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Crowdsourcing in National Mapping
EuroSDR Workshop
VGI-Map of Europe: The State of Play

January 16th - 17th 2020 - Leuven, Belgium

Rob Lemmens, Peter Mooney, Joep Crompvoets

Workshop Report

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CROWDSOURCING IN NATIONAL MAPPING

VGI MAP OF EUROPE: THE STATE OF PLAY

January 16th - 17th 2020 – Leuven, Belgium

EuroSDR Workshop Report and Abstracts

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Abstract

This report includes the proceedings of the third EuroSDR workshop on Crowdsourcing in National Mapping and contains seven abstracts of related presentations given during this event. This workshop entitled “VGI Map of Europe: The State of Play” took place in Leuven, on 16 (Full) and 17 (Half a day) January 2020. 23 professionals and researchers from National Mapping and Cadastral Agencies and universities participated the workshop.

1 INTRODUCTION

In the past number of years, use of crowdsourcing by National Mapping and Cadastral Agencies (NMCAs) has grown from being a disruptive technological idea to a mainstream source of geographic data and information. Today, many NMCAs and companies within the geospatial technologies industry use crowdsourcing to update databases and registries. However, it is often difficult to find information about what projects or initiatives are currently in operation or have been used in the past. Where has crowdsourcing being used? What role did crowdsourcing play in collecting, editing or updating data and information for NMCAs, companies or other institutions?

In this context, submissions were welcomed from participants who were willing to share their experiences, knowledge, expectations, use cases, future planning, etc., for Volunteered Geo-Information (VGI) and crowdsourced geospatial data.

The workshop served two principal aims:

- Create **VGI-ME** (the VGI Map of Europe). We gathered information and examples on projects and initiatives in European National Mapping and Cadastral Agencies and geospatial companies/SMEs where crowdsourcing has been successfully implemented. VGI-ME will be a conceptual ‘map’ of projects from around Europe which used crowdsourcing as a means of collecting geospatial data and information.
- Plan the design and delivery of a **VGI Hackathon** event in the second half of 2020 which will feature the creation of new crowdsourcing applications (mobile and web) and extending/improving existing ones. For this part of the workshop we actively encouraged the participation of developers from NMCAs, universities, research institutions and companies who were/are active in developing crowdsourcing applications. We invited them to present their software, the data produced with it and its use in the organization’s workflow and discuss extensions/new ideas which can be developed as proof of concept in a hackathon with other developers and creative thinkers, in order to make VGI apps more versatile, more user-friendly, and more effective.

The workshop engaged with stakeholders from NMCAs, the Geomatics Industry, academic research, software developers, citizens involved in geographic crowdsourcing and VGI, leaders or managers of crowdsourcing or VGI projects over 1.5 days to understand the most prominent and pressing questions related to crowdsourcing and national mapping in Europe (and beyond) today and to begin building the inventory of projects for VGI-ME.

The main conclusions of this workshop were that the research topic Crowdsourcing/VGI covers multiple disciplinary areas such as geomatics, computer science, law, ethics and governance. NMCAs are currently under pressure to consider/use crowdsourced data in their production flows, a possible divergence between research community and NMCAs on future VGI focus. More attention is needed for state of the art examples of the use of crowdsourcing at NMCAs and the legal and ethical issues involved in deploying them.

PROGRAM

The program of the workshop was interesting. The next tables present program form Day 1 (Thursday, 16 January 2020) and Day 2 (Friday, 17 January 2020)

Day 1 – Thursday, January 16th 2020

Time	Activity
08:30 – 09:30	Registration and arrival – The Irish College, Leuven
09:30 – 10:00	Welcome to the Crowdsourcing in National Mapping 2020 Workshop (pdf) Joep Crompvoets and Rob Lemmens. This will include a brief ‘tour de table’ for all delegates to introduce themselves.
10:00 – 10:30	The VGI-ME concept – Explaining purpose, hackathon, etc. Presentation on previous hackathons, Living Textbook, etc Rob Lemmens
10:30 – 11:00	Coffee Break
Session: Developments and Overviews of Crowdsourcing Approaches Chair Joep Crompvoets	
11:00 – 11:25	Crowdsourcing at the Dutch Cadastre (pdf) Magdalena Grus, Kadaster NL.
11:25 – 11:50	Feedback on the collaborative program managed by the French National Mapping Agency (pdf) Yolene Jahard ¹ , Ana-Maria Olteanu-Raimond ² , Marie-Dominique Van Damme ² , Bénédicte Bucher ² 1. Collaborative program, Direction of Programs, IGN, F-94160 Saint-Mande, France 2. Univ. Paris-Est, LASTIG MEIG, IGN, ENSG, F-94160 Saint-Mande, France
11:50 – 12:15	Research Developments in Crowdsourcing and National Mapping (pdf) Peter Mooney, Dept of Computer Science, Maynooth University, Ireland.
12:15 – 12:40	Crowdsourcing Opportunities at the OS (pdf) Ross Muir, Ordnance Survey-GB, Southampton, UK
12:40 – 12:50	Short time for additional questions, comments from delegates
12:50 – 14:00	LUNCH – At venue in Irish College Leuven

