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**Community mapping in developing contexts – limits  
and benefits**

Case study of OpenStreetMap Senegal

Master Thesis

Supervisor: Mgr. Jiří PÁNEK, PhD.

Olomouc 2015

I declare in lieu of oath that I wrote this thesis myself. All information derived from the work of others has been acknowledged in the text and in the list of references.

Olomouc, 23<sup>rd</sup> March, 2015

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Signature

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## ZADÁNÍ DIPLOMOVÉ PRÁCE

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### Z á s a d y p r o v y p r a c o v á n í :

The main objective of the paper is an analysis of limits and benefits of community mapping in the context of development and humanitarian assistance and its potential in capacity building, disaster risk reduction and crisis preparedness. The research included in the paper will be focused on the very basis of the phenomenon of participatory and community mapping - the specifics of data gathering and producing the baseline data in developing contexts. Special attention will be given to the process of validation of crowd sourced data. The main contribution of the diploma thesis will consist in the introduction of the concept of community mapping and its connection with the development and humanitarian assistance.

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## ABSTRACT

The thesis is dedicated to the phenomenon of community mapping, specifically to its online form, and its potential in the context of development assistance and humanitarian aid. First part presents the background for online community mapping by introducing specific milestones in its evolution. Further the concept is described in detail. Its definition is outlined and its significance for the international development agenda is discussed and demonstrated on several examples. The special attention is given to the constraints to online community mapping and their possible mitigation. Finally the case study of OpenStreetMap community in Senegal is introduced. The structure of the group, its characteristics, challenges and achievements are presented. Using the examples of Senegal and Burundi the specifics of the data collection for online community mapping and its further use in developing contexts are described.

**Key words:** community mapping, development assistance, geographical information systems, humanitarian aid, OpenStreetMap

## ABSTRAKT

Diplomová práce se zabývá fenoménem komunitního mapování, konkrétně jeho online podobou a jejím potenciálním využitím v kontextu rozvojové spolupráce a humanitární pomoci. V první části jsou popsány důležité milníky ve vývoji online komunitního mapování, čímž je současně představeno jeho pozadí. Koncept je detailně popsán v další části, ve které je mimo jiné nastíněna jeho definice. Tato část dále pojednává o významu online komunitního mapování pro mezinárodní rozvoj, který je demonstrován na několika příkladech. Zvláštní pozornost je věnována limitům online komunitního mapování a jejich možnému předcházení. Poslední část představuje případovou studii OpenStreetMap komunity v Senegalu. Struktura skupiny, její charakteristiky, problémy a úspěchy jsou představeny v rámci této studie. Specifika sběru dat pro online komunitní mapování a jejich další využití v kontextu rozvojových zemí je popsáno na příkladu Senegalu a Burundi.

**Klíčová slova:** komunitní mapování, rozvojová spolupráce, geografické informační systémy, humanitární pomoc, OpenStreetMap

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## LIST OF ABBREVIATIONS

**AJDI** – Association des Jeunes pour la Démocratization de l’Informatique

**APA** – American Psychological Association

**CAR** – Central African Republic

**CBOs** – Community Based Organizations

**COPEd** – Conseil pour l’Education et le Développement

**D4D** – Data for Development

**DRC** – Democratic Republic of Congo

**EUROSHA** – European Open Source Humanitarian Aid

**FOSS** – Free and Open Source Software

**GDP** – Gross Domestic Product

**GIS** – Geographic Information System

**GPS** – Global Positioning System

**HOT** – Humanitarian OpenStreetMap Team

**HFOSS** – Humanitarian Free and Open Source Software

**ICRC** – International Committee of the Red Cross

**ICTs** – Informational and Communicational Technologies

**IOF** – International Organization of the Francophonie

**IRC** – International Rescue Committee

**IT** – Information Technology

**MSF** – Médecins Sans Frontières

**NGOs** – Non-Governmental Organizations

**ODbL** – Open Database License

**ONPRA** – National Office for the Protection of Refugees and Stateless Persons

**OSM** – OpenStreetMap

**PGIS** – Participatory Geographic Information System

**PSI** – Population Services International

**SDGs** – Sustainable Development Goals

**UN** – United Nations

**UNICEF** – United Nations Children’s Fund

**UN OCHA** – United Nations Office for the Coordination of Humanitarian Affairs

**VGI** – Volunteered Geographic Information

**WFP** – World Food Programme

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## INTRODUCTION

The technological advance has been fundamentally changing nearly every aspect in today's globalized world. The world is shrinking due to information and communication technologies (ICTs), the distances between people are becoming less relevant than ever, what was once perceived as a local issue is now influencing people on the global scale. International development is also taking an advantage of this process by incorporating the new technologies into its agenda. This thesis examines community mapping as one of the concepts that has emerged from this technological boom and its implications for the field of international development and humanitarian aid.

Community mapping can emerge as a collective response to particular incident but often it happens without any external impulse. Various groups involved in community mapping work under different patterns, with different tools and for different reasons. They can work with or without supervision and they may or may not be involved in an official agenda of development assistance actors. Consequently it is very problematic to compare each initiative in its results as the incentives for mapping and the methods vary significantly.

Furthermore, identifying the geographical disparities in community mapping is very complicated as well. Community mapping occurs in the countries of the global south as well as in the developed world where the share of data produced by mapping is bigger. This is often due to higher availability of the technology that is needed specifically for the online form of community mapping. Technology and the access to the Internet in particular, played a key role in the evolution of community mapping to the form that is covered in this thesis – online community mapping. Nowadays, people who are keen on mapping can take part in such actions through the Internet and can support community mapping everywhere in the world, not just in their own environment. Therefore, communities in the global south can benefit from the skills of mappers from all over the world and can take advantage on their contribution and experience and vice versa.

Based on the selected articles (Soden & Palen, 2014; Pánek, 2014; Bello & Ojigi, 2013; Shemak, 2014; Boccardo & Giulio Tonolo; 2015) the online community mapping is one of the most recent forms of community mapping. The literature on this topic is scarce as there is still a lack of research done. The need for qualitative and

quantitative data is therefore very high. This thesis is mainly focused on online community mapping in the contexts of Western and Southeast regions of Africa. The specific cases of mapping communities are referred to a case study of local OpenStreetMap community in Senegal and to the European open-source humanitarian aid project in Burundi. The focus of the case study highly reflects the author's personal motivation as both of the projects represent her own experience with the subject of the thesis.

# 1. AIMS OF THE THESIS

This thesis represents a comprehensive study of community mapping in developing contexts. Community mapping as such is a highly complex phenomenon that is nearly impossible to cover in depth in the scale of this thesis. For the purposes of the thesis the main attention is therefore given to the online form of community mapping. **The general objective of the thesis is to analyze the limits and benefits of the community mapping in the context of development and humanitarian assistance.** This objective is further divided into intermediate objectives that are elaborated in detail into the specific chapters under the research part of the thesis.

The first part of the thesis is the introduction to the concept of the technological change that constitutes the background for community mapping. This part represents historical contextualization of the concept of online community mapping. Each sub-chapter describes specific milestone in the evolution of the concept and logically follows from the rise of the Web 2.0 to the emergence of community mapping. The main concepts that arose from the new technologies are outlined as they are inseparably interconnected with community mapping as such. Special attention is given to the open source/open data initiative, crowdsourcing information, the role of the social media in this process and the importance of crowdsourcing in the context of development assistance and humanitarian aid.

The following part of the thesis presents the online community mapping. Firstly the definition is drawn and the significance of the concept for the development assistance is highlighted. Furthermore the motivation of people to join such initiatives is explored. Then the concept of online community mapping is discussed in the different frameworks of international development and the concrete examples of its use are given. As a conclusion to the first part the challenges of online community mapping are discussed.

Finally, the case study of the OpenStreetMap (OSM) community in Senegal which is the essence of the thesis is presented. The research conducted by the author in summer 2014 focuses on the characteristics of the mapping community in Senegal that emerged from the western-based project of the Humanitarian OpenStreetMap Team (HOT) and is now working independently.

On this particular example the three intermediate objectives are elaborated. The first intermediate objective is to characterize the OSM community in Senegal. In this part the history of the community is outlined as well as its current structure, challenges and achievements. The second objective is aimed on exploring the specifics of the collection and production of primary geographical data in the developing context. The relevance of this particular aim for this thesis lays in the fact that the availability of baseline data in developing countries is often very limited and requires therefore a different approach than the data collection in the developed world. The last intermediate objective of this thesis is to explore the usage of the data and maps that emerged from community mapping in developing countries. This part gives an overview of the current state of usage of such data and it discusses the potential that lies in that data.

## 2. METHODOLOGY

For the purposes of the thesis both primary and secondary sources of information were used. The thesis contains compilation and analysis of existing literature with results of the field research. The primary data are results of a field research conducted by the author in the summer 2014 in Senegal while the secondary data originates from the related literature, case studies and other sources. The authors' experience from another mapping project in Burundi presents a source of the complementary data in the case study of online community mapping.

The third and fourth chapters are based mainly on secondary data analysis. For the theoretical part the existing relevant literature covering the topic of community mapping was reviewed. While the majority of literature used as a source for this paper was written in English language, the small part of the resources was written in Czech language.

The fifth chapter represents the results of the field research conducted by the author in Senegal in 2014. Nevertheless, some information used in this chapter is also based on the author's genuine experience from the mapping project that was implemented in Burundi in 2012/2013. The methodology of the research, specific objectives and the description of the sites are further elaborated in chapter 5.1 Research Methodology.

Throughout the whole thesis the American Psychological Association (APA) citation style is used. All literature and other sources used for the purposes of this paper are listed in the Bibliography section at the end of the thesis. Both direct and indirect citations are used in this paper. The direct citations are written in italics and the text is demarked by the quotation marks. If the text is not quoted neither the reference is used the statement is made by the author alone.



### 3. BASIC CONCEPTS

The following chapter presents several technologies and movements that represent the background for the revolution that has been happening in the world of geographic information systems (GIS). Those concepts and their mutual interactions enabled the phenomenon of online community mapping to emerge.

#### 3.1. Open Source and Open Data

Before speaking about online community mapping there are a few terms that need to be explained for they create the concept's background and are inseparably interconnected. Among those concepts open source and open data are perhaps those that deserve the most space as they represent the very basis of the phenomenon.

According to the Open Source Initiative (2013) the term “open source” is being used to characterize computer software with a freely accessible and modifiable source code. Software under the open source license is free to redistribution and all derived works has to be released under the same license. Consequently, as mentions Corbly (2014, p. 66), the open source software products often arise from a collaborative work of contributors from all around the world which ensures the quality of the software. Goodchild and Li (2012) explain: *“the bugs in a piece of software are most likely to be found and corrected if a large number of software engineers have an opportunity to review the software.”* (p. 112)

The advantages of open source software have been used in a framework of development under the term Humanitarian Free and Open Source Software (HFOSS) which represents projects that aim on engaging open source communities in building free and open source software (FOSS) that benefits the society. (Morelli, Tucker, de Lanerolle, 2010, Abstract section, para.1) As claim Currion, De Silva and Van De Walle (2007, p. 62), the principles of free and open source software align to those in the humanitarian domain and therefore bring together two different volunteering communities towards the common goal.

While the term “open source” is limited to the software description, “open data” term covers something more extensive. It refers to the idea that certain data should be freely available to everyone without any restrictions. Although the philosophy of open

data is broader, the term itself refers mainly to the data that can be published on the Internet. Other important features connected to the phenomenon are the licensing and format of the data. The license allowing them to be freely re-used is an essential attribute of open data. Same thing applies for the format in which the data are released that needs to ensure their simple extraction. (Pánek, 2013, p. 33) The open data movement challenges the traditional perception of control over the existing data that, by being unlocked, can achieve their full potential. (Miller, Styles, Heath, 2008, Conclusions and Outlook section, para 1)

Releasing the data for public use creates numerous opportunities for the international development community to engage. The United Nations report Disaster Relief 2.0 that was released in 2005 carries the subheading “the future of information sharing in humanitarian emergencies” and examines, among other things, the potential of open data for humanitarian assistance. Others, like Linders (2013, p. 426), argue that by leveraging released data properly the international aid can actually advance the global aid effectiveness agenda of the development community.

### **3.2. Web 2.0**

The term Web 2.0 refers to the recent shift of using the World Wide Web from a viewing tool to the platform where users can interact with each other, share their skills and experience and collaborate. Whereas the earlier web sites were limited to the passive usage such as simple browsing the content, the Web 2.0 allows Internet users to participate. This can involve mutual interaction through the social networking sites, creating the web applications or data sharing.

Tim O’Reilly (2009), supporter of the open source movements, who is perceived to popularize the term Web 2.0, argues that the concept does not have any hard boundary but rather “*gravitational core*”. (The Web as Platform section, para. 1) Therefore it is not easy to find a comprehensive definition of the term. On his website O’Reilly (2005) defines the Web 2.0 as “*the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that*

*allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences."*

In the connection with the development assistance the rise of the Web 2.0 means a significant turning point. The traditional actors of development aid and humanitarian response are suddenly being complemented with the Internet users who are willing to contribute their skills and experience to the cause. The parallel spreading of the Internet connection availability consequently allowed the very recipients of aid to change their passive roles and to take part in the cycle. The line between the aid providers and its recipients is slowly becoming faded as the latter are more and more incorporated into the processes and are not anymore represented only by the facts and figures provided by the traditional development and humanitarian actors such as non-governmental organizations (NGOs). The possibility of the participation provides the traditional recipients of humanitarian aid with the voice to articulate their needs, to proclaim them and allows them to take action themselves.

