VGI and crisis mapping in an emergency situation

Comparison of four case studies: Haiti, Kibera, Kathmandu, Centre Italy

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Fig.1 - Sequentially mapping OSMs to Port-Au-Prince: the first concerns the pre earthquake situation, the second situation as of January 29, 2010 and the latest situation in December 2016. Source: http: www.openstreetmap.org; www.hotosm.org

Over the last decade new voluntary mapping patterns are commonly known as VGI – *Volunteered Geographic Information* – that is, geo-localized information created voluntarily and consciously by web users. These are supported by platforms such as OpenStreetMap that have been shown in many emergency cases and not, a valid source of data, such detailed to be used for rescue operations.

In recent crisis contexts, the use of geo-spatial data analysis has been a precious resource in coordinating of rescue operations (Boccardo & Pasquali, 2012). As a consequence, numerous Open Source platform born to answer to the growing demand for geo-information. Crisis Mapping (CM) consists of the spontaneous process of gathering and geo-locating data from different sources, including closed/open-data, or crowdsourcing databases. These data are verified, catalogued and finally made visible in *ad hoc* platforms (Poser & Dransch, 2010).

With the overwhelming of technology, the spread of smartphones and mobile or fixed connections, humanitarian aid management during the post-emergency phases has radically changed. Today, even in less developed countries, most people have a mobile phone and they are able to send at least a simple SMS. Therefore, the term Crisis Mapping is often used to identify mapping activities during humanitarian crises. The activity of CM is targeted at collecting, displaying, updating and analysing real-time data in emergencies due to natural disasters such as earthquakes, floods, tsunamis, hurricanes, or anthropic disaster such as landslides, terrorist attacks or serious industrial accidents. When a disastrous event occurs, local or remote people (Crisis Mappers via web) mobilize themselves to update maps, report emergencies and spread news. This participation also helps to increase awareness of the event. Crisis Mappers are generally (unpaid) voluntary with or without specific skills. Indeed, a group of mappers is generally composed by simple resident of the area affected by the disaster who want to contribute to the rescue activities, computer science experts, web programmer who want to provide their

scientific contribution to the coordination operations.
To this purposes, a number of online groups have been created. Among them, one of the most important is Humanitarian OpenStreetMap Team (HOT), which supported OpenStreetMap (OSM) mapper activity in the first use of the application for an humanitarian goal: he Haiti earthquake in 2010 (Soden & Palen, 2014). Another example of Crisis Mapping is Ushahaidi, a web platform that uses OSM maps and is updated through the geo localization of messages from SMS, tweets and emails that contain certain keywords, called alert.
Other experiences adopted during the Hurricanes Sandy and Irene classified tweets on maps based on hashtags (http://faculty.washington.edu/kstarbi/TtT_Hurricane_Map_byEvent.html).
The availability of free satellite data and the experimentation of ever-new remote sensing techniques played a primary role in the spread of these approaches. CM activities can be considered as open participatory policies. Indeed, anyone join these communities, update their country map or a distant country one that they do not know, report discomfort launching a crisis map or report the quality values of a region through a map showing all the parks in the area, the paths without architectural barriers, or anything else.
This article proposes an analysis of several case in which volunteering activities were carried out in some post-emergency phases to contribute to the rescue operations and to build a previously non-existent cognitive framework.
The analysed web platforms are OpenStreetMap e Ushahidi.
Four case studies are considered: the Haiti earthquake of 2010, the post election crisis of Kibera in 2007/2008, the Kathmandu experience with the Nepal earthquake of 2012 and the central Italy earthquake of 2016. These four cases show substantial differences:

Haiti

With the disastrous earthquake, affecting Haiti in 2010, begins the spread of OSM in a natural emergency situation. Here the OSM community has had to endure a hard work to gain credibility before being recognized as an association. This is the first striking case in which is the population with SMS, Tweet e App, direct the rescue. The rescuers, with the support of platforms such as OSM and Ushahidi, receive updates without any third party intermediation (Neis, Singler, & Zipf, 2014) (Fig.1).

Kibera

Ushahidi is born in a contest of electoral violence. In Kibera, following the presidential elections in 2007, there was a climate of civil violence and a part of the population felt the need to make the whole world aware of the situation that was affecting their country. This led to the birth of Ushaihdi, which in *swahilli* means "witness" (Goldstein & Rotich, 2008). This case highlights how technology can be used not only as an evidence of the violence suffered but also to spread messages of hatred and violence.