Session: Crowdsourcing in practice – spotlight on projects. Chair Peter Mooney	
14:00 – 14:25	Slovenian applied research project to utilise volunteered images for the national topographic map updating in scales 1:5000 and 1:50000 (pdf) Mihaela Triglav Čekada, Geodetic Institute of Slovenia, Ljubljana, Slovenia
14:25 – 14:50	Crowdsourcing gardens in Flanders (pdf) Pieterjan De Geest, KU Leuven, Belgium
14:50 – 15:15	Crowdsourcing projects in the National Land Survey of Finland (pdf) Sakeri Savola and Risto Ilves, National Land Survey of Finland, Helsinki, Finland
15:15 – 15:40	The OpenVetMap project (pdf) Bonato P., Mazzucato M., Trolese M., Lorenzetto M., Casarotto C., Bassan M., Ferrè N., Istituto Zooprofilattico Sperimentale delle Venezie, Viale dell'Università 10, Legnaro (PD), Italy
15:40 – 15:50	Short time for additional questions, comments from delegates
15:50 – 16:15	Coffee Break
Session: The VGI Map of Europe (VGI-ME)	
16:15 – 17:15	Session Leader. Rob Lemmens What is VGI-ME? Working with the conceptual model – how to capture metadata about VGI projects. Hands-on activities in small working groups.
17:15 – 17:30	Wrap up and finish for Day 1
19:00	Dinner at Irish College

Day 2 – Friday, January 17th 2020

Time	Activity
09:00 - 09:05	Scene Setting Day 2 – Led by Joep, Rob and Peter
09:05 – 09:35	<p>Lightning talks</p> <ul style="list-style-type: none"> • Michael Kölle, Institute for Photogrammetry (ifp), University of Stuttgart, Germany (pdf) • Lena Norberg and Elin Gyllenhammar, Lantmäteriet (The Swedish mapping, cadastral and land registration authority), Sweden (pdf) • Eszter Kiss, Federal Agency for Cartography and Geodesy, Germany (pdf) • Joep Cromptvoets, KU Leuven Public Governance Institute, Belgium (pdf)
09:35 – 10:45	<p>VGI-ME Continuation</p> <p>Requirements for conceptualisation;</p> <p>Suggest usability improvements;</p> <p>Suggest other ways to manage VGI-ME.</p>
10:45 – 11:15	Coffee Break
11:15 – 13:00	Plan the design and delivery of a VGI Hackathon event in the second half of 2020 which will feature the creation of new crowdsourcing applications (mobile and web) and extending/improving existing ones.
13:00 – 13:15	Workshop Close (pdf) – Wrap up, farewell and next steps (Joep, Rob and Peter)
13:15 – 14:00	LUNCH
14:00	Departures

Figure 1. Group picture of workshop participants



2 ABSTRACTS

This proceedings contains the following seven abstracts presented during the workshop:

- 2.1 Crowdsourcing at the Dutch Cadastre (Magdalena Grus)
- 2.2 Mapping of private gardens in Flanders via crowdsourcing (Pieterjan De Geest et al)
- 2.3 Crowdsourcing projects in the National Land Survey of Finland (Sakeri Savola & Risto Ilves)
- 2.4 Feedback on the collaborative program managed by the French National Mapping Agency (Yolene Jahard, Ana-Maria Olteanu-Raimond)
- 2.5 Crowdsourcing at Lantmäteriet (Tobias Lindholm)
- 2.6 OpenVetMap Project at Istituto Zooprofilattico Sperimentale delle Venezie (Paola Bonato et al)
- 2.7 Slovenian applied research project to utilise volunteered images for the national topographic map updating in scales 1:5000 and 1:50000 (Mihaela Triglav Čekada)

2.1 *Crowdsourcing at the Dutch Cadastre* ([ppt](#))

Magdalena Grus
Kadaster, Apeldoorn, The Netherlands

The Netherlands' Cadastre, Land Registry and Mapping Agency – in short Kadaster – is responsible for the data production and dissemination of the Topographic (BRT) and Cadastral Key Registry (BRK). Furthermore it is responsible for the storage and dissemination of several other key registries such as Buildings and Addresses (BAG) and Largescale Topography (BGT) and many other official datasets. To ensure the quality of data, crowdsourcing is used for several purposes.

Crowd-sourced feedback

Already more than three years, Kadaster's crowdsourced feedback system is in use. Via the website 'www.verbeterdekaart.nl' ('Improve the map'), everyone can give feedback on the large and small-scale topography of the Netherlands. The system is also in use for the Key Registry on Buildings and Addresses. Since 2019, feedback can also be reported directly from other applications through an API. Contributors can always track and trace their feedback via e-mail, the website ('Improve the Map'), WMS, WFS or the REST API.

Since the introduction of this system, the amount of feedback has been more than doubled. The overall quality of the feedback is high. Only 11.1% percent is rejected. Although fluctuating from day to day, the overall flow of feedback is quite stable over the years. The amount of feedback marked as spam is quite limited, only 0.4% percent.

Challenges lie in stimulating data providers to assess the feedback on the large scale topography, buildings and addresses key registers is distributed among more than 300 local data providers (mainly municipalities). Despite being a legal requirement to examine the feedback within two or five working days, not all governmental organisation reach this obligation. For the large scale topography, this data is now shown in the quality dashboards for data providers. Since then, also the assessment of feedback for this dataset is improved, which also stimulated the contribution for more feedback. One of the developments for 2020 will be an API for data providers. With this API data providers can integrate the assessment of feedback into their own (GIS) applications.

Curriculum for children and adults “sensor walk”

As part of a new research theme about sensor registration, we made the “sensor walk” curriculum for children and adults. The aim of this curriculum is to detect sensors placed in the open space. Nowadays there are growing amounts of sensors placed in the public space without any transparency

about their aim, owner and collected data. “Sensor walk” is a tool to help increase awareness about the number of sensors placed in the public space. It also stimulates the discussion about the role of the government in access provision to information about sensors, their aim, location and collected data. By means of the curriculum Kadaster tests the requirements for a national sensor registry.

2.2 Mapping of private gardens in Flanders via crowdsourcing ([ppt](#))

Pieterjan De Geest^a, Ben Somers^a, An Steegen^a, Paul Verschueren^b, Aurelie De Smet^{a,b}, Wouter Vanreusel^c, Thérèse Steenberghen^a

^a KU Leuven, Leuven, Belgium,

^b Erasmushogeschool Brussels, Brussels, Belgium

^c Natuurpunt, Mechelen, Belgium

In the framework of ‘Mijn Tuinlab’ (My Garden Lab) project, the Department of Earth and Environmental Sciences of the KU Leuven develops ways to crowdsource spatial data from private gardens in Flanders, Belgium. Participants from the general public in Flanders will be able to subscribe their garden via an online interactive platform. Upon subscription the participants zoom in on an aerial photo of their garden on which they can then digitally draw the land cover types of the garden. They make a distinction between a number of pre-determined land use classes like grass, hard surfaces, water, vegetable garden, shrubs, herbs, trees (evergreen/deciduous). Combined with a questionnaire, these land cover/use information allows participants to calculate a score for their garden on several ecosystem services like air quality improvement, carbon sequestration, temperature and water regulation, biodiversity and pollination. In this way garden owners get an incentive to improve their garden score and as such improve the ecosystem service potential of their garden. Another goal of the data collection is scientific: validating and optimizing a garden map of Flanders based on high-resolution aerial and satellite images. Such a garden map of Flanders gives opportunities for research and for policy.

2.3 Crowdsourcing projects in the National Land Survey of Finland ([ppt](#))

Sakeri Savola^a, Risto Ilves^b

^a National Land Survey of Finland, Helsinki, Finland

^b National Land Survey of Finland, Jyväskylä, Finland

Map Gretel: social map service supporting a national mapping agency in data collection

As a part of the Finnish National Topographic Database programme, a social map service pilot was made. The pilot supported a national mapping agency (NMA) in data collection. Pilot is not on-going any more, but some of the ideas were exploited in Osoitehaavi, which is ongoing service.

