

HARMONISATION AND MULTILINGUAL TOOLS - 1

OCTOBER 2015

SDI4Apps

The logo for SDI4Apps, featuring a red dot above a white Wi-Fi symbol (three curved lines) positioned above the 'p's in the text.

DELIVERABLE

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D4.1.1 HARMONISATION AND MULTILINGUAL TOOLS - 1

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EXECUTIVE SUMMARY

This report contains the results of the data harmonisation activities conducted as part of the SDI4Apps project, work package 4, tasks T4.1-3. It is the first of two incremental deliverables concerned with the same subject and will be updated and extended by the end of the project.

This document must be understood in context of the objectives of the project as well as in alignment with the stages in which the platform, Open API and client-side JavaScript library will be implemented.

In order to build applications on the SDI4Apps platform and APIs, it is necessary to upload data onto the Cloud. Some of these data are application specific and unique to each user and use case; other data are shared across several applications running in the platform. The latter type of datasets include background maps and generic thematic layers that are useful in a wide range of professional domains. When making such data available, harmonization and multilingualism becomes an issue, for data to be useful they have to be combined in ways that make sense to a broad group of users -- for data to be understandable they have to be multi-lingual.

SDI4Apps selected three key data sets for this purpose:

- Transport network
- Points of interest (POIs)
- Open land use (OLU)

In addition to these three data sets, the SDI4Apps platform will come 'preconfigured' with background maps that are composed of OpenStreetMap (OSM) data - and based on OSM cartographic templates. In the case of OSM, the harmonization is a community effort - and while consistency cannot be guaranteed, the history of the data sets has demonstrated its continuous improvement.

Data harmonisation is an expert discipline. It is necessary for shared and re-usable data - but regular users should not attempt such tasks without undergoing specific training; SDI4Apps has therefore placed the harmonisation process 'outside' the platform. The project assumes harmonization to take place prior to loading data into the platform.

While harmonization processes requires expert knowledge, such processes may have to be repeated; as foundation data are updated, the same integration processes will have to be re-run. Thus, in addition to describing the harmonization process, this deliverable also studies a selection of technologies for automating data harmonization processes. In this respect, the approaches that have been assessed include:

- HALE - an expert tool for data harmonization
- Relational database tools - data manipulation using low-level database languages like SQL
- GIS tools - software like QGIS, uDig and similar
- pyWPS - data harmonization as a web processing service

The deliverable deals with both spatial data in a broad sense as well as Linked Data specifically. The deliverable presents possible approaches to transforming enterprise data into RDF and publishing them as Linked Open Data.

The final subject of the deliverable is technologies to handle issues related to multilingualism. In addition to modifying data models, it is necessary to deal with the issue of content language when preparing datasets for exploration and discovery. The document discusses implementations of statistical translation as means for real-time query expansion or auto-generation of multilingual indexes on single language content.

1 HARMONISATION

In collaboration with the OpenTransportNet project, the data interoperability, harmonisation processes and harmonisation tools were described and are included in this report as well as in the OpenTransportNet report D4.4 Data Harmonisation and Integration. These tools and processes are based on the experience from previous projects of the SDI4Apps project partners.

1.1 Interoperability

The SDI4Apps platform will act as a spatial data infrastructure (SDI). SDI, sometimes referred to as spatial information infrastructures, 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).

There exist many definitions of SDI. The authors use the definition adopted by the INSPIRE directive. INSPIRE defines SDI as “the metadata, spatial data sets and spatial data services; network services and technologies; agreements on sharing, access and use; and coordination and monitoring mechanisms, processes and procedures, established, operated or made available in an interoperable manner.” (European Parliament 2007).

Interoperability is defined by the International Organisation for Standardization (ISO) 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):

- 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. (p. 2)

EIF distinguishes four levels of interoperability including legal, organisational, semantic and technical.

1.2 How to Achieve Interoperability

Interoperability on all levels can be achieved through common standards, specifications and other agreements. If all data, services, legislation, technologies etc. share the same set of agreements, the interoperability can be achieved. The most important international and well-respected standards in the geospatial domain are from the Technical Committee 211 of the International Organization for Standardization (ISO/TC 211) and Open Geospatial Consortium (OGC). Together with national standards, they create the core for SDI implementation. It is highly recommended to keep the national standards compliant with ISO and OGC standards to enable interoperability across national borders.

ISO/TC 211 Geographic information/Geomatics is responsible for the ISO geographic information series of standards. 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. The ISO/TC 211 standards provide a framework for the development of sector-specific applications using geographic data.

The Open Geospatial Consortium (OGC) is an international industry consortium of 467 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards. OGC standards support interoperable solutions that “geo-enable” the Web, wireless and location-based services and mainstream IT. The standards empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications. OGC standards are developed in a unique consensus process supported by the OGC’s industry, government and academic members to enable geoprocessing technologies to interoperate, or “plug and play”. (Open Geospatial Consortium 2012).

As OTN is dealing also with non-spatial data and Web platforms, the World Wide Web Consortium (W3C) standardisation organisation should be mentioned. W3C is developing a set of standards for semantic Web. The W3C and the OGC announced in January 2015 a new collaboration to improve interoperability and integration of spatial data on the Web.¹

1.3 Harmonisation Tools and Processes

Data harmonisation is necessary for combining data from heterogeneous sources (e.g. regional datasets) into integrated, consistent and unambiguous information products (e.g. European datasets). Such datasets can be then easily used in combination with other harmonised data for viewing as well as querying and analysing. Data harmonisation is a complex task that has not a universal solution that can cover all possible scenarios. Ideal technical solution (system architecture, software) is always determined by many specific facts such as the way in which the original data are stored, data volume and the type of harmonisation. The harmonisation process is a best practice in the geoinformation domain and therefore following chapters firstly describes harmonization experiences of the UWB team, acquired during previous projects (Humboldt, Plan4all and Plan4business) and formulated in Janečka et al. (2013) into a 5-step harmonisation approach.

