	Velo is the public bike share scheme in Antwerp. This dataset has the locations of the stations.	City of Antwerp	http://opendata.antwerpen.be/datasets/velo-stations	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Incinerator - shape	Shape coordinates for the Antwerp incinerator	City of Antwerp	http://opendata.antwerpen.be/datasets/verbrandingsoven-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum.info/files/Modellicenties_ENG.pdf	
Traffic signs - shape	Location of traffic signs in Antwerp - shape coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/verkeersborden-vlak	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Traffic signs - point	Location of traffic signs in Antwerp - point coordinates	City of Antwerp	http://opendata.antwerpen.be/datasets/verkeersborden	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Traffic lights	Location of traffic lights in Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/verkeerslichten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Docks and Canals	Docks and Canals	City of Antwerp	http://opendata.antwerpen.be/datasets/water	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Road category	The road category defines speed restriction, technical services, road marks,…	City of Antwerp	http://opendata.antwerpen.be/datasets/wegcategorie	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON

Road functions	Functional segmentation of the Antwerp roads (bike lane, parkin, underground access, speed bump,…)	City of Antwerp	http://opendata.antwerpen.be/datasets/wegvakken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Road connectors	Road are divided in road connectors, bridges and junctions. This data sets lists all the road connectors.	City of Antwerp	http://opendata.antwerpen.be/datasets/wegverbindingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Shopping streets	Location of Antwerp shopping streets.	City of Antwerp	http://opendata.antwerpen.be/datasets/winkelstraten	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Zone 30 areas	Location of Zone 30 (max speed) areas, current and proposed.	City of Antwerp	http://opendata.antwerpen.be/datasets/zone-30	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Barriers	Location of 'barriers': water, ringrond, traintracks,…) with its crossings.	City of Antwerp	http://opendata.antwerpen.be/datasets/barri%C3%A8res	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Federal roads	Antwerp roads that are the responsibility of the Flemish government	City of Antwerp	http://opendata.antwerpen.be/datasets/gewestwegen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.o	CSV/KML/XML/JSON

					pendataforum .info/files/Mo dellicenties_E NG.pdf	
Public Wifi spots	Location of free wifi points provided by city of Antwerp	City of Antwerp	http://opendata.antwerpen.be/datasets/openbare-wifi-plekken	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Road connectors	Road are divided in road connectors, bridges and junctions. This data sets lists all the road connectors.	City of Antwerp	http://opendata.antwerpen.be/datasets/wegverbindingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Road connectors	Road are divided in road connectors, bridges and junctions. This data sets lists all the road connectors.	City of Antwerp	http://opendata.antwerpen.be/datasets/wegverbindingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Road connectors	Road are divided in road connectors, bridges and junctions. This data sets lists all the road connectors.	City of Antwerp	http://opendata.antwerpen.be/datasets/wegverbindingen	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	CSV/KML/XML/JSON
Demographic composition	Age, nationality, ethnicity, marital status, family size,…	City of Antwerp	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/

Births/deaths	Amounts of births/deaths	City of Antwerp	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/
Moves	Amount of people that move in or outside of Antwerp	City of Antwerp	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/	City of Antwerp	Free Open Data License. For the English version, see pp5-6 on http://www.opendataforum.info/files/Modellicenties_ENG.pdf	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/
Employment status	Self-employed, unemployed, …	City of Antwerp	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/	VDAB, office for employment		only accessible and exportable via http://www.antwerpen.buurtmonitor.be/
Income		City of Antwerp	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/	Federal office of Economy		only accessible and exportable via http://www.antwerpen.buurtmonitor.be/
Event list	List of events organised by the city or that got a license from the city	City of Antwerp	not open yet	City of Antwerp		not open yet
Velo usage data	Live usage from the public bike sharing system Velo	City of Antwerp	not open yet	Velo Antwerpen/Clearchannel		not open yet
Economic activity	# employment, tax, sector,…	City of Antwerp	only accessible and exportable via http://www.antwerpen.buurtmonitor.be/	VKBO		only accessible and exportable via http://www.antwerpen.b