More information about Map Gretel is available here:

<https://link.springer.com/article/10.1007/s10109-018-0288-z>

Osoitehaavi – a web service for crowdsourcing entrance and waypoint data

As part of the Finnish Geospatial Platform programme, a project on development of new address data system was started at National Land Survey of Finland (NLS-Finland) in 2017. The main aims of the project were to gather high-quality address data directly from the municipalities and provide it to the users. At the beginning of the project, the address data, consisting mainly of addresses for buildings, was not enough. Information about entrances and waypoints showing the routing to the building or to the entrance are essential for many use-cases. In addition to the locations of the entrances and waypoints information about the door identifiers, information like the type of the entrance or waypoint and travel restriction of waypoints are needed. This information is not collected on a large scale by authorities and thus, crowdsourcing seemed to be the most viable method for data collection.

We developed a web service named Osoitehaavi (Address net in English) for data collection. In the service users can give locations of entrances and waypoints and appropriate attribute data. In addition,

also notifications about errors in address data can be sent via the service. The data is linked to the addresses of buildings, produced by municipalities. As the service is meant for citizens, extra attention was given to the application's user-friendliness and appropriate instructions. The usability of the service was tested during a pilot campaign in spring 2019 and the service was further developed based on the collected user experiences.

The service was developed in NLS-Finland utilising components commonly used in public web services and open source libraries. The map component is based on an embedded Suomi.fi map (based on OSKARI) and the users are identified in Suomi.fi e-Identification service.

The reliability of the crowdsourced data can be questioned. We wanted to prevent intentional malpractice by identifying the users although the identity information is not linked to the address data. Entrances and waypoints also have a status attribute. Status gives information about the method of data collection and the role of the person who has recorded or verified the information. At the moment, we have two kinds of users in the Osoitehaavi service: citizens and authorized users, e. g. municipal personnel.

The service was opened in beta mode in November 2019. Time will tell how we can mobilise citizens to record entrances and waypoints and what will be the quality of the data.

2.4 Feedback on the collaborative program managed by the French National Mapping Agency ([ppt](#))

Yolene Jahard^a, Ana-Maria Olteanu-Raimond^b, Marie-Dominique Van Damme^b,
Bénédicte Bucher^b

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In the nowadays context of the development of the Open Data Policy and the next generation of public services, the collaborative program is one of the main axis defined by IGN (the French National Mapping Agency) in 2018. The goal of the collaborative program is to develop and improve the capacity of collecting and editing data in a collaborative way in order to enrich, maintain and update geographic data necessary to different public policies. IGN is going to have a facilitating role rather than being the single data producer.

To achieve this ambition, the collaborative system is one of the main levers. Instead of considering the collaborative system as an overlay of services around the authoritative geographic data, the new governance of IGN proposes to place it as one of the main components of the system that allows partners to co-produce authoritative data by giving them more autonomy to support public policies. This inclusive vision erases the historical dichotomy and the deep-rooted tradition in IGN, where the limit between internal and external production was very pronounced. In the new vision, IGN is seen as a federating actor in the geographic information ecosystem in France, one of its missions being to support public authorities, public policies and to reinforce the collaboration with its partners.

Since 2009, IGN started to develop different tools allowing editing and managing information coming from collaborative initiatives. Up to now, different pilots have been launched involving public authorities, citizens and academic institutions. In addition, regarding data, the national mapping agencies no longer define the perimeter of data independently. Datasets must become more compatible and IGN need to establish co-building initiatives with partners.

At last, in the trend of "Government as a Platform", IGN took the initiative to build a GEO platform, a public space for geographic information, to gather usage around geographic data and web services. In parallel, an Infolab was launched to offer a solution to organize the exchange of information around the usage of open data and to share a model of mediation for discovering, reusing data on a demand-driven basis and translate it in the most relevant result for users.

The goal of this presentation is to share IGN's experience both in term of collaborative program and pilots. Thus, first we present the new collaborative eco-system at IGN which is divided into four axes: technical developments (e.g. tools), data governance and pilots, evolution of professions, and animation of communities. After a global overview of these aspects, we present a crowd and

community pilot managed by IGN. This pilot is part of the LandSense European H2020 project (<https://lep.landense.eu/>) aiming to build a citizen platform for monitoring Land Use and Land Cover (LULC) data by integrating citizen observed data and proposing a set of services (e.g. change detection, quality assessment). The goal of the pilot managed by IGN is to study the potential of the crowd and community observed data in order to enrich and update LULC authoritative data by engaging with citizens, academic and partners. Three aspects will be tackled in this presentation: 1/ the developed tools (PAYSAGES: web, mobile and wiki), 2/ the proposed strategy for running in-situ and web based campaigns; 3/ data-collection, validation, and integration in order to update LULC authoritative data.

