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Open Land Use Map

T. Mildorf[1,2], K. Charvát[3], J. Ježek[1,2], S. Templer[4,5], C. Malewski[4,5]

[1] University of West Bohemia, Czech Republic

[2] New Technologies for the Information Society, Czech Republic

[3] Help Service – Remote Sensing, Czech Republic

[4] Fraunhofer Institute for Computer Graphics Research IGD, Germany

[5] TU Darmstadt, Interactive Graphics Systems Groupe, Germany

Anotace

Open Land Use Map je iniciativa, která byla spuštěna v rámci projektu Plan4business a která bude dále rozšířena v rámci projektu SDI4Apps. Tato služba si klade za cíl vytvořit mapu využití půdy s celosvětovým pokrytím. Úvodní mapové podklady budou tvořit data Corine Land Cover, Global Cover a Open Street Map. Přispěvovatelé, především dobrovolníci, budou moci měnit geometrii vzhledů jevů a přiřadit aktuální využití půdy dle klasifikace HILUCS. Podrobnější datové sady budou využívány ke zvýšení úrovně podrobnosti open Land Use Map. Výsledkem bude báze otevřených dat, která budou dostupná v různých formátech a pro uživatelem vybrané území. Tento článek popisuje technické a obchodní aspekty aplikace Open Land Use Map včetně integračních a harmonizačních nástrojů, plán udržitelnosti a aplikace doplňující celou platformu.

Klíčová slova

Integrace dat, využití půdy, otevřená data, obchodní plán, udržitelnost, INSPIRE.

Abstract

Open Land Use Map is an initiative that has been started by the Plan4business project and that will be extended as part of the SDI4Apps project in the future. This service aims to create an improved worldwide land use map. The initial map will be prepared using the CORINE Land Cover, Global Cover dataset and Open Street Map. Contributors, mainly volunteers, will able to change the geometry and assign up-to-date land use according to the HILUCS specification. For certain regions more detailed datasets, if available, will be used as an update of the Open Land Use Map. The product is treated as Open Data and users will be able to download the data in a specified format and for a selected area. The paper introduces the technical and business aspects of Open Land Use Map app including the integration and harmonisation tools, sustainability plan and apps that accompany the entire platform.

Key words

Data integration, land use, open data, business model, sustainability, INSPIRE.

Introduction

"Land use and land management practices have a major impact on natural resources including water, soil, nutrients, plants and animals." (Hart, 1996). The term land cover is often mistakenly used instead of the term land use. Kannegieter (1998) uses land use as a combined data theme including land use and land cover. However, their actual meanings are quite distinct. Land cover refers to the surface cover on the ground. The INSPIRE Directive (European Parliament, 2007) defines land cover as "physical and biological cover of the earth's surface including artificial surfaces, agricultural areas, forests, (semi-)natural areas, wetlands, water bodies." (INSPIRE, 2012). Land use is defined as "territory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational)." (INSPIRE 2012)

On the one side, there are global mapping initiatives for land cover mapping (e. g. CORINE Land Cover, Africa Cover, Global Cover) and voluntary initiatives such as Geo-WIKI for updating global Land Cover Maps. The idea of collecting spatial data by citizens is described by Goodchild (2011). Heipke (2010) explains the basic technology needed for crowdsourcing geospatial data, discuss the underlying concepts including quality issues and give some examples for this novel way of generating geospatial data.

On the other hand, there are no global initiatives for land use mapping. The only sources of land use are heterogeneous and scattered data from local and regional levels. Cerba (2008) describes in detail the aspects of heterogeneous spatial data. The problem of land use data heterogeneity was the main challenge for the Plan4business project. This EU co-funded project aimed at harmonising and integrating spatial planning data sets so they can be used for cross boarder information and analysis services. Charvat et al. (2013) explains why there is a need to harmonise data. Müller (2013) presents some of the interoperability issues of land use data.

The work started in the Plan4all project by defining the land use application schema which was then used for the INSPIRE Data Specifications on Land Use (Camerata et al., 2011). The Plan4business project developed a platform that can serve to users as a catalogue of land use and planning data such as transport infrastructure, regional plans, urban plans and zoning plans. The platform represents not only a central access point for integrated, harmonised and thus ready-to-use formatted data, it moreover offers rich analysis and visualisation services via an Application Programming Interface (API) and an interactive web frontend. As a result, a large data pool of integrated land use and open data was created.

