

# Assessing the sustainability of opensource software development: the role of sociology in software development

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## Abstract

Opensource software development is frequently used to serve the human society especially in finding solutions for environmental issues such as floods, droughts and tsunami incidents. Careful consideration of the technical accuracy as well as the social acceptance is essential to guarantee the sustainability of the software development. Forecasting the interaction between the technology and human behaviour is vital in opensource software development in terms of minimizing the negativities after the implementation. Sociology is a tool to understand the human aspects involved in software development. The sociology of software development often underrepresented or not considered well enough in professional or practical filed. The paper discusses the societal factors that can attribute when implementing opensource disaster relief management platforms. Humanitarian disaster relief coordination involves a number of actors with different levels of power and authority. By using theories of multilevel governance and power relations, this paper focuses on understanding the consequences that may arise when implementing common open source platforms especially in developing counties. Finally, the paper provides recommendations to minimize such obstacles for better functionality and the sustainability of the platform.

**Keywords:** Humanitarian relief coordination, Multi-level governance, Opensource, Power relations Sociology of software development

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## 1. Introduction

Natural disasters are becoming increasingly common in Sri Lanka. In such situations, complexities arise from a variety of elements, systems, processes and actors, and it is difficult to obtain a clear picture of the entire situation within the timeframe of a crisis. Disaster and post-disaster phases involve stakeholders engaging in different aspects of work, including relief distribution and reconstruction. A major challenge faced in current humanitarian and disaster relief efforts is the presence of significant amount of diverse information and data that is often distributed among different organizations, and a lack of coordination between such agencies (Bharosa, Lee, & Janssen, 2010; Zhang, Zhou, & Nunamaker, 2002) .

Exchanging information and accessing core information enhances the effectiveness of responses and improves coordination within the network of responding organizations. Poor information sharing and coordination during

inter-agency disaster responses could negate the disaster response process, by impeding efficient collective decision-making and action. Timely and accurate data will enable the government, non-governmental organizations and other volunteers to respond to real crises promptly and effectively. Real-time information will not only assist decision-makers but will also enable different users to share and reuse their resources, improve efficiency and reduce wastage.

Opensource software solutions are increasingly becoming popular for managing information now a day. Disaster relief information management is one of the areas that open source software engineers pay attention to minimise the complications and losses in the current coordination system. The smooth functionality and the sustainability of such systems are questionable as the unpredictable nature of disasters as well as the unjudgmental nature of the human behaviour. Early identifications and predictions of the socio-cultural aspects of using open source technology in similar situations

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provide vital information on how to develop and manage information management platforms.

The paper provides a review of the social aspects that should be considered in implementing a disaster management information sharing platform. First, it provides a brief justification on the need of a disaster relief information management system, with special focus on the current system in Sri Lanka. Then the importance of the opensource development as a solution for the disaster relief coordination is discussed. How multilevel governance and power relations come into action at the implantation stage is discussed as the theoretical background of the paper. Then the paper presents a review on socio-cultural conditions that may arise in implementing a disaster relief platform guided by some recommendations as the discussion.

## **2. Disaster Information Coordination - Need of a Common Information Management Platform**

During a crisis, the unpredictable, dynamic and complex nature of the situation often restricts the sharing and coordination of information between different government and non-government organizations and volunteers. The lack of coordination could lead to some potential failures – for example, inappropriate allocations of first responder resources, counter-productive orderings of sequential relief processes, and delayed evacuation leading to higher numbers of casualties and even the loss of lives and livelihoods. Inefficiencies in aid distribution may lead to unnecessary economic losses and increase the poverty level of the country (Gao, Wang, Barbier, & Liu, 2011). Instances such as delivering aid supplies that cannot be used or consumed due to religious reasons or the misidentification of beneficiaries only leads to an increasing communal sense of injustice, frustration, and wasted funding. Ultimately, disaster relief operations are most effective when aid meets the identified needs of the affected community at the correct time. