Shifting Boundaries of Volunteered Geographic Information Systems and Modalities: Learning from PGIS

Michael K. McCall[1]

National Autonomous University of Mexico (UNAM), Centre for Research in Environmental Geography (CIGA), CP 58190. Morelia, Michoacan, Mexico. Tel (443) 322-38-79 Fax (443) 322-38-80
University of Twente, Faculty of Geo-Information Science and Earth Observation – ITC, P.O. Box 217, 7500AE Enschede, The Netherlands
mccall@ciga.unam.mx

Javier Martinez

University of Twente, Faculty of Geo-Information Science and Earth Observation – ITC, P.O. Box 217, 7500AE Enschede, The Netherlands

Jeroen Verplanke

University of Twente, Faculty of Geo-Information Science and Earth Observation – ITC, P.O. Box 217, 7500AE Enschede, The Netherlands

Abstract

This paper develops a framework for assessing how Volunteered Geographical Information (VGI)[2] systems, modalities and practices perform, as measured against principles of good governance and participation; the framework is applied to two case studies. From this, we argue for a shift towards recognising, valuing and incorporating into VGI, the values of participatory processes which are the essence of PGIS (Participatory GIS). We firstly over-view the current range of handling citizen's local (spatial) knowledge in VGI by identifying two foundational drivers, which are: the recognition of the value of vulgar local knowledge, and the acceleration of cyberspace communication capacities. Section 2 analyses VGI modalities and systems in terms of their characteristics and practices, in a frame of good governance principles and participatory process. In Section 3 this analytical framework is used in evaluating two specific cases in terms of governance and participation principles and practice. The paper concludes with needs and challenges about shifting the boundaries of VGI towards a deeper, more participatory construct of 'vulgar grounded intelligence'.

Introduction

Innovative VGI platforms (internet and GIS-enabled fixed and mobile devices, such as Smartphones), and the ubiquity of free-to-use Web maps and Virtual Globes have created enormous potential for cheap, simple tools to acquire, analyse and present spatial information from individual and community viewpoints. The ultra-rapid growth in the quantity, speed and breadth of information produced by the public, beyond the formal and informal regulations of structured organizations, is producing two structural fault lines.

On one hand, it is putting institutional embedded expert knowledge under operational performance, political, and ethical pressures. People are no longer 'civilians' - passive consumers. Policy-makers, politicians and researchers are increasingly recognising that a richer understanding of local people's accumulated knowledge of their local physical and social environmental conditions, such as their vulnerabilities and capacities, is essential.

On the other hand, it is undermining the perceived value and appreciated benefits of the participatory spatial knowledge which is acquired through slow, small-scale, limited, collaborative practices of PGIS (Participatory GIS) or social mapping. Volunteered Geographical Information (VGI) is generating so much information so fast and so cheaply, that the careful, considered and accepted steps of PGIS approaches are over-ridden and seen as uncompetitive.

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[2] Without a consensus on a suitable overarching term for the set of approaches, systems, and modalities for acquiring citizens' local (spatial) knowledge, we use the term VGI to also incorporate relevant UGC (user-generated content) systems.

But the basic suppositions of PGIS remain valid: local people know the variability and dynamics in the environmental and socioeconomic situations of their areas. Local people have both historical experience and contemporaneous knowledge, they understand subtleties of people's behaviour and local cultural and institutional structures, and they work out mechanisms for resilience and coping. Local people specifically have local spatial knowledge.

The motivations behind this paper are: to understand better where VGI fits into handling 'local spatial knowledge' (LSK) based on the drivers and structure of working with citizens' knowledge inputs, to propose an approach for evaluating how VGI practices and their operational characteristics relate to participation and good governance principles, and to apply that approach to two case studies. Finally, we consider a convergence from VGI as 'volunteered geographic information' towards a deeper, more participatory construct of VGI as 'vulgar grounded intelligence'.

Handling Citizens' Local Spatial Knowledge

Two Drivers – People Power meets Cyberspace

There are two deep drivers of the VGI explosion, which have developed separately, but also are intertwined. The first is the critical drive for more of people's participation in planning, design, policy, and, everything. A direct consequence of this is that recognition, value and social significance are gradually being accorded to lay people's phenomenological and technical knowledge. This popular 'vulgar knowledge' formation and usage is an alternative knowledge which is usually critical and therefore often in conflict with authoritative information. (It is not necessarily spatial information). Overarching conceptualisations contained in this drive are UGC (user-generated content), VCI (volunteered citizens' information), and citizen journalism – although these are not necessarily driven by 'scientific' knowledge. Through their Citizen Science activities and Citizen Observatories (McGlade 2009), people's participation and vulgar knowledge may bring them into epistemological and political conflict with established science.

The second driver comes from the rapid technological advances in handling, dissecting and utilising geospatial information in GI science and technology. The term 'WebGIS' summarises the broader social and cultural implications of what are specifically technical extensions of conventional GIS technologies and systems, such as: mash-ups, dynamic GIS, Cybercartography, geotagging, and locative media. These all have broad implications for knowledge frames in Citizen Science and other UGC.

The two drivers come together in an array of approaches, activities and methods which are shaping the geospatial face of citizen science. They deal with the generation, management, and visualisation of popular, local information and understanding which is essentially geospatial, that is, 'local spatial knowledge' (LSK). These approaches and activities are to varying degrees, participatory,

critical and subversive. PGIS and participatory / social mapping which are both well-established, as well as Qualitative GIS, are more participatory and more critical, whereas VGI and HSW (Human Sensor Webs) which form the focus of this paper, are less participatory and less critical.

Shifting Authoritative Information: 'Citizen Science' and People's Participation

At the level of conceptualization of alternative knowledge formation, the proto-concepts behind VGI in this paper include: Citizen Science (Cohn 2008; Silvertown 2009; Haklay 2012) and Crowdsourcing (Howe, 2006; Elwood & Leszczynski 2012)[3]; though these two are not necessarily dealing with spatial knowledge. These conceptualizations of knowledge formation and usage are critical and alternative, and often in conflict with authoritative information. However the growing demands for public engagement in participation, and the realisation by professionals that the public can provide knowledge, labour, skills, computing power and even funding, have led to the concept and reality of citizen science projects (Silvertown 2009; Cohn 2008).

The Internet as a global infrastructure has enabled a reincarnation of *Citizen Science*. Innovative projects utilise the abilities of personal computers, GPS receivers, mobile phones and other personal e-devices to double as scientific instruments. This type of citizen science is sometimes termed 'citizen cyber science' (Grey 2009); within it can be identified three sub-categories: volunteered computing, volunteered thinking and participatory sensing (Haklay 2012). In volunteered computing, non-specialists – the volunteering citizens - participate in collaborative data collection and analysis. A pioneering project was SETI@Home which harnessed the idle computing time of millions of participants in the search for extra-terrestrial life; similarly with modelling of malaria epidemiology by Malariacontrol.net[4] [5]. An essential of volunteered knowledge production is that people are not just passive sensors, but active participants in checking, assessing or commenting on scientific observations' for example the observation and classification by volunteers of galaxies and 'habitable' planets circling stars, such as in Galaxy Zoo[6] with its celebrity volunteer Hanny van Arkel[7]. Participatory sensing is the broadest category; for example, citizen scientists make detailed observations of the natural world, as in the long-running Audubon Society's Christmas Bird Count[8], now in its 114th year.