All relevant steps to perform data harmonisation are depicted in Figure 1. The first three steps are common steps for all scenarios. The theory of spatial data harmonisation within the framework of INSPIRE is based mainly on the INSPIRE conceptual models. The understanding of both source and target data is based mainly on particular data specifications, documentation and metadata.

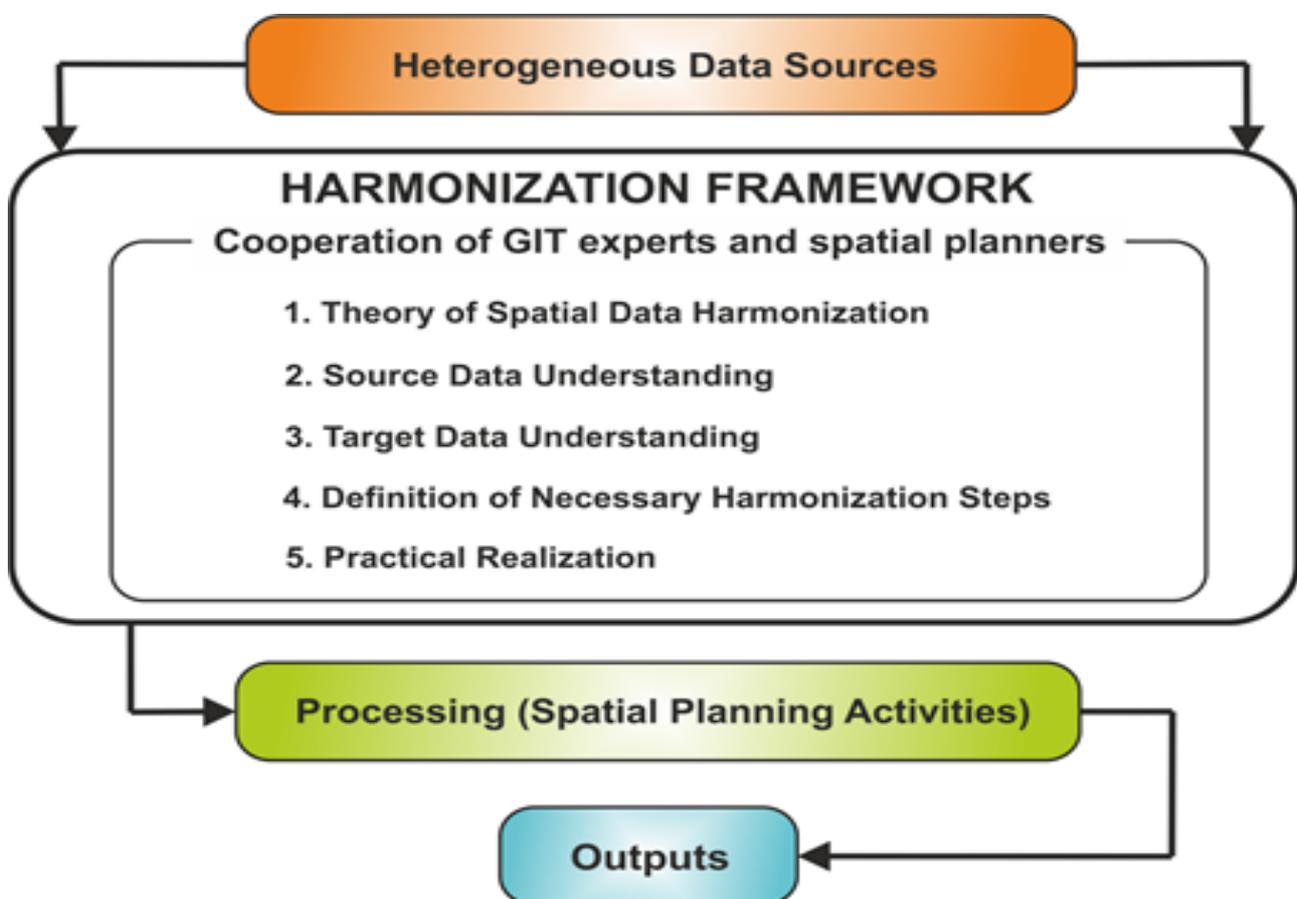


Figure 1 Data harmonisation process (Janečka et al. 2013)

From the technical point of view there exist several ways how to handle data harmonisation. Relevant approaches are based on ETL tools (e.g. FME) or specialised software designed for the harmonisation (e.g. HALE or Shape Change). Other solution is to use the capabilities provided by relational database management systems (RDBMS) like PostgreSQL with PostGIS. Another solution could be to use a geographic information

¹ <http://www.w3.org/2015/01/spatial.html.en>

system such as ArcGIS. In the upcoming sections, we mention the tools most relevant for the use within the SDI4Apps project. Adapted from Janečka et al. (2013). Important role in the harmonisation processes play also Web processing services (<http://www.opengeospatial.org/standards/wps>), allowing design and execution of the complex geospatial processes within the environment of the internet (e.g. pyWPS).

1.3.1 HALE

The Humboldt Alignment Editor (HALE) is an open source software framework that was designed in the scope of the Humboldt project. “HALE is a tool for defining and evaluating conceptual schema mappings. The goal of HALE is to allow domain experts to ensure logically and semantically consistent mappings and consequently transformed geodata. Furthermore, a major focus is put on documentation of the schema transformation process and its impacts, e.g. in the form of lineage information attached to the resultant transformed data.”²

For advanced harmonisation projects, where a collaboration over a large community is required, there is a platform where professionals develop and share data transformation processes. The platform is available at www.wetransform.to.

1.3.2 Relational Database Tools

Harmonisation frameworks focus on setting up the harmonisation rules and maintaining the harmonisation lifecycle. Data harmonisation can be also performed by using a database technique and build in functions.

