Economy, Society and Climate Change – The impact of mega trends in the Built Environment, Construction Industry and Real Estate

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New Trends in Spatial Information: The Land Surveyors Role in the Era of Crowdsourcing and VGI

Current state and practices within the land surveying, mapping and geo-science communities, Report by FIG Commission 3

Vlado Cetl, Croatia, Charalabos Ioannidis, Greece, Sagi Dalyot, Israel,
Yerach Doytsher, Israel, Yaron Felus, Israel, Muki Haklay, United Kingdom,
Hartmut Müller, Germany, Chryssy Potsiou, Greece, Enrico Rispoli, Italy, David Siriba, Kenya

Session FIG – ECCE, Thursday 9 November, 2018, 15:30-17:30

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HIGH-LEVEL INTERNATIONAL INTERDISCIPLINARY CONFERENCE

Economy, Society and Climate Change – The impact of mega trends in the Built Environment, Construction Industry and Real Estate

FIG Commission 3 Spatial Information Management

FIG Commission 3 Workshop
The Empowerment of Local Authorities:
Spatial Information and Spatial Planning Tools
Paris, France, 25-28 October 2011

International Federation of Surveyors
Fédération Internationale des Géomètres
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Spatial Information   10-14 December 2012, Athens, Greece

FIG
New Trends in Geospatial Information:
The Land Surveyors Role in the Era of
Crowdsourcing and VGI

Current state and practices within the land
surveying, mapping and geo-science
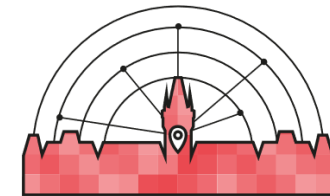communities

Report by Commission 3

2018

FIG COMMISSION 3
WORKSHOP & ANNUAL MEETING
4/7 NOVEMBER 2014 BOLOGNA - ITALY

Joint Workshop
FIG Commission 3 & Commission 7
and Annual Meeting
MALTA 16-20 NOVEMBER 2015

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Spatial Information Management
FROM VOLUME TO QUALITY
BRIDGING THE GAP FOR
SPATIAL DATA INSTRASTRUCTURE
Iaşi 3|7 November 2016

Geo-SEE

International Federation of Surveyors
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Internationale Vereinigung der Vermessungsingenieure
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Spatial Information Management

International Scientific Conference "Spatial Data Infrastructures and Spatial Information Management" SDI & SIM 2013 13-16 November 2013, Skopje, FYROM

WORKSHOP AND ANNUAL MEETING
Volunteered Geographic Information:
Emerging Applications in Public Science
and Citizen Participation

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Spatial Information Management

LISBOA
27-30 NOVEMBER 2017

Overview

What is Crowdsourcing?

What is Volunteered Geographic Information VGI?

Professional Geospatial Data Production vs. VGI Data Production

Some VGI Land Administration Applications in Africa and Europe

What is Crowdsourcing? (I)

Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call

Howe J., 2006. The Rise of Crowdsourcing. Wired Magazine, vol. 6, no. 14, pp. 183.

What is Crowdsourcing? (II)

'a distributed problem-solving model, (that) is not, however, open-source practice… and can be explained through a theory of crowd wisdom, an exercise of collective intelligence… a model capable of aggregating talent, leveraging ingenuity… enabled only through the technology of the web'

Brabham D.C., 2008. Crowdsourcing as a Model for Problem Solving: An Introduction and Cases. Convergence: The International Journal of Research into New Media Technologies, vol. 14, no. 1, pp. 75-90.

What is Crowdsourcing? (III)

'Crowdsourcing is a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task… (thus, it) entails mutual benefit… the user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowdsourcer will obtain and utilize to their advantage that what the user has brought to the venture, whose form will depend on the type of activity undertaken'

Estelles-Arolas E. and Gonzalez-Ladron-de-Guevara F., 2012. Towards an integrated crowdsourcing definition. Journal of Information Science, vol. 38, no. 2, pp. 189-200.

The 8 Elements of a Crowdsourced Process (I)

Central elements

1) *Diversity*, each individual contributes diverse pieces of data or information;
2) *Decentralization*, the crowd's input are not subjective or biased from the inner groups' hierarchy;
3) *Independence*, the person's opinion is not influenced by people from the group that exist in his close vicinity, but from their own personal judgment;
4) *Aggregation*, a mechanism that combines the individual opinions received unto a single collective decision, conclusion or infrastructure.

Dror T., Doytsher Y., and Dalyot S., 2015. A Quantitative Evaluation of Volunteered Geographic Information Paradigms: Social Location Based Services Case Study. Survey Review, Vol. 47(344): 349 – 362.

The 8 Elements of a Crowdsourced Process (II)

Supplementary elements

5) **Knowledge**, familiarity volunteers are assumed to have to supply with the data and information;
6) **Activity**, the measure of volunteers functionality, i.e., how diligent and actively contributing the volunteer should be, to initiate a beneficial task or mission;
7) **Privacy**, how the data and information collected from volunteers – and on volunteers - is used (and to what extent), and what options do volunteers have in regard to this issues;
8) **Exploitation,** the deliberate misuse of service and the damage that is caused in case of fake or misleading data and information input from the volunteers.

Dror T., Doytsher Y., and Dalyot S., 2015. A Quantitative Evaluation of Volunteered Geographic Information Paradigms: Social Location Based Services Case Study. Survey Review, Vol. 47(344): 349 – 362.

What is Volunteered Geographic Information VGI?

'… the widespread engagement of large numbers of private citizens, often with little in the way of formal qualifications, in the creation of geographic information, a function that for centuries has been reserved to official agencies. They are largely untrained and their actions are almost always voluntary, and the results may or may not be accurate. But collectively, they represent a dramatic innovation that will certainly have profound impacts on geographic information systems (GIS) and more generally on the discipline of geography and its relationship to the general public.'

Goodchild M., 2007. Citizens as sensors: the world of volunteered geography. GeoJournal, 69(4), 211-221.

# Technical Drivers of Crowdsourced Geospatial Data Collection

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Smartphones – portable, versatile

GNSS sensors – georeferencing and geo-tagging

Web 2.0 – the two-way Web

Humans as Sensors - Motivation

OpenStreetMap, a Prominent VGI Use Case
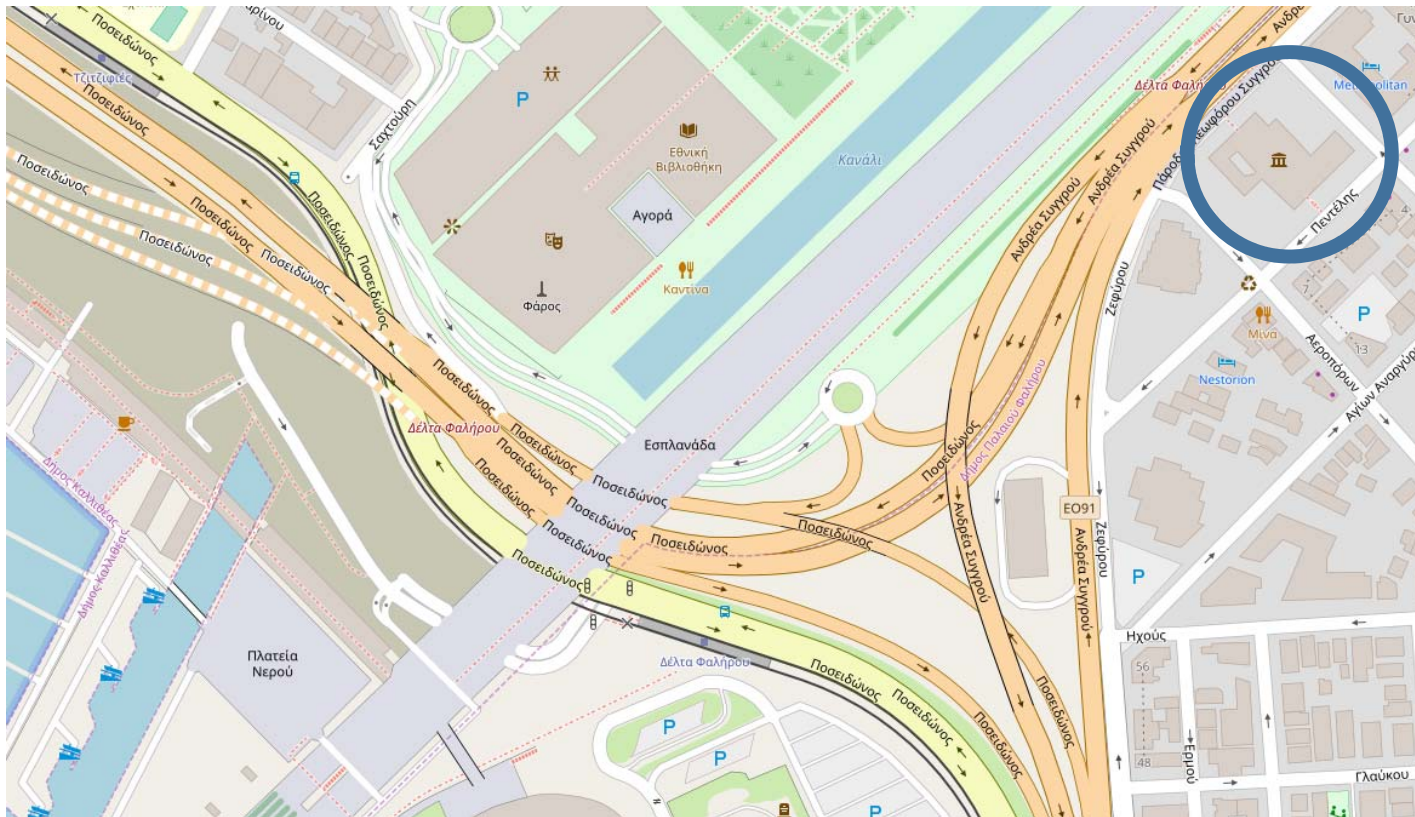
Use of Volunteered Geographic Information VGI in the European NMAs
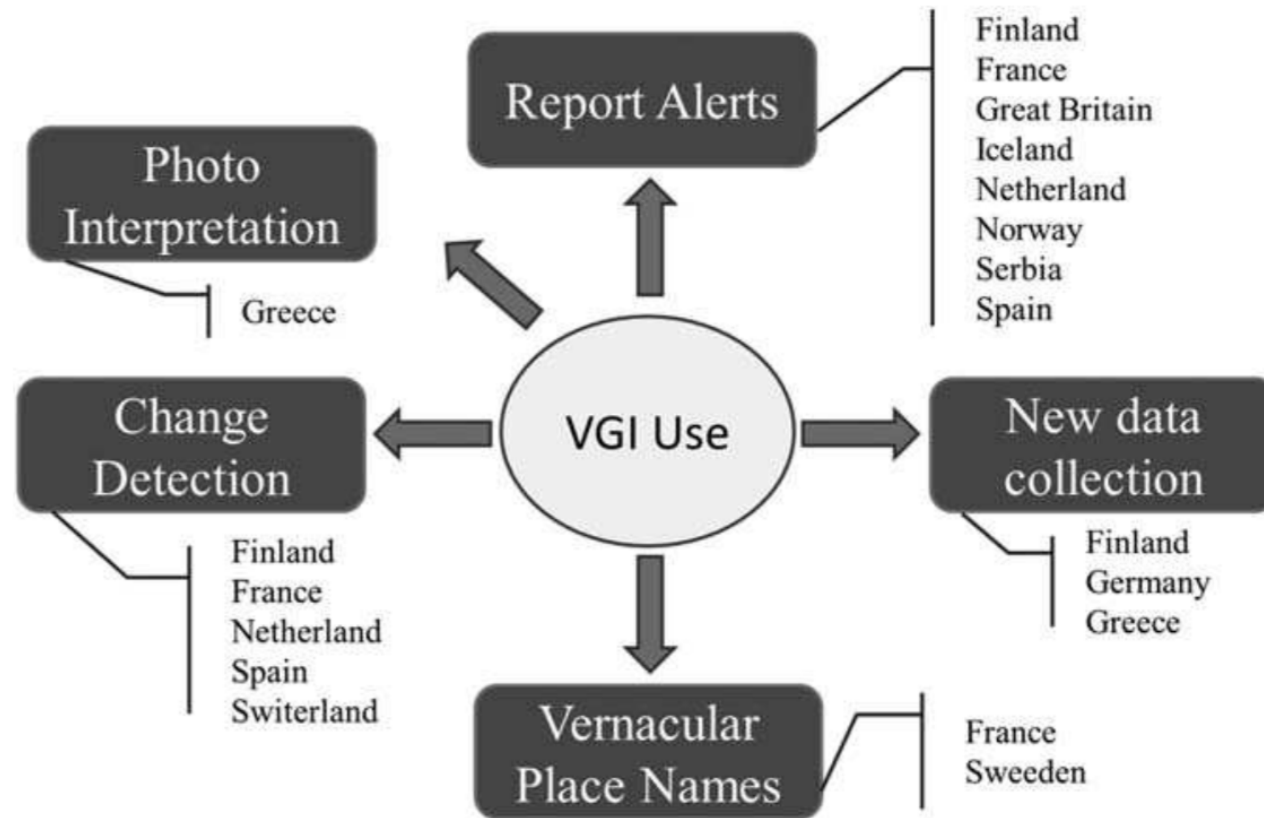
Olteanu-Raimond A. M., Hart G., Touya G., Kellenberger T., Foody G., and Demetriou D., 