Crowdsourcing is usually considered as voluntary, participative and mutually-rewarding. "The undertaking of the task, of variable complexity and

[3] Citizen journalism and blogs and Citizen Observatories would also belong under this category, but are not analysed here.
[4] NOTE: all web references accessed in August 2013.
[5] http://www.malariacontrol.net/
[6] http://www.galaxyzoo.org/
[7] http://www.hannysvoorwerp.com/
[8] http://birds.audubon.org/christmas-bird-coun t

modularity, and in which the crowd should participate bringing their work, money, knowledge and/or experience, always entails mutual benefit" (Estellés Arolas & Ladrón-de-Guevara 2012: 9; c.f. Elwood & Leszczynski 2012; Vivacqua and Borges 2012). Crowdsourcing covers a variety of actual modalities and practices, but not all are highly voluntary beyond the initial accordance to join a platform. Some crowdsourcing activities are highly intensive, calling upon time and effort inputs from dedicated volunteers, but others are not. Crowdsourcing may be dealing with specifically spatial information such as OpenStreetMap[9] (OSM), or it may be non-spatial.

Adding Location – GIS and geo-referencing in the Web

This topic deals with the specifically GIS technologies and systems using Web powers and functionalities, such as map mash-ups, WebGIS, cloud based GIS, and 'locative media' (e.g. Thielmann 2010; Baud et al. 2011; Pfeffer et al 2013) - all of these have broad implications for Citizen Science. It is not helpful to categorise these entirely as being non-participatory; however, they mainly function at low intensities of participation compared with the intertwined approaches.[10]

The term *WebGIS* refers to a GIS developed specifically for the Web, and differing from traditional GIS for the specific purposes of communication and information sharing with other users in real time, as exemplified by WebGIS sites for location maps or street maps online, like the popular Google Maps, OpenStreetMap and associated Walking Paper maps[11], or Bing! Maps. "Web GIS is similar to web mapping but with an emphasis on analysis, processing of project specific geodata and exploratory aspects" (Leroux 2011).

Standing out among many geospatial applications in Web 2.0 are *Google Earth* and its currently thousands of *mash-ups* on Google Maps (Google My Maps). The strong technical basis of Google Earth allows all kinds of information to be uploaded on the Google image, including captions, photo images, videos, sound, links, and metadata which can all be geotagged or geo-referenced[12] [13] (Miller 2006; Goodchild 2007a; Bugs et al 2010) *Wikimapia* supports specialised place descriptions in about 90 languages including Anglo Saxon, and there are the geotagged entries in Wikipedia[14].

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[9] http://www.openstreetmap.org

[10] An expression of this approach designed to be more participatory, is Cybercartography, (coined by Fraser Taylor 1997), defined as "The organization, presentation, analysis and communication of spatially referenced information on a wide variety of topics of interest and use to society in an interactive, dynamic, multimedia, multisensory and multidisciplinary format" (Fraser Taylor 2003, 406).

[11] http://walking-papers.org/

[12] Google Earth Mashups http://googlemapsmania.blogspot.com/ , and Google Earth hacks website www.gearthhacks.com

[13] http://maps.google.com/support/bin/answer.py?hl=en&answer=62843

[14] http://wikimapia.org/wiki/Main_Page ; http://blog.wikimapia.org /

Similarly, the *OpenStreetMap* (OSM) project is reaching to cover the whole world with local inputs of 'crowdsourced' volunteered spatial information (Goodchild 2007a, 2008, 2009; Tulloch 2007, 2008; Rouse et al. 2007; Haklay & Weber 2008) in a free editable map data repository, for instance, with Mapping Parties[15]. This type of crowdsourcing is special because it is voluntary, dedicated and demands a big time resource from the volunteer participants. "A growing sentiment of the crowdsource community, at least within this mapping sector, is that this group is out to create value for the common good. They are willing to share their hours of hard work for a mission that vests them in a creation that they can be proud of" (Ball 2010) (See also Heipke 2010).

The billions of bits of information embodied in social networking sites like *Facebook* and *Twitter* may not yet be geo-referenced, but they will be, and this will mega-multiply the geo-information explosion overload and all the locational-ethical issues below (Elwood 2009). *Flickr* already has hundreds of millions of geo-tagged photos uploaded by ordinary people[16], and consider the impact of social media maps[17], and Twitter GeoAPI, Twitter maps[18] and Tweetscapes.

Adding Criticality to Geo-Spatial Knowledge

In these critical approaches, the drive for more participation and 'citizen science' stocks of rich local knowledge, especially local spatial knowledge, fuse with the new GIS and Web capabilities to respond to users (Baud et al. 2011; Pfeffer et al. 2013). Our review focuses on these activities, modalities and methods which are dealing with the generation and management of local spatial information and knowledge. They are, to varying degrees, participatory, critical, diverse and subversive. They include conceptual bases and methodologies as with: GIS/2, Neogeography, Qualitative GIS, and PGIS.

An early name for these approaches was *GIS/2* (Schroeder 1996), given as a set of methods and instruments emphasising participatory process (of a GIS activity) and oriented towards communication about representations, as much as toward the representations themselves. GIS/2 should emphasise the role of participants in creating and evaluating data and it should aim to equitably represent diverse views, preserve contradictions, inconsistencies and disputes, and, be more dynamic. Outputs of GIS/2 should reflect the standards and goals of the participants and be reflexive, rather than privilege the closeness of fit to measures of spatial accuracy.

The concept of *Neogeography* "is about people using and creating their own maps, on their own terms and by combining elements of an existing toolset. Neogeography is about sharing location information with friends and visitors,

[15] http://wiki.openstreetmap.org/wiki/Mapping_parties
[16] (160,216,588 geotagged items as of 17.9.2011). http://www.flickr.com/groups/geotagging/
[17] http://blogs.esri.com/esri/arcgis/2011/08/26/social-media-hurricane-irene-map/
[18] http://blogs.esri.com/esri/arcgis/2011/05/02/tweet-mapping-template/

helping shape context, and conveying understanding through knowledge of place". (Turner 2006: 2-3). Thus, Turner's neogeography appears very similar to some interpretations of PGIS. Neogeography allows for a wide range of tools, methods and deliveries that use spatial information, and it opposes, though it may also complement, professionals' use of what Sui & DeLyser (2012) call "paleogeography". It is not necessarily standard GIS-based, and there is a generously broad interpretation of both 'spatial' and of 'information'. Roche (2010: 6) called this the development of the "geospatial democratisation process", which he breaks into four 'dimensions': new types of information, new technologies and standards (Web 2.0, wikis), new "user-creators", and, new forms of materialisation like VGI, geoblogs, geo-wikis, geo-tagging, or mashups.

The same arguments are made for the approach of *Qualitative GIS* (Cope & Elwood 2009), though with more emphasis laid on criticality and positionality. Qualitative GIS is intended to bring political dimensions to the fore, to critically assess the multiplicity of spatial representations and significations, such as through *counter-mapping*, and to challenge hegemonic power settings and interrelations, such as by reflecting a feminist stance.

PGIS, initially a merger of Participatory Learning and Action methods with geographic information technologies, is by now an emergent practice in its own right with forceful emphases on active local participation, on LSK, on local ownership of PGIS products, and on pushing for local empowerment.

[P]*PGIS* refers to the uses and applications of geo-spatial information (GI) and/or GIS technology used by members of the public, individually or as grassroots groups, for participation in public processes that affect their lives (data collection, mapping, analysis, and/or decision-making) (Tulloch 2003; Tulloch & Shapiro 2003).

PGIS aims to represent local people's spatial knowledge by map products that can facilitate participatory decision-making processes and support communication and community advocacy. PGIS practice is geared towards community empowerment through tailored, demand-driven and user-friendly applications of these geospatial technologies. Good practice in PGIS is flexible and adapts to different socio-cultural and biophysical environments, relying on the combination of 'expert' skills with local knowledge. In contrast to traditional GIS applications, PGIS places the control on access and use of culturally sensitive spatial data in the hands of the communities who generate it (Rambaldi, Kyem et al. 2006).