One example of taking the benefits of Web 2.0 for international development is a platform launched by the United Nation Volunteers programme – [www.onlinevolunteering.com](http://www.onlinevolunteering.com). The platform brings together NGOs, United Nations (UN) agencies and individuals who are willing to contribute their time and skills for purposes of sustainable human development. Online volunteers work together on tasks that can be performed through the Internet, like creating websites, translations, or distance mapping. The service has been working since 2000 and just in 2013 it was used by more than 11,000 volunteers. (United Nations Volunteers, 2014)

### **3.3. Crowdsourcing**

By the definition of Bynum (2013) in Salem Press Encyclopedia the term crowdsourcing refers to *“an established way of conducting business on the Internet, where specific content is solicited from a large, and often anonymous, online community.”* The term was first used by Jeff Howe (2006) in an issue of *Weird* magazine where he describes crowdsourcing as another step of outsourcing, powered by the new technology. He states: *“Technological advances in everything from product design software to digital video cameras are breaking down the cost barriers that once*

*separated amateurs from professionals. Hobbyists, part-timers, and dabblers suddenly have a market for their efforts, as smart companies in industries as disparate as pharmaceuticals and television discover ways to tap the latent talent of the crowd. The labor isn't always free, but it costs a lot less than paying traditional employees. It's not outsourcing; it's crowdsourcing"* (p. 2)

While Howe in his article uses examples mainly connected to the private sector, crowdsourcing has a lot to offer to the international development community as well. A very characteristic example of crowdsourcing used for benefits of the community is Wikipedia as *"a multilingual, web-based, free-content encyclopedia project (...) based on a model of openly editable content"* (Wikipedia, 2015)

In the form of social media, crowdsourcing fundamentally challenges the traditional pattern of journalism and information sharing on a global scale. Pryor, Wulf, Alanzi, Alhamad and Shomefund (2014, p. 19) highlight the role of social media as a real-time network of users spreading out unfiltered information that can consequently encourage diffusing democratic principles such as freedom of speech, assembly and press. Meier (2011) even titles social media as *"the new nervous system of our planet"* (p. 2). The power of social media as a real time crowdsourced form of journalism has been used many times in recent history. During the Arab spring, when there were just a limited number of foreign journalists on site, Twitter users, the majority of them locals, were the quickest and the most accurate source of information for the outside world. Similarly Iranian elections in 2009, terrorist attacks in Mumbai and Haitian earthquake were covered by hundreds of thousands of tweets before traditional journalism took over the task. (Hermida, Louis, Zamith, 2014, p. 481-482)

The leverage of the crowdsourcing in the framework of development is still very limited, as will be discussed further, yet it has already achieved certain goals. In 2007 soon after the Kenyan presidential election the local web platform Ushahidi<sup>1</sup> was launched. In the atmosphere of the post-election unrest and the governmental ban of mainstream media, a few local volunteers were engaged in gathering information about violence from citizens and posting it online. The number of participants eventually grew to 45,000 and the project gained the attention of the international development community. The Ushahidi platform has grown into the shape of a non-profit tech

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<sup>1</sup> Ushahidi is a Swahilli word for „testimony“

company that specializes in developing free and open source software for information collection, visualization and interactive mapping. (Marsden, 2013, p. 53)

Although the crowdsourcing can provide valuable real-time information, that is especially useful in times of crisis, there is an ongoing dispute over its verification. The character of the social media creates an environment where releasing false information is extremely easy and as Meier (2011, p. 2) states with the amount of information the immediate verification is often challenging. Further Meier explained that the problematic verification of crowdsourced data is the main reason for the reluctance of the international development community of leveraging more of the potential of this phenomenon. Nevertheless as Hermida et al. (2014, p. 479-499) presents on the example of crowdsourcing journalism during the Arab spring, with the right approach even such an enormous amount of information can be effectively verified and further used.<sup>2</sup>

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<sup>2</sup> The verification of crowdsourced information is further discussed as a part of chapter 4.5 Challenges to community mapping

## **4. ONLINE COMMUNITY MAPPING**

In places where base data are often scarce or out of date, free and collaborative maps are valuable sources of information to the humanitarian and development assistance. Not only do they provide unique geolocalized information about health service, infrastructure, education, and so on, but the process of their creation enables communities all over the world to take over the action by sharing their knowledge.

As the conventional view of the humanitarian and development work assumes the latter to be performed exclusively by professionals in the relevant field, online community mapping represents the approach that takes an advantage of the globalized world where everybody can take an action by using technologies available to all. Community mapping creates an opportunity for people to map with a cause as well as filling the gap between the field workers and their need for available up-to date maps during their mission.

### **4.1. Defining the Community Mapping**

Community mapping is not a new concept and its traditional forms have been used for the purposes of community empowerment by numerous international organizations. However its online form that emerged with the rise of the new technologies has been neglected by traditional actors in the development framework as well as by major policy makers so far. (Meier, 2011, p. 2) This attitude is slowly changing towards a greater incorporation of community mapping into the global development agenda. It is mainly due to the role the online community mapping played during the destructive earthquake on Haiti in 2010.<sup>3</sup> (Soden & Palen, 2014, p. 315) Nevertheless, finding an appropriate definition of this phenomenon is still quite difficult. As notes Perkins (2007, p. 127) the community mapping is largely subsumed into the participatory geographic information systems (PGIS) literature and is not given proper space. Although the two terms overlap largely, community mapping refers mostly to the data gathering whereas PGIS is more connected with the data processing. (Forrester & Cinderby, 2012)

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<sup>3</sup> This particular case is further discussed in chapter 4.4.3 Community Mapping's Role in Disaster Response

Moreover, the concept of community mapping blends together with very similar terms like collaborative mapping, participatory mapping, neocartography or even crisis mapping and it is not possible to draw the clear boundary among them. For the purposes of this thesis the most comprehensive definition of community mapping is presented by Perkins (2007) that describes it as “*local mapping, produced collaboratively, by local people and often incorporating alternative local knowledge.*“ (p. 127)

However the definition above presents community mapping in its broadest concept and even though the online form of community mapping is somehow covered by the definition it is not very straightforward. To approach the concept more precisely it is therefore necessary to look for another term that helps with drawing the definition. The term is volunteered geographic information (VGI) and was defined by Goodchild and Li (2012) as “*a version of crowd-sourcing in which members of the general public create and contribute georeferenced facts about the Earth’s surface and near-surface to websites where the facts are synthesized into databases.*“ (p. 110)

By compiling those two definitions we can consequently characterize online community mapping as a specific form of crowd-sourcing performed by members of the communities who collaboratively create and contribute geographical data about their nearest environments to online mapping platforms.

Community mapping is basically a result of what Rød, Ormeling and Elzakker (2001, p. 38) describe as a democratic approach to cartography. They explain further that since 1995 cartography, discipline once highly specialized, is now becoming available to everyone. Unlike in past times, when maps created by professionals were always used, people are slowly discovering the participatory approach to the cartography and are contributing their natural mapping abilities<sup>4</sup> to the cause. (Perkins, 2007, p. 127)

The major role in this shift towards community, rather than institutional-based, mapping plays the wide availability of open source software for production high-quality maps. These can be used without literally any previous expertise in cartography. The general belief is that with this software people can create maps of their own

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<sup>4</sup> According to Blaut, Stea, Spencer and Blades (2003) all human beings are naturally capable to map, regardless cultural background. This ability is considered as a “*fundamental part of human ecological adaptation*” (p. 165)

environment, using local knowledge, more effectively than external mapping experts. (Goodchild & Li, 2012, p. 111) Together with the emergence of community mapping several web-based mapping platforms grew up. By the number of its contributors the OSM project is by far the most successful one with over 1,900,000 of people registered there. (OSM Stats, 2015) A general goal of such platforms is to create global datasets of geographical information that are not restricted by copyright or proprietary rights and could be accessed, edited and modified by its users. (Rouse, Bergeron & Harris, 2012, p. 156)

## 4.2. Significance of Community Mapping

According to Pickles (2004) throughout modern history, mapping has always been a tool to project one's perception of the world. Traditionally the art of cartography was privileged to a few and it often reflected the limited geographical knowledge or it intentionally distorted the reality as the incentives for mapping were different in the past. (as cited in Perkins, 2007, p. 127)

For example, as mention Kraak and Ormeling (2011, p. 64), the maps in the nineteenth century were created specifically with the military purpose, typically to support colonial projects. McClintock (2013, p. 27) states: "*The colonial map vividly embodies the contradictions of colonial discourse. Map-making became the servant of colonial plunder, for the knowledge constituted by the map both preceded and legitimized the conquest of territory. The map is a technology of knowledge that professes to capture the truth about a place in pure, scientific form, operating under the guise of scientific exactitude and promising to retrieve and reproduce nature exactly as it is. As such, it is also a technology of possession, promising that those with the capacity to make such perfect representations must also have the right of territorial control*". Therefore, from the detached point of view, the predicative potential of those maps was generally very low. Moreover, the ability to create a map often meant the ability to define the reality. Pickles (2004) goes even further by claiming that "*the world has literally been made, domesticated and ordered by drawing lines, distinctions, taxonomies and hierarchies: Europe and its others, West and non-West, or people with history and people without history.*" (as cited in Banerjee & Das, 2008, p. 194)



Compared to the monopolizing of the power that is to a certain extent represented by the traditional approach to cartography, community mapping offers an alternative that is not only much more inclusive but also prone to facilitate communities' empowerment on a local as well as on a global scale.

Among other things community mapping significantly influences the perception of cartography and its potential role in social change. As examples of the struggles that can be addressed by community mapping Perkins (2007, p. 127) lists the following: reasserting indigenous people's rights, re-mapping lost place-names, re-publishing the past for contemporary consumption, protecting local wildlife, conserving landscapes, advancing local land claims, putting forward arguments over resources such as forests, minerals or fishing, protesting against planners, opposing military power, rejecting surveillance. Further, he argues that through community mapping marginalized groups can gain a voice and since it encourages collaborative participation it can be used as an effective medium to organize opposition as well.

During recent history community mapping has already been applied in the framework of development aid and has had some astonishing results. Among others Chambers (2006, p. 4-5) mentions prevention of crime in South Africa and Tanzania, where the most dangerous places for women were identified by locals and the map of potential crimes was created. Or mapping the farming practices in India as early as 1990. In the framework of that mapping project the farmers were asked to create the baseline maps that were consequently used for soil monitoring, water conservation analysis or changes in farming practices. (Chambers, 2006, p. 5)

### **4.3. Motivation of Mappers**

The whole concept of online community mapping is fundamentally rooted in the mappers' own initiative to map. To understand the phenomenon means therefore to acknowledge what drives individuals to join an existing mapping activation or to start to map on their own. As was already mentioned the most successful web-based platform to which mappers can contribute is OSM with 1,924,425 registered mappers on 8<sup>th</sup> January 2015 (OSM Stats, 2015). The following analysis will therefore be focused on motivations of the contributors to this specific platform.

OSM is a progressive project with the significant annual growth<sup>5</sup> of its membership. However it is important to realize that the registration itself does not ensure active contribution. Although the number of users of the OSM project may seem impressive, as Steinman, Gröchenig, Rehrl and Brunauer (2013, Introduction section, para. 1) argue only around 5% of mappers contribute the majority of the data. This phenomenon is further described by Nies and Zielstra (2014, p. 87) as the “participation inequality” has been identified for the Wikipedia project as well. In both cases the research similarly suggests that 90% of registered users actually never contributed to the project, 9% of them add information irregularly and 1% is responsible for almost all of the contribution. Same inequality pattern applies also to the contribution distribution over the week. While the weekdays show approximately consistent share of data edits during Sunday the contributions raise. On the days’ scale the afternoon and evening hours count for the majority of OSM contributions. Since the project does not require its users to provide their nationality during the registration it is not easy to determine their areal distribution. However according to Budhathoki (2010, p. 67) who, by analyzing the number of added nodes per country for each contributor, created a model with the contribution pattern three out of four contributors come from Europe.

The OSM community is a very heterogenic group that brings together people with diverse background and with different motivations. Nevertheless there are some trends that can serve as a tool for deeper understanding of its structure. According to Nies and Zielstra (2014, p. 90-91) who have reviewed the recent studies on the topic the overwhelming majority (97%) of OSM contributors are males and more than 60% are in the age between 20 and 40 years. Between 63% and 78% (depending on the concrete study) poses college, university or higher degree whereas around 50% have a degree or work in the field of geography, urban planning or related field.

A comprehensive study among OSM users that was carried out by Bufhathoki (2010, p. 69-76) has generated a scale of motivating factors that has brought the participants of the research to mapping. The one that has been expressed the most was the value of the free availability of digital geographic information followed by a desire to help others, fascination with the map, enjoyment, achievability of the project goal, belief of the goal, creation of an accurate map, meeting the geographic information

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<sup>5</sup> On January 6 2013 the OSM project reached 1,000,000 of registered users. Since then the annual growth in user registration is 500,000. (OSM Stats, 2015)

needs of others, representation of place and so on. Nies and Zielstra (2014) compiled results from this study with data generated by other studies on this particular topic<sup>6</sup> and present it in a comprehensive classification. (Table 1)

**Table 1:** Motivating factors for community mapping (Nies, Zielstra, 2014, p. 90)

Constructive motivating factors		Negative motivating factors
<u>Intrinsic</u>	<u>Extrinsic</u>	
Altruism	Social reward/relations	Mischief/vandalism
Fun/recreation	Career	Malice or criminal intent
Learning/personal enrichment	Personal reputation	
Unique ethos	Community/project goal	
Self-expression/image	System trust	

Another interesting aspect that came out of the attempts to characterize OSM community is examined by Mooney and Corcoran (2012) in their study of the collaboration within the OSM project. By analyzing geographical data that were created and edited in the London area they conclude that “*there is no explicit social network structure to the OSM spatial database.*” (p. 286) However in the case of the most active contributors in a given area some collaboration was detected.

All of the above studies were carried out on a global scale, or were concentrating on case studies from western part of the world. However the dynamics, motivations and the structure of mapping communities in other contexts might vary significantly. As has been already indicated the vast majority of the contributors have European origin. That also reflects the state of the OSM data in different parts of the world. While in Europe and North America the geographical data cover most of the area, the places with fewer contributors are in general very poorly mapped. In the majority of the cases those places make part of the developing world. According to the Budhathoki (2010, p. 67) out of

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<sup>6</sup> Other studies mentioned in Nies and Ziestra (2014) were not concentrated specifically on the OpenStreetMap project but included also other VGI initiatives

more than 30,000 active contributors to OSM only around 400 come from Africa, 1,800 from Asia and 600 from South America.<sup>7</sup>

There are several reasons for such differences throughout the world. Although the technology that is necessary for contributing to a web based mapping platform is already quite widespread it is still not an asset that every family would possess. That statement is particularly valid in the context of developing countries. Even in the capitals or technological hubs of the regions, the Internet connection is not reliable and it is often unaffordable for ordinary citizens.<sup>8</sup> People are therefore obliged to use the connection through the Internet cafés or in the workplace. However the problem lies not only in the lack of the Internet access in the developing countries. As Goodchild (2007, p. 220) explains, another problematic fact is that many web-based mapping platforms support only Roman alphabet and English language which consequently excludes potential users from certain linguistic circles from participation. Another difference comes with the free time that is necessary for community mapping which is, for the majority of contributors, a leisure activity. Whereas having the free time to spare is common in the western culture, many citizens in the developing countries often have no such choice. The working patterns are different and do not guarantee the free time to individuals. Finding a sufficient time for mapping is therefore much more challenging in developing contexts. The scheme of actual mapping differs as well. As was mentioned by Mooney and Corcoran (2012, p. 286) the mappers in the developed world are often mapping individually rather than collaboratively. There were no such studies carried out that would focus solely on the mapping community in the developing world. However this might not be a case in those contexts. The author's experience suggests that while the awareness of the existence of such project is generally high in the developed world, in the countries of the global south the primal incentive to start the mapping community often comes from an external factor. A large portion of the active OSM contributors from the developing world therefore is, or used to be, part of the development project, humanitarian response or a reach out project of OSM community.

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<sup>7</sup> The author of this paper is aware of the disparities within the continents however there are no data available for each country. Hence for the purposes of this analysis the continents are perceived as homogenous entities.

<sup>8</sup> According to the Internet Society (2013) the average price for 1 GB of traffic is 120 US Dollars in South Africa. However the prices varies throughout the continent and do not reflect the income of the households, hence affordability of the connection.

As the general motivation factors were discussed above they may also vary significantly while examined in a different context. Although the mapping activities are not primarily carried out with the purpose of financial rewards, by learning how to map individuals can broaden their portfolio hence increase their employability. In places where the competition within the labor market is extremely high, this might be a strong motivational factor. Furthermore, the emphasis on the community empowerment as a motivating factor can be stronger in the context of the developing world.

