

Crowdmapping: Inclusive Cities and Evaluation

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Abstract. Recent technological innovations are redefining some key steps in the disciplines dealing with urban changes and the evaluation processes connected to the decision-making support system. Moreover, the voluntary input of community stakeholders has, over time, become the procedural center of most decision-making nodes. In addition to traditional participatory techniques, technology is enabling a new phase of less wasteful citizenship practices, where the participatory contribution is the provision of knowledge-based local knowledge the return of data based on voluntary contribution. This is the case of crowdsourcing, a web model based on open and voluntary collaboration in investigation or research by an indefinite and large group of people, aimed at building an informational mapping.

The paper aims to return some of the recent applications of crowdmapping by highlighting the possible contributions that these processes can make to the implementation of information in the service of project evaluation tools.

Keywords: Crowdmapping · Crowdsourcing · Inclusive city · Participation process

1 Introduction

Recent technological developments impact on many disciplines, including those dealing with urban policy, planning, design, and management of urban transformation, and, in the end, support system approaches to decision-making. However, while new technologies had the power to revolutionize the financial sectors, health care or consumer and service delivery systems, in the field of urban planning the adjustments are much slower [1] including the assessment methods that affect and guide it. Among the most relevant (though no longer extremely recent) innovations are the ability to handle large amounts of data, decision support tools, and applications of geographic information systems (GIS) [2]. The recent scientific literature, moreover, shows evidence of a wide and growing application of artificial intelligence (AI) related techniques for planning, in various areas such as land use, zoning, environmental planification, and transportation [1] and for big data management, which is increasingly available and accessible. These new technologies approaches allow openings to innovative ways of collecting, managing, and returning the information needed to implement any assessment operation: among these, the concepts of crowdsourcing and crowdmapping stand out for innovativeness.

Crowdsourcing is a key element of research on open innovation and co-creation processes that addresses whether a large number of individuals, the "crowd," can actively

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participate in a company's innovation processes [3] enabling access to intelligence and knowledge that would otherwise be scattered among many users or stakeholders.

The concept of crowdsourcing consists of a web model based on open and voluntary collaboration to develop innovative solutions; this resolution first appeared in an article by Jeff Howe for Wired Magazine [4], as the act of outsourcing a job, investigation or research to an unfinished and large group of people, usually in the form of an open and anonymous call.

The methodology -framed as public and participatory- draws on diverse and multiple subjects through Web 2.0 technologies[1] easing the spatial and temporal constraints associated with data collection in public participation processes [5].

As early as 2010, in response to the Haiti earthquakes, the first examples of crowdsourcing were glimpsed: Yates and Paquette [6] use the action line of participatory research for community involvement in disaster management. In the management of the same disaster Starbird and Palen [7] highlight how a severe lack of map data has hampered aid organizations in understanding places in need of assistance.

There are multiple definitions, subcategories, and applications in the literature in crowdsourcing field[2], which differ in the type of application, in the characteristics of the participatory model, in the scope of use in different application fields, and in the complexity through which the so-called crowd, and thus the users, will contribute their knowledge. In this process, the crowdsourcer will benefit by resolving the proposed problem [8] by the demand for mapping. In addition, the proliferation of participative platforms has made it more accessible and easier for individuals to get involved in different types of crowdsourcing initiatives.

Considering what introduced crowdsourcing field, this paper considers the sub category of crowdmapping, whereby one can intend to aggregate crowd-generated inputs, and thus the crowd component such as text messages and social media accompanied by geographic data, and thus the mapping component, in order to provide real time interactive information [9].

Participatory type mapping is used in inclusive research and initiatives in planning and management of development activities at the local level, in planning and management of development activities at the local level. In its broadest sense, participatory mapping refers to the creation of maps by local communities often with the involvement of supporting organizations, comprehending governments, NGOs or other actors involved in development or land-use planning [10].

The paper aims to return some of the recent experiences in which the shared and bottom-up construction of maps has posed itself as a tool with a dual effect: on one hand, that of increasing the level of information, enriched by perceptual information, reconstructed through the user's experience; on the other hand, that of transforming the mapping process into an experience of engagement in which the construction of

[1] There is a tendency to refer to Web 2.0 as the set of all online applications that allow a high level of site-user interaction such as social media, forums etc.

[2] Some of the sub-categories in the literature are: crowdfunding (collective financing), crowdcreation (collective creativity), crowdvoting (collective voting), crowdwisdom (collective wisdom), crowd-shipping (collective shipping services), crowd-solving (col-lective problem-solving).

information becomes an act of participation and citizenship. Both land transformation processes and assessment methods are always looking for inclusive and participatory procedures to be implemented within their operational and procedural baggage [11].

2 Crowdmapping e Crowdsourcing: Definition and Principal Platforms

Crowdsourcing is helping to democratize the planning process by providing low-cost data for real time planning, and to mitigate the limitations of traditional data collection methods, such as, for example, census data [12]. In terms of urban planning, crowdmapping is extensively debated in the literature in relation to issues such as problem-solving, idea proposals, and collaborative mappings [13]. The goal is to provide cities with inclusive spaces, framed as spaces that equally value each user, are accessible, and in which the users themselves are self-representative, invested with a role in governance and planning processes [14].

Crowdmapping, therefore, can be interpreted as the collection and sharing process of geographic information through crowdsourcing, understanding them, in some cases, as tools as well as processes. Collaborative maps and the use of related platforms - such as Application Programming Interfaces (APIs) -and major cartographic datasets propose a democratic approach for topics very often related to issues of civic engagement and digital activism.

The first experiments in the crowdmapping arena take place in Kenya in 2008, with the aim of collecting citizen complaints and reports on post-election violence on a map [15]; In this context, an open-source platform was developed [16] in order to collect necessary information and data (via SMS, e-mail, or web) and then match it with geolocation data so that it can be displayed on a map.

Data collection, which is widely debated in the scientific literature, can be done first through social media with voluntary participation on social pages and second through skimming through other datasets (Table 1), such as: Ushahidi, which manages and visualizes data, collects georeferenced information from multiple sources through customized crowdsourced surveys developed by the crowdsourcer; OpenStreetMaps, whose initiative is to foster the growth, development and distribution of geospatial data, a team of volunteers manages the infrastructure and websites where collaborative projects are found for specific purposes, while users contribute data to the map; Google My Maps, where places can be indicated and selected in the form of different labels or layers; StreetBump, designed for the purpose of improving public streets; Crowdspot, designed to generate greater levels of participation, education and engagement. On one hand, the method is seen as a less costly approach to mapping the urban environment; on the other hand, it is seen as an exclusive method due to limited participation and, consequently due to spatial coverage and dutiful specification of variables [17]. Several studies [18] integrate different platforms in order to make the participants familiar with the area of interest, through a street-level imagery, (Google Street view or mapillary) facilitating the participant in simulating the process of walking along the streets, thus providing detailed three-dimensional information of the visible spatial elements. Recent applications [17] associated 100 google street views images with the construction of a database through

online theme data collection development and the construction of an algorithm based on three main steps: (1) Initialization; (2) Crowdmapping; and (3) Geolocalization. From the perspective of the geographic data management model, three classifications emerge [19] -for tools and datasets- based on the code used to make it (open source or closed) and the possibility of being able to re-access or reuse data collected by users or crowdmappers: open, open source platform collecting data produced by crowdmappers free and reusable by anyone; hybrid, open source system embedded within a proprietary platform and data are not reusable; closed, proprietary platform collecting data are not reusable.

The use of collaborative platforms not only can return a comprehensive picture of the state of affairs in relation to the problem but can become a potential tool for defining indicator [20] For the scope of smart cities and the assessment of urban sustainability goals and project quality assessment [21].

Table 1. Most widely used platforms for crowdmapping.

Name	Classification	Data Collection
Ushahidi www.ushahidi.com	Open source	Data can be managed and classified with filters and workflows according to a role-based security model that grants permission to each defined user. Data visualization can be done through a map, list, chart or table, setting the periods when specific variables need to be analyzed and confronted
OpenStreetMaps (OSM) www.wiki.openstreetmap.org	Open source	Data collection is based on two structures (elements and labels). Elements correspond to nodes (defined points), paths (linear features and boundary areas) and relationships. Labels, on the other hand, are used to describe the significance of elements
Google My Maps www.google.com/maps	Closed	Data collection and subsequent classification is done through user labels
Street Bump www.streetbump.org	Hybrid	Data collection occurs during users' use of devices connected to the platform while they are driving
CrowdSpot www.crowdspot.com.au	Hybrid	Collection of "spot" data can be done manually by user input or via Social Networks

3 Application Experiments

There are multiple applications in the literature declined in different areas of intervention and research, demonstrating the versatility of use of the tool.

The supporting platforms fall into the three classifications previously repurposed, and the most widely used ones are Google My Maps, OpenStreet Maps and Ushashidi. Below, we report more precisely on the projects summarized in Table 2.

Table 2. Summary of Crowdmapping projects displayed.

Name	Location	Year	Platform & Support
CrowdMapping Mira Fiori Su – MiraMap	Turin (Italy)	2013–2016	Ushahidi
Recostruction of Building interior	-	2015	IndoorCrowd2D
CIRCO	Rome (Italia)	2017–2023	Google My Maps
Free to Be Map	Sidney (Australia) Lima (Perù) Madrid (Spain) Kampala (Uganda) Delhi (India)	2018	CrowdSpot
Pedestrian street lengths around the world	992 cities around the world	2022	OpenStreetMaps

The paper aims to return some of the most interesting experiences encountered in crowdmapping projects.

3.1 The Project MiraMap

The CrowdMapping Mirafiori Sud project, conducted at the Politecnico di Torino [22, 23] aims to map and identify the barriers and obstacles that prevent vulnerable users from accessing and using public spaces, focusing on connections in the territory and of institutional relations between the community and the public administration, to propose active and participatory solutions in which citizens are active subjects. The information collected, processed, and classified is made available through an opensource platform. The project was developed in two phases: the first, as a preliminary phase of knowledge and translation of citizens' needs, through interviews, data collection, support in the use of smartphones, etc.; the second, as a phase that provides innovative solutions for citizens to interact with the public administration, with particular attention to the needs of the elderly. The collected data were addressed in three main categories: problem in case there was the presence of criticality; proposal, in case a potential solution could be identified; positive reality, in case the element to be detected was positive. Among the data extrapolated, as problems reported were the presence of architectural barriers, obstacles to the use of space, and the scarcity of street furniture. Among the positives reported was the area of green areas, whether public or pertaining to schools, and neighborhood commercial premises. In terms of contributing to project evaluation tools, it is stressed that such mapping can provide a very useful procedural basis for ex post evaluations, (or monitoring) of public space transformation projects. In that case, the evaluation would be based directly on the direct perceptions of users by returning an experiential and direct evaluation without the mediation of questionnaires or other techniques.

3.2 Reconstruction of Building Interior

The project proposes a smartphone supported crowdmapping system for indoor environment reconstruction [24]. The method consists of to formulate the aimed problem solved, and through the system developed by the project researchers, image information and sensory data are used in a coordinated manner. Evaluation results show that IndoorCrowd2D achieves 85% accuracy for reconstructing university buildings from 1,151 datasets uploaded by 25 users. It is, in fact a hybrid method of images and sensors here the result is an interactive panoramic map, which can be divided into two parts: the first part includes panoramic images of the interior, and the second part includes the structure of the building in which the environment of interest is contained.

3.3 CIRCO Laboratory: The Map of Urban Waste in Rome

Since 2017, a Teaching and Research Laboratory called CIRCO (an acronym in Italian for Irreplaceable Home for Civic Recreation and Hospitality) has been launched at the Department of Architecture of Roma Tre University[3]. The theme of the Design Studio is the transformation of disused heritage into a metropolitan network of intercultural condominiums based on hospitality and stems from the direct observation of the limits of hospitality policies, proposing a rethinking of hospitality by starting again from the many abandoned empty spaces in the city, reinserting them into an innovative process of reuse and management [25]. The research, which is still in progress, addresses both the urban and spatial aspect and the economic strategy; the latter refers to new modes of social regeneration based on the involvement of third sector actors, social enterprises, social managers, and a new generation of urban actors who frame their business vision by combining the use of fixed public territorial capital, the creation of social value, the ability to intercept public funding, and the use of innovative financing tools (such as ethical finance) in a new model of welfare [26]. In the economic-functional mixite CIRCO substantiates its strategy, with the idea of a context in which residents self-manage the delivery of services conjointly with social managers (legal counters, clinics, reading rooms, cultural exhibition spaces, etc.). The elements of feasibility (technical, economic, and social) become key aspects of project implementation. The first necessity of the CIRCO Laboratory was the reconnaissance of disused housing stock, especially of public property, as a fundamental and prodromal act for the formulation of systemic proposals for residences and services to residences. Over the years, as part of teaching activities, a student led mapping system has been implemented, which has engaged in the reconnaissance of different types of disused space. The mapping, which immediately took the form of crowdmapping, was based on a preliminary categorization of what were called discards, divided into: former health care facilities, abandoned sports facilities, disused military garrisons, large disused mobility storage and sorting spaces, former places dedicated to education and culture (schools, cinemas, theaters), decommissioned church heritage, and, finally, the many production-related properties such as factories

[3] The CIRCO project maps can be found at the following address: https://laboratoriocirco.wordpress.com/2018/04/07/mappe/; CIRCO is a research lead by proff. Francesco Careri e Fabrizio Finucci with Chiara Luchetti, Alberto Marzo, Sara Monaco, Serena Olcuire, Enrico Perini, Maria Rocco.

or warehouses, containers of activities that the city has expelled to its margins but has not yet replaced. Over the years, the project has continued to set up processes of map production and to develop specific thematic maps (Fig. 1).

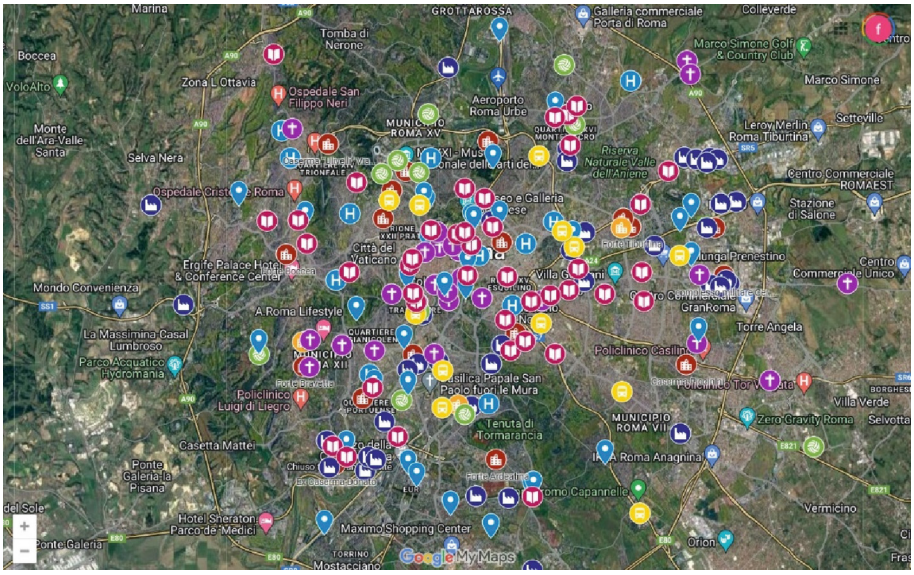

Fig. 1. CIRCO mapping: urban waste in the city of Rome. Source: *Laboratorio* (Laboratory) CIRCO, available on: https://laboratoriocirco.wordpress.com/2018/04/07/mappe/

In addition to the monitoring of the quantity and dispersion of abandoned properties, the crowdmapping process designed in CIRCO, from the assessment point of view stands as a useful tool for the possible identification of possible alternatives for intervention, based on the locations of the abandoned property and early construction and dimensional characteristics. In addition, the monitoring of unused property resources can be an excellent framework for urban-scale assessments of possible strategic reuses.

3.4 Free to Be Map

The map was developed by Plan International in collaboration with XYX Lab and CrowdSpot. Piloted in Melbourne in 2016 and spread to Sydney, Lima, Madrid, Kampala and Delhi in 2018 [27]. The purpose of the tool is the identification of so-called Safe and Unsafe Spots for women and young women through an interactive map that allows them to individuate "bad pins" within their city by answering a small number of closed and open-ended questions. In addition, given the risk of bias related to possible "bad pins," participants were asked to identify not only negative experiences in the city, but also positive ones through "good pins," and, in addition to adding their own pins, users can cast votes via social media. Methods of recruiting participants in order to collect as much data as possible include social media campaigns, media news, television and radio

exposure. To collect data from those who otherwise would not have access to the necessary digital and online facilities, in Delhi and Kampala, and to a lesser extent in Lima and Madrid, women and young women were recruited directly from the streets. Survey results were evaluated by country and comments attached to the pins were translated into English and coded.

3.5 Pedestrian Street Lengths in 992 Cities Around the World

The goal of the project is to compensate for the poor quantification analysis of pedestrian streets around the world in order to ascertain the possible benefits in their implementation in terms of urban quality of life, sustainability and public health. In addition, the integration of comparable global indicators on the quantity of pedestrian streets is proposed as an objective [28]. The tool used for the project is OpenStreetMap (OSM) combining it with spatial analysis techniques (Fig. 2).

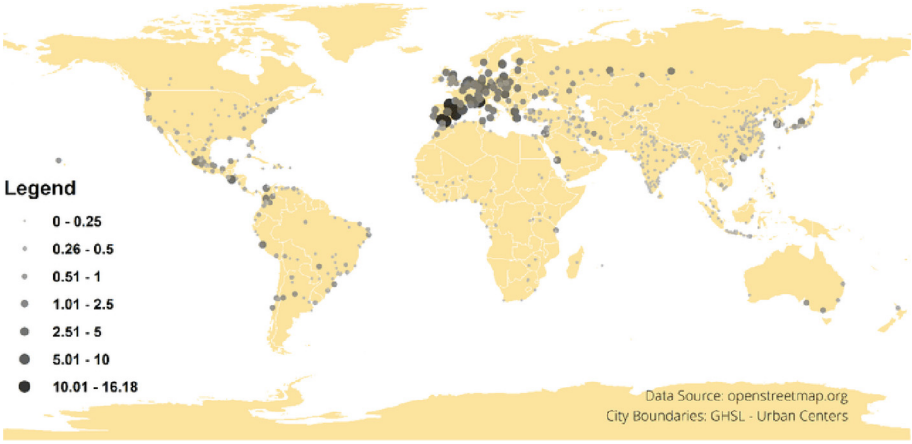

Fig. 2. Pedestrian street length (km) (OSM) per 100.000 inhabitants per city. Source: Bartzokas-Tsiompras, A. (2022)

The results show that European cities have the largest amount of pedestrian street networks, revealing, however, huge differences between southern and western European cities. In urban quality assessment processes, based on the reading of indicators, detailed knowledge of such data can stand as an excellent informative and in-depth knowledge tool of the urban contexts being addressed.

4 Conclusion

Although many crowdmapping applications are still in their beginning and need to be further implemented, the practices and experiences reported in this paper undoubtedly work on different issues and at different scales. In the background, the crowdmapping approaches presented assume a social point of view with respect to the urban issues they

aim to address people with vulnerabilities, urban safety, returning abandoned heritage to the citizenry, etc. It is precisely the use of inclusive and participatory practice that may be the key to understanding this prevalent social valence of crowdmapping processes. Not surprisingly, these experiences, with the support of technological developments, are leading to increasingly participatory forms of communication, referred to as self and social mapping [29]. Access to the production and use of geographic information and, therefore, maps, through Web 2.0 cartographic applications, are challenging top-down narratives of territories, reflecting a renewed need for the social construction of knowledge expressed and articulated in the meshes of the participatory architecture of the social web [30]. The user who collaborates in the construction of knowledge simultaneously carries out an interpretive reading activity of the urban space in which he or she lives, a narrative and perceptual restitution activity, a self-representation and, last but not least, a participatory process.

The map produced by the community in a shared form can be considered an enabling factor of active and participatory citizenship, a map that allows for the representation through a non-technical description of the landscape, knowledge, products, stories, memories, favorite places to remember and where one meets, in which one recognizes or identifies oneself, as well as places characterized by social and environmental vulnerabilities, by critical elements such as those related to urban decay, a map that can become, therefore, an act of denunciation [19]. It should also be considered that decision-making processes related to new forms of urban transformation now postulate the involvement of communities in every aspect of enhancement projects, given the civic and inclusive nature of the commons involved in transformations [31]. Information produced by inhabitants with the help of digital technologies is shaping a citizenship made up of "citizens as sensors" [32] in reference to a new "citizen science" in which the role of the citizen in building a bottom-up vision of his or her territory and urban sphere becomes decisive.

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