2015. The scale of VGI in map production: A perspective of European National Mapping Agencies, Transactions in GIS.
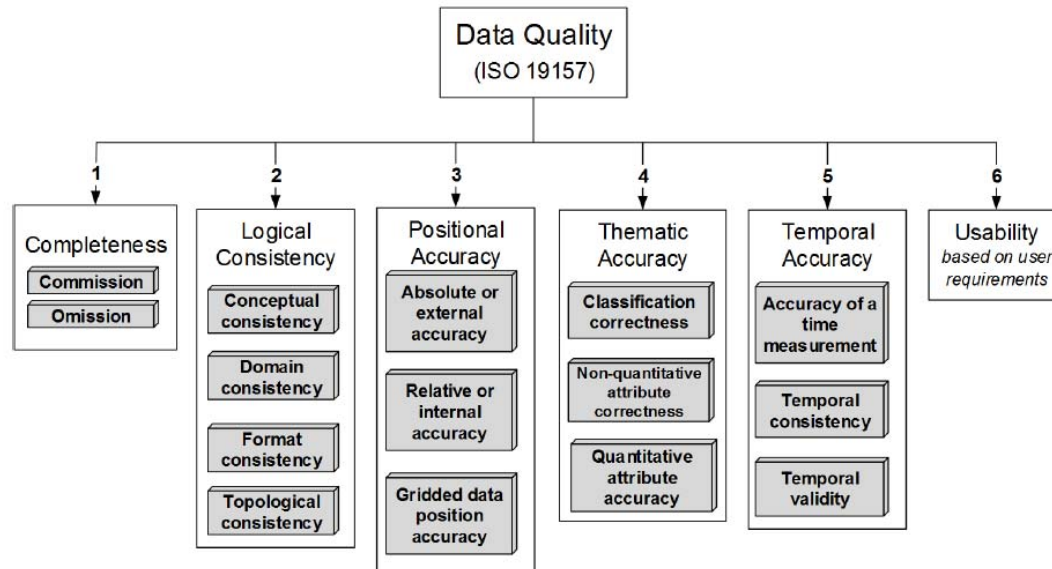
The Professional Production of Geospatial Data
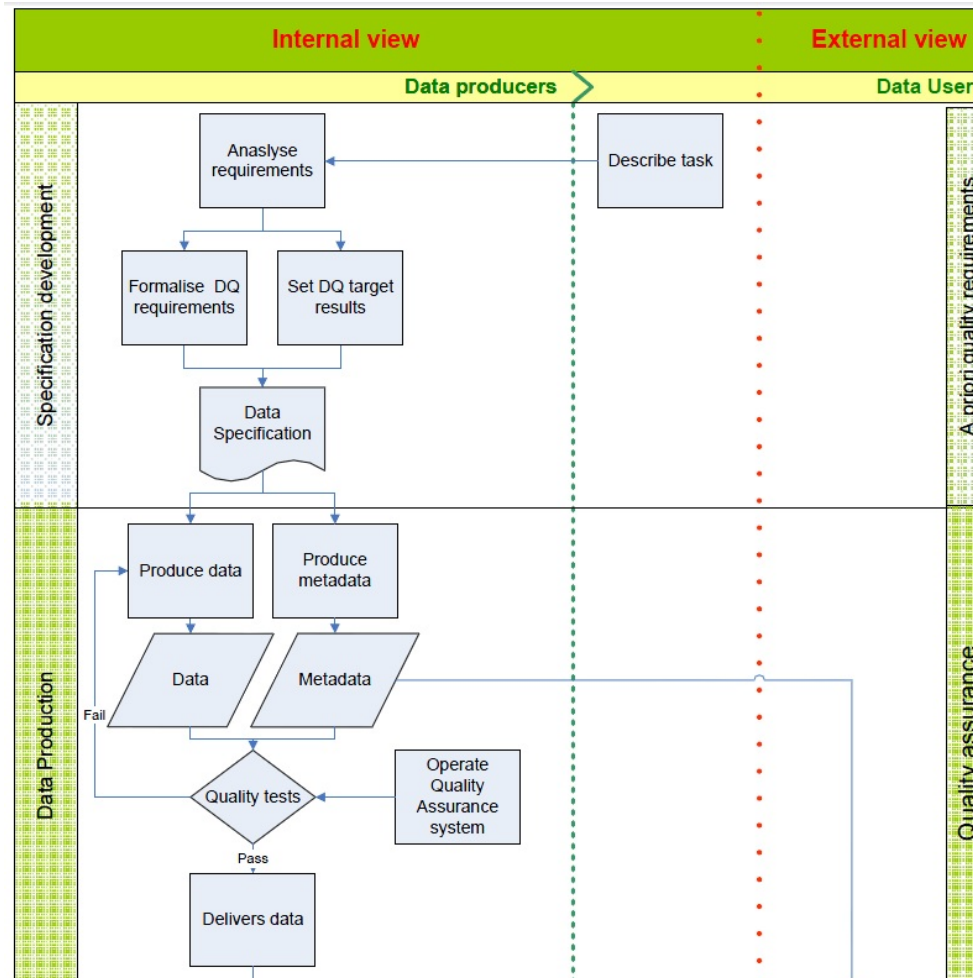
Tóth K., Tomas R., Nunes de Lima V. Cetl V., 2013. Data Quality in INSPIRE: Balancing Legal Obligations with Technical Aspects. Technical Report by the Joint Research Centre of the European Commission.
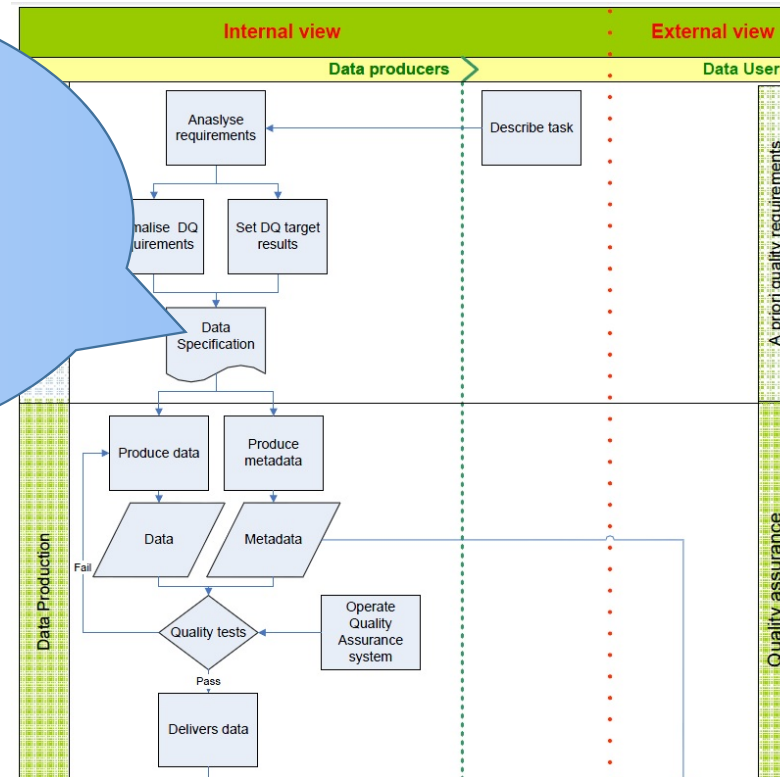
Professional Quality Framework for Geospatial Data