When we focus on the sub-process that deals with conceptual schema transformation, we can find that RDBMSs can offer capabilities to deal with this issue. Once we are able to import our data to RDBMS, we can utilise existing functions and SQL language to fulfil harmonisation processes focused on change of taxonomies and any related harmonisation of attributes (rename, retype) as well as geometry processing (depending on available spatial functions of particular RDBMS).

1.3.3 GIS Tools

The primary objective of GIS tools is not on data harmonisation. However, GIS tools can be used for this purpose. On the one hand, GIS tools are more suitable for harmonisation of geometries than the relational database tools. On the other hand, typical database tasks such as attribute mapping are more difficult in a GIS tool than in a database. GIS tools also follow the geoprocessing principle during the data processing: “input -> operation -> output” and therefore, they produce many temporary layers. Therefore, the user has to take care about naming conventions and data management during the process. ArcGIS (with Arc Toolbox, Model Builder and Python) can serve as a GIS example of harmonisation tools.

1.3.4 pyWPS

Python Web Processing Service (<http://pywps.wald.intevation.org>) is an implementation of the Web Processing Service standard from the Open Geospatial Consortium. It offers an environment for programming own processes (functions or models) which can be accessed from the public. The main advantage of PyWPS is that it has been written with native support for GRASS GIS. Access to GRASS modules via web interface should be as easy as possible. pyWPS also supports the data model transformations (e.g. INSPIRE) which are foreseen to be used to support the Slovakian Ecosystem Services pilot.

1.3.5 Short Comparison of Harmonisation Tools

All above mentioned harmonisation tools can handle both spatial and non-spatial data - even if first two are primarily focused on attribute schema mapping and the third one is more focused on geometry. What do all the tools have in common is that once the data harmonisation schema is set up, then it could be written as a batch and run in an automated way - with little or no knowledge of the inside of the routine. Practical example of data harmonisation in SDI4Apps is described in the next section.

² <http://community.esdi-humboldt.eu/>

1.4 Harmonisation Examples

1.4.1 Harmonisation of Transport Data Model

The Transport Network Schema, as depicted in Fig. 1, is a result of a collaboration between four European projects: SDI4Apps, FOODIE (<http://foodie-project.eu/>), OpenTransportNet (<http://opentnet.eu/>) and SmartOpenData (<http://www.smartopendata.eu/>).

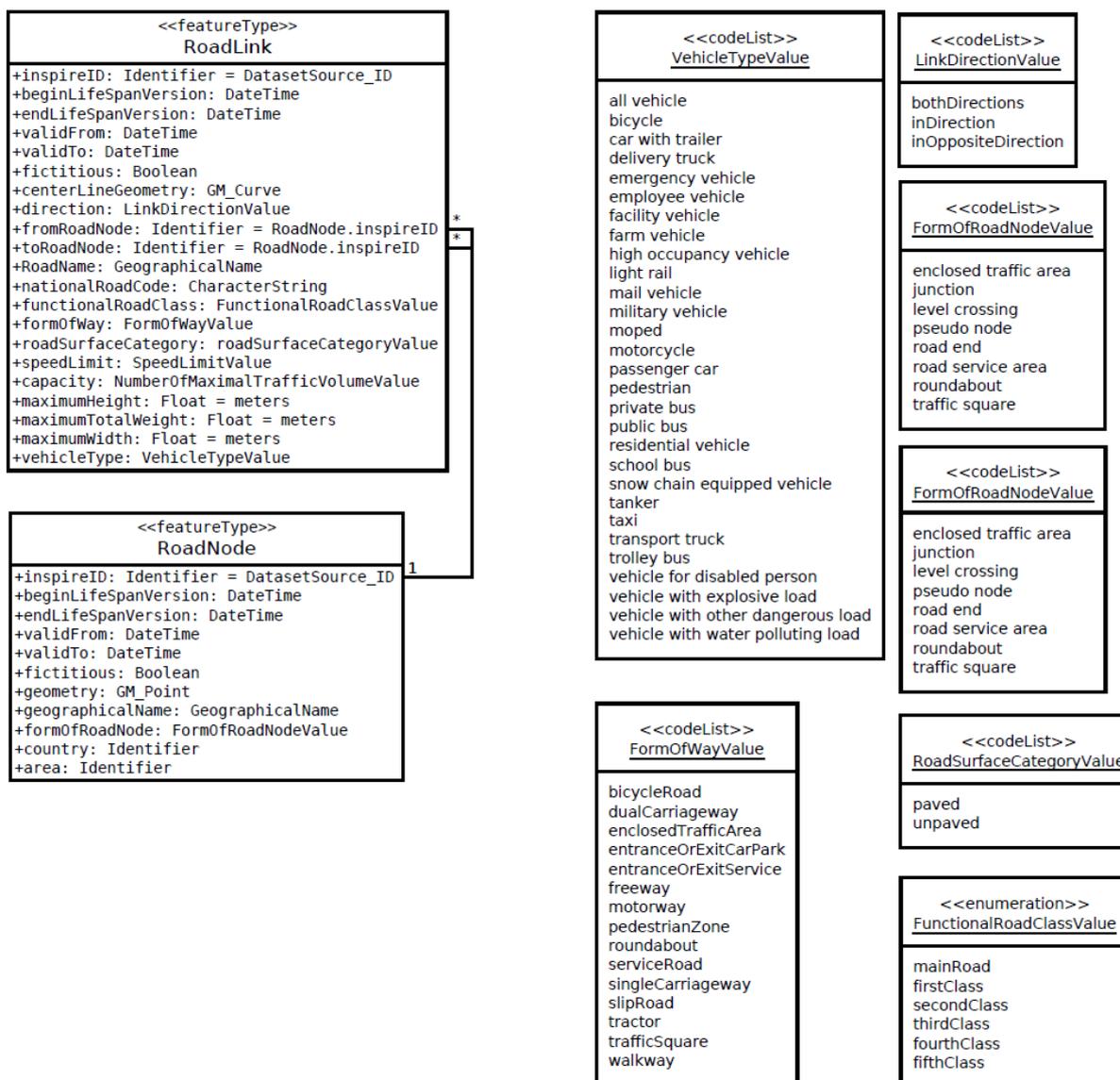


Figure 2 The UML component diagram of the FOODIE Transport Network Schema as a basis for the navigation application in (precision) agriculture.