Most PGIS activities are deliberately local and small-scale, but examples of a global reach are the multi-lingual PPGIS discussion and information forum[19]; and

[19] 'Open Forum on Participatory Geographic Information Systems and Technologies' www.ppgis.net

the Green Maps project[20] which handles LSK with volunteers and NGOs making counter maps in hundreds of cities worldwide devoted to issues usually overlooked by municipal authorities and official maps, such as urban safety and women's security, child-friendly spaces, greenness and bikeability.

Where does VGI fit?

The acquisition techniques of VGI and of HSW ('human sensor webs') have flourished with the unforeseen global proliferation of cell phones and the internet. We address HSW first.

A *human sensor web* is an assembly of publicly available Web services which people with mobile phones ('human sensors') use to report and publicise issues and share information (Georgiadou et al. 2011). Water, electricity and urban transportation networks contain a multitude of electronic sensors recording parameters continuously or on demand, accessed remotely or physically. The human sensor can be considered as equivalent to this network, allowing operators to use them as collectors of quantitative and qualitative parameters. Human sensors enable their mobile devices (phones or tablet computers) to record these parameters, actively - when encountering an event or by allowing third parties to use their devices for sensor measurements, or passively - if the mobile device enters an active monitoring network. HSW is thus positioned between the open ended VGI and the more focused Participatory Sensing (Burke et al. 2006; Verplanke et al. 2010). In HSW, (see Case 2 below: HSW project, Zanzibar), the supplier of the content is "volunteering" to generate content with limited degrees of freedom; and with crowdsourcing techniques (participatory sensing), the task and purpose of collecting information are usually even more explicitly indicated to the user.

HSW should be distinguished from techniques that "silently" collect user (locational) information. These are termed *Web scraping* (or its more obfuscatory name 'Web harvesting/mining'), opportunistic sensing, and mobile phone tracking. There is more locational and time-registerable information in the data extraction of credit cards (application forms or history) and online purchasing by Amazon, Facebook, or Google+[21], and yet more in involuntary CCTV footage and in the data mining of the NSA and GCHQ, as the revelations of Edward Snowden[22] confirm.

The current technology of Web and cellphone services provides rich, abundant, high-frequency flows of geographic and geo-referenced volunteered information. *Volunteered Geographic Information (VGI)* is the harnessing of tools to create, assemble, and disseminate geographic data provided voluntarily by

[20] http://www.greenmaps.org

[21] E.g. Forbes story, 2/16/2012 @ 11:02AM "How Target figured out a teen girl was pregnant before her father did".

[22] Greenwald et al. (June 10, 2013). "Edward Snowden: the whistleblower behind the NSA surveillance revelations". The Guardian (London).

individuals (Goodchild 2007a, 2007b, 2008, 2009, 2010; Tulloch 2008; Elwood 2008a 2008b; Gouveia & Fonseca 2008; Leszczynski 2010; Roche 2010; Goodchild & Glennon 2010; Budhathoki et al. 2010; McCall 2011; Haklay 2012; Elwood & Leszczynski 2012; Sui & DeLyser 2012; Sui, Elwood, et al. 2012). This volunteered spatial information can be disseminated on the internet in e.g. My Maps, Wikimapia or OSM. VGI sites provide general base map information and allow users to create their own content by marking locations where events occur or certain features exist, but are not already shown on the base map.

Ushahidi[23] is a widely-accepted VGI platform, originally developed in Kenya for monitoring election political and ethnic violence, now having scores of applications worldwide. (e.g. Okolloh 2009; Meier 2010; Berdou 2012). FrontLineSMS[24], originating in South Africa, has functioned in many countries in health, agricultural marketing, post-disaster, and political elections among other applications. (e.g. Freifeld et al. 2010; McGee & Gow 2012) [25]

VGI is a special case, geospatial in nature, of the larger Web phenomenon of UGC and Web 2.0. It is associated with aspects of geographical Citizen Science and geo-referencing on the Web (two sections above), and thus with GIS/2 and Neogeography,

But the position and status of VGI within the domain and principles of critical geo-spatial knowledge, is very contested. This is especially pertinent in relation to the degree of participatoriness of VGI. In this, it is significantly different from PGIS (Table 1).

Table 1. Is VGI participatory? Differences between VGI and PGIS

Participatory GIS	VGI
Small groups	Aggregation of individuals OR of small groups
High degree of participation	Low OR medium degree of participation
Two-way, multi-party interactive	No OR little interaction – likely to be one-way flow. Searchable
Transparent process - actors and their inputs are known and visible	Not transparent – actors are unknown, manipulation of actors' inputs is feasible
Trust is created over time, and by peer validisation	Creating Trust requires other forms of Validation
Small sample of people, usually selected by some criteria	Large sample of people but biased towards specific socio-economic groups (there is a "long tail effect" statistical distribution)
Low frequency of information flow. Slow response times	High to very high frequency. Fast response time, if needed

[23] http:// www.ushahidi.com
[24] http:// www.frontlinesms.com
[25] See also Avila et al. (2011) who examined over 100 projects globally which use new technologies aimed at increasing 'Transparency and Accountability'.

Huge time investment, slow, very slow [26]	Small time investment, fast
Normally voluntary, but …	Voluntary (voluntary at initiation, but can become more opportunistic)
.. it can be dominated by cliques	Difficult to dominate
Empowering on a small scale – generates confidence, capacity and satisfaction	Empowering – for society on a macro (political) scale, but not usually at the individual level
Richness and depth of information / knowledge	Unlikely to be rich and deep data / information
Explanation and understanding created	Description, and more amenable to statistical analysis

Source: this paper

The Framework - Characteristics of VGI Systems and Principles of Participation and Good Governance

To better understand VGI systems and activities we need to analyse them in terms of their characteristics and practices, and clarify what are the primary purposes and potentials. How and to what extent do the innovations in VGI systems meet the needs of citizens, governing institutions and private enterprise sectors? Are they 'fit for purpose' in terms of: dealing with reporting 'real space'?, in satisfying 'real actors demanding good governance'? (cf. Floreddu and Cabiddu's 2012 measures of satisfaction with participation), and in supporting societal development?

We develop a framework for assessing how VGI systems and actions perform, or can potentially perform, with respect to principles and measures of societal development and good governance criteria, including participation. The aim of developing such a framework is constructivist: towards a more appropriate matching of the many different VGI modalities with their different purposes, actor categories, and governance contexts.

'Good governance' principles have implications and messages for the analytical and operational characteristics of VGI. The functional challenge is to relate the governance categories to the VGI characteristics and indicators. We review nine pronounced analytical and operational characteristics of VGI activities, based on the extensive VGI literature (e.g. Goodchild 2007a, 2007b; Elwood 2008a 2008b; Tulloch 2008; Sui & DeLyser 2012; Adams 2012; Haklay 2012; Sui, Elwood, et al. 2012). These characteristics can be grouped under five headings of - Purpose of the VGI information flow, Characteristics of relationships, Characteristics of the providers, Characteristics of the messages and delivery, and

[26] The importance of 'slowness' can hardly be overstated. There is no substitute for spending time engaging and interacting with people to have any chance of effective trust and acceptance. (e.g. Sammy Musyoki of Map Kibera http://mapkibera.org/ interviewed in Berdou 2012).

Technological characteristics. (Summary, Table 2). These characteristics appear in, and shape, the VGI activities and approaches.