The Plan4business platform offers not only data but also tools and apps for different user groups:

- data providers - planning authorities, engineering bureaus and researchers who provide data into the platform using the Plan4business tools,
- data curators - who perform integration and quality assurance,
- clients and data brokers - who will be hosting and exploiting the Plan4business platform and its apps.

The Plan4business platform is twofold. On the one side, there is an Open Data Platform which is accessible for free and contains mainly open data. On the other side, in order to keep the platforms sustainable, there will be a Commercial Platform which revenue will be generated via on-demand and subscription services to different customer groups ranging from environmental and planning authorities and companies to banks and real estate companies and developers.

The Plan4business developments and results serve as a basis for another EU co-funded project Uptake of Open Geographic Information Through Innovative Services Based on Linked Data (SDI4Apps). SDI4Apps will exploit the integration tools and the Open Data Platform developed in Plan4business for one of its pilot applications – Open Land Use Map. This application is focused on land use data collection through voluntary participation, data integration, harmonisation and visualisation.

Objectives

Land use data, urban and regional planning data sets were not aggregated so far, and thus it was very laborious to use them for any other purpose than for printing or simple publishing by the authorities that collected them. Creating time series or comparative analyses on these data sets was not yet possible; researchers, spatial planners and professionals from the real estate world and other disciplines, such as insurance industry, investors, or market-relevant activities related to urban development have a growing stake in such capabilities.

There is neither global nor European initiative for mapping land use on local and regional levels. The INSPIRE land use represents scattered resources of various quality and with limited coverage in Europe. The CORINE Land Cover (CLC) is land cover map, not land use map. Moreover, the map is too generalised for regional and local purposes. The Urban Atlas is only for major European cities and does not cover rural areas and remote suburbs of cities.

The needs for a European land use map were expressed during the collection of requirements within the Plan4business project. The voluntary approach is the only way how to perform the collection of data with minimising the costs. The intention of Open Land Use Map is to start support voluntary initiative for open land use

mapping. The initial work was already done in Plan4business and the initiative currently continues under the SDI4Apps project.

Materials and methods

The work is divided into the next steps:

- Define data model for land use mapping based on the Hierarchical INSPIRE Land Use Classification System (HILUCS).
- Transfer existing data and build initial land use map as a combination of different sources:
  - Land use from Open Street Map,
  - Land cover datasets (CORINE Land Cover, Global Cover) which include information on land use,
  - National information sources such as cadastral data in the Czech Republic.
- Make Open Land Use Map publicly available.
- Deploy SDI4Apps mobile and desktop interface for updating of Open Land Use Map.
- Deploy harmonisation tools for updating of Open Land Use Map using existing available open data.

The Open Land Use Map will become freely available for download and accessible through OGC interfaces, but also through Application Programming Interfaces (API) developed within SDI4Apps.

The Open Land Use Map will use the following available global data sources:

- European and global land use and land cover data including CORINE Land Cover, Urban Atlas, Global Cover, Africa Cover;
- Land Use Data from Plan4business and other projects;
- Regional, local, spatial and urban plans of the SDI4Apps partners;
- Publicly available land use data.

Sustainability of the Open Land Use Map

The main aspect of all emerging initiatives is to secure their sustainability. The idea is not only to build an open data set for land use but also to offer a set of added value commercial services. From the business model point of view, there will be two main platforms with the following pricing:

Open Data Platform (ODP) – a data hub containing open data, management and harmonising tools, open applications (e.g. Open Land Use Map). All the services will be available for free with no restrictions. Any party can access the data pool and make commercial or non-commercial apps based on these data. The use of the data must be in line with data licences.

The non-profit ODP will have the following sources of financing in order to keep it sustainable:

- In-kind contributions - sponsorships of companies contributing to the system maintenance, server infrastructure, update and upgrade.
- Future project contributions – there is a number of future projects (e.g. Smart Open Data, SDI4Apps, Open Transport Net, FOODIE) for which the portal can serve for their purposes. The projects would not only use the data but they would also feed the platform with new data. These projects could contribute to the system maintenance, server (cloud) infrastructure and new tools development.
- Advertisement - the hub will offer space for advertising.
- Public funding from the side of organisations who don't want to build their own infrastructure or who would like to support the Open Data Platform.
- Other contributions.