Such collaboration enabled in 2015 to create a very efficient data model for navigation purposes based on the open network data. The basic source of the open network data is the OpenStreetMap (<http://www.openstreetmap.org>) which represents a volunteer-based project aiming at achieving a free editable map of the world. OpenStreetMap has also been intended for the navigation purposes, however such application is still not directly feasible (September 2015). For that reason, four above-mentioned projects have unified their forces in order to create:

1. the Consolidated Transport Network Schema, as depicted in **Error! Reference source not found.**, as a basic data model for the navigation purposes in all four projects;

2. mapping between the OpenStreetMap as a source and the Consolidated Transport Network Schema as a target in order to transform data;
3. the PostgreSQL + PostGIS database defined according to the Consolidated Transport Network Schema;
4. population, verification and correction of the OpenStreetMap data for navigation purposes, such as to eliminate undershoots and/or overshoots in order to get topologically clean dataset;
5. export the corrected geometry back into the OpenStreetMap.

The crucial requirements of the FOODIE project on the FOODIE Transport Network Schema have been following (see also the Listing 1):

1. *RoadLink* feature type as the core of the topological graph when composing the edges of such graph;
2. attributes *inspireId* (unique identifier of the edge), *fromRoadNode* and *toRoadNode* (connection to the beginning and ending nodes), *roadName* (unique human designation of the edge), *formOfWay* (a classification based on the physical properties of the edge), *roadSurfaceCategory* (specification of the state of the surface of the associated *RoadElement*, indicates whether a road is paved or unpaved), *maximumHeight* (maximum height of a vehicle for an explicit edge), *maximumTotalWeight* (maximum total weight of a vehicle for an explicit edge), *maximumWidth* (maximum width of a vehicle for an explicit edge) and *vehicleType* (list of possible types of vehicles);
3. *RoadNode* feature type as the core of the topological graph when composing the nodes of such graph;
4. attributes *inspireId* (unique identifier of the node) and *formOfRoadNode* (functions of road nodes).

Listing 1. Mapping between the OpenStreetMap structure and the TransportNetworkSchema

=====	=====
«featureType»	
RoadLink	OpenStreetMap source
=====	=====
+ inspireID: Identifier [1]	OSM.roads.osm_id
+ beginLifeSpanVersion: DateTime [1]	<date of import>
+ endLifeSpanVersion: DateTime [0..1]	<null>
+ validFrom: DateTime [1]	<date of import/<null> if OSM.roads.type=planned/proposed/c onstruction>
+ validTo: DateTime [0..1]	<null>
+ fictitious: Boolean = false [1]	false
+ centerlineGeometry: GM_Curve [1]	OSM.roads.geometry (topologically cleaned)
+ direction: LinkDirectionValue «codelist»	OSM.roads.oneway
+ fromRoadNode: foreign key [1]	RoadNode.inspireID {FK}
+ toRoadNode: foreign key [1]	RoadNode.inspireID {FK}
+ RoadName: CharacterString [0..*]	OSM.roads.name {street names}
+ nationalRoadCode: CharacterString [0..1]	OSM.roads.ref {FK}
+ functionalRoadClass: FunctionalRoadClassValue «enumeration»	OSM.roads.type
+ formOfWay: FormOfWayValue «codelist»	OSM.roads.type
+ roadSurfaceCategory: RoadSurfaceCategoryValue «codelist»	OSM.roads.surface
+ speedLimit: SpeedLimitValue (km/h)	OSM.roads.maxspeed
+ capacity: NumberOfMaximalTrafficVolumeValue [0..1]	<null>
+ maximumHeight: Float (meters)	OSM.roads.maxheight

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```

+ maximumTotalWeight: Float      (tons)          OSM.roads.maxweight
+ maximumWidth: Float            (meters)        OSM.roads.maxwidth
+ vehicleType: VehicleTypeValue  «codeList»    null

=====
«featureType»
RoadNode
=====
+ inspireID: Identifier [0..1]          generated
+ beginLifeSpanVersion: DateTime [1]    <date of import>
+ endLifeSpanVersion: DateTime [0..1]   <null>
+ validFrom: DateTime [1]              <date of import>
+ validTo: DateTime [0..1]             <null>
+ fictitious: Boolean = false [1]      false
+ geometry: GM_Point [1]               generated from RoadLink
+ geographicalName: CharacterString [0..1]
                                         OSM.highway=motorway_junction.name
+ formOfRoadNode: formOfRoadNodeValue «codeList» <null>

=====«codeList»
Network::LinkDirectionValue          OSM.roads.oneway
=====
+ bothDirections                      0
+ inDirection                          1 (follows the way of
                                         vectorization)
+ inOppositeDirection                 1 (opposite)

=====
«enumeration»
FunctionalRoadClassValue              OSM.roads.type
=====
mainRoad                              motorway, motorway_link, trunk,
                                         trunk_link
firstClass                             primary, primary_link
secondClass                             secondary, secondary_link
thirdClass                              tertiary, tertiary_link
fourthClass                             residential, living_street,
                                         unclassified
fifthClass                              <all other values>

=====
«codeList»
FormOfWayValue                        OSM.roads.type
=====
+ bicycleRoad                          cycleway
+ dualCarriageway                       motorway_link, trunk, trunk_link,
                                         primary_link, secondary_link,
                                         tertialy_link
+ enclosedTrafficArea                  raceway

```