Kathmandu

In Nepal, a country with a high seismic and tsunami risk, the OSM community started to take shape since 2012, helping to update the cartography of the country and to create information and interest toward the topic of disaster risk,

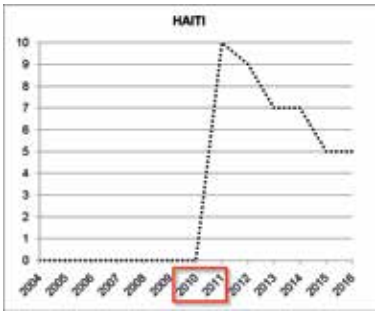

Chart 1a - utilization crowd mapping platforms Haiti

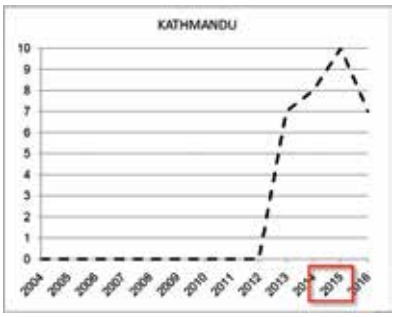

Chart 1b - utilization crowd mapping platforms Kathmadu

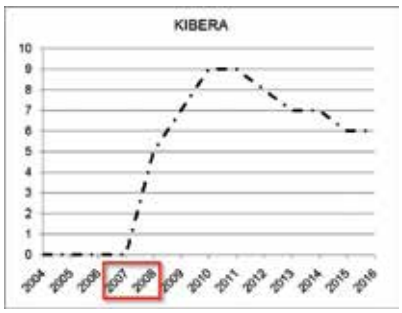

Chart 1c - utilization crowd mapping platforms Kibera

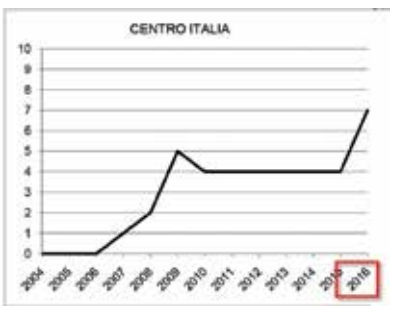

Chart 1d - utilization crowd mapping platforms Centro Italia

especially in schools (Soden, Budhathoki, & Palen, 2014). In 2015, when the earthquake occurred, the country was not taken unprepared by the fact that the OSM community had long been consolidated and could therefore act more easily (Poiani, dos Santos Rocha, Castro Degrossi, & de Albuquerque, 2016).

Central Italy

Following the earthquake swarm hitting the territory of Central Italy since 24 August 2016, the OSM community has been working hard to update local maps and make them available to everyone. This promptness with which the community developed a huge quantity of useful geo-information has aroused the interest of the Copernicus project, that has acquired OSM data and redistributed them to the rescuers, i.e. the italian civil protection. Therefore, there was not a direct passage between OSM and rescuers, as Copernicus mediation was needed.

To correctly evaluate and compare these experiences, an evaluation of the temporal continuity of the projects would be necessary. Indeed, they sometimes produce the highest results right after the disasters to face an emergency, except

	Haiti	Kathmandu	Kibera	Centro Italia
Character of the event	Natural	Natural	Anthropic	Natural
Type of event	Earthquake	Earthquake, Tsunami	Post-elettoral violence	Seismic swarm
Main open source platforms used	OSM, HOT, Ushahidi, Sahana, Crisis Commons	OSM, Ushahidi, HOT	Ushahidi, OSM	OSM, HOT
Main closed source platforms used	Google Mapmaker, DigitalGlobe GeoEye	Google Maps	Google Maps	Copernicus, DigitalGlobe
Web and social	Facebook, Twitter	Facebook, Twitter, Skype	Facebook, Twitter	Facebook, Twitter, Flickr
Developed projects and non-profit organizations	HOT	Open Cities Kathmandu, Kathmandu Living Labs (KLL), MapGive	Map Kibera, Voice of Kibera	terremotocentroitalia.info
Direct relationship between rescuers and the technology community	YES	YES	YES	NO

Tab. 1 - A comparison table between the various case studies reveals the platforms used and the relationships between the data produced and the rescuers.

then die with the same speed when the emergency ends.
The different cases were first evaluated individually, each from the OSM platform's birth year (2004) up to the end of 2016 (Chart 1a-d). Subsequently, they were compared through a qualitative graph based on the period before the emergency event, the period of the emergency event and the next one.
Therefore, analyzing the pre-emergency, emergency and post-emergency were given the following scores:
Haiti (Chart 1a): as far as the pre-emergency period is concerned, a score of 0 is assigned. This is because there was not an active technological community in the area before the seismic event. For the emergency period, the maximum score of 10 was assigned. In fact the OSM community is formed during the emergency period (seismic event) and the emergency responders directly use the datasets created by it. For post-emergence a score ranges from 9 to 5. Numerous initiatives and coordination operations with humanitarian organizations took place in the years after the event; today the OSM community continues to work on Haiti territory and is very active.
Kibera (Chart 1b): as far as the pre-emergency period is concerned, a score of 0 is assigned. This is because there were not an active technological community in the area before the emergency event (electoral violence). For the emergency period a score ranges from 5 to 7. The score is increasing in this period since during the emergency phase, several crowd mapping groups started to spread in the area; Ushahidi is born in this period and news are spread through crisis maps. For post-emergence a score ranges from 9 to 6, since immediately after the emergency, all site maps are updated to allow humanitarian organizations to be in direct contact with local events.
Kathmandu (Chart 1c): as far as the pre-emergency period is concerned a score ranges from 0 to 8. In a period of peace, in fact, Kathmandu (Nepal) becomes an active community.

