

# Chapter 25

## Crowdsourcing for Geodesign: Opportunities and Challenges for Stakeholder Input in Urban Planning

Júnia Borges, Piotr Jankowski and Clodoveu A. Davis Jr.

**Abstract** This chapter examines the relationship between geodesign and crowdsourcing, informing urban planning by collecting the opinions of stakeholders. It focuses on conditions for facilitating democratic participation in urban planning in light of the Brazilian legal framework, and on possible interactions between participatory urban planning and crowdsourcing. Collecting opinions, preferences, and impressions by a local community is a fundamental aspect of public participation in planning, seeking valuable information that can be used in geodesign. We demonstrate how online crowdsourcing techniques can be used to efficiently gather citizen views and opinions. A case study developed as part a course taught at the Federal University of Minas Gerais, in Belo Horizonte, Brazil, called Collaborative Mapping and Citizen Participation, is presented. In the case study, students were asked to develop a volunteered geographic information (VGI) project to collect and analyze urban values of citizens of the São Luiz and São José neighborhoods in the Pampulha region in Belo Horizonte, and to show different approaches to using citizens as information providers. We demonstrate how simple mapping techniques can be instrumental and revealing citizen stakeholder preferences and values affecting spatial organization of urban areas.

**Keywords** Geodesign · Crowdsourcing · Volunteered geographic information

---

J. Borges (✉) · C.A. Davis Jr.  
Universidade Federal de Minas Gerais, Belo Horizonte, Brazil  
e-mail: juniaborges@yahoo.com.br

C.A. Davis Jr.  
e-mail: clodoveu@dcc.ufmg.br

P. Jankowski  
San Diego State University, San Diego, USA  
e-mail: pjankows@mail.sdsu.edu

## 1 Introduction

This chapter presents a potential use of crowdsourcing tools and techniques as part of the geodesign approach to urban planning. Crowdsourcing can play an important role in geodesign as a tool to collect the opinions of stakeholders and determining their view on the quality of the urban environment. As an approach to participatory planning, geodesign helps to collect input on citizen needs and to assess their feedback on how proposed changes in land use meet their needs. In Brazil, public participation in urban planning projects is a legal requirement, and we pursue the idea that online interaction using crowdsourcing can be an effective way to gather data and information on citizen views and opinions that are important for urban planning.

It is potentially revealing to look at the interaction between crowdsourcing and urban planning through the lens of the urban values included in geographic information. We discuss the crowdsourcing concept along with its collaborative and contributory functions, and its benefits to citizens. The discussion is based on experiences gained during a 15-h course, called Collaborative Mapping and Citizen Participation, taught during 2014 at the Federal University of Minas Gerais. In the course, we used a crowdsourcing tool built upon the Ushahidi platform<sup>1</sup> directing students to develop a volunteered geographic information (VGI) project about urban problems identified in the São Luiz and São José neighborhoods in the Pampulha region of Belo Horizonte—Minas Gerais. The main purpose of the course project was to understand the urban values of the community. Groups were given full autonomy in information collection and project structuring after receiving a project tutorial. The pedagogic objectives of the course were to present and discuss new techniques and procedures for collaborative management, with emphasis on the process, to employ VGI techniques that are deemed relevant to urban planning, and to train students in procedures for collecting and managing VGI using geographic information techniques.

We discuss the concept of VGI for urban planning in the context of Brazilian legal framework for democratic participation, established by the Federal Constitution of 1988. In our discussion, we also draw upon the “Statute of Cities” as yet another important legal document affecting urban planning and the practice of crowdsourcing in Brazil.

Next, we present results of the VGI collection effort undertaken as part of the course on Collaborative Mapping and Citizen Participation. We conclude the chapter by presenting our thoughts on how geodesign and crowdsourcing can empower citizens and support urban planning.

---

<sup>1</sup>[www.ushahidi.com](http://www.ushahidi.com).