```

+ entranceOrExitCarPark      <not a corresponding value>
+ entranceOrExitService     <not a corresponding value>
+ freeway                   <not a corresponding value>
+ motorway                  motorway
+ pedestrianZone            <not a corresponding value>
+ roundabout                <not a corresponding value>
+ serviceRoad               <not a corresponding value>
+ singleCarriageway         <all other values>
+ slipRoad                  <not a corresponding value>
+ tractor                   <not a corresponding value>
+ trafficSquare             <not a corresponding value>
+ walkway                   pedestrian, footway, steps, path

=====
<<codeList>>
VehicleTypeValue           <not a corresponding value>

=====
<<codeList>>
RoadSurfaceCategoryValue   OSM.roads.surface

=====
+ paved                     paved, asphalt, cobblestone,
                           cobblestone:flattened, sett,
                           concrete, concrete:lanes,
                           concrete:plates, paving_stones,
                           paving_stones:30,
                           paving_stones:20, metal
+ unpaved                   <all other values>

=====
RoadLink-osm_extension
=====
+ z_order: Int = 0 [1]     if OSM.roads.bridge=1 then
                           z_order=1 if OSM.roads.tunnel=1
                           then z_order=-1

```

1.4.2 Smart Tourist Data Model

As Part of Smart Tourist Data, there were prepared harmonised database Smart Point of Interest (SPOI). SPOI is the seamless and open resource of POIs available for other users to download, search or use in applications and services. The data model (see Figure 3) of SPOI comes from review of literature, existing data (for example OpenPOIs), and recommendations of W3C and OGC and user requirements. The current version of the data set has been created as a harmonized combination of selected OpenStreetMap data, GeoNames.org data, experimental ontologies developed in the Section of Geomatics of the University of West Bohemia, local data provided by the Uhlava region (Czech Republic) and other data available on the Internet (for example selected files from POI Plaza). The transformation was realized by XSLT templates and Saxon processor. Data are stored in the Virtuoso tool as RDF triples. SPOI is published via map client and SPARQL endpoint that enables comfortable, efficient and standardized querying of data.

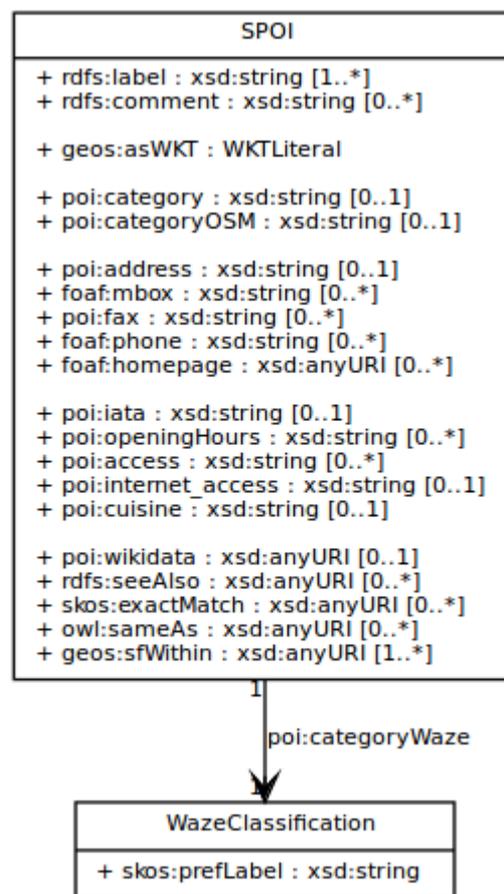


Figure 3 SPOI data model

SPOI uses mainly respected and open web standards such as RDF format, SPARQL query language or several vocabularies (for example FOAF). The data storage and SPARQL endpoint is implemented in Virtuoso tool.

Data harmonization includes following steps (their concrete implementation depends on particular input data resources):

1. Transcription to structured data - several data are provided by users as tables or texts, which have to be transformed to an XML structure that is then processed by XSLT templates.
2. Transformation to common data model - this harmonisation step is realized by XSLT templates (developed for every source data set) and Saxon processor.
3. Preparation of common vocabularies (Waze-based classification of POIs).
4. Mappings and reclassification between categories used in source data (OSM, GeoNames.org...) to Waze.
5. Preparation of topological links to relevant countries.
6. Filtering of original information.
7. Export to common data format (RDF).

1.4.3 Open Land Use

The Open Land Use data set was initially harmonised for the Czech Republic as an example. This approach will be applied in other countries.

The land use classification is based on the Hierarchical INSPIRE Land Use Classification System (HILUCS) (see http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_LU_v3.Orc2.pdf) as well as colour scheme for the visualisation.

The translation tables that are used to translate original land use/land cover classes into HILUCS are legacy of the Plan4business project.

Data sources for the pilot area (Czech Republic):

1. Cadastral data (RUIAN)
2. Land Parcel Identification System (LPIS)
3. Spatial plans (functional areas)
4. Urban Atlas (European Environmental Agency)
5. Corine Land Cover (European Environmental Agency)

The data for the project is downloaded and stored in PostgreSQL database. The concept of the database is influenced by the huge volume of highly detailed spatial data that we are dealing with (there are about 17 000 000 parcels available in vector format for the whole country - and as vectorization/mapping of cadastral map is ongoing - this number will increase, also there are many thousands of features in other layers).

Database structure:

1. Master table
2. Child tables that inherit from the master table

It was decided to divide the data by the LAU2 administrative units. Every LAU2 table with land use features is a separate child table that inherits from the master table that has the following structure:

```
CREATE TABLE olu_master  
(  
lbigserial NOT NULL,  
-- unique id  
geom geometry NOT NULL,  
-- geometry of feature  
hilucs_land_use numeric(3,0) NOT NULL,  
-- hilucs landuse  
id_original bigint NOT NULL,  
-- id from the child table  
id_adm_unit numeric(6,0) NOT NULL,  
-- administrative unit id (to which feature belongs)  
CONSTRAINT parcely_master_pkey PRIMARY KEY (id)  
);
```

The features inside each LAU2 table are made up based on the following rules:

- Initially, each table gets filled in with land parcels (most detailed level),
- if vector land parcels don't exist in that given LAU2 - or don't cover the whole LAU2 region - we go to the next level: LPIS data - and fill with it what is not filled with land parcels (geometrically LPIS - Cadastre) - after that, again, if not everything in LAU2 is filled with with Cadastre + LPIS we go to available spatial plans and fill gaps with these data, if again some gaps are left - we use Urban Atlas to fill it - if not - Corine Land Cover (this dataset is the least detailed but covers the whole Czech Republic). So in the end we have the database covering the whole pilot area - Czech Republic.

2 LINKED OPEN DATA HARMONISATION

Harmonisation of linked open geospatial resources can take place with the support of various frameworks (<https://docs.google.com/spreadsheets/d/1l9-j-0lhb2NBKU7VBC5lIhYRURBnDdZHtGLoEteDE9E/edit?pli=1#gid=1213263047>). This document provides an overview of the solutions deployed via project partners during the initial phase of the project implementation.

2.1 Open Data Node

Linked open data provide almost unlimited potential for enrichment with the new knowledge by linking to semantically related resources across the world. In order to utilise the power of semantic web set of minimal requirements have to be met. These requirements can be addressed with the support of the Methodology for the publishing of Open Data (http://www.comsode.eu/wp-content/uploads/COMSODE_D5.1_OD-publication-in-nutshell.pdf) developed within the COMSODE project (<http://www.comsode.eu>).

In order to support the possibility to harmonise linked open data with the set of procedures as transformation, storage and publishing of linked open data, Open Data Node framework can be used (<http://opendatanode.org>). See the over of Open Data Node depicted in Figure 4.

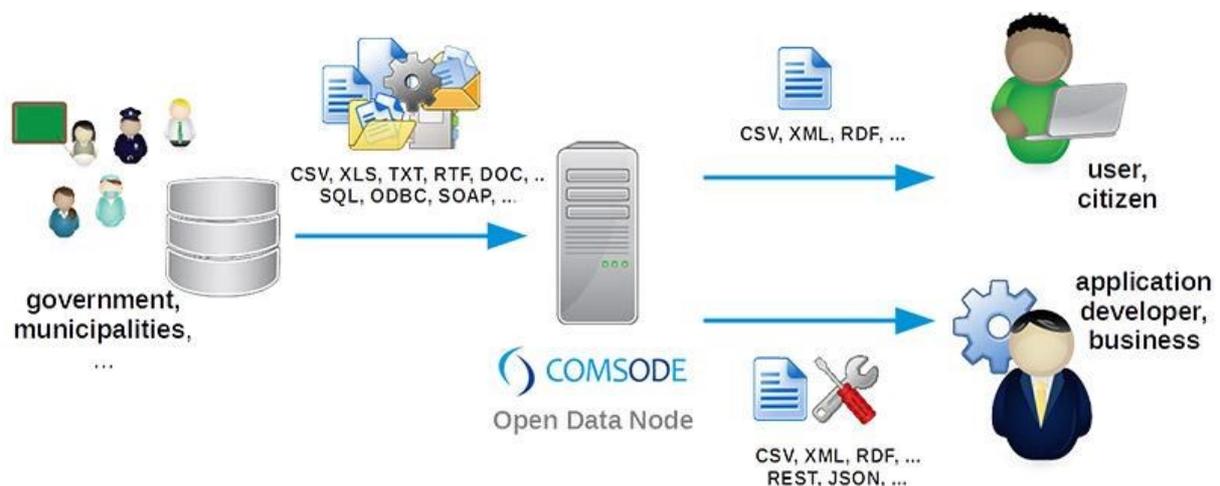


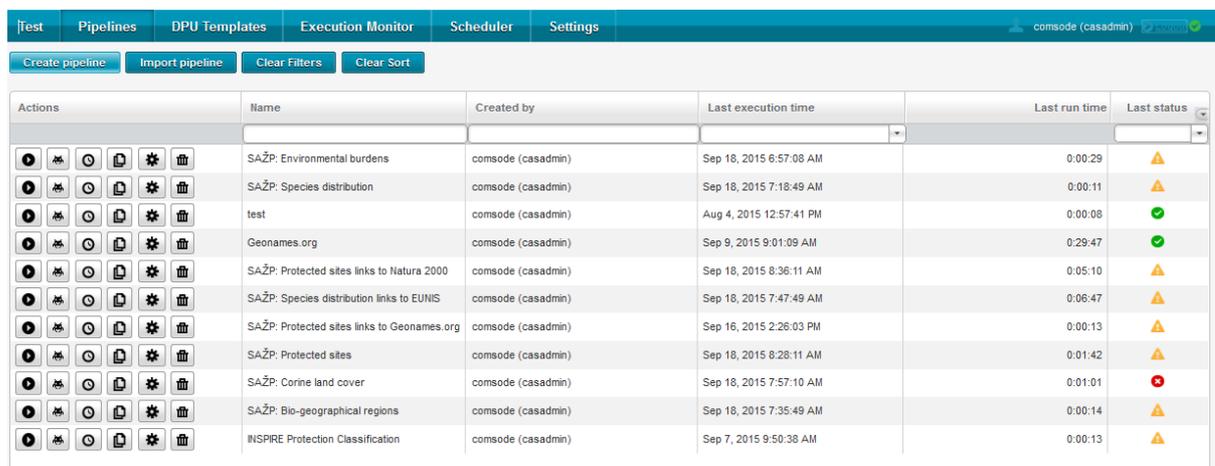
Figure 4 Open Data Node overview

2.2 LOD Harmonisation Examples

In order to support semantic data harmonisation OpenDataNode framework has been deployed under the Slovakian Ecosystem Services pilot, allowing transformation of heterogeneous structured data resources and linking to the available third parties 5* linked data resources (<http://5stardata.info/en/>).

OpenDataNode represents the framework composed from following set of components:

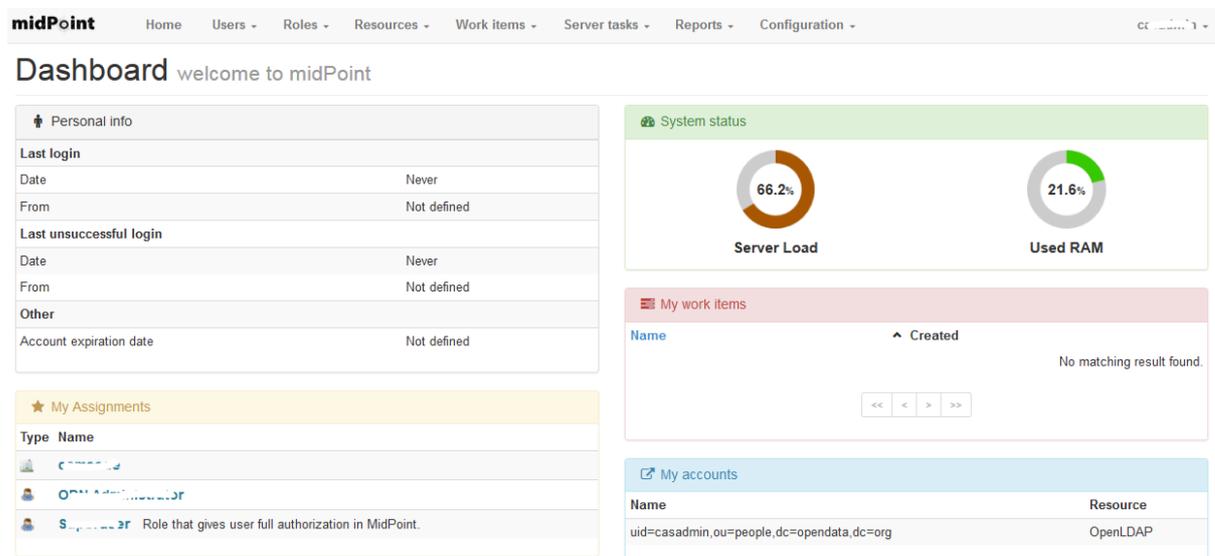
- UnifiedViews (Figure 5) - ETL capabilities, both for Linked Data and tabular/relational data, to allow publishers to convert, clean, enrich and link data before publishing as Open Data (<https://cloud48b.cerit-sc.cz/unifiedviews/>)



Actions	Name	Created by	Last execution time	Last run time	Last status
	SAŽP: Environmental burdens	comsode (casadmin)	Sep 18, 2015 6:57:08 AM	0:00:29	
	SAŽP: Species distribution	comsode (casadmin)	Sep 18, 2015 7:18:49 AM	0:00:11	
	test	comsode (casadmin)	Aug 4, 2015 12:57:41 PM	0:00:08	
	Geonames.org	comsode (casadmin)	Sep 9, 2015 9:01:09 AM	0:29:47	
	SAŽP: Protected sites links to Natura 2000	comsode (casadmin)	Sep 18, 2015 8:36:11 AM	0:05:10	
	SAŽP: Species distribution links to EUNIS	comsode (casadmin)	Sep 18, 2015 7:47:49 AM	0:06:47	
	SAŽP: Protected sites links to Geonames.org	comsode (casadmin)	Sep 16, 2015 2:28:03 PM	0:00:13	
	SAŽP: Protected sites	comsode (casadmin)	Sep 18, 2015 8:28:11 AM	0:01:42	
	SAŽP: Corine land cover	comsode (casadmin)	Sep 18, 2015 7:57:10 AM	0:01:01	
	SAŽP: Bio-geographical regions	comsode (casadmin)	Sep 18, 2015 7:35:49 AM	0:00:14	
	INSPIRE Protection Classification	comsode (casadmin)	Sep 7, 2015 9:50:38 AM	0:00:13	

Figure 5 Graphical user interface of the UnifiedViews

- midpoint (Figure 6) - ODN’s Single-Sign-On (SSO) user management, authentication and authorization systems organizations may already be using (<https://cloud48b.cerit-sc.cz/midpoint/>)