Purpose of the VGI Information Flow

Purpose is the single most important operational characteristic. The purpose of the VGI will always hugely influence the degrees of spatial precision and of cognitive precision needed, and the spatial and temporal scales employed, etc. The 'purpose' determines: Who benefits?, Who volunteers?, and the selection of procedures and processes and tools. The core question is of course, '*who* decides what is the purpose(s)?' (Rambaldi, Chambers et al. 2006).

The purposes do not easily fall into definitive broad categories, but we reviewed the gamut of applications of VGI (e.g. Goodchild 2007a, 2007b; Elwood 2008a, 2008 b; Gouveia & Fonseca 2008; Tulloch 2008; Goodchild & Glennon 2010; Resch et al. 2011; McCall 2011; Sui & DeLyser 2012; Adams 2012; Boulos et al. 2011; Haklay 2012; Sui, Elwood, et al. 2012) and identified the following significant categories of VGI purposes:

- Personal and social presentation ('vanity mapping').
- Cultural communication (this overlaps with the personal / social category).
- Consumption and marketing, which may be commercially sponsored or may be countered by consumers' rants.
- Environmental reporting on the quality of life (water, waste, air, noise). This is more common in urban areas; there is a small specialised focus on environmental and safety qualities for children.
- Grievance and complaints reporting about public spaces, services, nuisances, etc. (this overlaps with the category above).
- Transport has a significant share of environmental and grievance reporting.
- Security and personal safety, including urban safety and violence (often a gender issue); and disaster risk, such as water, pollution, fires, and weather events.
- Land and resource claims are significant, though currently a small share of VGI use[27] [28].

In relation to purpose, a distinction needs to be made between VGI systems which are the uni-directional provision of citizens' data and information 'upwards', and,

[27] This is changing - even national cadastral agencies are recognising the values of citizens' information for speed, timeliness, range, costs, local accuracy, local acceptability, etc. (RICS 2011)

[28] In VGI, land claims are commonly local or regional, but an example of VGI for national territories is 'Palestine remembered' (Wood & Quiquivix 2011)

systems which are interactive - whether these be only simple feedback, or, reciprocal dialogue flows. Pertinent examples of simple uni-directional platforms created to collect grievances and discontent are the platforms "Ipaidabribe.com" in India[29] and "fixmystreet.com" (global)[30], and platforms intended as citizen-on-citizen surveillance[31]. Interactive (two-way, reciprocal) platforms have been set up with the intention to facilitate the generation of collaborative solutions for which Patrick Meier of Ushahidi suggests the term 'crowdfeeding'[32] to imply returning aggregated and/or processed information back to the providers, e.g. Cidade Democrática[33].

E-grievance redressal systems are public feedback mechanisms with the characteristic that citizens' complaints to the authorities can be traced back (see 3.1 Mysore case).[34] Because of this characteristic, e-grievance redressal systems and public feedback mechanisms are considered by some as 'the key to increase transparency in e-government initiatives' (UNDP 2005). E-grievance redressal systems are also considered as a mechanism of accountability to citizens whenever citizens are encouraged to participate in service delivery (Cavill & Sohail 2004). They are usually presented as an opportunity to increase openness and transparency within the public administration, to support efficient (city) management, and to monitor effectiveness of responses (Wallack & Nadhamuni 2007: 9).

An important characteristic is the degree of *open-endedness / closedness* of the information flows between the actors who are acquiring and uploading information, and the actors at the destination of the messages. The flows may be in a *joint relationship*, - with a dedicated information flow for dedicated purposes, or they may be *mixed flows* – which are partially to dedicated receivers, and partly are free-flowing into the Webosphere. Furthermore, the flows may be uploaded into the free-flowing Web with a primary known purpose, or, they may be uploaded into the Web without any specified purpose.

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[29] http://www.ipaidabribe.com/

[30] http://www.fixmystreet.com/; http://reparaciudad.com/

[31] e.g. http://www.meldpuntmiddenenoosteuropeanen.nl/ was a controversial platform -already closed- set up by the Dutch right-wing political party PVV during 2012 to collect complaints about middle east Europeans.

[32] Crowd *feeding* may have the negative intonation of suggesting only selected feedback, or promoting dependency.

[33] http://www.cidadedemocratica.org.br

[34] Avila et al (2011, #7) found that the majority of 'transparency/accountability' projects are aimed at the executive or legislative branches of government, with a smaller number focusing on the judicial branch, or on media, private sector, or donors.

Characteristics of Relationships between Providers and Receivers

Power and Trust Relationships

The accelerating ability to easily generate masses of local data from a large population means that verification, validation and cross-checking of the exploding input material is a huge challenge. A major problem in VGI is the credibility of the information. Recipients, whether government institutions, NGOs, or communities, need to understand how and why information should be accepted as reliable before they work with it, and they need to assess the competences of the people who are the sources of the VGI.

Distinction must be made between: *volunteered* (a conscious choice, and known, activated and engaged) involvement – and thus, truly volunteered information; and *opportunistic* involvement. 'Opportunistic' involvement may be known-but-passive involvement (and therefore might be interpreted as 'voluntary'), or, it may be really 'opportunistic' which is involuntary (unconscious and unpermitted) involvement, as in the 'silent' capturing or harvesting of information from individuals. Therefore, *conscious transmission* should be included in the understanding and definition of volunteered information.

Beyond this, there is a range of degrees of 'voluntariness' in the process. This is analogous to analyses of the 'intensity' or degree of participation in social development processes, as in participation ladders. Much of 'volunteered citizen information' (and VGI) is not really 'voluntary' at all, it's just that the information suppliers haven't bothered to switch off or don't know what Google or Facebook are using them for.[35] Cell phone service providers are capable of doing plenty with triangulation, such as in supermarket shopping research to know where the marks are loitering. This is not voluntary at all, but it is very geo-precise.

The key value in this spatial information dilemma, as in others parts of life where we rely on other people's knowledge, is reciprocated trust. Academics trust peer review, local rural communities may trust traditional leaders and some NGOs, but rarely trust Government, (do they trust researchers?); mapmakers trust surveyors and satellite images; teenage tweeters trust peer review of cool places; customers too easily trust commercial Websites. How do NGOs or responsible planners know how to trust the volunteers in VGI? And how do volunteers in the community know they can trust that their uploaded delivered knowledge will be used safely, carefully and wisely? (Elwood 2008; Flanagin & Metzger 2008; Coleman et al. 2009; Sanvig Knudsen and Kahila 2012; Brown et al. 2013). Local communities commonly perceive authorities as too far away from their problems and do not expect useful help from them; and from the other side, the authorities believe that information collected from the locals is not sufficiently reliable

[35] "Right to be forgotten law": http://www.presseurop.eu/en/content/news-brief/1440901-right-be-forgotten-law-welcomed

The degree of *trust* required between giver agents and receiver agents depends on several issues. They include how symmetrical the power relations are, the *credibility* of the exchanged information, and the *reputation* of the volunteer who provides the information (the giver agent). Reputation is built upon the history of past interactions between the agents. The other party's "abilities and disposition" (Resnick et al. 2000: 46) are the features that reputations are based on. The 'reputation' is then used to estimate the risk of future interactions. Rambaldi points out that 'reputation' and thus 'accountability' and trust are immensely more transparent and immediate in a PGIS mapping or a P3DM situation than in a VGI – ".. [they] put your reputation at stake ..."[36].

Cross-checking VGI and HSW is an issue tackled by Laituri & Kodrich (2008), Flanagin & Metzger (2008), Goodchild & Glennon (2010), and White et al. (2010). Whether the 'Crowd Sourcing' in VGI results in 'Crowd Wisdom' or not, is part of the same debate as 'who is checking the information?', and 'how?'. As we contemplate massively more easily-accessible data, and much more real-time observations, we can no longer afford to rely solely on the authority of the academy and governing agents.