Daniela Cristiana Docan 6th Sept. INSPIRE Conference 2017, Strasbourg
https://inspire.ec.europa.eu/sites/default/files/presentations/Docan_INSPIRE_2017_Print.pdf

The VGI Production of Geospatial Data

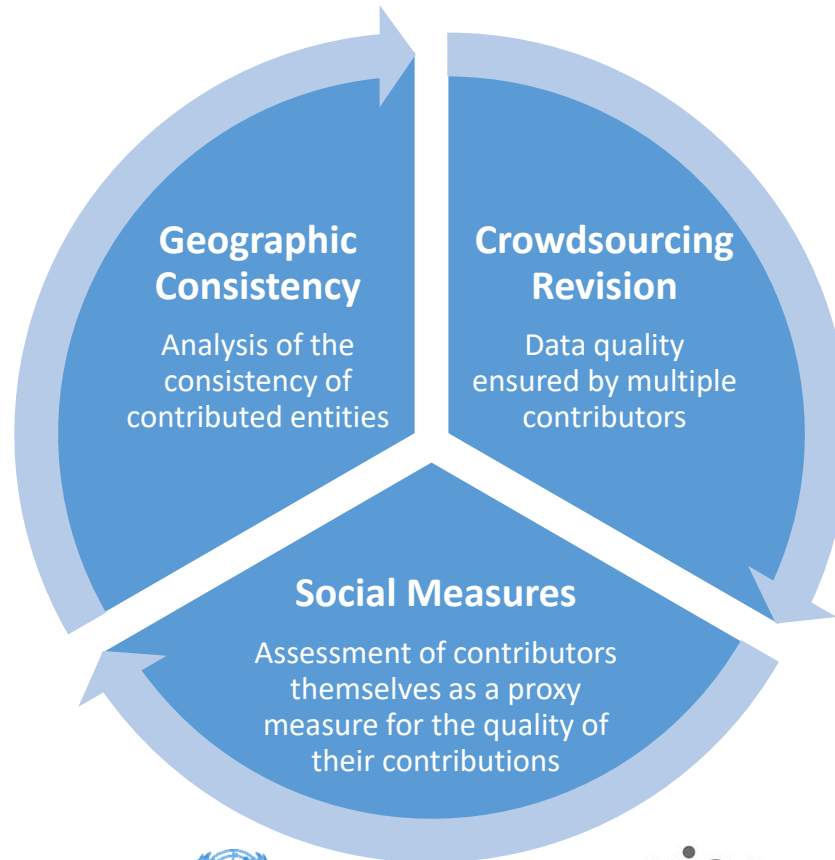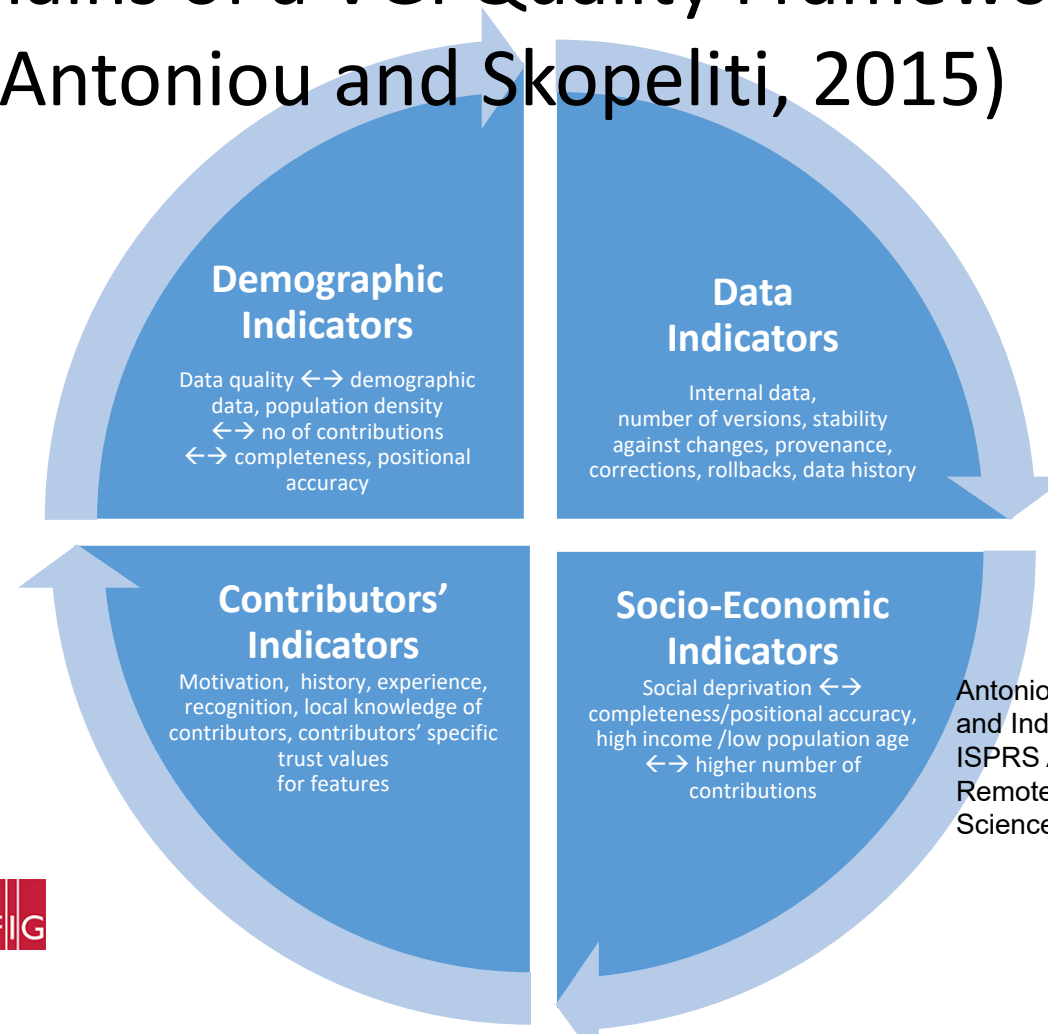https://www.flickr.com/photos/harrywood/29781942052/in/pool-43599786@N00/lightbox/

Tóth K., Tomas R., Nunes de Lima V. Cetl V., 2013. Data Quality in INSPIRE: Balancing Legal Obligations with Technical Aspects. Technical Report by the Joint Research Centre of the European Commission.

