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Hudumia:
A platform to support spontaneous
volunteers' situational awareness, coordination
and safety underemergency scenarios
Élton Cláudio Araújo Teixeira



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MASTER DISSERTATION

Élton Cláudio Araújo Teixeira
MASTER IN INFORMATICS ENGINEERING


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Élton Cláudio Araújo Teixeira

MASTER IN INFORMATICS ENGINEERING

GUIDANCE

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Abstract

Spontaneous volunteers always emerge under emergency scenarios and are vital to a successful community response, yet some uncertainty subsists around their role and its inherent acceptance by official entities under emergency scenarios. In our research we have identified that most of the spontaneous volunteers do have none or little support from official entities, hence they end up facing critical problems as situational awareness, safety instructions and guidance, motivation and group organization. We argue that official entities still play a crucial role and should change some of their behaviors regarding spontaneous volunteerism.

We aim with this thesis to design a software architecture and a framework in order to implement a solution to support spontaneous volunteerism under emergency scenarios along with a set of guidelines for the design of open information management systems. Together with the collaboration from both citizens and emergency professionals we have been able to attain several important contributions, as the clear identification of the roles taken by both spontaneous volunteers and professionals, the importance of volunteerism in overall community response and the role which open collaborative information management systems have in the community volunteering efforts. These conclusions have directly supported the design guidelines of our software solution proposal.

In what concerns to methodology, we first review literature on technologies support to emergencies and how spontaneous volunteers actually challenge these systems. Following, we have performed a field research where we have observed that the emerging of spontaneous volunteer's efforts imposes new requirements for the design of such systems, which leaded to the creation of a cluster of design guidelines that supported our software solution proposal to address the volunteers' requirements. Finally we have architected and developed an online open information management tool which has been evaluated via usability engineering methods, usability user tests and heuristic evaluations.

Keywords

Volunteering; information management; software design requirements; emergencies; disaster relief; emergency response.

Resumo

Os voluntários espontâneos emergem sempre em cenários de emergência e são vitais para uma bem-sucedida resposta da comunidade. Mesmo assim, alguma incerteza existe acerca do papel destes voluntários e na sua aceitação por parte das entidades oficiais. Identificámos que os voluntários espontâneos não recebem apoio das entidades oficiais e deparam-se com problemas na percepção da situação, instruções de segurança, orientação no terreno, motivação e com a organização dos grupos. Argumentamos ainda que as entidades oficiais continuam a ter um papel crucial e que deveriam mudar alguns dos seus comportamentos no que diz respeito à consideração pelos voluntários espontâneos.

Temos como objectivo nesta tese, desenvolver uma arquitectura de Software e uma *framework* de forma a implementar uma solução para suportar as actividades dos voluntários espontâneos em cenários de emergência. Simultaneamente constituímos um conjunto de directrizes para a concepção de sistemas de gestão de informação abertos relacionados com apoio a acções de voluntariado em cenários de emergência. Conseguimos obter importantes contribuições no que diz respeito à clara identificação dos papéis tomados pelos voluntários e profissionais. A combinação das conclusões alcançadas, serviu como suporte directo à criação das directrizes de concepção da nossa solução de Software.

Quanto à metodologia, foi efectuada uma revisão da literatura sobre tecnologias de suporte a emergências e na forma em que os voluntários espontâneos desafiam esses sistemas. De seguida, foi realizada uma pesquisa de campo onde nos foi possível observar o aparecimento de acções de voluntariado espontâneas, impondo novos requisitos para a concepção de tais sistemas. Estes requisitos originaram a criação de um conjunto de directrizes de desenho, que conduziram e suportaram uma solução de Software para resolver os requisitos impostos pelos voluntários. Finalmente foi desenvolvida a solução de Software, cuja avaliação foi efectuada segundo métodos de engenharia de usabilidade, nomeadamente avaliações heurísticas e testes com utilizadores.

Palavras-chave

Voluntariado; sistema em tempo-real; requisitos desenho de software; emergências; ajuda humanitária; resposta a emergências

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Table of Abbreviations

GIS	Geographic Information System
ERS	Emergency Response System
EOC	Emergency Operations Command
EMIS	Emergency Management Information System
ECS	Emergency Communication System
CSCW	Computer Supported Cooperative Work
PPGIS	Public Participation Geographic Information System
UML	Unified Modeling Language
VRC	Volunteer Reception Center
NGO	Non-Governmental Organization
ICT	Information and Communication Technologies
OCHA	Office for the Coordination of Humanitarian Affairs
VTC	Volunteer Technical Community
SMS	Short Message Service
POI	Point of Interest
API	Application Programming Interface
ADD	Attribute Driven Design
DMS	Data Management System
MVC	Model-View-Controller
PHP	Hypertext Preprocessor
HCI	Human Computer Interaction
RSS	Rich Site Summary
DBMS	Database Management System

CHAPTER 1. INTRODUCTION

We will start this thesis introduction by presenting volunteerism in emergencies, where we describe the different types of volunteerism. In sequence we present problems found in spontaneous volunteerism, a special type of volunteerism. Following we approach the existing emergency and volunteering support information systems, ending up with the presentation of this thesis goals and detailing its contribution to the research community.

1.1. Volunteerism in Emergencies

Volunteerism is internationally recognized as being free will activities that are of benefit to others outside of a household (United Nations Volunteers, 2011, pp. 3-4). There are basically 2 types of volunteering, the affiliated volunteering (standard volunteering), which is by signing to an organization (usually stated as Non-Governmental Organization – NGO) as the Red Cross (Red Cross, 2012.), where the volunteers will have training and will commit to a scheduled time-oriented job, hence they will work under an organization command hierarchy. Secondly, we have the non-standard volunteering, spontaneous volunteering where volunteers are not trained neither are affiliated with any organization. Therefore they emerge to volunteer on a free will basis without being under any command and control structure, neither schedules.

In affiliated volunteering, citizens feel helpful at being volunteers as they are directly contributing to community well being and fast recovery by helping the official entities efforts (United Nations Volunteers, 2011, p. 5). Analogous, in spontaneous volunteering citizens have a clear notion of the limitations of official resources and usually they have good will to take care of lower priority tasks (usually unhandled by professionals due to lack of resources) in order to contribute to overall community's emergency response efforts. According to literature, these volunteer efforts are important to the successful recovery of a community when facing an emergency scenario (Volunteer Florida, The Governors Commission on Volunteerism & Community Service, 2008).

Usually, under emergency scenarios, spontaneous volunteers emerge in small groups to handle community needs which were not prioritized, neither handled by emergency professionals. In highly emergency resilient (ability of communities to prevent, prepare, cope with and recover from disasters (United Nations Volunteers, 2011, p. 74) locations, affiliated volunteering is always present and in expressive amounts. For

instance, in Australia, which is a highly emergency resilient area there are over 500.000 officially trained volunteers through the country (Emergency Management Australia, 2006). Despite that most of these volunteers area usually affiliated with some organization, there also reports of spontaneous volunteers efforts. In contrast, at low emergency resilient locations there is no need for a community to be continuous under alert to the occurrence of emergencies. Henceforward affiliated volunteering is not so expressive since community doesn't have the need neither the motivation to take that responsibility and commitment. Therefore, in these locations spontaneous volunteering efforts become more expressive when some unexpected emergency triggers.

Moreover in certain low resilient communities, such as Madeira Island (Portugal), spontaneous volunteerism is not politically recognized as a volunteering activity, hence the official entities don't prepare themselves and neither train to handle spontaneous volunteers. This implicitly creates difficulties for the spontaneous volunteer's efforts, since they are not provided with any official support, which usually coordinates all of the emergency handling activities. On the analyzed emergency scenarios we have observed several situations where non-trained volunteers who approached the official entities have been directly rejected by them. Analogous we have also observed similar scenarios as in Australia, where two thirds of spontaneous volunteers who approached the official entities were never used in the response (Cottrell, 2010).

In large countries as the United States of America, the emergence of spontaneous volunteers has started to be acknowledged and written in disaster management handbooks (Volunteers of America , 2009) and we've seen a first example of a Volunteer Reception Center (VRC) being settled up in Florida (USA) (Volunteer Florida, The Governors Comission on Volunteerism & Community Service, 2008) which aims in receiving untrained spontaneous volunteers whom are willing to help integrated into the official emergency handling structure.

1.2. Problems found in spontaneous volunteerism

Overall it remains clear that spontaneous volunteers face a lot of difficulties when they put their efforts on performing emergency handling activities. According to our research, we have identified that most of the spontaneous volunteers emerge after acquiring some initial awareness about community needs which require support or the volunteer response efforts being actually taken. This awareness usually comes from

TV footages or is told by friends and citizens, as observed in our field researches. Yet, according to our research with lack of awareness, most citizens remain unsure of what to do regarding an emergency situation, turning acquisition of awareness into a problem to solve, since it turns out to be a major obstacle for spontaneous volunteering efforts to emerge.

One of the main concerns from official entities regarding spontaneous volunteerism is in ensuring that the activities being taken are performed safely and that volunteers remain non-injured. According to them, spontaneous volunteers usually don't have enough knowledge to act safely under distinct emergency scenarios, hence they should have minimum instructions and guidance. This is analogous of what is being done in VRCs (Groselle, 2006) where non-trained volunteers receive an express training in order to be minimum safety prepared to perform emergency handling activities under the control and command of officials. As an example of this implicit training sessions, in Australia (a highly emergency resilient location), official entities provide citizens with quick instructions flyers in order to allow overall community to act safer when facing an emergency scenario. To some extent this may apply to officials in non-resilient areas facing unexpected emergency scenarios, where both officials and community could benefit from outside tested and validated guidance.

Spontaneous volunteering is usually unorganized since these volunteers are not integrated within the official emergency handling structure. Despite that this unorganized structure belongs to the nature of the spontaneous volunteers, we have seen that introducing some organizational level could allow them to perform faster and safer. As a supportive example to this, we have observed in the field research a group of approximately 50 spontaneous volunteers which have been able to slightly organize themselves by distributing tools and contacts before going to the emergency scenario. If there were no organization, they would end up being fewer volunteers with fewer tools, possibly leading to a slower and unsafe performance.

1.3. Lacks of existing Information Systems

In order to support emergency organizations activities, two basic types of systems exist: single phase light solutions which support one or two phases of the emergency response and the full featured suites which are usually used only within emergency response organizations and are able to support all phases of the emergency response. These are usually named as Emergency Response Systems (ERS) and Emergency Management Information Systems (EMIS), but can have other naming, since there is

no pre-defined standard name for them. In what concerns to the state-of-the-art volunteering support software systems, I have seen that the last advances in technology together with the availability of the internet around the world have enabled new forms of emergency volunteering (most of them related to disaster relief). Some large-scale tools are currently being used around the world (e.g. *Ushahidi* (Ushahidi, 2012)) and international organizations have given them credit over their proven usefulness under emergency scenarios.

Yet, there is a small cluster of information systems designed to support volunteering under emergency scenarios. Has we've seen on literature, most of the used systems are designed on-the-fly and end up being used only as temporary ad-hoc solutions. Usually these solutions (identified on the literature) are addressed to the Volunteer Technical Community (VTC) and allow them to do information management tasks online which aims in contributing to a better on-field response support for emergency professionals. As an example, we have seen the successful usage of applications under Haiti Earthquake where VTC services have been requested by officials to do tasks as translations of field reports and digital geo-referencing of health facilities locations, which didn't have any location data in order to support official responder's efforts (Harvard Humanitarian Initiative, 2011). The VTC *CrisisMappers* community (CrisisMappers, 2012) have used *OpenStreetMap* (OpenStreetMap, 2012) web application in order to attempt geo-referencing the requested locations via satellite imagery.

Figure 1 – OpenStreet Map with Haiti facilities geo-referenced.

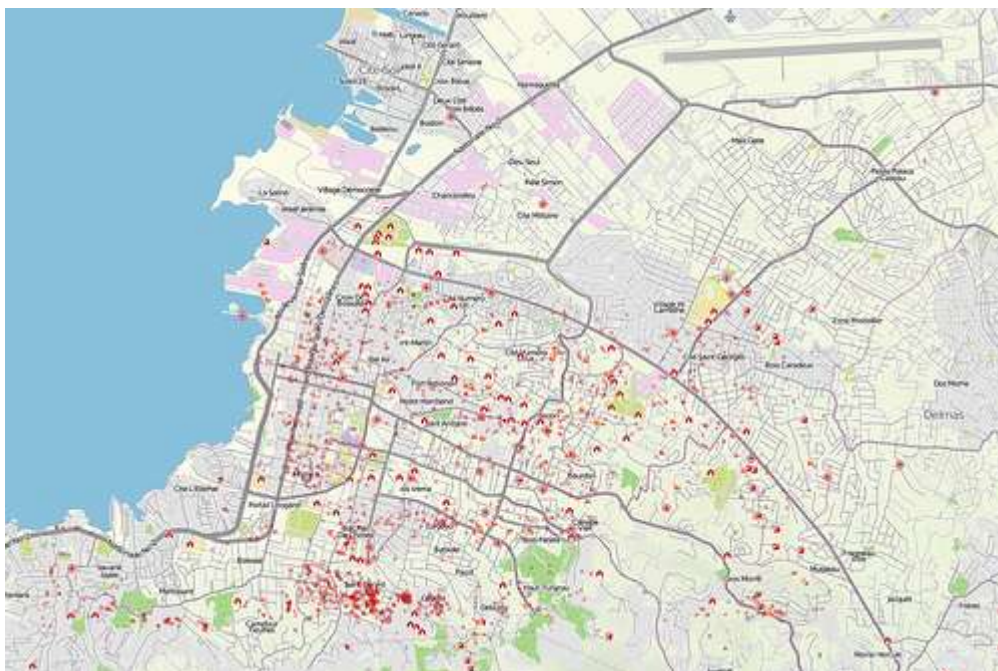


Figure 2 – VTC Community working “Humanitarian OpenStreetMap Team” (Harvard Humanitarian Initiative, 2011)



It happens that all of these ad-hoc VTC focused information systems were not designed to directly support on-field spontaneous volunteering efforts, as our identified problems relate to. We have analyzed 6 currently available online volunteer support systems directed to VTC and 3 distinct-purpose online applications, *Google Docs* (Google, 2012) , *Ushahidi* (Ushahidi, 2012) and *Twitter* (Twitter, 2012) and they do not comply with some of our cluster of requirements for designing volunteer support information management tools (refer to Chapter 4). Furthermore, we have not identified any available solution designed to support on-field activities taken by emergency volunteers, that is, with focus on supporting physical volunteering activities rather than online volunteering tasks (e.g.. organizing data, micro tasks), hence the currently available solutions are not capable of addressing situational awareness, guidance, safety or organization, neither can we do a later direct comparison between them and our system proposal.

1.4. Thesis Goal

This thesis has as a main goal to architect and develop a web information management tool which addresses a research-identified cluster of problems which spontaneous volunteer's usually encounter under emergency scenarios, hence it will allow spontaneous volunteers to have some support to the accomplishment of their efforts. We've used some of our research findings and conclusions to guide the development of the software platform.

1.5. Thesis Contribution

We have noticed that the subject of spontaneous volunteering under emergency scenarios is currently poorly understood by literature and that there is a lack of software tools to support their efforts. Therefore, 2 clusters of contributions have

become materialized from our research conclusions and further analysis, a framework which clarifies the role of spontaneous volunteers under emergency scenarios and finally a cluster of high-level design guidelines to guide future volunteer support open information management systems development.

1.5.1. Framework

We have been able to identify and pack the different roles usually taken by spontaneous volunteers under emergency scenarios, regarding official entities collaboration and interaction. We have then combined these distinct roles into a framework, wrapping up dissimilar interactions of volunteers with official entities which depend on two variables: the scale of emergency and the capacity of the response organization. In addition we have clarified the role which open emergency focused collaborative information management systems have in the overall community volunteering response efforts.

1.5.2. Design Guidelines

As stated, we have also created a cluster of design guidelines to guide the development of open information management systems to be used on volunteering support. These guidelines provide support for the different roles identified on the framework. They contain information reporting suggestions, clarifications of the high-level purpose and contribution of open information management systems and ways in which officials can contribute to those systems development and deployment. We've also created a set of research-derived functional requirements for guiding the development of our software solution.

1.6. Methodological Approach

This thesis followed a sequential approach which covered several interconnected research phases, literature review, field research, reflections, prototype and its evaluation.

The Literature Review had as a goal to discover and review software support tools both on official emergency support and volunteering support, as also to analyze how spontaneous volunteers are currently being supported under emergency scenarios. It brought up some findings, regarding emergency support software where we have found that 2 types of distinct solutions exists, regarding volunteering support software, where we have found that most of the existing volunteering support tools do not support emergency response. This gave us some knowledge about software solutions

used by both professionals and by volunteering community. Inherent to this, we have also extended research to cover related subjects which were detected in online emergency volunteering tools, geographic frameworks, computer supported cooperative work (CSCW) and crowdsourcing systems, which gave us some established guidelines on how to successfully design such systems. Finally we have identified the different types of volunteerism in emergencies, 3 distinct viewpoints over volunteer roles took by several literature authors and that volunteers actually emerge in large proportions and are usually rejected or not-used by professionals.

With this literature review we have mostly acquired design guidelines, requirements for developing solutions to support emergencies and clarifications regarding spontaneous volunteerism in emergencies. In order to complement this, we have performed a field research consisting of 2 field studies accomplished in Madeira Island (Portugal) regarding an emergency simulation exercise and a real emergency scenario where observation and analysis of activities and interactions from both officials and volunteers was performed.

This field research had as main goals to observe interaction patterns between volunteers and professionals under realistic emergency scenarios. We have identified 3 problems spotted during analysis of the spontaneous volunteering efforts being taken, the lack of situational awareness, lack of guidance and safety and lack of organization which could limit the performance and safety of the volunteers. Other findings were extracted from the analysis of the field research data, from which we can highlight the detection of official response overwhelming, emergence of spontaneous volunteerism under a real emergency scenario, motivational factors which led to the volunteering emergence, awareness acquired by affected citizens and lack of collaboration between officials and volunteers. Some design opportunities have been also extracted, as the enhancement of professionals and volunteer's collaboration and interaction, contribution of open information management tools to the overall emergency community response, providing volunteers with awareness and assisting them in informing community requested tasks and volunteers efforts being taken.

The combination of these field research findings together with the findings from the literature review led to the creation of a framework and a cluster of design guidelines which drove our solution proposal to support spontaneous volunteerism with focus on supporting the following central unattended identified problems: lack of situational awareness, lack of guidance and safety and lack of organization.

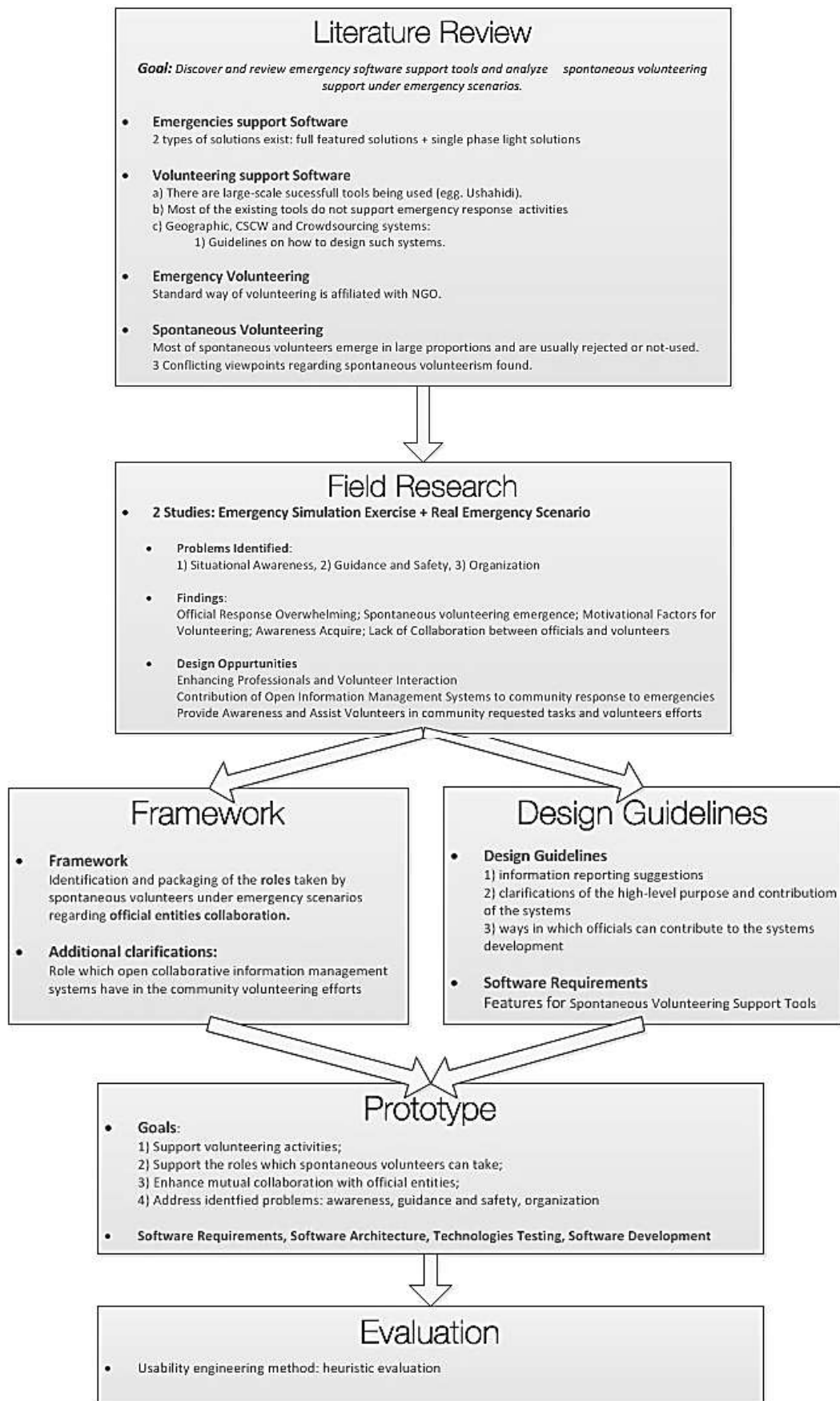
The creation of this framework together with the design guidelines concentrates the core contributions of this thesis. The framework contains an identification and packaging of the roles taken by spontaneous volunteers under emergency scenarios, regarding official entities collaboration which were identified on the literature review (3 conflicting viewpoints) and later detected on the field researches. The framework is complemented with some additional clarifications regarding the role which open collaborative information management systems have in the community volunteering efforts.

The cluster of design guidelines aims in supporting the development of volunteering emergency support information management tools. It's organized in 3 categories, information reporting suggestions, clarifications of the high-level purpose and contribution of the systems and ways in which officials can contribute to systems development, which were based both on field research and literature review conclusions. The cluster also contains software design requirements (functional requirements) in order to directly support the development of spontaneous volunteering support tools and which were actually used in our solution proposal.

At this point, we have gained enough knowledge to develop a solution to better support volunteering activities, to understand the different roles which spontaneous volunteers can take, to enhance mutual collaboration with official entities and volunteers under emergency scenarios and finally to address the identified research problems: awareness, guidance and safety and organization.

The prototype development, started with some requirements engineering methods which with the support of the created design guidelines we have been able to create the functional requirements and non-functional requirements clusters. The software architecture had as architectural drivers some of those requirements. We have created from scratch a MVC based software architecture built with a components tying analogy. The architecture is decoupled in modules, and could be used to develop other solutions. In addition, one should be able to use our cluster of design implications to start the development of an emergency volunteering focused open information management system or related. In order to evaluate the prototype we have used the usability engineering method 'heuristic evaluation' in order to evaluate the platform interface usability.

Figure 3 – Diagram of the Thesis Methodological Approach Research



CHAPTER 2. LITERATURE REVIEW

This chapter includes the literature review which aimed at understanding the subject of volunteering in emergencies and to discover and review some emergency software support tools to it. The first topics present a brief introduction to the emergency support subject, where we address the different types of emergency support systems and related software solutions.

2.1. Emergency Support and Web 2.0

Information and Communication technologies have become a must in order to handle the arising trend that has been scaring the communities for the last years, natural disasters. We've observed that the use of technology for handling disaster operations has grown in last decades. The Web 2.0 technology with its distinct features (e.g. wikis, forums, social networks) makes it suitable to be applied into the emergency handling (Caron, 2010). With the Web 2.0 users can do more than simply retrieve information, they can now generate and distribute content among the online networks (Caron, 2010). By making use of the numerous features that Web 2.0 brings to us (e.g. online maps) anyone is now able to contribute to disaster response activities.

Some of the today's largest used websites were created with the new Web 2.0 technologies as *Wikipedia* (Wikipedia, 2012), *Facebook* (Facebook, 2012) or *YouTube* (Google, 2012). This new technologies take advantage of the users network community, bringing them together into one place and allowing them to share and consume multimedia content published by the community itself. Usually, the web applications which feature Web 2.0 technologies are social and open to the world, and their values get increased according to the inherent growth of active users. As an example *Google Maps* (Google, 2012) is a platform and an Application Programming Interface (API) that displays geographic information about places, routes and Points of Interest (POI) around the world and was built with Web 2.0 technology. With this platform, users can create their POI's, plan trips, within several other navigation related activities.

Yet, nowadays the use of credible sources of information (older ones) is still favored against the "brand new" based on Web 2.0 technologies, for companies which usually work with decision-making activities as emergency response (Caron, 2010). Web 2.0 is in general more used for communication purposes rather than coordination or problem-solving tasks, hence having as a direct consequence the low influence of this technology on emergency operations coordination (Caron, 2010). Inherent to that, only

a few percent of organizations use Web 2.0 tools to smooth their internal communication. Some authors also remark that organizations in general should start looking at the public as some kind of reliable source of information (Nuojuua & Kuutti, 2008).

2.1.1. Usage of Web 2.0 Technologies on Emergencies

The majority of people usually and implicitly use social networking, on-line media sharing tools and blogs (Caron, 2010) when facing emergency situations near their location or country. Wiki's and crowdsourcing tools are quite less used in comparison to the big cluster of social networking (e.g. *Facebook* (Facebook, 2012)) and related tools. One of the identified reasons for this seems to be ignorance, skepticism and lack of resources (Caron, 2010), together with the fact that users actually use social networking tools on a daily basis. This brings up an aspect that we should definitely take in consideration, which tools and hardware do people actually use on a daily basis, and which of them do they have access when facing an emergency situation.

One characteristic that brings some light to stimulating Web 2.0 usage on emergency situations is the reinforcement brought to the collaboration within official entities which are working on the emergency field (Caron, 2010). The information customization is another strength in which under a practical situation, allows the personalization of the emergency scenario information flow to meet the organizational needs (e.g. by topic, region, severity) still being easy and simple enough for the laymen to be able to input and understand. An example of a solid on-line Web 2.0 emergency tool which is currently used for emergency reporting is *Ushahidi* (Ushahidi, 2012)

There could be some breakdowns brought by the introducing of Web 2.0 technologies into emergency response activities, since some argued that while taking emergency response procedures, the main workload “came from the invalidated nature of the data flowing in” (Caron, 2010).

2.2. Emergency Systems

There is a lot of work being done in emergency related systems with more emphasis in the last decade, mainly due to the enhancement of awareness to public safety by the governments and the natural evolution of technology. According to a quick overview over the existing emergency systems, I have noticed that most of the software systems available on the emergency management field are private or closed and only a few remain open-source, usually the ones that are not fully ad-hoc due to commercial

issues. In general they allow emergency management personnel to deal and handle a wide range of disasters and emergencies.

By researching and analyzing the existing mapping tools and projects we gained an understanding over some contextual concepts, their technology and their features, We have also went through some simulations and trials over some of those systems. There are a lot of solutions out there, but at this phase I will only cover the ones which are highly related to our concept of supporting emergency response activities. As a remark, most of the solutions which we've tested so far are full featured emergency management suites, since they cover all phases of emergency response (from trigger of emergency to post-emergency) and were designed for professional usage by emergency organizations. These emergency management suites share the following components (within others):

- Geographic Information Systems (GIS)
- Resources Management and Modeling
- Command and Control Support
- Communications Support

Following we present a table with a short description and some features of some analyzed tools which aim in supporting emergency response efforts.

Table 1 - Examples of emergency response support tools

Tool Name	Quick Description
GeoVISTA CrimeViz	<p>Single phase support, web-based map application for exploring space-temporal patterns of violent crime in the District of Columbia. * Plots up-to date crime incidents on a base map using the Google Maps API for Adobe Flash</p> <p>Features</p> <ul style="list-style-type: none">• Crime incidents plotted over map with circles.• Time control (by month) on the bottom.• Several Data Layers over the map• Toggle visible POI's over the map• Identify regions inside layers.• Can play timeline and see POI's moving around the map.

	<p>Link</p> <p>http://www.geovista.psu.edu/CrimeViz/</p>
Ushahidi	<p>Single phase support application, which gathers information sent by citizens via SMS, MMS, etc. for situational awareness regarding emergency or high tension scenarios and plots it into an interactive map.</p> <p>Used by US Military organizations to aid conclusions about the on-going ground situation.</p> <p>Private companies also use the information to identify partners and desired institutions.</p> <p>Link</p> <p>http://www.ushahidi.com</p>
Sahana	<p>Shana software foundation provides several products (Mayon, Eden, and Vesuvius) which cover specific contexts regarding emergency support.</p> <p>Mayon is a full featured emergency management application directed to emergency professionals and its remarked by being a personnel and resource management solution which is highly scalable to manage large numbers of events, persons and resources. It's directed to high level emergency entities charged with preparedness, response, recovery and mitigation responsibilities. Mayon is still in development phase.</p> <p>Eden is an open-source platform directed to support disaster management. Despite that is designed for use under emergency scenarios it can be highly customized to other contexts. It provides mapping functionality to aid and visually support the emergency response.</p> <p>Link</p> <p>http://sahanafoundation.org/products/</p>

2.2.1. Emergency Response Systems (ERS)

Emergency response is an activity that comes from the decisions outlined by the collaborative exchange of messages within the professional emergency structure and is highly human-decision based. Furthermore, it's still relatively usual that some decisions are taken from the re-analysis of previously exchanged messages (Kanno & Furuta, 2006).

Aside from the information tools which support and allow smoother emergency management, real actions take place, where teams are dispatched to the terrain and instructions are given to the various branches that are on the field handling the on-going scenario. All of the acquainted information is immediately made available to be accessed by all of the coordination and planning teams since its update frequency is critical in aiding the crucial process of an accurate response. Cooperation is also a crucial term to have under consideration when we talk about the response actions to emergency situations. It's important to remark that exceptionally some decisions and actions are taken based on experience or common sense from the professionals (Kanno & Furuta, 2006).

An ERS is a professional software suite which provides features like scenario mapping, call management, dispatch operations, automated record keeping and mobile communications support. This cluster of features makes an ERS of a powerful tool to aid the emergency teams work (Kanno & Furuta, 2006). Most of the ERS are installed in Emergency Operations Centers (EOC) where instant coordination and emergency response decisions are usually taken. These systems are usually operated by members of local government, governmental agencies and also by some private companies, implicitly creating a multi-task work environment. The ERS are extremely important nowadays since they're one of the key work tools of emergency professionals which are used in order to pro-actively support emergency handling activities and support action against natural disasters, industrial accidents or terrorist acts over a country or citizens (Kanno & Furuta, 2006). Any help provided by the ERS has an immediate and direct impact over the response decisions and actions taken to handle an emergency. They were created to minimize the damage potential when facing emergency situations, due to its high capability of organizing and aiding the decision making in intense collaborative environments. During the emergency handling activities, adaptive and flexible responses are required in order to successfully handle the situation (Kanno & Furuta, 2006). It's important to underline that this type of responses may lead to confusion and inherently could put in cause the success of the

ongoing emergency. In order to handle a situation like this, an effective and efficient response is required from the professionals, putting this kind of support systems in a highly critical position. Despite ERS is the most generic term applied to these systems, they could be also called as an Emergency Communication System (ECS), within others.

2.2.2. Emergency Management Information Systems (EMIS)

An EMIS is a system powered by a computer database for disaster response that provides graphical and real-time information to emergency professionals that are currently handling some emergency situation. It should provide continuous support during the full cycle of emergency management. This cycle contains several phases which start in identifying the risks and reducing vulnerability (mitigation), planning a response, the actual emergency response efforts and end up with the emergency recovery phase (Walle, et al., 2010). Some authors remark that these systems have failures and research is needed to improve them. This kind of system is expected to provide detailed and real-time information and to fully support all of the professional's activities in a quick and flexible way. The system has some facilities as aero-photos and maps where places could be easily located by the professionals using the system and in most of the times they are internally supported by a GIS component (Lowe, 2012). Overall, the EMIS should allow the emergency professionals to run their activities faster and easier.

2.3. Geographic Systems

Since maps are important in emergency response organizations (according to our research) and as most of the analyzed emergency software products have a built-in geographic component, we have briefly researched this subject in order to gain some knowledge and understanding about the state-of-the-art of geographic systems, since my software solution (prototype) would almost certainly make use of one. Geographic systems (usually entitled as Geographic Information Systems (GIS)) are usually used as a framework for a bigger system or as a tool for accessing or processing geographic information, in which some of the public ones are freely available for public usage. It is significant to state that lighter geographic systems as *GoogleMaps* (Google, 2012), usually don't have the power and features of a full featured geographic tool (usually known as GIS), which provides a cluster of geographic processing features. Despite that, it's expected that the gap between this lighter frameworks and traditional full featured GIS will be reduced in future.

2.3.1. Geographic Information Systems (GIS)

GIS systems are used in a large scope of domains, including emergency response. Some of the systems are freely available to public, but they're not accessible to every user, since they require some geographical background for a smooth usage. They are full-featured suites, and mostly used to run simulations (e.g. crisis scenarios), calculate and predict future environment changes (e.g. natural disasters) and doing spatial analysis activities, between others. One of the most commonly used GIS is *ArcGIS* (ESRI, 2012), which is used in a large scope of industries. These sorts of system also have a tendency to be too complex for completing simple tasks as visually plotting points over a map.

2.3.2. Public Participation Geographic Information Systems (PPGIS)

Public Participation Geographic Information Systems (PPGIS) appeared from the joint of community interests with the support provided by the available GIS tools. They have as a key objective to generate geographic knowledge from the public. They reflect how people understand, manipulate and interact with geographic representations of the real world. They also greatly facilitate the public participation in some geographic based activities which are done to improve community knowledge about geo-related issues (e.g. environmental protection, ethnography studies, etc.) (Longley, et al., 2005). Online participation has the advantage of the participants being anonymous, and this allows most of the citizens to participate when and where they feel it's convenient and helpful (Carver, 2001).

One of the main challenges that developers find when designing a new PPGIS is the fact that they are intended to be used both by experts and laymen (usually the government and citizens). In order to overcome this design challenge, some authors suggested a user-centered design approach, in which both laymen and experts directly influence the design of the system from the beginning. This is usually insured by usability evaluation methodologies by meeting user requirements. If experts and laymen are taken under consideration since the beginning of the project, designers can then take into account usability and acceptability issues.

2.3.3. Geographic Mapping / Visualization Tools and API's

I went through a quick overview over some geographic mapping and visualization tools were some were extensively tested. This has given a greater and more solid knowledge base around the common features provided by this kind of tools. Following

we present a short table with of some of the tools which were analyzed, consisting on a quick description of the tool or API, along with some of their key-features.

Table 2 - Short List of geographic mapping and visualization tools

Tool Name	Quick Description
SensePlace2	<p>Prototype web application that supports knowledge-enabled retrieval of news stories and other documents relevant to user-specified issues and places. It extracts and geo-tags references to places and enables situation assessment through web-map services that build a geo-historical context through which to interpret ongoing events.</p> <p>Features</p> <ul style="list-style-type: none"> • User Drawing over the map • Smart Zoom Leveler • Mapping of Geo-Tag references with circles over the map <p>Link http://www.apps.geovista.psu.edu/SensePlace2/ </p>
Herbaria Viz	<p>Web-based map that facilitates easy querying, displaying, and spatiotemporal exploration of a large plant sample collection (data provided by the Consortium of California Herbaria).</p> <p>Link http://code.google.com/p/herbaria-viz/ </p>
The Pennsylvania Cancer Atlas & The National Cancer Atlas	<p>Highly interactive web-based GIS-enabled cancer atlas prototypes, designed as a model for implementation of atlases to support government cancer control activities. The model integrates symbolization and design principles from print cartography, interaction strategies from exploratory geo-visualization, and web-map/web-feature service advances from GIS.</p> <p>Link http://www.geovista.psu.edu/grants/CDC/national.html </p>
ArcGIS	<p>This is a full featured GIS Suite, developed by ESRI. It</p>

	<p>allows numerous sources of maps to be chosen from (e.g. ESRI, NavTeq, TomTom, etc.).</p> <p>Link http://www.arcgis.com/</p>
WikiMapia	<p>Online editable map that allows users to add information about any location around the globe. Its purpose is to identify as much locations as possible from single spots to large cities. A Wiki based system is used since anyone who's registered can edit existing ones and add new places.</p> <p>Features</p> <ul style="list-style-type: none"> • Changes are applied immediately. • On-the-fly base-map switching. • Polygon creation for marking places. • API available for querying data from the WikiMapia databases. <p>Link http://www.wikimapia.org</p>
OpenLayers	<p>Framework intended to separate map tools from map data. OpenLayers implements a JavaScript API for building rich web-based geographic applications, similar to the Google Maps and MSN Virtual Earth APIs. OpenLayers is a pure JavaScript library for displaying map data in most modern web browsers, with no server-side dependencies.</p> <p>Link http://openlayers.org/</p>
FixMyStreet	<p>Online tool for reporting, viewing, or discussing local problems (like graffiti, fly tipping, broken paving slabs, or street lighting). Only works on Great Britain (UK) at the moment.</p> <p>Features</p> <ul style="list-style-type: none"> • Geo-Locate me (identifies user location) • Searching for locations by text queries

	<ul style="list-style-type: none"> • Visually presents fixed and to fix reports (flag pin icons) • Allows community participation (outside the map) <p>Link</p> <p>http://www.fixmystreet.com/</p>
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2.4. Crowdsourcing (Collaboration)

The research on collaboration with the support of computer tools started in the early 80's. Since that, crowdsourcing has become a quite popular activity in the Web environment, where small tasks are outsourced to a lot of users, usually via open calls. In some cases, users can be rewarded for the task completions, but in most cases via goodwill and community safety systems such as *Ushahidi* (Ushahidi, 2012) users act as volunteers for the project and its inherent cause. Crowdsourcing directly implies decentralization strategies and collaborative intelligence by distributing a group of tasks to a crowd (Caron, 2010) and it conveys a lot of advantages for the emergency subject since it brings speed, affordability and more important, the decentralization of information as also contributing to a participatory culture among the communities (Caron, 2010). When referring to emergencies, this participatory culture will reflect the awareness from citizens to the emergencies (e.g. natural disasters). Networked teams work faster and are more accurate than the usual hierarchical teams that we encounter in the traditional management of information structures.

2.4.1. Crowdsourcing and GIS

The first produced GIS didn't support spatial collaboration since they were initially designed for individual use only. However, today some projects exist which extend the GIS with collaborative features, as *Wikimapia* (Wkimapia, 2012). Inherent to the ease of finding web mapping technology and related tools nowadays, common citizens can now have a simplified and easier access to geographic data. This has caught the public attention and curiosity to focus and to use the freely available tools which provide geographic information. Users are now familiar with the tools and are becoming active users of geographic information technologies such as *GoogleMaps* (Google, 2012). Maps are then becoming mediators of human-human collaboration in areas like urban planning, where decision making tasks are conducted.