#### **4.4. Community Mapping in the Context of International Development**

According to the selected sources (Soden & Palen, 2014; Lüge, 2014; Pánek, 2015, Bello & Ojigi, 2013; Shemak, 2014) community mapping has become a notable phenomenon in the context of development and humanitarian work all over the world in the past years. Goodchild (2007, p. 217) states that the significance of community mapping in the context of the developing world reflects among other things the general cartographical crisis those countries have been going through. As he further explains many of them do not even sustain the national cartographical agencies especially due to the high costs. The available maps (that come almost exclusively in the paper formats) therefore often represent the heritage of the colonial times. Furthermore, the recent emergence of this phenomenon as a part of an international development agenda greatly reflects the need for up to date maps throughout the whole cycle of relief work as well as for the long term planning under the development projects. The other reason for such a boom is the current shift towards community empowerment and recognition of volunteering as a legitimate manner of performing the development and humanitarian assistance. This process is highly represented by the probable incorporating of the volunteerism into the post-2015 agenda known as the Sustainable Development Goals (SDGs). (Dictus, 2015)

##### **4.4.1. Counter-mapping**

The concept of counter-mapping is not tied exclusively with the context of the developing countries. Nevertheless, according to Perkins (2007, p. 128) it has been most practiced there. Counter-mapping is strongly connected with challenging the conventional cartography and biased power effects of mapping. Therefore, it finds its

most use in the contexts where mapping was traditionally carried out by the external power structures and caused significant reality distortion. Perhaps the most relevant definition is provided by Harris (2006) who defines counter-mapping as “*using mapping to overcome predominant power hierarchies, interspecies injustices, and other power effects.*” (p. 116)

The counter-mapping is perceived as an effective tool in the natural resources management and has been used in various contexts to stake the formal claims to historical territories, to re-write colonial and apartheid maps, to depict environmental injustice etc. In the context of counter-mapping efforts the mapping technologies are seen as accessible tools to empower communities in their struggles over resources that are perceived fundamentally linked to the questions of culture, identity and power. (Hodgson & Schroeder, 2002, p. 79-80)

Moreover, in the framework of political empowerment of local communities Hodgson and Shroeder (2002) presents the following functions of counter-maps: “1) *gaining recognition of land rights* 2) *demarcation of traditional territories*; 3) *protection of demarcated lands*; 4) *gathering and guarding traditional knowledge*; 5) *management of traditional lands and resources*; and 6) *community awareness, mobilization and conflict resolution.*” (p. 80)

#### **4.4.2. Gaining Visibility through the Community Mapping**

It was already mentioned that in the context of the imperial bureaucracy the maps were traditionally used as an instrument of power in the process of visualization of desired results. By the cartographical means the people were deliberately made invisible hence ejected from the decision making process. (Moore & Garzón, 2010, p. 66-67)

Often the claims over the land and resources were justified by government-made maps. Nowadays, community mapping is therefore used as a highly effective tool to secure tenure, manage natural resources and strengthen cultures. Hagen (2011, p. 71) argues that without communication channels (that community made maps can represent) the poor do not have any influence which can consequently lead to the flawed, top-down development. Hence, mobilizing communities for the mapping cause can not only empower them through the new technology tools but can also address their omission by the mass media and by the policy makers.

Already in the second half of the twentieth century an indigenous mapping approach was undertaken as a tool for native populations' claims over the land disputes. As explain Chapin, Lamb and Threlkeld (2005, p. 623) since the nineteenth century, when colonizers began to invade the native populated territory the general belief was that because the indigenous people do not practice agriculture, they do not use the land. To counter those prejudices several indigenous mapping projects were launched from the late 1960s. They recorded the indigenous people's perception of their relationship to the land, historical changes, place names and other cultural information. The results of such studies now compose an important part of the negotiation aboriginal rights efforts. (Chapin et al., 2005, p. 624)

Whereas the indigenous mapping case represents the use of community mapping without incorporating the GIS technologies and the web based mapping platforms, the following example builds upon the digital approach to mapping. Until November 2009 Kibera, one of the largest slums in the world and the most densely populated part of Nairobi, was a blank spot on the map. Although, as Hagen (2011, 69) mentions, Kibera was not unmapped none of the existing maps were publicly available or shared with the citizens of the slum. There were many researches and mapping projects carried out in the past but the people of Kibera did not have access to its results. In 2009 the project Map Kibera was launched aiming to visualize nearly a quarter of a million of its inhabitants by using the new information systems. The geographical data were collected, edited and contributed to the OSM web platform. Through the cooperation with local community based organizations (CBOs) and citizens of Kibera the map was completed in three weeks.<sup>9</sup> Special emphasis was given to the local knowledge of the slum's inhabitants. Hagen (2011) states that "*the mapping experience validated the knowledge that participants already held: their intimate knowledge of the paths, businesses, and social relations of their own neighborhood. Now they were regarded as holders of important information rather than poorly educated slum dwellers.*" (p. 74)

#### **4.4.3. Community Mapping's Role in Disaster Response**

In the cases of disaster strike geographical data and tools are extremely important throughout the whole cycle of emergency management. They are needed during the rescue work, damage assessment, humanitarian aid coordination or

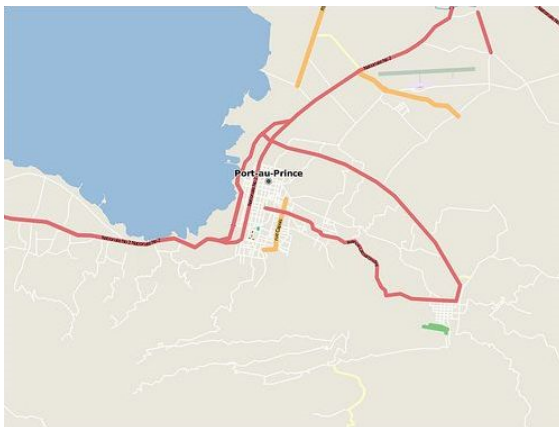
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<sup>9</sup> The mapping initiative is still ongoing in Kibera as well as in other Nairobi slums Mukuru and Mathare.

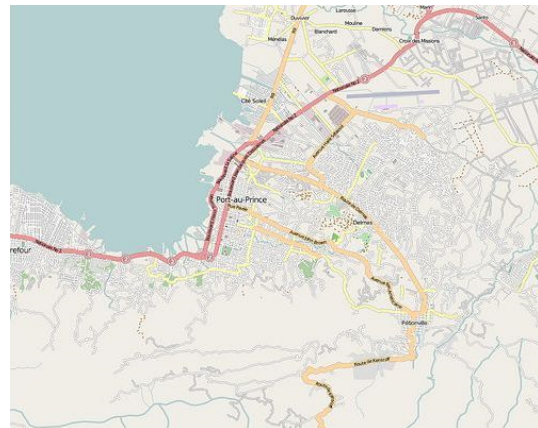
resettlement organization. While in some places the traditional maps can provide relevant and up to date information this does not apply for the majority of the cases. Moreover, paper based maps are likely to be destroyed during a natural disaster whereas web based maps continue to exist regardless of the catastrophe. As an alternative to the authoritarian mapping agencies data the online community mapping recently proved itself as an effective way to tackle the demand for geographic information during a disaster response.

Meier (2011) states that the “*crowdsourced information can provide rapid situational awareness especially when added to a live crisis map.*” (p. 1) And indeed for an effective reaction during the emergency crisis time is the essential variable. The relevance of community mapping for disaster response was demonstrated immediately after the Haiti earthquake in 2010 when a number of mainly remote crowdsourcing initiatives rose for a common goal – to help the relief workers on the ground. Among those was the response from OSM. Nearly 600 contributors from all over the world were able to map the affected area and within three weeks they built a base layer map of Haiti nearly from scratch. Consequently the map was used as a default map for actors performing the relief work on Haiti and is considered to be the most detailed map of Haiti that have ever been made. (Meier, 2012)

**Figure 2** Port au Prince on OpenStreetMap before the earthquake (Mikel Maron, 2010)



**Figure 1** Port au Prince on OpenStreetMap after the earthquake (Mikel Maron, 2010)



As a result of this particular activation after the earthquake on Haiti, an ambitious non-governmental organization – Humanitarian OpenStreetMap Team (HOT) has emerged. While its main task is to assist with geographical data gathering in the



post-disaster frameworks it also aspires to enhance the community empowerment through promoting online community mapping in developing countries.

Nearly five years after the earthquake the field of activity of HOT has broadened significantly, especially regarding its geographical coverage. Through the intensive work of distant mappers as well as on-site experts the team responds to nearly every crisis that occurs in the world. By gathering together the most productive mappers of OSM project and by encouraging and supporting the local communities they have been successful in mapping the crucial areas of the Central African Republic (CAR) during its crisis, the most hit areas of Philippines after the typhoon Hayan strike or the flood-prone areas in Malawi. The most recent project of HOT tackles the issue of the Ebola outbreak in West African countries. From the launch of the activation in March 2014, more than 2,500 mappers have contributed to creating detailed and accurate maps. (Humanitarian OpenStreetMap Team, 2014) The base maps are now serving humanitarian NGOs in the region to carry out an effective response. In Guinea three priority cities identified by Médecins Sans Frontières (MSF) were mapped in less than three days. Those particular maps serve as the foundation for medical maps, that are necessary for the organization's performance and it is very likely that "*many of the internal MSF maps that were created by the GIS officer could not have been produced without these base maps.*" (Lüge, 2014, p. 18)

Soden and Palen (2014, p. 313) state that the time preceded the earthquake on Haiti was a time of great innovation in the field of technological advance in the humanitarian framework. Therefore, it is not that surprising that the event functioned as a catalyzer for many other volunteer technology communities with respect of mapping. By using the Ushahidi platform the initiative Crises Mappers launched a live crisis map of Haiti just a few hours after the earthquake. As Meier (2012) mentions there were thousands of tweets coming from Haiti following the disaster articulating the need for help. By collecting the reports from social media and messages from Haitians the initiative managed to create a live crisis map that was used by US Marine Corps and by US Coast Guard for urgent medical evacuations. Whereas in previous activations Ushahidi platform used Google maps as a base map, for the purposes of Haitian disaster response Crises Mappers switched for the OpenStreetMap that was only a few days after the earthquake already far more detailed than any other web based map. (Meier, 2012)

## **4.5. Challenges to Community Mapping**

Community mapping can play a critical role in sustainable community development that can consequently lead to poverty alleviation, wider civic engagement and participation in decision making processes. (Vlok & Pánek, 2012) In a broader scale it can therefore be perceived as a trigger for bottom-up approach. Nevertheless, there are several constraints to the deeper leverage of this concept by international development actors. There are a general set of concerns related to community mapping in the framework of international development that are outlined by Villanueva (2007). Firstly he explored the participation that is a crucial aspect of community mapping for an effective empowerment process. Therefore, with the lack of participation the process misses its purpose. He stated: *“The use of a community mapping approach supplies a process for dialogue and discussion, which is vital in establishing the socio-cultural context conducive for doing sustainable resource management/poverty reduction/sustainable community development.”* The other potential issue is the ownership of the data that should be ideally primarily owned by the community. However in the context of online community mapping the data are usually uploaded to the web portal, thus freely used and redistributed by anyone. Acceptance of GIS technology by local governments poses questions as well since the lack of acknowledgment can cause the omission of such maps in local planning. In order to mitigate this potential problem greater promotion of the technology is therefore needed. Finally, the costs of the training and equipment are still high and the GIS technologies are usually not priority in the budgets of international development actors. (Villanueva, 2007)

### **4.5.1. Data Quality Assurance**

The quality of gathered information is a major subject of the discussion about further leveraging the crowdsourced geographical data. For the purposes of international development the information gathered through community mapping often carries not only the geographical value but contains also another aspect that makes it essential and often irreplaceable within the given context. The following analysis is therefore divided into two separated chapters, each dealing with one of the aspects.

#### **4.5.1.1. Verification of Geographical Value of Crowdsourced Data**

With the growing interest in the VGI the number of contributors to mapping platforms is growing as well. The concept is generally considered as an effective tool

for gathering detailed geographic information in a short time at a very low cost. However the VGI approach does not carry an assurance of quality contrary to traditional cartography. The general belief though, is that the data produced by a large number of contributors, rather than by individuals, contain less error due to the ability of the crowd to validate the potential errors of individual contributors. This premise proved itself to be true in places where the number of contributors is high. However where there are not a lot of mappers the probability of such validation is lower. Therefore areas mapped by only a few contributors are more likely to contain errors. (Jackson et al. 2013, p. 507)

The concerns can therefore be raised around participation of contributors in the developing countries that is generally quite low, as was already discussed, and can produce errors and cause distortion and imbalance between mapped and unmapped areas.

Goodchild and Li (2012, p. 112-119) present three alternative approaches to the VGI data quality assurance. They called the first approach “*the crowdsourcing approach*”. This approach refers to what has already been outlined earlier in this chapter – larger participation in the data gathering and editing process ensures fewer errors in the final product. In the context of VGI the crowdsourcing approach is typical for the OSM project; however it is used in other crowdsourcing projects as well.

The second approach that is presented by Goodchild and Li (2012, p. 112-115) is “*the social approach*” and it builds its assumed validity upon the hierarchy that is being created within the contributing society. Certain contributors (usually those who engage themselves the most) are given special rights and are awarded as “*advanced users*”. Their role is therefore to act like the moderators and to prevent the errors or to correct them. This system of data quality assurance is already implemented in the OSM project where the Data Working Group has been established to deal with this issue. MapMaker, the service launched by Google to open the Google maps for collaborative efforts, uses the approach among the volunteer crowd but the highest level of hierarchy is left for the Google employees who have the power to accept or decline the contributions. Goodchild and Li (2012) state that this approach actually “*emulates the structure of traditional authoritative mapping agencies, where experience and qualifications act as surrogates for reliability, and promotion leads to greater authority and higher salaries*” (p. 115)

The first law of geography is: “*Everything is related to everything else, but near things are more related than distant things.*” (Tobler, 1970, p. 234) On this premise the third approach to the data quality assurance – “*the geographical approach*” is built. Goodchild and Li (2012, p. 115) argue that there are certain rules in geography determining what can or cannot occur in a given location. It basically assumes that the contributed fact about the location needs to be consistent with what is already known about the location. Consequently, both previous approaches can be applied to explore the information that does not seem right and to edit it if required.

To bring the discussion closer to community mapping within the developing context it is necessary to explore the particular approach undertaken by OSM, considering that this platform is densely used within the framework. All the three approaches outlined earlier apply to the case of OSM. With the strong core of contributors the crowd sourcing approach is automatic and the implication of the social approach was already presented as well. However there are some specific features that bring the issue of verification to a more tangible level. Firstly, the registration is required before contributing or editing any information in the OSM platform. Consequently, all edits are connected with concrete users and are retrospectively traceable. Although it does not present an assurance of the prevention of errors it is assumed that it can discourage the contributors from creating deliberate mistakes. There is also an automatic tool in the OSM editor that detects possible errors and reports them before uploading the data. Furthermore, a number of data quality assurance features and tools were developed to ensure the quality of OSM. These tools automatically generate the errors and publish them so the OSM community can fix them.

#### ***4.5.1.2. Verification of the Information value of the Crowdsourced Data***

Perhaps the challenge that is most discussed in the context of disaster relief and development aid is the problematic verification of information value that is contained in the crowdsourced geographical data. Whereas the approaches to the data quality assurance in the context of community mapping that were discussed in the previous chapter are connected strictly to the geographical value of those data, the following approaches deal with the information aspect that is contained in those data. Furthermore, by examining this side of the crowdsourced data, the analysis touches on the possible damage that can be caused by misleading information in the contextual perspective of its purpose. The following analysis is focused mainly on the verification

of crowdsourced geographical data in the context of disaster response as the need for up-to-date timely data is generally very high in that framework

As was already discussed, the crowdsourced information included in a crisis map can be essential for an effective disaster response. But the immediate verification of that information is often not possible in the short timeline. Humanitarian actors can therefore find themselves facing an uneasy decision whether to use the information collected through the crowdsourcing methods even though it is not verified or not. To wait for confirmation can deprecate the potential advance that can be made by using that information. Therefore “*the potential value of information must be weighed against the urgency of the situation.*” (Meier, 2011, p. 1)

Verifying of the information that is carried by the crowdsourced data is a challenging issue, especially in the time pressure that accompanies the effective disaster response worldwide. However by undertaking certain approaches this challenge can be reduced or even overcome. Meier (2011) investigated several concrete examples of crowdsourced data verification and described different possible approaches that have been leveraged during those events. The Arab spring social media journalism case was already mentioned earlier in this paper. Twitter users were reporting from Libya, informing the public about the latest news nearly at the same time that they were happening. The approach that was chosen by an American reporter to validate those sources was cross checking. By re-posting certain tweets while asking for other sources to confirm the information, he was able to validate it in a rather short time period. Furthermore, by systematical verifying the information following this pattern he was soon able to identify the most reliable sources among the reporting crowd.

Another case describes how Skype was used to counter rumors during the violence clashes in Kyrgyzstan in 2010. More than 2,000 people across the country joined the chat group to verify or to disprove the rumors that were spreading deliberately and were threatening the effectivity of humanitarian aid. (Meier, 2011, p. 9)

A rather complex approach to the data verification was undertaken by Ushahidi platform during the parliamentary elections in Egypt in 2010. The report was verified if it met one or more out of the three criteria set by the Ushahidi team. The report was considered well-founded when it was supplemented by a picture or another multimedia

component, when it was reported by more independent sources or it was confirmed by three different sources (social media, SMS, direct witness, etc.). (Meier, 2011, p. 5)

## **5. CASE STUDY: OPENSTREETMAP COMMUNITY IN DAKAR AND SAINT-LOUIS, SENEGAL**

The case study of Senegal presents local community of mappers who dedicate their free time to contribute their knowledge and skills to the OSM project. Many of them have been part of the group for several years now while some of them have decided just recently to join the mapping project.

In the first part of the study the research methodology and the site of the study is described. The following part presents and discusses the results of the research. The third part draws the conclusion of the research and makes the final statement.

### **5.1. Research Methodology**

The case study covering the mapping communities in Dakar and Saint-Louis, Senegal, is based on the field research conducted by the author in the summer 2014. The research was realized in partnership with HOT and local OSM community. The author's experience from another development project<sup>10</sup> partly coordinated by HOT is used as a complementary source of the information when elaborating on some of the research's objectives. In the framework of the project the author spent six months in Burundi, therefore the complementary data focus on this country specifically and do not reflect the situation of other countries of the project.

#### **5.1.1. Aims and Specific Objectives**

The particular group of online mappers in Senegal has been chosen upon the discussion with the representatives of HOT that initiated the OSM outreach project there in 2012. The aim of the research was to characterize the group and to explore the specifics and potential obstacles that are connected with the online community mapping in developing contexts. The main research questions therefore were:

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<sup>10</sup> Project "European open source humanitarian aid" (EUROSHA) was one of the pilot projects of the European Union's initiative EU Aid Volunteers implemented in four African countries (Burundi, Chad, Central African Republic and Kenya) in 2012. Its overall aim was to address humanitarian issues and to promote the information-sharing within the crisis preparedness context. To achieve the goal the project identified the online community mapping as an appropriate tool and sought to establish the OSM communities in the countries that would eventually carry on with the activities after the initial project was over. The project was partly coordinated by HOT what ensured the major emphasis was given to the OSM activities.

1. **What are the specifics of the online community mapping in Senegal?**
2. **What are the implications of the Senegal experience for international development community?**

To be able to answer the questions the following three intermediate objectives were set:

- a) To characterize the OSM community in Senegal.
- b) To explore the specifics of the data collection and production in developing contexts.
- c) To explore the further use of the data that emerged from the online community mapping in developing contexts.

Consequently the concrete objectives analyzing more specific questions were outlined in the framework of this research. (Table 2)

**Table 2:** Specific objectives of the research and methods used

	<b>Specific objective</b>	<b>Research methods</b>
<b>1.</b>	To define the internal structure of the OSM community Senegal	Expertise interviews, questionnaires, observation
<b>2.</b>	To analyze the motivation of mappers	Questionnaires
<b>3.</b>	To explore the evolution of the OSM community in Senegal	The documents analysis, expertise interviews
<b>4.</b>	To explore the specifics of the data gathering in given context	Expertise interviews, observation
<b>5.</b>	To explore the further use of the gathered data in given context	Expertise interviews
<b>6.</b>	To define and analyze challenges the OSM community in Senegal is facing	Expertise interviews

The research was designed by following the relevant sources (Chavent 2012; Chavent 2013; Steinman et al., 2013) upon prior discussion with HOT and by using the author's experience from EUROSHA project in Burundi. However it had to be slightly modified and adjusted to the local conditions and the community's willingness to participate upon arrival on the site. Specifically, the original research assumed the focus



groups to be arranged for exploring certain objectives. Nevertheless, after the observation of the site this idea was abandoned mainly due to the tight time schedule and the challenging communication issues.

### **5.1.2. Primary Data Collection and Methods Used**

The primary data for this case study were collected during the five weeks long field research in Senegal. The community of online mappers is active in other cities as well, however for the purposes of the research only the groups in Dakar and in Saint-Louis were targeted. Author's stay was arranged with the significant help of the HOT representatives as well as of the representative from the local OSM community Mr. Bassirou Thiam who consequently became author's key informant and gatekeeper. During the preparatory phase the author used the contacts gained during the EUROSHA project in Burundi that was conducted with the strong support of HOT. Within this phase the HOT representatives helped with the facilitation of author's stay in Dakar and they introduced her to the mapping community through the email communication channel. Since then (February 2014), until the arrival to Senegal (June 2014), the author was in constant contact with the community, which helped with designing the research.

The members of HOT that have been contacted represent the Francophone part of the organization.<sup>11</sup> That is one of the reasons that Senegal was chosen as a site for the research. Comparing to other francophone countries in Africa that are targeted by HOT<sup>12</sup>, the project in Senegal has already reached an advanced stage of progress. It has developed internal structure and to a certain extent it is able to work independently. In Senegal the research was primarily aimed to the mapping community in Dakar, although the community in Saint-Louis was also visited. The visit of another community in Ziguinchor was also planned but this idea was abandoned due to the complicated accessibility<sup>13</sup> of the city from Dakar and the limited time of the field research.

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<sup>11</sup> HOT is unofficially divided into Anglophone and Francophone section. The latter administrates the projects in the French speaking countries in Africa and Caribbean while the Anglophone section deals with covering the projects in rest of the world.

<sup>12</sup> In the Francophone part of Africa HOT currently facilitates projects in Benin, Burkina Faso, Niger, Senegal and Togo

<sup>13</sup> The city is situated in the southern part of the country and its accessibility by land is saddened by the long strip of Gambia. Therefore, the easiest way is by the ferry that leaves Dakar only twice a week and the travel takes close to 16 hours.

Within the period of the research the author encountered several obstacles. The cooperation with the local informal leadership was often difficult in terms of time keeping and internal organization. Furthermore, the lack of communication caused that the deeper interaction with the mapping group in Saint-Louis was also restrained.

During the research different methods of qualitative and quantitative research were used. *Observation* was a crucial source of information especially within the initial period of the research. Based on the findings that emerged as the results of this method the research was adjusted to the local conditions. More precisely, the interviews were reformulated and some methods were abandoned. The observation also had a complementary function to other methods throughout the whole research. Within the activities of this method plenty of informal interviews were held. Furthermore, the author attended the Data for Development and Innove Africa conferences and several formal and informal meetings of the group. The author also assisted the group with the material transportation and further logistic activities connected to the external consultant deployment. Consequently, all findings were registered in a journal that was kept by the author during the research and that served as a complementary data resource when analyzing the research's results.

The essential source of information during the research was represented by the *expertise interviews* held with the authorities relevant to the mapping project in Senegal. The respondents were chosen before the research during the preparatory phase when the structures of the interviews were also designed. However the questions were later adjusted within the field research period based on the observation findings. The criteria considered in the process of selecting the respondents for the interviews were following: relation with the OSM group in Senegal, potential information value and accessibility. During the interviews only open-ended questions were asked and the respondents had the opportunity to extend their answers into the areas that were not included in the original interview structure. To avoid the misunderstanding the complementary questions were asked when necessary. The questions were designed to explore the history of the group; its relation with the initiating actor – HOT; its working patterns, internal structure, financing and partnerships; challenges and achievements; consolidation of the group and its potential for the local development structure. Within the research four expertise interviews were held with three respondents of whom all were men. One respondent was interviewed shortly after the author's arrival and then

again before departure to clarify some misconceptions that occurred during the research. Two respondents represented the informal leadership of the mapping community in Senegal and one respondent represented the initiating actor of the project – HOT. Originally another respondent from HOT was supposed to be interviewed as well but due to the change of plans in his travel itinerary it was not possible. One interview was held in French whereas the rest were in English. With the verbal agreement of the respondents all interviews were digitally recorded. The names together with the language and positions of respondents are listed in Table 3. Further in the text, when the information that emerged from the interview is used, the name of the respondent is noted in the bibliography.

**Table 3:** Expertise interviews list<sup>14</sup>

	<b>Name</b>	<b>Position</b>	<b>Language</b>
Interview 1	Bassirou Thiam	Informal leadership of OSM Senegal	English
Interview 2	Ismaila Seye	Informal leadership of OSM Senegal	French
Interview 3	Bassirou Thiam	Informal leadership of OSM Senegal	English
Interview 4	Nicolas Chavent	HOT representative	English

The only quantitative method used within the research is represented by the *questionnaire survey* among the members of the mapping community that was conducted throughout the whole research period. The aim of the survey was to explore the structure of the mapping community, the age, education and gender balance as well as the motivation of the mappers and their overall satisfaction with the project. Altogether 24 local mappers participated in the survey, 14 of them were based in Dakar and 10 in Saint Louis. The survey was anonymous and voluntary and the respondents were introduced to the purpose and aims of the research in advance. The questionnaires contained 10 questions of which nine were closed-ended. The only open-ended question was used to explore participants' age. Within the survey the participants were further asked for their previous experience with the community mapping. To analyze the efficiency of the group the frequency of the mapping activities was explored as well. Moreover the mappers were asked if joining the group has met their expectations and if they planned to continue with the online community mapping. Both questions were

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<sup>14</sup> The interviews are ordered in the sequence of their occurrence

aimed to explore the consistency of the group. The questionnaires were distributed in a paper form and the results were analyzed in the Microsoft Excel 2010 software

### **5.1.3. Secondary Data Analysis**

Secondary data were used as a complementary resource for the field research. The overall aim of the data analysis was to understand and to explore the community evolution through time and its future mission and perspectives. Although no study that would focus on this particular mapping community exists, through the HOT website it is possible to obtain some information. To record the evolution of the project in Senegal, the online blog was conducted and published periodically by the HOT representatives during the implementation phase of the initial outreach project. This blog was a valuable source of the information about the beginning of the mapping project in Senegal as it is the only source available describing the evolution of the project and its obstacles and achievements in its primal stage. The blog was published both in French and English. For the purpose of the research the author extracted the information from the English one.

In the preparatory phase the author was promised to be given access to the documentation concerning the project realization but unfortunately it was never provided despite the author's several requests. However during the field research in Senegal there was a follow-up project implementation in progress aiming at the formal recognition of the community that was accompanied by the external consultant Nicolas Chavent deployment. For one week the author had the opportunity to work closely with him and was also invited to the online common space with all the internal documentation for the project. Those documents were very useful when exploring the aspirations of the community and its possible perspectives in the context of Senegal.

Another important source of information were internal documents and training material that was kindly provided to me by B. Thiam, the informal leader of the mapping community in Senegal. This included power point presentations, pdf files and other documentation used during the mapping workshops that are organized by the community. Together with this file I have also obtained an activity plan for the OSM Senegal group for the year 2014. All of the provided documents were very helpful throughout the research for they constituted an essential complement to the observation process.

For the purposes of this thesis two maps were created in the ArcGIS 10.0 software. Both use the data extracted from the OSM database and represent the work of the EUROSHA team and its partners in Burundi in 2012/2013.

#### **5.1.4. Limitation of the Case Study**

There are several limitations of the case study that are caused by various aspects. Following features could impact or influence the interpretations of the case study's findings and therefore cause the distortion.

The first possible bias could be generated by the sample of participants that took part in the research. Due to the fact that the mapping does not represent a source of income for the mappers but rather a leisure activity it was not easy to reach them and convince them to devote their time to the research. Consequently, the time spent within the community was limited by this factor which also affected the size of the sample. Additionally, many mappers are university students and during the time of the field research they were occupied by the final exams. These constraints were partly countervailed by B. Thiam who organized the meetings of the community and facilitated the author's interaction with the group. However compared to the original plan there were less mappers reached and no organized field mapping conducted which could consequently distort the final outcome.

Another limitation is possibly caused by the author's insufficient exploration of the overall concept of the online community mapping in the context of Senegal. Although several conferences on the topic were attended there was a lack of interaction with the policy makers and partners of OSM Senegal mainly due to limited time of the field research. The information on further use of the community maps in Senegal and on ongoing partnerships was gained through the expert interviews with the mapping group representatives. Therefore the findings were not verified with another source and can be biased.

Finally, it is necessary to stress the fact that the data that originated from the case study cannot be applied universally. Online community mapping occurs in various shapes throughout the world depending on many factors among which the context is perhaps the most relevant one. The groups over the world vary significantly depending on the members' primal incentives for mapping, their personal objectives and the groups' structure. This particular case draws an example of the community that was

initiated by an external actor (HOT) with which it is still in close collaboration. In the time of writing the group was still not legally recognized however was working systematically under its informal organization structure. In addition, the research was conducted while using mainly qualitative research methods and is therefore incomparable with other studies on the topic.

#### **5.1.5. Justification of the Case Study**

The relevance of the study lays particularly in its subject matter. There are only a limited number of researches that target the online community mapping in the Western African context. Existing literature covering the subject<sup>15</sup> focuses especially on Southern and Eastern Africa (see Lieberman & Coulson, 2004; Vlok & Pánek, 2012; Pánek, 2015; Hagen, 2011) but the western part of the continent has not been put in the research spotlight yet. However with the online community mapping approach being heavily used in the framework of the Ebola response this may change soon. Although there are some studies targeting the concept in Nigeria (e.g. Bello & Ojigi, 2013) and Cameroon (e.g. McKall & Minang, 2005) but there was no literature found covering the topic in Senegal. Given the fact that the Senegal's capital Dakar is perceived to be the region's technological hub with a special emphasis on ICTs the significant lack of research on this topic is elusive. (Szulenyiova, 2014)

Thus the study is innovative because it presents the bottom up approach in the form of community empowerment through the online mapping in the environment of ongoing technological boost. It proves the potential that the local communities have to digitally visualize their surroundings while using their territorial knowledge. As will be shown further it also presents an example of a relatively young locally-led initiative that performs its activities not only within the scale of its own country but engages in various forms throughout the region as well.

## **5.2. Description of the Sites**

Dakar is the capital of Senegal situated on the westernmost place of the African mainland – the Cap-Verde Peninsula. Due to its strategic location it is a major regional port for trans-Atlantic and European trade. Historically, the advantages of Dakar's

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<sup>15</sup> The resource survey focused only on the English written literature.

position were used by the colonial powers for the commodity and slave export. With more than 3,000,000 (The World Factbook, 2014) inhabitants it is the country's most populous city.