## 2 Concepts

### 2.1 *Where Crowdsourcing Fits into Geodesign*

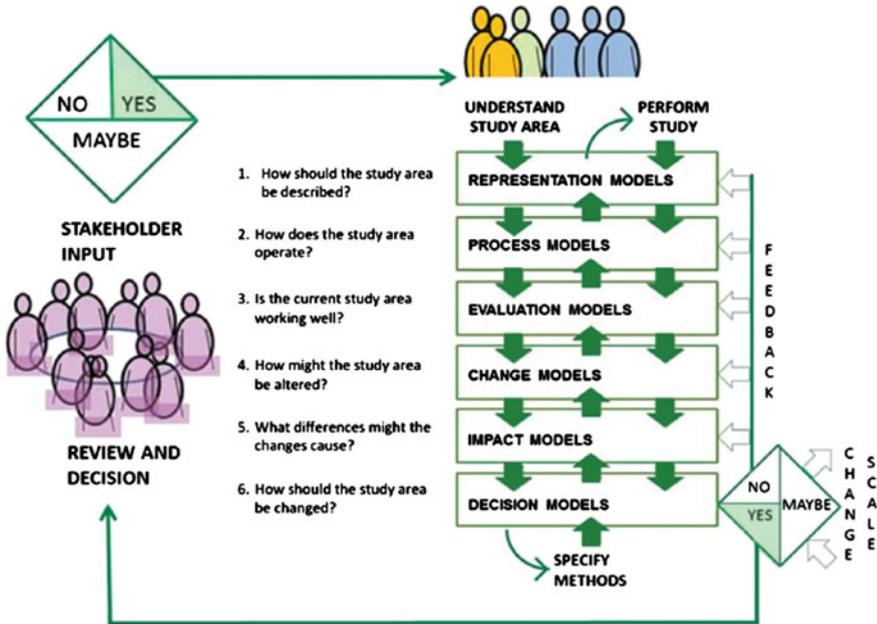
Geodesign is a relatively new concept in spatial planning, aimed at problem solving through a systematic assessment of impacts resulting from proposed solutions and decision-making feedback, leading to better potential for accomplishing needed changes. Steinitz (2012) identified the conflict of interests between stakeholders as a catalyst for geodesign. This chapter does not describe in details the geodesign procedure suggested by Steinitz (2012). Instead, it highlights a link between geodesign and public participation. The geodesign process proceeds through loops and is self-fed by its own conclusions, although many times, as shown by Steinitz (2012), some deviations may occur.

The process is facilitated by six questions that are reviewed at least three times with different objectives, and by answers that can be obtained from models employed in the process. The flowchart depicting the process shows that the first three questions (“How should the study area be described?” “How does the study area operate?” and “Is the current study area working well?”) refer to the problem description. The next three questions refer to a desired future state (“How might the study area be altered?”, “What differences might the changes cause?” and “How should the study area be changed?”).

The first pass through the questions is aimed at understanding the study area and the underlining question that one should ask is “Why?” It is a data driven process. The second pass addresses the “How”, and should specify models proposed in the first pass and be followed from the bottom up, because of the nature of the questions and of a decision driven process. The third and last time the questions are answered addresses “What”, “Where,” and “When” to detail the project. Finally, if the decision and its calculated impacts satisfy the needs of the stakeholders, the process should be reviewed, thus leading to decision-making and to action for the implementation of changes. If not, the whole process should be repeated, identifying bottlenecks and problems that interfere with needed changes (Fig. 1).

According to Steinitz (2012), geodesign could be inspired by Genius Loci and solutions should appear immediately or perceptions may be the only end result of the process. Writing about understanding the urban planning, Cullen, in his masterpiece “The Concise Townscape,” indicated:

The first change is to popularize the art of environment on the principle that the game improves with the amount of popular emotion invested and this is the crux of the situation. The stumbling block here is that in the popular mind administrative planning is dull, technical and forbidding whilst good planning is conceived as a wide, straight street with bushy-topped trees on either side, full stop. On the contrary! The way the environment is put together is potentially one of our most exciting and widespread pleasure sources. It is no use complaining of ugliness without realizing that the shoes that pinch are really a pair of ten-league boots. (Cullen 1971: 17)



**Fig. 1** The stakeholders, the geodesign team, and the framework for geodesign. *Source* Steinitz (2012)

Cullen understands as the crux of the situation the involvement and interest of citizens. Solutions depend on the potential of the minds present at the process and also on their inventive, innovative, and creative process engagement (Steinitz 2012). Another key element to solutions is technological availability, resources, etc. Steinitz concludes his main chapter (Chap. 3), in which he presents the geodesign framework, paraphrasing Pasteur, “Fortune favors the prepared mind.”

The possibility for interaction can be afforded through the diverse range of users. Various authors see people not only as consumers, but as contributors and information creators (Silva and Davis 2008 and Goodchild 2007). This relationship changes completely how a community takes position on many decisions affecting their everyday space. Crowdsourcing can be a key element of geodesign because it helps to provide answers to questions and in problem identification. It is tightly related to the roles of stakeholders and communities. It should be used in several steps of geodesign process, in which information from the crowd is needed.

## 2.2 How the Brazilian Legal Framework Facilitates Participation

Brazilian legislation is based on democratic participation principles, the culmination of which has been the 1988 Federal Constitution, known as the “Citizen

Constitution.” This instrument determines that cities with more than 20 thousand inhabitants (among other criteria) should have a Participatory Master Plan and that city management should be done democratically. The 10.257 Bill of July 2001 established the “Statute of the Cities” that “indicates standards of public order and social interest that regulate the use of urban property in favor of the collective good, safety and welfare of the citizens, and of environmental balance” (Brasil 2001).

According to Moura et al. (2013) “municipal authorities began to listen to the people in the decisions affecting cities through various instruments such as participatory budgets and municipal conferences on urban policy. The population is called on to represent the city, its conflicts, its problems and potential.” The authors point out that the legislative rule does not only depend on citizen participation but also creates conditions for organized and accessible production of territorial data. A core issue is the bridge between information and interests that leads to effective citizen participation.

Despite the legal framework supporting public participation, very few people in Brazil know how to participate—or even have an interest in doing so. Citizen participation is valuable because it is a potential source of opinions, suggestions, and solutions based on local experience and perception of problems. It happens often that technical solutions may not be the best for a place and its citizens because technical experts do not have first-hand experience with problems contextualized by place and its culture. Community solutions tend to be sustainable following the bottom-up decision logic. Quality and quantity of participation are important. Most of the times the participation is mediated through representatives, which is problematic, because often the opinion of a person who represents others does not reflect a consensus or the range of opinions in a community. Hence, widening participation to achieve a more representative opinion(s) is a desirable goal that VGI could help to bring about. Local experience should be understood as an empirical system of knowledge.

### 3 Interaction Between Crowdsourcing and Urban Planning

Many authors argue that geographic information is crucial for decision support, because it aids the government in its various activities related to urban planning, environmental monitoring, crime prevention, among others (Miranda et al. 2011). The use of geospatial technologies enables the construction of complex databases, quick access to data, and development of predictive scenarios.

As a deployment of postmodernity, contemporaneity arises in new processes to represent and manage the urban territory, based on principles of parameterization, interoperability between systems, geodesign, strong investment in communication and distribution network, community involvement (VGI - volunteered geographic information), and regulation of processes by legislation to support standardization and policies on access to information (Moura et al. 2013: 10).

Among citizens, technical experts, and managers there is a lack of “shared code” on urban values. When discussing a parameter, based on which the landscape will be transformed, stakeholders often express a frustration that lay people have no idea or have little cognitive ability to figure out what will happen in the landscape as a result of the proposed transformation. The challenge is in creating horizontal knowledge on planning and conducting consistent and well-discussed proposal processes.

Crowdsourcing is a set of techniques that allow the creation of datasets by collecting and joining contributions from citizens with no previous training or special expertise. Usually, citizens contribute voluntarily, and the Web is used as a platform for receiving contributions. In many cases, the data are geographic in nature, thus comprising what is known as VGI (Goodchild 2007). Other sources of geographic data, generally useful for crowdsourcing or VGI efforts, include access to large datasets using application programming interfaces (API). APIs are collections of functions that are used to query and retrieve information from such datasets or services in an organized way, i.e., so that the data owner’s servers are not overcome with excessive requests and the users does not need to know details on how data are organized and stored at the source. Examples of geographic APIs include Google Maps Geocoding API (which includes functions for obtaining geographic coordinates from an urban address) and Twitter’s API (which allows capturing streams of tweets based on some selection criteria). Harvey (2013) proposed that “crowdsourced data collected with user control is volunteered, whereas crowdsourced data collected with no or limited user control is contributed.”

According to Elwood (2006), GIS is tremendously important because it is such a powerful mediator of spatial knowledge, social and political power, and intellectual practice in geography. In this context, Critical GIS refers to the body of work that emerged in response to the GIS and Society critiques of the mid-1990. Critical GIS asserts that GIS cannot be viewed as a series of tools developed and implemented in a vacuum. Instead, GIS is viewed as interplay of science and technology happening in a specific social context. It is important to note that access to technology needed to create VGI is more open today than ever before. Development of the Internet, webGIS, multimedia, mobile GIS, and decreasing cost of hardware, software, and data production have been essential in for creating foundation for broad access to VGI. An open issue, however, is still access to knowledge and social capital needed to create VGI. In this regard, efforts of researchers active in critical GIS aimed at “altering participatory decision-making process to enable more equitable access to GIS and digital spatial data; developing representational strategies to diversify the forms of spatial knowledge that can be included in a GIS; and re-designing GIS software and databases to alter the way in which they represent and analyze spatial data in digital form” have been instrumental in focusing on the issue of social capacity needed to engage in VGI (Elwood 2006).

After creating and promoting the use of tools for citizen participation as suppliers of VGI, technicians expect to gain much information on localized problems—that is, problems that citizens know from personal experience and that occur in

places related to their daily activities. Such data should fill the gap between small-scale (generalist) and large-scale (specific) local information. VGI contributions are usually more active as soon as a data collection effort starts, because people are motivated by a given subject or cause; however, once the subject is exhausted, people tend to gradually stop collaborating. Continuous motivation is therefore required for most VGI efforts, and several different strategies have been proposed in that respect (Soares 2011). Miranda et al. (2011) confirm that VGI is of special interest for urban mapping, because volunteers produce important and unique contributions related to their individual interests and first-hand knowledge.

Crowdmap,<sup>2</sup> developed by Ushahidi, is an example of a software platform used in VGI projects, enabling connectivity and putting activism on the map. Connectivity and entrepreneurship are the building blocks of the digital economy. The creators of Ushahidi speak about collective intelligence filling in the void created by the lack of information flow and resilient response initiatives. These are very interesting ideas that can add substance to urban planning, as crowd-generated data supplements or at times even supplants authoritative data, empowering people to influence decision making rather than being solely an object of decision making.

The value of VGI is dependent not only on first-hand knowledge, but also on training citizens to comprehend the landscape and its relations, as well as developing a capacity to understand the spatial context of the place where they live. As a case in point, one could highlight environmental issues; people usually do not know where the water used in their households comes from. In order to realize the potential of VGI, there is a need for “Spatially enabled citizenry characterized by their ability to express, formalize, equip (technologically and cognitively) and of course consciously—or unconsciously—activate and efficiently use their spatial skills.” (Feick and Roche 2013: 20).

Citizenship is related to the comprehension of the spatial context. How can one rationally use the water if one does not know its sources? So, VGI, along with the spread of Google maps and other spatially enabled social media, brings a comprehension of where one is in space, where one goes, and what are one’s surroundings. There are some mobile applications that have been very useful in developing spatial cognition skills (Waze<sup>3</sup> for example). It spurs citizens to understand the urban network in order to predict if a traffic jam is likely to occur on their way home; the user has to navigate through a map to see if there is any obstacle on the intended travel path. Until spatially enabled and easy-to-use navigational tools had become widely available, few people were able to read a map (especially in Brazil).

The understanding of the landscape and townscape (as defined by Cullen 1971) and its relationships is a key to empowerment of citizens. The orthogonal point of view supercedes the azimuth point of view in using freely available map-based

---

<sup>2</sup><https://crowdmap.com/welcome>.

<sup>3</sup><https://www.waze.com/>.

tools and apps. The orthogonal view is more complex to process for ordinary people who have little or no experience in reading and comprehending maps, but in return it allows them to infer and mentally process spatial relationships. Spatial relationships inferred from maps can have values attached to them, and these values that can bring social and political cohesion. Hence, maps and mapping values have a potential for promoting innovation and social understanding as citizens start to understand space and begin to be curious about its use.

Crowdsourced evaluation of services<sup>4</sup> has also benefited from geotagged and crowdsourced information, bringing insight on individuals and groups that can reshape, redesign, and reformulate how places are represented and understood. It is a valuable tool for citizens to see other opinions.

The urban values that we seek to understand are strongly related to cultural, temporal, and locational background. Cultural background might differ between cities and their residents. Temporality refers to what is acceptable for a city in a certain timeframe of its development and what may not be acceptable for another city in a different developmental stage. Also, people who live in an area might characterize it differently than visitors. For instance, a neighborhood with university students would accept very different parameters than an area with families that have lived there for many years. Therefore, time refers both to an individual inhabiting a given area and to the development stage of the area. Locational values might vary significantly, which is easy to understand if one can imagine that each place could have a different environmental context.

It is very important to understand the urban values of citizens affected by change (development or decline) because depending on the problem focus, the questions being asked might differ. The study reported here focuses on asking what is special about a place. What is out there that the residents value so much that no changes could be made to it, or otherwise it would lose its importance to local people.

## 4 Study Cases: Identifying Urban Values in Pampulha

We taught a graduate course called Collaborative Mapping and Citizen Participation in Architecture and Urban Planning Program at the Federal University of Minas Gerais. As part of the course, we went through Crowdsourcing analysis and used Ushahidi's Crowdmap tools to develop study cases. Students formed 4 groups of 4 or 5 students each and had as their assignment to investigate urban values in the São Luis and São Jose neighborhoods in the Pampulha area. Those neighborhoods are residential areas inhabited by higher income residents and also include important urban landmarks of Belo Horizonte such as the Mineirão soccer stadium, and some architectural icons of the Pampulha Complex designed by Oscar

---

<sup>4</sup>Such as [www.tripadvisor.com](http://www.tripadvisor.com) and <https://pt.foursquare.com/>.

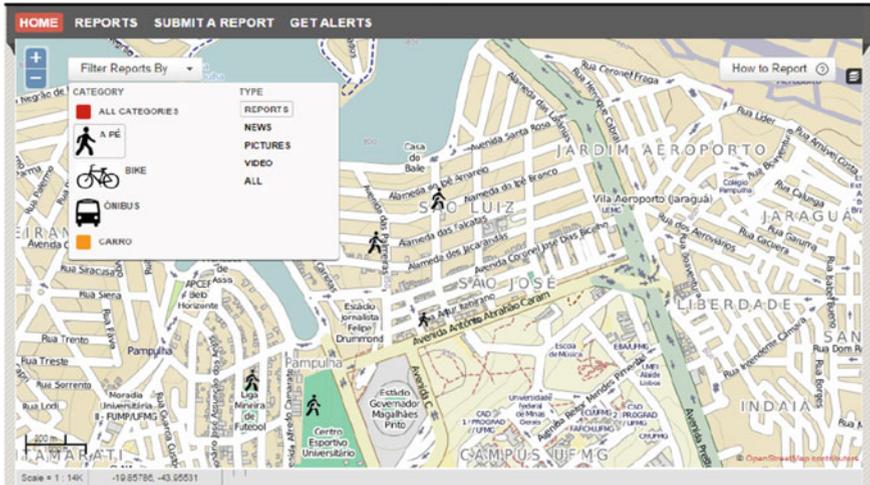


Fig. 2 “Porondeandei” project and its map result. Legend refers to all modes of travel: by foot, bicycle, bus and car. Source <https://porondeandei035.crowdmap.com/>

Niemeyer such as “Igreja da Pampulha” and “Casa do Baile”. Students were free to investigate one or more urban values.

The first group worked on pathways and modes of locomotion (pedestrian, car, bus, and bicycle). The group’s objective was to understand the causes of shifts/alterations in space usage by the residents and their patterns of movement. The choice of objective was motivated by the work of Jane Jacobs (1961: 45), who states that people are the eyes of the street, their presence is what brings real feelings of security. Using a map compiled from information given by the local residents it is possible to identify the areas where people feel more secure. The group of students interviewed people on the streets, handed out a folder explaining the project and its objectives and asked them to indicate on the map the main walkways and how they traverse them (Fig. 2).

The group confirmed the assumption they made at the outset of their project—namely, that there are some public spaces where fear (insecurity) is greater than elsewhere because of the lack of people on the streets. They confirmed that some areas are avoided for that reason.

The second group called its project “Tranquilibel”. They wanted to map the urban values of people living in the area through interviews and then start a VGI collection effort. They found out that most people referred to “tranquility” as a positive value. The group built a VGI service, with which the users could post noise levels using a free smart phone app. As the course timeframe did not allow for sufficient time to advertise the VGI service among the residents, they defined a spatial footprint of the area and collected noise data themselves at a certain time each day (Fig. 3).



**Fig. 3** “Tranquilibel” project and its results. *Legend refers to decibels ranges.* Source <https://tranquilibel.crowdmap.com/>

The group concluded that high population density, people and car traffic, and commercial activity contributed to elevated noise levels and that wooded areas tend to be quieter. The group compared their findings with decibel levels recommended by the United Nations World Health Organization for a healthy life, and concluded that the area was good because most of its locations had an average between 56 and 75 db and that is considered a tolerable noise level.

The third group mapped urban cleaning.<sup>5</sup> They pointed out different aspects that motivate urban cleaning values: health, aesthetics and wellness, economic and social aspects. They created categories based on observations of the study area: dustbins, garbage on the ground, and pruning.

The last group worked with a more sensitive and Genius Loci-related subject, which they named “Deriva dos Sentidos” (which could be translated as “Sensory Drift”). They were inspired by the ideas of the Portuguese Urban Planner José Lamas, who wrote “Urban Morphology and the City Design” (Lamas 2004). They focused on shape and form. They pointed out that Lamas proposes a reading of the city as an “architectural fact” (Lamas 2004: 41), an expression involving the built-sequence of existing buildings, but also the time instance, and, thus, their succession (Fig. 4).

This work show that qualitative information could be addressed by VGI and that in turn can be mapped and used in a quantitative synthesis. It demonstrates values that an urban planner should pay attention to in order to understand people’s cognitive reactions to constructs of urban infrastructure. It is potentially a valuable diagnostic information category for planners.

<sup>5</sup><https://limpezaurbana.crowdmap.com/>.

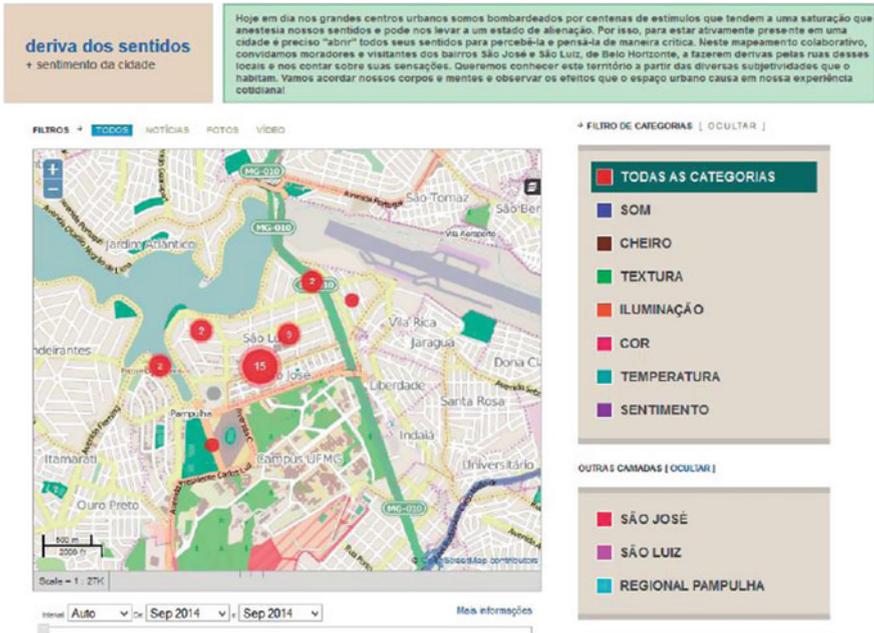


Fig. 4 “Deriva” project and its reports. Legend refers to sound, smell, texture, illumination, color, temperature and feelings. Source <https://deriva.crowdmap.com/>

## 5 Conclusion

The relation between geodesign and crowdsourcing is constructed through the range of stakeholders involved in urban planning. Geodesign could benefit from crowdsourcing, by collecting answers and identifying problems, and by helping the community to fulfill their citizenship role.

The Brazilian legislative framework shows that the country is committed to democratic participation; however, Brazilian cities are lacking tools to facilitate an effective interaction between citizens with urban planners.

An interesting study published by the USA government <sup>6</sup> shows that Americans are increasingly relating to one another in different ways, particularly through online forums; the American society is becoming more mobile; “amateurs” are increasingly becoming trusted sources of information at the expense of “experts”; public trust in institutions in the United States is decreasing and shifting to social networks. The document indicates that people are decreasingly demonstrating their activism at a physical location such as a city hall, and that they are increasingly

<sup>6</sup>[http://www.fema.gov/pdf/about/programs/oppa/changing\\_role\\_individual.pdf](http://www.fema.gov/pdf/about/programs/oppa/changing_role_individual.pdf); accessed on October 10, 2014.

doing it online. This proves that development of online tools with locational information gives cities better chances of increasing citizen participation.