2.5 Crowdsourcing at Lantmäteriet ([ppt](#))

Tobias Lindholm
Lantmäteriet, Gävle, Sweden

In May 2019 we had a campaign at the Swedish Land Survey where we wanted the people's help.

We wanted to create an alternative collection method for the objects that we don't get or see in aerial photos, an interactive platform for modern dialogue with active users. We went out on social media's where we asked people to report road barrier/blocks. Both missing, removed or incorrect placement. Road barriers seemed like an easy point object to collect. We used our current service called "Improve the map" which is available at www.lm.se to report any kind of improvement for the map. During the project we collaborated with the Swedish Transport Administration.

Result: Positive that our ads have been viewed and resulted in increased number of cases. We have also seen a pattern in which those who have submitted a case regarding road barriers continue to use "Improve the map" for other types of cases, such as paths, roads, buildings etc.

The ad on Facebook has reached thousands of users, many of them whom interacted and clicked on the link (12498 exposures). Facebook is obviously a good tool. Around 105 road blocks were reported from May to October (compared to 15 the year before).

Figure 2. Data collection ad



2.6 OpenVetMap Project at Istituto Zooprofilattico Sperimentale delle Venezie ([ppt](#))

Paola Bonato^a, Matteo Mazzucato^a, Matteo Trolese^a, Monica Lorenzetto^a, Claudia Casarotto^a,
Massimiano Bassan^a, Nicola Ferrè^a

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Legnaro (PD), Italy

OpenVetMap Project

Veterinarians of Local Health Units are the main providers of spatial information in the veterinary field with the assistance of the Veterinary Institutes of their referring areas. The project OpenvetMap will aim to increase the veterinarian information providers using existing open information systems, such as OpenStreetMap database (OSM), and developing a web application that will simplify the addition and the update of useful information in the veterinary and epidemiological fields, to expand the information available, with particular reference to animal farming.

The project will be developed in two parts: an 'application part', where users could update information about the farms on OSM and an 'integration and synchronization part', where the OSM data will be integrated with the information already available to IZSVe.

Application

The application part will display some points of interest (called pins) on the OSM basemap on the user device (pc, tablet or smartphone) (Errore. L'origine riferimento non è stata trovata.). Pins will be generated according with the OSM elements that have informative gaps on specific fields, defined in advance by the developers (for example, the animal species present on a farm). Elements that have not been updated for a long time will also be highlighted with pins.

To identify farms with absent/missing information OSM tags will be used but also the references to geographical coordinates of the farms, available at the IZSVe.

To fill in the information a wizard will be developed and graphical elements will be used to simplify and encourage the contribution to update data by the users (Errore. L'origine riferimento non è stata trovata.).

Integration and synchronization

The integration and synchronization part will combine the information of OSM with farms information filed by IZSVe.

OSM allows a limited number of queries to its database and each query may request a limited number of information. For this reason the OSM database will be replicated on a local sever and all queries will be made on this database. The update of the data in local storage will take place using OSM diff (<https://wiki.openstreetmap.org/wiki/Planet.osm/diffs>) which contains the changes of OSM for a certain period of time, in our case it will be daily.

The combination of OSM information with IZSVe data will be done via OSM ID joined with the farm code available at IZSVe. During the update of the local database, it is important to check the changes on the spatial elements or on the farms descriptions to ensure that no accidental changes or errors were applied. To check the information, specific scripts will be developed. These scripts will detect the changes and the type of the changes applied.

Benefits for the community

The advantages for the community will be the integration and improvement of the OSM database, which will be used in the veterinary and/or agronomic-zootechanical sector. The advantages for IZSVe will be the availability of global data and the possibility to integrate this information with the data archives from IZSVe for specific farms. This will allow to increase the number of information about farms, without being dependent from individual veterinarians. The combination of these two aspects will make it possible to form a common database among different organizations on veterinary health given subjects.