The first settlements on the Cap-Verde Peninsula rose in the fifteenth century and from the 1440s the area was influenced by the European colonial project. Originally the area of today's Dakar was used by the Portuguese army however during the history other European powers controlled the territory as well of whom France was the most influential. The independence from France was gained in 1960 however some features of the French dominance have remained until now such as the official language of Senegal – French. (BBC News, 2015)

Nowadays' technological environment in Dakar is perceived as favorable for new initiatives and start-up<sup>16</sup> competitions. A number of international events such as Start Up weekend, GIST Start Up Bootcamp or MIT Global Start Up Lab have already taken place there. Major assets that make Dakar's ecosystem unique among other Western African cities are above all the best telephone and Internet infrastructure<sup>17</sup>, high level of connectivity and presence of distinguished academic institutions that attracts talents from the region. All of these factors have helped many facilitators of the Senegalese start-up scene to emerge. One of the most active is CTIC that works as an incubation space and accelerator of the new enterprises' evolution. Other important actors of the start-up scene in Senegal are Jokkolabs<sup>18</sup>, Synapse Center and Bantalabs. (Szulenyiova, 2014)

Some of the major challenges Dakar has been facing are disaster risks and natural hazards. Flooding in particular is an increasing issue that annually affects its residents. The worst flooding so far occurred in August 2012 with more than 120 millimeters of rain fell within two hours. (International Development Research Centre, 2012) The World Bank (2012) estimated that the cost of flood damages in 2009 was more than 103,000,000 USD. It is assumed that the major reasons for the repetitious

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<sup>16</sup> The term "start-up" refers to an enterprise or a project in a first stage of its operations that is accompanied by securing the finances, initiating activity and setting the structure. (BusinessDictionary.com, n.d.)

<sup>17</sup> Compared to other countries in the West African region Senegal has the highest share (19 %) of Internet users among the population. (International Telecommunications Union, 2012)

<sup>18</sup> JokkoLabs is an open source movement for social change. It is constituted by the entrepreneurs' community and the network of co-working spaces that have been created in Senegal, Mali, France and Burkina Faso. (JokkoLabs, 2015)

flooding during the rainy season are rapid urbanization in the 1970s and 1980s, informal settlements in flood-prone areas and high demand for buildings and roads. Moreover, several other problems like malaria and cholera spreading accompany the flooding each year. (The World Bank, 2012)

The original online community mapping project in 2012 represented an international response to the flooding problem in Senegal. Therefore, the initial OSM community has emerged around the two areas of Dakar that are the most prone to the flooding – Pikine and Guédiawaye communes. Those parts of the city are the most densely populated and are threatened by the groundwater rises at the same time; therefore, they are the most vulnerable to flooding. (The World Bank, 2010) Currently, the mapping community in Dakar is concentrated mainly around a commune of Grand Dakar which is situated in the south-central part of the capital and has around 64,290 inhabitants. (Ville de Dakar, n.d.)

One part of the field research was conducted in the city Saint-Louis located in the north-west of the country on the border with Mauretania. The city is a former capital of French colony Senegal and for a short period it was also a capital of the French West Africa. It is situated on the mouth of the Senegal River which divides the city into three parts. (Figure 3) The mapping community in Saint-Louis is concentrated mainly around the Gaston Berger University – the second oldest university in Senegal.



**Figure 3:** The aerial imagery of the city of Saint-Louis (Bing imagery, 2015)



### **5.3. OSM Community in Senegal**

Following part represents the results of elaboration the first intermediate objective of the field research – to characterize the mapping community in Senegal. The history of the group is outlined mainly on the basis of the interviews and the documents analysis. The elaborated results of the questionnaire survey constitute the basis for the description of the community’s structure and the motivation of mappers. Furthermore, the challenges posed to the OSM community in Senegal are discussed. Eventually, the achievements are presented and demonstrated on the chosen examples.

#### **5.3.1. Emergence of the OSM Community in Senegal**

The original impulse for the OSM community in Senegal to be formed came in 2012 through two independent projects. The first one was an initiative of the World Bank’s ICT group that would tackle the flooding risk in the urban areas of Dakar. The initiative was aimed particularly to Pikine and Guédiawaye, the communes that are most prone to flooding. With the improving of the drainage system, the parallel step was

to put in place a community based participatory mechanism to help to maintain the network and to update the information about the drainage system. Moreover, to address the issues of land use while building the network, it was necessary to involve the communities as well as the local governments to set up a proper joint management of the drainage system. OSM was considered as an appropriate tool for creating a base line map and for empowering the communities to articulate their claims and to produce their own data as well. For the purposes of the project N. Chavent of HOT was personally contacted to carry out the OSM related activities on site. The second project was designed by HOT itself together with OSM France and was to explore the potentials of OSM in disaster preparedness abroad. Consequently, the possibility of the two streams of funding allowed the HOT to expand its activities to West Africa. (N. Chavent, personal communication, July 17, 2014)

Although the funding opportunity was a strong motivating factor to launch the project particularly in Senegal, N. Chavent (personal communication, July 17, 2014) mentions also other components that played a role in that decision. The educational system in Senegal is considered to be very good which consequently attracts young people from the whole region. Moreover, Dakar serves as headquarters of many NGOs operating in West Africa and, as explains N. Chavent (personal communication, July 17, 2014), *“by doing a good work in Senegal you end up with creating a network and possibility of [cooperating with] interesting actors not only from the country but also on the level of bigger regions”*. He further mentions that another element that has influenced this decision is that he knew the Senegalese context very well and was able to *“operate with very agile and low budget operational process [...] which was the best way to help creating a self-sustaining governance of OSM community in Senegal that would work primarily on voluntary basis”*.

In the framework of the World Bank’s project the first HOT deployment took place in May 2012. During the three weeks several trainings were organized reaching out to primarily civil servants from national and regional entities and CBOs and NGOs working with the crisis response. After the flood strike in August 2012 the immediate remote response of OSM community occurred. The baseline map for the affected area was created and complemented with the field mapping on site that consequently brought together people that laid the foundation of the OSM community in Senegal. (N. Chavent, personal communication, July 17, 2014)

The evolution from the World Bank funded project to the current independent OSM community occurred with relatively small budget. N. Chavent (personal communication, July 17, 2014) estimates that throughout the two years (2012 – 2014) around 40,000 USD<sup>19</sup> were spent out of which the majority was used during the initial period of the first two deployments. In the timeline of the first two HOT experts' deployment in 2012 the strategic partnerships were established within the academic sector, local and national governmental groups, non-governmental sector and start-up facilitators CTIC and JokkoLabs. To reach the humanitarian actors in place a “mapping party”<sup>20</sup> was organized in Dakar with participation of representatives from the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), World Food Programme (WFP), United Nations Children's Fund (UNICEF), the International Committee of the Red Cross (ICRC) and JokkoLabs. Geographically, in its initial stage, the project was active in Dakar, Saint-Louis and Louga, a city in the north-west of the country. (Chavent, 2012)

While the initial stage of the project was divided into two short deployments the following period consisted of a six month long field work in Senegal starting in November 2012. During those six months HOT has deepened its presence and strengthen its position within the local ICT ecosystem particularly through organizing several trainings within the InnovAfrica 2012<sup>21</sup> event. From various outreach projects and workshops held throughout the country the core of the current OSM Senegal group has originated. (Chavent, 2013)

The approach undertaken by HOT to establish the OSM community in Senegal was described in detail by N. Chavent (personal communication, July 17, 2014). The initial aim was to encourage the creation of a self-sustaining governance of the group that would work primarily on a voluntary basis and independently on HOT. As he further explains the main objective of HOT in Senegal and other countries as well is not to create HOT branches but to help the communities to build their autonomy. Moreover,

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<sup>19</sup> This budget also covered the three HOT deployment of together five external consultants that occurred in 2012 and 2013

<sup>20</sup> The term refers to a community event organized with an aim to map, socialize and discuss the issues connected with mapping in the framework of OpenStreetMap. The event is open to the public and offers attendees a possibility to learn how to map, to get to know other mappers or just to participate in a complex mapping effort.

<sup>21</sup> InnovAfrica is a “nomadic forum” that brings together different projects with an innovative approach to development in Africa. It is being held annually since 2009, each year in a different western African city. (InnovAfrica, n.d.)

he draws a comparison with an approach within the framework of a similar project that was implemented by HOT in Haiti after the earthquake in 2010. After the immediate response of the mappers from all over the world the local community had begun to grow with the significant support of HOT. Consequently, after rather short time period, the group has acquired the legal status of a national association. Although the community was constituted by dedicated local mappers and individuals with expertise in organizing and managing people the group has gone through some difficulties in its internal governance which eventually prevented it to work efficiently. N. Chavent (personal communication, July 17, 2014) claimed that there were two probable reasons for that. Firstly, the context of Haiti is very complicated, much different from other countries and represents an unfavorable environment for international actors to work efficiently. Secondly, the community was rushed into forming the legal association and therefore did not have enough time to structure itself independently first.

As N. Chavent (personal communication, July 17, 2014) explains, it is necessary to take into account the Haiti experience in other HOT projects. Both he and B. Thiam agree that the right approach in the case of Senegal is to strengthen the community first by building the volunteering spirit around the project and by working informally. According to N. Chavent (personal communication, July 17, 2014) after some time the group eventually starts to feel the need to structure itself legally and that is the right time for HOT to support them. In the case of OSM Senegal the need was expressed in 2014 and in the time of the field research first steps were being taken to accomplish the goal. By becoming a legal association the group would be able to ask for financial support from the government and it would open the possibilities of new partnerships. As mentions B. Thiam (personal communication, June 21, 2014) there were already some actors willing to cooperate with the group, however from their policy perspective they could not deal with unregistered groups. Therefore, creating an association is currently one of the main focuses of the OSM community in Senegal.

One of the strongest partnerships was established with the International Organization of the Francophonie (IOF) in 2013. Since then, the organization supports the activities of the group by financing the volunteers' exchanges, material translation<sup>22</sup> or outreach projects in the region. Similarly, the IOF supports the group's effort to

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<sup>22</sup> Significant share of the OSM learning material is not suitable for West African context for it is written in English language

structure itself legally by financing the external consultant's deployment and related actions.<sup>23</sup> (B. Thiam, personal communication, July 15, 2014)

### **5.3.2. Structure of the OSM Community in Senegal**

As was already discussed the community has been working informally since its emergence as a part of the WB project. Therefore, the current hierarchy structure is also informal and has evolved naturally during the time. The leadership is represented by four people, three men and one woman. All of them joined the group during the third mission of HOT and have been active ever since. Formally, there are no sources documenting the number of active OSM contributors in Senegal but the community's estimation is around 30. (B. Thiam, personal communication, June 21, 2014) However this number represents only the mappers involved in the activities of the community (meetings, trainings, mapping parties, etc.) and does not consider individual contributors. Following analysis including the graphs was created mainly upon the results of the questionnaire survey.

From the gender perspective the group is rather consistent with the majority being men. More specifically, 17% of the respondents were women and the 83% were men. This proportion reflects, according to B. Thiam (personal communication, June 21, 2014), the general greater involvement of men in the IT sector. Nevertheless, as he further states, women are represented in the core team of OSM Senegal and are highly encouraged to join.

Although the community is formally open to everyone who wants to join, it brings together people with mainly a university education. (Figure 4) There are several possible reasons for this effect. Firstly, there has been a strong emphasis given to the partnership with the academic sector and the universities often host trainings and workshops organized by the community. Students therefore obtain more information about the OSM and are more prone to join the initiative compared to the rest of the population. Another reason can lie in the technical character of the OSM activities. Although I. Seye (personal communication, June 25, 2014) and B. Thiam (personal communication, June 21, 2014) stress that people that want to join the community do

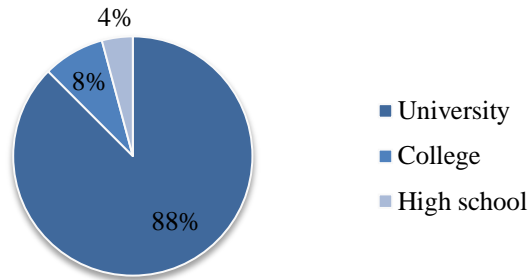
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<sup>23</sup> The IOF's support to the OSM Senegal makes part of a complex project „Espace OSM Phrancophone“ that aims to support the grow of the OSM communities in the Francophone countries. (Projet EOF, n.d.)

not need to have prior information technology (IT) skills, it can still discourage potential applicants without any computer skills.

**Figure 4:** Educational background of the OSM Senegal community members

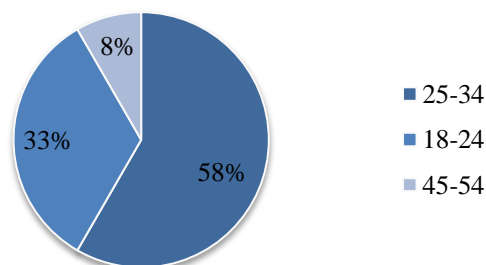
### Education



According to the questionnaire survey, the community attracts mainly young people. (Figure 5) The respondents were asked to provide their exact age in an open-ended question and the data were consequently assigned to the categories in order to visualize them in a pie chart. There were no respondents younger than 18 and older than 54. Similarly, no respondent represented the category of people between 35 and 44 years. This category was therefore eliminated from the visualization. The age structure can be caused by the same effects as the educational structure of the group since the university students are generally young people.

**Figure 5:** Age structure of the OSM Senegal community

### Age

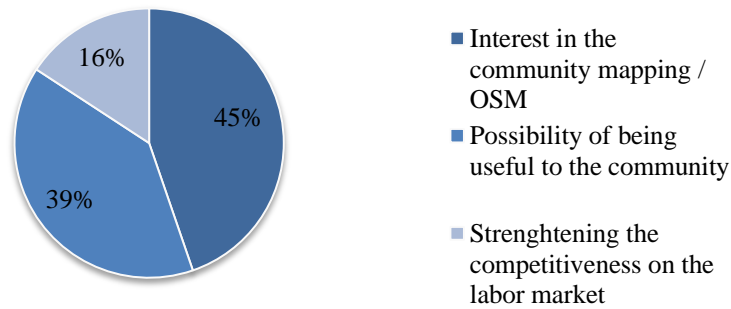


To explore the motivation of the members to join the mapping initiative the respondents were asked to choose from four possibilities or to define another factor that influenced their decision. The answer “possibility of the financial compensation” was

not chosen by any respondent and neither another factor was identified. There are therefore only three overall motivations relevant to the survey. (Figure 6)

**Figure 6:** Motivational factors that encouraged members of OSM community in Senegal to join the initiative

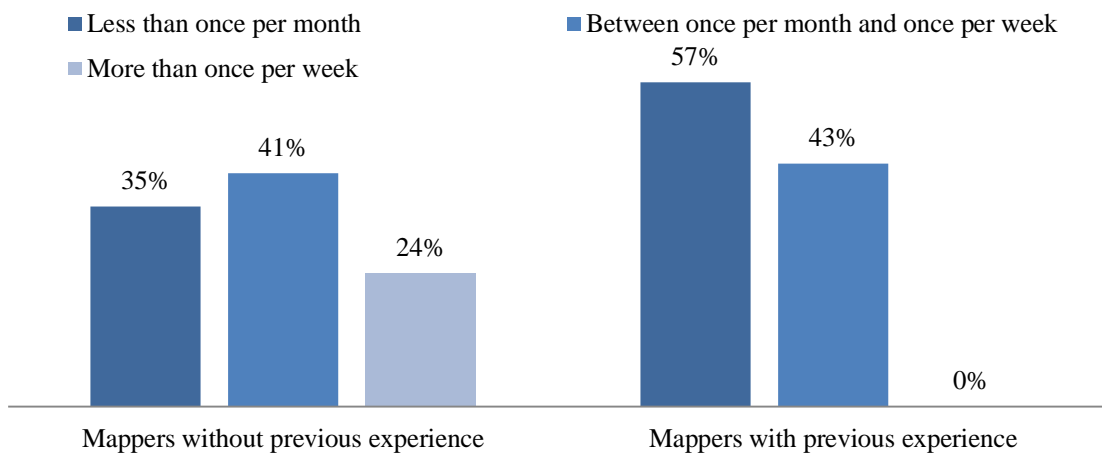
### Motivation of the mappers



The results of the survey further suggest that the majority of the community members are actually not very active in the mapping. Less than 20% of the respondents carry out the mapping more than once per week. This applies to the same share of the data collection as well as to the distant mapping. Furthermore, the questionnaire survey has shown that mappers without previous experience with the community mapping tend to dedicate more time to the field mapping than those who are already familiar with the concept. (Figure 7)

**Figure 7:** Relation between field mapping frequency and previous experience with the OSM among the OSM Senegal

### Relation between field mapping frequency and previous experience with the OSM



The cooperation with the OSM Senegal has met the expectations of 92% respondents and all the respondents are planning to continue with the online community mapping in the future.