Domains of a VGI Quality Framework (Goodchild and Li, 2012)

Geographic Consistency

Analysis of the consistency of contributed entities

Crowdsourcing Revision

Data quality ensured by multiple contributors

Social Measures

Assessment of contributors themselves as a proxy measure for the quality of their contributions

Goodchild, M. F., Li, L., 2012. Assuring the quality of Volunteered Geographic Information. *Spatial statistics*, 1, pp. 110-120.

Domains of a VGI Quality Framework
(Antoniou and Skopeliti, 2015)

Demographic Indicators

Data quality ←→ demographic data, population density ←→ no of contributions ←→ completeness, positional accuracy

Data Indicators

Internal data, number of versions, stability against changes, provenance, corrections, rollbacks, data history

Contributors' Indicators

Motivation, history, experience, recognition, local knowledge of contributors, contributors' specific trust values for features

Socio-Economic Indicators

Social deprivation ←→ completeness/positional accuracy, high income /low population age ←→ higher number of contributions

Antoniou, V., Skopeliti, A. 2015. Measures and Indicators of VGI Quality: An Overview. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume: II-3/W5

TEE TECHNICAL CHAMBER OF GREECE

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European Council of Civil Engineers

Data Indicators Domain Dimensions (I)

| Dimension	Sym.	Purpose & indicators
Accuracy	I_{ac}	Distance between conceptualization and domain knowledge. It can be seen as the degree of correctness in the classification of features τ into classes C. *Indicators:* Number of features with multiple classifications; number of contributors.
Granularity	I_{gr}	Level of thematic description present in the data, moving from very abstract to very specific concepts. *Indicators:* Depth of classes in the class hierarchy (if applicable).
Completeness	I_{cl}	Coverage in the conceptualization of the features of interest. A distinction exists between class completeness and attribute completeness. *Indicators:* Number of classes; number of attributes
Consistency	I_{cn}	Degree of homogeneity in the descriptions of geographic features. *Indicators:* Number of features in a class described with the same attributes; ratio between consistent features or attributes to all others, weighted against the absolute number of attributes.
Compliance	I_{cm}	Degree of adherence of an attribute, a feature, or a set of features to a given source S, ranging from non compliance to full compliance. *Indicators:* Ratio between the number of classes and attributes defined in an external source S and the total number of classes and attributes.
Richness	I_{ri}	Amount and variety of dimensions that are included in the description of the real-world entity. *Indicators:* Number of attributes describing a feature.

Table 1. Dimensions of conceptual quality for VGI

Ballatore A., Zipf A., 2015. A Conceptual Quality Framework for Volunteered Geographic Information. International Workshop on Spatial Information Theory, October 2015, DOI: 10.1007/978-3-319-23374-1_5

Data Indicators Domain Dimensions (II)
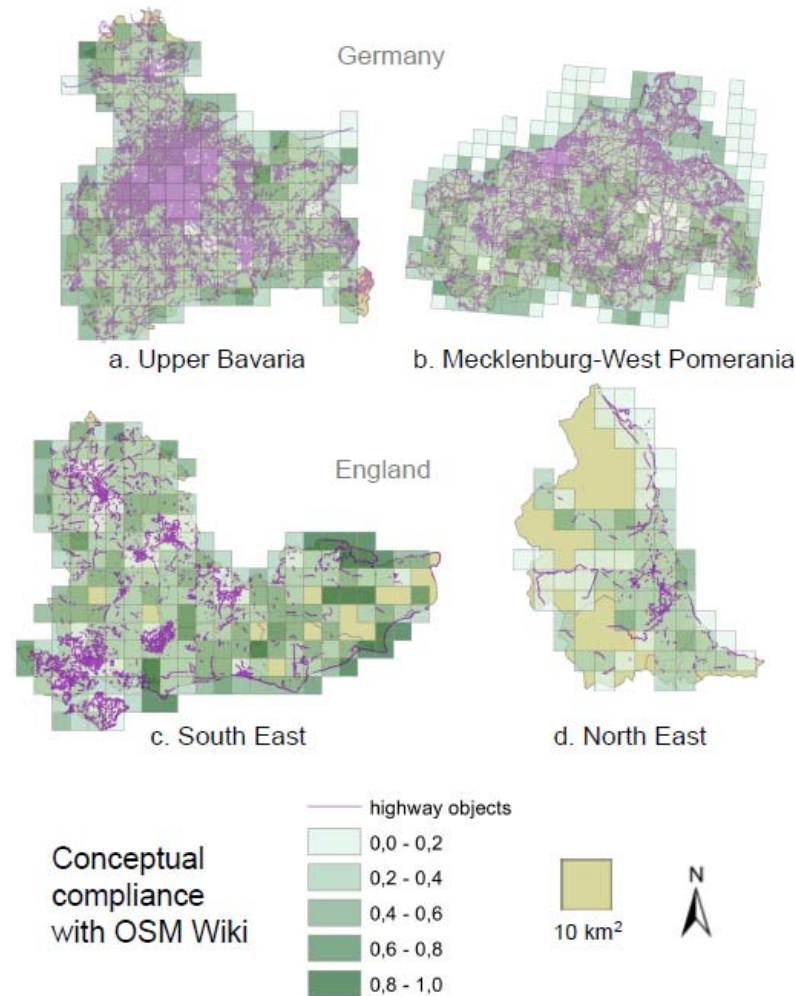
Germany

a. Upper Bavaria   b. Mecklenburg-West Pomerania

England

c. South East   d. North East

Ballatore A., Zipf A., 2015. A Conceptual Quality Framework for Volunteered Geographic Information. International Workshop on Spatial Information Theory, October 2015
DOI: 10.1007/978-3-319-23374-1_5

Conceptual compliance with OSM Wiki

— highway objects

- 0,0 - 0,2
- 0,2 - 0,4
- 0,4 - 0,6
- 0,6 - 0,8
- 0,8 - 1,0

10 km²

N

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Professional Quality Framework
vs. VGI Data Indicators Domain

- Positional accuracy

- Temporal accuracy

- Thematic accuracy

- Logical consistency

- Completeness

- Usability

Geographic information — Data quality (ISO 19157:2013)
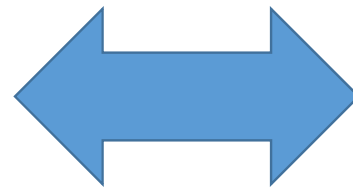
- Accuracy

- Granularity

- Completeness

- Consistency

- Compliance

- Richness

Ballatore A., Zipf A., 2015. A Conceptual Quality Framework for Volunteered Geographic Information.