A few analysts have examined current mechanisms and the needs for stronger methods for determining acceptable-credible reputation in VGI and 'collaborative metadata' (see Maué 2007a, 2007b; Flanagin & Metzger 2008; Ball 2010; Haklay 2010; Berdou 2012; Elwood & Leszczynski 2012). Research shows that under appropriate conditions, VGI information can be trusted (accepted) as reliable (Haklay 2010; Haklay et al. 2010). In the Extreme Citizen Science (ExCiteS) approach, the usual Web-based GIS in which users view and analyse existing information becomes "WebPGIS", in which people can improve and update information as well as validate or review information made available by others.

Other approaches from the Web 2.0 world for VGI to learn from, are EBay's rating system, which is used to assess the credibility of auctioneers based on their reputation, and Wikipedia, with its extensive, endless peer reviews and a hierarchy of managers (Goodchild 2007, 2008; Rowley & Johnson 2013). CouchSurfing relies on a triple check – after the posting of self-description, the formal checking for validity of the email / name ownership, endorsements by known 'reliable' members (as with LinkedIn), and a follow-up questionnaire[37] (Rosen et al. 2011). The reliability/ trust assessment in CouchSurfing is claimed to be extremely effective, and this is for an activity which could expose people to real immediate dangers.

[36] Interview with Giacomo Rambaldi, 1.11.2011 in Berdou (2012, p.16)
[37] http://www.couchsurfing.org/about/safety/

Competing Values of Information.

The experience and settings of a VGI activity and its trajectory and eventual impacts are shaped by the value of the information which is being uploaded and consumed. But values are very different for different actors, and they are dynamic, responding to changing actor power relations and contexts. Maps and other GI products are dangerous weapons that can be employed progressively or regressively; note that Mapping for Indigenous Advocacy (2004) used the assertion "Maps are inseparable from the political and cultural contexts in which they are used" as their conference title. The ethical imperatives in PGIS are no less valid for VGI activities, including to ensure that vulnerable participants are not placed in any danger (Rambaldi, Chambers et al. 2006) and that FPIC principles are followed.

A measure of the value of information is the degree of effort made by actors to acquire the information, that is, to check, (to share), to upload, to re-check, and so on. But that is only a hedonic measure of the value. There are economic, cultural, group-social, and personal-emotional types of value of knowledge for the different actors. Further, the values of the information do not stand still to be measured, they are highly dynamic, responding to changing actor power relations and contexts. It is daunting to model the significance of the values as they are felt, but what we know is that the values attached to the information flowing in the VGI are a major determinant of the efforts that actors put into uploading, checking, validating, and using.

The ownership issues, that is, the ownership of the information / knowledge products are interrogations about value – 'for whom are the knowledge and the knowledge products valuable'? Ownership is closely related to issues of purpose (Rambaldi, Chambers, et al. 2006). The current and future status of the ownership of local (spatial) knowledge must be clear, taking into account for instance the liabilities for protection of indigenous (local) Intellectual Property Rights. In New Zealand, Maori communities devised various methods of protecting their ownership of, and access to, sensitive spatial information in a GIS set-up (Harmsworth 1998).

Characteristics of the Providers

Social, Cultural and Economic Characteristics

Who are considered as acceptable parties to collect data and knowledge and to share with the community (the local population), and with local government, NGOs, and external experts? Who are the 'volunteers' providing information? (Coleman et al. 2009). The types of actors likely to be engaged in a VGI activity are mainly determined by the purpose of the VGI activity, the relations of power and trust between the 'governing' and the 'governed' actors, and the types of participation which have been built into the platform, or which can be leveraged in.

The active and less active participants can range over the whole gamut of citizenry, but there are some generalisations. Any participation takes time and a variety of resources and skills, social and technical, as well as opportunity and motivation to enter and remain engaged. Access to the Internet and smartphones or other platforms for uploading, and some operational skills (cf. Goodchild & Glennon 2010) are pre-requisites. But access is becoming much less of a barrier, even in rural developing areas with limited Web networks and bandwidth, because cellphones and texting substitute for computers.

Other skills and resources are essential for people's involvement in VGI. Time is paramount among these, and some basic awareness of the phenomena in question – crime, hazards, social hotspots, the music scene, demonstrations, restaurants, bargain shopping, noise and pollution spots, traffic jams – whatever, (the range is limitless). Teenagers and 20-somethings have technical skills and energy, whereas the retired hold social skills of experience and judgement and have time. But the young will always be the more e-savvy whatever the technological innovations, so there is likely to be a perpetual bias in responses. The 'gender gap' in usage however, is shrinking fast.

The drive to participation in these processes should encompass government and service providers as well as NGOs and citizens. Avila et al (2011, #3) concluded that technology for 'transparency and accountability' projects were more likely to produce effective change when they collaborated with all parties.

There is a strand of concern whether VGI participants should be self-selecting or appointed. In discussing VGI for local hazards in Caucasus, worries were voiced that reports could be uploaded by tourists or youngsters with shallow local knowledge which would not represent local priorities. The conclusion was, it is better that 'volunteers' are selected and organised as in NGOs, rather than as uncontrolled uploaders (Spanu & McCall 2013). Similarly in Nairobi, Map Kibera[38] seeks 'bounded' crowdsourcing where the reports come from known and trusted individuals in the community (Berdou 2012)

Scale of Reporting Units

VGI output usually aggregates information upto the 'crowd' scale, depending on the purpose, so as to gain economies of scale and efficient cross-checking. There may be legal restrictions to the minimum scale of information outputs, or it may be technically infeasible to dis-aggregate them for further analysis. But what is highly significant for the operations and experiences of VGI is the original social scale at which the information was uploaded; in practice we are talking about whether it's at individual or household / family scale, or from community to larger scale.

[38] See http://mapkibera.org/

It makes a big difference to the actual content of the uploaded final messages and their validity or credibility, whether the final product (i.e. the delivered message) is the aggregated or averaged of individual readings or records, or, the uploaded information is already *a priori* created by group discussion. Group discussions create wholly different social processes of communication, because they incorporate both 'positive' and 'negative' discourse elements from the group-inspired debate, peer pressure, consensus formation and conflict generation.

A related issue is the aggregate size of the reporting population and the total number of reports coming in. A rationale of VGI of course is that it aggregates the observations and knowledge of a very large number of reporters; however this depends on the ability and skills of the VGI organisation to mobilise people. In Map Kibera for instance, there were two tiers of participation, an 'inner circle' of citizen-journalists who initiated, trained, supported, and then evaluated the in-coming information, and an 'outer circle' of occasional reports or eyewitnesses. (Okolloh 2009; Berdou 2012).

Degree of Spatial Precision

The degree of spatial precision called for, depends on the purposes of the VGI and on the expectations or demands of the different actors. The question becomes '*precision for whom?'*, for whom of the actors and to what ends? There are appropriate degrees of 'precision' for different mapping purposes for different actors. VGI does not include only precisely geo-referenced locations, but VGI should extend to natural language messages, saying, 'this is a nice bar / picnic spot / garbage dump', or 'this stretch of beach is too sandy', by adding perception of place. VGI however, as with conventional GIS, is open to the temptations of employing misleading, unnecessary 'false' precision, along with other seductions of sexy hi-tech visual appearances and obfuscatory statistical outputs (McCall 2006; McCall & Dunn 2012).