2.4.2. Web Technologies on Facilitating Public Collaboration

Some authors (Kingston, et al., 2000) argue that internet-based technologies for public participation are able to bring more people into participation (e.g. environment planning systems). In other words, on-line systems which aim in converging the public into a shared participatory environment can bring the public closer to some on-going public participation session and inherently engage more people into the activities. Since the massification of the internet, computers and mobile devices are becoming widely used and the ability from the public to use and feel comfortable using these technologies has increased expressively.

Nowadays, we see that citizens in general are deeply embedded into the process of helping and protecting each other under emergency scenarios with basis in a mutual help approach (inside a community). The web-supported collaboration is created as an alternative way to enhance and not to replace current traditional methods and systems of collaboration, communication or report under emergency scenarios.

2.4.3. Crowdsourcing Reliability

For any crowdsourcing focused system, reliability and credibility of information is an important element which should be insured, but despite that, in human controlled systems it's highly probable that reliability will auto-establish itself with time. On the emergencies field, according to (Kanno & Furuta, 2006.), when information is received from an unknown source (e.g. anonymous individual), the emergency professionals first ask the provider to validate the information with other agencies and then make an on-the-fly comparison between the official source information and the one that they already have in hands. If one uses crowdsourcing for providing on-going emergency scenario information (geo-located or not), we can assume that this action of preliminary validating the data would be an action taken by the information consumers (e.g. emergency professionals) in case they find it useful to support their already validated information. Please note that, these are non-standardized procedures (Kanno & Furuta, 2006) and could vary among different organizations. Analogous validation activities are usually taken by professionals when facing conflicting information.

When conflicting information appears on community powered systems, a problem regarding the reliability of information, instantly arises and as mentioned before users will still assume that the system presents only correct information. Despite that, this requires some fast action to be taken in order to clear the conflict and avoid the proliferation of the unreliability feeling over from the users regarding the system.

Having this said, trust and confidence issues are likely to occur in a collaborative scenario, in case that some of the crowdsourcing members aren't willing to help or contribute, but instead to "play".

2.4.4. Crowdsourcing as a Contribution in Emergencies

By having crowdsourcing volunteers collaborating within them, one can assume that a quality arise (inherent from the amount and multi-personality of the collaborative users) and improvement over the spatial collaboration will emerge regarding emergency response and relief activities, when in comparison with the traditional on-field collaboration and communication methods. When facing emergency scenarios, the availability of collaboration and GIS tools usually play a crucial role in the emergency response and coordination activities for professionals. Most of the decisions taken by the active on-field responders are based on latest information, so by having a public supported system with up-to-date information, can lead to an improvement of the overall performance of response operations.

2.5. Computer-Supported Cooperative Work (CSCW)

We refer to this topic in order to gain a better understanding on how can one "emulate" the way people work with the support of computers. This is an important research topic since it brings up some concepts and disciplines that should be understood and implicitly applied simultaneously with the development of any groupware based system. One of the reasons for CSCW existence is that limiting ourselves only to the building of systems is not enough, we need to learn more about how people work in collaborative environments and how technology can affect that. In order to exist, group work requires 3 elements to be present: communication, collaboration and coordination (Ellis, et al., 1991). A shared environment is an important requirement in order to quietly notify all active participants about each other activities. (Ellis, et al., 1991). Coordination is seen as a key element in collaborative environments, and when we refer to emergency activities support we aim in using collaboration between active responders.

The groupware systems cluster evolution brought up some dependent and directly related subjects of research on the following domains: Human Computer Interaction, Artificial Intelligence, Social Theory and Distributed Systems within others (Ellis, et al., 1991). These domains should be taken in account when designing a groupware based

system, and this is by far one of the main contributions brought by this contextual approach to groupware systems. The author also remarks that one groupware system usually combines two or more of these domains (Ellis, et al., 1991).

2.5.1. Groupware Software Systems

Groupware are "computer-based systems that support groups of people engaged in a common task and that provide an interface to a shared environment" (Ellis, et al., 1991). According to (Ellis, et al., 1991) definition, groupware covers a wide variety of systems, by not limiting itself to the old-fashioned communication and management tools. Nowadays we have large systems that integrate information processing and communication activities together in one accessible place. The research over these peculiar systems is also known as CSCW (Computer-Supported Cooperative Work) (Ellis, et al., 1991). In CSCW one mainly looks at how groups physically work and discover new ways to better technologically support their work (Ellis, et al., 1991).

There are a lot of benefits from using a groupware based system against the traditional ones. By having different people and inherent multi-interaction applied to a collaborative system, one is able of noticing big improvements especially on the speed and accuracy of the tasks being done. An additional advantage is that when working in a distributed way, one can have access to external information (computer based or books) that could implicitly enhance its work. When under emergency scenarios, this can turn out to be a big improvement, at least for professionals since messaging and protocols consulting are usually an eminent pro-active task on emergency control centers (according to our field research). Citizens users can also benefit from this kind of working since they can analogous make calls, consult additional information, and validate physical information, between other activities.

Having a solid human-human interaction can also bring a lot of benefits and simultaneously erase or minimize some of the breakdowns already known from the physical interactions. According to (Ellis, et al., 1991) one can benefit from using a groupware system on the following apprehensions: encourages work within a group or can help prevent information losses. Additionally, the authors remark that once one has had experienced a groupware tool with all of its features, inevitably would want those features to be present in all tools that are regularly used.

The authors, (Ellis, et al., 1991) also argue that "groupware developers need to be conscious of the potential effects of technology on people, their work and interactions". We consider this as being a crucial aspect to be analyzed, since it goes along one big

progressive line where we find users with: motivation to use, desire to try or need to help as also taking in account their availability under emergency scenarios to use the system. Yet, according to (Rein & Ellis, 1990), two different teams while performing the exact same task use collaborative systems in dissimilar ways. This becomes an important aspect to have in consideration when developing a groupware system, since we will have distinct groups of individuals from crowdsourcing (e.g. laymen, professionals, experts) which will use the system in quite different ways and possibly with different purposes. Along with the difference of team individuals, the size of the team could also turn out to be a breakdown, since when facing small groups of collaborative individuals one can easily notice the cooperation between those active elements, but when turns to be large groups, coordination problems (between the users) can be noticed, since there could be conflicting goals, ethnics, opinions, between others factors.

2.5.2. Usage of Collaborative Geographic Systems on Community

In order for a community-based geographic system to be able to facilitate public participation, one needs to take in attention how maps are used by people. When Collaborative Geographic Systems (e.g. PPGIS) are introduced into communities, a variety of issues could arise, usually happening mostly when one tries to make it a community-based activity (MacEachren , 2011). Literature remarks that these systems, once successfully integrated into the community should handle the public knowledge as valuable and expert in order to be successful (MacEachren , 2011).

When we join a group of people together in a shared and collaborative environment, where geospatial data is used, some issues could implicitly arise. Issues which appear from the representation of distinct visual artifacts using a group approach as each person creates its own “mental picture” of each artifact which is being seen, should be taken under consideration, so that some efforts should be done in order to make most of the public interpretations as similar as possible. Allowing group members to interact between them over a map environment is also a subject which may require special attention. A good suggestion from the author MacEachren (MacEachren , 2011) to ensure a good interaction would be using direct manipulation interfaces, since it's a common approach used in desktop computing. Yet, this kind of visual manipulation should be reviewed in order to take the best of it under a group collaboration situation (MacEachren, 2011). Following the author suggestions, one may need to review or develop new presentation forms for displaying geospatial information (visual artifacts).

2.6. Emergency Volunteering

Under most of the emergency scenarios, volunteering is an implicit action taken by the citizens which occurs almost naturally. It's a natural part of human society and is defined by the United Nations General Assembly as activities that are of benefit to others outside of the household, which are carried out by free will and without being motivated by financial reward (United Nations Volunteers, 2011, pp. 3-4).

According to literature, the standard way of volunteering is by signing to an NGO (e.g. Red-Cross (Red Cross, 2012)) and then work under schedules with an organized hierarchy under some official emergency command. In the other side we have the unorganized volunteering which is not integrated within the emergency handling structure, and sometimes could be bigger than the standard way of volunteering. This type of volunteering is usually not well seen by both NGO's neither professionals, and in extreme situations neither stated as "volunteering" in some countries law policies (e.g. Portugal), according to an interview with local volunteering reception center collaborators. Despite that, it always happens and one cannot avoid it, as I've observed in the field researches. I've also seen both in field researches and literature that this kind of volunteering can be quite helpful most of the times and at this time no or low attention is given to this type of volunteering. Please note that spontaneous volunteering it's not a new movement since as identified on literature, it comes from a long time ago. For now on, we will refer to spontaneous volunteers as simply "volunteers".

2.6.1. Disaster Volunteers

Under emergency scenarios usually the common citizens with no prior experience (neither training) in emergency response or volunteering practice are the first to step in the scene and they implicitly start preliminary emergency response activities, just before the professionals arrival (Brennan, et al., 2005). Despite that these volunteers (citizens) do not have expertise or train in emergencies they should have their own professional skills that could match needs of response activities (e.g. construction works, electricity, etc.). This type of citizens usually don't want to commit to a NGO, hence they feel like staying out of any form of centralized coordination. Analogous to this type of spontaneous volunteering from citizens, private organizations frequently volunteer their services and resources without any kind of financial compensation. In addition, willing to help spontaneous volunteers can both arrive from inside (local

knowledge) as also from outside the community ((Fernandez, et al., 2006), (Cottrell, 2010), (United Nations Volunteers, 2011, pp. 76-78)).

2.6.1.1. Volunteering Activities

Usually spontaneous volunteers take 3 major activities when they arrive at emergency scenarios as stated by (Stallings & E.L., 1985, pp. 93-100): damage assessment, operations and coordination. These in somehow emulate the professional activities in their first approach over emergency scenarios. These set of activities are defined as being small-scale and low-risky activities as emotional support for victims, fast rescue, medical and psychological aid, building and construction, translation within others ((Dynes, et al., 1990), (Brennan, et al., 2005), (Cottrell, 2010)).

Despite most the activities are simple and non-risk, more advanced activities have also being documented as the setting up of an on-site wireless communication infrastructure (Wireless Emergency Response Team, 2001), setting up a disaster relief center or a new bus route for transportation (Wilson & Oyola-Yemaiel, February 23, 1998), setting up an ad-hoc logistics network (Fernandez, et al., 2006), within others.

2.7. Spontaneous Volunteering

We've seen that Spontaneous Volunteers can be a citizen or group of citizens which appear on an emergency scenario crafted with equipment and motivation and which are not affiliated with any organization. Usually, they are willing to help on their own or to join other non-official groups.

According to our field research (both Madeira Island real floods emergency and a full-scale emergency training exercise), both officials and NGO's neglected the spontaneous volunteer support, and according to our research their appearance turns out to be a reality in most of the emergencies. Despite that spontaneous volunteers are usually not counted or taken under consideration by the official entities, they usually appear in large numbers, "Whether you plan or not, they will come" (Volunteer Florida, The Governors Commission on Volunteerism & Community Service, 2008, p. 2) and in most of the scenarios there is no support or plans to handle them, according to official entities. Some countries are now contemplating the handling of spontaneous volunteers by turning them into affiliated volunteers on-the-fly via re-direction to NGO's which are on site.

2.7.1. *Conflicting Viewpoints in literature*

We have conducted a literature survey on volunteering in emergencies which led to the identification of 3 conflicting viewpoints in disaster response towards the role of volunteers, which we briefly present:

- a) Volunteers are a disruptive element
- b) Volunteers are a resource for professional responders
- c) Professional responders are a resource for community volunteers

2.7.1.1. *Volunteers as a Disruptive Element*

Following a 1950's traditional model for disaster response we can see that emergencies are characterized by chaos in which citizens are seen only as victims who are unable to respond or protect themselves effectively to the situation. The effective response to handle the emergency situation is then delegated only on emergency response organizations (professionals and NGO's) which are capable of controlling the situation (Dynes, 1994, pp. 141-158). Following this approach, professional emergency responders are then more efficient without the involvement of any spontaneous volunteers (on their own). With this model under consideration, the appearance of spontaneous volunteers which are not affiliated with a NGO can potentially disrupt emergency response efforts (management problems, reduce overall efficiency, hamper coordination, etc.,) (Green, 2003, pp. 1-16). This point is clearly described by Halford and Wenger (as cited in (Lowe & Fothergill, 2003, pp. 293-314)).

2.7.1.2. *Volunteers as a Resource for Professionals*

The old 1950 traditional model still has dominance but it has been criticized for its lack of adaptation to scalability of emergency scales, which sometimes goes beyond the capacity of the organization. In order to clear this gap, several authors have argued how official entities should use and reach communities in non-disaster time to recruit, train and integrate volunteers into the official response structure. This would have increased their capacity to meet needs which overflow the official's capacity (usually in large scale disasters) (Gonzalez, 2005), (Britton, 1991, pp. 395-414), (Fernandez, 2007)). One of the strongest points which support this attitude of training common citizens was the "cost-effectiveness" of this additional source. Usually this happens in high emergency resilient areas (e.g. Australia) where recurrent emergencies occur (e.g. wildfires).

In order to have a clearer understanding over the dimension of the active volunteering in emergencies, the Australian volunteer groups are able to field over 500,000 trained members throughout the country (Emergency Management Australia, 2006) and in China over 100 million volunteers have been registered and trained for disaster response (China Daily, 2009).

The inevitable emergence of spontaneous volunteers in emergencies scenarios is now acknowledged and written in disaster management handbooks (Volunteers of America, 2009). It has also been discussed how to best keep and handle control over the presence of volunteering groups.

In order to assess volunteer's skills and match them with on-going needs, a new concept has been created, the Volunteers Reception Centers (VRC), and for creating it "the procedure is straightforward, logical and easy" (Volunteer Florida, The Governors Commission on Volunteerism & Community Service, 2008). These enable some coordination level around volunteers by keeping them away until it is safe to integrate them into the emergency structure on the affected areas. Best practices to support this concept are shared on disaster management handbooks.

It's important to state that the point of view inherent to this concept is that disaster affected citizens are still seen as victims and volunteers are locals who had some preliminary training (via pre-disaster registration) or non-locals which arrive to help in the post-disaster phase. We have not found any discussion regarding collaboration of spontaneous volunteers (unaffiliated) and professionals. The traditional emergency manuals suggest that this kind of volunteers should be kept away from the emergency area during the early response phase due to safety issues, but "unaffiliated" does not mean unskilled" (Volunteer Florida, The Governors Commission on Volunteerism & Community Service, 2008).

2.7.1.3. *Officials as a Resource for Volunteers*

The command and control model is largely used in most emergency handling structures (including the Civil Defense of Madeira which collaborated in our field researches). This has been criticized and stated as not being suitable for disaster response (Quarantelli, 2008). Non-traditional tasks or tasks which don't go in the "manuals" are often refused by professionals who follow this model under disaster scenarios response. From the big cluster of existing demands and needs, they only accept demands which are within their handling capabilities instead of trying to increase their handling capability (Dynes & Aguirre, 2008). A study by the Australian

Red Cross (Cottrell, 2010) revealed that two thirds of volunteers who approached the organization during two large-scale natural disasters to offer their help were never at all used by the organization in actual response. These unused volunteers report negative feedback with disappointment, frustration and anger. Research has shown that regardless the help provided by volunteers, the volunteering act also has significant therapeutic effects for the volunteers themselves by changing community member's role from being a passive victim to having a feeling of active contribution to the resolution of the problem (Lowe & Fothergill, 2003).

Professionals work under a "control" ideation, and since control is a prerequisite for action, it introduces latency in the deployment of official resources (in some cases it could take days). This, together with the organizational reluctance to handle problems outside of the traditional area of responsibility means that many needs have to be met by other groups within the affected community (Dynes & Aguirre, 2008).

Despite that the dominating point of view of professionals among affected citizens are that they are helpless victims, which many of them are actually highly active participants in the response (United Nations Volunteers, 2011, p. 77), since they usually form the first line of response under emergency scenarios, in most cases they have an implicit responsibility to provide immediate support. Therefore, community emergency coordinators with critical expertise (emergency) have a responsibility to help and facilitate organized response, and their focus should be on coordination and collaboration rather than control ((Quarantelli, 2008), (Brennan, et al., 2005)).

2.8. Conclusions

We have done this literature review with the core goal of discovering and reviewing emergency software support tools and analyzing spontaneous volunteering support under emergency scenarios.

Emergency Response Systems (ERS) which are currently used by emergency professionals turn to be crucial to the success of minimizing damage from emergency situations and can have an immediate and direct impact over the response decisions and actions taken to handle some emergency. In addition, these helped clarifying the notion that the existence and support provided by software tools are today a requirement for a successful response to emergency scenarios, for both emergency professionals and volunteers. Analogous, statements as "maps are becoming mediators of human-human collaboration" and the observed presence of map components on the analyzed cluster of emergency support tools strongly emphasize

and solidify the need and requirement of using map components in new emergency response support software solutions. We have found and tested systems as *Ushahidi* (Ushahidi, 2012) which is an example of a pretty mature system currently used in emergencies by professionals and volunteers.

From the analysis of volunteering support systems we have extended the review to cover related subjects of interest to these systems, as geographic information systems (GIS), crowdsourcing and computer supported cooperative work (CSCW) systems, which we've seen that are important when developing a software solution to support emergencies response activities. We have also acquired some knowledge which allowed identifying the position of our solution proposal in the large software tools cluster.

We have now a better and clear understanding over available geographic information systems and their API's, the 2 different types of emergency software tools and their functionality, how public participation and crowdsourcing systems appear on the volunteer support systems cluster and their relative importance. All of these gave us important guidelines on how to design such systems.

Finally, we have clarified the 2 different ways of volunteering in emergencies, acknowledging that spontaneous volunteering is not the standard way, hence the exception. Spontaneous volunteers are a reality and usually emerge in large proportions and actually end up being rejected by professionals or not-used in the emergency response. In addition we have explicitly identified 3 conflicting viewpoints regarding spontaneous volunteerism collaboration with emergency professionals.

Following we have performed a field research containing 2 field studies, one over an official exercise of a full-scale emergency and a real emergency scenario which has happened recently in Madeira Island. This field research helped us spotting some problems regarding spontaneous volunteerism support under emergencies which results are presented in the following topic.

CHAPTER 3. FIELD RESEARCH

We have performed 2 field studies in Madeira Island, where one covered a real emergency scenario (massive floods) and had the support from both emergency professionals and local community citizens which were directly affected. The other one covered an emergency exercise and had full contribution of a local official emergency entity (Civil Defense of Madeira Island) on the subject of handling and responding to emergency scenarios. We report our observations and analysis of activities from officials and volunteers regarding the multi-contextual emergency response, which was observed both on the simulation exercise and the real emergency scenario.

3.1. Post-Disaster Real Emergency Scenario

We observed both the actions of volunteers and professional responders during a large-scale flooding disaster which occurred in 20th February 2010 at Madeira Island (Portugal). The Island of Madeira is exceptionally mountainous and cities and villages are typically located in valleys or along the coast, where water from the mountains forms natural or artificial rivers which pass through the centers of the populated areas. The mountains also create several microclimates and it is quite common to have both sunshine and heavy rainfall within a few kilometers distance.

3.1.1. *The Emergency: Floods*

In February 2010 the island was hit by unanticipated and extremely high rainfall, resulting in water surging down from the mountains and causing flash floods that overwhelmed the riverbanks and flood protection systems in many populated areas. Hardest hit was the capital and the largest city of the island, Funchal. Damage was also recorded around the island, including one village reachable only through a blocked tunnel, which remained isolated for days until the army broke through the obstacles. According to sources from the local Civil Defense organization, the community had very little experience with this type of event, and therefore the community disaster resilience was relatively low. Although loss of life was limited, the floods caused significant damage to infrastructure and homes, many people were temporarily displaced and damage was further amplified due to recently relaxed construction regulations around rivers.

3.1.2. *Methodology*

This research took place approximately one year after the occurrence of the floods emergency. Information was collected from articles in local newspapers and using the

fly-on-the-wall hybrid technique (Lethbridge, et al., 2007, p. 10), according to which activities people take, which are video-recorded. These recordings were directly observed on the web in social media sites and online video sharing sites, hence not requiring the researcher to be present at the scene. Two semi-structured interviews (refer to Annex I – I.4 Semi-structure interviews) were held both with directly and indirectly affected victims in order to get a more complete and realistic overview of their feelings and thoughts regarding the emergency which they've been through. We've also run small surveys among groups of citizens to help clarifying some aspects. The author of this thesis is also resident in Madeira Island, which led to several informal discussions that were held over time in parallel with victims, volunteers and professionals. By putting together all of this information, we were able to extract a big picture of the event itself as well as analyzing most of the response efforts taken by volunteers and professionals.

3.1.3. Findings

The findings extracted from this particular field-research are mostly related to the collaborative community's response to the disaster, featuring the interactions within them and the roles and responsibilities which are implicitly taken by spontaneous volunteers and professionals, together with the detection of overwhelming patterns on the official organizations according to the scale of the event. We have also observed that citizens are deeply embedded into the process of helping each other under emergency scenarios with basis in a mutual help approach.

3.1.3.1. Official response overwhelming

The citizens who were interviewed (both affected and non-affected) and inquired perceived that officials had applied their resources well and that their response was quick according to the dimensions and limitations of the emergency scenario. According to the dimensions of the island and our observations, this was a large scale emergency situation, since we have observed that the situation had reached a point where the official response was overwhelmed, leading to a forced prioritization of response efforts, regarding the entire emergency scenario (most parts of the island).

As expected and analogous to other analyzed emergencies around the world, the forced prioritization of response efforts is usually directed to hardest hit areas on the biggest or more important cities, in this particular emergency Funchal city, according to Civil Defense informal discussions and as observed on the fly-on-the-wall observational study "emergency services were only concentrated on working on some hot-spots".

Most of the remote or less affected locations around the island have received official response only after a few days after the beginning of the floods. Official responders shouldn't be criticized of that, since we understand the mission of professional responders and their capacity limitations. Official efforts primarily included the use of heavy machinery for redirecting torrents of water, mud and rocks away from critical facilities, as well as clearing canals and waterways from large rocks and debris and performing search and rescue operations for victims trapped in flooded buildings. Additional resources from private companies were used by the Civil Defense (construction companies) but under a paid work contract, hence should not be considered as volunteering.

3.1.3.2. *Spontaneous Volunteering Emergence*

After analyzing our data, we attained that due to the scale of the emergency (large-scale in this context), most of the cleanup efforts were handled by a great number of small-scale organized response efforts by spontaneous volunteers, which were not affiliated with any organization neither oriented or integrated into the emergency response structure by officials (according to official organization informal discussions). These spontaneous volunteers were mostly nearby citizens which were not directly affected by the emergency. Please note that we have not considered in any way as volunteers those citizens who clean their own houses, so they are not covered neither referenced in our findings.

The response activities took by the spontaneous volunteers in this emergency consisted mostly in straightforward tasks as cleaning mud and water in affected basements and streets (according to photographs and fly-on-the-wall analysis). Despite that most of the efforts were improvised without prior organization or performance strategy; they have been relatively well organized (according to photographs and interviews). In order to illustrate this, we have observed a particular example of a large office building where over 50 people were involved in cleanup activities, equipped with shovels, buckets and brooms (informal discussion with victims and experience of researcher).

Figure 4 - Spontaneous volunteers at work



3.1.3.3. Motivational Factors for Volunteering

There are several factors which contribute to the natural emerging of spontaneous volunteering. According to our research (survey, interviews and informal discussions with victims) several victims described that official sources (including SOS call center) were unable to provide them useful information (which is required to take decisions). We've also seen in the interviews, examples of critical companies and services that were completely unreachable (e.g. electricity company). Along with this, citizens reported in the interviews that in the absence of better sources they had approached operational personnel on field to seek for contextual information and advices, but they lacked from sufficient situational awareness in order to successfully help. Other citizens (informal discussions) felt that officials on field were giving them outdated or invalid information so the trust in official sources and its inherent capacity of handling the emergency scenario decreased.

One interviewee, who was affected by the disaster, and which had access to ground line communications, radio and face to face communication with officials on field, explained that despite all of that information sources he was still unable to make an informed decision due to the lack of sufficient information and situational awareness, regarding the simple decision whether to leave home or stay. An important piece of information that was missing to the interviewee and nobody could answer was: *"what are they doing, is the electricity coming back, what the dimension of this is, [and] when everything is going to be alright again"*. After 24 hours since the start of the

flooding the family's situation awareness was still extremely limited and despite fear of looting, the family finally decided to evacuate to a hotel for a few days due to the great uncertainty. They have returned home only after being aware of the safety on the area, after seeing a TV footage (inferred) where cleaning works were seen on their street. Regarding the professional's response and handling to the situation, the interviewee stated that *"I really don't think the municipality could have done more, except for the information part. There should be preventive information, or reactive information at the time it was happening, so people would go out of their houses."* The interviewee reported that they've become aware of the magnitude of the disaster only at this point. If future disasters strike again he stated that *"would just take [his] stuff and leave the house"* as *"it is not worth staying at home if you have zero information"*.

3.1.3.4. Awareness Attaining

One interviewee who lived on a hard hit area (city of Funchal) described that has requested help from professionals to clean-up his flooded building basement, but was informed that no resources were available at the moment. His family had started the flood cleaning works limited to their available tools and soon neighbors appeared to help (signals of emerging spontaneous volunteering). Despite communications were unavailable at that location, breaking news TV footage shown the street and that led some of his friends to infer that he maybe need some help and they actually arrived to help. Despite that friends and family are not considered volunteers, the appearance of neighbors and outside citizens willing to help is. The interviewee also described that his self-confidence increased and the need for professional assistance decreased as soon as the results of the collaborative efforts from friends, family and neighbors began to materialize. This is one example of several reports over which we've seen how citizens became aware that no official help is around or available and henceforth how volunteering groups emerge to handle localized response, to gather and distribute resources (e.g. freshwater) as well as important information such as when water or electricity are expected to return in affected locations (according to photos, fly-on-the-wall, informal discussions and interviews). Analogous to the example of our interviewee we've seen that most of the spontaneous volunteers emerge after acquiring some awareness about the need by seeing TV footages, by receiving requests from friends or others. As an example of failure on acquiring awareness we had one interviewee which was not directly affected by the disaster but expressed feelings of inadequacy and reported not being sure of what to do and if was required for volunteer she might get in the way of official responders.

3.1.3.5. *Officials and Spontaneous Volunteers Collaboration*

We've observed (according to photos and fly-on-the-wall sessions) a great prevalence of spontaneous volunteerism in this emergency scenario and simultaneously a general satisfaction among civilian citizens regarding the overall official response. Despite this, we have detected lack of reports (according to newspapers research included in fly-on-the-wall sessions and to official entities informal discussions) of collaboration between spontaneous volunteers and officials. Actually the few evidence came from an online amateur footage (according to fly-on-the-wall sessions) in which we see local citizens assisting fire fighters searching for survivors and retrieving a corpse, some photographs which also cover analogous situations and an informal report from Civil Defense, where they stated that there was little but some collaboration between professionals (Municipal Civil Defense Services) and groups of spontaneous volunteers and also according to them, they do not have explicit procedures on how to handle and collaborate with spontaneous volunteer's individuals or groups at the time this thesis was written. Elements from the Civil Defense organization and local volunteering reception center reported to us (via informal discussions) that groups of non-affiliated volunteers (spontaneous) arrived and got in touch with them to help but their assistance was refused, since the officials were too busy to be able to find tasks for volunteers and to assign supervision elements. According to this research we argue that this rejection is also based on the fact that professionals do not contemplate the integration of spontaneous volunteers in their current plans.

In order to conclude and cover the entire volunteering scope on this field research, we got in contact with the local volunteering reception center (*Casa do Voluntário*) in Madeira Island which are an integral part of the official response forces, and they have reported that rejected a lot of non-affiliated volunteers due to overwhelming of their capacity of the volunteers organization under the emergency scenario. This turns out to be also a motivational factor for spontaneous volunteering emergence, as this group of citizens which were willing to volunteer on the emergency and were rejected by official organizations (civil defense and volunteer reception center), will end up joining spontaneous volunteers groups which still have some improvised organization according to our field research.

3.2. Full-Scale Official Emergency Exercise

This field research was performed only to complement the previous real emergency scenario research since now we have the opportunity to change to the official's view

side and observe their interactions, how they plan and how they act. Since the observed exercise was full-scale it integrated the entire emergency services network structure that's currently implemented on the island. We believe that this turns out to be a good asset to fulfill this field-research.

3.2.1. The Exercise: Airplane Ditching

The full scale emergency training exercise was held at Madeira Island in 2011 by the Local Civil Defense authority. It was conducted in accordance to international security norms of civil aviation and had the following emergency scenario: on the 22nd of October 2011, at 09:00 an A330 aircraft carrying 147 civilian passengers and eight crew members was approaching Madeira's airport for landing, but had a technical problem which resulted in a controlled emergency landing in the ocean (ditching) around 10 km from the airport. As the plane ditched, an alert was given by the Airport Operations and Services to the Civil Defense (via SOS call center). As an effect, out of the 155 victims, 48 died on impact, 83 were injured and 3 were missing.

All emergency handling procedures were initiated and coordinated by the Civil Defense Operational Structure and one of the key goals of this exercise was to train interaction between all the different entities which are expected to take part in response to a major emergency affecting the community; civil defense, several fire departments including volunteer sea rescue, navy, fast medical intervention, local hospitals, social security services and the Red Cross medical volunteering support. Rescue activities took place on water, land and air and were centered on rescuing victims from the water at the crash site, transporting them to land for physical and psychological examination, and finally transporting injured victims to a nearby hospital.

3.2.2. Methodology

This field research was held in contextual inquiry format during the entire exercise time window. An initial planning meeting was held with the organization members of the Civil Defense and representatives of the different branches of the organization (fire departments, sea rescue, medical team, military, and commanders at operational, tactical and strategic level) in order to get a broad understanding of the activities that would take place during the exercise. Following this meeting, a contextual inquiry (Holtzblatt & Jones, 1993) was performed on-site during the exercise, covering the activities of the full six-hour time-window. We had setup an observation scenario with 2 researchers (one from HCI background and the author of this thesis from Military/Software Engineering background) directly on the "Operational Command Post"

(OCP) of the under-analysis emergency exercise and observe the information flow between the Strategical level (High) and the corresponding lower levels (Tactical and Operational) as also external channels (e.g. 911 Operator Center). We have reasoned and chosen the highest level of the emergency structure (strategical) to observe, since one can observe both the big picture of the emergency scenario and its handling as also avoid misunderstanding some details due to the introduced abstractness of the Strategical Level (highest). This command center was installed on a van in close proximity to the emergency scenario where some activities could be visually observed on field. We have given special emphasis to the actions, procedures and decisions being taken at the strategic level. All incoming and outgoing communications were audio recorded, since the strategic command was the center node of information and communication on the entire exercise. By recording those, we were able to fully monitor the communications between the subordinate operational commands and this command center. Additionally, photographs and paper notes were taken and later categorized where the resulting clusters were then iterated by three researchers. Some photographs over the field operations were also collected in order to support the understanding of some activities which had taken place.

3.2.3. Findings

Full-scale exercises are usually designed to approach the limits of the response organization at least in terms of coordination and organization. The interaction between the several entities is trained and tested in order to simulate a real emergency. Despite that, we had not seen any presence of spontaneous volunteering in the plans of the exercise. We had assumed initially that this was due to the nature of the exercise itself, so this exercise was planned to fit the emergency network of resources, not to overwhelm them, and a plane crash is well localized in time and space.

In order to figure out if it was possible to contemplate spontaneous volunteering in an emergency like this, we've done a quick analysis regarding the pipeline of activities which took place in the exercise and we've found a bottleneck where the integration of spontaneous volunteer resources could have improved the capacity of response which could save lives in a real emergency.

The findings also clarify that external information from citizens or help is not required under a scenario like this, which despite putting in play all emergency entities is still under complete control.

3.2.3.1. *Possible Integration of Volunteers*

In this particular exercise, the location of the ditched plane (on sea) was far from the medical facilities (on land) which were used for triage and to provide first aid support to victims on land. The travelling time between these locations was long in comparison to the loading and unloading operations of victims on the rescue rubber boats. Due to the high number of victims and mainly to the limited capacity of the rescue boats, multiple trips had taken place, lasting several hours in order to rescue every victim from the water. This was a clear bottleneck, since it relates only to the particular activity of water victims extraction, and even if all of the on standby official resources were put into the play, it wouldn't give a noticeable impact over the overall effectiveness of the operations. It happens that two harbors exist close to the airport, adjacent to each side (east and west), allowing any private boat to reach the improvised medical facilities of the scenario in less than 5 minutes, which can be called and securely maintained close-by the extraction zone where the sea-rescue personnel would recover victims and load them into the volunteering boats. In order to clarify the safeness of introducing these volunteers, we argue that trained sea-rescue personnel maybe needed to physically recover injured victims from water. There is little need for those personnel to be passengers during the boats travelling to the rescue point on shore, and then travel again to sea rescue area. Despite this valuable (possibly) volunteering resource, the request of additional vessels from these harbors or simulating the arrival of spontaneous volunteer boats who could have heard the alert of the plane ditching was not considered at all by the exercise planning team. A representative of the Civil Defense agreed with us that volunteers transportation resources discriminated in our "example" would help and be beneficial in a real ditching scenario. This is an example of an easy to find bottleneck and many others could be easily found in other exercises or emergency scenarios. With this bottleneck identification we want to highlight that professionals usually don't attempt to identify the resources shortages, neither identify possible ways of mitigating that shortages, by making use of spontaneous volunteering which in this exercise were only 5 minutes away and in a generous amount. Informal discussions with the official entities under study on this research stated that integration of spontaneous volunteers in any emergency is highly dependent on political decisions. Let's note that also in this particular example, volunteers could be used for data entry support tasks on medical triage zones, hence releasing the efforts put by the nursing and medical teams on field.

After analyzing this emergency scenario and together with our bottleneck identification which has arisen from the simple pipeline draft analysis, we argue that if the emergency exercises were designed to train interaction with volunteers, it's highly probable that a lot of opportunities would turn to be been present.

3.2.3.2. *Volunteers Contribution to Official Emergency Handling Structure*

This study also allowed us to observe and study the high-level information flow between distinct parts of the response organization. We have gained an understanding of their internal actions, roles and procedures which could also assist the development of our software solution. Despite that, most of their workflow is related to the coordination and positioning of their resources and vehicles, and it's marked as sensitive information (e.g. position of an emergency vehicle at some time). For safety issues this information should not leave the organization internal information workflow (and inherent systems).

One that argues that volunteers can highly contribute with external information to the emergency professional's structure under controlled scenarios could be wrong, since we've identified according to the information workflow of the emergency structure that such a contribution is not realistic in any way (after the trigger of the emergency). As an example, a volunteer should not report a position of an emergency vehicle at some time, neither the timestamp which it left the hospital.

However, some of the information which professionals work with is not confidential neither sensitive and in our opinion it could be released to the public. This information also stands close resemblance to what we believe served as an incentive for volunteering, and help connect potential volunteers with suitable tasks. Information as the locations and nature of needs and response activities being done on the emergency scenario, in which some of it already reaches the official entities thorough citizen reports via the SOS call center at the initial phases of the emergency.

3.3. Opportunities and Conclusions

These studies illustrated several opportunities for how professional and volunteer interaction can be increased and improved, and the extracted findings help us better understand how open information management systems can contribute to effective community response when facing emergency scenarios. Following, we outline the findings which we had given more emphasis:

- We have highlighted the importance of collaboration and communication dynamics between professionals and volunteers in emergency response, which led to the clarification of their roles under emergency scenarios within the community's response. This gave us high insights of how open information management systems can support the identified roles and also how they could facilitate the coordination and collaboration between and within the professionals and spontaneous volunteers groups (e.g.. sharing locations and activities being taken by both).
- Citizens need to be able to acquire awareness in order to make their own choices regarding their attitudes while facing an emergency scenario as also in order to encourage volunteering. As an interviewee stated: *"it is not worth staying at home if you have zero information"*. We have observed that most of the times, professionals on field don't have enough or updated information to provide to citizens (information which is required for taking even simple decisions). Spontaneous volunteer groups emerge after acquiring some awareness about the needs by seeing TV footages, by receiving requests from friends or others, or by seeing requests (e.g. social networking sites). One can argue that they emerge to handle localized response.
- Spontaneous volunteers always emerge, and as observed on this research, despite that officials do their job well, they can't handle everything since they always do prioritization of response efforts. In order to support even more this, we have observed that usually trust in official sources decreases over time and the need for professional assistance decreased as soon as the results of the collaborative efforts from volunteers begins to materialize.
- Professional emergency responders should train to handle and integrate spontaneous volunteers. Instead, volunteers are currently being rejected, and even volunteering reception centers get overwhelmed when facing emergency scenarios and proceed to punctual rejections. It's highly possible that those rejected individuals will end up joining spontaneous volunteering groups.
- Volunteers can help in a lot of scenarios, even those which at first sight doesn't seem to need them (emergency scenarios which do not overwhelm professional sources), as in the exercise analyzed on the field-research.
- Volunteers cannot contribute too much with information to the emergency handling structure itself (excluding the normal SOS Reports at initial stages), hence they it's possible that they could contribute with physical work (tasks).

- Professionals could release some of their information to the public. Such attitude would motivate volunteering and increase citizen's awareness. Professionals should keep community updated on-the-fly in order to increase the awareness of most citizens.
- Professionals should have the role of handling and collaborating with spontaneous volunteers, since they already have the responsibility of keeping citizens safe, leading to a collaborative community's response to an emergency scenario.
- Spontaneous volunteers are able to organize themselves in relatively large groups, as observed in the first field-research (floods).
- Professionals should pay more attention to the overwhelming of their resources, and should be feeling free to use willing to help volunteers to increase performance in a safe way.
- The researches brought up an enormous breakdown, the missing of relevant information which should be available to citizens but as far as we know it turns out to be a complex topic to be solved, as one interviewed stated that there should be updated preventive or reactive information in order to allow them to make decisions.

These cluster of findings attained from our field researches suggest that some tools should exist in order to encourage, provide awareness and assist spontaneous volunteers with information management regarding the tasks which are requested by the community or the unattended needs by the professionals. This conclusion strongly supports our solution proposal in developing a software tool to support spontaneous volunteers activities and give them an easy to use and simple centralized center of operations (analogous to official entities) to keep the unattended citizen's needs and volunteer efforts being taken, when facing emergency scenarios were no or few official help is around.

In order to generate the design requirements for the prototype software solution, we present in the following topic an analysis of our findings regarding both this field research and literature review. This analysis leaded to the creation of a framework together with a cluster of design guidelines that will drive our solution proposal to support spontaneous volunteerism with focus on the unattended identified problems: lack of situational awareness, lack of guidance and safety and lack of organization.

CHAPTER 4. FRAMEWORK AND DESIGN GUIDELINES

By doing an analysis over the findings from both the literature review and the field research on volunteering support under emergencies we were able to generate a set of design guidelines to develop new open information management tools for volunteering support under emergency scenarios. These guidelines contain information reporting suggestions, clarifications of the high-level purpose and contribution of volunteering support systems and ways in which officials can contribute to emergency volunteer support systems development and deployment. In addition we have created some software design requirements, which will support our software solution and can assist in development of future open collaborative information management tools regarding disaster volunteering.

4.1. Integrating Findings from Field Studies with Literature Review

Via the 2 field-researches and some additional research (formal meetings with professionals) we were able to understand the collaboration between official and spontaneous volunteer disaster responders as well as to clarify the roles that the two groups have in response to different scale emergencies. This was supported with this second literature review by the identification of the 3 conflicting mindsets regarding volunteering in emergencies. All of these conflicting mindsets were detected on the field researches. Due to the complexity inherent to these conflicting viewpoints it's not clear how one should design an open information management tool to be applied on volunteering support. It's challenging to create use-cases, scenarios, personas, even functional requirements which are usually a great guide to software design. It's becomes also unclear how to test a system like this under realistic settings.