Architecture

Application

The structural components of the web application is three-tier (Figure 3) and include:

- the front-end web application which permits the users to interact with pins displayed on the map, it will be developed in HTML, CSS and Javascript;
- the server side that handled the users requests, processes them and returns to users the information. It will be developed using PHP.
- the databases: contains information/data that are stored and managed by the server side. the web server will get information from two databases:
 - o IZSVe farms spatial database, used to get the coordinates of the farms useful to add parts of the pins on the map;
 - o OSM database, used to extract the farms information available in OSM and to store changes made by the users. It is a PostgreSQL database with specific API to read and edit data (API v.06, OverpassAPI).

Integration and synchronization

The integration and synchronization part consists in the creation of a new database that combines the OSM farm data with IZSVe farm data (Figure 4). The integration DB will be in PostgreSQL server with PostGIS extension. Uploading data into integration database will be performed using ETL process developed ad hoc. The ETL processes will be performed through a dedicated application tier, which exploits, in addition, OSM API.

The daily update of the database will be performed with OSM diffs, a compressed xml file in OsmChange format.

2.7 Slovenian applied research project to utilise volunteered images for the national topographic map updating in scales 1:5000 and 1:50000 ([ppt](#))

Mihaela Triglav Čekada

Geodetic Institute of Slovenia, Ljubljana, Slovenia

In the years 2019-2022 we are conducting an applied research project named “L2-1826: Lidar-facilitated volunteered geographic information for topographic change detection”. The main intention of this project is to study how to acquire additional cartographic data for the national topographic map updating in the scales 1:5,000 and 1:50,000, with the help of volunteered geographic information (VGI) data gathering, especially volunteered images. An interactive orientation (monoplotting) enables acquisition of 3D-data from single volunteered image with help of the dense digital elevation model. Based on our previous experience when we used single volunteered images for the 2012 flood delineation, this project has the following main intentions:

- Asses what kind of data, which can be useful for map updating in the scales 1:5,000 and 1:50,000, can be derived from volunteered images.
- Optimise the interactive orientation method (monoplotting) to enable a quick orientation of arbitrary single images obtained from volunteers by means of different dense digital elevation models or dense point clouds (in Slovenia we have free available aerial lidar data).
- Perform a controlled VGI collection and processing, with a stress on volunteered images. Controlled VGI collection will enable analysis of the role of different cognitive strategies applied by the involved volunteers to better plan the future open VGI collection campaigns, analysis of the role of involved experts and non-experts in providing adequate images for topographic map updating, etc.

At lecture, also lessons learnt by the open VGI collection of volunteered images for 2012 flood delineation will be presented.

This research project is funded by the Slovenian Research Agency, the Surveying and Mapping Authority of the Republic of Slovenia and the Ministry of Defence of the Republic of Slovenia. The project is performed by the Geodetic Institute of Slovenia and the Faculty of Electrical Engineering and Computer Science of the University of Maribor.

3 VGI-MAP OF EUROPE

To improve the exposure and reuse of VGI across projects, the VGI Map of Europe initiative was launched. VGI Map of Europe is intended to function as a hub for VGI providers, NMCAs and consumers. During the workshop, the participants were introduced to the initial ideas behind this platform and the tools to create and use the content. Basically this involves working with a conceptual model, created for VGI concepts (see Figure 3) and capturing metadata about VGI projects. This was done by hands-on activities in small working groups (see Figure 4). The projects as presented during this workshop (see Section 2 of this report) were taken as a basis.