VGI for Land Administration

Figure 1: Observation of an area (left, orthophoto) and cadastral data of the same area (right)

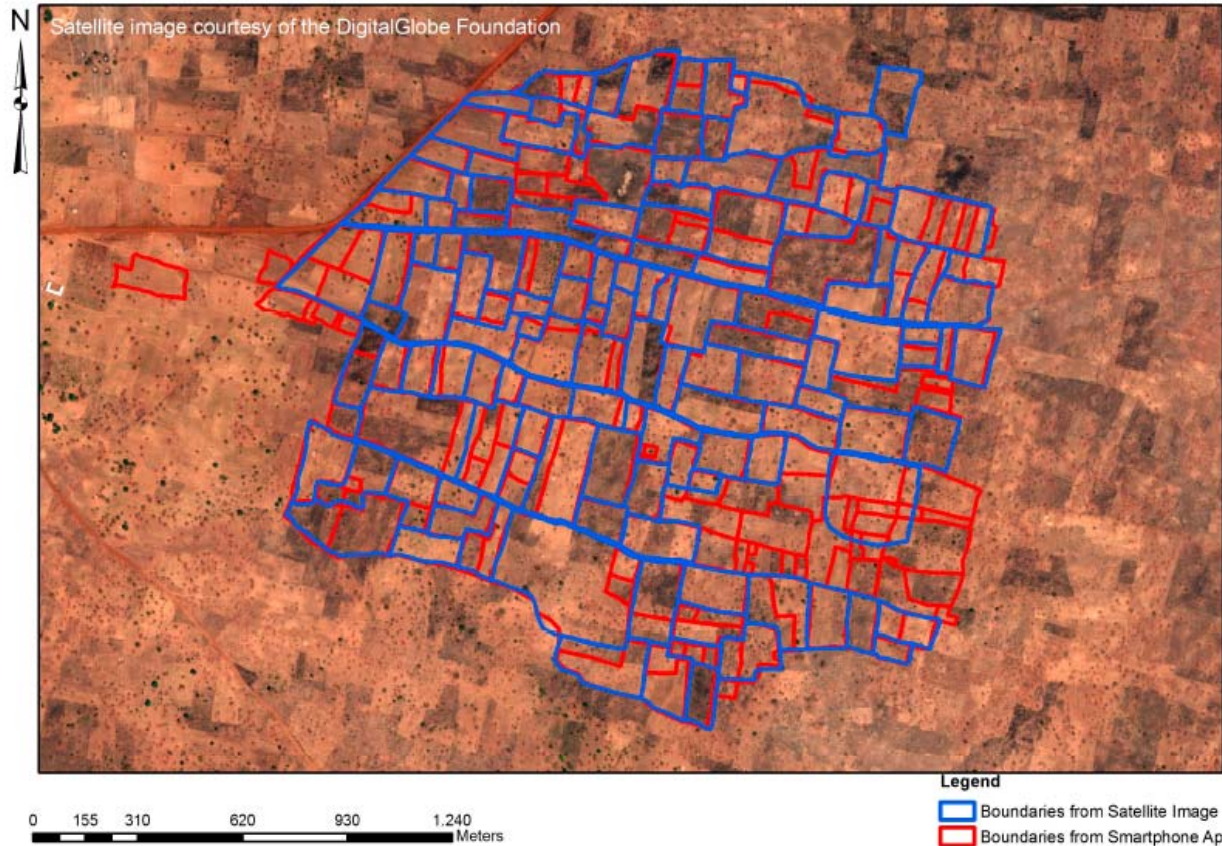# Participatory Land Administration, Ghana, Conceptional Framework
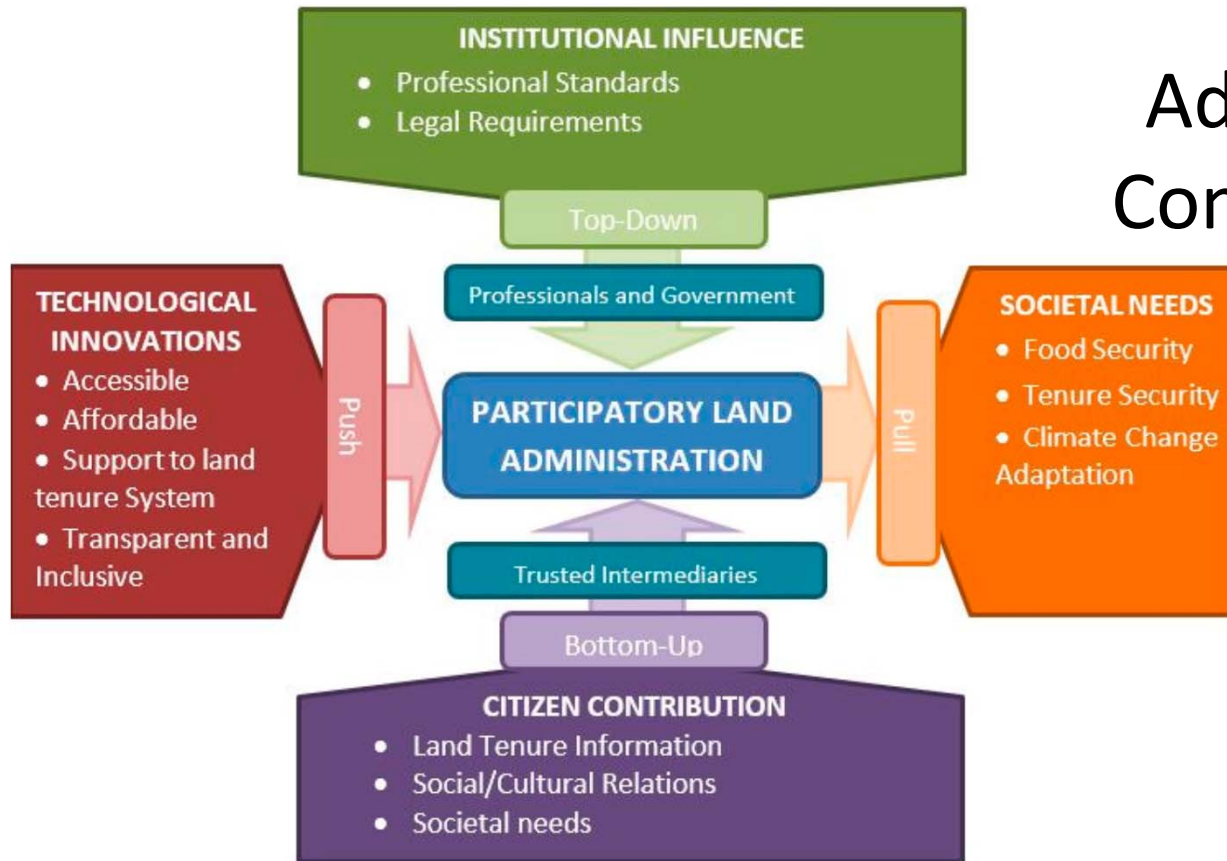