### **5.3.3. Further Characteristics of the OSM Community in Senegal**

At the time of the field research the community did not have its own working space; however, its establishment was in process. Nevertheless, due to the partnership with the town hall of the Grand Dakar commune, the group has been using its conference rooms upon the mayor's agreement. In Saint-Louis the trainings and meetings have been held in the co-working space provided by the JokkoLabs that functions also as a space to store the community's belongings.

The material currently possessed by the community includes Global Positioning System (GPS) devices, laptops, video projector and some other technical components. All of these were provided by HOT during the initial stage of the project in 2012. When trainings and workshops are organized by the community, the participants are required to use their own laptops. For the purposes of field mapping the GPS devices can be lent to the mappers against their initials, identification number and signature. When uploading the data the mappers are also allowed to use the community's Internet connection. (I. Seye, personal communication, June 25, 2014)

Similarly to the OSM activities all over the world, the members of the community do not generate any income out of the mapping. As was already mentioned, currently there is no financial support from the government due to the informal structure of the group. However the community has adopted a particular approach to be able to cover some of their expenditures (Internet, travels, meals...). Some of the group's partners offer financial compensation for the volunteers when implementing a project together. The mappers that are involved in these projects are consequently asked to give half of their salary back to the community. This mechanism applies for all members of the community including the informal leadership and to a certain extent for the HOT representatives as well. (B. Thiam, personal communication, June 21, 2014)

### **5.3.4. Challenges to the OSM Community in Senegal**

As was already described in detail, the greatest challenge of the community at the time of the field research was acquiring the legal status of an association. With the financial support of the IOF and the technical assistance of HOT the preparation of



support materials was in progress. The achievement of the registration would potentially mitigate another challenge the community is facing – the lack of financing. Although the group has undertaken the approach that was mentioned above, the financial resources are still very limited and restrict the group from implementing more outreach projects that would attract new mappers.

Another challenge described by B. Thiam (personal communication, June 21, 2014) is the geographical imbalance of the mapping activities. OSM Senegal has formed itself around bigger cities and the rural areas have been neglected so far. However as he further mentioned, before starting to reach out to the rural areas the map of the three major cities – Dakar, Ziguinchor and Saint-Louis, needs to be completed. Nevertheless, the urban areas suffer from the disparity in the data coverage as well. Although the community is very active in the cities, the mapping activities are focusing mainly on some of their parts. The typical example would be Grand Dakar. The map of this commune is already very detailed and contains great amount of data. However when compared to other parts of the capital the difference is vast. It can be explained as a side effect of the fact that the group uses the Grand Dakar's town hall as its meeting base and often coordinates the field mapping from there as well. Therefore, the commune serves as the most proximate area to conduct the thematic mapping as well as to train new mappers there.

The mitigation of the OSM data coverage imbalance requires perhaps more coordination among the community members. During the field research the efforts to extend and coordinate the mapping activities were manifested at the technical training of the community held in the town hall of Grand Dakar. Within the scale of the activity plan for 2014 the identified objectives for mapping in Dakar were the following: to map all the medical structures in the Dakar region, to map the road system in Pikine commune, to map the flood-prone zones in Rufisque commune and to identify the crime zones in Grand Dakar commune. At the time of writing this thesis the contrast of the data coverage between Grand Dakar and other communes in Dakar was still remarkable but the advance was visible in other parts of the city as well. Nevertheless, the objectives listed above have not been met.

As was already mentioned, OSM Senegal does not have its own working space. Although in both Dakar and Saint-Louis the group can use the rooms of Grand Dakar

town hall and JokkoLabs upon prior agreement, it restricts the group to work absolutely flexibly and independently. Furthermore, as mentions B. Thiam (personal communication, July 15, 2014) the cooperation with JokkoLabs is often very difficult in terms of ownership of the projects. He also claims that the JokkoLabs in Dakar is not working as a co-working space but rather as a self-styled coordinator of local open data and open source communities. That creates further tensions because often the partnerships negotiations are not communicated to the group and following projects are coordinated and conducted independently by JokkoLabs. (B. Thiam, personal communication, July 15, 2014)

According to N. Chavent (personal communication, July 17, 2014) there are two significant challenges posed to the community by the turnover of the skilled people in the project. As he explains, the OSM activities require rather long learning process, particularly if the goal is a proficient and autonomous community. In general, the most active mappers are young people from the universities who often tend to look for jobs or higher academic degrees abroad after completing their studies in Senegal. Therefore, the first challenge is a remarkable drop of high skilled mappers which consequently slows the growth and the consolidation of the group. However this is not an issue just in this particular case but it influences all OSM projects operating with almost no budget, particularly in developing countries. The other challenge faced by the mappers is a time issue. There are skilled people interested in the OSM throughout the spectrum of actors but they cannot take an active role in the community due to the limited free time they have outside their jobs. (N. Chavent, personal communication, July 17, 2014)

The following challenge is strongly connected with the knowledge aspect of the OSM initiative. As was mentioned above, there is a certain level of necessary skills community members ultimately need to have in order to perform the OSM activities. This is especially true in the context of the community project aiming to take an active part within the humanitarian and development sector. Surprisingly, as explains N. Chavent (personal communication, June 17, 2014), it has to do more with project engineering than with a technical side which is, according to him, very easy to gain. The issues are more connected to the proper use of the technical skills, timeline and funds management, fundraising, internal organization and reporting. To acquire these skills it is necessary to spend some time within the community to understand deeper its structure

and to gain the confidence to perform them. He further states that this is the area, where the support from HOT to the emerging OSM communities is needed the most.

To address the described issues it is necessary to continue to organize people in order to build up an ecosystem around OSM that would eventually associate the municipalities, NGOs, academic sector and the technical space facilitators. By having that kind of network a certain volume of continuity of the activities would be ensured and therefore the durability of the project would be sustained. According to N. Chavent (personal communication, June 17, 2014) the community approach is something fundamentally needed within the humanitarian and development sector. *“The actors can take benefit of using directly OSM or subcontracting the use of OSM by GIS or survey companies but money is never going to create the community. The community in Africa, in Senegal, in poor countries, is something that is still to be invented and the technics we see abroad are things that are not helping it. There are ways that have to be implemented. It has to do with volunteerism, ethics and motivation. It cannot be just money”* he stated.

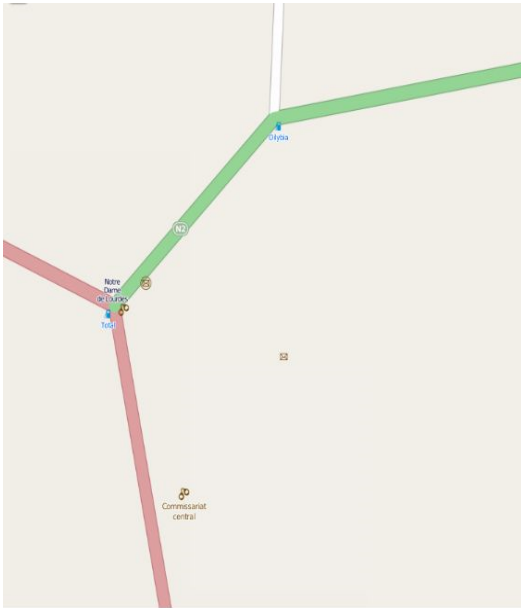
### **5.3.5. Achievements of the OSM Community in Senegal**

Although similar communities exist in other countries of Western Africa, the community in Senegal is the one that carries out the biggest amount of the OSM activities. At the time of writing it was also the only group of that kind that has reached the stage to structure itself legally. Several reasons may exist for such an achievement. However it is impossible to determine whether and on which scale those factors influenced the evolution of the community. Nevertheless, it is very probable that one of the most important driving forces was the persistent and continuous focus of HOT and their activities in Senegal especially at the initial stage of the project. By establishing the partnerships and by organizing groups in different cities with a special emphasis on the capacity building they have managed to create a strong network of mappers that are now able to drive the community towards an autonomous and effective work.

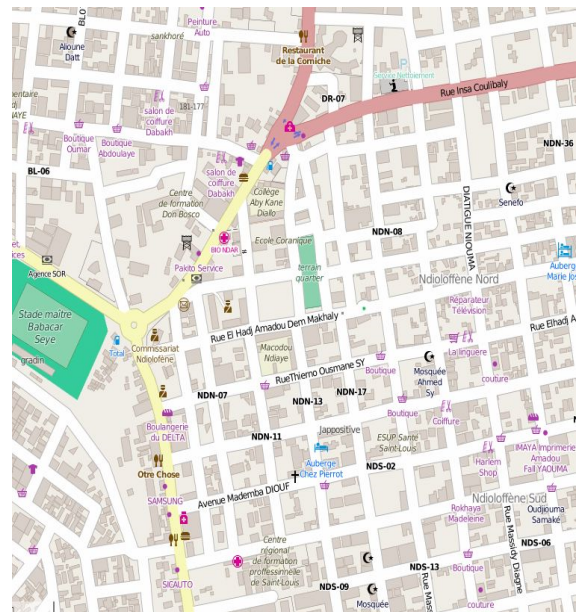
To discuss the most significant accomplishments of the community it is necessary to begin with an advance of the data coverage on the OSM in Senegal since the emergence of the community in 2012. According to B. Thiam (personal communication, June 21, 2014) comparing to private agencies that focus on geographic data gathering in the country the amount of the data collected by the community in two

years with almost no budget is vast. The following screenshots (Figure 10, Figure 11) show the differences in the data coverage on OpenStreetMap between chosen areas in November 2012 and February 2015.

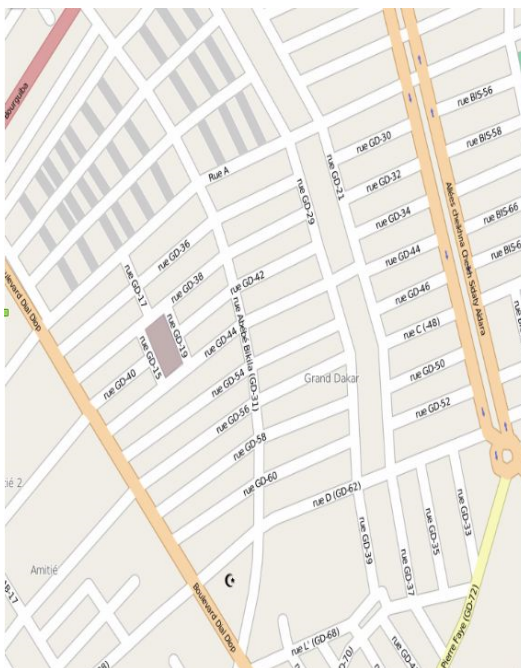
**Figure 10:** Saint Louis on OpenStreetMap in 2012 (OSM Senegal, 2013)



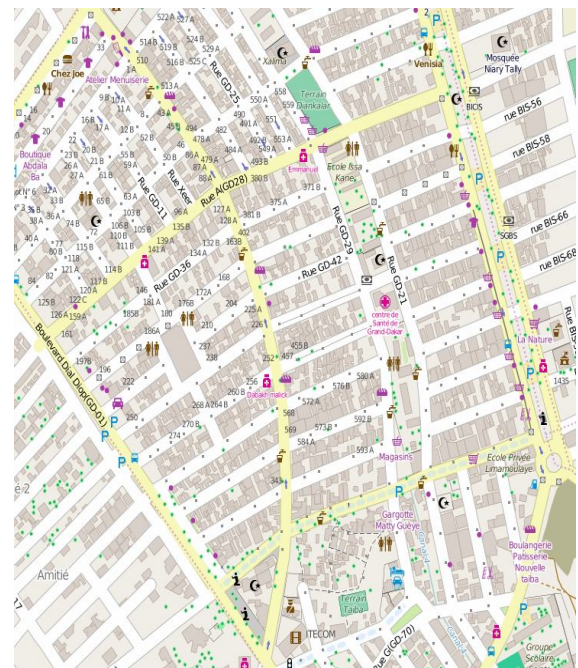
**Figure 11:** Saint Louis on OpenStreetMap in 2015 (OSM, 2015)



**Figure 8:** Grand Dakar on OpenStreetMap in 2012 (OSM Senegal, 2013)



**Figure 9:** Grand Dakar on OpenStreetMap in 2015 (OSM, 2015)



Apart from the dramatic improvement of the base maps demonstrated above, the community has succeeded in other fields as well. I. Seye (personal communication, June 25, 2014) mentions the creation of an application “NanuYegglé”<sup>24</sup> as one of the greatest accomplishments of the group. The application serves to the local authorities by notifying them with urban and territorial problems. According to I. Seye (personal communication, June 25, 2014) it is a first FixMyStreet application<sup>25</sup> with the free and open technology developed in Africa. Currently, the application works only for three communes in Dakar (Grand Dakar, Biscuiterie and Point E) however with the possibility of the funding from government it has a potential to be operational on a national level. (I. Seye, personal communication, June 25, 2014)

Furthermore, the particular character of the OSM community in Senegal lies also in its capacity to not only map their surroundings but to get involved in projects with a greater geographical sphere of activities as well. The group organizes special gatherings with an emphasis on distant mapping of places affected by Ebola, crisis in Central African Republic etc. Moreover, some of the mappers from Senegal are also involved in similar projects in other countries in Western Africa and work as OSM trainers there. In the framework of another project aimed on the reinforcement of OSM communities within the region the representatives of the OSM Senegal participated in the mission in Burkina Faso. As argues N. Chavent (personal communication, July 17, 2014) the “*African dimension*” is a very important aspect in the process of building a self-sustained OSM group for it can serve as a motivation for newcomers to the project.