Characteristics of the Message and Delivery

Levels of Cognitive Precision (of the reported attributes in the messages)

The questions here are whether the messages concern: 'facts' and direct measurements, or opinions and preferences and value statements, or predictions and expectations, or perceptions? In practice, they are usually some combination of these. A significant issue also is whether the messages are recorded at the moment in time that something is observed or measured or felt; or, if they are based on historical recall.

Operationally in VGI platforms, as found in questionnaire design, there are distinctions between *'controlled'* formats, i.e. pre-specified sets of information messages for uploading, implying a limited range of information, and, *'open-ended'* formats allowing degrees of freedom in responses. This methodological issue of critiquing cognitive (content) precision (vis-a-vis positional precision) has been addressed more in PGIS debates than in the analysis of VGI. (see below). In

standard cartography and GIS the focus is on positional precision, whereas PGIS emphasises the understanding (precision) of the objects being portrayed, and thus their representational accuracy (Rundstrom 1990; Wood 1993; McCall 2006).

Timeliness, and Frequency of Reporting

A strong case for VGI is made by its technical and social capacities in the temporal dimension, the dynamics of the data stream, and the timeliness and currency of information. All geographic information deteriorates through time at varying rates between geological and wildfire speed, and fast acquisition of geographic information is critical to its value (and sometimes its accuracy) by maintaining the currency of information. Avila et al.'s (2011: 21) empirical cases showed that "A key element of successful technology for transparency and accountability efforts is their speed, both in execution and in stimulating change." Time-critical community mapping and information are needed especially during crises. "During emergencies time is of the essence, and the risks associated with volunteered information are often outweighed by the benefits of its use" for preparedness, response, recovery and mitigation (Goodchild & Glennon 2010: 231).

The Technological Choice

Roche (2010: 16) identified the geodata weaknesses of the VGI/virtual globe culture as its homogenisation and standardisation - for instance if Google API becomes "the unique way" to represent the earth, and the over-simplification of cartographic representation. There are also professional concerns about: data quality, the misuse and misinterpretation 'out of context', and non−expert spatial reasoning capabilities. There is a natural reluctance amongst professionals, whether geographers, cartographers, or spatial planners, to allow too much penetration into their professional worlds by 'civilians' or amateurs (e.g. Tulloch 2007, Goodchild 2007, 2008, 2009; Roche 2010), although there can be admiration also, e.g. Tulloch (2007) re CommonCensus.

There are two main issues here. The first reprises the characteristics relating to positional and representational precision. The choice of technology in VGI in part reflects the temptations to gild the lily with seductive fancy packaging, including unnecessary but visually impressive false precision of location. Avila et al. (2011, #5) have demonstrated that the technology of transparency and accountability tools do not have to be sophisticated, but they need to be designed intelligently with an eye towards local context.

Another issue is related to another aspect of trust, in this case, the balance of faith of VGI owners, designers and users between animate human sensors (reporters) and inanimate physical sensors (monitoring devices for water, air, noise, or remote sensing). If there are physical sensors, what is the role, if any, of human actors in managing and utilizing them? What is the role of community actors or observatories in the decisions to employ sensors, and in the technical selection?

The answers to these questions significantly affect the degree and type of participation of local actors in the whole process. (Francis et al. 2008)

Principles of Good Governance and Operational Characteristics of VGI

This section examines the nine operational characteristics of VGI above with respect to how they function in the context of 'good governance'. There is a plethora of theoretical commentary on social and political concepts in governance and critiques of the failure of good governance in many supposedly participatory processes (van Kersbergen & van Waarden 2001; Aubut 2004; Pan Suk Kim et al. 2005). There is no single acceptable definition of 'good governance'; however, the vagueness of its meaning is a reason why this term has such traction as a boundary concept - it conveys slightly different meanings depending on who uses it (Aubut 2004). Thus, good governance is both a process and an outcome – an emergent property of a complex system. Literature provides at least 25 named dimensions or characteristics of governance / good governance, among which the UNDP (1997) list is accessible and acceptable.

The core concepts of good governance which form the imperatives and basic principles are identifiable as follows (from: UNDP 1997; van Kersbergen & van Waarden 2001; McCall 2003; Aubut 2004; Pan Suk Kim et al. 2005; Béne & Neiland 2006; McCall & Dunn 2012).

1) Respect - for dignity of people and cultures, including respect for local vulgar knowledge and LSK; for rights and entitlements; and for localness and spatial grounding.

2) Equity - Human and gender rights; rights of social and cultural groups; and of future generations ('sustainable development').

3) Competence - Local manageability, efficiency and effectiveness in delivery, currency and learning, and appropriate cost.

4) Legitimacy - Lawfulness; participation; empowerment; ownership of products and process; trust and confidence.

Over and above these principles is that of:

5) Accountability, which can be expressed in terms of: transparency and visibility of government decisions and policies; accessibility; selection of accountability and lawfulness mechanisms; and responsiveness to lower levels.

In Table 2 the analytical and operational characteristics above are related to the five key principles of good governance. There is no simple 1-to-1 relationship between the operational characteristics and the five good governance principles and criteria. Each of the operational characteristics which are observable, concrete, and felt on the ground by people involved in a VGI, relate to several principles.

Table 2: Analytical Characteristics of VGI in relation to Governance Principles

	RESPECT for rights and entitlements	EQUITY	COMPETENCE	LEGITIMACY	ACCOUNTABILITY
1 PURPOSE					
1.1 Purpose of the Information Flow				✓	
2. CHARACTERISTICS OF RELATIONSHIPS					
2.1 Power and Trust Relationships	✓	✓		✓	✓
2.2 Values of the information (multiple views, local knowledge)	✓	✓			
3. CHARACTERISTICS OF THE PROVIDERS					
3.1 Social / Cultural / Economic characteristics of Reporting units		✓		✓	
3.2 Scale of reporting units [spatial grounding]	✓		✓		
3.3 Degree of Spatial Precision			✓		
4. CHARACTERISTICS OF THE MESSAGE and DELIVERY					
4.1 Levels of Cognitive Precision of Messages			✓		
4.2 Timeliness, Frequency of Reporting			✓		
5. TECHNOLOGY					
5.1 The Technological Choice	✓?	✓?	✓	✓?	✓?

Source: this paper

Case Studies: Mysore and Zanzibar

This section examines examples from Zanzibar and from Mysore and assesses how they measure up on the criteria of 'good governance'. It is a qualitative assessment based on a range of evidence and supporting stories.

Mysore, India: grievance and complaint reporting system

Mysore, the second largest city in the state of Karnataka (India) has a population approaching one million. The Mysore City Corporation initiated in 2008 a "Public Grievance Redressal System" to register and track public complaints via different channels (web, phone and paper). The system was developed by the Bangalore-based not-for-profit trust, eGovernments Foundation (MCC 2011; E-Governments Foundation 2011).

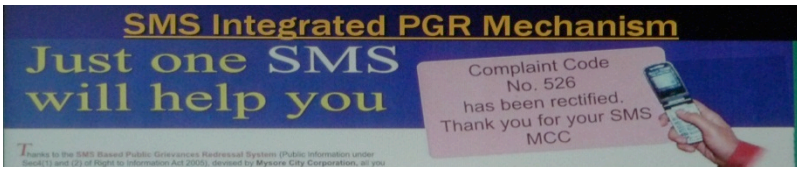


Figure 1a. "Just one SMS will help you" e-grievance redressal promotional folder.

Figure 1b. "24/7 control room" poster, e-grievance redressal control room, Mysore.

In the case of the Mysore e-grievance redressal systems the *purpose of the information flow* is very clear: complaint and grievance reporting. Until the Web system was implemented complaints were received in hard copy or via telephone. It is claimed by the Mysore City Corporation that the system is set to ensure timely redressal of the complaints. In this particular case the municipal corporation formulates the objective to produce reports to allow the identification of trends and patterns of location of problems (MCC 2011).

Considering the *relationships between providers and receivers,* the case of Mysore is voluntary and reciprocal, but unbalanced in terms of empowerment and legitimacy towards better-off areas and groups. A spatial analysis of the distribution of complaints for one calendar year (August 2008-2009) per ward shows that they are not concentrated in the most deprived areas (Miscione et al. 2012, unpublished); this coincides with analyses of complaints in other Indian cities (Martinez et al. 2011; van Teeffelen & Baud 2011). Some concerns may be raised in terms of equity, despite the system being open and not blocking anyone from participating. Some vulnerable and deprived groups might not actually participate, and the use of certain categories of complaints might stigmatize them, such as 'illegal water connections' or 'encroachments'. In terms of accountability, volunteers can trace complaints through a case number and identify the concentration of complaints in their ward. Reports of complaints are published

online and visualized in maps indicating ward-level concentrations of complaints (Figure 2).

Power and Trust Relationships are reflected in several aspects of the system. The local government is in line with a national push towards ICT and "e-governance" which legitimises the system. One expected output mentioned by the Mysore City Corporation is the "escalation of complaints to higher authorities" (MCC 2011). The system does not allow anonymity since the name of the volunteer and the address are required. It seems to be an asymmetrical power relation between volunteers since some categories of complaints imply citizen-on-citizen surveillance, such as 'illegal construction' or 'unhygienic eateries'. Nevertheless, other categories favour accountability by suggesting a citizen-on-government surveillance such as "demand for illegal gratification". It is unclear how this will affect the actual number of complaints submitted via the Web if anonymity is not guaranteed.

In terms of *values of the information,* the e-grievance system does allow for multiple views and incorporates local knowledge; however, it is likely to favour typical middle class values such as related to 'beautification ideals" and aversion for urban blight (encroachments, slums, hawkers, and beggars). Equity criteria are incorporated in the design since the forms are provided in English and Kannada.

The *social-cultural-economic characteristics of reporting units* can be understood by analysing the distribution of categories of complaints. The highest frequency of complaints (August 2008-2009) were topics reflecting typical concerns of better-off groups. The three most frequently mentioned complaints (82% of the total) were underground drainage blockages, street lights and garbage. Other complaints such as 'public toilet cleaning' are marginal (only 3 out of a total of 36619 complaints). Suggested categories in the Web forms such as 'encroachment in parks' which is listed under "horticulture", reflect similar values.

The *level of cognitive precision, the scale of reporting units and the degree of spatial precision* indicate the focus on competence found in the technical design of the system. The citizen who volunteers to submit a complaint is guided by a menu of categories with the option to specify a new category if is not included. The complaint is reported at individual level (the address of the volunteer is required), but the final spatial unit of the reports is aggregation at ward level.

Timeliness and frequency of reporting are characterized by an instant registration of the complaint (at the time that the volunteer decides to submit the complaint). However the map of the complaints aggregated at ward level is shown at a frequency of approximately a month.

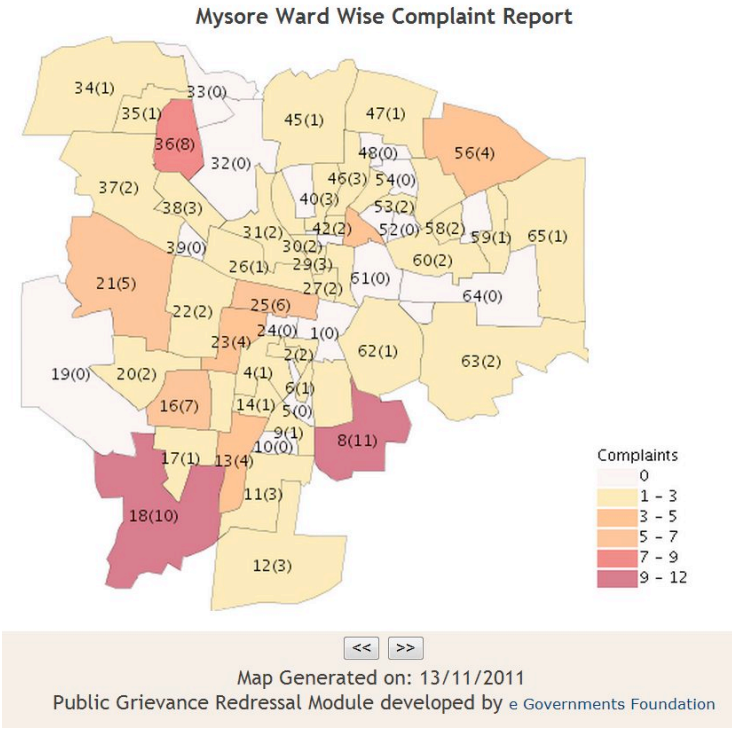


Figure 2. Map of complaints reported on 13/11/2011 (http://www.mysorecity.gov.in/pgr/grievance-redressal.jsp)

Zanzibar, a Human Sensor Web for public water service

Figure 3a. Example of signboard placed at each water point

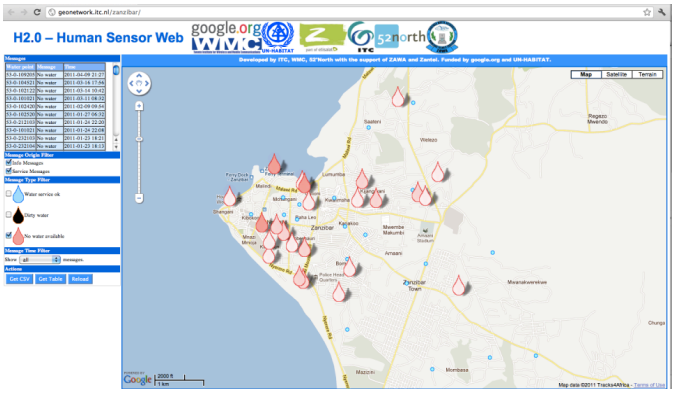


Figure 3b. Screenshot of the HSW user interface, publicly accessible on the Internet.

Under the h2.0 'Inform and Empower' initiative (UN-Habitat 2009) a research project was established to develop a Human Sensor Web for the collaborative generation and interoperable dissemination of well-defined water supply information. The purpose of this pilot project was to capture and assess the social, economic, cultural, institutional, political, and technical conditions required for a Human Sensor Web to function. The *purpose of the information flow* was to capture the functionality of 50 pre-selected public water points in Zanzibar Town, Tanzania.

In term of the contextualising *characteristics of the relationships*, the project unearthed a few of the many issues at play in the wider social-cultural setting of Unguja Island of Zanzibar. In the societal dimension a discrepancy appears between water collection and phone ownership (Sung 2010). In many parts of Unguja, it is women who collect water, but mainly men who possess phones. Leaving aside social and cultural gender implications of this 'digital divide', this caused problems for the data collection in HSW with direct consequences for the *timeliness and frequency of reporting*, because women who encountered a problem with the water service were unable to report it immediately. As a consequence they would report at a later time (back at home, or in the evening when the husband came home) when it was possible that water service had already been restored. Ndungu (2012) found this not to be the case however in urban parts of Unguja where phone ownership was more or less equal between men and women.

Power and Trust Relationships. It was found (Sung 2010; Yusra 2011) that there was little trust among people in the capacity of the local water authority to solve the water problems. Despite a long-running programme, the water authority was still facing image problems, probably tainted by years of bad service provision. People did not see the point of sending a message from which they did not expect to receive any responses. Two wider societal dimensions were also important for HSW. The local governance setting creates the specific situation that on Zanzibar the *Sheha* - the elected leaders of the smallest administrative units (10 to 20 households) - have significant influence. Traditionally the *Sheha* is approached when people encounter a problem with public services. This concept was not well understood when HSW was designed. If the Sheha were not favourable towards HSW, they would not motivate their constituents to file reports by SMS. Therefore the *Sheha* (totalling about 40) all needed to be included in the institutionalization efforts.

Another power/trust issue in Zanzibar is the way people interact socially. HSW was designed to record very short coded messages. In Zanzibari culture however, personal interaction is highly respectful and sensitive when approaching 'seniors' - officials and the elderly. People appeared to be reluctant to send a mere code without context or proper elaborate greetings to an unknown person (Sung 2010). This could lead to error messages when the system received SMS messages with long text strings that it could not interpret. The 'errors' in the message were actually due to the greetings and lengthy explanations of the problem in the context

of a specific water point. HSW was unable to deal with such data-rich text strings due to its design for automated response.

In terms of the *value of the information,* the physical setting of water provision on Zanzibar sets up another problem. The water infrastructure is limited and deficient, pipes are poor quality or too old, causing frequent breaks and leaks, and many are too low capacity. There are also electricity pumping failures, and therefore the piped water distribution is mostly intermittent. However, Zanzibaris have adapted to this situation of intermittent supply; although not liking it, people would accept the situation as a given because they had coping mechanisms (Sung 2010; Yusra 2011). A requirement for HSW to function properly is that people report all problems; however, at those times of day when water supply was not anyway expected, people would not feel the need to send a message. Thus although HSW did record situations when water service was worse than normal, it did not reflect whether or not the situation was unsatisfactory during the periods with no reports. An important lesson therefore, is that the HSW reporting system was monitoring felt needs, rather than service quality.

The *scale of reporting units and the degree of spatial precision* for the pilot design allowed for 50 of the available public water taps on the island to be included as fixed point locations for citizens' reports. At each of the 50 water points, a signboard was placed informing people about the project and asking them to report problems with water provision. SMS messages would be sent to a special phone number, requiring a specific code indicated on the signboard. Messages were relayed through a local internet provider and then uploaded on an online accessible map, which showed individual reports. The purpose of the map was to reflect points with more frequent reports and make them stand out. In terms of the captured *information flow* it was found however that the system does not capture functionality, but rather the need for public water services. Reports were predominantly made when the service had unexpectedly ceased and also during peak hours of domestic water needs. Although these seem obvious facts, the system did not record service failures that were not observed (e.g. night time service interruption). The system could therefore only properly be used to assess functionality of public water service if the active sensor network, which records water flows, would be included in the HSW.

A major component of this project was the development of an operational HSW prototype. *The technological choices* came from an emphasis on prototype development, with the consequence that the project design was mainly technology-driven. Major assumptions were that cell phone communications are already widely used in East Africa, and the anticipation that in the near future most people would have 'smart phone' capabilities.

Shifting the Boundaries of Volunteered Geographic Information Systems, Modalities and Practices

4.1 Analysing VGI and Governance

The current conceptualisation of VGI is imprecise and confusing. Therefore, first we looked again at VGI and associated UGC modalities, to identify the two foundational drivers: growing recognition of the value of vulgar knowledge, and the acceleration of cyberspace communication capacities.

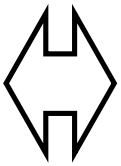
Then, we have developed a framework that assesses VGI performance and operational characteristics with respect to participation and good governance principles. By examining two case studies to assess how they measure up on the VGI framework, we see the complex local specificities in space, time and society that are embedded in any VGI practice, thus creating the need for converging with participatory knowledge processes, namely PGIS.

Key values and ethics in the modalities of practice must be addressed in order to assess VGI activities and extend VGI to a closer fit with the nature of participatory involvement. Seemingly simple, but profound, is the question of 'who volunteers to provide VGI information?' We identified a continuum from passive physical sensors, through passive human sensors and then active human sensors, and hence to VGI 'volunteers' who are involved in acquisition and reporting and maybe also in assessing the observations. Further along the continuum are PGIS 'participants' who should be incorporated in all these activities, and, beyond this, be involved in analysis and critical evaluation, and in reflection. Pertinent questions concern the many other actors participating in VGI systems and actions. Who designs the specific VGI activities and platforms? Who tests and processes the outputs? Who are the final users? And significantly, who will be the owner of the information? The governing in many instances may have reason to resist increased empowerment and transparency in VGI practice, if and when it converges towards PGIS and its tools of counter mapping.

4.2 VGI to VGI.2 (Vulgar Grounded Intelligence)

If VGI is to be more credible as an approach and medium to represent local knowledge and people's priorities, needs and hopes, and to fulfil conditions of good governance, then it must more fully represent the values of the people who are 'volunteering' the information. For that, we can aim towards a more appropriate meaning to the acronym "VGI", thus, '*vulgar grounded intelligence*' ***(VGI.2)***. 'Vulgar Grounded Intelligence' (VGI.2) is germane, because we are dealing with local spatial knowledge of, and from, the 'common people' (Vulgar), which is well-grounded in people's life experience (Grounded), and which is representing not only observations and information, but also the 'citizen science' of knowledge analysis and assessment (Intelligence).

Table 3 Shifting from Low to High Levels of Participation in VGI – from VGI to VGI.2

VGI Lower Participation		VGI.2 Higher Participation
• One–way elicitation • Closed set of questions, categories and layers • Not interactive • Selective respondents • Involuntary • Maybe hidden process • Faster • Crowdsourcing for external purposes		• n-way participatory group discussion • Open-ended conversations, no fixed agenda • Interactive, feedback, reciprocal, • Inclusive (proactive inclusion) • Voluntary • Transparent process • Slow (deliberately slow) • Empowering participants over time

Source: this paper

PGIS has always challenged the status quo of 'authoritative information', that is, the official information of agencies which is inextricably linked with their relative power position. Below the surface of the map products are the underlying power structures. Whereas VGI activities are rarely actively subversive, there are cases, which we can term as VGI.2, that are motivated towards critical and reflective "vulgar grounded intelligence". Ushahidi is a leading global platform that can and does challenge authoritative information, and consider also such politically motivated examples as Cidade Democrática (Brazil), 'I paid a bribe' (India), 'Bribr' (Russia)[39], or 'Palestine remembered' (Palestine/Israel)[40], or the 'counter-cultural' 'Price of weed' (USA and global)[41].

At the 'low participation VGI' end of this continuum, VGI activities can be conceived of as cheap data production relying on a cheap labour force providing data for information-crunchers, whether government or commercial. At this extremity, society's growing acceptance of and nonchalance towards the GIS/2 milieu and its software combined with the explosion of CCTVs and other spy devices, including billions of smartphones with cameras, exposes us to unprecedented levels of surveillance and governing control (Elwood 2009). Here, the 'P' has been utterly discarded.

A richer understanding of the rapid, fairly raw spate of information from VGI and the like, and the capability to cross-communicate it as trustworthy knowledge, involves locational, historical, and cultural-social specificities, and this need for localness favours participation. The challenge is to benefit from both VGI and PGIS, that is, how to better exploit the 'breadth' of VGI together with the 'depth' of PGIS, and thus, how to shift from VGI towards VGI.2.

[39] http://www.crowdsourcing.org/editorial/in-russia-the-crowd-targets-corruption-and-bribes/22322
[40] http://www.palestineremembered.com/Articles/General/Story1913.html
[41] http://www.priceofweed.com/

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