Commercial Platform (CP) – a data hub containing restricted data and commercial apps and tools. The restricted data hub includes all data that cannot be included in the ODP. The CP will be used for commercial applications and in line with data licences. Restricted data will be either not available for download or there will be a possibility to download the data only for a certain group under given conditions and in line with data licences. The incomes will be composed of:

- Advertisement with the focus on concrete user groups (e.g. real estate businesses).
- Data hosting for public and private bodies who don't want to make data freely available, but they need to publish their data.
- Profits from the commercial apps.

- Payments from the project partners for the infrastructure utilisation.
- Payments from third parties accessing the CP or offering the commercial apps in other counties and regions.

Figure 1 shows these two platforms, associated apps and tools and the potential users.

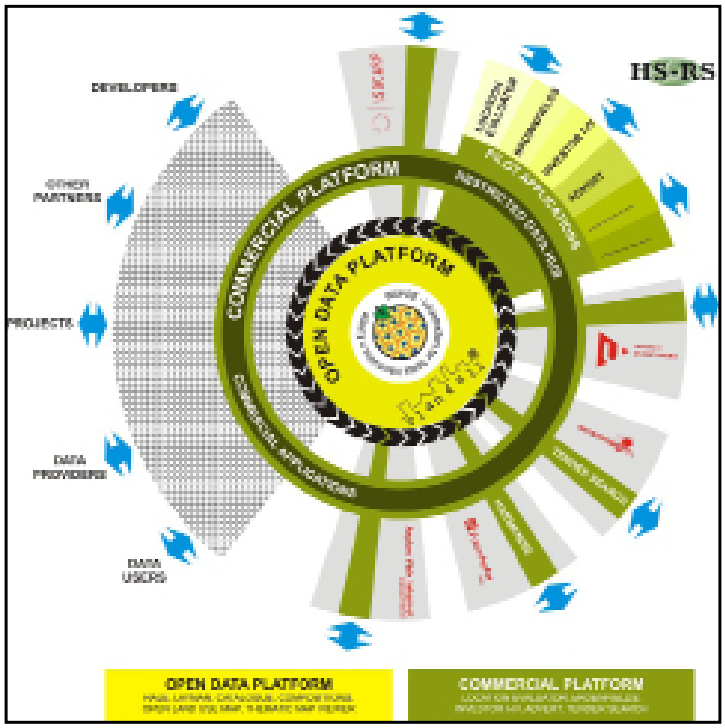
Technology Description

The Plan4business system is realised through a composition of three engine layers, namely the integration layer (1), the storage layer (2) and the analysis layer (3) (Figure 2). The layer's tasks are either to harmonise (1), store and provide (2), or visualise and analyse (3) data related to urban plans (Templer et al., 2013).

The integration engine's task is to transform spatial data sets based on a set of schema mapping instructions. Examples for mapping instructions are reclassifications of land use nomenclatures, spatial coordinate transformation and assigning object types from the source data to a target schema. The integration engine has been realized as a web service based on the Humboldt Alignment Editor (HALE) software stack. HALE, which has been started during the Humboldt project (Fichtinger at al., 2011), provides the functionality to perform interactive mapping of geospatial schemata. HALE's user interface has been adopted in order to allow for performing the mapping process online. Therefore, a step-by-step wizard guides the user through the mapping process and asks to map the source entity types to a pre-determined target schema. The latter is a simplified subset of the INSPIRE Data Specification on Land Use. Besides spatial coordinate transformation and retyping of entities and attributes, re-classification of land use categories is one of the core aspects in the land use domain (Figure 3). Re-classification can be realized through mapping -tables connecting a source classification to one or more classification categories of HILUCS.

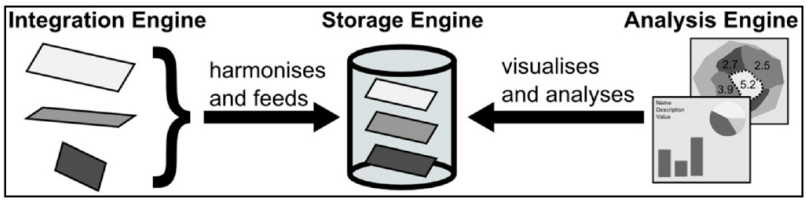
Once the schema mapping is finished it may be executed, published and shared with other users.