midPoint Home Users Roles Resources Work items Server tasks Reports Configuration

Dashboard welcome to midPoint

Personal info

Last login

Date: Never

From: Not defined

Last unsuccessful login

Date: Never

From: Not defined

Other

Account expiration date: Not defined

My Assignments

Type	Name
	ODN Administrator
	Superuser Role that gives user full authorization in MidPoint.

System status

Server Load: 66.2%

Used RAM: 21.6%

My work items

Name: Created

No matching result found.

My accounts

Name	Resource
uid=casadmin,ou=people,dc=opendata,dc=org	OpenLDAP

Thank you for using midPoint, developed by Evolveum and partners, © 2010-2015

Figure 6 Graphical user interface of the midpoint

- CKAN (Figure 7) - providing internal and external cataloguing of the resources (<https://cloud48b.cerit-sc.cz/internalcatalog/>)

Open Data Node

ver. 1.1

Datasets
Organizations
About ODN
Project Comsode
Tools

Please update your profile and add your email address. Open Data Node - Internal catalog uses your email address if you need to reset your password. ✕

Search Your Data

🔍

Comsode: Open Data Node

ODN is platform for publishing, retrieving and interchange of open data supporting whole process of publication. [More information...](#)

Methodology for publishing Open Data

Open Data methodology is the next component of Open data suite provided by Comsode project. It is intended for data owners and publishers (mainly public bodies) as the generic methodology for the design of their internal processes. [More information...](#)

FP7 Project COMSODE

www.comsode.eu - @FP7COMSODE

Powered by:

Language: English

Project Comsode has received funding from the Seventh Framework Programme of the European Union in Grant Agreement number 611358.

Figure 7 Graphical user interface of the ODN CKAN

3 MULTILINGUAL TOOLS

3.1 Statistical Translation

Machine translation is a subfield of computational linguistics that investigates the use of software to translate text or speech from one language to another. On a basic level, MT performs simple substitution of words in one language for words in another, but that alone usually cannot produce a good translation of a text because recognition of whole phrases and their closest counterparts in the target language is needed. Solving this problem with corpus and statistical techniques is a rapidly growing field that is leading to better translations, handling differences in linguistic typology, translation of idioms, and the isolation of anomalies. Current machine translation software often allows for customization by domain or profession (such as weather reports), improving output by limiting the scope of allowable substitutions. This technique is particularly effective in domains where formal or formulaic language is used. It follows that machine translation of government and legal documents more readily produces usable output than conversation or less standardised text. Statistical machine translation tries to generate translations using statistical methods based on bilingual text corpora. Where such corpora are available, good results can be achieved translating similar texts, but such corpora are still rare for many language pairs. Generally, the more human-translated documents available in a given language, the more likely it is that the translation will be of good quality.³

3.2 MOSES

Moses is an implementation of the statistical (or data-driven) approach to machine translation (MT). This is the dominant approach in the field now, and is employed by the online translation systems deployed by the likes of Google and Microsoft. In statistical machine translation (SMT), translation systems are trained on large quantities of parallel data (from which the systems learn how to translate small segments), as well as even larger quantities of monolingual data (from which the systems learn what the target language should look like). Parallel data is a collection of sentences in two different languages, which is sentence-aligned, in that each sentence in one language is matched with its corresponding translated sentence in the other language. It is also known as a bitext. The training process in Moses takes in the parallel data and uses concurrences of words and segments (known as phrases) to infer translation correspondences between the two languages of interest. In phrase-based machine