Figure 3. Conceptual model of VGI-ME in the Living Textbook

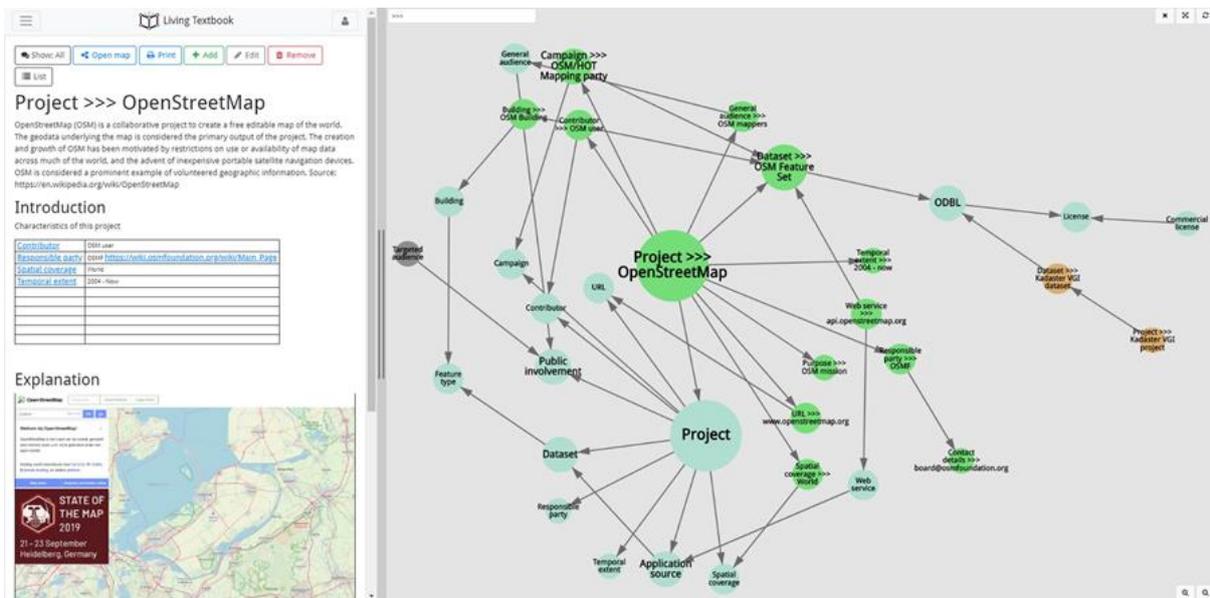
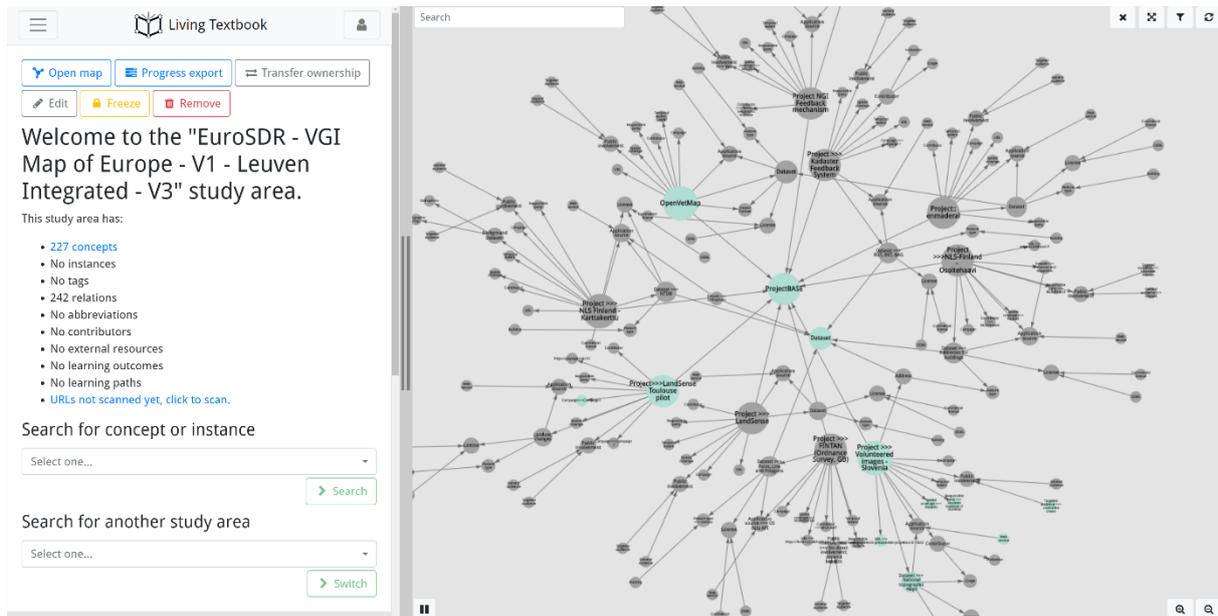


Figure 4. VGI project metadata in the Living Textbook as a result of the workshop



4 HACKATHON

Taking the projects discussed during this workshop, a further discussion was held on the possibilities to improve the uptake of the information produced in these projects by:

- Improve web apps and mobile apps
- Improve integration between VGI and between VGI and authoritative data
- Showcase the use of VGI
- Innovate methods of VGI handling

This discussion led to initiate a further planning of (1) a hackathon (an event in which software developers and subject-matter-experts collaborate intensively on a software project, either by creating new software or combining existing software), or (2) a datathon (an event to add value to data by processing it with existing software). The latter seemed more feasible. It is expected that this could be organized towards the end of 2020, possibly in relation to entries held in the VGI-ME initiative.