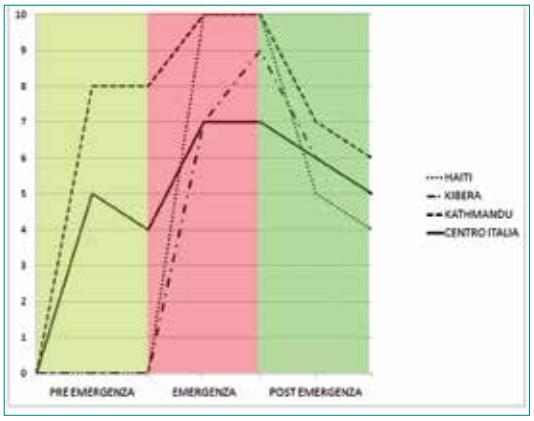

Chart 2 - Comparison chart between the four case studies analyzed.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HAITI	0	0	0	0	0	0	10	9	8	7	7	5	5
KIBERA	0	0	0	0	5	7	9	9	8	7	7	6	6
KATHMANDU	0	0	0	0	0	0	0	0	0	7	8	10	7
CENTRO ITALIA	0	0	0	1	2	5	4	4	4	4	4	4	7

	:PRE-EMERGENCY
	: EMERGENCY
	: POST EMERGENCY

Tab. 2 – Assign score from 0 to 10 to four case studies with relative legend.

The OSM community starts to update maps and spreading knowledge about seismic risk, especially in schools. For the emergency period, the maximum score of 10 was assigned. Thanks to the work done by the OSM community during the pre-emergence period, the emergency period becomes an opportunity to test the efficiency of crowd mapping. In fact, it is the time of maximum efficiency of the platforms thanks to a well-established community, ready to face the event. For post-emergence a score of 5 is assigned. Today the OSM community continues to persist.

Central Italy (Chart 1d): as far as the pre-emergency period is concerned a score ranges from 0 to 4 with a peak of 5 in 2009. The OSM community starts working already before the events. In 2009, the score increases to 5 as after the earthquake striking Abruzzo, the OSM community worked to update the maps of L'Aquila. Nevertheless, they only worked on the maps after the earthquake (to support the reconstruction).

For the emergency period a score of 7 is assigned. In fact, during the emergency, the OSM community appears to be efficient in updating the maps. Despite that, the use of the data by the rescuers was only possible through the intermediation of other entities. For the post emergency period a score of 6 or 5 is assigned. This score is indicative, it is only an estimate of what could happen considering that Central Italy is still in the state of emergency (January 2017). The qualitative chart represents the four case studies compared. The yellow zone represents the period before the event, the red zone the event and the green zone the following period. It showed that: In cases where prior to the event (seismic or other) there was a already stable and already active crisis mapper community, the use of the platforms and datasets made available was immediate. It is also evident, under some circumstances, that these platforms are being used most in the emergency period by reaching high peaks, and are left out in pre and post-emergence periods.

Using crowd mapping platforms since the birth of OSM in 2004:	
0	Null usage. There isn't technology community in the site involved in crowd mapping.
from 1 to 5	Creating technology communities interested in the subject that begin to enrich the maps and spread the use of crowd mapping platforms.
from 6 to 10	Crowd mapping platforms are used for humanitarian purposes and as support for the administrations concerned.

Tab. 3 - utilization crowd mapping platforms since birth of OSM in 2004.

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KEYWORDS

Crowdsourcing; OSM; Ushahidi; Crisismapping; VGI

ABSTRACT

Over the last decade new voluntary mapping patterns are commonly known as VGI – *Volunteered Geographic Information* – that is, geo-localized information created voluntarily and consciously by web users. These are supported by platforms such as OpenStreetMap that have been shown in many emergency cases and not, a valid source of data, such detailed to be used for rescue operations. Another completely open source platform that has revolutionized the world of geographic information and how to make reports is Ushaidi that through interactive maps represents testimonies, reports, diaries, and citizen reports.

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