The inversion of the power of information away from being the exclusive domain of experts and technocrats toward information sharing with ordinary citizens could pave a way for a new model of democratically managed city. Further research should be focused on finding out whether this trend is also taking hold in Brazilian cities.

Another important matter is related to the shared code of mutual understanding of urban values. It is important to understand stakeholders and enable horizontal lines of communication to include all potential actors.

Collaborative and contributed crowdsourcing are here to stay. We have argued that many values held by citizens can be elicited thanks to VGI tools, and that the use of geolocation is becoming common in crowdsourced information. Urban values are closely related to culture, time, and location, hence understanding a community and its interaction area is key to better urban planning. The case study examples demonstrated different ways that can be used to collect information on urban values. Spatially-enabled citizens enhance citizenship. Both urban values and spatial enablement demonstrate the importance of collecting VGI information to support citizenship.

Further research on empowering society with effective tools, enabling their participation in local planning and decision-making, shall be very helpful for arriving at sustainable land arrangements in cities. We posit that future studies should focus on developing geodesign approaches to urban land use planning aided by crowdsourcing, to help identify solutions to real problems confronting cities in this day and age.

## References

- Brasil C (1988). *Constituição da República Federativa do Brasil*. Brasília, DF: Senado Federal: Centro Gráfico, 1988. 292 p
- Brasil. Lei nº 10.257, de julho de 2001. *Estatuto das Cidades – Brasília, DF*. Senado Federal. Centro Gráfico, 2001
- Cullen G (1971) *The concise landscape*. Butterworth Heinemann, London
- Elwood S (2006) Critical issues in participatory GIS: deconstructions, reconstructions, and new research directions. *Trans GIS* 10(5):693–708
- Feick R, Roche S (2013) Understanding the Value of VGI. In: Sui D, Elwood S, Goodchild M (eds) *Crowdsourcing geographic knowledge*. Springer, Dordrecht 396 p
- Goodchild MF (2007) Citizens as voluntary sensors: spatial data infrastructure in the world of web 2.0. *Int J Spat Data Infrastruct Res* 2:24–32
- Harvey (2013) To volunteer or to contribute locational information? Towards truth in labeling for crowdsourced geographic information In: Sui D, Elwood S, Goodchild M (eds) *Crowdsourcing geographic knowledge*. Springer, Dordrecht, 396 p
- Jacobs J (1961) *The death and life of great American cities, failure of town planning*. Vintage, Middlesex, 478 p
- Lamas JMRG (2004) *A Morfologiaurbana e o desenho da cidade*. Lis-boa: Fundação CalousteGulbenkian, Fundação para Ciência e Tecnologia

- Miranda TS, Lisboa Filho, J, Souza WD, Silva OC, Davis Junior CA (2011) Volunteered geographic information in the context of local spatial data infrastructures. In: Urban data management symposium (UDMS), 2011, Delft, Holanda. Proceedings of the 28th urban data management symposium. CRC Press/Balkema, Taylor & Francis, Leiden, The Netherlands, pp 123–138
- Moura ACM, Davis Jr CA, Araujo RPZ, Borges KAV, Jankowski P, Campagna M, Zungier CM, Borges JLC, Pensa S (2013) Modelagem Paramétrica da Ocupação Territorial Submissão Fapemig – Edital Universal
- Soares MD (2011) Employing citizen science to label polygons of segmented images. Theses (Doutorado em Computação Aplicada), Instituto Nacional de Pesquisas Espaciais
- Silva JCT, Davis Jr CA (2008) Um framework para coleta e filtragem de dados geográficos fornecidos voluntariamente. In: X Brazilian symposium on geoinformatics 2008, Rio de Janeiro (RJ). Proceedings of the X Brazilian symposium on geoinformatics. Porto Alegre (RS): SBC—Sociedade Brasileira de Computação
- Steinitz C (2012) A framework for geodesign. Esri Press, Redlands

## Websites

<https://deriva.crowdmap.com/>

<https://limpezaurbana.crowdmap.com/>

<https://pt.foursquare.com/>

[http://www.fema.gov/pdf/about/programs/oppa/changing\\_role\\_individual.pdf](http://www.fema.gov/pdf/about/programs/oppa/changing_role_individual.pdf)

<http://www.ushahidi.com/>

<https://www.waze.com/>

[www.tripadvisor.com](http://www.tripadvisor.com)