						uurtmonitor.be/
CORINE Land Cover 1990-2000 Changes	Consistent information on land cover. This database shows the changes between the CLC90 inventory and the CLC2000 inventory. Semless Vector database.	Europe	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-changes-clc1990-clc2000-seamless-vector-database-version-8-2005	European Environment Agency	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: European Environment Agency.	SHP
CORINE Land Cover 2000	Corine land cover 2000 is the year 2000 update of the first CLC database which was finalized in the early 1990s as part of the European Commission programmed to COoRdinate INformation on the Environment (Corine). It provides consistent information on land cover changes during the past decade across Europe.	Europe	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-clc2000-seamless-vector-database-3	European Environment Agency	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: European Environment Agency.	SHP

	The CLC2000 database covers 32 countries.					
CORINE Land Cover 2006	Corine land cover 2006 is the year 2006 update of the first CLC database which was finalized in the early 1990s as part of the European Commission programme to COoRdinate INformation on the Environment (Corine)	Europe	http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version-1	European Environment Agency	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: European Environment Agency.	SHP
Urban Atlas	The Urban Atlas is providing pan-European comparable land use and land cover data	EU - Large Urban Zones with more than 100.000 inhabitants	http://www.eea.europa.eu/data-and-maps/data/urban-atlas	European Environment Agency	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is	SHP

					acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: Directorate-General Enterprise and Industry, Directorate-General for Regional Policy.	
Natura2000	borders of sites under the Birds Directive (Special Protection Areas, SPAs) and the Habitats Directive (Sites of Community Importance, SCIs, and Special Areas of Conservation, SACs).	EU	http://www.eea.europa.eu/data-and-maps/data/natura-2	European Environment Agency	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: Directorate-General for Environment. There are specific terms and conditions relating to the use of downloaded boundary data within the United Kingdom. If you intend to use the UK data you must first agree to the end user licence http://www.jn	SHP

					cc.gov.uk/page-5232.	
Nationally designated areas (National - CDDA)	information about protected sites and about the national legislative instruments, which directly or indirectly create protected areas	Europe	http://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-5	European Environment Agency	EEA standard re-use policy: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: European Environment Agency.	SHP
Open Street Map	OpenStreetMap is an initiative to create and provide free geographic data, such as street maps, to anyone. Map features include (but are not limited to) http://wiki.openstreetmap.	Global	http://www.openstreetmap.org/	OpenStreetMap Contributors	Open Data Commons Open Database License (ODbL)	OSM XML

	org/wiki/Map_Features					
Celostátní sčítání dopravy (National traffic census)	Results of statistical investigation focused on the volume of traffic on roads Tabular and graphical outputs.	Czech Republic	http://scitani2010.rsd.cz/	Road and Motorway Directorate of the Czech Republic	Open, shp on demand	HTML, XML, SHP
Web mapping application "road and highway network of the Czech Republic"	Applications developed and operated by the department of road database or created in a collaboration and using data from the Information System on road and highway.Application uses ArcGIS Server and allows you to view, search and identification data ISSDS. The aim is to make selected pasport data to the public.	Czech Republic	http://geoportal.jsdi.cz/geoportal_RSDCR/default.aspx	Road and Motorway Directorate of the Czech Republic	open	HTML, WMS, SHP

Public database Czech statistical office	VDB contains solely aggregated statistical data covering all observed areas of statistics. It uses results of statistical data processing in the CZSO as well as statistical data from external and administrative sources especially from other work places of the state statistical service. It does not focus only on data covering the Czech Republic, but, in addition, it provides data for territorial administrative units of the CR (regions, districts, municipalities and cities, etc.) and also data from abroad.	Czech Republic	http://vdb.czso.cz/vdb/en/vdb.jsp	Czech statistical office	veřejně přístupné	XLS, PDF
ArcČR 500	Digitální vektorová geografická databáze České republiky ArcČR® 500 je vytvořena v podrobnosti měřítka 1 : 500 000. Jejím obsahem jsou přehledné geografické informace o	Czech Republic	http://www.arcdata.cz/produkty-a-sluzby/geograficka-data/arccr-500/	ARCDATA PRAHA, s.r.o.	open	GDB, SHP