If we have based ourselves only on literature review in order to create the design requirements for our system proposal prototype, we would not be focusing realistic and clear scenarios. By looking side-by-side to the ethnographic field work (field research) and the 3 conflicting viewpoints that were found in literature review, it was possible to understand how they actually fit together. This is a great advance in this thesis in the way that the grounding support of the proposed software platform becomes even more solid.

4.1.1. The real picture of Officials and Volunteering

In our fieldwork we had implicitly highlighted a connection between the officials training exercises and their real response under actual emergency scenarios. The organization which we had observed (Civil Defense of Madeira) trains for situations where full command and control is possible, that is, despite they have most of their sources working for them, the entire emergency handling structure is not overwhelmed during trainings. Furthermore, they look to volunteers as a disturbance and to some extent as a resource.

It happens that on the field-research which covered the real emergency scenario, it had gone slightly beyond the normal scale, leading to some control problems in the emergency handling structure. Under this scenario, professionals sought to satisfy their control through “isolation”. We have also seen that they do not involve volunteering during training exercises; neither have plans to handle them. It happens that the professionals stated themselves (in formal discussions) that potential volunteer integration was an additional load or problem since the professionals were already exhausted. According to our findings, their need for control is strongly emphasized and they only consider incorporation of volunteers to increase organization response capacity only under extreme scenarios. There was almost none interaction between professionals and volunteers as also a complete lack of support from officials.

When under controlled situations, the official communications to public follow a mass-media pattern where the public is informed that everything is calm and under control. This is focused on victims calming and according to our discussions we can assume also that it's also to deter any non-requested volunteering involvement. During the real floods emergency this pattern was observed thorough TV, internet and newspapers (via fly-on-the-wall research method) but citizens kept asking for information that could better support their roles as independent disaster volunteers.

It was clear that best practices (plans) of the official entity under analysis for interacting with the disaster affected community remain the same in all emergency-scales. We argue that situations which may overwhelm officials should be kept in mind when developing plans and training exercises.

4.1.2. Case Study: Mindsets towards Spontaneous Volunteering of an Official Emergency Response Organization

As we've seen, the literature review revealed the existence of 3 separate and conflicting viewpoints towards spontaneous volunteering in emergencies. Following we

present a brief review over the conflicting viewpoints found in literature and apply them to our field-research analyzed official entity, leading to the creation of their mindsets towards spontaneous volunteering.

1. Volunteers are a disturbance to professional emergency response

Several authors argued that spontaneous volunteers are a disturbance to professional emergency response, which leads to an exponential increase on the official's workload. They support this point of view stating that they get in the way of professionals and that they can harm themselves leading to an increase of victims, as also the volunteers can organize redundant response efforts which will reduce the overall efficiency of the overall response.

2. Volunteers are a resource to professional emergency responders

Others argued that many opportunities exist for emergency organizations and they could benefit and use the spontaneous volunteers as a valuable resource to their operations always in a coordinated way. This would increase community resilience and organizational capacity to handle large-scale events, which usually overwhelm official resources. The literature also states that is possible to keep the desired levels of command and control by presenting different ways of achieving flexibility and on identifying simple tasks within the response organizations which can be delegated to spontaneous volunteers without prior training.

3. Professional emergency responders are a resource to volunteers

The last mindset towards the spontaneous volunteers in literature contrasts with the first two, since they criticize the old-fashioned command and control model used by most emergencies structures. They argue that independent efforts by local spontaneous volunteers are critical for the community ability to recover from a major natural disaster, both for practical and psychological reasons, and the current command and control model separates officials from volunteers under emergency scenarios. As a last point they state how the focus in disaster response evaluation should be directed to coordination and sharing of expertise, rather than official control.

Figure 5 – Conflicting viewpoints diagram



In the field research I've studied the emergency exercise followed by post-exercise discussions with the official entities (Civil Defense mainly). It became clear that they share a mix of the first and second mindsets. They strongly emphasize the existing need to keep command and control over the entire emergency scenario and they see as their responsibility to fully handle the needs of the community in a crisis scenario by trying to keep everyone safe.

They have also claimed a great concern regarding the emergence of spontaneous volunteers and its inherent involvement in the response operations, since according to them this can expose civilians to a great risk, decrease the control and coordination of the officials and the overall efficiency of the response, generally causing more problem than they solve (as supported by the first mindset). In the exercise field research we have not seen the integration of spontaneous volunteering, neither to test their handling being a disruptive element, a resource or independent response entity.

Despite all of their negative thoughts regarding spontaneous volunteering, the field-research revealed that the official organization under analysis does not reject the idea of volunteer incorporation in order to increase their organizational capacity when facing extreme resource consuming scenarios (as supported by the second mindset).

According to them, they actually reject the spontaneous volunteers while facing overwhelming of resources arguing that they felt it was too difficult to supervise, find and assign tasks to the volunteers. Likewise, since no plans had been designed to support the involvement of spontaneous volunteers in this organization, no training to interact with volunteers had taken place. Despite this, we find their reaction under stress (large emergency scenarios) to be natural. We have seen similar scenarios

around the world, where official entities do not have capacity to handle community requests, as one from an OCHA report "Humanitarian field staff had neither tools or capacity to listen to the new flow of requests arriving directly from citizens" (Harvard Humanitarian Initiative, 2011, p. 11)

4.1.2.1. *Role of Spontaneous Volunteers*

Despite the lack of support and little interaction between officials and volunteers, we find that the volunteers had played a key role in the under study community's response to this large-scale natural disaster.

The floods caused such widespread damage that professionals were forced to prioritize the use of their finite resources in a utilitarian manner in order to address high-impact problems and achieve the greatest good for the greatest many. We've seen that less urgent needs as flooded basements and mud-covered streets were largely taken care of by citizens groups which emerged naturally and some by request.

Interestingly these findings are in agreement with our third mindset which state that volunteers are fundamental to accomplish large-scale response, and in this case in an explicit collaborative community response. We've seen on the floods field-research that the official implicit desire to command and control has led to the separation of official and volunteer response efforts. Most of the victims which we've contacted (informal discussions, surveys and interviews) expressed great understanding of the current limitations of official sources, many telling how difficult it was to acquire situational awareness. We saw how access to highly contextual information was a prerequisite for citizens to take informed decisions and attitudes regarding volunteering and evacuation activities.

4.2. Framework of the Role of Spontaneous Volunteers

With the findings which were achieved with the support of both field-researches together with literature review, we have settled the 3 conflicting views (mindsets) into a continuous framework of the role of spontaneous volunteers which highlights the importance of volunteering, once a community's needs go beyond the capacity of its official response organizations. With this framework I was able to clarify the role that open collaborative information management tools can play in a community's recovery actions from an emergency of shifting scale and outline a set of design guidelines for future systems.

We argue that official entities need to adjust their forms of interaction with spontaneous volunteers when designing plans and training exercises in order to be applied in practice. This interaction should be dependent on the scale of the emergency (related to the available capacity of the response organization regarding the amount of population on the covered region). This leads to the primary driver of the framework where the relationship between volunteers and officials is moderated by the scale of disaster.

4.2.1. Small-Scale Emergency Scenarios

Fortunately most of the emergencies are usually small scale, where the professional resources are fully able to handle and respond to the situation; hence volunteers are usually seen as a disturbance. Since this scale of emergencies takes only slight resources from the whole emergency handling structure, most of the resources will be on standby and ready to move in, therefore no volunteering is required, neither would be helpful. Instead if volunteers eventually appear to a small scale emergency they could put themselves in risk, since the scenario is too limited and professionals are already commanding and controlling the entire scene according to their tested plans. We argue that communication techniques should be applied by professionals to cover this practice of keeping away any kind of volunteering regarding small scale emergency scenarios. Those can be prepared and tested during the planning and training exercises.

4.2.2. Medium-Scale Emergency Scenarios

As the scale of an emergency increases, its complexity inherently and proportionally also increases in such a way that the official resources and its capability of management approaches the limit. Despite that they're still capable of handling the situation. Some bottlenecks (most related to performance issues) may appear and volunteers could be used as a resource.

In order to clarify this performance issues we have detected an issue in our second field-research regarding the airport exercise which was designed to put all entities related to the entire emergency structure into play, in the form of shortage of rubber boats for victims on water extraction (please refer to 3.2.3.1- Possible Integration of Volunteers). During a full-scale response (all entities involved) it's important to look for bottlenecks and creatively (Kendra, 2002) assess if volunteer resources could be securely used in some way to improve the response effectiveness. We argue that this kind of exercises (full-scale) can be used to prepare professionals to interact and use

the spontaneous volunteering resources, where an official command structure is maintained but where shortages and holes in the organization can be patched with those volunteering resources. Scenario planning and training needs to include identification of possible bottlenecks and effective ways of rapidly integrate safely spontaneous volunteering resources into the emergency handling cluster of activities, leading to a lower level risk of injury to volunteers and victims. Communication strategies should be prepared to discourage unrequested volunteering which may interfere with official response, while safely retaining willing volunteers as a stand-by resource in case new needs emerge.

4.2.3. Large-Scale Emergency Scenarios

It's not practical for a community to allocate too many resources for the purpose of countering the consequences of an emergency or disaster (Britton, 1991). This implicitly implies that most communities will eventually face abnormal situations which go beyond the currently allocated official emergency response resources, both at the operational and management level. Despite this, we've found both in the real emergency scenario (floods) and in literature that community members have a clear understanding of this real limitation and usually are willing to find ways to take care of lower priority tasks which they notice that fall beyond the capacity of official responders. Following this sense of willingness, when facing large-scale disaster scenarios, there will always be ongoing volunteer efforts in parallel with the official response activities. Although these efforts may be improvised and simultaneously lack of some efficiency, they are critical and healthy to the successful recovery of the community, so we argue that they should be encouraged and supported.

Having this said, officials have a responsibility towards their community of not isolating themselves when they became overwhelmed as also not to look to all citizens as powerless victims. In parallel to this, they also need to acknowledge their resources limitations, being able and agile to take supportive roles to the community during large-scale disaster response and relief. Interaction with volunteers should center on coordination and information sharing, which contributes to situation awareness and using best practices for response. It's when facing large-scale emergency scenarios that official's expertise and experience is of greatest need for community.

It's important to state and to have in consideration that most spontaneous volunteerism which is partaking in disaster response for the first time could see the effectiveness of their efforts improved if advice is provided on how to address lower-priority needs

using common household equipment. In order to face more challenging problems, volunteers can be instructed on how to prepare themselves for the arrival of professionals (since volunteers usually arrive first or are already there when emergency strikes). Such instruction material should be prepared and provided by official entities (already being done in some countries) and should be reused in different disaster and among different communities. In abnormal situations which are usually not expected by officials, they may lack of knowledge in order to be able to give preliminary instructions. Henceforth, they should give more insight on how their resources should be used. This will lead to better and earlier decision making and reasoning by both victims and volunteers. As an example, early information that states any delay in professional arrival or similar could result in earlier evacuation and preliminary emergence of volunteering efforts.

4.3. Design Guidelines for Emergency Focused Open Information Management Tools

Taking in account the presented framework of the role of spontaneous volunteering under emergency scenarios we were able to derive some high level software design guidelines grounded on the findings over field researches (empirical research) and literature review on volunteering, which will be used as design drivers for guiding the design of my software solution to the addressed problem of supporting volunteers under emergency scenarios as also could be used for future open information management systems.

The set of guidelines passed through an iterative process of clustering and simplification where traceability of each implication to our research findings was always insured in order to preserve integrity of the guidelines set. The reader should note that the final set of guidelines presented here was informally pre-validated by official sources (Madeira Island Local Civil Defense representatives).

These guidelines should be reasonable and helpful when applied in the context of supporting the design of emergency focused open information management tools. The guidelines are presented on the following topics and were separated in 3 themes according to their context for a better understanding.

4.3.1. Scope and Information Needs

These guidelines are related to information needs of both volunteers and citizens together with motivation and action scope delimiting regarding volunteering under emergency scenarios.

1. Focus on Large Scale Events

The tools should be designed in order to better support or having as main purpose the supporting of large-scale scenarios, since according to our framework it's where the support and need for spontaneous volunteering is most expressive.

2. Situational Awareness provided via Contextual Information not summaries

Usually the official communications are provided in summary format, and according to our research, the old-fashion summaries do not provide enough situational awareness, hence they have limited use in practice by the citizens and volunteers. Therefore this design implication enforces that contextual information (e.g. ongoing response efforts, damaged infrastructures) should be provided instead in order to allow community to use in their own decision making (Endsley, 2000).

3. Motivate volunteering by communicating shortages

Following the context of the last design implication and according to our field researches we have seen that people usually overestimate the scale of the emergency event and the inherent likelihood of receiving official assistance. This implication states that officials should communicate their emergency response shortages to the community in order to motivate spontaneous volunteering with supportive roles under the emergency scenario according to the shortages. This implication can be extended to volunteers who are taking response activities on emergency scenario.

4. Provide actionable instructions

Both professionals and volunteering community can benefit from tested and validated guidance. This guidance can be provided via documented best-practices, equipment usage or information directed to citizens on how to prepare and what to do before professional assistance arrives. This will also instruct on-the-fly citizens and volunteers on how to safely respond to emergencies and related problems.

4.3.2. Reporting and Feedback

This cluster of guidelines covers the bi-directional reporting of information between professionals and the community.

1. Facilitate Collaborative Reporting

We've not seen any applications which improve flow of contextual information from officials to community. Therefore, we strongly support that officials and volunteers should collaborate to piece together an accurate and faster picture of an emergency situation and applications should allow the share of an event model between officials and community.

2. Enable early reporting by volunteers

Usually operational response is postponed until responders have gained enough situational awareness to act. When facing large scale emergency scenarios, this becomes a time consuming task and we support that volunteers should be integrated at this initial stage via information gathering tasks in order to create enough situational awareness as fast as possible.

3. Provide Report Templates

This design implication supports that templates and types of reports should be identified and then defined during preparation and planning of emergency scenarios by officials, and later provided to community which would allow reliable and actionable information to be reported and communicated by professionals and volunteering community. This would allow volunteers and citizens to contribute on their own to the understanding of a new complex emergency situation.

4. Enable learning from every disasters

System development resources and testing can be shared between crises with a high level entity (official) responsible for its development and maintenance. Then, lessons learned from some deployment of a system in one scenario would then be shared and made available to new deployments (on similar scenarios), leading to improvements in overall actions which are a physical action originated from the usage of the application. This information should be imported and reused between disasters in some easy way (e.g. report templates, documented best practices).

4.3.3. Mechanisms of Access

This last set of design guidelines is directed to security and information sharing and its inherent visibility.

1. Define publicly sharable information

Most of the information that officials work with is confidential and should remain inside the emergency structure as we've observed on the field researches. It happens that some of that information could be shared with the community in order to enable volunteers to act independently as also increasing everyone's situational awareness. Official organizations should identify how that information should be treated and implement the information publicizing on a daily-basis.

2. Respect the integrity of official information management

The open information management tools cannot interfere with official information under any circumstances neither let volunteers impersonate official entities.

3. Safety through volunteer registration

According to emergency professionals, spontaneous volunteers can put themselves in risk when facing abnormal scenarios, leading to more injuries on civilians. This implication was strongly supported by the emergency officials who collaborated in the research and it's based on encouraging spontaneous volunteers to report their on-going activities and some personal contact information. This would support official responders on better coordination of their rescue efforts on ensuring safety of community.

4. Allow diverse channels of access

According to our field research community members use a large cluster of distinct technologies on their daily lives, hence we strongly support with this implication that upcoming information management systems need to support a wide range of technologies for easier and effective accessing and reporting of information. Also subscription services are likely to be of great use to access relevant updates.

4.4. Features for emergency volunteering open information management tools

Following we present a list of features that were derived from the literature review, field researches and from the design guidelines. The following set of features will be used on our solution prototype and it's intended to be used in future emergency focused open information management tools.

- **Geographic Plotting of Activities (Map)** - According to our field research, users require full contextual information and this includes exact location of the need.

- **Complete situational awareness information** - Capacity of showing simultaneously the time (interval), date and exact location of the request/event. This feature is supported by field researches and based on the design implication: "Situational Awareness provided via Contextual Information not summaries"
- **Re-using knowledge from past events** - Capacity of allowing knowledge transfer between events in the system (e.g.. via templates or an import feature). This feature is supported mainly by the design implication: "Enable learning from every emergency".
- **Subscriptions updates** - Capacity of allowing a user to subscribe to event updates. This feature is supported by field researches where we have observed that users always try being updated on the status of the event. This can also bring volunteering opportunities to event subscribers, due to locations and time changes.
- **Paper Printing** - Capacity of allowing map printing as a contextual report of on-going efforts, between other important information which may require being taken in hand to field with the volunteers. This feature is mainly supported by field researches, where official entities highlighted the importance of having paper maps.
- **Geographically Opened** - Capability of the system to cover the entire world and not being restricted to a specific location, since according to literature review there were past events which have taken large proportions. This feature is also supported by the design implication "Information Freedom" and "Focus on Large Scale Events".
- **Context Independent Usage** - Capability of the system to be used under different contexts other than emergency response. This feature is supported by the literature review conclusions where we have seen that users only tend to frequently re-use systems when they use on a daily-basis approach.
- **Location Searching** - Capability of the system to allow user to search for a location in order to easily identifying events or activities under a location. This feature is supported by the field researches where we have observed that volunteers took place in several locations and since transportations were limited, possible volunteers could only apply to location dependent activities.
- **Provide Guiding and Safety instructions** - Capability of the system to present safety instructions and guides which are published by official entities or experienced users. It can enable spontaneous volunteers to act more securely and organized when facing an emergency scenario or on daily-life volunteer activities. This feature is supported by the design implication "Provide Actionable Instructions"

and strongly supported by the on-field research via the emergency official's suggestions.

- **Open Reading Access** - Capability of the system to allow any non-registered user to read instantly the partial or full content regarding the volunteering requests. This feature is supported by the design implication "Information Freedom" and "Define publicly sharable information".
- **Provide Instant Action Instructions** - Capability of the system to provide preliminary instructions on the fly to the user, which is willing to help. These instructions should allow the user to easily take action as soon as possible according to context. According to our research, where we've seen that volunteers are motivated by the communication of shortages together with sufficient information awareness, we think that this delay should be avoided and that special attention should be given to "immediate" response volunteering, even if it's for an NGO (e.g. Need volunteers to catalogue clothes for giving to poor children. Please go to "location x" from 9AM to 7PM during all week if you want to help"). This is also directly supported by the design implication "Provide actionable instructions".
- **Activity Feedback** - Capability of the system to give user feedback that some artifact or activity is taking some action or being used by the users. This feature is supported by the field researches where we've observed that volunteers groups usually start growing once potential volunteers become aware of the efforts being taken.

4.5. Volunteering Support Software Systems

Under any emergency scenario, the need for information management tools exists both for NGO's (Non-Governmental Organizations) as also for Official entities (e.g. Civil Defense), where I have seen that such systems exist and should be mature by now.

Recent years' advances in Internet and communication technologies (ICT) have enabled a new form of disaster volunteering; that of using open and distributed online systems to collaboratively contribute to disaster information management. This development is very promising as it potentially enables volunteers anywhere in the world to contribute to community recovery by helping local decision makers be more informed and thereby enabling quicker decisions to be made with better outcomes. As stated before, this is a recently researched topic leading to some poor understanding generally spread over the topic, such as decision makers' information needs, how official response organizations can support the collaborative work of online volunteers, and how use of online information systems fits into on-the-ground disaster response.

Despite that this a quite novel topic, some on-line volunteer's information management systems already exist but do not directly support emergency response, neither comply with our proposed design guidelines for such a system. The appearance of new systems in this context could change the nature of disaster response, by allowing a more organized volunteering and easier recruitment of new members as also easier and instant sharing of volunteering needs and efforts.

4.5.1. State-of-the-art VTC Emergency Support Information Systems

In the aftermath of 2010 Haiti Earthquake, we've seen for the first time a combination of several distinct information systems into systems that were mature enough to show in some way the available possibilities for the future in disaster information management. In Haiti earthquake several solutions were set-up, such as one which allowed that many victims could send reports of their needs via short message service (SMS) which were further redirected to twitter (Twitter, 2012) micro blogging service. In USA, members of the Haiti diaspora were recruited and organized to translate those reports and others from native language Creole into regular English. Other communities members then collected the translated reports and mapped them into *Ushahidi* (Ushahidi, 2012) web platform where they became visually available in a common geographical database. Also high resolution satellite images of the affected disaster area were released by a *GeoEye/Google* partnership, as well as *Digital Globe*, which was used by 2 communities, the *CrisisMappers* (CrisisMappers, 2012) and *OpenStreetMap* (OpenStreetMap, 2012) in order to construct previously unavailable road maps with buildings outlines. This type of data is a requirement for geo-locating reports as in this example at the *Ushahidi* (Ushahidi, 2012) web platform (Harvard Humanitarian Initiative, 2011, pp. 16-29).

The United Nations Office for Coordination of Humanitarian Affairs (OCHA) (Nations, 2012) has credited volunteers and technical community for having extremely impressive capabilities and by collecting more information related to situation awareness in 48 hours' time-window than OCHA normally does during the entire first week. (Verity, 2011)

Existing research over Information tools used in volunteering context under emergency scenarios has consisted on documenting information platforms used by community members in disaster scenarios. That research covered both discussion forums (Qu, et al., 2009, pp. 1-11), Flickr (Liu, et al., 2008), Twitter (Hughes & Palen, 2009), (Mills, et al., 2009), (Starbird & Palen, 2010), and combinations of several platforms (Palen,

2008). Others argue the need for a specific type of system (Wu, et al., 2008) and several projects have produced software tools and research prototypes with the goal of improving different aspects of information management in disaster scenarios (e.g. (White, et al., 2009), (Gupta & Knoblock, 2010), (Frassl, et al., 2010), (MacEachren, et al., 2011), (Foundation, 2012), (Ushahidi, 2012)).

Despite that some of these tools are currently used widespread in practice, a recent report by OCHA (Verity, 2011) highlights that future research is required to increase our understanding of several basic areas as clarifying the decision maker's needs and outlining procedures for managing volunteers. It's also unclear how officials should take part in the collaborative work of online volunteers and how online information systems connect with on-the-ground disaster response. The report also questions whether such an open information management approach is indeed beneficial in all disasters.

4.6. Volunteering Systems Analysis (VTC)

We have analyzed 6 volunteering support web systems in order to gain an overview of their features and the variety of existing applications. We haven't found any open volunteering support system strictly aimed in supporting emergencies, hence the presented systems are meant to be used in several areas of application. Following we present a table with the quick analysis results.

Table 3 - Analysis of Volunteering Systems

System Name / Description	Distinct Features	Volunteering Tasks (examples)
<p>Sparked</p> <ul style="list-style-type: none"> ▪ <i>MicroVolunteering Network</i> ▪ http://www.sparked.com/ <p>Volunteer system based in challenges. It asks users for their skills and the causes which they are interested in. It then matches users with the challenges most suitable.</p>	<ul style="list-style-type: none"> • Allows only online volunteering tasks • Indicates the number of people who share the user's interest • Volunteers choose what to offer based on interest and skills • Variety of projects available • Assortment of activities with varied time commitments 	<ul style="list-style-type: none"> • Brainstorming • Graphic design • Copywriting • Suggestions • Ideas • Slogans

	<ul style="list-style-type: none"> Shows time remaining 	
Dolt <ul style="list-style-type: none"> <i>Volunteer Recruitment</i> http://www.do-it-org.uk <p>For organizations that recruit volunteers and volunteers who want to work (UK Only).</p>	<ul style="list-style-type: none"> Email is sent with local and instructions to go to Local Volunteer Centre. Allows only physical volunteering 	<ul style="list-style-type: none"> Red-Cross NGO recruitment Generic Volunteering
VolunteerMatch <ul style="list-style-type: none"> <i>Volunteer Recruitment</i> http://www.volunteermatch.org <p>For organizations that recruit volunteers.</p> <p>"Find opportunities, Recruit Volunteers".</p>	<ul style="list-style-type: none"> NGO's can Recruit Volunteers 	<ul style="list-style-type: none"> Advice Counselors Theater Actor Web Developer
Vinspired <ul style="list-style-type: none"> <i>Teenager Volunteers Hub</i> http://www.vinspired.com <p>Connects teenagers into a volunteering hub. Allows to connect to volunteering opportunities</p>	<ul style="list-style-type: none"> Shows when they need the volunteers Record Volunteering participations (tracking) 	<ul style="list-style-type: none"> Walking groups Education Fundraising
Koodonation <ul style="list-style-type: none"> <i>Online Volunteers Hub</i> http://www.koodonation.com <p>Online Hub to connect people through micro volunteering challenges.</p> <p>Powered by Sparked.</p>	<ul style="list-style-type: none"> Join a team to see the challenges of it. Requires joining a team Pick a cause, tell your skills to filter the challenges 	<ul style="list-style-type: none"> Web Design Design Copywriting
BigTent <ul style="list-style-type: none"> <i>Online Group Management</i> http://www.bigtent.com <p>"An application created to help volunteer groups organize members, events, news, and dues."</p>	<ul style="list-style-type: none"> Provides calendars Forums Reviews Other management resources 	<ul style="list-style-type: none"> Art Health Education

4.6.1. Testing against Design Guidelines

After having acquiring a quick understanding over some of the existing volunteering support systems, we've tested them against our recently created cluster of design guidelines for open information volunteer support management tools.

Table 4 - Testing of Volunteering Systems against design guidelines

Set: Scope and Information Needs	
Criteria	Systems which meet the criteria
	<i>*Testing was made by identification of features which are capable of implementing each criteria</i>
1. Focus on Large Scale Events	Sparked; Koodonation; BigTent
2. Situational Awareness provided via Contextual Information not summaries	BigTent
3. Motivate volunteering by communicating shortages	Sparked; Do-It; VolunteerMatch; Koodonation; BigTent
4. Provide actionable instructions	Sparked; Koodonation; BigTent
Set: Reporting and Feedback	
Criteria	Implementation
1. Facilitate Collaborative Reporting	None
2. Enable early reporting by volunteers	Sparked; Do-It; VolunteerMatch; Vinspire; Koodonation; BigTent
3. Provide report templates	<i>Not Feasible – Requires action from official entities</i>
4. Enable Learning from every emergencies	None
Set: Mechanisms of Access	
Criteria	Implementation

1. Define publicly sharable information	<i>Not Feasible – Requires action from official entities</i>
2. Respect the integrity of official information management	Sparked; Do-It; VolunteerMatch; Vinspire; Koodonation; BigTent
3. Safety through volunteer registration	Sparked; Do-It; VolunteerMatch; Vinspire; Koodonation; BigTent
4. Allow diverse channels of access	None
Set: Additional Design Guidelines	
Criteria	Implementation
1. Information Freedom	None *In all systems a non-registered user cannot see any content; Some systems are geographically limited; Some systems don't allow creation of new artifacts.
2. Low computer skills (user's perspective only)	Do-It; VolunteerMatch; Vinspire; BigTent
3. Users Familiarity	Sparked; Do-It; VolunteerMatch; Vinspire; Koodonation; BigTent
5. Updated	Sparked; Do-It; Vinspire; Koodonation; BigTent

Most of the analyzed systems do not comply with some of the design guidelines, leading to a non-adequacy status of them regarding the successful usage under emergency scenarios, according to our research. In addition, half of the systems are not capable of fully supporting emergencies, due to being context-dependent on too technology-dependent on-line micro-tasks (e.g.. graphical design).

4.6.2. Testing Features

After this quick overview on the applications we have done a features comparison, regarding the most common features found on the under analysis applications and some features inherited from the research and from successful emergency support tools (e.g. *Ushahidi* (Ushahidi, 2012)). Following we present the table with the results.

Table 5 – Volunteering Systems Features Comparison Matrix

	Features	Sparked	Do-It	Vol. Match	VInspired	Koodonation	BigTent
1	Provides a Map	No	No	Yes	Yes	No	No
2	Geographic Plotting of Activities	No	No	No	No	No	No
3	Supports Physical Volunteering Activities	No	Yes	Yes	Yes	No	Yes
4	Gives users awards	Yes	No	No	Yes	No	No
5	Provides Complete situational awareness information (complete time, date and location)	No	No	No	No	No	Yes
6	Allows users to give feedback (text)	Yes	No	Yes	Yes	Yes	Yes
7	Keeps the needs up-to-date	Yes	Yes	No	Yes	Yes	Yes
8	Re-using knowledge from past events	No	No	No	No	No	No
9	Allows hiding some information	No	No	No	No	No	Yes
10	Subscription Updates	No	No	No	No	No	No
11	Makes source of request/event accessible	No	No	Yes	Yes	Yes	Yes
12	Provides API access	No	No	No	No	No	No
13	Allows sharing to SNS	Yes	Yes	Yes	Yes	Yes	No
14	Paper Printing	No	Yes	No	No	No	Yes

15	Has an Interactive Map	No	No	No	No	No	No
16	Geographically Opened (not location dependent)	Yes	No	No	Yes	Yes	Yes
17	Allows upload of Media	Yes	No	Yes	Yes	Yes	Yes
18	Automatic Cleanup	Yes	No	Yes	No	Yes	No
19	Context Independent Usage (Supports emergencies / disasters)	No	Yes	No	Yes	No	Yes
20	Location Searching	No	Yes	Yes	Yes	No	No
21	Provide Guiding and Safety instructions	Yes	No	No	No	Yes	Yes
22	Open Reading Access	No	No	No	No	No	No
23	Provide Instant Action Instructions *sometimes immediate action is not available, you need to wait for instructions	Yes	No	No	No	Yes	Yes
24	Shows detailed information of a need/event	Yes	Yes	Yes	No	Yes	Yes
25	Allows viewing active volunteering users (globally or in a group)	Yes	No	No	Yes	Yes	Yes
26	Requires joining a team	No	No	No	No	Yes	Yes
27	Allows Searching of Needs/events	Yes	Yes	Yes	Yes	Yes	No
28	Requires Advanced Computer Skills	Yes	No	No	No	Yes	No
29	Allows some management of volunteers (within an event)	Yes	No	Yes	No	No	Yes

30	Allows SNS Login (e.g. Facebook)	Yes	Yes	Yes	Yes	Yes	Yes
31	Supports Multi-Language	No	No	No	No	No	No

Most of these volunteering support systems do not share a cluster of fundamental features that could make them an emergency volunteering support system successful, both according to our design guidelines and the feature requirement. Following we present an overview of the features which the applications lacks have.

- **Geographical plotting (map)** - Most of the systems did not provide a visual presentation of the location of the request/need. This is by far one of the most important features to have on an emergency support platform. (Refer to features comparison matrix features 1,2,15)
- **Complete situational awareness information** – Most of the systems do not provide full situational awareness information, leaving out information that could be crucial for community citizens to take decisions upon on. (Refer to features comparison matrix feature 5)
- **Re-using knowledge from past events** is not present in none of the identified systems. If before creating a new event, we can browser for past ones (templates) that have been actually used successfully it can directly contribute to the success of the new event as simultaneously fastening the event deployment process. None of the systems supported this. (Refer to features comparison matrix feature 8)
- **Subscriptions updates**, is not allowed by most of the systems, and this is a big breakdown in our point of view, since as an example, if a user doesn't want to help today due to the bad timing of the event and if there are event timing changes in the following days, it suddenly becomes a good opportunity to help. (Refer to features comparison matrix feature 10)
- **Paper printing**, is not available in most of the tested systems, and this feature can be quite helpful in real volunteer scenarios, since the volunteer can take on its hands a physical quick read description of the event and its exact location, between other information. (Refer to features comparison matrix feature 14)
- **Geographically Opened** is a feature which is not available in some systems which are geographically limited to a specific location (e.g.. USA, UK), and we strongly believe that a volunteer directed system should be opened to anyone around the world in order to create an agility concept around it. Since most of the systems have built-in location search, this should not affect the performance of those

systems. Despite these arguments, we understand that political or business oriented issues could limit the target audience of an application, hence the limitation of available locations. (Refer to features comparison matrix feature 16)

- **Context Independent Usage** is a feature which was not seen in most of the systems, that is, the systems are not prepared to support distinct contexts, including emergencies. Despite that each system is aimed in supporting specific natures of volunteering, we strongly believe that any volunteer support system should be flexible enough to allow adding new categories / artifacts to extend support. Despite this argument we understand that political or business oriented issues could limit the nature of an application. (Refer to features comparison matrix feature 19)
- **Location Searching** is a core feature which aims in easier finding of volunteer opportunities and activities, and some systems did not have it. This is clearly a must-have in any information structure that works with geo-referenced events as volunteerism is. (Refer to features comparison matrix feature 20)
- **Provide Guiding and Safety instructions** it's a feature strongly supported by emergency officials according to our field research, and only a few systems provide forms of accomplishing this. (Refer to features comparison matrix feature 21)
- **Open Reading Access**, it's a feature which turned out to be one of the biggest breakdowns of all, the "forcing" of users to authenticate (or in some cases to pass through a long and boring registration form) in order to simply read the volunteering requests/events. This forcing can keep away a lot of potential volunteers who could be willing to help. We believe that volunteer-directed systems should be openly accessible and that only some editing features should require some authentication process. (Refer to features comparison matrix feature 22)
- **Provide Instant Action Instructions** was not available for those systems which work with NGO's, since they do not allow immediate response/acting to an event, hence they usually send the interest request to some NGO and then the volunteer is contacted back by the NGO to act. (Refer to features comparison matrix feature 23).
- **Activity Feedback**, was available only for a few systems, which in their context allowed some overview over active volunteers (even if it's through a simple list of active "volunteers" over an event or stating that someone has answered to a volunteer request) and we strongly believe that this quite helpful for implicit-organization in case of spontaneous volunteers groups. (Refer to features comparison matrix feature 29)

4.7. Other Systems Analysis

This analysis of systems would not be completed if we didn't run it over more generic systems which have at first sight some potential to emulate the role of a volunteer support platform. Therefore, we have decided to run the same features comparison with 3 non-volunteer related applications, *GoogleDocs* (collaborative work tool), *Ushahidi* (Ushahidi, 2012) (Emergency Reporting), *Twitter* (Twitter, 2012) (Social Network/Micro blogging) and the results are presented in the following table.

Table 6 - Features Comparison Matrix with Generic Applications

<u>Features</u>	Google Docs (spreadsheet)	Ushahidi (Deployment Example) http://geoavalanche.org/incident/	Twitter
Provides Visual Location (Map)	Yes	Yes	No * can provide url
Geographic Presentation of Needs (events)	Yes	Yes	No
Physical Volunteering	?	?	?
Gives users awards	No	No	Yes * # followers
Shows complete time, date and location	Yes * via comments	Yes	No *time + date, location optional via url
Allows users to give feedback (text)	Yes	Yes	Yes *Reply, re-tweet
Keeps the needs up-to-date	Yes *allows manually editing	No * older reports are available	No *Tweets reply
Allows Knowledge Transfer between events	Yes *templates	No	No *not in context
Allows hiding of information	No *document can	No	No *not in context

	be all private		
Allow subscriptions	Yes	Yes	Yes *Followers, geotagged tweets near location
Makes source of request/event accessible	Yes *user email	No *still allows seeing the user name	Yes
Provides API access	Yes	Yes	Yes
Allows sharing to SNS	No	No	-
Allows paper printing the data	Yes *not in context	No	No *not in context
Has an Interactive Map	Yes	Yes	No *not in context
Is location-free (not location dependent)	Yes	Yes	Yes
Allows upload of Media	Yes	Yes	Yes
Allows Rating the artifacts	No *not in context	No	Yes *Retweet
Supports emergency / disasters	Yes *not in context	Yes	Yes
Permits Searching (nearby) a location	No	Yes	Sometimes *via hahstags
Provides instant guiding instructions to help	Yes *can be manually added	No *Can introduce "Additional data"	No *not in context
Openly accessible (no registration to see)	No *requires google account	Yes	No

Supports immediate responding to needs (acting directly) * sometimes immediate action is not available, you need to wait for instructions	- *not in context	No *not in context	- *not in context
Shows detailed information of a need/event	Yes	Yes	Yes *140 chars
Allows viewing active volunteering users	Yes	No *not in context	Yes *conversations are open
Requires joining a team	No	No	No
Allows Searching of Needs/events	No *users cannot search for other documents	Yes	Yes
Requires Computer Skills	Yes *office tool	No	No
Allows management of volunteers	No	No *not in context	Yes * direct communication; often used together with tools like google docs
Allows SNS Login (e.g. facebook)	Yes	No *does not require login	Yes
Supports multi-language	No	Yes	Yes

4.7.1. Ushahidi

Ushahidi (Ushahidi, 2012) is one of the most complete applications which we've tested (context independent), regarding the fulfillment of our design guidelines. It supports

most of the features that one may expect to have in a volunteer support system, although some of them are merely implicitly supported. Despite that, we've also identified lacks on the platform:

- Enable Learning from every emergency is not available on the *Ushahidi* platform.
- Not always the source of the reports is accessible (for contact purposes), this is also a feature which we support that should exist (based on the design implication: "Safety through volunteer registration").
- Sharing an event to a SNS is also an important feature which *Ushahidi* lacks, since that users spend most of their time inside SNS (based on the implication: "Allow diverse channels of access").
- Printing of reports is also not available (a critical feature in emergency response according to official entities).

Some other features are not present in the *Ushahidi* platform due to not being in context of emergency reporting philosophy, so we can't comment, neither criticizes them. The presence of those features could make possible to use *Ushahidi* in volunteerism (e.g. take action over a need).

Figure 6 – *Ushahidi* map of Haiti Earthquake (*Ushahidi*, 2012)



4.7.2. Google Docs and Twitter

One of the biggest drawbacks present in both of these tools is that they both require registration prior to be use. Following we present the points which would lead to failure on short-term period of usage (adaptation) on volunteering efforts under emergency scenarios.

- Twitter currently doesn't provide any situational awareness information clearly. The user needs to follow several links in order to see maps, official sources announcements, etc.
- Google Docs allows multiple users to edit a document, but it's predictable that some confusion would appear if a lot of users are editing the same document.
- Despite Google Docs supports adding map gadgets to a spreadsheet, it's not immediate for a non-expert user to search for a location (but can be done).
- In Google Docs, one cannot make parts of a document private, so it doesn't support the feature of hiding some of the information.
- In twitter one can search for a location via hashtags, but a user can easily lost track of the event or could be directed to non-relevant tweets.
- When we talk about sharing detailed information of an event, in twitter we are limited to 140 characters which can limit the amount of information that could be posted and this may lead to a incompleteness of information awareness.
- In Google Docs assuming that a "spreadsheet" relates to one event, it doesn't allow one to search for other docs (events). Twitter allows searching.
- Google Docs require some computer skills in using an office application to be able to use it flawlessly and that can be seen as a breakdown.

Despite this cluster of breakdowns, we can find some strength (related to our context) on both Twitter and *Google Docs*:

- *Google Docs* presents a slight advantage when we refer to the design implication of enabling learning from every emergency, since it allows the creation of templates.
- Both of the systems can support subscriptions (each one in its way) as also are not location-dependent.
- Twitter is already used in emergency scenarios and Google Docs seems "capable" of supporting it too.
- In both systems we can do conversations with the other users and trace back who's connected/following.

Despite that both Twitter and Google Docs can handle some of the features of a volunteer support system, in order for them to be successfully used in volunteerism support they lack some important features that could compromise the success of it (e.g.. lack of full situational awareness). Either way, they were not developed and it's not their philosophy to support volunteerism.

4.7.3. Volunteering Support Systems Features

In order to create an initial cluster of features to support the development of our solution and future ones, we have inherited some basic functions from the systems which were analyzed on the previous topics as also some novel features brought from our research.