translation, these correspondences are simply between continuous sequences of words, whereas in hierarchical phrase-based machine translation or syntax-based translation, more structure is added to the correspondences. For instance a hierarchical MT system could learn that the Czech ‘hat X gegessen’ corresponds to the English ‘ate X’, where the ‘Xs’ are replaced by any Czech-English word pair. The extra structure used in these types of systems may or may not be derived from a linguistic analysis of the parallel data. Moses also implements an extension of phrase-based machine translation known as factored translation that enables extra linguistic information to be added to phrase-based systems.⁴

3.3 Implementation

The implementation was provided as subcontract of Charles University in Prague, Institute of Formal and Applied Linguistics (UFAL in the following) for Czech Centre for Science and Society. In the first phase of the collaboration between CCSS.cz, one partner in the SDI4Apps project, and UFAL, UFAL implemented a baseline machine translation (MT) system for Czech-to-English translation. The system is based on the Moses open-source toolkit and as such relies on parallel and monolingual data coming from the domain in question as much as possible. For this, we collected parallel and monolingual texts from EUR-lex. EUR-Lex was accessed in two ways, directly browsing the files and also by its search facility. The respective entry points are:

- <http://eur-lex.europa.eu/oj/direct-access.html>
- <http://eur-lex.europa.eu/search.html>

³ https://en.wikipedia.org/wiki/Machine_translation

⁴ <http://www.statmt.org/moses/?n=Moses.Overview>

The size obtained corpora is detailed in Table 1.

Table 1 Corpora

	Segments	English Words	Czech Words
Direct Access, Parallel	5.19M	36.10M	28.75M
Search Access, Parallel	10.38M	91.98M	122.76M
Direct Access, Monolingual	20.96M	--	141.12M
Direct Access, Monolingual	20.93M	158.74M	--
Search Access, Monolingual	40.10M	--	304.49M
Search Access, Monolingual	45.24M	633.99M	--

After de-duplication at the segment level, we have, approximately figures as indicated in Table 2.

Table 2 After de-duplication

	Segments	English Words	Czech Words
Direct Access, Parallel	1.54M	26.83M	20.42M
Search Access, Parallel	2.92M	63.25M	95.68M
Direct Access, Monolingual	5.36M	--	97.38M
Direct Access, Monolingual	5.15M	107.83M	--
Search Access, Monolingual	10.77M	--	169.32M
Search Access, Monolingual	13.94M	462.76M	--

The data were divided into training and development set ourselves and UFAL had a baseline system ready, although not optimized for the intended domain. Ideally, the development set of at least 2000 sentences, each equipped with its translation, would come exactly from the domain we want to translate.

All the reported work has been carried out on the computer cluster at UFAL. After this Moses was installed on the supercomputer of the Masaryk University.

Further, clean-up of the corpora is desirable, but we first need to see the translation quality on some real input documents, to assess if better translation quality will be reached more likely by additional data or by data clean-up.

4 CONCLUSION

The harmonisation processes and their performance are for experts only. A team of experts from the SDI4Apps consortium dedicates most effort to data harmonisation and integration with other data sources. These data include spatial data, non-spatial data and linked data.

The three data sources that will serve as a basis for the SDI4Apps platform are being harmonized and the harmonisation will continue until the end of the project. Data are key components of the platform and represent more than 80% of the platform value. The rest belongs to software and hardware.

The multilingual tools were implemented and being trained to perform translation for the platform. The following aspects were taken into account:

- some relevant sources crawled for training data,
- further sources are still needed,
- the training corpora were processed at a rather basic level, further clean-up desirable, esp.,
- in case we fail to find additional data sources,
- baseline batch MT system has been prepared, relevant development set of documents needed to optimize the system for the given domain,
- Installation of the MT system at CCSS computers in progress.

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