Applying the mapping instructions to the source data uploads the resulting transformed data to the storage engine. The latter is a combination of two separated data bases following the relational paradigm on the one hand and the graph paradigm on the other. The main component of the storage



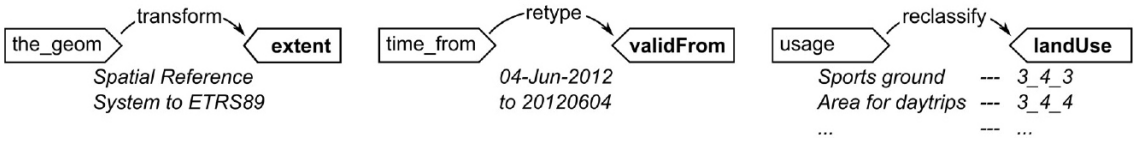
Source: own processing

Figure 1: Open Data and Commercial Platforms and associated tools, apps and users.



Source: Templer et al. ,2013

Figure 2: Composition of the three core engines; integration engine for data harmonisation, storage engine for data storage and provision, analysis engine to visualise and analyse harmonized data.



Note: The bold attribute names belong to the target schema INSPIRE Data Specification on Land Use..

Source: own processing

Figure 3 - Exemplary mappings for spatial, temporal and thematic attributes.

engine is the relational data base. Although the relational paradigm has been carried out successfully for many years, it lacks in performance when it comes to more complex queries that require a lot of table joins. Thus, we have supplemented it with a graph data base that runs particular use cases. Both, the relational data base and the graph data base, can be managed via the web portal. This allows for storing, deleting or updating transformed data sets. The data is either accessible as INSPIRE compliant files (e.g. Geography Markup Language) or via SQL.

The analysis engine encapsulates data access and represents a base for an extensible collection of analysis and visualisation apps. (Ježek, 2013). The solution has been developed within the Plan4business project with the aim of automated spatial planning data automation. This could be used for the implementation of the INSPIRE specifications on land use, which is a challenging task in many countries (Jaroszewicz et al., 2013).

Results and discussion

This section presents the end-user apps built on top of the analysis engine, such as Brownfields (an app for brownfield advertisement), Embed Map (embedding an interactive map window with user defined maps into user's website) and Advert (placing an advert for selling real estates). The Plan4business platform and the apps are available at www.whatstheplan.eu. The apps combine the data harmonized through the integration engine with open data available from various sources. As an example the Thematic Map Viewer and the Location Evaluator apps are described in more detail.

The Thematic Map Viewer (Figure 4) enables to navigate through thematic maps and results of predefined analyses from local to European level. Based on the level of zoom in a certain area a list of thematic maps is dynamically offered to the user. The user can then select one of the thematic maps, display it in the map viewer and analyse it in an interactive manner.

The Location Evaluator is an app for user friendly access to data from various sources including statistical, analytical and cadastral information. User can generate a comprehensive report about a region in Europe (Figure 5), a municipality or a point of interest in selected countries through navigation in a map.

Another app that will be enhanced within the SDI4Apps project is the already mentioned Open Land Use Map.