	České republice. Data vznikla ve spolupráci ARCDATA PRAHA, s.r.o., Zeměměřického úřadu a Českého statistického úřadu					
Jednotná dopravní vektorová mapa (Uniform Transport Vector Map)	Uniform Transport Vector map contains thematic data layers on the administrative structure of the Czech Republic (administrative units and counting circuits, source CSO) data on road, rail, inland waterway and air transport	Czech Republic	http://www.jdvm.cz/cz/s477/Rozcestnik/c7314-Jednotna-dopravni-vektorova-mapa	Ministry of Transport	This GIS MD are having access only to registered users from the ranks of government and public administration, education and research, design and the transport infrastructure. Applications are open to the public, "Statistical analysis of accidents in the map" and "Statistical evaluation of traffic accident rates in the selected area" in which it is incorporated spatial data on road traffic accidents from 1.1.2007 updated in collaboration with the Police with monthly	HTML, XML, SHP on demand

Systém hospodaření s mosty (The management of bridges)	Application Type the agenda, addressing the complex issue of bridge inspections resulting from the Road Traffic Act. Currently, this system recorded bridges, underpasses, tunnels and culverts on I-III class roads and highways. The system includes a modules: registration, inspection, maintenance and financing.	Czech Republic	http://bms.vars.cz/	Road and Motorway Directorate of the Czech Republic	Access without registration (basic access) or via name, password (extended administrative access bridges)	HTML, JPEG, SHP on demand
		Local	https://www.data.gouv.fr/fr/dataset/points-d-interet-poi	City of Issy-les-Moulineaux and Urban community of Grand Paris Seine Ouest	Open License (http://wiki.data.gouv.fr/images/0/05/Open_Licence.pdf)	CSV
		Regional	http://data.ratp.fr/	RATP	Open Data Commons Open Database License (ODbL) / RATP / Etalab	XLS, XML
		Regional	https://twitter.com/Ligne12_RATP	Twitter feeds / RATP		
		Local	https://www.contact-everyone.fr.orange-business.com/ContactEveryone/Registration.do?action=home&valeur=1159&key=1959	SMS alerts / City of Issy-les-Moulineaux		
		Global	http://openweathermap.org/	OpenWeatherMap		JSON, XML

		Local	https://developer.jcdecaux.com/#/home	Vélib / JC Decaux	« Open Licence » from Etalab	JSON, CSV
Past Accident Data		Europe	http://ec.europa.eu/transport/road_safety/specialist/index_en.htm			
Air Quality Data (GI)		Europe	http://www.eea.europea.eu/data-and-maps			
Crime and Safety Data		Europe	http://www.europeansafetyobservatory.eu			
Range of Transport data sets – samples below:		Europe	http://open-data.europa.eu/en/data/dataset?q=road			
Employment in Goods Road Transport Enterprises by Sex		Europe	http://open-data.europa.eu/en/data/dataset/YnD8cmeU4AixkicywkACbQ			
National and International Transport of Foodstuffs		Europe	http://open-data.europa.eu/en/data/dataset/VfqSaCe5gSOKLDuslYsKVw			
Modal Split of Freight Transport		Europe	http://open-data.europa.eu/en/data/dataset/nBzPy96nGSqKAmNInRC2Hg			
Final Energy Consumption by Transport		Europe	http://open-data.europa.eu/en/data/dataset/9qKm7j3oojpXNiOkWnlaaQ			
Motorisation rate		Europe	http://open-data.europa.eu/en/data/dataset/5SZvRGQh7IOTif5jZV5VA			
Rail Timetables		Belgium	iRail.be			
Public Transport in		Belgium	http://data.gov.be/dataset/			