#### **5.4. Specifics of the Data Collection and Production in the Developing Contexts**

For the purposes of elaboration of the second and third objective another project focusing on the OSM community building in Africa was taken into consideration. The specifics of the geographical data gathering within the OSM activities as well as its further use are strongly connected with the particular contexts of researched regions or countries. To achieve the given objective of describing the different dynamics of the

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<sup>24</sup> <http://nanuyeggle.innovafrica.org/fr/>

<sup>25</sup> FixMyStreet is a term used for a web based application that aims to inform local authorities of problems that require their attention. The initial FixMyStreet project ([www.fixmystreet.com](http://www.fixmystreet.com)) was founded in the United Kingdom in 2007 but has inspired similar projects to emerge around the world since then.

data collection and production in developing contexts it is therefore necessary to examine this issue in more than one country.

The process of mapping within the OSM project involves several steps. The creation of a baseline map of given area by using mainly aerial imagery, collecting the geographical data in the area and editing gathered data on a computer. The data collection itself requires a field deployment and a detailed survey in the targeted area by using GPS devices, questionnaires and printed baseline map created under the first step of mapping. This part of the process is performed mainly within the complex OSM trainings on specific topic, mapping parties or outreach projects of the OSM community. The field mapping is an essential part of the map creating for it allows the mappers to collect important information about the area of interest that are not detectable from the aerial imagery. These include identifying purposes of the buildings, quality and material of the roads, name of the streets, the street lighting and so on.

While the data collection process is generally widely accepted in the developed world and mappers rarely encounter any problems, this is not entirely true when applied to a different context. Walking around a neighborhood with GPS devices and writing down information about the infrastructure can be very sensitive in the developing countries. Taking the discussion closely to the African context many of the countries experience (or experienced in the past) severe internal problems like civil wars, military oppression or governmental neglect of certain social groups. Hence collecting information about the points of interests may fuel suspicion among the officials as well as spreading fear among the local population. Furthermore, the perception of white men can be still heavily influenced by the colonial history of the continent. (Finkelman, 2009, p. 214) Therefore another sensitive issue arises when the field mapping is conducted by western looking people.

Taking into account all the factors that contribute to the increased sensitivity of the data collection in the developing contexts, some mitigating precautions should be ideally introduced prior to the field mapping. Depending on the country context following measures can help to address potential problems: informing the local authorities about the mapping activities, having written permission signed by the officials and, when the situation allows it, engaging the local authorities or officials in

the data collection. All of the measures are further discussed in the context of the two projects in Africa.

Another aspect that is particular to the field mapping in developing contexts is a rather complicated data extraction. While the information sought, is in general, easy to explore in developed countries, in other contexts the situation is different. Just to find out the name of the street is often challenging. Therefore, the approach to extract information has to be different in these countries and has to engage local knowledge as much as possible. The interaction with the local populations is a necessary aspect of the data collection within the developing countries. It prevents the mappers from misunderstanding some factors and it allows them to investigate deeper relation within the area, informal functions of the buildings, name of the streets etc. Moreover, by engaging the locals, the field mapping promotes cooperation among people from different levels of the humanitarian and development system and can fuel further engagement of the local populations in the decision making processes.

#### **5.4.1. Data Collection in Senegal**

As mentioned N. Chavent (personal communication, July 17, 2014) there were never any problems with the local authorities throughout the implementation phase of the project in Senegal. He explains that through the connection of the WB the relations with the Senegalese administration have been eased significantly. The partnership with such a strong actor during the first stage of the project has mediated the contact establishment with the ministries, universities and local authorities. Furthermore, it helped to facilitate the consequent recognition of the OSM group emergence as an autonomous initiative. However N. Chavent (personal communication, July 17, 2014) also argues that even without the WB project the relations with the authorities would probably have not represented any problems. According to him Senegal is a “*very liberal country in terms of allowing people to work with geographical data*” especially when compared to other African countries HOT has been working in.

B. Thiam (personal communication, June 21, 2014) shares the same opinion in the question of collaboration with the authorities. Prior to the mapping the community used to contact the local town halls but usually they did not receive any answer. Moreover, throughout the three years of its activities the group did not encounter any problems in this area. Therefore, the group currently does not ask for an authorization

before mapping and does not inform the local town halls. The same applies for the police that have traditionally very strong administration in Senegal. Some of the mappers within the community are members of the police force therefore their attendance at the meetings may create the notion of the good relations with the police in general. (B. Thiam, personal communication, June 21, 2014)

Different situation occurs in the relations with the town hall of Grand Dakar. As explains I. Seye (personal communication, June 25, 2014) the mayor of the commune was contacted by the community during the second stage of the project and has been very supportive since. As was already mentioned, the community is allowed to use the conference rooms and the internet connection in the town hall. Furthermore, when travels to different parts of the country are required the members usually earn the travel authorization of the Grand Dakar's mayor office. The relations with the town hall are further facilitated by the fact that some of the community's most active mappers are employed there.

Some constraints that the community has experienced during the data collection were further described by B. Thiam (personal communication, June 21, 2014) and I. Seye (personal communication, June 25, 2014). While most of the local people are interested in the mapping, it is very common that the population of the mapped areas does not understand the purposes of such activities and therefore is very reluctant to cooperate by providing any information. B. Thiam (personal communication, June 21, 2014) explains that the reason can lie in the common perception of the traditional entities carrying out similar projects. People are used to seeing private companies with employees or public structures doing the mapping but to see a team of volunteers is very unusual in the Senegalese context. Both representatives of the community's informal leadership therefore stressed the importance of communicating with the local population. By explaining the goal and the character of the project the potential tensions and anxiety of the people can be mitigated and even reversed into the cooperation.

#### **5.4.2. Data Collection in Burundi**

Burundi is a small landlocked country situated in the eastern part of the African continent. It borders with the Democratic Republic of Congo (DRC), Rwanda and Tanzania. The capital Bujumbura is located 15 kilometers from the border with DRC on the shore of Lake Tanganyika. In recent history Burundi has experienced a violent civil



war. It is estimated that during the 12 year long conflict more than 200,000 Burundians have died and several hundreds of thousands of people were internally displaced or fled the country. (The World Factbook, 2014) According to The World Bank (2013), Burundi has the second lowest Gross Domestic Product (GDP) per capita in the world and almost 67% of the population is living below the national poverty line. (The World Bank, 2008) The country has been facing severe food insecurity with 58% of the population being chronically malnourished. (World Food Programme, 2015)

Since the context of the two countries is very different so is the experience from the data collection within the OSM project. After the civil war the peace between rebel groups and the government is still very fragile in Burundi and the position of the police and the army is very strong. (Ames & Kavumbagu, 2015) Without any authorization of the commune's authorities the data collection could therefore easily cause misunderstanding. Several times the data collection carried out within the EUROSHA project faced constraints from the authorities of the communes and once had to be suspended due to the missing authorization. To prevent any problems with the armed forces, the ministry of the defense was contacted and the members of the police also attended several trainings on mapping. Furthermore, the data collection project with the specific aim to map the police offices in Bujumbura was implemented upon the request of the office of the National Police of Burundi and involved just the members of the armed force.

Due to the fact that the project was international another relevant issue had occurred. The data collection was very often conducted mainly by western people. Even though this was partly mitigated by the group of volunteers containing two Burundians the fact that the majority was still represented by white women affected the project significantly. While it has eased the communication with the authorities several times, during the data collection in the peripheral areas of the capital it was often a reason for distrust from the local population. Another by-product of such composition of the group was a language barrier<sup>26</sup> that caused misunderstandings and a lack of cooperation with the local population. These problems were encountered during the first weeks of the project and consequently several precautions were introduced to mitigate this effect. The data collection was conducted only as a part of the mapping parties and OSM

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<sup>26</sup> The official languages in Burundi are English, French and Kirundi. However majority of the population in the peripheral areas of the capital and in the rural areas speak only Kirundi.

trainings or with a close cooperation with local youth group Assotiation des Jeunes pour la Démocratization de l'Informatique (AJDI). This eventually resulted in the majority of volunteers during the data collections being Burundians, therefore the perception of the group was different and the cooperation with the local population has intensified.

## **5.5. Use of the OSM data in Developing Contexts**

The potential of the open geographical data that is offered by the OSM platform has been already discovered and to a certain extent leveraged in the developed world. The data have been used by national agencies, private companies and individuals to create applications, maps, databases etc.<sup>27</sup> As was already shown on the example of the Haiti earthquake response, the possibilities that lie in the OSM data are relevant for the development and humanitarian actors as well. However their full potential in this area is still to be discovered.

The OSM is registered under the Open Database License (ODbL) which means the data are free to reuse and redistribute while maintaining the same license. (OpenStreetMap, 2012) This fact poses both an advantage and a challenge for the leverage of the OSM data in the developing countries. In an environment where the geographical information is traditionally provided mostly by private agencies and their price is often very high, the OSM data can represent a welcomed alternative. Furthermore, in many cases the OSM is the only source of the data under the ODbL which consequently ensures its advantage. Nevertheless, one particular challenge connected with the ODbL in the developing world exists. The awareness of this option is generally quite low in those regions and the actors may be therefore hesitant over leveraging the OSM data rather than buying or collecting their own data using other tools. At the same time, in countries where the OSM communities are already established and operational, there is a space for collaboration that offers the option of acquiring the free, up-to date and in detailed geographical data. The specific and concrete outcomes of such collaboration will be further presented on the examples of the two African countries.

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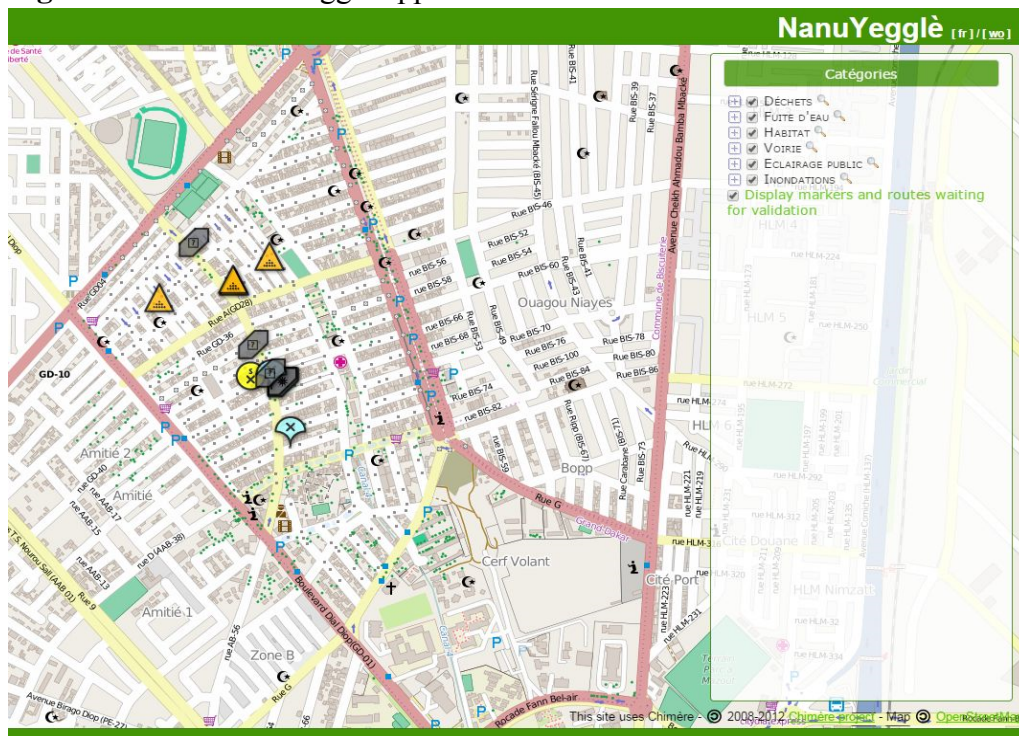
<sup>27</sup> OSM data serve as a base for cycling applications (<http://www.cyclemap.biz/>), public transportation maps (<http://www.xn--pvnkarte-m4a.de/>), maps for handicapped people (<http://wheelmap.org/>) or to find an affordable place on travels (<http://openmarkers.tuxfamily.org/lang/en/>)

### 5.5.1. The use of the OSM Data in Senegal

As was already mentioned, Dakar is considered to be a technical hub of the West Africa region. However, the discussion about the open data and especially the ODbL is something very recent there and as B. Thiam (personal communication, June 21, 2014) explains it has not been consolidated into the local ICTs ecosystem yet. At the time of the field research the OSM was the only initiative registered under that license in Senegal. Nevertheless, there were already some actors incorporating the OSM into their activities and the mapping community itself was focusing on the practical use of the data as well.

One of the examples of the initiative that came out from the community directly was already presented in the chapter 5.3.5. Achievements of the OSM community in Senegal. The application Nanuyeglé (Picture 9) has been created during the InnovAfrica conference in 2012 where it has drawn attention to the OSM Senegal by major actors in the humanitarian and development sector. The application aims to visualize the territorial problems of the neighborhood so they can be presented to the authorities and resolved. (I. Seye, personal communication, June 25, 2014)

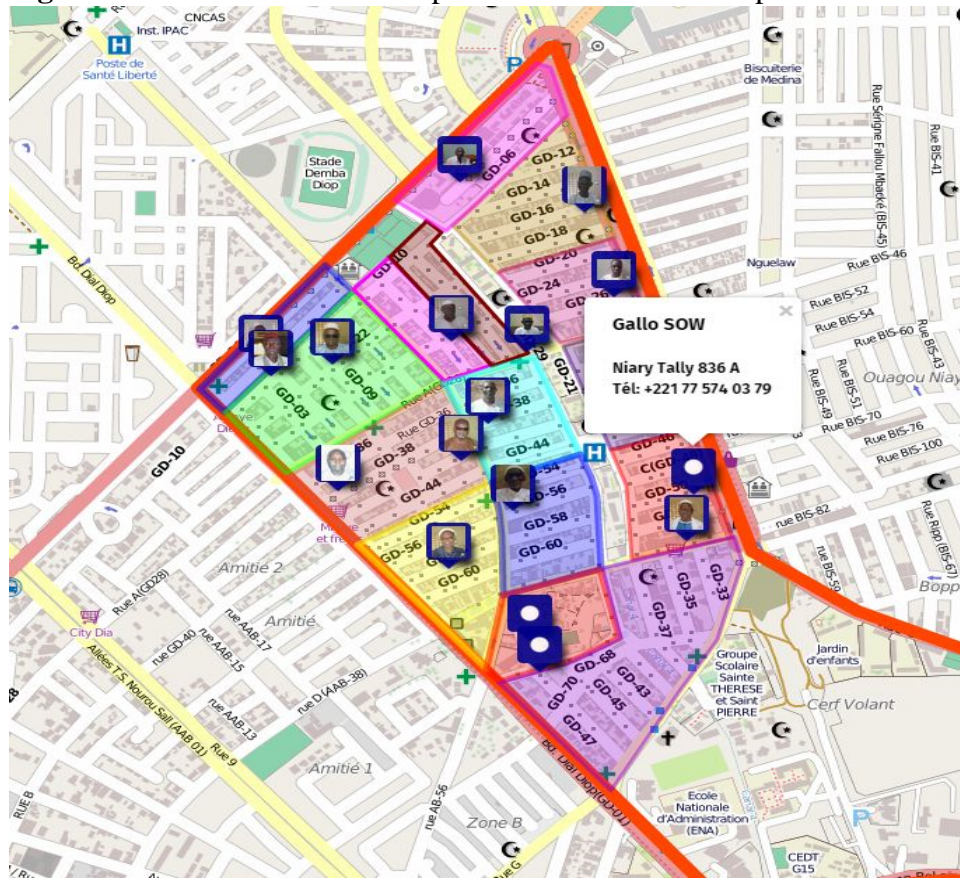
Figure 12: The NanuYeggè application



The following example presents another product that has arisen from the community's own initiative. It is a collaborative map of the Grand Dakar commune

placed at the Umap portal. (Figure 13) The OSM data are used as a baseline map and contributors<sup>28</sup> can add contact information of their neighborhoods representatives.