Asiama K., Bennett R. and Zevenbergen J., 2017. Participatory Land Administration on Customary Lands: A Practical VGI Experiment in Nanton, Ghana. International Journal of Geoinformation,6,1–22.
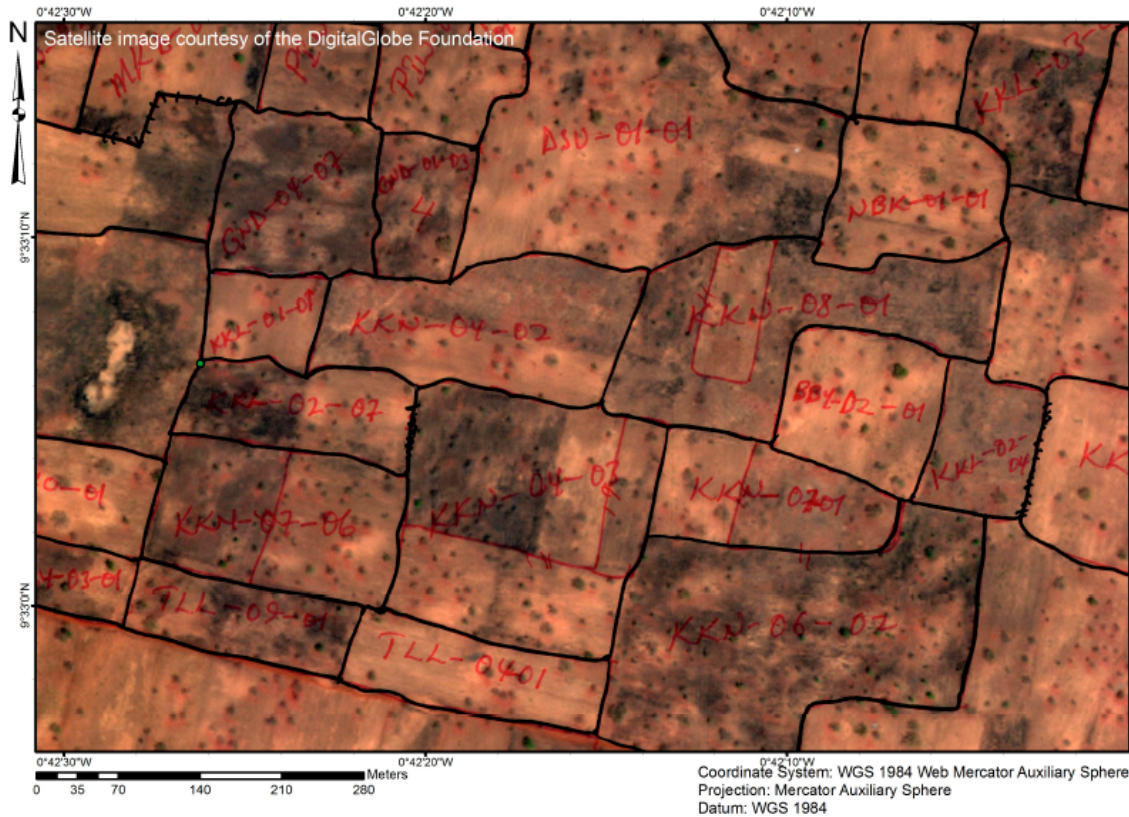
Participatory Land Administration, Ghana, Role of Trusted Intermediaries