Flanders			public-transport-flanders-gtfs			
Traffic Accidents		Belgium	http://data.gov.be/dataset/traffic-accidents			
Summary Transport Statistics		Belgium	http://data.gov.be/dataset/summary-transport-statistics			
Maritime Transport		Belgium	http://data.gov.be/dataset/maritime-transport			
Registration New and Used Vehicles		Belgium	http://data.gov.be/dataset/registration-new-and-used-vehicles-municipality			
Road Distance Travelled by Municipality		Belgium	http://data.gov.be/dataset/road-distance-travelled-municipality			
Travel Survey		Belgium	http://data.gov.be/dataset/travel-survey			
Air Quality		Belgium	http://data.gov.be/dataset/air-quality			
Traffic Speed Controls		Belgium	http://data.gov.be/dataset/traffic-speed-controls			
Travel Advice News Feed		Belgium	http://data.gov.be/dataset/travel-advice-news-feed			
Topographic Data		Belgium	http://data.gov.be/dataset/topogeographic-data-services			
Railway Network Inspire Data (GI)		UK	http://data.gov.uk/dataset/railway-network-inspire			
Highways Agency Road Network Inspire Data		UK	http://data.gov.uk/dataset/ha-road-network-			

(GI)			inspire			
Digital Boundary Datasets from Natural England (GI)		UK	http://www.naturalengland.org.uk/publications/data/default.aspx			
National Public Transport Access Nodes (GI)		UK	http://data.gov.uk/dataset/naptan			
National Public Transport Gazetteer (GI)		UK	http://data.gov.uk/dataset/nptg			
National Public Transport Data Repository (GI)		UK	http://data.gov.uk/dataset/nptdr			
Bridges (GI)		UK	http://data.gov.uk/dataset/bridges			
Canal Centre Line (GI)		UK	http://data.gov.uk/dataset/canal-centre-line			
Outfall Discharge Points (GI)		UK	http://data.gov.uk/dataset/outfall-discharge-points			
Locks (GI)		UK	http://data.gov.uk/dataset/locks			
Wharves (GI)		UK	http://data.gov.uk/dataset/wharves			
Aqueducts (GI)		UK	http://data.gov.uk/dataset/aqueducts			
Bedrock of Great Britain (GI)		UK	http://data.gov.uk/dataset/national-bedrock-fence-diagram-of-great-britain-gb3d-v2012			
Transport Statistics		UK	http://data.gov.uk/dataset/transport_stati			

			stics_great_britain			
Road Conditions England		UK	http://data.gov.uk/dataset/road_conditions_england			
Renewable Transport Fuel Obligation		UK	http://data.gov.uk/dataset/renewable_transport_fuel_obligation_biofuel_statistics			
Taxi and Private Hire Vehicle Statistics		UK	http://data.gov.uk/dataset/taxi_and_private_hire_vehicle_statistics			
Light Rail Statistics		UK	http://data.gov.uk/dataset/light_rail_statistics			
Waterbourne Freight in the UK		UK	http://data.gov.uk/dataset/waterborne_freight_in_the_united_kingdom			
Annual Bus Statistics		UK	http://data.gov.uk/dataset/annual_bus_statistics			
Port Freight Statistics		UK	http://data.gov.uk/dataset/port_freight_statistics			
Public Attitudes Towards Road Congestion		UK	http://data.gov.uk/dataset/public_attitudes_towards_road_congestion			
Bus Punctuality Statistics		UK	http://data.gov.uk/dataset/bus_punctuality_statistics_great_britain			
Road Traffic Statistics		UK	http://data.gov.uk/dataset/road_traffic_statistics			
Congestion on Local Authority Managed A Roads		UK	http://data.gov.uk/dataset/congestion_on_local_authority_managed_			