4.7.3.1. Inherited Features from Existing Systems

The following cluster of features contains features which were observed on the analyzed systems, and according to our research they should be present in any volunteer support system.

- Allow users to give feedback about some event (in some way)
- Keep the needs/events up-to-date
- Allows sharing to SNS
- Permits searching for a location
- Shows detailed information of a need/event
- Allows viewing active volunteering users
- Allows Searching or Browsing through Needs or events
- Allows reading information without prior registration

4.7.3.2. Novel features from our Research

Following we present a cluster of features which we consider as being new regarding volunteer support software systems. These features could possibly exist in other context software products.

- Allows Knowledge Transfer (learning) between events (implicitly suggested by literature review)
- Allows paper printing of data (suggested by emergency professionals under research)
- Allows professionals to add guiding instructions (suggested by emergency professionals under research)
- Allows users to create custom locations and name them (suggested by field research)
- Keeps and enforces request/event creators contact details to be accessible (suggested by emergency professionals under research)
- Provides complete situational awareness information (suggested by field research)

4.8. Conclusions

Due to the significance of the achieved results in this topic, the author of this thesis co-authored (second author) a paper together with Jakob Rogstadius (PhD Candidate) and other authors, titled “Disaster volunteers as a nuisance, resource or partner? Guidelines for open information management systems”, which covers some of the content present in this topic (Rogstadius, et al., 2012). At the time of this thesis submission, the first version of the paper has been submitted for review to CSCW, but rejected (as expected). Therefore, it's still an unpublished paper, since it's under modifications in order to be submitted for publication to a journal (last trimester of 2012).

We have researched community volunteering efforts when facing disaster scenarios, where 3 viewpoints were identified on literature and later revealed on the field researches. These viewpoints covered the role of spontaneous volunteers on emergency response activities. In order to make these viewpoints more solid and coupled, we've combined them into a single framework of the volunteer roles, covering different interactions of volunteers with official entities depending on the scale of emergency in association with the capacity of the response organization. We also highlighted the collaboration and communication dynamics between these two groups as presented in literature and which we've seen manifested in our two field studies.

Furthermore, integrated in the contribution of this thesis, we've created a unique set of high level design guidelines for designing open information management tools focused on supporting volunteers in emergencies. These set of guidelines was complemented with a cluster of ready to use software requirements which were presented as features. The combination of these guided the design of our solution and could guide future open information management systems, allowing them to better support volunteering activities, the different roles which spontaneous volunteers can take and enhancing mutual collaboration with official entities under emergency scenarios.

CHAPTER 5. PROTOTYPE

5.1. Introduction

As we've seen with this thesis research, spontaneous volunteers are usually not taken under consideration during emergencies scenarios emergency, neither in training exercises. Due to the limited capacity of emergency professionals, many victims end up remaining out of the priority list of official response, leading to situations where these victims remain waiting for help, up to several days. In order to fulfill that limited capacity, we have seen that spontaneous volunteering efforts always emerge under emergency scenarios and that they can be quite helpful in a lot of situations (research over reports shows that some countries which are starting to successfully using them, as United States of America). Along with the detection of this design opportunity we have envisioned and built a software solution which could support spontaneous volunteers when they act under emergency scenarios as also during their normal life volunteering activities (e.g. cleaning the park).

A software prototype codenamed *Hudumia* was developed as a proof the concept and it exemplifies our solution to the identified problem, directly supporting volunteers with situational awareness, coordination and safety on their ground activities as also official emergency responders by enabling emergency professionals to produce useful knowledge about the volunteer's activities which are taking place.

Anyone who wishes to develop systems for disaster response is required to have an understanding of desirable actions and interactions between professionals and volunteers. The omission of this big picture leaves the design of the systems open to trial and error (experimentation), since it becomes impossible to evaluate the features in terms of how well they encourage and support desirable behavior. Therefore, in order to successfully develop the prototype, the requirements engineering phase was one of the most crucial. The design of the architecture was also an important phase to focus since it will turn out to be foundation of the software product. After the requirements engineering phase and just after completing the architecture design itself, we have tested several open-source technologies, followed by the creation of quick prototypes to test the capabilities of the technologies under analysis. This gave a better understanding of the available technologies to choose from in order to make better decisions at these initial implementation phases.

Since we had already a grounded base of design requirements for the application (both the generic ones suggested by applications analysis and literature review and the

specific suggested by the field researches), we have started the software modeling of the software system. The prototype is based on a Collaborative Graphic Information System (CGIS) that features collaboratively augmentation of maps with volunteering activities artifacts. A first barrier which we expect to face is that the system should be able to support users without advanced mapping knowledge and simultaneously expert users or professionals with enough knowledge to quickly and extensively interpret the map and its data.

5.1.1. Codename – Hudumia

Prototype application has been codenamed *Hudumia*, which is a verb from the Swahili language (African). *Hudumia* means assisting, helping and has a lot of verb variations (Dictionary, 2012). Following we present the logo which we have created for the application prototype.

Figure 7 – Prototype logo



5.1.2. Leading Features

The prototype contains a cluster of features which ensembles its functionality. Following we present the main features which the prototype provides in order for the reader to have a preliminary overview regarding the system capabilities:

- Real-Time synchronization between clients
- Asynchronous wiki data editing
- Importing of past Events/Deployments activities
- Creating need and response activities
- Responding to Needs
- Real-Time event mail subscription system
- Deployments creation and editing at any time

5.1.3. Volunteers Reception Center comparison

This application it's an approach on supporting integration, implicit recruitment and collaboration of volunteers within the community and simultaneously supporting both officials and NGO's. Usually when facing large-scale emergency scenarios, Volunteer Reception Centers (VRC) are created (improvised) on the field in which some tasks are usually done in sequence: Registration, Interviews, Data Coordination, Volunteer Identification, Safety Training and Specific Job Training (Volunteer Florida, The

Governors Commission on Volunteerism & Community Service, 2008). Basically the citizens or victims who wish to volunteer for the disaster relief efforts and are not affiliated with any organization (NGO) go to this center in order to be assigned to an organization which will integrate the volunteer under the control and coordination of the official entities. All of this work is done quickly close to the emergency scenario and volunteers pass through a sequence of actions from the greeting to the integration into an official team.

The main difference between a VRC and our solution concept is that our solution does not allow the officials a direct level of control; instead on its most basis usage, it treats volunteers as independent actors. Since “the function of an information system is to improve one’s ability to make decisions” (Ozdilek & Seker, 2004) and taking under consideration that spontaneous volunteers usually like to act on their own groups, our system proposal can implicitly help them to coordinate within themselves, acquire new volunteers on-the-fly and inform the official sources of their position, contacts and activities, which is also an important outcome from our system. Our solution partially agrees with our design guideline, that is, our defined criteria for success of an emergency collaborative support tool as described in the previous topic (please refer to Design guidelines for Open Information Management Tools). The solution was also envisioned in a way that several instances of it could be deployed for specific usages (e.g. ad-hoc emergencies, bird-watching, emergency trainings/simulations, manifestations). Having this said, one of the most important outcomes from our system will be allowing the emergency officials to know the exact position of spontaneous volunteers as also the efforts being taken.

Following we present a volunteer reception center plant (Groselle, 2006 p. 31) in order to allow an easy and clear understanding of its working flow.

Figure 8 – Volunteer Reception Center plant

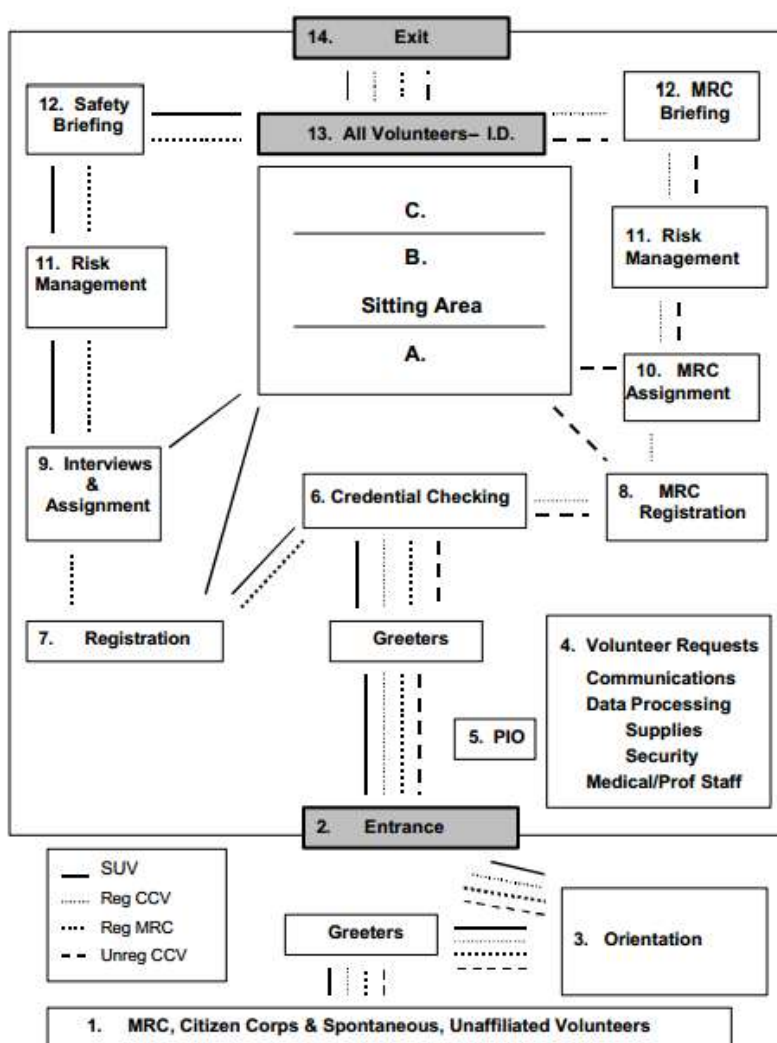


Table 7 – Prototype vs Volunteer Reception Center

VRC Phase	Prototype (example of existing functionality)
Accessing infrastructure	Getting to know the system in social networks.
Entrance	Accessing website link.
Orientation	Selecting a deployment, selecting a location
Volunteer Requests	Viewing active Needs and Requests for volunteering efforts.
Credential Checking	Login Validation in order for the users to able to respond to activities requests or create new ones.

Registration	Registration process
Assignment	Respond to a need
Risk Management	Viewing areas marked as risky or marking areas as risky.
Safety Briefing	Viewing wiki safety instructions to each activity.

As we can see through this table, our prototype is capable of acting as a Volunteer Reception Center if required under emergency conditions.

5.2. Prototype Architecture

The following topics will document the architecture and are part of the software architecture documentation of this prototype. The documentation tables, diagrams and views have been adapted from the template presented in by CMU/SEI - “*Views and Beyond*” Architecture Documentation Template (Clements, et al., 2010).

5.2.1. Problem Context

The system is intended to support spontaneous volunteer efforts around the world by supporting any location, any context (e.g. emergencies, bird-watching, emergency trainings/simulations, manifestations) and any number of users. It is also an architecture requirement for the system to be deployable, so it should allow instantiation of unlimited number of deployments. Special attention was given to existing emergency support platforms (e.g. *Ushahidi* (Ushahidi, 2012)).

5.2.2. Objectives and Context

We’ve selected the Attribute-Driven-Design (ADD) design methodology in which the architecture design is mainly based on the system attributes. By using this methodology, we have been able to design an architecture which fulfilled both our quality requirements and functional requirements. Several tactics and architectural patterns were selected in order to reflect the defined quality attributes.

5.2.3. Design Guidelines Traceability

This software solution agrees with our research based high level design guidelines (criteria for success of an open information management tool focused on emergencies) as described in our research conclusions and contribution. Following we present traceability table regarding the agreement of this prototype to the design guidelines.

Table 8 - Prototype Design Guidelines Traceability Table

Set: Scope and Information Needs	
Criteria	Implementation
1. Focus on Large Scale Events	Solution has an architecture which allows custom deployments to be created.
2. Situational Awareness provided via Contextual Information not summaries	<p>Solution presents only contextual information plus last updates from on charge official sources.</p> <p>Solution gives all stakeholders full access to all known SA information which relates to them, but also provides higher level summaries.</p> <p>Provides visual summaries of SV's/Officials/NGO's (displayed over a map) which also provides some SA information.</p> <p>Provides filtering capabilities to access information that is contextually relevant.</p> <p>Provides access (via a feed) to the official sources "official updates".</p>
3. Motivate volunteering by communicating shortages	Solution allows the creation of volunteering activities in format of Need or a Response
4. Provide actionable instructions	Solution includes a wiki module which allows editing of each activity instructions which is then reflected on-the-fly in the system platform
Set: Reporting and Feedback	
Criteria	Implementation
6. Facilitate Collaborative Reporting	Solution presents data using traditional map plotting techniques which can be used and access by professionals at any time
7. Enable early reporting by volunteers	Solution can be deployed at any time on-the-fly and its instantly ready to be used
8. Provide report templates	<i>Not Feasible – Requires action from official</i>

	<p><i>entities</i></p> <p>These should be first defined during preparation and planning of emergency scenarios by officials</p> <p>Solution is deployable.</p>
9. Enable Learning from every emergencies	<p>Solution has a central database which contains all the deployments which have been used as also all of the activities which have been reported under all deployments containing all past contributed information in the central wiki module. All past content is accessible to be imported when deploying a new instance of the system.</p>
Set: Mechanisms of Access	
Criteria	Implementation
5. Define publicly sharable information	<p><i>Not Feasible – Requires action from official entities</i></p> <p>Solution can be connected to official sources news system (e.g.. RSS). Publicly sharable information from officials should be defined by them.</p>
6. Respect the integrity of official information management	<p>Solution does not interfere with official information under any circumstances, neither is stated as being official or supported by officials</p>
7. Safety through volunteer registration	<p>Solution has an easy login system which forces the user to enter communication details in order to be used by professionals if required. Solution only allows creation of geo-located activities.</p>
8. Allow diverse channels of access	<p>Solution was developed with a modular architecture containing distinct modules and corresponding API's. This allows the easy development of applications in other supports and technologies. Solution also allows subscription to events</p>

5.2.4. Additional Design Guidelines

Despite that we've derived a core design guidelines cluster from the research, we were still able to extract some other guidelines which are also relevant and could aim the creation of the software design requirements.

Table 9 – Prototype Additional Design Guidelines

Set: Purpose	
Criteria	Implementation
1. Information Freedom	Information is accessible globally, not only within the community. Solution doesn't require any kind of login to access the information in reading mode
2. Low Technologies Requirements Information User	Solution matches the scope of the community. Not too complex and not too limiting.
3. Users Familiarity	Solution can be used also during non-crisis time, or for reporting small incidents. Preferably both by officials and locals, so that everybody is familiar with it. Deployment and marketing should not take place post-incident. The deployments can related to daily-life spontaneous volunteer activities (e.g. cleaning the park) and not stick only to emergency situations. Both Officials, NGO's and SV's will be familiar with the system
10. Updated	Solution keeps the events up to date. Users can solve activities or respond to them (updated situational awareness information) Users can Subscribe to events (in order to receive event updates)

5.2.5. Architecture Qualities

The architecture should have the following core qualities: Conceptual Integrity which would be fulfilled by the usage of modules and Feasibility since the development team is limited to 1 element with constrained time for development. Therefore the creation and integration of the system modules should be simple enough in order to develop the prototype within the depicted constraints.

5.2.6. Business Requirements

The business requirements are the highest level of requirements for any software system and the results of our software architecture will be largely influenced by the following set of business requirements.

Table 10 – Business Requirements

Requirement ID	Requirement Description
BR1: Time to Market	Flexible with no specific date of delivery
BR2: Target users	Any citizen, with or without advanced computer skills
BR3: Cost/Benefit	A system directed to support volunteering would always be free to use, hence some costs should be supported by donations. Open-Source technologies should be used to reduce development costs.
BR4: Lifetime	The system doesn't have a limit to its lifetime; hence the architecture shouldn't be directly dependent upon specific technologies.

5.2.7. Use-Cases

This cluster of requirements reflects the user requirements and it's in a lower level than the business drivers, since they look at the functionality of the prototype from a user's perspective. Following we present a prioritized list of the use-cases.

Table 11 – Prioritized List of Use-Cases

Actor	Id	Title	Priority *3 – highest	Difficulty *3 – hardest
User	UC1	Register an Account	2	1
User	UC2	Login with System Account	3	1

User	UC3	Login with Facebook Account	2	1
User	UC4	Create New Activity	3	3
User	UC5	Create New Region	3	2
User	UC6	Search a location	2	1
User	UC7	Toggle Activity Types	3	1
User	UC8	Toggle Activity Categories	3	1
User	UC9	Respond to an Activity	2	3
User	UC10	Solve an Activity	2	2
User	UC11	Create a new Activity Category	3	2
User	UC12	Zoom and Pan Map	2	2
User	UC13	Import a Wiki Activities Set	2	2
User	UC14	Subscribe to Updates	1	1
User	UC15	Cancel Subscription	1	1
Admin	UC16	Create a new Deployment	3	3
User	UC17	Share Activities/Deployment on Facebook	1	1
Admin	UC18	Edit a Deployment	1	2
User	UC19	Print Map	1	1
User	UC20	Browse Deployments	2	2
User	UC21	Switch Real-Time Mode	1	3
User	UC22	View Activity Responders	2	2
User	UC23	View Activity Instructions	2	1
User	UC24	Match an Activity with a Region	1	2
User	UC25	Edit Wiki	3	1
User	UC26	Browse Activities	2	1
User	UC27	Browse Regions	2	1
User	UC28	Switch map type	1	1

User	UC29	View Activity Data	1	2
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5.2.8. Quality Attributes

The requirements of quality attributes will serve as a basis to the development of the architecture. These attributes reflect the overall software product quality and are not related with the system functionality. Following we present a table with the quality attributes scenarios for our prototype architecture, followed by some scenarios which contain already some tactics and architectural styles which validate the scenarios.

Table 12 – Quality Attributes Scenarios (Requirements)

Actor	ID	Title	Priority *3 – highest	Difficulty *3 – hardest
User	QAS1	Accessibility trough distinct platforms (Desktop, Android, iOS)	3	1
User, Admin	QAS2	Ensure quick introduction of new system components.	3	3
Admin, Owner	QAS3	System response time	3	2
Admin, Owner	QAS4	Ensure moving of system components to other servers.	2	2
Admin, Owner, User	QAS5	Ensure system availability if platform components temporarily fail.	2	1
Admin, User	QAS6	Ensure any data editing is done only by authorized users.	1	1

5.2.9. Architectural Drivers

The architectural drivers will reduce the cluster of available design options and decisions. Our architectural driver's cluster of this prototype includes:

1. Non-Functional Requirements (NFR)
2. Functional Requirements (FR)
3. Quality Attributes Requirements (QAS)

Following we present a list of the architectural drivers.

Table 13 – Architectural Drivers

Driver ID	Driver Description
QAS1	Accessibility through distinct platforms (Desktop, Android, iOS).
QAS2	Ensure quick introduction of new system components.
QAS4	Ensure moving of system components to other servers.
NFR8	The system shall be developed with an ad-hoc purpose created framework (prototype environment).
NFR15	The system architecture shall be designed using MVC architectural style.
FR33	The system shall have the capability of connecting to an external wiki for loading past deployments.
FR11	The system shall access database information data via API calls.

5.3. Tactics and Architectural Styles

Most of the software architecture design makes use of multiple design tactics, which are usually clustered into architectural patterns. It's important to understand at this phase, the collateral effects and inherent risks of choosing the tactics. Furthermore, the combining of our selected tactics should fulfill our defined quality requirements and simultaneously guide the architectural decisions. All of the decisions which we have taken should be seen as foundations of our architectural design. Following we present some of the tactics and architectural styles which were selected to fulfill the quality attributes scenarios (QAS) and following the defined architectural drivers.

Table 14 – Tactics and Architectural Styles

QAS 1	Accessibility through distinct platforms (Desktop, Android, iOS)
Quality Attribute: Portability	
Tactics	<ul style="list-style-type: none"> ▪ Separate the presentation interface from the application logic ▪ Slightly couple some application logic to the data management system (DMS) ▪ Access to data management system done via a Proxy
Architectural	<ul style="list-style-type: none"> • MVC

Styles	<ul style="list-style-type: none"> • Client-Server (system divided into 2 applications)
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QAS 2 Ensure quick introduction of new system components.	
Quality Attribute: Availability/Scalability	
Tactics	<ul style="list-style-type: none"> ▪ Sub-Component tying (divide components in subcomponents and tie them together via interfaces)
Architectural Styles	<ul style="list-style-type: none"> • Component-Based Architecture (application design decomposed into logical components)

QAS 3 System response time	
Quality Attribute: Performance	
Tactics	<ul style="list-style-type: none"> ▪ Asynchronous call reply mechanism (Data Management System API) ▪ Heart-beat based mechanism to provide keep-alive connection between DMS and Client application.
Architectural Styles	n/a

QAS 4 Ensure moving of system components to other servers.	
Quality Attribute: Availability / Scalability	
Tactics	<ul style="list-style-type: none"> ▪ System Data Management API
Architectural Styles	<ul style="list-style-type: none"> • Object-Oriented (division of tasks into distinct autonomous objects)

QAS 5 Ensure system availability if platform components temporarily fail.	
Quality Attribute: Availability	
Tactics	<ul style="list-style-type: none"> ▪ Asynchronous DMS Call handling (easily detect DMS

	failures)
Architectural Styles	<ul style="list-style-type: none"> • Message-Bus (messages are sent and received based on known formats, allowing communication to happen without knowing the recipient)
	<ul style="list-style-type: none"> • Data Centered System

QAS 6 Ensure any editing is done only by authorized users.	
Quality Attribute: Security	
Tactics	<ul style="list-style-type: none"> ▪ Server Side authentication mechanism
Architectural Styles	<ul style="list-style-type: none"> • Client-Server (system alienated into 2 clusters)

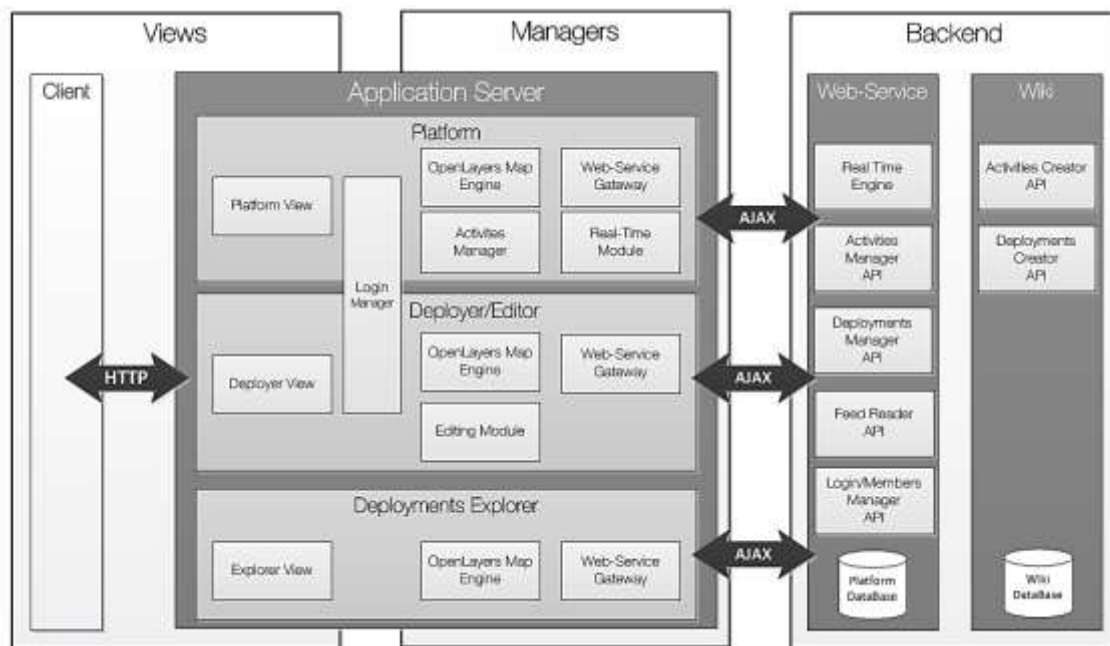
5.3.1. Architectural Approach

The presented architecture was designed in order to fulfill all architectural drivers. It's important to remember that the business requirements of our system specify that the system should be developed with the lowest cost possible and that it doesn't have a limit of lifetime. The architecture is an approach based on the Model-View-Controller (MVC), a client-server based architecture, where we clearly separate the logic of the system from the view (graphical component) and from the data management. The logic component of the system was segmented in several clusters according to the functional requirements and use-cases specifications

According to our defined architectural drivers, this allows an easy change of the presentation of data to the client, easy change of the database management system (DBMS) and it also makes it easier to extend the application to other platforms and devices, mainly due to the data management API's being physically separated from the application platform.

Other important implemented tactic was the data-centered system, where we have separated the data bases from the system logic. By using this approach interface/gateway modules are layered over the databases in order to be accessed by the several logic clusters of the system. Since the platform was built over this design pattern approach, we can argue that it's a flexible, extendable and reusable application. Following we present a diagram which shows an overview of the prototype architecture. This architecture covers all defined quality attributes (QAS).

Figure 9 – Overview of prototype architecture



5.4. Framework

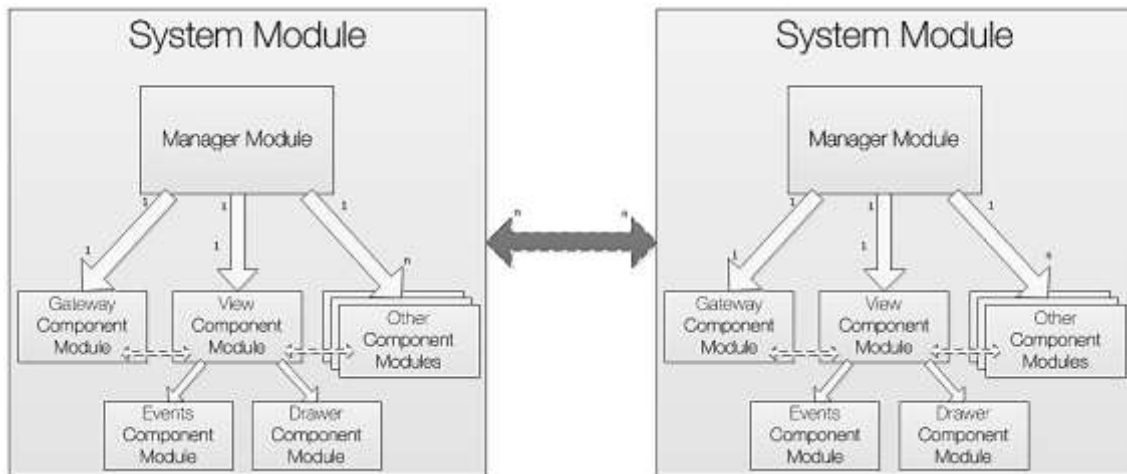
We have not used an external framework to build our system, since there was limited time availability to read its inherent documentation and study its architecture. As an alternative, we have built a simple and light framework which is based on some software engineering principles and allowed us to build the prototype in a 1 month and half development time-window. Therefore, since the framework was built on-the-fly, it could require some further adjustments and improvements, but as stated we were able to build the prototype under limited time, mainly due to the structure of our framework. Analogous, bug fixing was extremely easy, since after the identification of the bug it was immediate to identify and trace back which module component was causing it.

5.4.1. Modules

As described in the prototype architecture overview, our framework contains a cluster of system modules which interface with other system modules in the system, insuring some loose coupling. We have created the concept of “manager modules” and “component modules”, where component modules will have all functionality and are coupled to the manager modules (parents). The component modules may have some knowledge about their manager modules but they have limited knowledge about the other system’s loosely coupled modules. Each manager and component module has a special property called “components” which contains a cluster of coupled component modules. The component modules are designed to interface only with specific manager

modules (according to instantiation parameters), thus they are slightly coupled with their manager module.

Figure 10 – Prototype Framework



Therefore, most of the communication happens within the component modules of a system module, and between manager modules. Exceptionally communication may occur between manager modules and component modules of other manager modules, but under the rule of always requesting to the manager modules an interface to access their component modules.

5.4.2. Rules

In order to insure a non-erroneous communication between modules some rules were created:

- a) by default, a component module can only communicate directly with “familiar” component modules which are also coupled to the same manager;
- b) access to global objects is only allowed by manager modules;
- c) creation of global objects should be limited;
- d) access to non-familiar component modules must be through their manager modules (direct access should not be done);
- e) each manager module is responsible for creating and destructing its component modules;
- f) component modules should have limited access to their manager modules properties, hence these properties should be kept private;

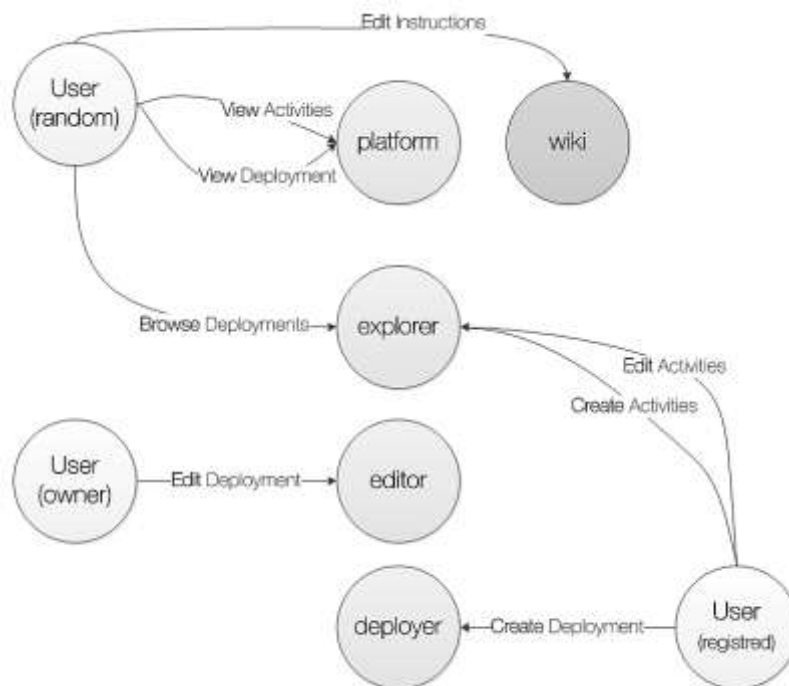
By making use of this ad-hoc light framework we were able to quickly project our prototype architecture and start the development of the system prototype.

5.5. Architecture Views

We support that a non-documented system may lead to a failure, since engineers and developers won't clearly understand its inherent architecture, hence they can possibly lose motivation and orientation regarding the system which they should change or edit. Therefore, we have documented the prototype architecture with some architectural views which we consider as being the minimum necessary to represent our system architecture. The created views and architecture documentation do not represent a complete architecture documentation document. Each view presents the system in a unique perspective, which helps any developer or software engineer to quickly understand the foundations of the system and its internals. We have created a Component and Connector, Module, Allocation - Deployment and Allocation - Implementation Views (refer to Annexes II.1 – Views).

Following we present a high level system context diagram which represents interactions from users with the system components. This will allow the reader to have a preliminary and better understanding of how the prototype works.

Figure 11 – Prototype Context Diagram



5.6. Prototype Technologies

This prototype resorts to the state-of-the-art of on-line mapping technologies and related services. Some research was taken in order to get in contact with state-of-the-

art map navigation and layering libraries by analysis of some open-source projects and inherent choosing of the most adequate technology. Since the software cluster around this theme is quite large, there were various open-source technologies to choose from. Following we present the select technologies for the corresponding prototype components.

5.6.1. Map Component

The web-based map display type that should be used in a system which implements our conceptual approach is the "Annotation maps" where "notes" are attached to a specific location over a map. These types of geospatial notes are critical when displaying valuable information between the distributed mapping participants (Hopfer & Maceachren, 2007) and can be: geo-located text notes, drawings, symbols, geographically anchored photographs. *OpenLayers* (OpenLayers, 2012) open-source mapping library supports geospatial notes and allows creation of multiple layers including Google-maps (Google, 2012) as base layer and vector based overlay layers. Mainly due to these facts it has been selected as the map engine of the prototype.

5.6.2. Wiki Component

We have analyzed several wiki frameworks, and ended up choosing *DokuWiki* (DokuWiki, 2012) due to its simplicity and facilities. It provides a built-in RSS feed client which can be accessed via any feed consumer client and provides a simple lightweight file-based database system, which has a well implemented locking mechanism and allowed us to create a simple API to write and read over that database. The *DokuWiki* is aimed in documenting anything, so it's not purpose specific and that was what we needed at most.

5.6.3. Real-Time Component

The real-time component of the platform was built for prototype demonstration purposes and it's a highly simplified version of what a commercial real-time component should be. We have used comet, a programming technique which allows the server to send messages for the client without requiring the client to request. In the front-end the connection is handled by AJAX. We have developed a PHP script which handles a persistent http request sent by the client and a JavaScript code snippet which with the support of *jQuery* AJAX request functionality which sends an initial request to the PHP script and handles the responses sent by the server.

5.7. Collaboration with other projects

Before the development of our prototype we have been invited to contribute (coding) to a geographical application focused on data mining and clustering regarding on-going crisis on twitter.

5.7.1. *CrisisTracker Project Description*

The *CrisisTracker* (Rogstadius, 2012) project is owned by *Jakob Rogstadius*, and it's an open collaborative tagging platform which monitors the social media network *Twitter* and aims in identifying and clustering posts regarding some ongoing crisis incident. Citizens, local governments and crisis response organizations are increasingly using social media to maintain situation awareness during large-scale and complex crises. However, social media generates enormous volumes of data during such major events, easily causing information overload. Therefore, to make it easier for disaster responders to use these already available reports in real-time decision-making, we have developed *CrisisTracker*. The system makes it possible for anyone with internet access to collaborate with other volunteers in organizing crisis-related information already available on social media. By doing so, remote volunteers can from home directly help improve the situation awareness of on-the-ground disaster responders. For more information about the system, please visit the *CrisisTracker* website.

5.7.2. *Contribution to CrisisTracker Application*

We have contributed to the front-end development of the *CrisisTracker* (CrisisTracker, 2012) prototype which shared some similar components to our prototype (e.g. map). With this quick prototyping we have been able to get more familiar with the web languages (PHP, *JavaScript*, HTML5), preliminary test some technologies and choose the best ones which could better fit our thesis prototype.

5.8. Prototype Coding

The prototype architecture has been implemented recurring to PHP (PHP: Hypertext Preprocessor) and JavaScript object-oriented programming languages. We have chosen these languages mostly due to our selected map engine technology being based on JavaScript and our selected database management technology being MySQL which runs over an Apache server, which makes it easier to use PHP as a language for communicating with the MySQL Database Management System (DBMS).

5.8.1. Framework Implementation

In order to implement the system over our defined framework, some adaptations had to be done due to the limitations of the selected languages. We have used an object oriented programming style, and followed a letter-case separated words (camel-case) language notation. We have also followed some design principles as loose coupling, where dependencies between modules are reduced or eliminated in order to make it easier to extend prototype functionality in future. Simultaneously we have tried to establish a high cohesion pattern within the modules such that, we are now able to modify single modules without affecting other system modules. Most the functions and properties of modules were kept in private closure by limiting classes and functions scope in order to show only public interfaces between system modules.

5.8.1.1. Object-oriented JavaScript

Despite that JavaScript is an object oriented language it is a class-less language, i.e., there is no term “classes”. Therefore we had to figure out a way to emulate classes using the common JavaScript functions, as presented in the code extract (refer to Annexes III.6 – Coding Practices for a code snippet example).

5.8.1.2. Object-oriented PHP

In what concerns to PHP we have also used an object-oriented programming style. This language contains explicit native support for classes, so it has been slightly simply to program using an object oriented approach (refer to Annexes III.6 – Coding Practices for a code snippet example).

5.8.2. Design Patterns

We have used several software design patterns in order to simplify the implementation process of our prototype. Following we present some of the design patterns which were used (Osmani, 2012).

Table 15 – Prototype Design Patterns

Pattern name	Implementation Description
Constructor	In objects which were instanced more than once, we have used the constructor pattern. In order to make inheritance easier we have not defined methods in the object constructor, leaving only properties. We added the methods via prototypes (special function of JavaScript). By doing this multiple instances of an

	object can be created which accesses the same prototype and the functions won't have to be redefined each time an object is created, instead they are shared between the instances and avoid being defined every time the constructor is called.
Singleton	With singleton, we can create a single instance of a class with a special method which creates a new instance of the class, only if one doesn't already exist. We have used this for classes which will be instanced only once, since the creation of additional instances is restricted by the constructor implementation.
Module	Since our architecture features modules, we had chosen to use the module design pattern to implement some of its modules. This pattern allowed us to emulate classes in JavaScript, ensuring private methods and properties inside each system's object. This pattern was used in conjunction with Singleton design pattern.
Facade	This pattern was used to create some module's public interfaces by showing limited and simplified functionality when in comparison with the real functionality of the module.
Decorator	This pattern was used to extend some modules (objects) functionalities in JavaScript.

5.8.3. Implementation Obstacles

Large teams of developers are usually created in order to design and implement medium to large scale projects. Conscious about the limitations of a single developer, we aimed in developing the prototype as a proof of concept. Due to the limited development time we hadn't time to use or improve existing frameworks and shape them to fit into our prototype. Therefore we have created a simplified framework which has speed up our development time (refer to 5.4 – Framework). Another implied obstacle was related to the unfamiliarity of the developer in designing web applications, hence developing a real-time web application which works with maps and is powered mainly by object oriented *JavaScript* was kind of challenge at the beginning. Finally, since the developer is not a graphic designer, designing the prototype interface and conducting and running the prototype evaluations was not a trivial task.

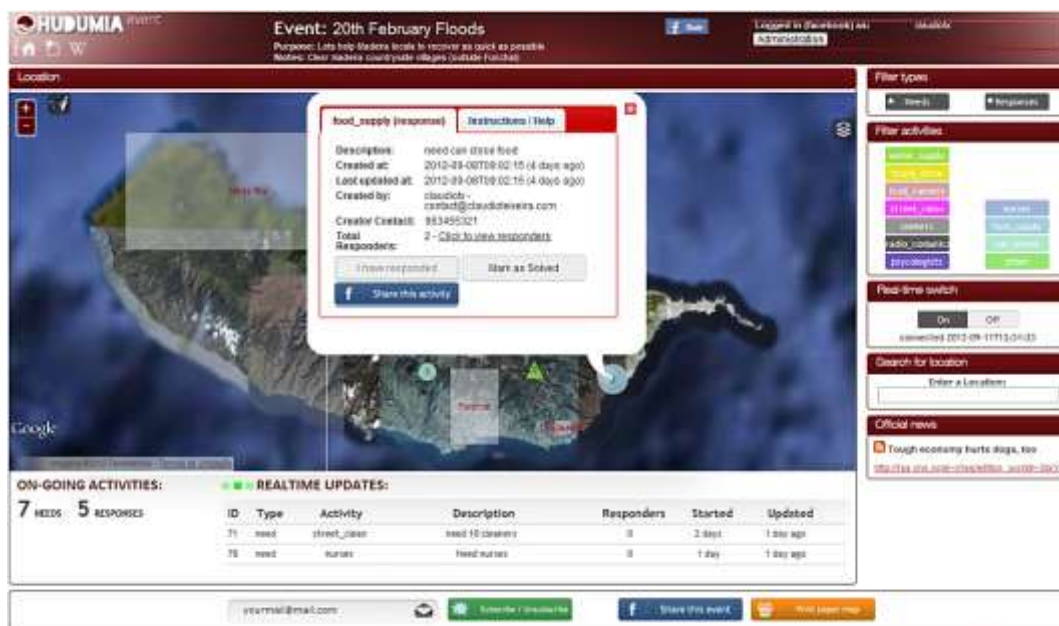
5.9. Prototype Presentation

The prototype turns to be accessible via a web link "<http://dev.hci.uma.pt/~ctexeira/hudumia>" or it can be installed into a webserver (refer to Annexes III.7 – Installation Guide). It features 4 main windows namely *Deployments Explorer*, *Platform*, *Editing Console* and *Deployments Creator*. In order to use it, a user only needs to visit *Deployments Explorer*, which is the welcome page of the prototype and the *Platform* which is opened after selecting a deployment. This is the main page of the system where all of the support functionalities to volunteering activities are provided. Following we present screenshots of both of this pages. Refer to Annexes VI.1 - Prototype Usage Instructions for more screens and prototype interactions.

Figure 12 – Prototype explorer (first page) window screenshot



Figure 13 – Prototype platform (event page) window screenshot



CHAPTER 6. USABILITY EVALUATION

It's quite challenging to test a platform like this in realistic settings scenarios. Hence we have decided to perform usability engineering techniques over the prototype interface, namely usability inspections and user tests. Therefore, we expect with this evaluation to shape the interface design and improve its usability according to the suggestions provided by the results of the methods.

6.1. Heuristic Evaluation (Interface Inspection)

We have selected the heuristic evaluation method suggested by Nielsen (Nielsen, 1994), which is an usability engineering method designed to find usability issues in software user interfaces by inspecting it. According to (Jeffries, et al., 1991) this is an efficient usability engineering method, and it has been proven that the effectiveness of the method increases with the increasing number of evaluators (Nielsen, 1994). Therefore it is suggested the participation of at least 3 evaluators, which will examine the interface against a list of usability principles (refer to Annexes I – Nielsen Heuristics) giving a severity rating from 1(minor) to 5(critical) to each identified usability violation (Nielsen, 1994).

An heuristic evaluation is performed individually by the evaluators and later the findings are clustered. Our evaluation was performed with the support of an observer (also the developer of the prototype) which aided each evaluator in operating the interface due to lack of domain expertise by the evaluators and to explain specific details of the interface, where each session lasted approximately two hours.

During the evaluation sessions, the evaluators went through predefined realistic usage scenarios (refer to Annexes IV.2 – Evaluation Scenarios), where they have figured out by themselves a sequence of tasks in order to accomplish the proposed scenario. The evaluators went through the interface for least 2 times, where in the first they were able to familiarize themselves with the available commands and flow of the interfaces and the second to complete the evaluation scenarios. The scenarios were designed to reflect as close as possible a real-world representation of the system usage under emergency scenarios. Since the evaluators had backgrounds in Human-Computer Interaction (HCI) they gave design advices just after the completion of the evaluation sessions.

Table 16 – Heuristic Evaluators

Evaluator Age	Evaluator Education (backgrounds)
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27	MSc Human Computer Interaction
29	MSc Human Computer Interaction
26	MSc Computer Science

6.1.1. Conclusion

The evaluators have given some design recommendations after the ending of their usability evaluation sessions. Following we present some of those recommendations.

Table 17 – Design Recommendations

Derived Design Recommendation	Implemented
Use a bold font in container box titles	Yes
Add a popup to subscribe notifications	No
Change “real-time-sync” title to “real-time switch”	Yes
Change “toggle-activities” title to “filter activities”	Yes
Add a new default activity called “other” to every deployments	Yes
Add a search bar in the import activities pop-up’s for easier searching	No
Keep the add activity button always visible in the import activities pop-up’s	Yes
Add a Undo button for adding activities when creating a new deployment	No
Force the login to be before accessing the deployments page	No
Change the draw region icon to a cross-hair with a pencil	Yes
Change the draw region icon position close to the map controls	Yes
Change the map layer switcher icon	Yes
Add titles to all popup-boxes	Yes
Add a tooltip close to the mouse when it’s left over the map with no action (2s) in order to inform users to click.	Yes
Change the add region dialog box title to “Improve map accuracy by adding a new region”.	Yes

Open the wiki in other window when clicked in the menu bar	Yes
Change the wiki button logo to 'W' with a globe.	No
Allow the activities to be clickable at the deployment creation phase, linking them back to the wiki.	Yes
Add "Enter" shortcut handling in all type of forms	No
Close dialog pop-up window after clicking their submit button.	No
Change title of deployment page to "Create a new deployment"	Yes
Use the same name to identify category and activity, meaning use only "Activity".	Yes
Change activities import buttons text to "Import a set of activities"	Yes
Changes create new activities dialog box title to: "Create new activity to be done by volunteers".	Yes
Create region button should have "create a region" text on it to be more explicit, since it's not a common feature to see.	Yes
Add a latest "activities" section to the platform view	Yes
Replace column title "edit" with "last activity" on the explorer.	Yes
In deployments explorer list, order the list by last updated.	Yes
Add some visual element to identify activity in real-time connection	Yes

6.2. User Tests

In order to extend our heuristic evaluation, we have tested our system with emergency professionals (from Madeira Island Civil Defense) who also contributed to our field research. These tests were executed after some corrections which were applied from the prioritized list of design recommendations.

We have done an usability test session in order to evaluate how well the professionals can use the prototype to improve their work regarding presence of spontaneous volunteers under emergency scenarios. This helped us to gain a better understanding of how easy it would be for the professionals to perform real tasks with the support of the prototype. We also wanted to ensure that the prototype actually (partially) addressed some of the professional's needs (refer to Chapter 4 – Framework and

Design Guidelines) in what concerns to collaborating with spontaneous volunteers under emergency scenarios, according to their suggestions on the research phase.

We had not excluded other user tests, but it was difficult to find spontaneous volunteers since most of the times they disappear from the emergency scenario after the needs are handled. Despite that, by using emergency professionals, we are still using stakeholders of our system which are also domain experts.

6.2.1. Performing the User Tests

We want to test the overall usage of the application regarding the activities support which professionals require in what concerns to spontaneous volunteers efforts monitoring and collaborating. The test execution team was composed by a single interviewer and observer which has coordinated 2 disjointed tests over the same scenario with 2 emergency professionals. The professionals had a brief introduction about the system concept but have not seen the interface before the tests. According to Nielsen (Nielsen, 2012), creating too elaborated usability tests is a waste of resources. Also, even if we had only 1 user testing the system we have learned more than 30% of all there is to know about the usability of our prototype (Nielsen, 2012). In order to perform the user's tests, we have created personas and a sequence of tasks which personify a realistic scenario, and observed the users performing the tasks, while taking notes of their actions, their breakdowns and their comments. Some quick interviews took place after the execution of the tasks. The results from this evaluation (refer to Annexes IV.4 – User Test Results, for detailed results) were organized in a table but were not corrected in the prototype due to time constraints and the low severity of the identified problems.

6.2.2. Emergency Professionals Comments

According to the emergency professionals which have contributed to the research of this thesis and tested the prototype for the first time, it fulfills all of the requirements which an emergency professional would require to ensure volunteer's safety under a system of this nature. This reaction was expected since the design guidelines include important and direct contributions from the professionals. They have detected potential in the prototype and the overall opinion was that it was stable enough for being used. They have questioned if there would be a future mobile version and we've had argued that the software architecture is separated in modules and that the backend is loosely coupled to the front-end by keeping all the data accessible via API's. With our architecture, extending the system to mobile devices is a quick and easy process. Still,

the prototype requires the client to have only JavaScript, which current mobile devices are capable of running, so a web interface for mobile devices could be an alternative to a native mobile application.

6.2.3. Conclusion

With this evaluation we have identified some aspects where the application usability has not completely addressed the emergency professional's expectations (as expected). Future versions of the prototype could have those identified faults fixed.

6.3. Evaluation Results

In the heuristic evaluation, each evaluator created a list of usability problems in the prototype interface which were violated (according to evaluator's judgment and the list of heuristics) during the performing of the scenarios tasks. Analogous, in the user tests the observer created a list of usability problems (please refer to Annexes IV).

6.3.1. Evaluation Conclusions

Overall it is difficult to test a system like this under realistic scenarios, since users should be motivated and with willing to help on some emergency scenario or volunteering event. This usability evaluation was successful since it has uncovered and highlighted some design flaws and usability issues. Overall it was a good choice of evaluation methods, since they gave quick and important results related to the usage of the prototype, i.e., it was a viable way of evaluating our prototype. The usage of evaluators with HCI background and emergency professionals (future users) as test users also contributed the validity and success of this evaluation.

CHAPTER 7. CONCLUSIONS

With this thesis, we have been able to understand how volunteering support systems and emergency support systems work, the state-of-the-art of spontaneous volunteerism around the world, how official entities handle emergency scenarios and how they interact and collaborate with spontaneous volunteers and the civilian community. As identified in our research, supporting spontaneous volunteers under emergency scenarios is an important concern and they usually don't receive any supported, neither attention from the official entities. Despite this lack of support, the collaboration between official entities and volunteers is essential in order to ensure volunteers safety and to contribute to a faster and united community recovery from emergency scenarios.

This thesis has identified several problems encountered by volunteers while performing their response activities via field research studies, respectively awareness, safety and coordination. After some reflections over those studies which led to the creation of a framework regarding the clarification of official's and volunteer's roles under emergency scenarios, the cause of the identified volunteer's problems became clearer.

Furthermore, the creation of design guidelines and the consequent software solution development was by itself a great advance in what concerns to supporting volunteers, and inherently decreasing the identified problems which volunteers face. This also turned out to be an incentive and contribution to effective and increasing of volunteerism under emergency scenarios.

We've argued in this thesis, that despite our contributions via the framework, design guidelines and the software support to spontaneous volunteerism, official entities still play an important role regarding their behaviors with spontaneous volunteerism. We have questioned official entities' standings against supporting spontaneous volunteer and later successfully matched those standings with our framework. This was a realistic test to our framework and a preliminary practical approval that the framework is actually able to match real settings.

We have designed a software prototype to support awareness, safety and coordination of volunteer's efforts (activities) regarding their on-field responses. The prototype has been evaluated initially via heuristic evaluations, which results led to interface and usability corrections, where some were actually corrected in the prototype. After applying these corrections a user test evaluation has taken place with emergency

professionals, which helped us obtaining important feedback from system stakeholders about system usability and features.

7.1. Author Reflections

One of the biggest challenges which we've faced with was the limited amount of resources, i.e., one individual for leading and conducting a research, establishing protocols with entities, attending several meetings, designing a prototype, implementing it, documenting it and testing with limited amount of time. It was also difficult to collect quantitative data from the community, due to the nature of the research. Most of the field research activities were done on-the-fly with lack of a solid preparation and establishing a research team with roles and responsibilities.

A lot of literature review was discarded due to low relation with the thesis topic. This could be avoided in future if the research topic is clearly defined at the beginning, therefore avoiding re-directions of the research topic and inherent usage of most of the literature review.

The design of the software architecture and framework and the inherent development of the software prototype were easy enough due to the backgrounds of the author. Some difficulties were encountered while graphically designing the interface, since usually is not the software engineer, neither the programmers who create the designs. Additional efforts were put by the developer in order to create a smooth interface.

7.2. System Evaluation Feedback

The heuristic evaluations were helpful to preliminary detect interface design and usability problems, and contributed to correct the system to a state where a new user is capable of using the system as we've witness in the user tests. According to emergency professionals, who have tested the prototype, it is capable of completely fulfilling the professional's requirements in what concerns to ensuring volunteer's safety under emergency scenarios. These testers were capable of smoothly working in the system with minor breakdowns which have not limited their performance while using it.

7.3. Emergency Organizational Changes

We have presented information reporting suggestions to official entities and ways which they can contribute to these software systems developments (integral part of design guidelines) by being responsible for deploying, doing maintenance and updating the system with safety instructions and validated guidance directed to volunteers. This

artifacts together with the framework regarding roles of professionals and volunteers, can aid and improve the continuous shifting and adaptation process which most emergency response entities deal with.

7.4. Future Work

Despite that we've used the created guidelines to guide our prototype design, they are also directed to design guidance of future information management systems related to volunteering in emergencies.

Due to the importance of this thesis work, we strongly believe that the prototype can be later improved, deployed and established as an on-line expressive platform, which could then be extended to other platforms (e.g. mobile) in order to pro-actively support spontaneous volunteers around the world. Both the design of the software architecture and the new software framework which we have built under an ad-hoc approach for our prototype can be later improved and re-used on developing other tools, being context related or independent. The framework can be directly applied to new map plotting based systems (context independent).

Finally, we expect that the knowledge generated from our research (chapters 3 and 4) could serve as a grounding for future research in spontaneous volunteerism, collective community emergency response or official's collaboration with community under emergency scenarios topics. One who wishes to improve collaboration with spontaneous volunteers or to obtain a deeper understanding over the needs of spontaneous volunteers and their contribution to community response could use our research results as a basis of research. As a first example of this, a copy of those results has already being handled to the local official civil defense authority.

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ANNEX I. REAL EMERGENCY SCENARIO

FIELD RESEARCH DATA

All of the data regarding this field research was collected 1 year after the emergency scenario, within the following period of time: February – April 2011.

I.1. Fly on the Wall (HCI Method)

In February 2011, two researchers speaking Portuguese watched a large cluster of videos on YouTube, TV News and read articles in local newspapers in order to understand how citizens handled the emergency situation. The combining of the observations allowed us to learn some interactions and behaviors over people that were caught in the middle of the emergency scenario regarding collaboration between community and between citizens and official entities.

The following observations were taken from several fly-on-the-wall sessions:

Citizen Behavior

After detecting several instances of some behaviors we've considered the following behavioral patterns as "recurrent" in the observed emergency scenario:

- Citizens immediately help each other and professionals during the disaster handling activities.
- Citizens tend to move closer to emergency professionals to observe them "work"
- Citizens that live in center of the city clean their house entrances during the disaster
- Citizens concentrate in the center of city some moments after the biggest floods
- Some Citizens travel around the flooded areas and tend to crowd in groups only to watch the damages (post-disaster)
- Citizens become video-reports and photo-reporters

Emergency Awareness

- Most of the people didn't expect this natural disaster
- Generally people don't think they're more aware/prepared for a similar situation
- People become more aware after noticing (by news) that it's an emergency situation

- People when in danger situations as during an emergency want information about damaged roads, current status of support or actions being taken by local authorities and volunteering activities which are taking place.

Breakdowns

1. Lack of coordination when getting out of city downtown
2. Emergency Services were only concentrated on working on some hot-spots
3. Some Local authority agents gave wrong (not updated) feedback to the locals

I.2. Survey

A cluster of 40 random individuals with ages comprehended between 18 and 35 which were affected directly or indirectly by the disaster were surveyed. The participants were chosen randomly on the street. This questionnaire had as main objective to identify the type of information which citizens required in order to successfully respond to an emergency situation.

Questions

1. On February 19 (day before), did you know/feel that an emergency could occur the next day?
2. Where were you in the morning of February 20th?
3. What kinds of communication were affected around you?
4. How did you realize that the situation had become an emergency?
5. Was your family affected by the floods?
6. Who was the first person you tried to contact?
7. During the initial stages of the emergency, what information source would you have wanted to use and which was the one you actually ended up using?
8. Did you change your behavior when you were informed/realized that it was an emergency?
9. Have you found problems in your communications (e.g. asking for help, talking to related)?
10. If you find an emergency situation again, which information would you like to be (strictly) available to you?
11. What did you do while waiting for help (or during the critical emergency time)?

12. Do you think you are better prepared to face an emergency situation again?

13. During the emergency handling activities, point out something you saw that didn't run according to your expectations (e.g. breakdowns)?

Results

In order to find the confidence interval (accuracy) of the proportion of this survey's sample size we have used a 95% confidence level for our sample size of 40 random individuals.

Table 18 – Survey Results

1. On February 19 (day before), do you knew/felt that an emergency could occur the next day?	
(2) Yes - 5% (38) No - 95%	Conclusion: Most of the people do not expect or feel that an emergency could occur on the next day. The corresponding confidence interval (accuracy) is: +- 6.95% *we can be 95% certain that the true population falls within the range of 88.25% - 101.75%
2. Where were you in the morning of February 20th?	
(11) Work – 27.5% (21) Home – 52.5% (8) Other - 20%	Conclusion: Most of the people were at home *For the 40% which were at home, the corresponding confidence interval (accuracy) is: +- 15.48% *we can be 95% certain that the true population falls within the range of 37.02% - 67.98%
3. What kind of communications were affected around you?	
(24) Mobile - 60% (13) Net – 32.5% (3) Landline Phone – 7.5%	Conclusion: Mobile phones were the most affected kind of communication. *For the mobile phones proportion, the corresponding confidence interval (accuracy) is: +- 15.18% *we can be 95% certain that the true population falls within the range of 44.82% to 75.18%

4. How have you realized that the situation became an emergency?	
(13) Radio – 32.5% (13) TV – 32.5% (6) Net - 15% (6) Phone - 15% (2) Talk - 5%	<p>Conclusion: Most of the people answered that they became aware only after watching the alert on TV and Radio.</p> <p>*For the 32.5% radio proportion, the corresponding confidence interval (accuracy) is: +- 14.51%</p> <p>*we can be 95% certain that the true population falls within the range of 17.99% to 47.01%.</p> <p>Note: Neither one inquiry answered that figured out that was an emergency by them.</p>
5. Was your family affected by the floods?	
(23) No – 57.5% (17) Yes – 42.5%	<p>Conclusion: inconclusive results</p> <p>*For the 55% which had not affect relative, the corresponding confidence interval (accuracy) is: +- 15.32%</p> <p>*we can be 95% certain that the true population falls within the range of 42.18% to 72.82%.</p>
6. Who was the first person you've tried to contact?	
(11) Father – 27.5% (9) Cousin – 22.5% (10) Boyfriend - 25% (7) Brothers – 17.5% (3) Other – 7.5%	<p>Conclusion: inconclusive results</p> <p>*For the 27.5% which tried to contact father first, the corresponding confidence interval (accuracy) is: +- 13.84%</p> <p>*we can be 95% certain that the true population falls within the range of 13.66% to 41.34%.</p>
7. On the beginning of the emergency, what type of information source have you wanted to use?	
(16) Internet - 40% (9) Phone – 22.5% (10) TV - 25% (5) Radio – 12.5%	<p>Conclusion: Most of the people wanted to use Internet.</p> <p>*For the 55% which wanted internet proportion, the corresponding confidence interval (accuracy) is: +- 15.18%</p>

	<p>*we can be 95% certain that the true population falls within the range of 24.82% to 55.18%.</p>
8. Have you changed your behavior, when you were informed / reasoned that it was an emergency?	
(20) Alert - 50% (1) Stress – 2.5% (3) Panic – 7.5% (6) No - 15% (10) Shock - 25%	<p>Conclusion: Most of the people became more alert after being aware that was an emergency.</p> <p>*For the 50% which changed their behavior to alert proportion, the corresponding confidence interval (accuracy) is: +- 21.91%. *we can be 95% certain that the true population falls within the range of 28.09% to 71.91%.</p> <p>Note: Only 15% of the people didn't change their behavior, hence we can state that most of the people actually changed their behavior (confidence interval of 15.65).</p>
9. Have you found problems in your communications (e.g. asking for help, talking to related)?	
(7) No – 17.5% (26) Network Problems- 65% (7) People Stress – 17.5%	<p>Conclusion: Most of the people faced mobile phone network problems.</p> <p>*For the 65% which faced mobile phone network problems proportion, the corresponding confidence interval (accuracy) is: +- 14.78%</p> <p>*we can be 95% certain that the true population falls within the range of 50.22% to 79.78%.</p>
10. If you find an emergency situation again, which information would you like to be (strictly) available to you?	
(11) Transport - 27.5% (12) Family - 30% (7) Shelter – 17.5% (8) Situation Progress -	<p>Conclusion: inconclusive results</p> <p>*For the 30% which wanted information about family proportion, the corresponding confidence interval (accuracy) is: +- 14.2%</p>

20% (2) None - 5%	*we can be 95% certain that the true population falls within the range of 15.8% to 44.2%.
11. What have you done, while waiting for help (or during the critical emergency time)?	
(15) Went Out See/Talk – 37.5% (11) Went Out to Help – 27.5% (7) Watched TV – 17.5% (7) Nothing – 17.5%	Conclusion: inconclusive results *For the 37.5% which had went out to see proportion, the corresponding confidence interval (accuracy) is: +- 15.0% *we can be 95% certain that the true population falls within the range of 22.5% to 52.5%. Note: Only 27.5% of the people answered that they went out to help other people.
12. Do you think you're better prepared to face an emergency situation again?	
(37) No – 92.5% (3) Yes – 7.5%	Conclusion: Most of the people don't feel better prepared to face an emergency situation again. *For the 95% which had went out to see proportion, the corresponding confidence interval (accuracy) is: +- 8.16% *we can be 95% certain that the true population falls within the range of 84.34% to 100.66%.
13. During the emergency handling activities, point something you've seen that didn't run according to your expectations (e.g. breakdowns)?	
(10) Lack Of Professionals Resources - 25% (13) Observed Incorrect Actions Of Professionals – 32.5% (8) Citizens Taking Risk Actions - 20% (9) Other – 22.5%	Conclusion: Most of the observed breakdowns are related to Emergency Professionals. *For the 57.5% (25+32.5) which are related to emergency professionals incorrect actions, the corresponding confidence interval (accuracy) is: +- 15.32% *we can be 95% certain that the true population falls within the range of 42.18% to 72.82%. Note: Only 20% of the answered breakdowns are related to citizens.

14. On the beginning of the emergency, which was the mean of communication you've actually ended up using?	
(10) Phone - 25% (9) TV – 22.5% (10) Radio - 25% (5) Talking – 12.5% (6) Net – 15%	<p>Conclusion: inconclusive results</p> <p>*For the 25% which are related to phone or radio, the corresponding confidence interval (accuracy) is: +- 13.42%</p> <p>*we can be 95% certain that the true population falls within the range of 11.58% to 38.42%.</p> <p>Note: Citizens ended up using several types of information sources and only 15% ended up using internet for communication purposes.</p>

I.3. Volunteering Efforts Photos

A cluster of photos from local photographers regarding the volunteering activities taken by community and collaboration with official entities was compiled in March 2011.

All photos are used with permission and are copyrighted.

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Figure 14 - Citizens asking for instructions to officials



Figure 15 - Citizen cleaning is own place



Figure 16 - Community helping each other



Figure 17 – Citizen trying to escape flooded street



Figure 18 - Spontaneous Volunteering efforts



Figure 19 - Spontaneous Volunteers helping official entities



Figure 20 - Police man giving citizen instructions



Figure 21 - Citizens grouping to help



Figure 22 - Citizens helping each other



Figure 23 - Private companies volunteering



Figure 24 - Spontaneous volunteer working at beach



Figure 25 - Spontaneous volunteer efforts



Figure 26 - Spontaneous volunteer alone



Figure 27 - Volunteer scout girl finishing her day



Figure 28 - Citizens helping each other



Figure 29 - Volunteers helping professionals



Figure 30 – Spontaneous Volunteer youngsters group



I.4. Semi-Structured Interviews

Two interviews were performed in March 2011 in the format: direct story telling with Interview at the end. We have interviewed 2 distinct victims, were one was explicitly and directly affected by the emergency and the other one was indirectly affected. These semi-structured interviews were important to find how a citizen handles and responds to the emergency situation, the information needs and the interactions which they have had with other citizens or official entities.

In these interviews we've asked the participants/victims to tell their whole story from the start phase of the emergency to the post-disaster phase. During this story-telling, we have interacted with the participants and asked contextual questions that were according to our scope of the interviews. Both interviews were audio recorded.

Following we present a brief synthesis in text-note formatting of the semi-structured interviews. The synthesis is categorized in 3 emergency phases (without scientific basis) for easier reading: a) Becoming Aware of Emergency, b) Emergency in Progress, c) Post-Disaster.

I.4.1. Interview #1 - Point of view of a: directly affected male by the disaster (32 years old)

I.4.1.1. Becoming Aware Of Emergency

- Woman was crying and water was coming into her store.
- Girlfriend phoned participant to say she was home and safe, shocking for participant.
- Checked window – went outside to see what the real problem was
- Saw some water coming in to street, but didn't expect it to be too bad because this has happened before. Other people in the coffee shop stayed there too.

Emergency progress

- 3pm First official information was from police man traveling through streets on Caterpillar machine. Police man was saying to get out of coffee shop. Participant asked if he should leave the house but was told to stay in place.
- 4pm Locals were helping to save woman trapped in ground floor store.
- 5pm Batteries for phones were running out. Started sharing phones journalist needed to coordinate to get out
- 6pm no electricity in house – no internet, phone (VoIP), no computers

- 6pm – Military showed up looking for journalists. Military asked if everything ok. Participant asked if they should stay or leave. Military said they don't have any info so they should stay home. If they want to leave they can.
- Mother was stressed and wanted to stay at home. If something happened she wanted to be there to save stuff.
- 9pm heard rocks being moved by caterpillar. Saw that it was caterpillar by going to terrace. Machine was building a ditch. Ditch directed water down their street. This was so they could clean out the lower part of the stream to return to normal flow.
- 1am Phoned civil protection to warn them that the water was getting too high. They said they know and they are doing this on purpose to clean the water canal. Participant was concerned water would rise above 1 floor.
- Phoned a second time and began to hear the caterpillar moving rocks and water began to go down.
- 3:30am people were walking on the rocks. Participant asked engineer why the water went into road and engineer told him that it was to clean the lower part of the stream.
- Participant attempted to sleep but wasn't able to because was unsure if they would divert the water again.
- Spent much of the night talking to neighbors

1.4.1.2. Pos-disaster (next day)

- 8am newspaper was delivered (crucial piece of information and connection to the events)
- 6pm Saturday – 5am Sunday used radio to get information. Listened to regional frequency between music segments there were reporting main streets that were affected. Most of news was about the bigger casualties in Rib. brava. Didn't indicate anything about their particular location.
- No electricity. Internal question: "Do we leave for hotel or should we stay because the electricity may come."
- Called electrical company, Electrical technician couldn't answer when electric would be restored.
- Concerns for not leaving: Food in the fridge, safety of personal belongings, electric may come back up any time, water may come back any time.
- Convinced mother to leave.

- Walked for 5 minutes on top of rocks until clear road. Had family member picked up on clean road. Mother went to hotel, participant went to GF house.
- Was out of the house for 2 to 3 days. Decided to go back when they saw photos of images of their road and saw that it was cleaned of rocks
- Used personal persuasion to have technician patch electricity to building.
- Watched TV regularly to get more news. Municipality had their own broadcast.
- They did their best, communication was really good after the disaster.
- Missing the most was information during disaster: Had to make critical choice but wasn't informed.
- Information given over radio wasn't location specific so couldn't make decisions.
- Because of this experience: "It's not worth staying at home if you have zero information besides what you see." Participant would leave immediately leave if he saw rocks in the street again.
- "In that situation it's more important what I didn't see rather than what I did see" – know more about what are they doing, when electricity coming back, what is the dimension of this to be able to assess the situation.
- Would warn friends more about what is happening.
- Overall perfect information would have been that while diverting water they were measuring it so it wouldn't go above the windows (communicating that they are still safe in the 1st floor)

I.5. Interview #2 - Point of view of a: not directly affected female by the disaster (28 years old)

I.5.1.1. Becoming aware of emergency

- I was here at the office
- You don't realize what is happening and then when this happened it was raining a lot it was a normal day for me.
- the location that I am is not floods it's where those problems happened because I'm here and the problems were in Funchal with the small rivers.
- I realized I couldn't believe because someone called me
- I don't know if it was my sister because then she told me she was looking for me and she was wondering where I was
- and this is when I connected the information on the internet and I see what was happening
- and it seemed that it wasn't here

1.5.1.2. Emergency progress

- I live close to Funchal, its about 10 minutes from here, it's in Funchal, 10 or 15 from center
- It's not easy to explain how close you are to this kind of thing and then if you don't deal directly with this situation because I was not dealing with the problem itself.
- Like I told you it seems that you are not dealing with this problem in madeira because to be honest with you if you see the information it came on the news, it was worse, but I think they made it worse than it really was. It seemed all Madeira was.
- because you are on an island, you are depending on the information they are giving to you
- for instance after I got home, um, you just, we are watching what is happening
- watched through the TV the news
- Mostly, still all that information we were amazed how this kind of rain suddenly became a storm
- I think at the beginning we didn't realize how dangerous it was because this is the first time we deal with this
- and I think even if it happens again, I don't know how can we deal with this
- government was doing as much as they did, they were giving a lot of information to the population saying what was happening

1.5.1.3. Pos-disaster (next day)

- I think to be honest, our government was very strong and very stand up in this kind of situation.
- not because I think, it's something that you can have in your mind, but what.. But you are on an island, we are on a limited space, you can't do much
- what we really can do to be safe enough with your family or whatever, and wait
- at least this is, um, expect, you can't do anything but wait and see how things roll along and get to an end people wanted to go there and be at the place and see how the disaster was.. I didn't even dare to go there
- I think it was too bad to be a spectator to be watching, I mean it was people who died.
- you see if this happens again there is not much that you can do, what really you can do is to, do, to do what they ask us to do. I mean the government and the ... to ask them, if they ask you to stay at home

- I know a lot of people, doing, I knew that even people wanted to help, and some times people want to go to help, but they were asking people to stay, because they couldn't control the people.
- the outsiders come and they don't know how things roll and sometimes you think you are helping, but you are not you are not, you are another problem to them.
- even volunteering, they have a lot, and even they asked us to, that they didn't need more people to go to
- madeirans they were a lot of approaching and trying to help and a lot of people did it.

I.6. Informal discussions

Several informal discussions were accomplished regarding the support given from official entities to community in the floods emergency, with the following individuals:

- 6 random location emergency victims (February 2011);
- 7 random location volunteers (February 2011);
- 4 civil defense professional emergency responders (April, October and November 2011);
- 1 volunteer reception center collaborator (June 2012)

The results extracted from these informal discussions were kept in note/draft and audio formats and are used as a support for the formal research methods used in this thesis.

I.6.1. Conclusions

- Citizens loose trust in official sources as soon as they notice that officials are providing erroneous or not realistic information
- There is a high necessity from people to help (willing to help) others when facing an emergency scenario. Some don't do volunteering due to lack of situational awareness
- Emergency professionals worry about every one safety, including spontaneous volunteers
- Spontaneous volunteers are not well seen in Madeira Island by any official entity.
- When facing emergency scenarios, most of the people go out to observe the damages and to engage into conversations with neighbors.

- A lot of photos start circulating in social networks as soon as citizens have internet connection.

I.7. Official Information Channels used by official entities

Following we present a complete list of the information channels used by official entities (governmental) during the Madeira Floods emergency.

Table 19 – Information Channels use by Official Entities (Madeira Floods)

Protecção Civil Madeira	http://www.procivmadeira.pt/
Twitter (madeira government) *30 min updates	http://twitter.com/pgram
Website (madeira government) * daily point of situation / summaries	http://pgram.gov-madeira.pt/
Facebook * Daily Point Of Situation / Summaries	http://www.facebook.com/pages/Presid%C3%A2ncia-do-Governo-Regional-da-Madeira
YouTube	http://www.youtube.com/pgrammadeira *Official TV Interview Public Statement
RSS Feeds	http://pgram.gov-madeira.pt/xml/rssfeeder.xml

I.8. Emergency Instructions Flyer

Figure 31 – Emergency instructions flyer (civil defense – Madeira Island)

Incêndios Florestais

AUTOPROTECÇÃO

Os incêndios florestais são uma das principais catástrofes em Portugal. Constituem uma fonte de perigo para as pessoas e bens, além de provocarem danos ambientais graves. As causas são muito variadas, mas muitos ocorrem por descuido humano.

Siga as medidas de autoprotecção contidas neste folheto e divulgue-as.

Se estiver próximo do incêndio

- Ligue no imediato para o 112 ou vá aos Bombeiros da área.
- Se não existir perigo tente extinguir com as extintores ou com a água.
- Não prenda-se e siga as indicações dos Bombeiros.
- Retire a sua família dos caminhos de acesso ao incêndio.
- Se notar a presença de pessoas em compartimentos de risco informe as autoridades.

Se o incêndio estiver perto da sua casa

- Avise os vizinhos.
- Corte o gás e a electricidade.
- Molhe abundantemente as paredes e os arbustos que rodeiam a casa.
- Solte os animais, eles tratam de si próprios.
- Em caso de evacuação ajude a sair as crianças, idosos e deficientes.
- Não perca tempo a recolher objectos pessoais desnecessários.
- Não volte atrás por motivo algum.

Se o incêndio estiver perto da sua casa



As autoridades só aconselham a evacuação se existir risco de vida.

Obedeça rapidamente, mas com calma.

Se ficar cercado por um incêndio. O que fazer

- Se a direcção contrária à do vento.
- Refúgio de uma zona aberta ou com pouca vegetação.
- Cubra o corpo com roupa e roupas molhadas.
- Retorne para o carro, afogue de todas as maneiras para garantir a fuga.
- Aguarde a chegada dos Bombeiros se não conseguir sair sozinho.



Em caso de emergência, ligue o 112 ou vá aos Bombeiros da área.

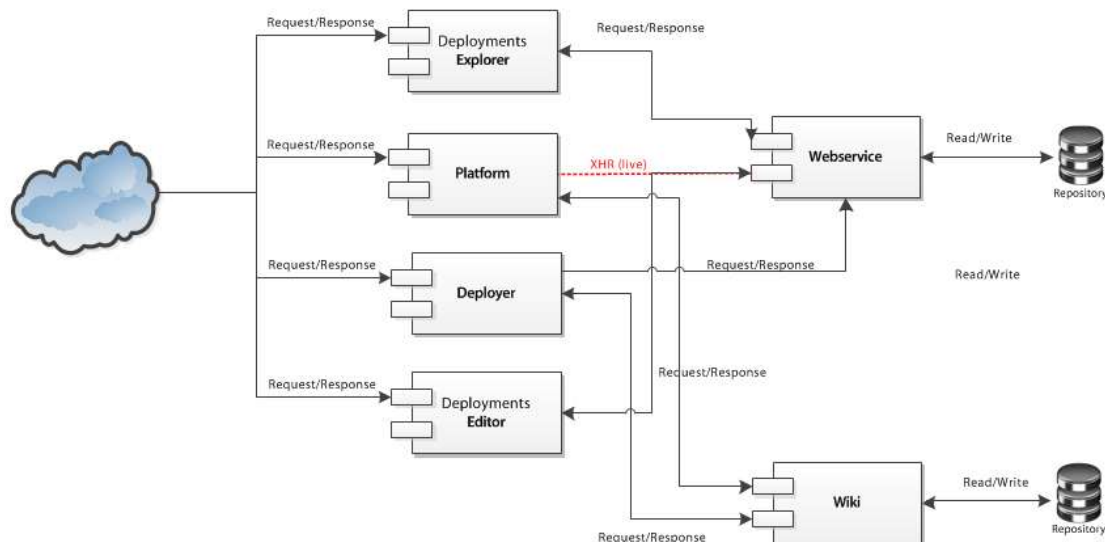
ANNEX II. PROTOTYPE ARCHITECTURE

II.1. Views

II.1.1. Component-Connector View

This view presents “runtime” elements and the connections within them. The view allow us to gain a quick overview over the main modules of the system, the way which they interact within them, the data flow within the system and which parts of the system work in parallel. This view is not related to any other view, since the level of abstraction presented is superior to the other views.

Figure 32 – Component-Connector View



II.1.1.1. Elements Catalog

Table 20 – Component Connector View Elements Catalog

Name	Description
Deployments Explorer	<p>This element is an integral part of the application-server of the system.</p> <p>It allows users to explore the existing deployments on the server platform in order to select one.</p> <p>Requests done by clients to this component are handled directly by this element, since on this prototype no caching</p>

	mechanisms were developed.
Platform	<p>This element is an integral part of the application-server of the system.</p> <p>It allows users to view and edit an active deployment. It is by itself the core element of the system, since it personifies most of the functional requirements.</p> <p>Requests done by clients to this component are handled directly by this element, since on this prototype no caching mechanisms were developed.</p>
Deployer	<p>This element is an integral part of the application-server of the system.</p> <p>It provides an interface to the users for creating a new deployment on-the-fly.</p> <p>Requests done by clients to this component are handled directly by this element, since on this prototype no caching mechanisms were developed.</p>
Deployments Editor	<p>This element is an integral part of the application-server of the system.</p> <p>It provides an interface to the owners of each deployment for editing their deployments parameters on-the-fly.</p> <p>Requests done by clients to this component are handled directly by this element, since on this prototype no caching mechanisms were developed.</p>
WebService	<p>This element is an integral part of the back-end of the system.</p> <p>It receives requests from the 4 first level components of the system (editor, platform, deployer, explorer).</p> <p>It keeps a XHR (XmlHttpRequest) long polling connection to the platform, in order to create a real-time synchronism between the connected clients and the server. Each time the server is updated, it notifies the connected users.</p> <p>It contains a high level interface to access the DMBS</p>

	<p>(Database Management System).</p> <p>It contains also security components to avoid non-authorized users to send data to the DMBS.</p>
Wiki	<p>This element is an integral part of the back-end of the system.</p> <p>It provides both a collaborative database and a wiki editing scenario for both users and professionals to edit the deployments activities instructions and safety tips.</p> <p>The wiki element receives requests both from the deployer and platform elements, where the deployer simultaneously writes and consumes data and the platform only consumes data. The element may be accessed externally.</p>

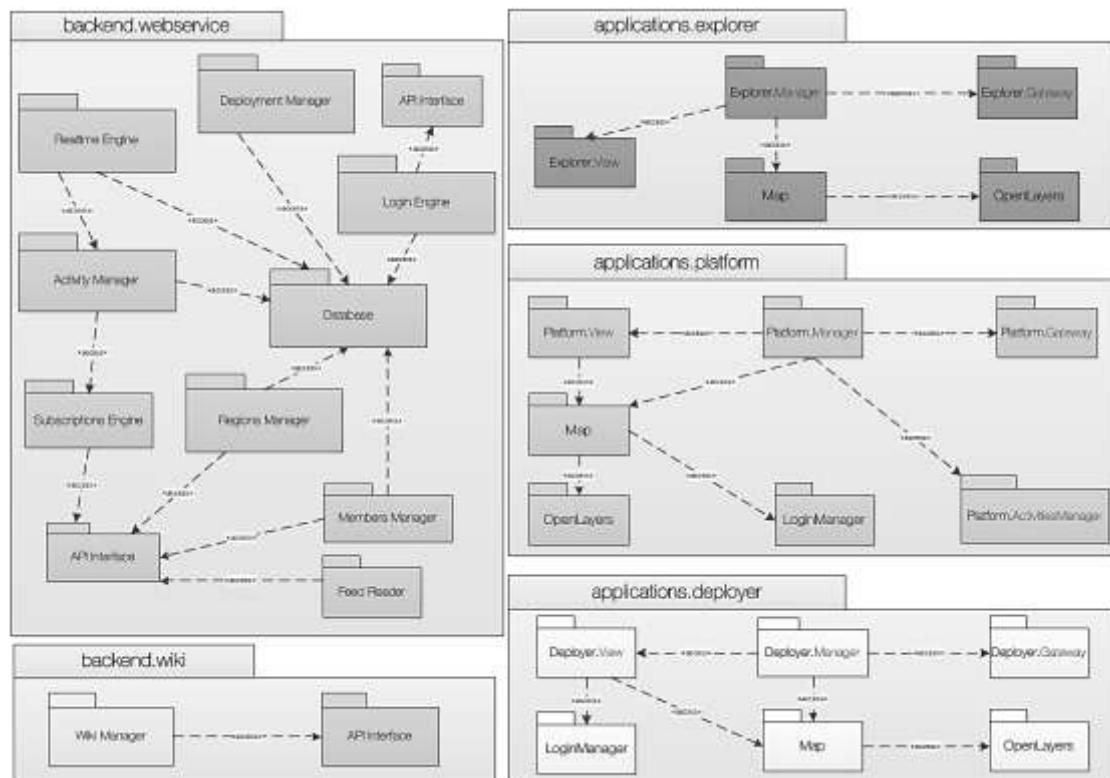
II.1.1.2. Variability Guide / Restrictions

A data mirroring approach could be later introduced (e.g.. via central dual tree) in order to both increase performance and insure data integrity. Caching mechanisms can be later introduced over the web service (higher abstraction layer). A more efficient real-time connection can be later introduced via web sockets (rather than XHR).