5 TAKE HOME MESSAGES

Overall, the workshop was a great success. As with all events like this one very often the most productive learning experiences come from the interactions between delegates, discussions and open floor exchanges. We close this report with a list of some of the main lessons learned or takeaway messages from the workshop. They are not necessarily listed in any order but each one delivers an important message to the overall less that whilst crowdsourcing is now viable and in operation in NMCAs, there is still much work to be done in the future as crowdsourcing and NMCAs change and evolve over time.

- Challenges remain in ensuring that feedback provided by crowdsourcing project participants is acted upon in a swift manner and within a reasonable timeframe. The more citizens can see that their feedback is being valued, and acted upon, the more likely they are to contribute to crowdsourced projects.

- There are still many terms and definitions within crowdsourcing. The vocabulary is varied and diverse. There are many different terms and words to describe the crowdsourcing of geospatial data meaning that it is not very well defined at all. There may need to be some consolidation and agreement on the vocabulary used in order to make it easier to identify what crowdsourcing of geospatial data is and is not.
- There remains pressures (budgetary, technologically, resource-wise, etc) on NMCAs to consider or use crowdsourced data in operational work and for the delivery of geospatial products and services. Some NMCAs are better equipped and positioned to consider and use crowdsourced data than others. For example, the preparation of tasks for citizens to carry out within a crowdsourcing campaign can be time-consuming and require a great deal of resources. While the use of ‘app-based’ crowdsourcing can greatly reduce these pressures other crowdsourced campaigns in areas such as object detection in imagery or collection of 3D information can be much more challenging.
- Linkages with local, regional and national open governance programs are suggested for any crowdsourcing activities initiated by NMCAs. This will help broaden the user community but also builds stronger bonds between citizens and their NMCAs.
- The quality and reliability of the data collected by crowdsourcing projects is still of concern to NMCAs. There is a delicate trade-off between giving citizens freedom to contribute to a crowdsourcing project with a national mapping activity and identifying those users who make the contributions. There is no easy answer to this question. Allowing anonymous or easy sign-up methods of contributions can lead to higher levels of participation but the quality and reliability of the data and information collected can be questionable. However, opting for a more extensive sign-up and identification approach for contributors can lead to an overall lower number of contributions but with more quality and reliability.
- Pilot projects to integrate crowdsourcing in national mapping often attract what are considered small numbers of citizens (maybe in terms of several hundred or thousands of people). However, this does not necessarily mean that this is a failed venture. On the contrary, even with these relatively small number of citizens (in comparison to the population of the country or region, for example), much can be learned if the contributions are meaningful and contain relevant data and information. Whilst engagement strategies should strive to attract as many participants for a crowdsourcing campaign as possible it should be concluded that small numbers of respondents can be valuable.
- The use of social media as a channel for advertising crowdsourcing campaigns for NMCAs yields positive results. Engagement levels are generally higher, and these channels carry the obvious ability to reach a larger number of people.
- OpenStreetMap (OSM) is still by any measure the most used VGI project or crowdsourced geospatial information (CGI) project used by NMCAs in their crowdsourcing work. The ability to access OSM data directly using APIs and the direct download of large amounts of OSM in formats such as ESRI Shapefiles remain great strengths of OSM.
- Personal information, collected as Crowdsourced Geographic Information (CGI), now creates data linkages between individuals, devices, organizations, the environment. When the spatial and geographical aspects of these datasets and information streams are explored new knowledge can be extracted. As crowdsourcing becomes more socio-technological more attention will be needed on the legal and ethical frameworks supporting crowdsourcing

projects. These types of questions will require multi-disciplinary research efforts involving multiple areas of focus. Concentration of efforts is needed to benefit both the VGI/CGI communities and the NMCAs.

- Mobile crowdsensing (Restuccia et al, 2017) allows ordinary citizens to monitor various phenomena related to themselves in relation to their community or environment. Given the ease at which smartphones can be used to collect this complex and integrated data and information, three complex research questions arise: How can we trust that the smartphone-human sensors will send useful information? How can we enforce the submission of useful information? How can we estimate the usefulness of the submitted information?

Restuccia et al. 2017. Quality of Information in Mobile Crowdsensing: Survey and Research Challenges. ACM Trans. Sen. Netw.13, 4, Article 34 <https://doi.org/10.1145/3139256>