Figure 3. Part of the satellite image from the farm parcel identification showing Red Lines that are parcels identified by farmers and Black lines being parcels verified by the Trusted Intermediaries.

Asiama K., Bennett R. and Zevenbergen J., 2017. Participatory Land Administration on Customary Lands: A Practical VGI Experiment in Nanton, Ghana. International Journal of Geoinformation,6,1–22.

Figure 4. Parcels boundaries collected by Satellite Image (Blue) and Mobile App (Red).
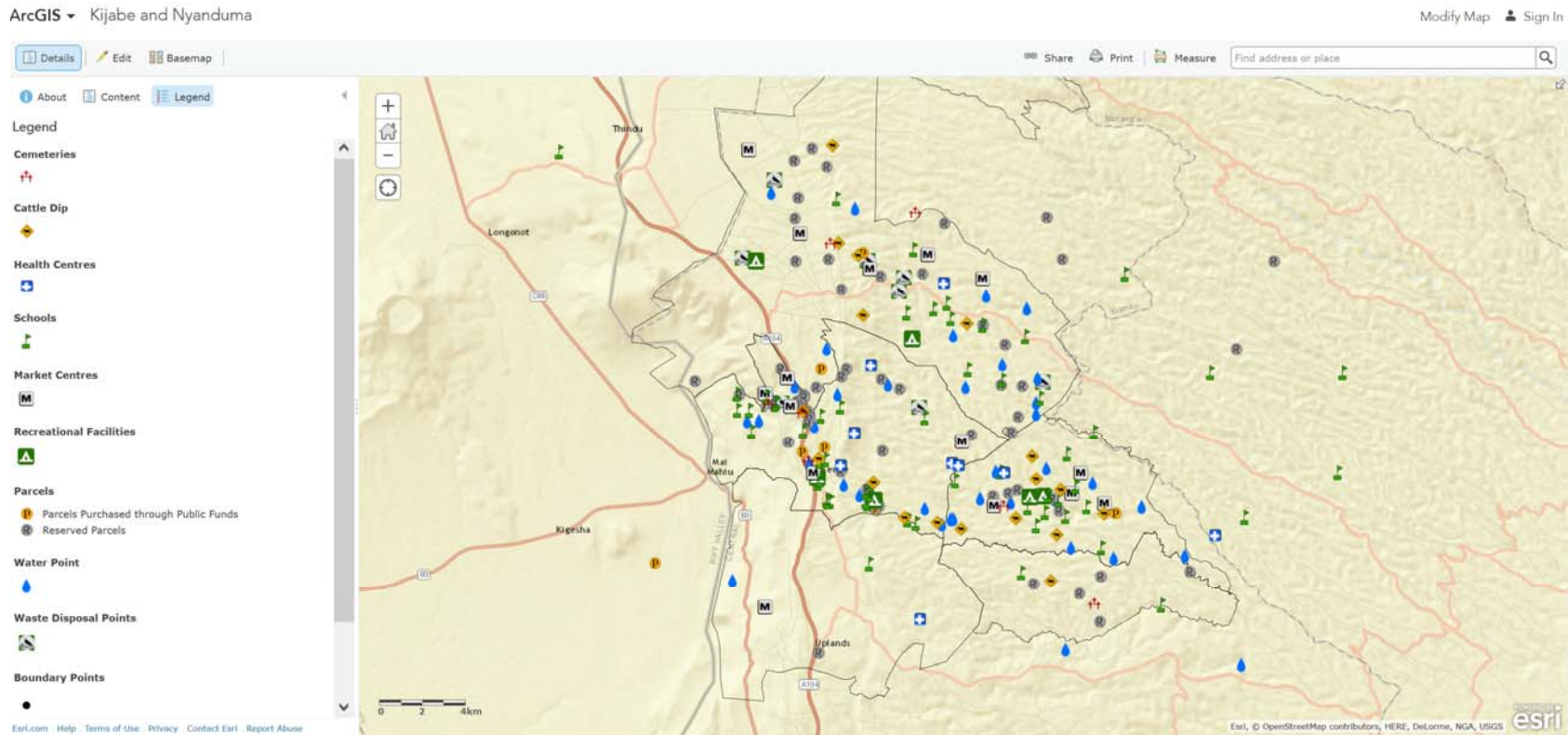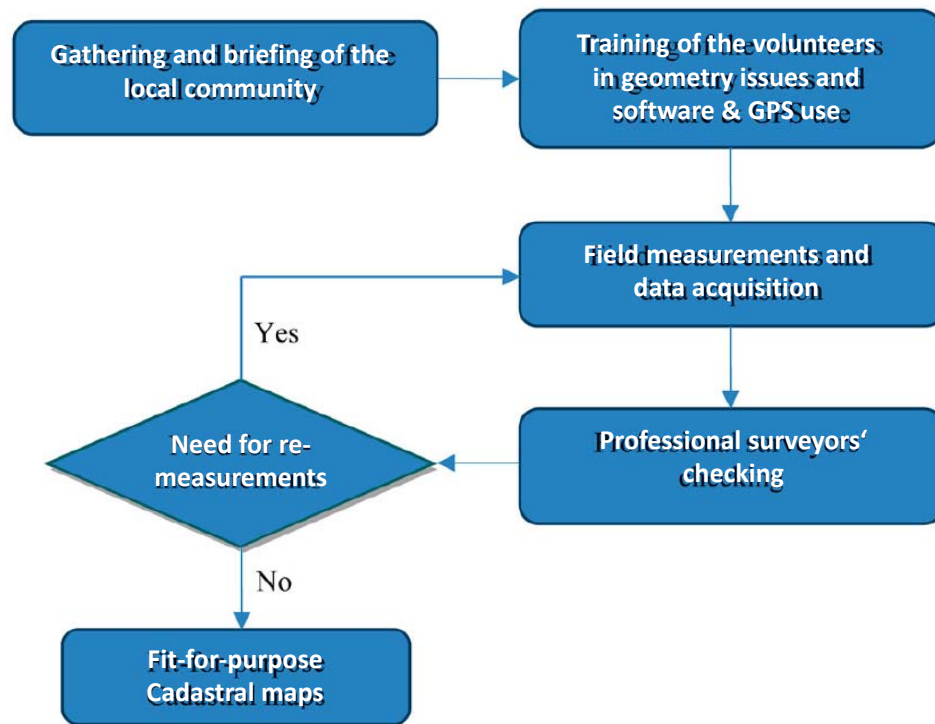
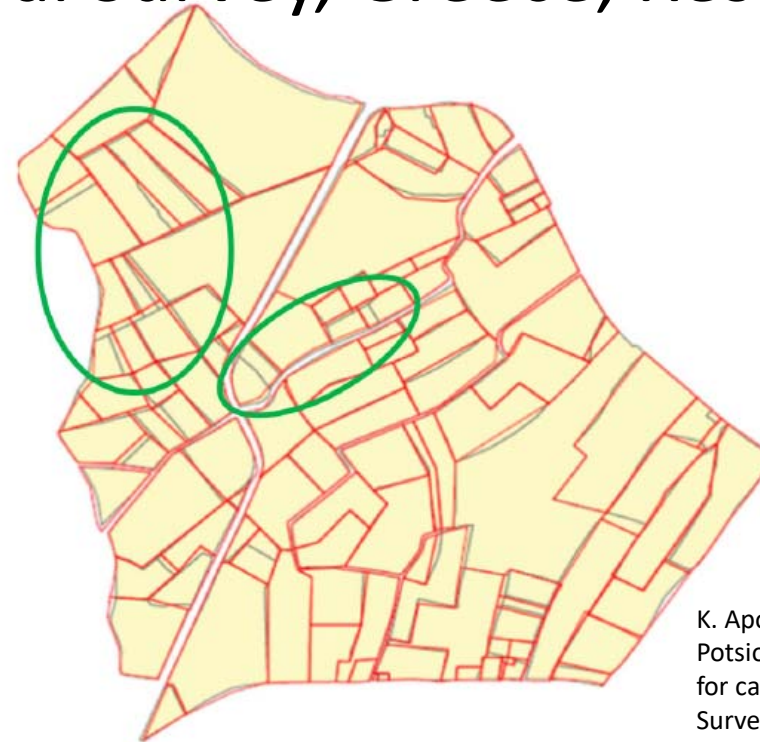# Participatory Land Administration, Ghana, Boundaries Satellite vs. Mobile App

Asiama K., Bennett R. and Zevenbergen J., 2017. Participatory Land Administration on Customary Lands: A Practical VGI Experiment in Nanton, Ghana. International Journal of Geoinformation,6,1–22.

Case Study Public Land Inventory, Kenya

http://www.arcgis.com/home/webmap/viewer.html?webmap=a57e0906be4d46e99fbc2bd4d6b5df2d

Case Study Cadastral Survey, Greece, Methodology

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K. Apostolopoulos, M. Geli, P. Petrelli, C. Potsiou & C. Ioannidis (2018) A new model for cadastral surveying using crowdsourcing, Survey Review, 50:359, 122-133, DOI: 10.1080/00396265.2016.1253522

Case Study Cadastral Survey, Greece, Results

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11 Left: digitised parcels in Panayiouda, Lesvos Island. Right: comparison between the polygons digitised by the volunteers (in red) and by surveyors (in blue)

Conclusions

Volunteered Geographic Information VGI, a serious player in generating mapping and GI databases

National Mapping Agencies NMA's top down vs. VGI's bottom up approach

VGI Quality Management System still to be further developed

Incorporating VGI and Crowdsourcing into NMA's production still an open subject