II.1.2. Module View

In this view, we will present system elements as modules. These modules represent code packages of the system, creating a lower lever representation of the system. We have used the “usage” style approach to demonstrate in a clear way, the relations between the modules. This view will be mostly used by the development team as an active support artifact in the coding and testing phases of the system. The view has been partitioned into 4 views in order to simplify its analysis and presentation: Backend, Deployer, Platform and Explorer.

Figure 33 – Module View (system overview)



II.1.2.1. Variability Guide / Restrictions

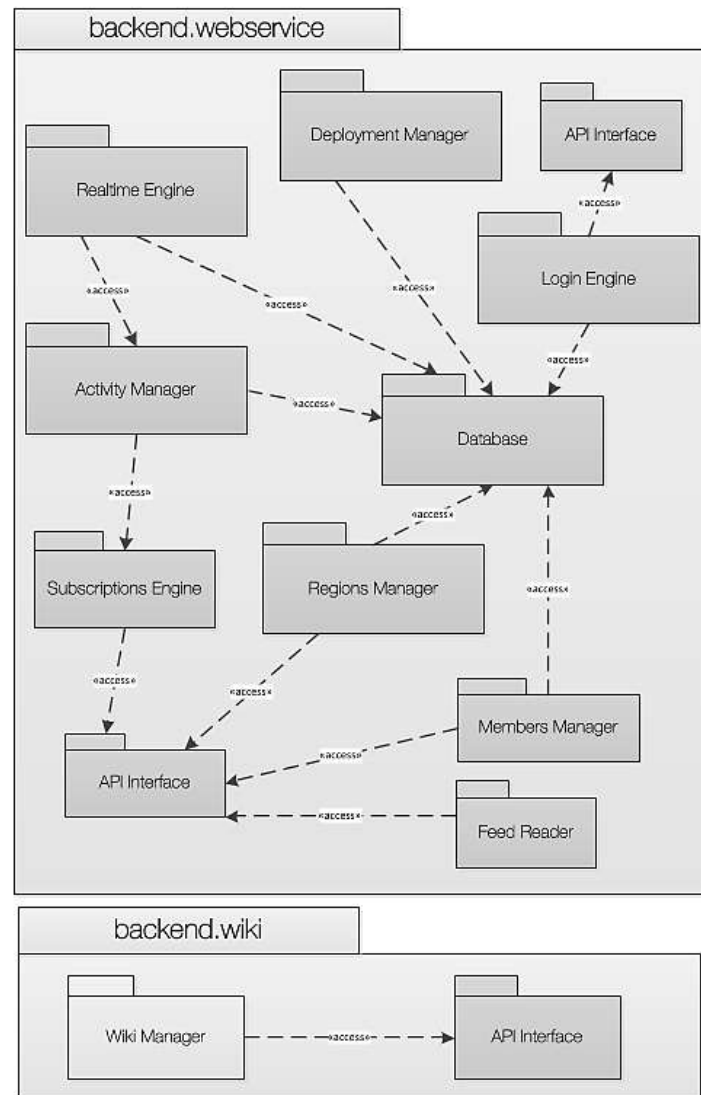
It's possible that some new functionality modules could be plugged to the controllers of each system components. Also, some security modules could be attached to the several gateways.

II.1.2.2. Related Views

This view is directly related with the allocation view, where it's possible to see the files which are contained within the modules.

II.1.2.3. Backend (UML Model View)

Figure 34 – Backend Module View



Following we present the elements catalog of this view.

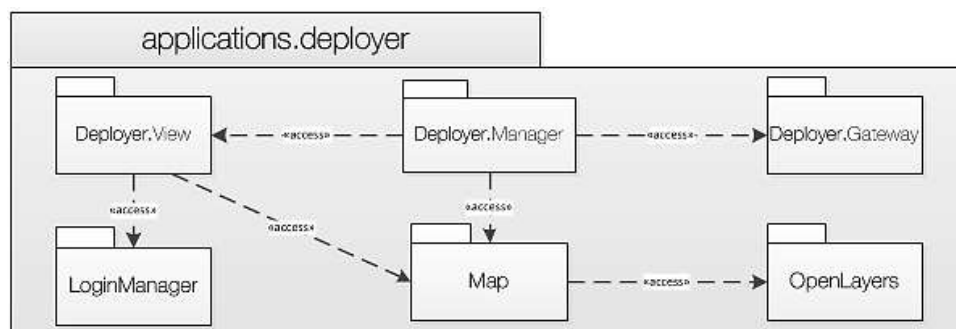
Table 21 – Backend Module View (backend) elements catalog

Name	Description
Real-time Engine	This module has the responsibility of establishing the real time live connection from the backend to the client. It contains the implementation of the real time engine used to keep simplified push notification system of the prototype (via http long request).
Deployment Manager	This module has the responsibility of creating, loading, removing and updating system deployments to the database.

Activity Manager	This module has the responsibility of creating, loading, removing and updating activities to the database.
Database	This module interfaces directly with the DBMS, and handles all reading and writing on the system database.
Subscriptions Engine	This module is responsible for adding new subscriptions to deployment updates, managing the subscriptions e-mails and sending mails for recipients.
Regions Manager	This module saves and manages user created map regions on the database.
API Interface	This module is responsible for reading incoming external client request parameters for each of the backend modules.
Members Manager	This module creates, retrieves and updates members in the system database.
Wiki Manager	This module contains an interface for reading and writing content on the external wiki database.
Feed Reader	This module loads and interprets external RSS feeds. It contains the implementation of the backend feed reader API's used to access external network feeders.
Login Engine	This module is responsible for managing server-side authentication of users thorough the system.

II.1.2.4. Deployer Module View

Figure 35 – Deployer Module View



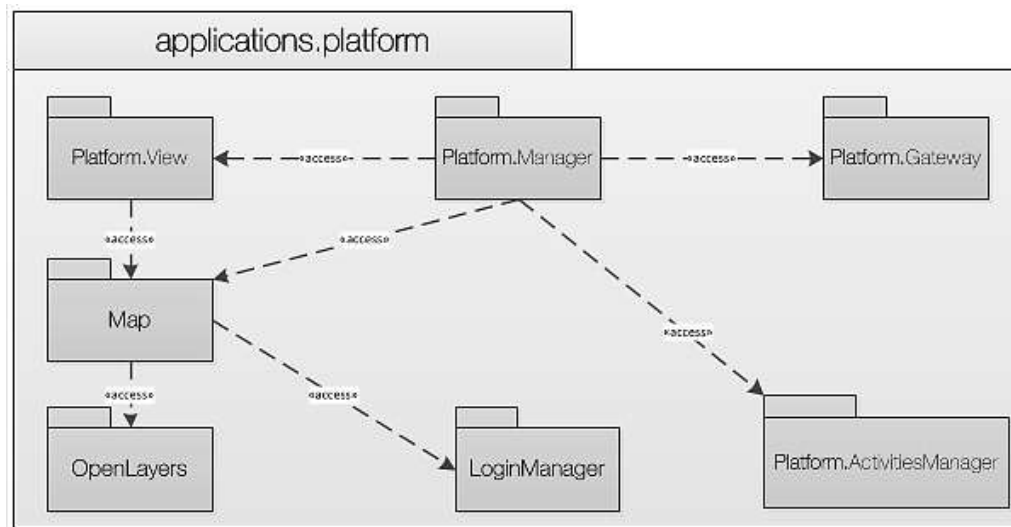
Following we present the elements catalog of this view.

Table 22 – Deployer View (applications-server) Elements Catalog

Name	Description
Deployer.Controller	This module is responsible for initializing and coordinating all elements and functionality of the system deployer. All of the deployer components are tied to this module for control purposes.
Deployer.View	This module is tied to the controller and has the responsibility of handling screen events, drawing data on screen and calling the web service for data querying.
Deployer.Gateway	This module is tied to the controller and is a gateway to the webservice. It provides an interface for the deployer components to query and submit data to and from the webservice. Any external communications from and to the deployer pass through this module.
LoginManager	<p>This is a shared module.</p> <p>It communicates with the webservice login module for managing the user's authentication thorough the system.</p>
Map	<p>This is a shared module.</p> <p>It communicates directly with the OpenLayers external module which is the map engine of the system. It has the responsibility of handling managing any kind of interaction and data operations related to the map, including a direct connection with the gateways of the modules where it's currently tied to, in order to load and submit external data.</p>
OpenLayers	<p>This is a shared module.</p> <p>This module is the map engine of the system and contains the external open-source OpenLayers library framework.</p>

II.1.2.5. Platform Module View

Figure 36 – Platform Module View



Following we present the elements catalog of this view.

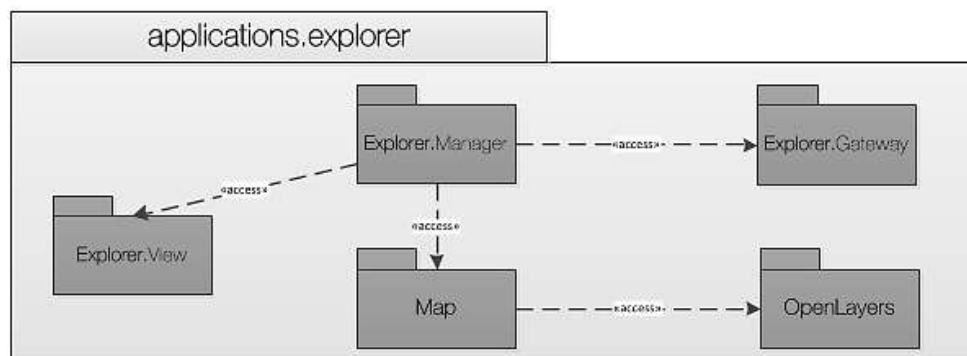
Table 23 – Platform Module View (application-server) Components Catalog

Name	Description
Platform.Controller	This module is responsible for initializing and coordinating all elements and functionality of the system platform. All of the platform components are tied to this module for control purposes.
Platform.View	This module is tied to the controller and has the responsibility of handling screen events, drawing data on screen and calling the web service for data querying.
Platform.Gateway	This module is tied to the controller and is a gateway to the webservice. It provides an interface for the platform components to query and submit data to and from the webservice. Any external communications from and to the platform pass through this module.
LoginManager	This is a shared module. It communicates with the webservice login module for managing the user's authentication thorough the system.
Map	This is a shared module. It communicates directly with the OpenLayers external

	module which is the map engine of the system. It has the responsibility of handling managing any kind of interaction and data operations related to the map, including a direct connection with the gateways of the modules where it's currently tied to, in order to load and submit external data.
OpenLayers	This is a shared module. This module is the map engine of the system and contains the external OpenLayers library framework.

II.1.2.6. **Explorer Module View**

Figure 37 – Explorer Module View



Following we present the elements catalog of this view.

Table 24 – Explorer Module View (applications-server) Components Catalog

Name	Description
Explorer.Controller	This module is responsible for initializing and coordinating all elements and functionality of the system deployments explorer. All of the platform components are tied to this module for control purposes.
Explorer.View	This module is tied to the controller and has the responsibility of handling screen events, drawing data on screen and calling the web service for data querying.
Explorer.Gateway	This module is tied to the controller and is a gateway to the webservice. It provides an interface for the platform components to query and submit data to and from the webservice and wiki. Any external communications from and to the explorer pass through this module.

Map	<p>This is a shared module.</p> <p>It communicates directly with the OpenLayers external module which is the map engine of the system. It has the responsibility of handling managing any kind of interaction and data operations related to the map, including a direct connection with the gateways of the modules where it's currently tied to, in order to load and submit external data.</p>
OpenLayers	<p>This is a shared module.</p> <p>This module is the map engine of the system and contains the external OpenLayers library framework.</p>

II.1.3. Allocation View

This view will allow us to observe the relation between the software elements in the environment where the software will be installed. It's possible to verify the files which will be installed and how they will be distributed.

II.1.3.1. Variability Guide / Instructions

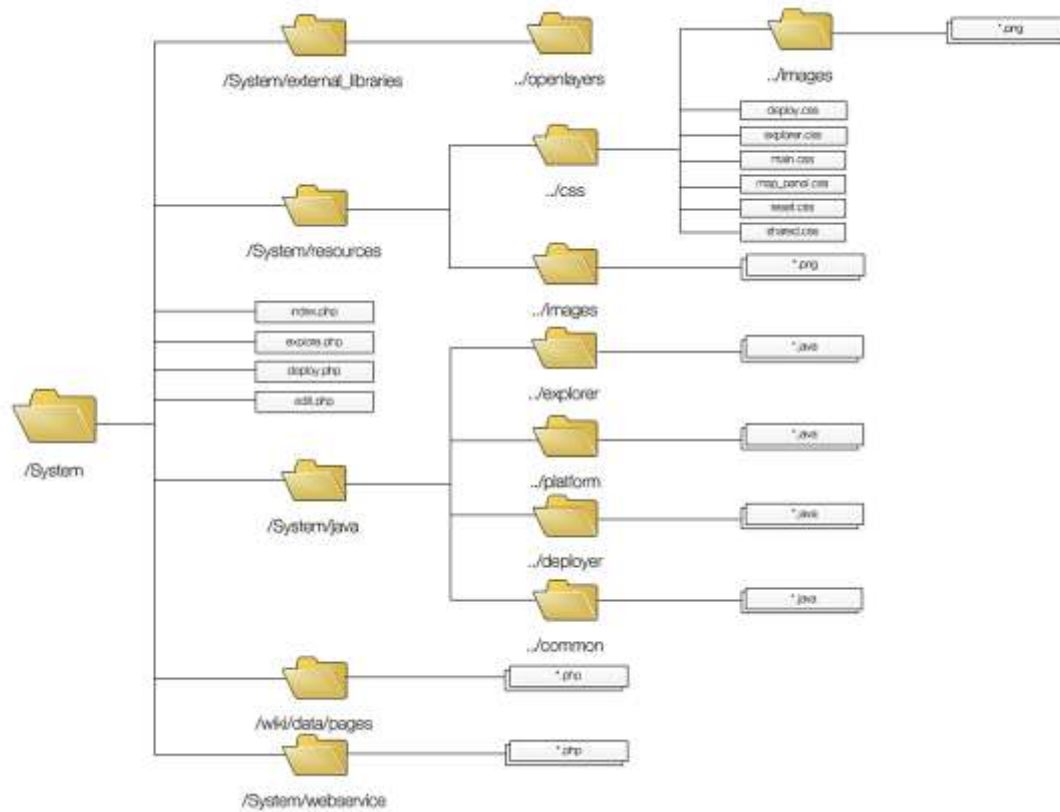
The directory structure can be easily adapted in order to be integrated into some framework.

II.1.3.2. Related Views

It's possible to identify in this view some of the packages described in the modules view. The overall directory hierarchy reflects in some way the packages of all the modules view.

II.1.3.3. Allocation View – Deployment (Overview)

Figure 38 – Deployment View (overview)

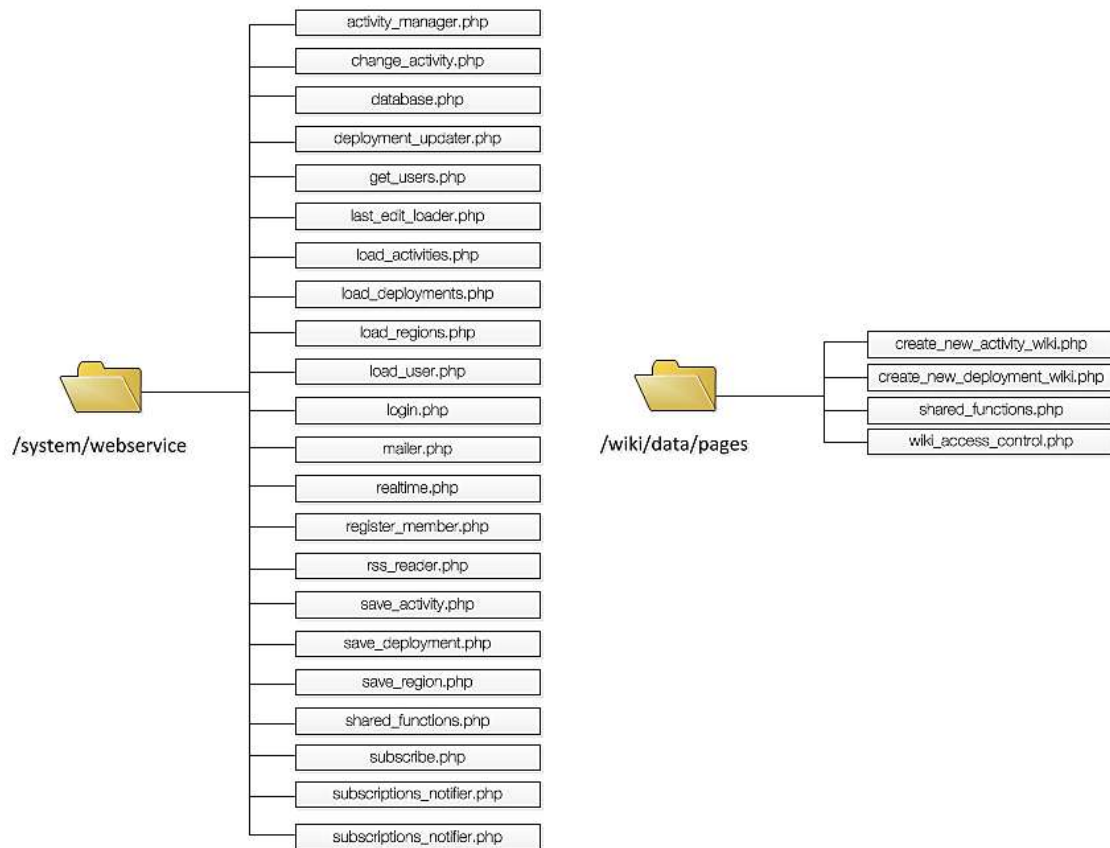


In this diagram we can identify the folder structure which holds the system files. Each component of the component-connector view is separated in modules, which are reflected in folders following an approach which will allow an easier editing in future.

Following we present an independent allocation view of the four system components.

II.1.3.4. Allocation View – Deployment (Back-End)

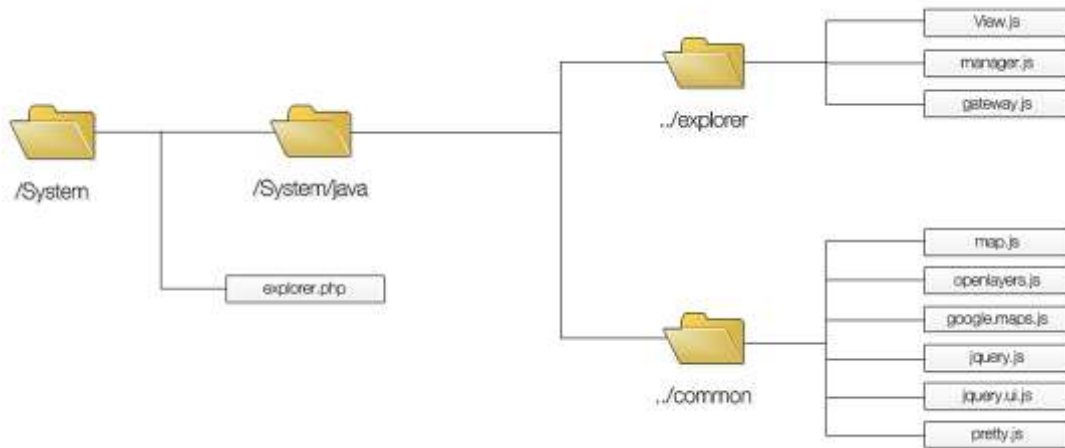
Figure 39 – Deployment View (Back-End)



In this view the web service API files are installed at a unique directory level, therefore if one requires access to web service it just need to call “/webservice/function_name”, ensuring a normalized and familiar way of accessing to database via web service functions. On the wiki, the files are installed inside the “/data/pages” directory since it’s the closest location to directly accessing the wiki database files, allow by this way external API access for reading and easily writing data on wiki.

II.1.3.5. Allocation View – Deployment (Explorer)

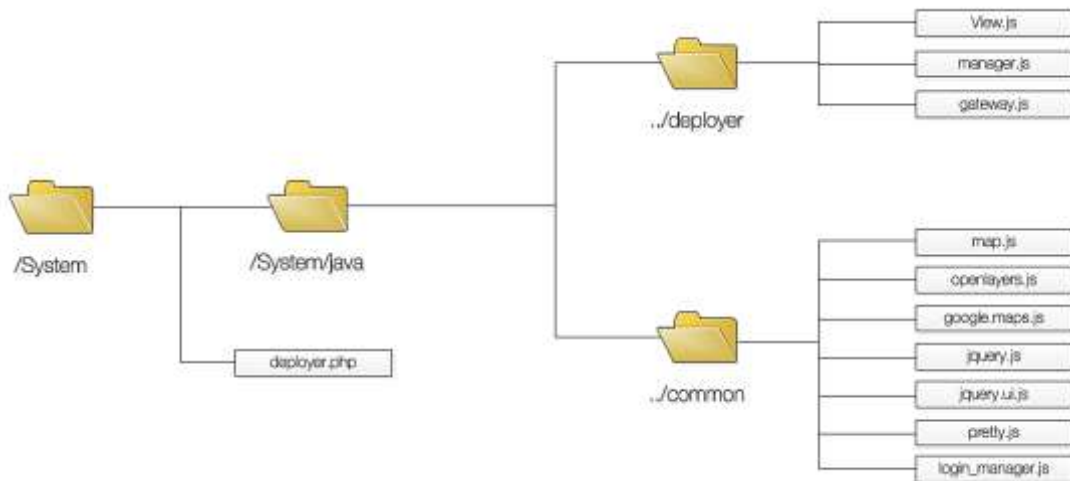
Figure 40 – Deployment View (Explorer)



In this view we can identify a specifically created directory to store explorer files. This files in the “/explorer” directory resemble the module view where we found 3 packages regarding View, Controller and Gateway of explorer component. The common directory holds the shared files among all of the system modules.

II.1.3.6. Allocation View – Deployment (Deployer)

Figure 41 - Deployment View (Deployer)



Analogous to the explorer view, the directory and file structure resembles the module view of the deployer.

II.1.3.7. Allocation View – Deployment (Platform)

This diagram proposes the installation schema for the components which together constitute our prototype. We have opted for using only open-source based technologies in order to reduce the development costs, the server acquisition costs and the maintenance costs.

Table 25 – Allocation View (Implementation) Elements Catalog

Name	Description
Linux	Linux Operating System has several server oriented distributions, as the RedHat Server which has commercial quality. We propose the usage of this or other linux distribution as the server's operating system.
Apache HTTP Server	Apache is a robust and safe implementation of a server with several modules which provide services, as HTML pages, SQL data base connectivity and PHP support.
MySQL	The persistent database MySQL allows an inexpensive and secure alternative for a DBMS.

II.2. Quality Attribute Scenarios

Table 26 – Quality Attribute Scenario 1

Title: Accessibility trough distinct platforms (Desktop, Android, iOS)		ID: QAS1	Version: 1
			Updated: 25/08/12
Quality Attribute: Portability		Characterization ID: QA1	
Active Stakeholders: User, Administrator, Owner		Priority(0-3): 2 Difficulty(0-3): 2	
Stimulus Source	System owner wants to add additional support for a mobile platform.		
Stimulus	System owner requires that the system is accessible thorough most common mobile devices (iOS and Android based).		
Environment	System development phase		
Artifacts	Platform independent data management modules.		

System Response	All data sources and related management have access API's (platform independent).
Response Measure	Make all system data API's permanently accessible to other platforms.

Table 27 - Quality Attribute Scenario 2

Title: Ensure quick introduction of new system components.		ID: QAS2	Version: 1
			Updated: 25/08/12
Quality Attribute: Availability/Scalability		Characterization ID: QA2	
Active Stakeholders: Developers, Owner		Priority(0-3): 3	
		Difficulty(0-3): 3	
Stimulus Source	Users want additional features for the system.		
Stimulus	System owner requires new features to be implemented.		
Environment	System Normal Operation		
Artifacts	Platform Component tying architecture		
System Response	System older functionality remains stable and new components have been coupled to the system.		
Response Measure	Add a new component within 2 days.		

Table 28 - Quality Attribute Scenario 3

Title: System response time		ID: QAS3	Version: 1
			Updated: 25/08/12
Quality Attribute: Performance		Characterization ID: QA3	
Active Stakeholders: Developers, Owner		Priority(0-3): 3	
		Difficulty(0-3): 2	
Stimulus Source	Database Administrator		
Stimulus	Several users request data		
Environment	System Normal Operation / Stress Operation		

Artifacts	System Data Management API
System Response	System replies with some answer.
Response Measure	Any response should be given to users within 2 secs (max).

Table 29 - Quality Attribute Scenario 4

Title: Ensure moving of system components to other servers.		ID: QAS4	Version: 1
			Updated: 25/08/12
Quality Attribute: Availability / Scalability		Characterization ID: QA4	
Active Stakeholders: Developers, Owner		Priority(0-3): 3 Difficulty(0-3): 2	
Stimulus Source	Database Server has only 25% of storage capacity remaining.		
Stimulus	Database administrators want to move database to other server.		
Environment	Normal Operation		
Artifacts	System Data Management API		
System Response	System should keep normal functioning and new change should be done on-the-fly.		
Response Measure	System should not exceed a 5 seconds down-time while changing Data servers.		

Table 30 - Quality Attribute Scenario 5

Title: Ensure system availability if platform components temporarily fail.		ID: QAS5	Version: 1
			Updated: 25/08/12
Quality Attribute: Availability		Characterization ID: QA5	
Active Stakeholders: Developers, Owner		Priority(0-3): 3	
		Diffculty(0-3): 2	
Stimulus Source	Database Server Failed.		

Stimulus	Users still want to use the system
Environment	Degraded Operation
Artifacts	System
System Response	System runs in failsafe mode.
Response Measure	System should inform users about the temporary low availability of functionalities.

Table 31 - Quality Attribute Scenario 6

Title: Ensure any editing is done only by authorized users.		ID: QAS6	Version: 1
			Updated: 25/08/12
Quality Attribute: Security		Characterization ID: QA6	
Active Stakeholders: Developers, Owner		Priority(0-3): 1	
		Difficulty(0-3): 2	
Stimulus Source	Non-authenticated users try to edit things.		
Stimulus	All system editing services		
Environment	Normal Operation		
Artifacts	System Login Management		
System Response	System automatically blocks non authenticated users from editing.		
Response Measure	Any unauthorized editing is informed by the system to the user.		

II.3. Functional Requirements (FR)

Following we present a list of functional requirements, which reflect the correct behavior of our prototype.

Table 32 – Functional Requirements

ID	R. UC	Description	Prior.	Ver.	Updated
FR1	UC4	The system shall allow only <u>one</u> category to be <u>assigned</u> to an activity.	3	1	28/08/12

FR2	UC4	The System shall <u>query</u> the user for an activity category, when creating a new activity.	3	1	28/08/12
FR3	UC4	The System shall <u>query</u> the user for an activity description when creating a new activity.	3	1	28/08/12
FR4	UC4	The system <u>shall</u> set an activity start time with the data management system clock time, at the time of the creation.	3	1	28/08/12
FR5	UC16	The System shall be able to <u>load</u> and display categories datasets from the wiki.	3	1	28/08/12
FR6	UC5	The system shall <u>query</u> the user to save a new region	2	1	28/08/12
FR7	UC25	The system shall allow any user to edit the Wiki and add <u>guiding instructions</u> for each category, reflecting changes on-the-fly.	2	1	28/08/12
FR8	UC1	The system shall <u>query</u> and force users to enter a communication detail when registering an account. (e.g. phone number)	3	1	28/08/12
FR9	UC4	The system shall allow creation of activities <u>only by registered users</u> .	3	1	28/08/12
FR10	UC26	The system shall allow any user to <u>view activities</u> .	2	1	28/08/12
FR11	UC20 UC26	The system shall <u>access</u> database information data via API's.	2	1	28/08/12
FR12	UC17	The system shall <u>allow</u> any user to <u>export</u> any activity or deployment to social networks (Facebook).	2	1	28/08/12
FR13	UC4	The system shall only <u>use</u> the data management system clock time to perform editing tasks.	3	1	28/08/12
FR14	UC4 UC5	The data management system shall <u>set</u> a unique identifier to any created element.	1	1	28/08/12
FR15	UC4 UC5	The system shall <u>allow</u> deployment owners to access a back office page.	2	1	28/08/12
FR16	UC18	The system shall <u>allow reuse</u> of user-created	3	1	28/08/12

		regions between different instances.			
FR17	UC4 UC21	The system shall visually <u>enhance</u> newly created activities.	2	1	28/08/12
FR18	UC20	The system shall <u>auto-remove</u> created deployments after 2 months of non-activity.	1	1	28/08/12
FR19	UC6	The system shall <u>adapt</u> the map view scale according to the user location query.	2	1	28/08/12
FR20	UC16 UC20	The system shall <u>store</u> and <u>display</u> exact geographic position of a deployment.	2	1	28/08/12
FR21	UC18	The system shall allow <u>updating</u> a deployment with additional information.	1	1	28/08/12
FR22	UC4 UC5 UC11	The system shall <u>allow</u> only registered users to <u>perform</u> any data editing tasks (except editing the wiki).	3	1	28/08/12
FR23	UC20	The system shall <u>display</u> a resumed list of all deployments.	2	1	28/08/12
FR24	UC26 UC20	The system shall not <u>require</u> any registration to be used in anonymous mode.	2	1	28/08/12
FR25	UC27	The system shall <u>display</u> user-added locations names on map.	2	1	28/08/12
FR26	UC28	The system shall allow users to <u>select</u> a map type according to user preference	2	1	28/08/12
FR27	UC7 UC8	The system shall allow users to <u>generalize</u> and <u>simplify</u> map details.	3	1	28/08/12
FR28	UC12	The system shall <u>provide</u> users with controls to zoom + pan the map for assisting map navigation.	2	1	28/08/12
FR29	UC28	The system shall <u>provide</u> users with map overlay layers <u>selection</u> control.	1	1	28/08/12
FR30	UC3	The system shall <u>allow</u> users to <u>login</u> with their Facebook account.	1	1	28/08/12
FR31	UC10	The system shall provide <u>capability</u> of marking	2	1	28/08/12

		an activity as solved.			
FR32	UC9 UC22	The system shall <u>track</u> the users which have responded to an activity.	2	1	28/08/12
FR33	UC13	The system shall <u>have</u> the capability of connecting to an external wiki for loading past deployments.	1	1	28/08/12
FR34	UC14 UC15	The system shall <u>have</u> capability of <u>sending</u> emails to users who have subscribed to deployment updates.	1	1	28/08/12
FR35	UC19	The system shall have <u>capability</u> of paper color printing the map with legend.	2	1	28/08/12
FR36	UC23	The system shall allow any user to <u>view</u> wiki added safety instructions when browsing activities.	1	1	28/08/12
FR37	UC24	The system shall <u>query</u> user for assigning an activity to a region, when users create new activities over user created locations.	1	1	28/08/12
FR38	UC3 UC2	The system shall <u>simultaneously support</u> both Facebook and internal system login.	2	1	28/08/12

II.4. Non-Functional Requirements (NFR)

Following we present a list of non-functional requirements, which reflect the qualities of our prototype regarding safety, usability, reliability and performance requirements.

Table 33 – Non-Functional Requirements

ID	Description	Prior.	Ver.	Updated
NFR1	The Data Management System shall have an <u>availability</u> of 90%.	3	1	28/08/12
NFR2	The system architecture shall allow easy <u>future adaptation</u> for iOS and Android mobile platforms.	3	1	28/08/12
NFR3	The system shall support deployments in <u>multi-contextual</u> environments. (emergencies and everyday volunteer efforts)	3	1	28/08/12
NFR4	The system shall be able to <u>handle</u> at least <u>100</u> daily	3	1	28/08/12

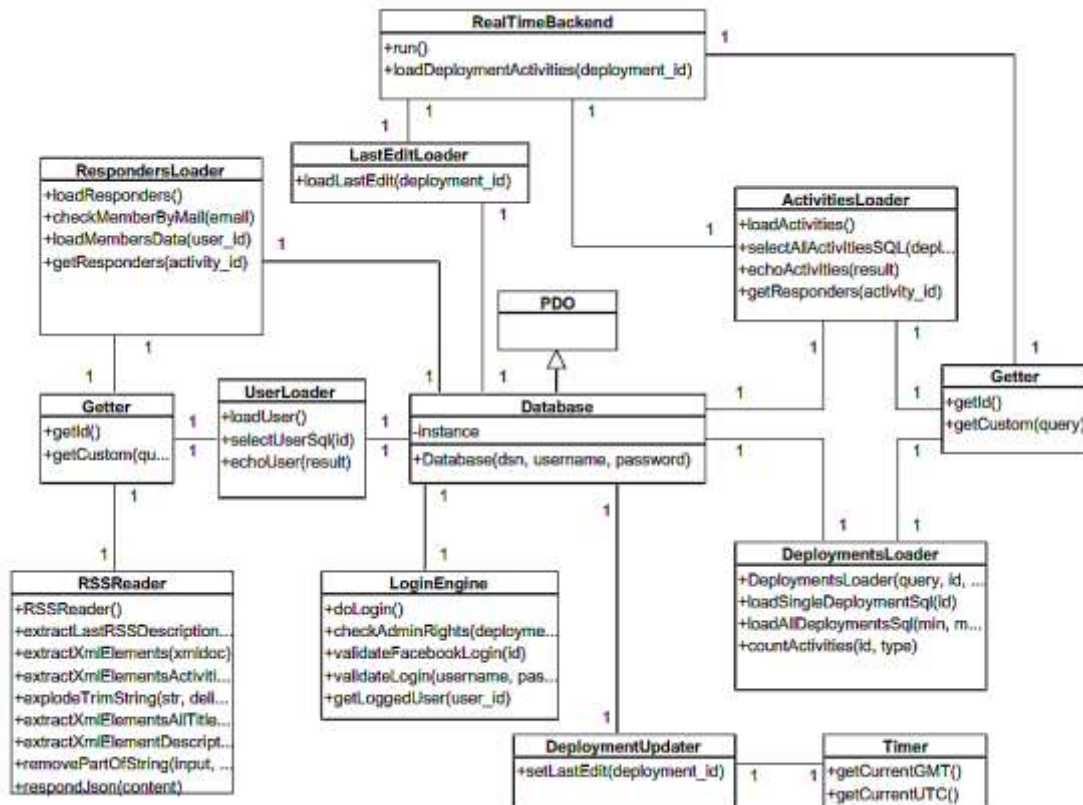
	visits.			
NFR5	The system shall be able to <u>handle</u> at least 2 <u>users</u> simultaneously (prototype environment).	2	1	28/08/12
NFR6	The system should <u>store</u> and <u>load</u> data from a Web Service API.	2	1	28/08/12
NFR7	Development process should take into account the <u>needs of victims</u> and volunteers as well as those of professionals.	2	1	28/08/12
NFR8	The system shall be <u>developed</u> with an ad-hoc purpose created framework (prototype environment).	2	1	28/08/12
NFR9	The system shall use a <u>contrast</u> driven coloring of symbols on map.	2	1	28/08/12
NFR10	The system shall provide a map <u>legend</u>	2	1	28/08/12
NFR11	The system shall Inform about <u>map</u> scale and coordinates.	2	1	28/08/12
NFR12	The system shall Inform about server time-zone <u>clock</u> .	1	1	28/08/12
NFR13	The system shall allow <u>start</u> & <u>play</u> (doesn't require any backgrounds)	2	1	28/08/12
NFR14	The system shall have a user's <u>login control</u> management module to prevent "players" on the system.	1	1	28/08/12
NFR15	The system <u>architecture</u> shall be designed using MVC architectural style.	3	1	28/08/12
NFR16	The data management system shall use a MySQL DMBS.	2	1	28/08/12
NFR17	The system shall be compatible with Mozilla Firefox and Google Chrome web browsers.	2	1	28/08/12
NFR18	The system shall allow at least 50 registered users in database.	2	1	28/08/12
NFR19	The system shall allow creation of at least 10 deployments.	2	1	28/08/12
NFR20	The system shall be developed using only open-source technologies.	3	1	28/08/12

ANNEX III. PROTOTYPE DEVELOPMENT

III.1.Class Diagrams (UML)

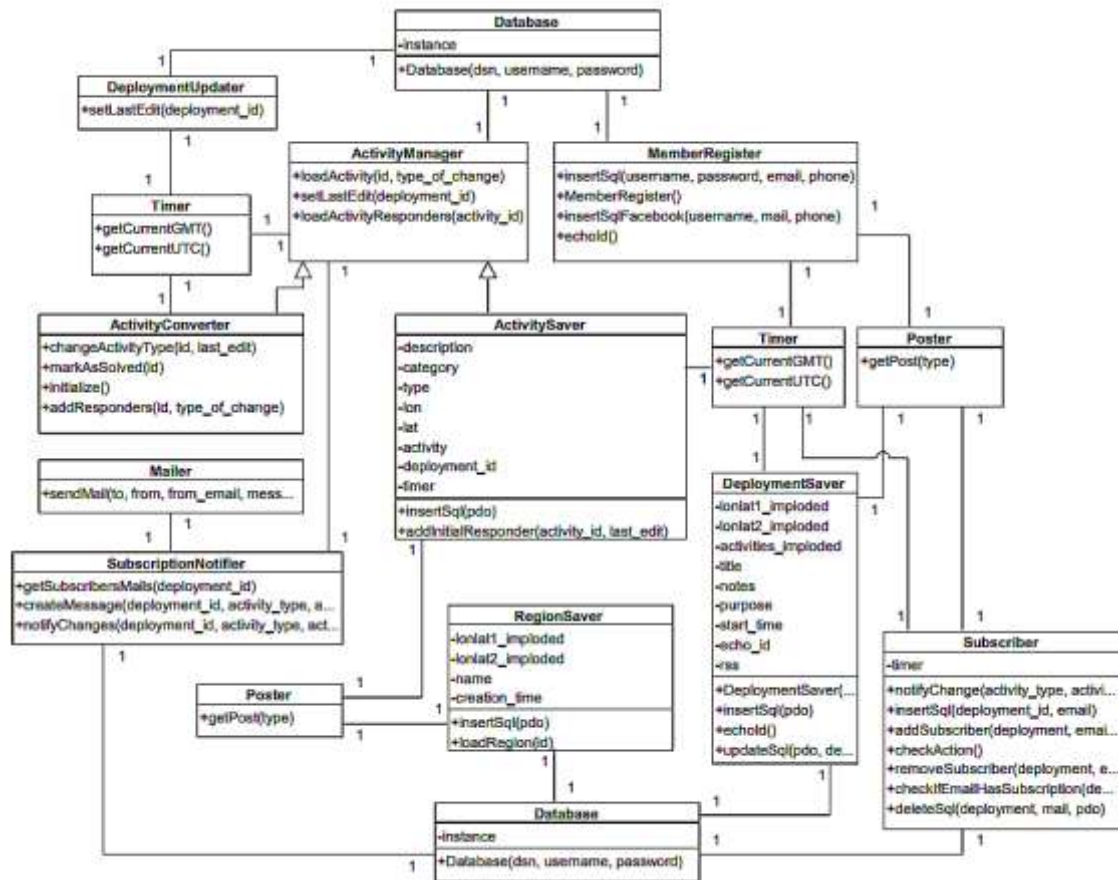
III.1.1. Web service (Part 1)