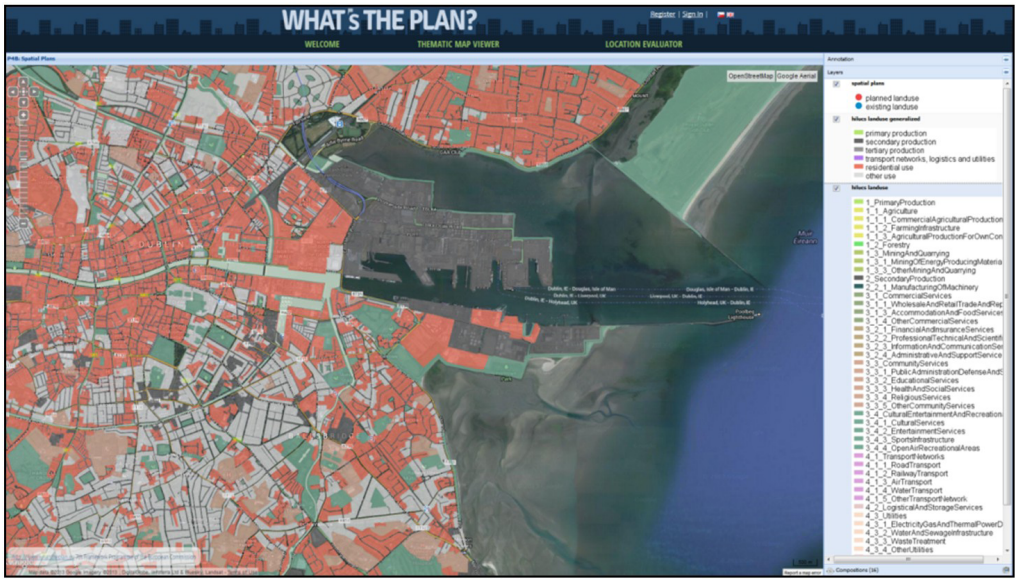


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Figure 4: Thematic Map Viewer.

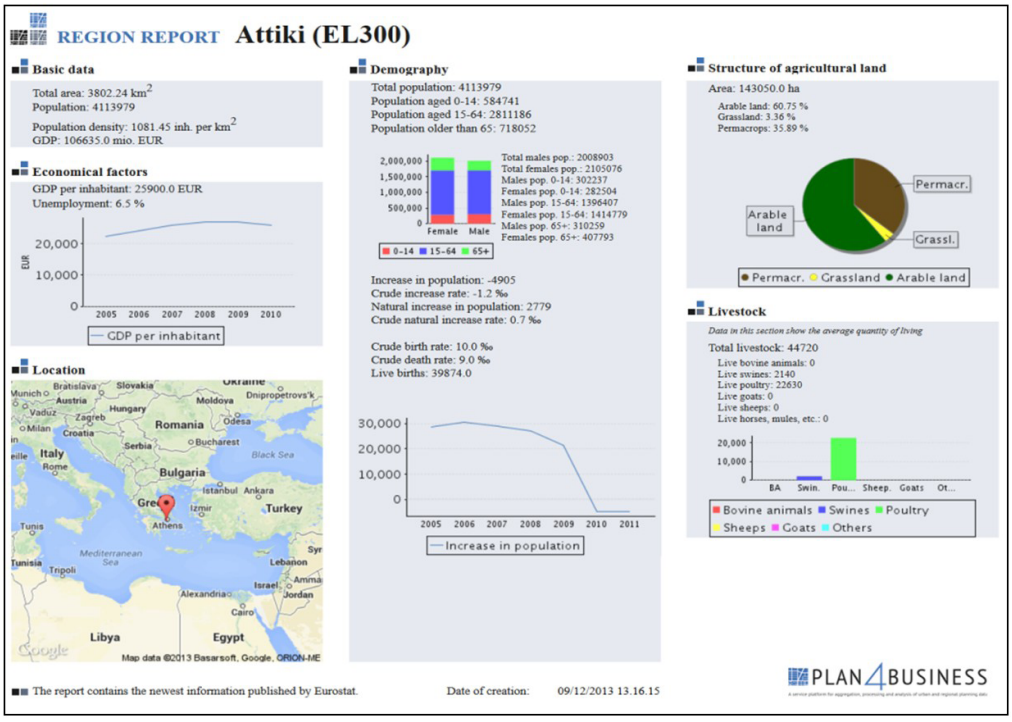

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Figure 5 - Report generated by the Location Evaluator.

Conclusion

The current situation with data availability and compliance to commonly used standards differ from country to country. But in general, most data from the public sector are not published in a standardised and machine readable form. This makes collection, integration and update of data rather difficult.

The Plan4business project developed a solution that can help to overcome this situation and enable effortless land use and other data integration. The solution is fully Open Source and can be

extended to any region in the world including African countries.

The results of the Plan4business project offer the first complete solution for users. The solution will be extended with additional data sets as well as further functionalities and applications to support different user communities. The SDI4Apps project will build on top of the Plan4business achievements and extend the platform with additional apps and tools including the Open Land Use Map.

The authors presented the technological solution for data integration, how to make the system sustainable in the future and the methodology for setting up the Open Land Use Map built on top of this platform. The Open Land Use Map has a great potential in various specialisms including forestry, agriculture, spatial planning and other environmental applications.

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Corresponding author:
Dr. Tomáš Mildorf
University of West Bohemia, Univerzitní 8, 306 14 Pilsen, Czech Republic
E-mail: mildorf@kma.zcu.cz

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