			a_roads_			
Blue Badge (Disabled) Scheme Statistics		UK	http://data.gov.uk/dataset/blue_badge_scheme_statistics			
Reported Road Casualties Annual Report		UK	http://data.gov.uk/dataset/reported_road_casualties_great_britain_annual_report			
Foreign Road Goods Vehicles in Britain		UK	http://data.gov.uk/dataset/survey_of_foreign_road_goods_vehicles_great_britain			
Port Employment and Accident Rates		UK	http://data.gov.uk/dataset/port_employment_and_accident_rates			
Reliability of Motorway Journeys		UK	http://data.gov.uk/dataset/reliability_of_journeys_on_the_highways_agencys_motorway_and_a_road_network_			
Motorcycling Statistics		UK	http://data.gov.uk/dataset/the_compendium_of_motorcycling_statistics			
Civil Parking Enforcement Statistics		UK	http://data.gov.uk/dataset/civil_parking_enforcement_statistics			
Road Casualties in Great Britain: Estimates involving illegal alcohol levels		UK	http://data.gov.uk/dataset/road_casualties_in_great_britain-estimates_for_accidents_involving_illegal_alcohol_levels			
Peak Rail Passenger		UK	http://data.gov.uk/dataset/			

Demand and Crowding Statistics			peak_rail_passenger_demand_and_crowding_statistics			
Local Area Walking and Cycling		UK	http://data.gov.uk/dataset/local_area_walking_and_cycling_in_england			
Smart and Integrated Ticketing Report		UK	http://data.gov.uk/dataset/smart_and_integrated_ticketing_report			
Compendium of Key Statistics for the Driver and Vehicle Agency		UK	http://data.gov.uk/dataset/compendium_of_key_statistics_for_the_driver_and_vehicle_agency			
Seatbelt and Mobile Phone Use		UK	http://data.gov.uk/dataset/seatbelt_and_mobile_phone_use_in_england			
Properties at risk of Flooding		UK	http://data.gov.uk/dataset/number-of-properties-at-risk-of-flooding			
Impact of Special Events on Economic Time		UK	http://data.gov.uk/dataset/the_impact_of_previous_special_events_on_economic_time_series			
Three Hourly Weather Forecast Data		UK	http://data.gov.uk/dataset/metoffice_uklocs3hr_fc			
Historical Monthly Metrological Data		UK	http://data.gov.uk/dataset/historic-monthly-meteorological-station-data			
Days When Air Pollution is Moderate or Higher		UK	http://data.gov.uk/dataset/days-when-air-pollution-is-moderate-			

			or-higher-1987-to-2010			
Detailed Accident Statistics		Birmingham	locally			
Traffic Master Point to Point Journey Time		Birmingham	locally			
Council Land Ownership		Birmingham	locally			
Cycle/Walking Maps/Networks		Birmingham	locally			
Traffic Count Data for Individual Junctions, Roads and Automatic Count Sites		Birmingham	locally			
Cycle Counting Data		Birmingham	locally			
Pedestrian Footfall Data in City Centre		Birmingham	locally			
Off Street Car Park Occupancy Data Including Real Time Parking Space Availability		Birmingham	locally			
Air Quality Information		Birmingham	locally			
Bus Timetable		Birmingham	locally			
Real Time Bus Information		Birmingham	locally			
Transport – road situation (incl. real-time via sensors, accidents reporting		Czech Republic				

etc.)						
Transport – road situation (incl. real-time via sensors, accidents reporting etc.)						
Transport – road situation (incl. real-time via sensors)		City - Brno				
Disabled/step-free access		City - Olomouc				
Disabled/step-free access		City part – Prague 6				
Addresses - RUIAN		Czech Republic				
Street network - TopoHelp and OSM		Czech Republic				
Forest roads		Czech Republic		Forest Management Institute, Czech Republic		