Figure 44 – web service Class Diagram (Part 1)



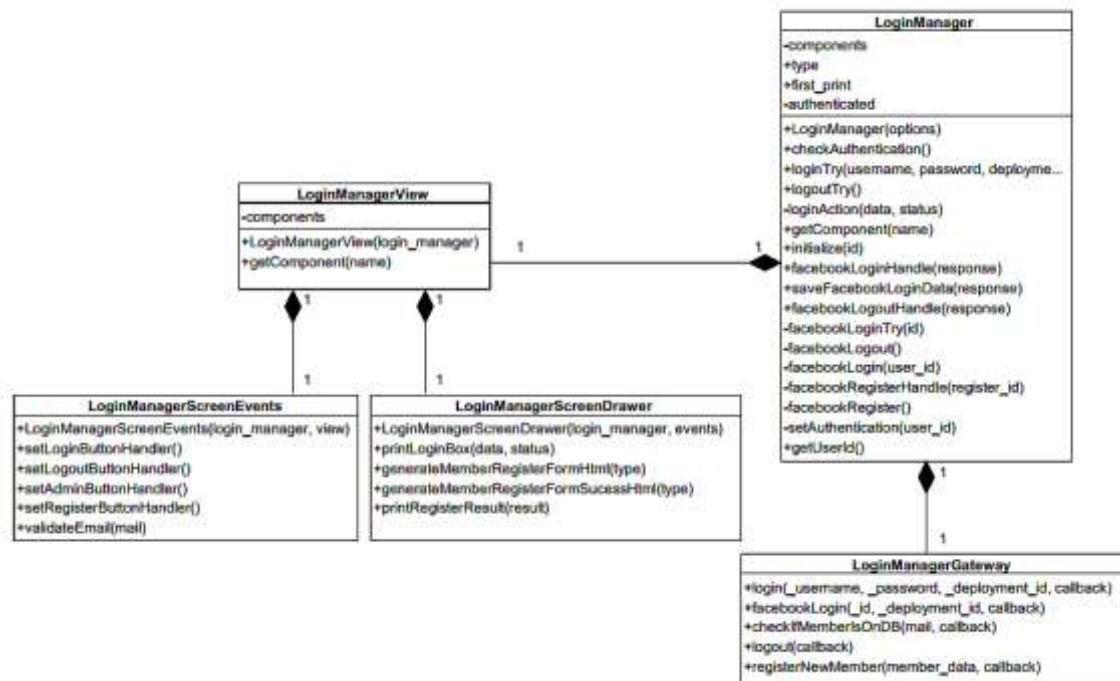
III.1.2. Web service Class Diagram (Part 2)

Figure 45 - Web service Class Diagram (Part 2)



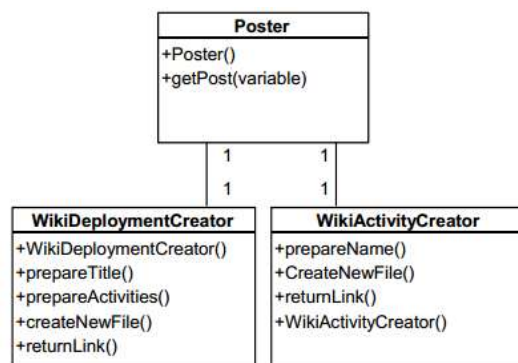
III.1.3. Login Manager API Class Diagram

Figure 46 – Login Manager API Class Diagram



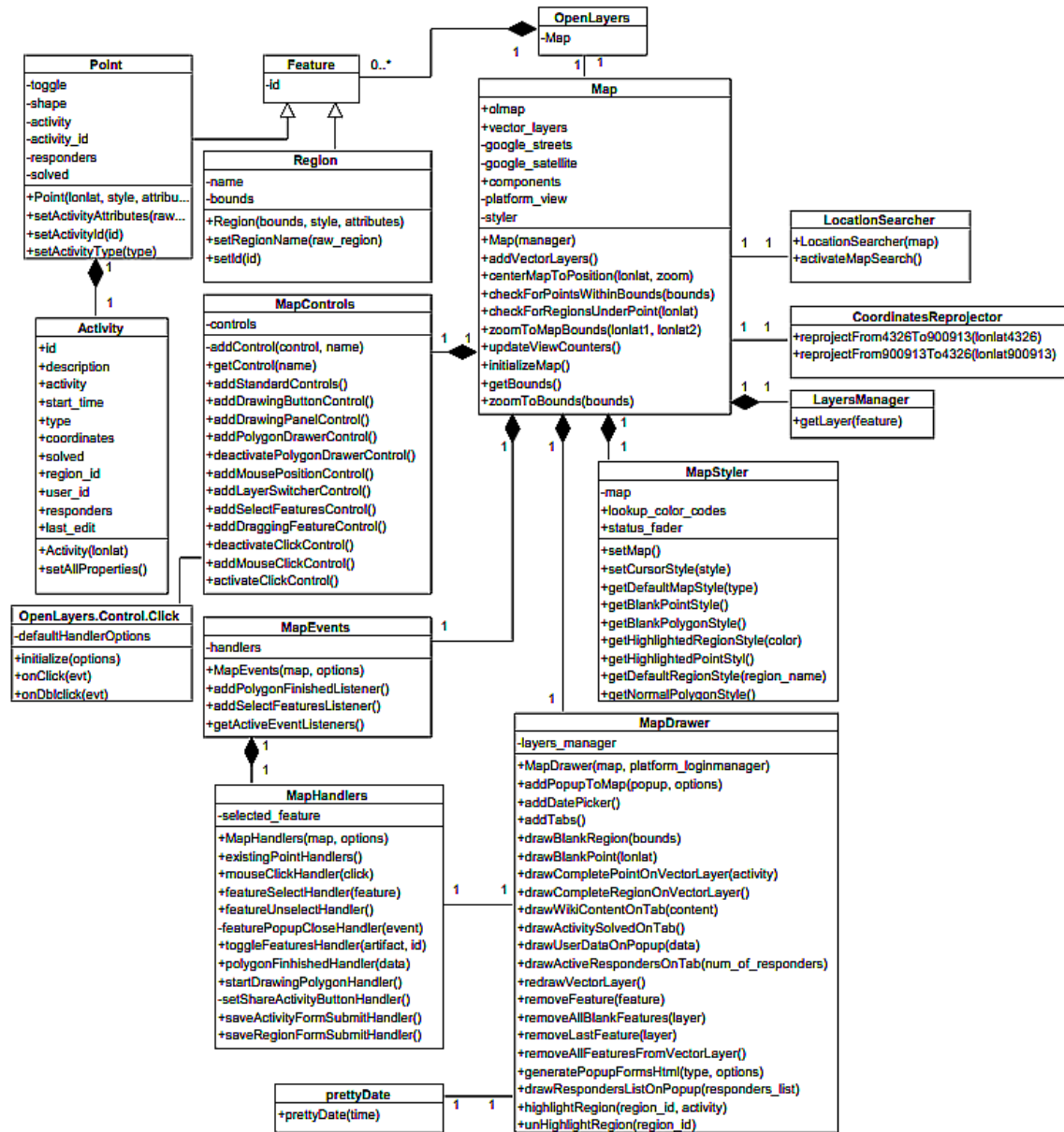
III.1.4. Wiki API Class Diagram

Figure 47 – Wiki API Class Diagram



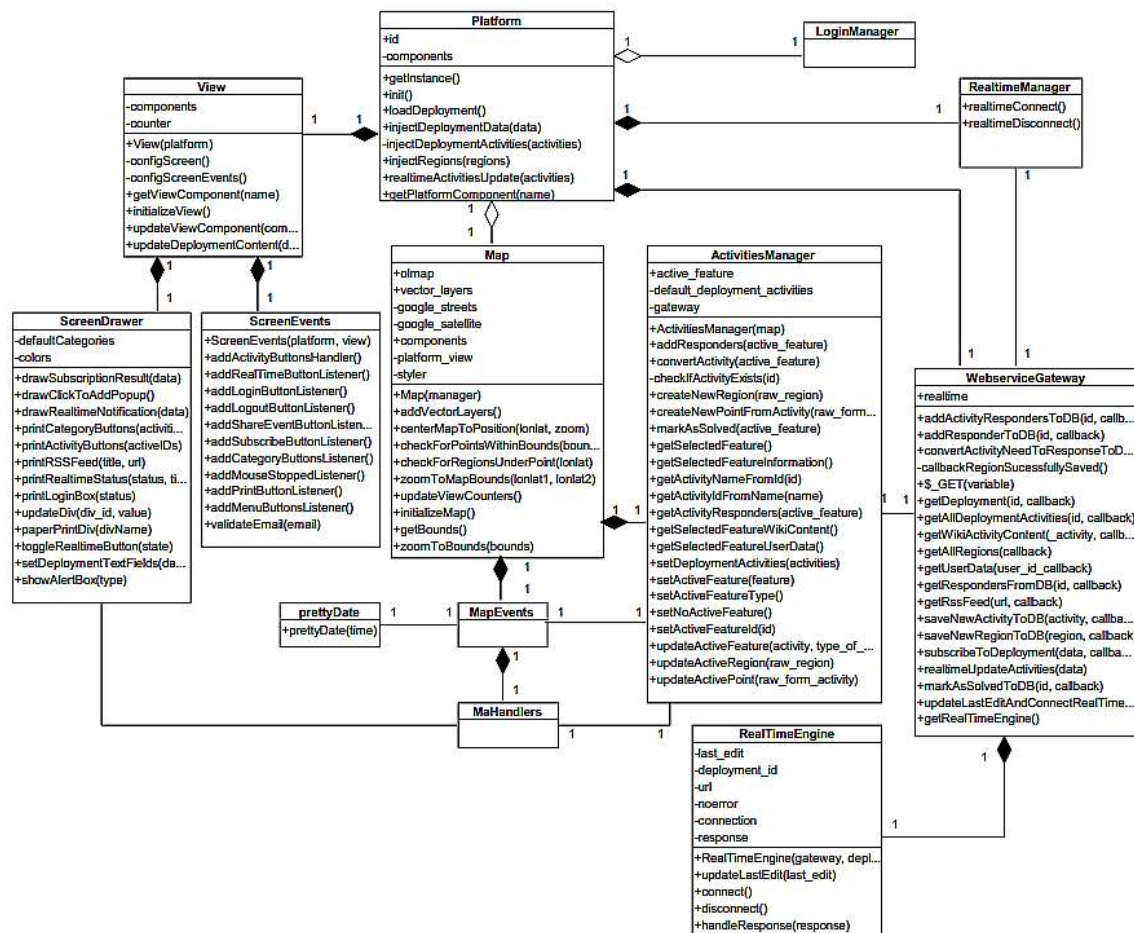
III.1.5. Map API Class Diagram

Figure 48 – Map API Class Diagram



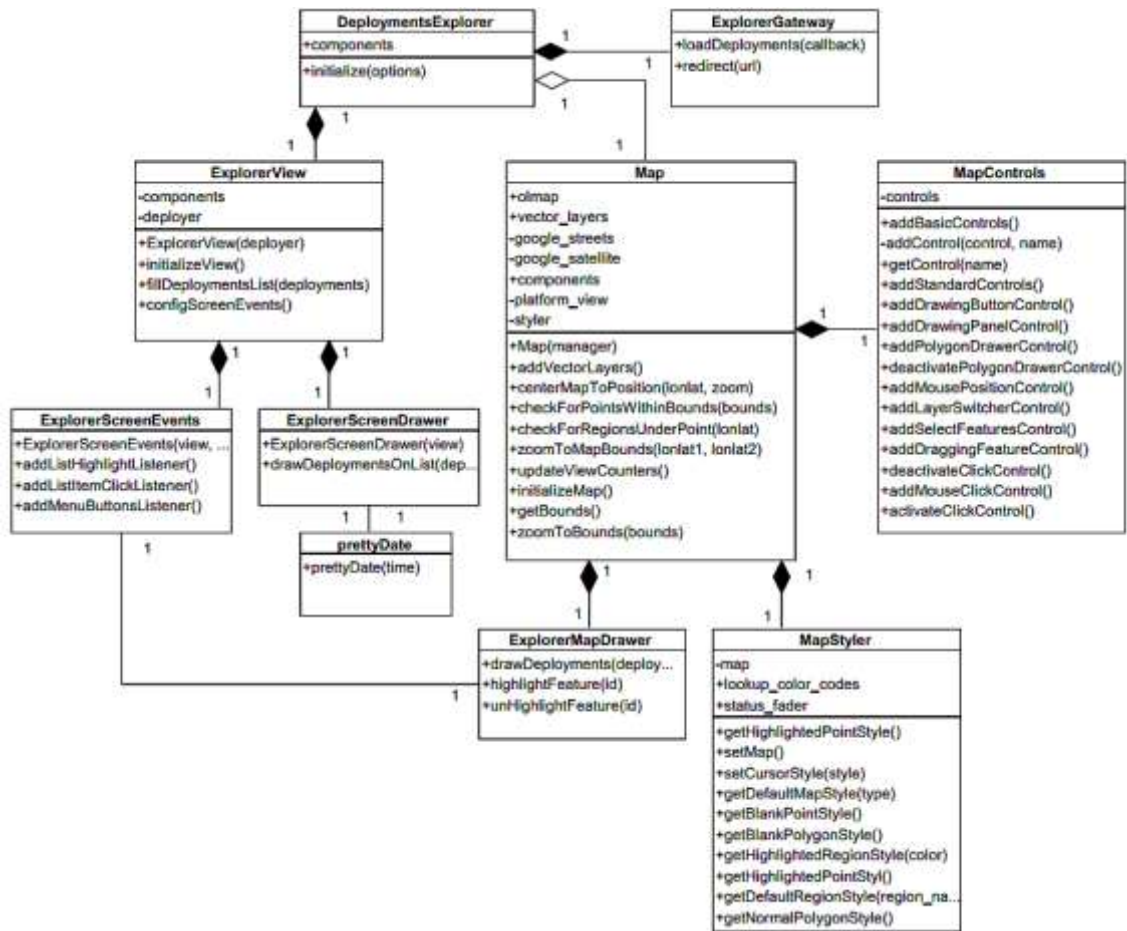
III.1.6. Application – Platform Class Diagram

Figure 49 – Platform Class Diagram



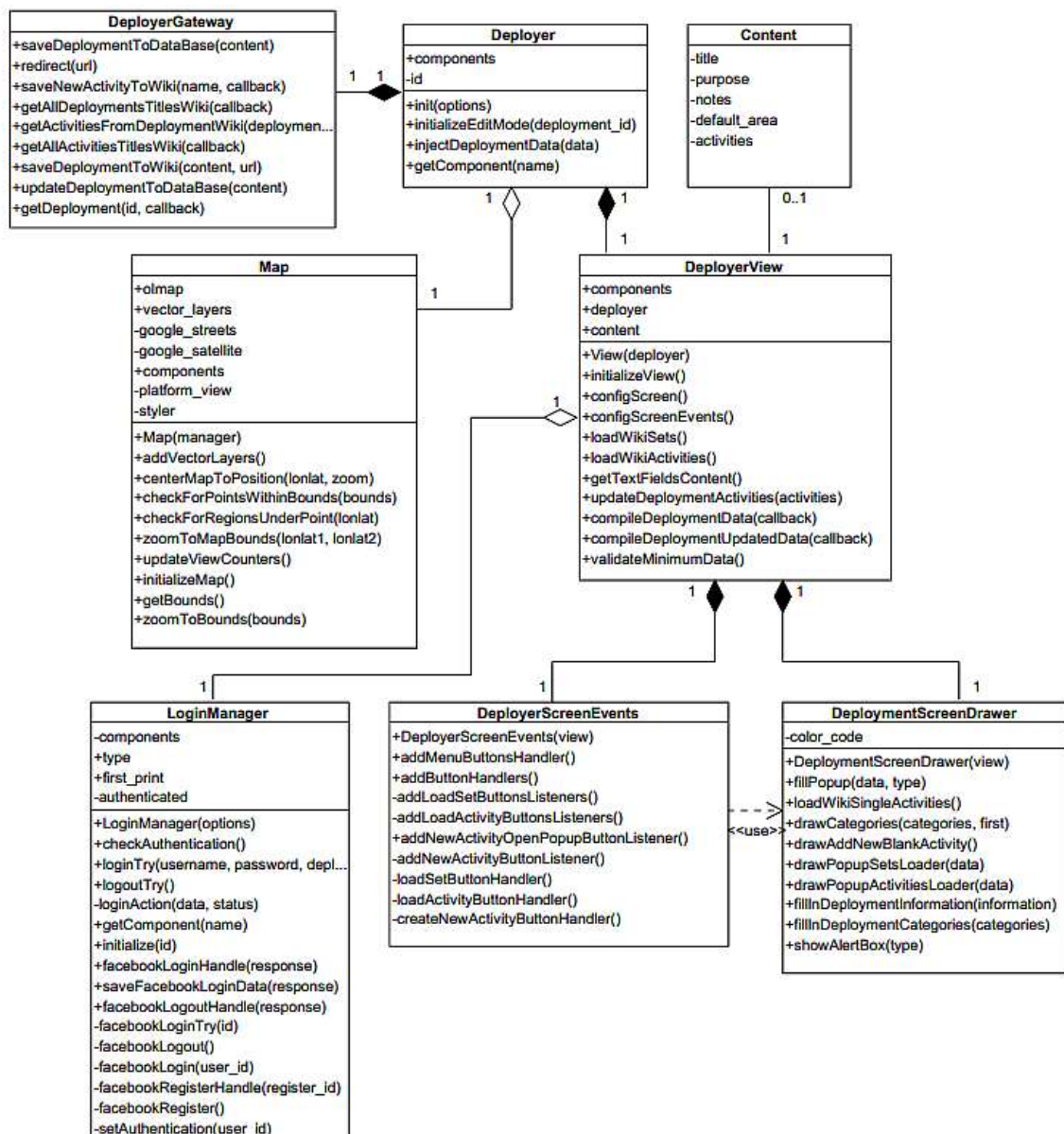
III.1.7. Application – Explorer Class Diagram

Figure 50 – Explorer Class Diagram



III.1.8. Application – Deployer Class Diagram

Figure 51 – Deployer Class Diagram



III.2. Use Case Diagram

Figure 52 – Use Case Diagram

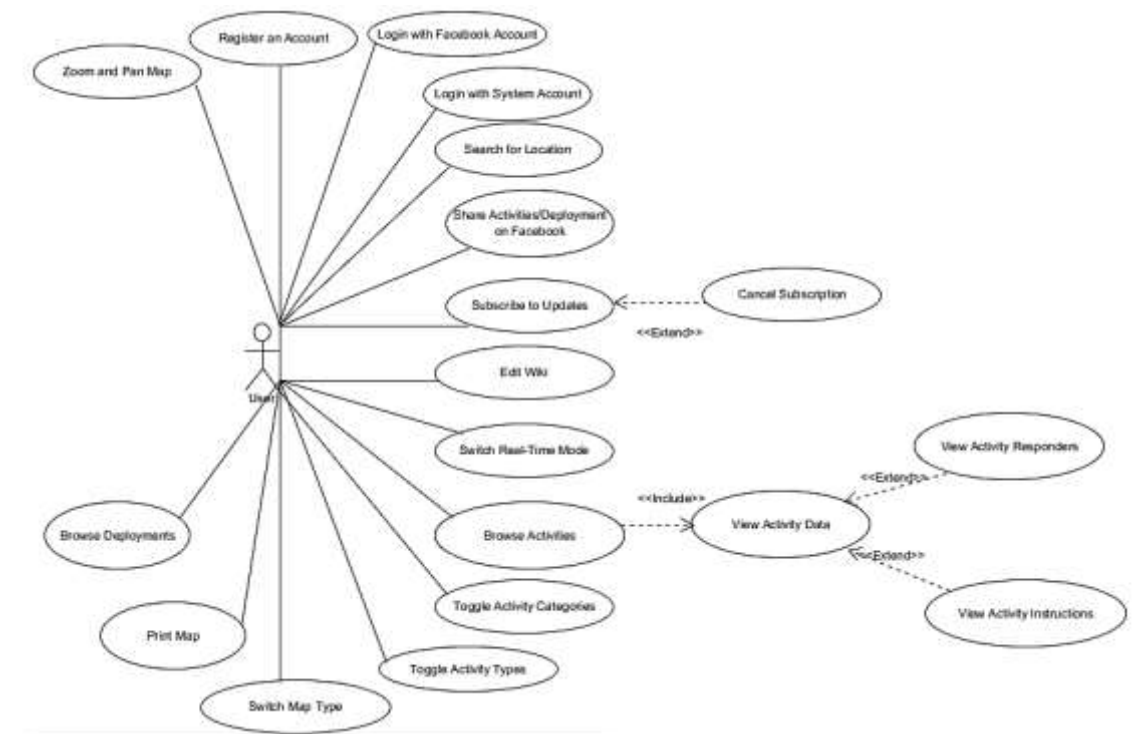
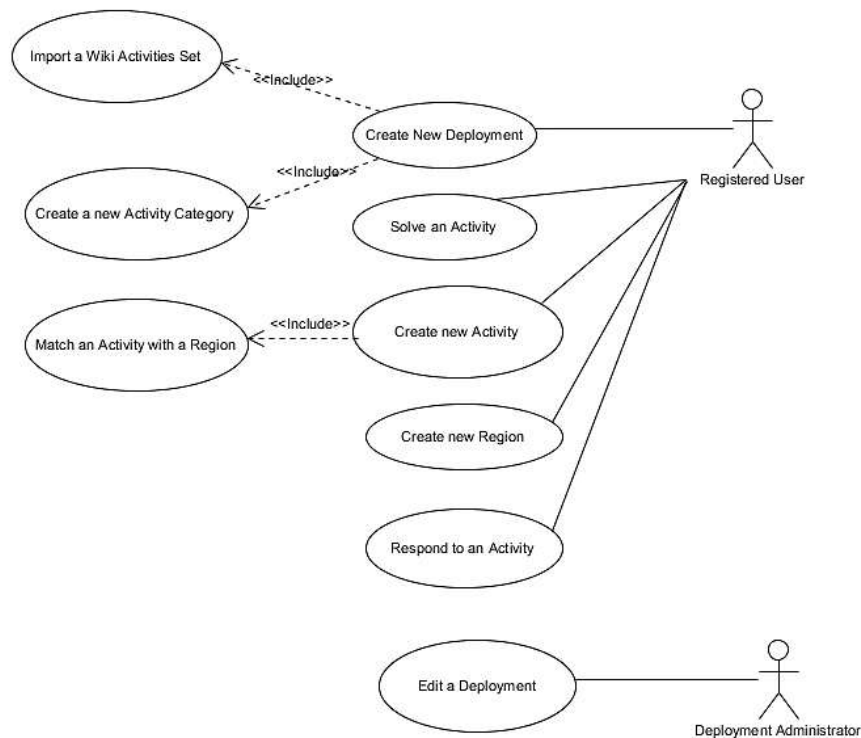


Figure 53 – Use Case Diagram (part 2)



III.3.Database ER Diagram

Figure 54 – Entity Relationship Model (ER)



III.4.External Dependencies (licenses)

III.4.1. Libraries

The prototype was built with the support of some external libraries which are presented in the following list:

Table 34 – Prototype External Libraries Licensing

Library	Version	Usage/Description	License
jQuery	1.7.1 (min)	Used to support user interface interactions	MIT and GPL licenses
jQueryUI	1.8.13 (min)	Used to support interface usability and design	MIT and GPL licenses

OpenLayers	2.12	Used as a map engine of the platform	Proprietary
Google Maps API	3.2	Used to support world location searching Used to provide world map image tiles (base map layer)	Free Service * our service must be free
Pretty Date	1.0	Used to convert ISO time to string representing how long ago the date represents	MIT and GPL licenses

All of the licenses related to the used external libraries do not present any special limitation against the usage of them in our prototype. Common limitations as not removing the author's identification on the library headers were followed.

III.4.2. Components

The prototype's Wiki was built with the support of an open source wiki *Dokuwiki* (DokuWiki, 2012). This wiki is open-source, so there are no implicit limitations against its usage in our prototype.

III.5.Data Types

The prototype contains several data types which were identified and inferred from field researches.

III.5.1. BNF Data Dictionary

Following we present a table with the main data types present in the prototype.

Table 35 – BNF Data Dictionary

Artifact	BNF Description
Platform Activity	Activity ::= [“need” “response”] Activity_Description ::= string Activity_Type ::= string
Platform Time (UTC) (2012-08-25T21:43:51)	Time ::= {digit} ⁴ ₄ , ‘-’, {digit} ² ₂ , ‘:’, {digit} ² ₂ , string, {digit} ² ₂ , ‘:’, {digit} ² ₂ , ‘-’, {digit} ² ₂

III.5.2. Wiki Activities Data Template

The wiki also contains a template for instructions editing, which was adapted from the local authority (Civil Defense of Madeira) advices that cooperated in our field researches. The template was highly influenced by emergency flyers which are distributed to population. Please check the annexes of this thesis for a screen of one of the flyers. Following we present the created template.

- **Instructions**

Bullet List with a maximum of 5 items, short lengthen to a maximum of 100 characters with easy to understand English actions.

- **Equipment**

Bullet list with a maximum of 3 items, short lengthen to a maximum of 100 characters which shows the equipment which volunteers should take with them.

- **Evacuation**

Bullet list with a maximum of 3 items short lengthen to a maximum of 50 characters which shows what to do in case of danger (evacuation required).

Figure 55 – Wiki instructions example (Activity – Fire Extinguish)

Instructions
<ul style="list-style-type: none">▪ Alert neighbours.▪ If you are not in danger, try to extinguish fire with hand-tools.▪ Wet walls and plants around you▪ Be alert and inform people which are taking risky behaviors.▪ Cut off any electricity or gas source nearby.
Equipment
<ul style="list-style-type: none">▪ Water can▪ Shovel
Evacuation
<ul style="list-style-type: none">▪ Run against the wind direction▪ Guard yourself in an area with water and low plants.▪ Wet yourself with water

III.6.Coding Practices

Following we present an example of how we have created our JavaScript classes.

Figure 56 – JavaScript class example

```
// CLASS =====  
function Class(options) {  
  
    // Properties  
    var options = options || {};  
  
    var components = {  
        component1: new Component1(this),  
        component2: new Component2(this)  
    };  
  
    this.public_property = "property";  
    var private_property = null;  
  
    // Methods  
    this.getComponent = function(component_name) {  
        return components[component_name];  
    }  
  
    this.public_method = function(parameter) {  
  
    }  
  
    var private_method = function(parameter) {  
  
    }  
}
```

In this example of the JavaScript class construction it's possible to observe how we have created of public and private fields and the instantiation of classes (check the components property).

Following we present an example of how we have created our PHP classes.

Figure 57 – PHP Class example

```
// CLASS =====
class ClassExample {

    // Properties
    public $public_property;
    private $private_property;

    // Constructor
    public function __construct($parameter1,$parameter2) {
        $this->public_property = $parameter1;
        $private_property = $parameter2;
    }

    // Methods
    // -----
    public function publicMethod($parameter) {
        $this->privateMethod($parameter);
    }

    private function privateMethod($parameter) {
        echo $parameter;
    }
}

$example = new ClassExample(1,2);
$example->publicMethod(3);
```

Analogous to the JavaScript example, in this one it's possible to observe how we have created of public and private fields, methods and the instantiation of PHP classes.

III.7.Installation Guide (Instructions)

1. Extract and Install Wiki

- 1.1. Extract 'wiki.tar.gz' contents to a temporary folder
 - 1.1.1. Execute command under Unix/Linux: "tar -xvf wiki.tar.gz"
- 1.2. Copy folder 'dokuwiki-2012-01-25a' to your Apache Server
 - 1.2.1. Run 'dokuwiki-2012-01-25a/install.php' and follow instructions (use defaults)
- 1.3. Copy files from folder 'api' to your 'dokuwiki-2012-01-25a/data/pages/' newly created folder
- 1.4. Run the newly copied file 'dokuwiki-2012-01-25a/data/pages/create_directories.php'
- 1.5. Ensure that the folder 'dokuwiki-2012-01-25a/data/pages/' is writable by your server
- 1.6. Wiki is Ready!

2. Setup Database

* Minimum Requirements: MySQL client version: 5.0.67, Apache Server, PHP5 or higher (with PDO Module)

2.1. Create a Database schema

2.1.1. Run MySQL command as super user: "mysql -u root -p"

2.1.2. Enter password (specified during MySQL server installation)

2.1.3. Run the following command: 'CREATE DATABASE hudumia;' to create an empty database

2.2. Create Hudumia database user

2.2.1. Run the following command: GRANT ALL ON hudumia TO user@'localhost' IDENTIFIED BY 'password'; and replace 'localhost' with the hostname or IP address of the server and replace user and password with one of your choice.

2.3. Create all Hudumia database tables

2.3.1. Extract 'mysql.tar.gz' contents to a temporary folder. That will extract a file containing SQL statements to create your database tables

2.3.2. Access MySQL from your command line.

2.3.2.1. In MySQL shell run the following command: 'mysql> \. hudumia.sql'

2.3.3. If you cannot access MySQL from the command line, please copy the text content from 'hudumia.sql', paste into MySQL's browser console and run it.

2.4. Hudumia database is set up!

3. Install Application Component

3.1. Extract 'application.tar.gz' contents your public html server folder

3.1.1. Execute command under Unix/Linux: "tar -xvf application.tar.gz"

3.1.1.1. You will see a directory named "hudumia" with all the application files inside. This will be your application access link:
"yourserver/udumia"

3.2. Hudumia Application component is installed!

4. Install WebService Component

4.1. Extract 'webservice.tar.gz' contents your hudumia root directory

- 4.1.1. Execute command under Unix/Linux: “tar -xvf application.tar.gz”
- 4.1.2. You will see a new directory called “webservice” in your hudumia root directory. The folder will now contain both Application and WebService components
- 4.2. Configure webservice to access your database
 - 4.2.1. Edit the file 'hudumia/webservice/database.php' with your MySQL database access Parameters (security).
- 4.3. Configure webservice to access your wiki
 - 4.3.1. Edit the file 'hudumia/webservice/config/wiki.cfg' with your Wiki server root link (e.g.. <http://hci.uma.pt/wiki/dokuwiki-2012-01-25a/>).
- 4.4. Hudumia webservice component is installed!

ANNEX IV. PROTOTYPE EVALUATION

IV.1. Nielsen Heuristics

The following heuristics were entirely copied from the author's website:

http://www.useit.com/papers/heuristic/heuristic_list.html.

Visibility of system status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom

Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

Consistency and standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Error prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

Recognition rather than recall

Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Flexibility and efficiency of use

Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Aesthetic and minimalist design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Help users recognize, diagnose, and recover from errors

Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

IV.2. Evaluation Scenarios

Following we present 2 realistic scenarios which were used to aid the performing of the usability evaluations. These scenarios reflect real situations where the system would be used. The evaluators didn't follow exactly the scenarios tasks, hence it only aided in non-clear situations where flow was interrupted due to lack of domain knowledge.

#1 - Creating a deployment about an on-going event

Table 36 – Scenario Task flow – Creating a deployment

Task 1	Go to the explorer view (home) Identify 'create new deployment' menu button
Task 2	Click on "Create new Deployment" menu button Wait while you are redirected
Task 3	Fill in the text information regarding your new deployment Only the title is required, others are optional
Task 4	Add activity types Create a new activity type Import a set of activities types from a past deployment

	Import a single activity type from past deployments
Task 5	Setup a location on map Input a location on search-box for easier searching Click on create deployment button Wait while you are redirected
Task 6	Login with Facebook Click Facebook login Introduce your Facebook login data Click accept for the application to access your Facebook email
Task 7	Create a region over the location you required to add needs Identify the region drawing control Click the drawing control Click and Hold while moving mouse over the map to draw the region Add a region name Click Submit
Task 8	Add an activity (need) out of that region Click on a location over the map Fill in the activity description Click 'Add' to add the activity
Task 9	Add an activity (need) to the created region Click over the region Fill in the activity description and mark "applies to region" Click 'Add' to add the activity
Task 10	Respond to a need Click over a newly created activity need Click respond
Task 11	Mark an activity as solved Click over a newly created activity response Click mark as solved
Task 12	Filter "Needs"

	<p>Click on the “Responses” filter button to hide the responses</p> <p>View the remaining needs on screen</p> <p>Check the counter</p>
Task 13	<p>Filter “Subscribe to Events”</p> <p>Add your email to event subscription email search field</p> <p>Click ‘Subscribe/Unsubscribe’ button</p> <p>Add a new activity on map</p> <p>Check your email</p> <p>Add your email again to event subscription email search field</p> <p>Click ‘Subscribe/Unsubscribe’ button</p> <p>Add a new activity on map</p> <p>Check your email</p>

#2 - Emergency professionals volunteer information gathering

Table 37 – Scenario Task Flow – Emergency professionals

Task 1	<p>Go to the explorer view (home)</p> <p>Identify active deployments near Madeira Island</p>
Task 2	<p>Click on the deployment under investigation</p> <p>Wait while you are redirected</p>
Task 3	<p>Identify Responses</p> <p>Show only “responses” by clicking on “needs” filter button</p> <p>Look for responses with more than 1 responder</p>
Task 4	<p>Click on a Response</p> <p>Note down the contact phone number and email of the creator</p> <p>Confirm total responders number</p> <p>Click on “View Responders”</p> <p>Note down the contact phone number and email of the responders</p>
Task 5	<p>Add instructions to a response activity type</p> <p>Click on a response</p> <p>Click on tab “Instructions”</p> <p>Click “See and Edit it on the Wiki”</p>

	Click the “Edit” button Fill in the template with safety instructions
Task 6	Close the wiki window Click on a response Click on tab “Instructions” Verify the added instructions
Task 7	Mark area as risky Login with the existing account or Quickly create a new account on the fly Identify the region drawing control Click the drawing control Click and Hold while moving mouse over the map to draw the region Add a region name “Risky Area – Do not Go” Click Submit
Task 8	Print Paper Map Zoom and pan to the location of the responders Click on “Paper Print” button
Task 9	Subscribe to deployment updates Enter the organization email on the subscribe input box Click on “Subscribe/Unsubscribe” button Wait for notifications

IV.3. Heuristic Evaluation Results

IV.3.1. Evaluator #1

This evaluator tested the system by performing the scenario “Create a deployment about an on-going event which has taken place”. Following we present a table with the evaluation results.

Table 38 – Usability Evaluation Results (Evaluator 1)

Issue - Description	Severity
<u>Visibility of system status</u> – After getting to deployment screen user lost	3

orientation about where they are in the system.	
<u>Visibility of system status</u> – Menu buttons are not elucidative. User couldn't figure out what they do.	3
<u>User control and freedom</u> – After entering the wiki there is no button to go back to the system.	3
<u>Aesthetic and minimalist design</u> – Button to add new categories is different than the standard button (others). Doesn't look like a button	1.5
<u>Match between system and the real world</u> – Language usage: “deployer” word is not clear enough.	1
<u>Consistency and standards</u> – In activity's panel identification is written 'Categories' and the buttons state 'Activities'. Not consistent	1
<u>Match between system and the real world</u> – Import buttons text is not clear and doesn't reflect what the actions which the buttons will perform.	2
<u>Flexibility and efficiency of use</u> - After creating an activity a popup window showed up in the middle of the screen with the wiki of that activity.	2.5
<u>User control and freedom</u> – Cannot click on already added activities while creating the deployment.	2.5
<u>Flexibility and efficiency of use</u> – Adding new activities pop-up dialog doesn't disappear after adding an activity.	2.5
<u>Flexibility and efficiency of use</u> – Enter key shortcut doesn't work for pop-up dialog buttons actions.	2
<u>Flexibility and efficiency of use</u> – List of activities requires scrolling down a lot to click on submit button.	3
<u>Aesthetic and minimalist design</u> – List of activities to import is too long to find a specific activity.	3
<u>User control and freedom</u> – Cannot undo or edit activities while creating the deployment.	3
<u>User control and freedom</u> – Login required just before submitting the data.	2.5
<u>Aesthetic and minimalist design</u> – Titles of containers have a too thin font. Difficult to read.	1

<u>Match between system and the real world</u> – Icon for creating regions is bad positioned and the chosen icon is not representative of its functionality.	1
<u>Aesthetic and minimalist design</u> – Add new activity pop-up dialog doesn't have a title.	1
<u>Flexibility and efficiency of use</u> – User doesn't have any button, neither instruction on how to create an activity.	2.5
<u>Match between system and the real world</u> – Regions vs. Activities relation is not clear enough.	2
<u>Aesthetic and minimalist design</u> – Create new activities popup dialog doesn't have a title.	2
<u>Aesthetic and minimalist design</u> – Mouse over a map activity doesn't show any information	2
<u>Aesthetic and minimalist design</u> – Filter buttons do not provide clear visual feedback of their action.	1.5
<u>Aesthetic and minimalist design</u> – Subscribe input field should be presented on pop-up after clicking and not always visible.	1
<u>User control and freedom</u> – Missing a default (non-categorized) activity.	2
<u>Aesthetic and minimalist design</u> – Real-time synchronization container title is not clear enough.	

IV.3.2. Evaluator 2

This evaluator tested the system by performing the scenario “Create a deployment about an on-going event which has taken place”. Following we present a table with the evaluation results.

Table 39 – Usability Evaluation Results (Evaluator 2)

Issue Description	Severity
<u>Aesthetic and minimalist design</u> – Popups don't have a title.	1
<u>Aesthetic and minimalist design</u> – Menu buttons don't have legends, it's not clear their functionality	2
<u>Aesthetic and minimalist design</u> – Draw region button leads to	3

misunderstanding. User tried to create activity with this button.	
<u>Aesthetic and minimalist design</u> – Location of create region button is not the appropriate	2
<u>Aesthetic and minimalist design</u> – Base layer switching button was not clear neither its icon is suggestible of the behavior.	1
<u>User control and freedom</u> – Popup boxes near map don't close when user clicks out-side the map	1
<u>Consistency and standards</u> – Filter activity types button is not clear enough due to the small images on it	1
<u>Match between system and the real world</u> – Column Text 'edit' in the explorer items list has not a clear meaning.	2
<u>User control and freedom</u> – Cannot undo a "respond" action over an activity	2
<u>Consistency and standards</u> – Maximum map zoom level is not high-enough resolution	1
<u>Flexibility and efficiency of use</u> – It's not clear to a user what real-time sync will do or why it should be turned off	2
<u>Aesthetic and minimalist design</u> – Wiki formatting is ignored in the pop-up window	2
<u>Aesthetic and minimalist design</u> – The pop-up window is incredibly small if people are supposed to read wiki content in it.	3
<u>Aesthetic and minimalist design</u> – The map feels cramped in size.	1
<u>User control and freedom</u> – Cannot pick the color of regions.	1
<u>User control and freedom</u> – There is no way to delete, rename or otherwise modify a region.	2
<u>User control and freedom</u> – Solved problems cannot be marked as unsolved again	2
<u>Aesthetic and minimalist design</u> – The red box-captions ("Toggle types", "Toggle activities", etc.) have a mouse-over effect, but nothing happens when I click them.	1

<u>Help and documentation</u> – No simple about-page or introduction is present. It's not clear to a new site visitor what this is	2
<u>Aesthetic and minimalist design</u> – Items on the map don't have a tool-tip showing their title. I got lost with so many items.	2

IV.3.3. Evaluator 3

This evaluator tested the system by performing the scenario “Emergency professionals volunteering information gathering”. Following we present a table with the evaluation results.