**Figure 13:** The Grand Dakar's representatives on the Umap



Within the scale of activities of the international actors in Senegal the OSM is being incorporated in the Data for Development (D4D) initiative of the French multinational telecommunications corporation – Orange.<sup>29</sup> D4D is an open data challenge that was implemented in the Ivory Coast in 2013. At the time of the field research the initiative has begun to expand its activities to Senegal. Blondel et al. (2013, p. 1) states that the overall goal of the initiative is to “*help address society development questions in novel ways by contributing to the socio-economic development and well-being*” Within the framework of D4D challenge the Orange is making statistical databases and the mobile network data available to use within the development projects. The initiative is aimed at researchers from around the world who are interested in using the data from the network’s signal database to support the innovative ICT solutions for

<sup>28</sup> Preferably the inhabitants of the Grand Dakar commune

<sup>29</sup> Within the framework of the corporate social responsibility “Orange 4 Development” approach has been undertaken by the company to address socioeconomic issues in the countries in emerging countries. (Orange, n.d.)

development in five priority areas – health, agriculture, transport, energy and production of national statistics. (Orange, 2013)

OSM Senegal is one of the official partners of the initiative offering its database as another possible resource for the researchers aiming to use the data for their development projects.

### **5.5.2. The Use of the OSM Data in Burundi**

In contrast to the situation in Senegal, there is no operational OSM community in Burundi. Although many mappers have been trained within the activities of the EUROSHA project, the establishment of the consistent and independent group, that would continue with the OSM activities after the project was over, has not been successful.<sup>30</sup> Therefore, the following examples of the further OSM data use represent only the work that has been carried out by the volunteers of the EUROSHA project in the collaboration with different partners.

As was proved during the EUROSHA project the OSM data can potentially represent an efficient tool in the management of the refugee camp. After the mapping training and the collaborative creation of the baseline map of the Gasorwe refugee camp in the north-east of Burundi<sup>31</sup> the possibilities of several concrete functions of the data were discussed. As the unwritten rule of OSM is not to place sensitive information to the database, the authorities of the camp suggested using the printed version of the map to identify where the individual families are living so they can have better overview about the situation in the camp. Furthermore, the data gathering part was focused mainly on the sanitary utilities therefore the data can serve to identify families that are disadvantaged by the proximity of the toilets and showers. Another possibility mentioned within the discussion about the further use of the data in the Gasorwe refugee camp was merging the results with the data of the public lighting in the refugee camp. The outcome can consequently reveal the population most threatened by night crime, and can serve for projecting safe paths in the camp. However within the initial field mapping project this was not an area of interest and this option would require further

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<sup>30</sup> According to Chavent (2014) HOT is currently considering a field deployment to Burundi, in order to mobilize the mappers and to re-establish the community.

<sup>31</sup> The mapping was conducted in the close cooperation with the actors operating in the camp - United Nations High Committee for Refugees (UNHCR), International Rescue Committee (IRC), Conseil pour l'Education et le Développement (COPEDE), National Office for the Protection of Refugees and Stateless Persons (ONPRA) and Caritas

data collection aimed on the public lighting. The outcome of the field mapping aimed on the sanitation is visualized on Figure 14.

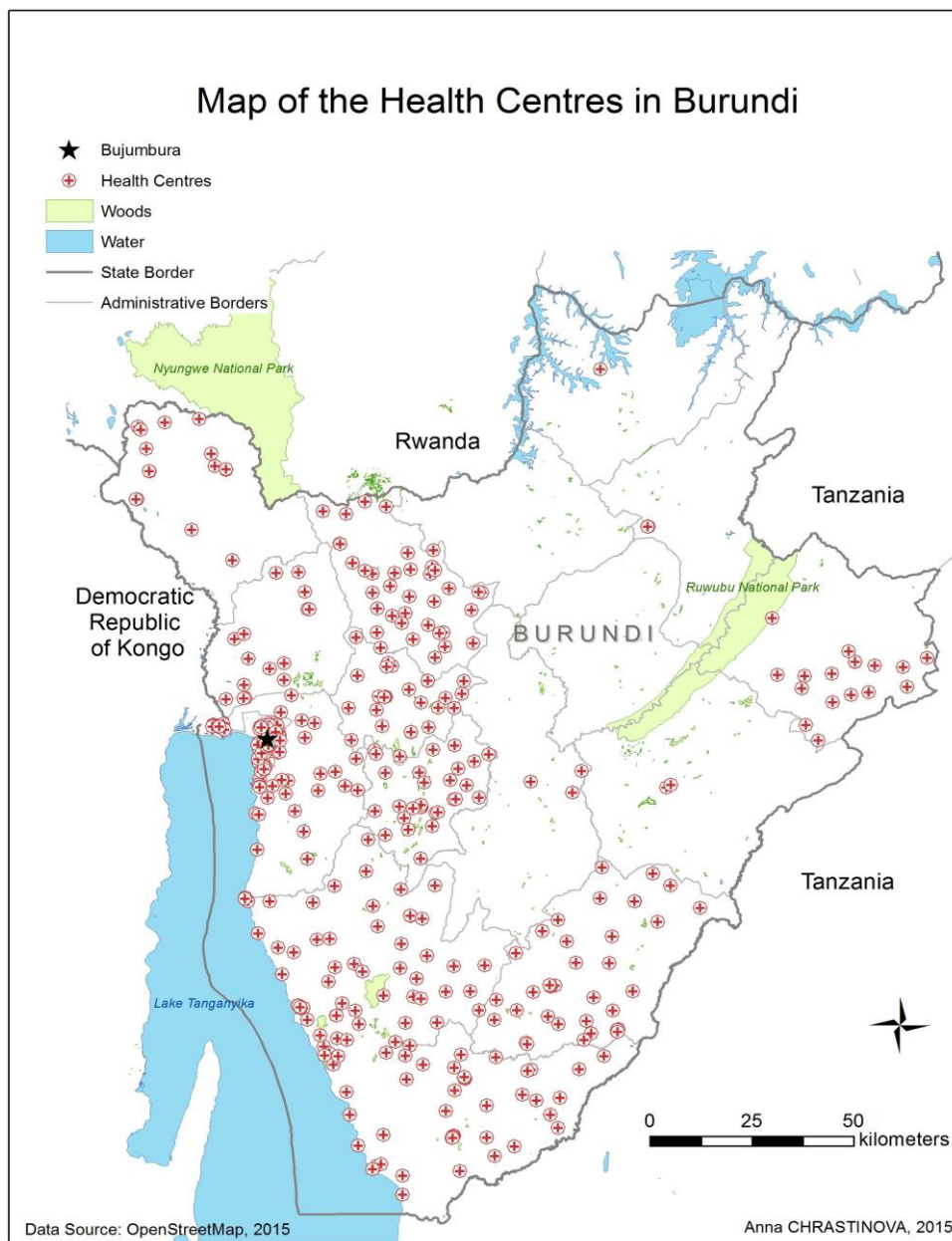
**Figure 14:** Sanitation map of Gasorwe refugee camp based on the data collected within the EUROSHA project



Following example documents another case of the collaboration between the OSM community and partners from the humanitarian and development structure of the country. In 2012 a project focusing on mapping the health infrastructure in Burundi was implemented by an American NGO Population Services International (PSI) and the

Burundian health ministry. Within several months the data of the health institutions in the country had been collected and consequently uploaded into the OSM platform. The OSM community represented by the EUROSHA project volunteers was involved in the training of the data collecting teams prior to their field deployment. After the field mapping part the volunteers conducted the data editing session with the teams as well. As an outcome of this collaboration the map of the health centers in Burundi was created. (Figure 15)<sup>32</sup>

**Figure 15:** Map of the health centers in Burundi created within the EUROSHA project



<sup>32</sup> The working teams of PSI have been trained on data editing during the project. However not all the data collected was uploaded as is evident from the map. The most probable reason is that the teams did not finish the editing after the initial training within the EUROSHA project was over.

## 5.6. The Results Discussion

The case of the OSM community in Senegal represents a comprehensive study of the online community mapping in developing contexts. Within chapter 5.3. OSM Community in Senegal the group was presented along with its structure, characteristics and the motivation of its mappers. The findings of this part were compared with the overview of the online community mapping in chapter 4, particularly with chapter 4.3. Motivation of Mappers. The typical motivational factors among the mappers within the community are fundamentally rooted in the altruism and the value of the open geographical data. Also the presumption of the predominance of men within the online mapping community has been confirmed. However the imbalance documented in the case of the OSM Senegal was smaller (83% being men) compared to the study carried out by Nies and Zielstra (2014, p. 90-91) which shows a more significant difference in gender distribution (97%). While it can be caused by the composition of the research sample this result may also suggest an advanced process of women empowerment in the IT sector in Senegal.

The educational background distribution in OSM outlined in chapter 4.3. Motivation of Mappers was confirmed as well with almost 90% of the OSM Senegal members having a university degree. Since the contributors of OSM are not required to provide their nationality it is impossible to define whether the share of inactive users in Senegal is as significant as in the global scale which was documented by Nies and Zielstra (2014, p. 87). However the overall frequency of the mapping activities is low with only 17% of the members of the community devoting their time to mapping more than once per week.

The findings of the field research also confirm the benefits of the online community mapping in the context of developing countries that have been mentioned in chapter 4. Especially concerning the volunteerism aspect of the phenomenon. The community promotes the values of volunteerism for its very essence lays in the volunteer work. The mappers do not receive any salary for their activities and they contribute their free time to the project. The community empowerment aspect of the mapping cannot be defined because of the rather complicated perception of the community in the context. The mapping carried out by OSM Senegal is concentrated mainly to the big cities where the community aspect of the population is generally quite blurry. However, when slightly customized to the level of communes in the capital, the



empowerment is certainly taking place in Grand Dakar, where its citizens can communicate problems of their neighborhoods with the commune's authorities by using OSM based applications. Furthermore, the important role of the OSM data in developing countries due to the high cost of the geographical data provided by the traditional agencies that was suggested in chapter 4.4. Community Mapping in the Context of International Development has been confirmed in the case of Senegal. Geographical data provided by the governmental or private agencies are expensive and compared to the OSM often less detailed.

Within the field research the limits of the online community mapping were also explored in the case of Senegal. The potential problems tied with the concept were discussed in chapter 4.5. Challenges to Community Mapping. The constraints that can be posed by the general low acceptance of the GIS technologies in the developing countries (Villanueva, 2009) is mitigated in Senegal by the fact that its capital is perceived to be the technological hub of West Africa. Therefore, the GIS, among other information systems, is already quite widespread in Senegal and integrated into its ICT's ecosystem. The lack of participation, data quality and ownership of the data are general challenges based in the very nature of the OSM project. These are therefore faced by similar communities around the world and in the context of the field research any special emphasis was not given to those constraints.

The data collection within the OSM project and its specifics in developing contexts was explored in the Senegal example as well. The findings that have emerged from this particular objective of the field research were complemented by the data from a similar project in Burundi. Experience from both cases reveals particular aspects of the data gathering process in developing countries. There is a high level of sensitivity of the mapping activities conducted in the field that needs to be taken into account in OSM projects. Particularly in some areas using GPS devices and writing down information can create suspicion and anxiety among the local population. To mitigate this effect it is therefore necessary to inform authorities about the mapping and to involve local population as much as possible. That can also prevent the mappers from misunderstanding some features in the area and to help them with extracting the information as well. Engaging the locals is an important step of the field mapping in developing countries for the information sought is often not clear without further investigation.

Similarly to the previous objective, to explore the further use of the OSM data the field research in Senegal was complemented by the author's experience from Burundi as well. The findings suggest that there is great potential in the OSM data leverage for the international development and humanitarian community. In the two countries the data were used in the context of refugee camp management, identifying the urban and territorial problems, mapping the health infrastructure or to support innovative solutions to the development problems.

The Burundian example has also shown one particular challenge to the online community mapping in the developing countries. Similar to other OSM outreach projects carried out in those contexts also this particular one was implemented by an external actor. Within the period of the six months of deployment, the project was not successful in creating an independent community that would carry on with the activities started by the EUROSHA team. Although many mappers were trained and some partnerships were established, without an external facilitator of the OSM activities, the project was not sustainable. Several reasons may exist for that outcome. Firstly, the EUROSHA team was not constituted by experienced mappers and OSM facilitators. Therefore the trainings may have not been conducted properly in terms of planning, activities or intensity. Secondly, the mappers reached within the project did not have the incentives or material means to carry on with the activities. While both aspects probably played the role in the long term failure of the project, perhaps the most relevant issue was an abandonment of the emerging mapping community both physically and in terms of distant support.

Neither the OSM group in Senegal was constructed naturally. However, in this case, the persistent focus of HOT has resulted in the successful creation and consolidation of the OSM community. The group has achieved a stage when it can work independently on its initiating actor. Currently, the group is working in several places in Dakar by collecting and editing the data, training other mappers or informing the public about the project. Moreover, the group is involved in the distant mapping organized by HOT. On the basis of the two experiences it is therefore possible to conclude that the presumption to achieve a self-sufficient online mapping community in developing contexts is a strong and continuous support of an external actor. Especially, in the initial period the presence of skilled mappers and experienced facilitators of the OSM

activities can boost the members' interest and motivation and can lay foundation to the successful mapping community as was proved in the Senegal case.

## CONCLUSION

Online community mapping is a phenomenon that has emerged quite recently as a part of the ICT boom. It is fundamentally rooted in the ideas of open source, open data and crowdsourcing. Although the concept has originated in the developed world where it has become already widespread its potential is being discovered in the different contexts as well. The significance of the online community mapping in developing countries has been discussed within this thesis and its findings support the assumption that the concept is relevant in these contexts as well and can represent an effective tool within the development and humanitarian assistance.

The structure of the thesis corresponds with its aims, outlined within the first chapter. The third chapter presents significant concepts that constitute the basis for the online community mapping. Special emphasis is given to the rise of the Web 2.0, open source and open data initiative and crowdsourcing. The examples of the concepts are given and their importance for online community mapping is discussed.

The fourth chapter is dedicated to the very phenomenon of online community mapping. It draws the definition of the concept and it presents its significance and challenges. Furthermore, it describes in depth the implication of the online community mapping in developing contexts and presents its examples. The findings of this chapter facilitate the results of the field research and constitute therefore the crucial part of the thesis.

The essential part of the thesis is represented by the case study of the OSM community in Senegal that is covered in the fifth chapter. The methodology of the field research is presented and the research site is described. The case study's findings are discussed progressively and their summary is provided in chapter 5.6. The Results Discussion where the conclusion is made as well.

The results of the thesis prove that there is great potential for the humanitarian and development agenda in the concept of online community mapping. It is therefore desirable that its leverage by governments, NGOs and other actors is further promoted. Its significance for the development and humanitarian system lies particularly in its volunteerism aspect and community empowerment that in many cases accompanies the

activities within the online community mapping concept. However the research has also shown that in the cases of externally initiated mapping groups the focus of the initiating actor is highly desirable and perhaps necessary to ensure the creation of effective and independent community.

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