Table 40 – Usability Evaluation Results (Evaluator 3)

Issue Description	Severity
<u>Help and documentation</u> - Should have a help button or some explanation on the first page of the application	1
<u>User control and freedom</u> - Missing link to homepage by clicking on application logo	1
<u>Aesthetic and minimalist design</u> - The title of the event shouldn't be in the banner	1
<u>Flexibility and efficacy of use</u> - Notification popup boxes should disappear automatically.	2
<u>Aesthetic and minimalist design</u> - Filter activities buttons don't make clear if they are active or none.	3
<u>Visibility of system status</u> - When page refreshes, banner has the a default title (before the page is fully loaded)	2
<u>Aesthetic and minimalist design</u> - Draw region button doesn't have a tooltip description	1
<u>Aesthetic and minimalist design</u> - Layers button doesn't have a tooltip description	1
<u>Aesthetic and minimalist design</u> - Real-time connection title is not clear of its purpose	2
<u>Error prevention</u> - In the explorer if there are few markers close to each	3

other they appear overwhelmed.	
<u>Visibility of system status</u> – When activities are updated in real-time, user cannot clearly see which activity was updated.	3

IV.4. User Tests Results

The users test was performed with 2 emergency professionals from civil defense. They were presented with a realistic scenario to accomplish without any prior interface knowledge. Only a simple introduction on the system was done verbally. Following we present the scenario.

- **Persona:** created and personified by emergency professionals
- **Scenario:** You are an emergency professional and we are under an emergency scenario, the 20th February Madeira Floods, and you need to check if volunteers are safe and contribute to their safety.
- **Tasks**

Task 1: Find if there is any deployment regarding the floods in Madeira

Task 2: Find active volunteers on the floods scenario and note their locations

Task 3: Try to contact the creators of the responses or the first responders

Task 4: Contribute with instructions for activity 1 and activity 2 on the wiki.

- **Results**

The following usability problems list were compiled from the participant's comments and our observations regarding their actions while performing the tasks based on the triangulation technique by (Dumas & Redish, 1999).

Table 41 – User tests results

Usability Problem + Recommendation	Scope (0-local, 3-global)	Severity (0 – Low; 3- Critical)
Regions should not be universal, they should be related to unique deployments.	3	2
Deployments administrators should be able to delete regions.	2	2
Enter 'Key' should be working for all text	3	1

input fields.		
Wiki safety instructions updates should be included in the real-time notification system	1	2
Wiki editing should be limited to professionals.	1	1
Wiki features which don't need to be used should be hidden.	1	1
Login box should be present in all system screens.	3	1
Map layers icon is not representative of its behavior.	2	1
Menu bar is not visible enough	3	1
Real-time updates list should have more activities, and not limited to only 2.	1	2

ANNEX V. LOW-FIDELITY PROTOTYPE

Following we present the low-fidelity prototype images which were created just after the requirements engineering phase and served as a guide for the prototype interface design.

Figure 58 – Home screen

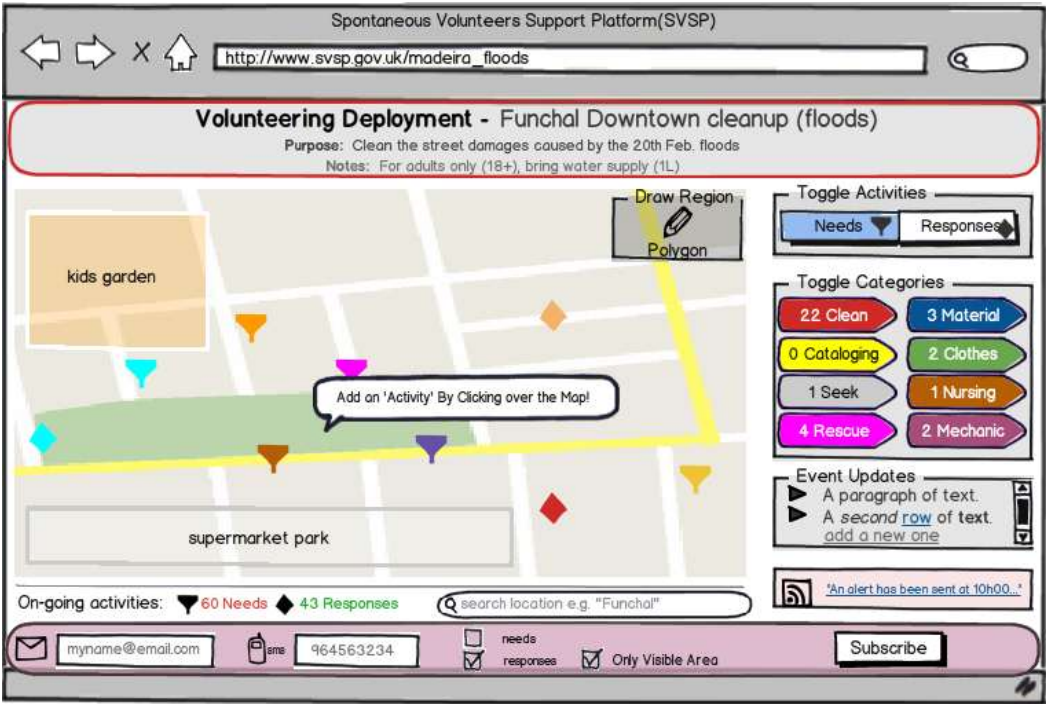


Figure 59 – Add activity via point screen

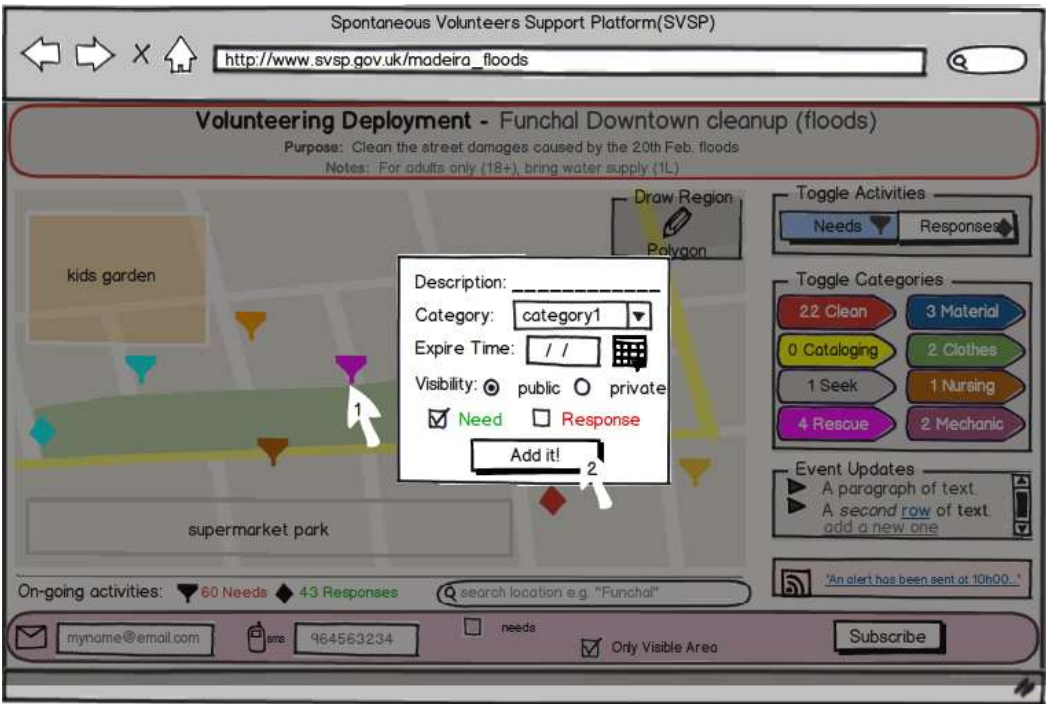


Figure 60 – Add activity via region screen

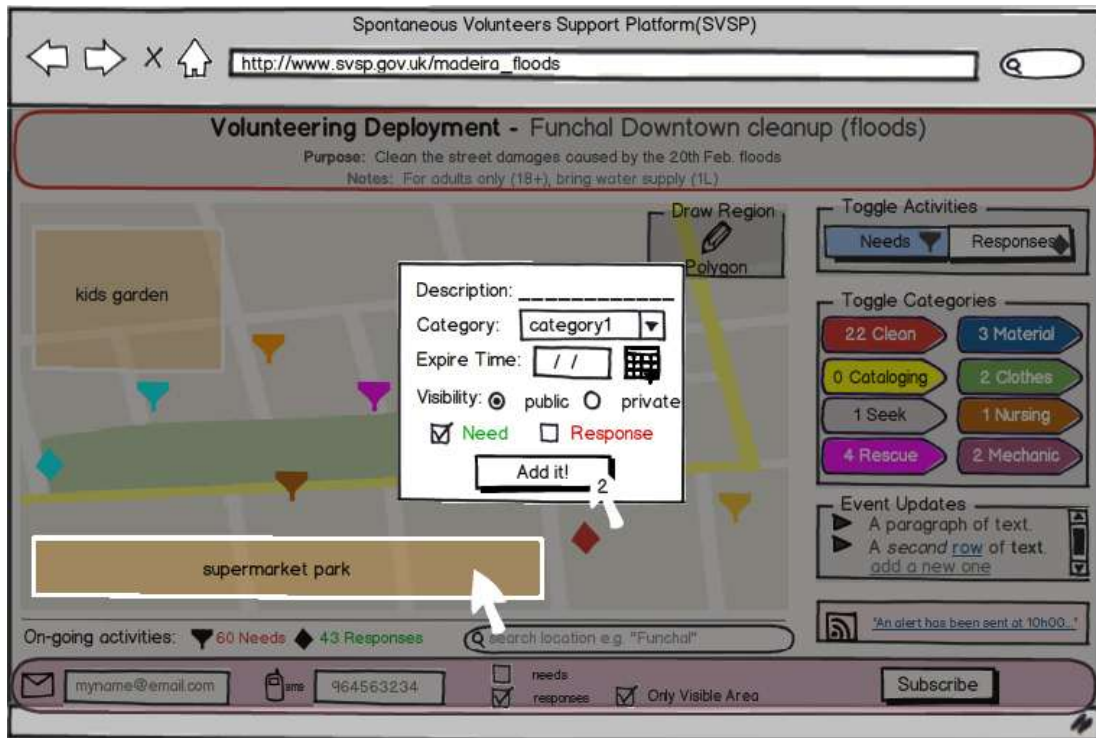


Figure 61 – Subscribe to deployment screen

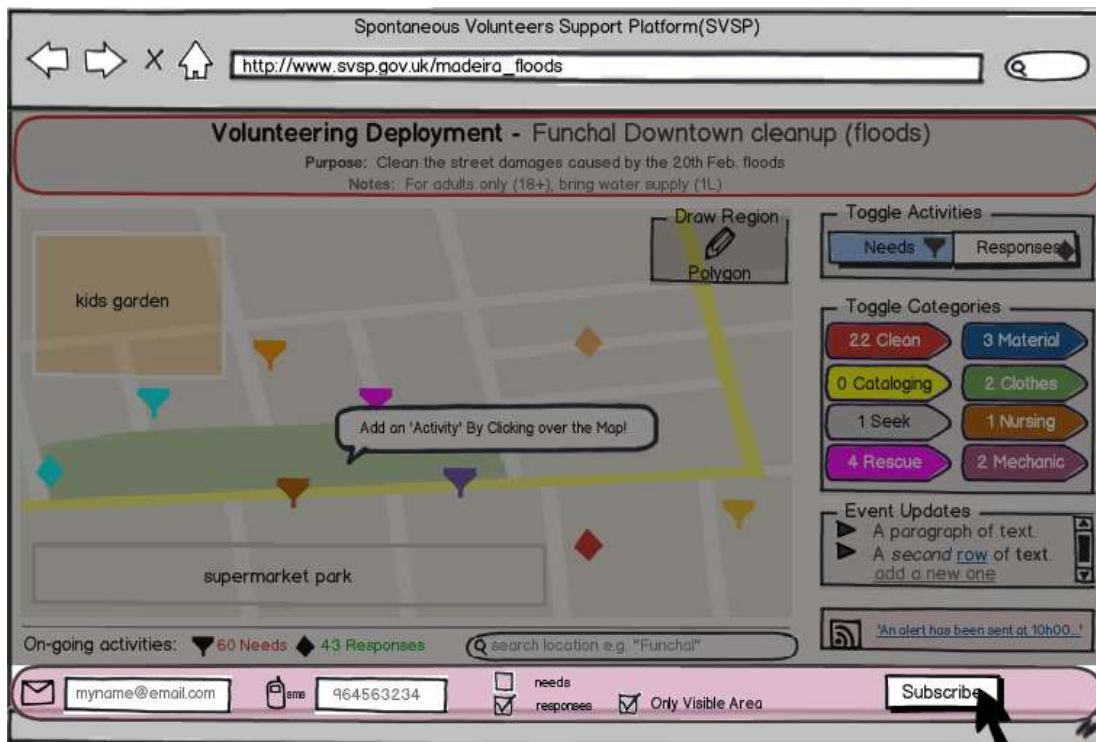


Figure 62 – Create region screen

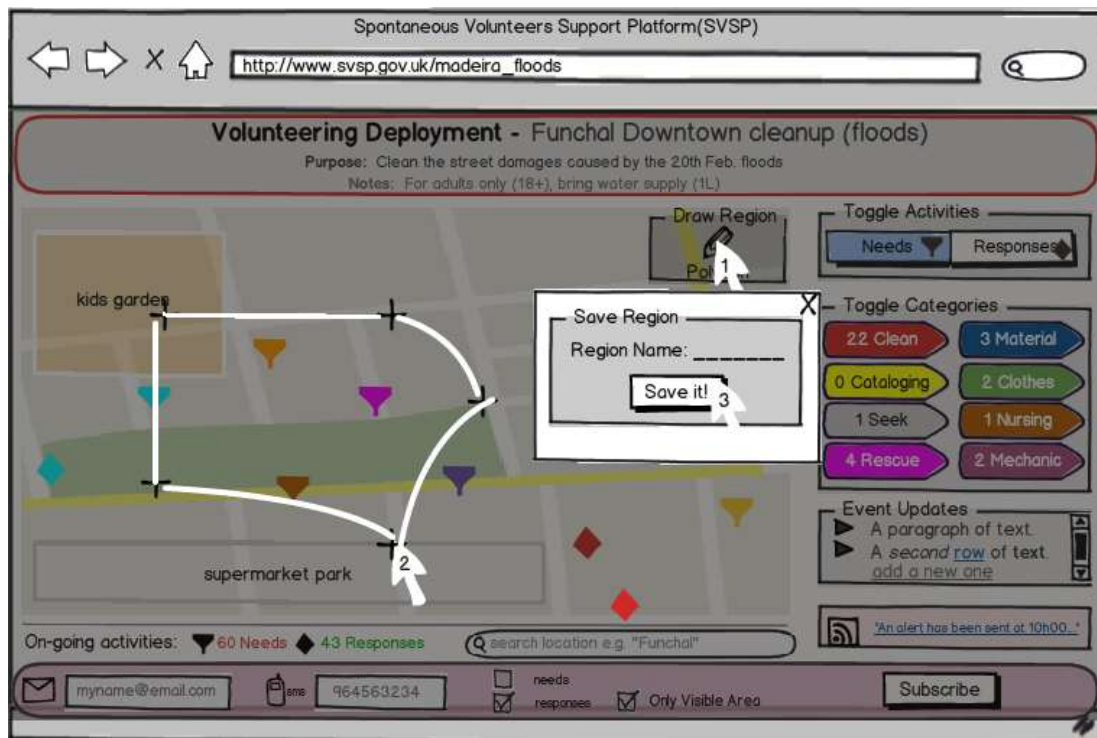


Figure 63 – Respond to need screen



Figure 64 – View safety instructions screen

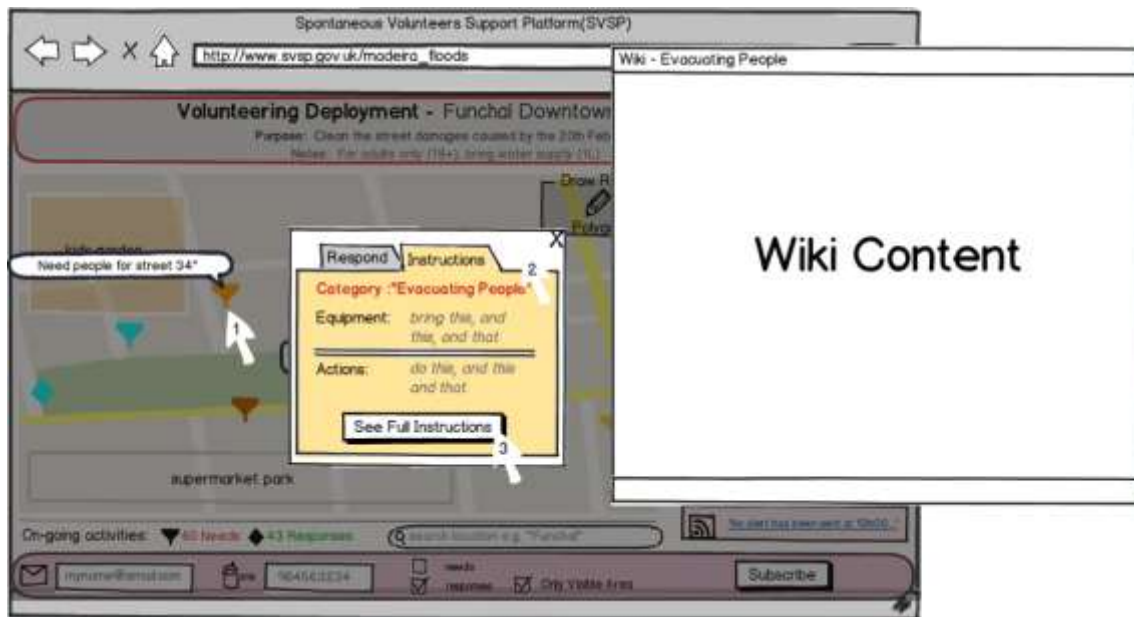


Figure 65 – Create deployment form screen

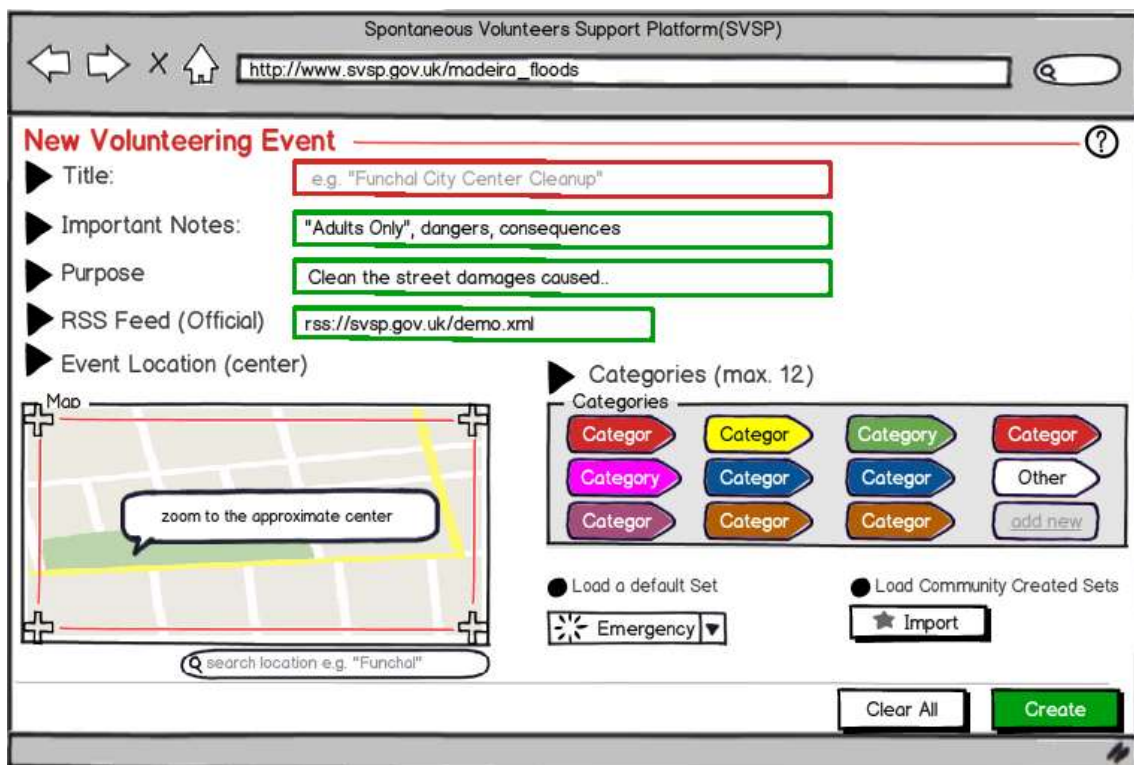


Figure 66 – Import category-set screen

Spontaneous Volunteers Support Platform(SVSP)

http://www.svsp.gov.uk/madeira_floods

New Volunteering Event

► Title: e.g. "Funchal City Center Cleanup"

► Important Notes: "Adults Only", dangers, consequences

► Purpose: Clean the street damages caused..

► RSS Feed (Official):

► Event Location (center):

Map

zoom to the appro

search location e.g. "Funchal"

Community Created Category-Sets *Wiki

► Select a Category-Set filter by keyword

- ☐ Floods
- ☒ (event)Funchal DownTown Cycling
- ☐ (event)Canary Islands Orienteering Meeting
- ☐ (event)Airplane Cleaning on Porto Santo

click to see on the wiki

Load

Category

Other

add new

Community Created Sets

Import

Clear All

Create

ANNEX VI. PROTOTYPE SCREENSHOTS

Figure 67 – Welcome Popup



Figure 68 – Explorer Screen



Figure 69 – Platform Screen

The screenshot shows the HUBUMIA Platform Screen for the event "Porto Santo extreme winds". The interface includes a header with the event title, purpose, and notes. A map of Porto Santo is displayed with a red pin indicating the location. A pop-up window shows details for a "radio_boats" activity, including its description, creation date, and creator contact. A table lists ongoing activities and real-time updates. The right sidebar contains filter types, filter activities, a time switch, a search for location, and official news.

Event: Porto Santo extreme winds
 Purpose: evacuate Porto Santo citizens from the island
 Notes: send private boats to evacuate citizens

Location

radio_boats (response)
 Description: 4 user have
 Created at: 2012-06-07 16:45:43 (8 days ago)
 Last updated at: 2012-06-07 16:46:03 (8 days ago)
 Created by: claudine...
 Creator Contact: 963495321
 Total Responders: 1 - [Click to view responses](#)

ON-GOING ACTIVITIES:
 4 needs 1 responses

REALTIME UPDATES:

ID	Type	Activity	Description	Responders	Started	Updated
56	need	radio_communications	send radio amateur boat	0	6 days	6 days ago
55	response	radio_boats	rescue radioer boat here	1	6 days	6 days ago

Filter types:
 - Needs
 - Responses

Filter activities:
 - radio_boats
 - radio_communications
 - truck_drive

Time switch:
 On Off
 connecto 2012-06-06T16:46:53

Search for location:
 Enter a location:

Official news:
 No Official RSS feed was set for this deployment

[yourmail@gmail.com](#) [Subscribe / Unsubscribe](#) [Share this event](#) [Print event map](#)

All timestamps are in UTC.

Figure 70 – Deployment Editing Console

The screenshot shows the HUBUMIA Deployment Editing Console for the event "Porto Santo extreme winds". The interface includes a header with the event title, purpose, and notes. A map of Porto Santo is displayed with a red pin indicating the location. The left sidebar contains information about the event, a list of activities, and buttons for adding new activities or importing existing ones. The right sidebar contains a search for location.

Event: Porto Santo extreme winds
 Purpose: evacuate Porto Santo citizens from the island
 Notes: send private boats to evacuate citizens

Location

Activities:
 Add new: radio_boats, radio_communications, truck_drive
 Import Existing Set: Import Single Activity

Save **Cancel Editing**

Search for a location:

All timestamps are in UTC.

Figure 71 – Deployment Creation Console

Figure 72 – Wiki Home Screen

Figure 73 – Wiki Activity Editing Screen



Figure 74 – Share Deployment on Facebook Screen



Figure 75 – Facebook Deployment Share





Figure 76 – Share event on Facebook screen

sail boats (response)
Instructions / Help

Description: 4 over here

f Publica no teu mural





We need your help to: sail boats
This activity is currently a: response
There are 1 volunteers on field helping on this activity
através da aplicação Volunteer Support.

*

Partilhar

Cancelar

REALTIME

Type	Activity	Description	Responders	Started	Updated
eed	radio_comunicators	one radio amateur here	0	6 days	6 days ago

VI.1. Prototype Usage Instructions

In order to allow any reader to understand the basics of working with the prototype without installing it or accessing it via: <http://dev.hci.uma.pt/~ctexeira/hudumia>, we have created several screens explaining it's basic functions.

VI.1.1. Explorer Component

In the following screen we present an overview of the explorer component and the available options on the screen.

Figure 77 – Explorer Screen Instructions



The screenshot displays the HUDUMIA explorer interface. At the top, a red banner contains the HUDUMIA logo and the word 'explorer'. Below the banner is a map of North Africa and the Middle East. A white text box with a black border is overlaid on the map, containing the text 'You can also click on the menu'. Below the map is a table with the following columns: ID, Title, Started at, Duration, Needs, Responses, Updated, and Active. The table contains several rows of event data. A mouse cursor is pointing at the row for 'Algarve summer bush fires' (ID 12). Below the table, a light gray box contains the following instructions:

1. Click over a deployment (event)
2. you will be redirected to that event page

VI.1.2. Platform Component

In the following figure we display most of the most used functionalities which are available on the main system screen (as known as platform), where you've been redirected to after clicking over a deployment on the explorer window.

Figure 78 – Platform Main Screen Instructions

The screenshot shows the HUDUMIA event platform interface for the "20th February Floods" event. The interface includes a map of Madeira, a list of activities, and various filters and controls. Annotations with mouse pointers highlight specific features:

- On these right panels you can filter the activities by categories and types**: Points to the "Filter types" and "Filter activities" panels on the right.
- These are the current volunteer activities taking place**: Points to the "ON-GOING ACTIVITIES" section on the left.
- This is a real-time updated list containing all activities updates occurring on the map**: Points to the "REALTIME UPDATES" table.
- This button allows you to mail-subscribe real-time updates**: Points to the "Subscribe / Unsubscribe" button at the bottom.
- The first button allows sharing on facebook. The second button allows printing a paper map with legend**: Points to the "Share this event" and "Print paper map" buttons at the bottom.

Event: 20th February Floods
Purpose: Lets help Madeira locals to recover as quick as possible
Notes: Clear madeira countryside villages (outside Funchal)

Location

Filter types
Feed Responses

Filter activities
Need Supply Need Cleaners Need Damaged Need Damaged Need Damaged

Real-time switch
On Off
connected 2012-09-11T12:31:33

Search for location
Enter a Location

Official news
Tough economy hurts dogs, too
http://blog.mtm.com/rings/bottom_secret-33x33

ON-GOING ACTIVITIES:
7 NEEDS 5 RESPONSES

REALTIME UPDATES:

ID	Type	Activity	Description	Responders	Started	Updated
71	need	street_clean	need 10 cleaners	0	3 days	1 day ago
78	need	nurses	Need nurses	1	1 day	1 day ago

yourmail@mail.com

Subscribe / Unsubscribe

Share this event

Print paper map

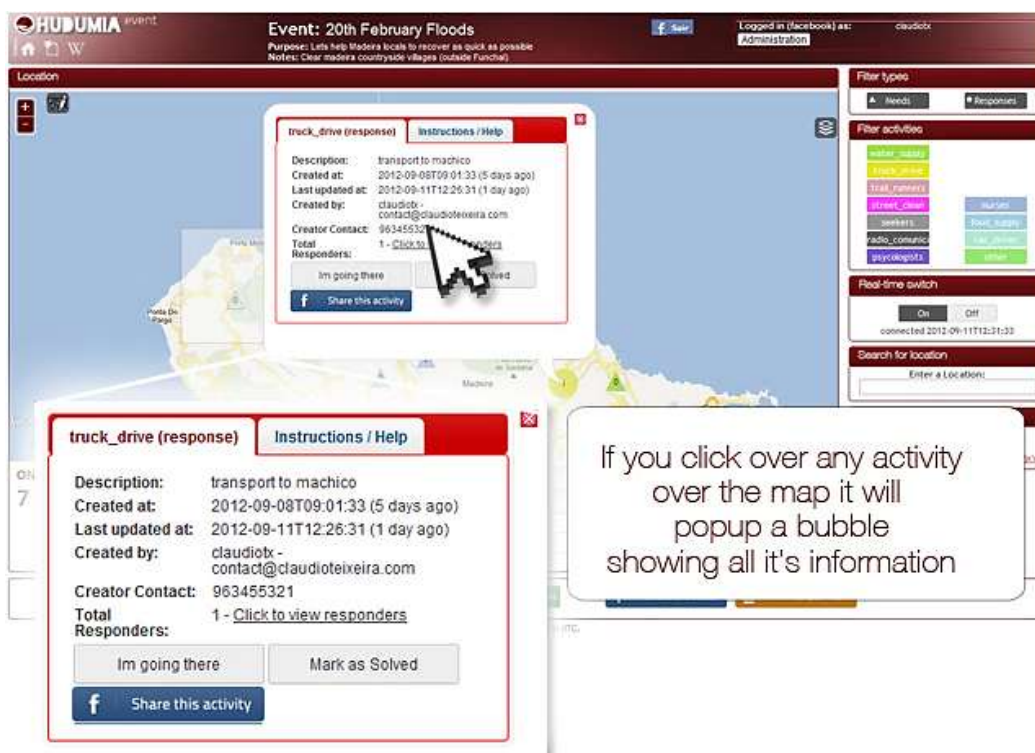
Now, we present how to add/create a new activity on the system.

Figure 79 – Create an Activity Instructions



Now, we present how to view an activity information.

Figure 80 – Viewing Activity Instructions



Now we present how the real-time synchronization engine of the platform notifies the users.

Figure 81 – Real-time Synchronization Instructions

Event: 20th February Floods
Purpose: Lets help Madeira locals to recover as quick as possible
Notes: Clear madeira countryside villages (outside Funchal)

Location

Filter types
Needs Responses

Filter activities
water_supply
food_supply
street_clean
workers
radio_communic
psychologists
other

Real-time switch
On Off

Search for location
Enter a Location

Official news
Tough economy hurts dogs, too
http://the.irs.com/2011/03/15/edition_world/330/

Here it is. We can confirm at the right filter panel that "water supply" is on green color. Its a triangle, so it's a need, hence a "need of water supply"

If we mouse over the list of real-time updates the map zooms automatically to the changed or added activity.

ON-GOING ACTIVITIES: 0 NEEDS 10 RESPONSES

ID	Type	Activity	Description	Responders	Started	Updated
11	need	water_supply	required 1000litres	0	4 hours	4 hours ago
71	need	clean	need 10 cleaners	0	3 days	2 days ago

yourmail@gmail.com

Other users have updated activities

Someone has created a new activity and we were instantly notified in real-time about it!

We have here a green popup over all page elements notifying that activities have been updated.

Now, we present how to see the safety and acting instructions of an activity.

Figure 82 – Reading an Activity Safety Instructions

Event: 20th February Floods
Purpose: Lets help Madeira locals to recover as quick as possible
Notes: Clear madeira countryside villages (outside Funchal)

Location

Filter types
Needs Responses

Filter activities
water_supply
food_supply
street_clean
workers
radio_communic
psychologists
other

Search for location
Enter a Location

Official news
Tough economy hurts dogs, too
http://the.irs.com/2011/03/15/edition_world/330/

food_supply (response) Instructions / Help

Instructions
Contact local markets for contribution of food supply
Instruction 2.
Instruction 3.
Equipment
Tool 1.
Tool 2.
Evacuation
Instruction 1.
Instruction 2.
Instruction 3.

You can click here to edit them in the system wiki. When edited, they became instantly available on this window.

If you click on the instructions tab you will see instructions, equipment and evacuation instructions, provided by official entities.

ON-GOING ACTIVITIES: 7 NEEDS 5 RESPONSES

Responders	Started	Updated
0	3 days	1 day ago
0	1 day	1 day ago

yourmail@gmail.com

Subscribe / Unsubscribe

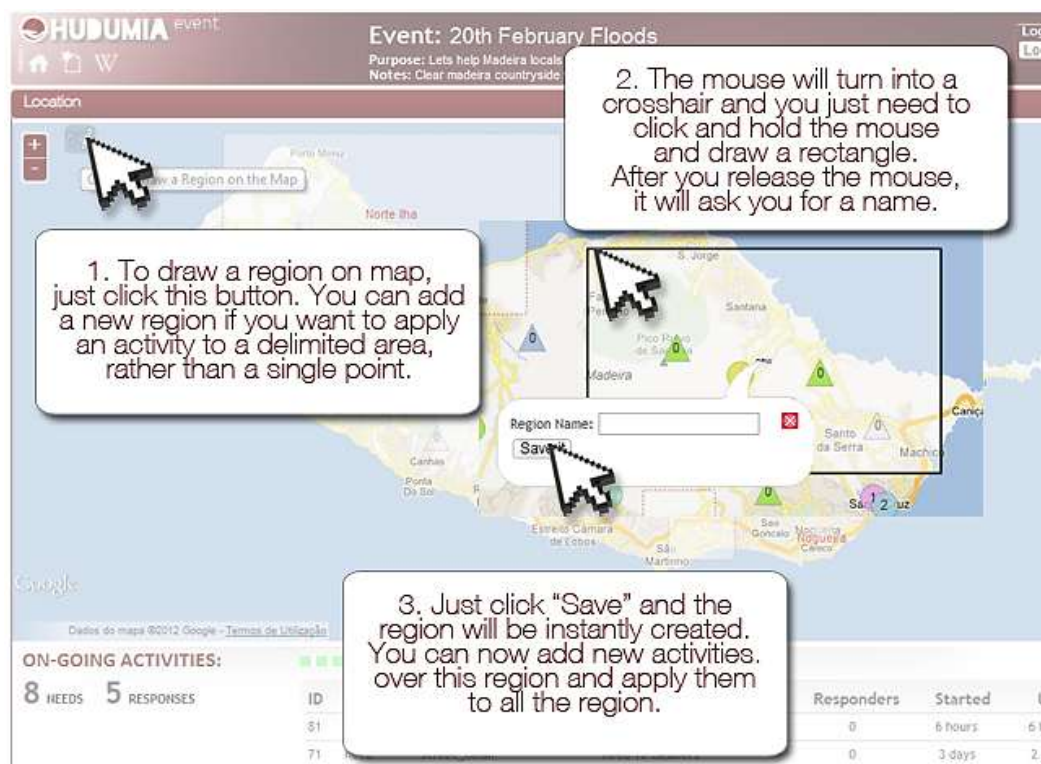
Share this event

Print paper map

The wiki is opened to editing to any user, and has a purpose to allow anyone to contribute with updated and validated safety instructions and guidance. Some security scheme could be added in order to allow only official entities to contribute to the activities instructions wiki.

Now, we present how to create a new region on the map in order to allow you to add new activities (volunteering necessities or needs) to entire regions, if you require it.

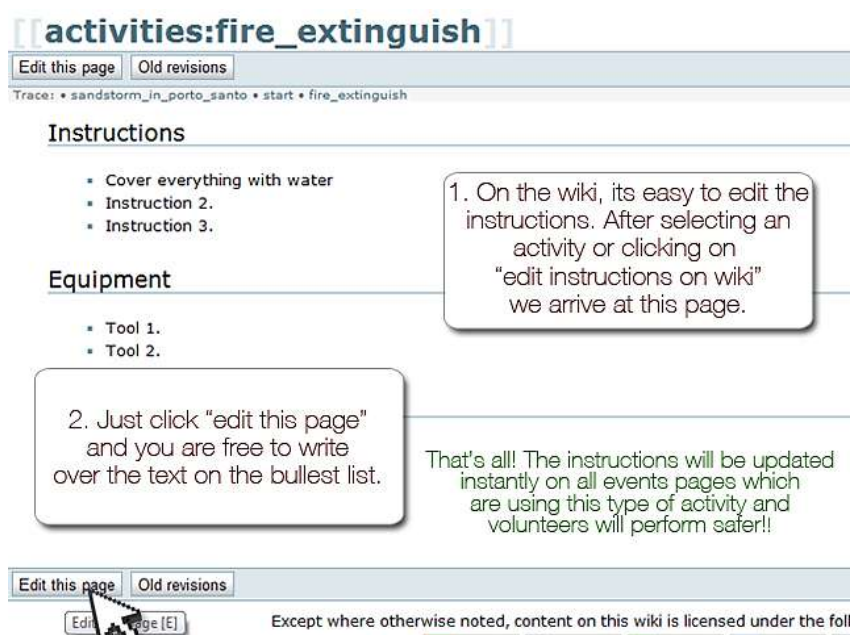
Figure 83 – Add a new Region Instructions



VI.1.3. Wiki Component

Now, we present how to edit activity instructions on the wiki.

Figure 84 – Adding Safety Instructions on Wiki



VI.1.4. Deployer Component (creator)

Following we present how to fill in the forms of create new deployment page (or the editing page which is basically the same but with already filled in content), which was accessed by the top left menu.

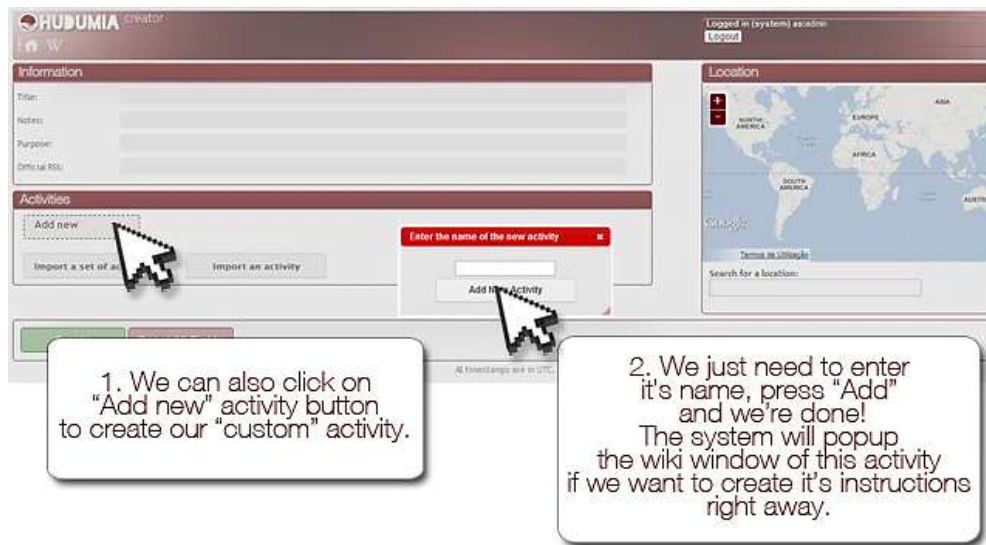
Remember: The activity types which you are required to add to your deployment will delimit the available actions which volunteers can take in your deployment. For instance, if my deployment event is related to a fire I would add activities related to fires in order to speed up volunteers performance while creating new activities. By delimiting the available type of activities we are also ensuring that volunteers only perform safe activities (there is always an “other” activity which is automatically added by the system, in case the creator of the deployment forgets some). As you’ve seen its possible to edit the deployment at any time in real-time, so you are free to add new activities later.

Figure 85 – Create a new Deployment Instructions



Now, we present you how to add the activities to your new deployment (or in editing mode).

Figure 86 – Add a new Activity to Deployment Creation Instructions



There is another way of adding new activities to a deployment, importing them from past deployments.

Figure 87 – Importing Activities to a New Deployment Instructions

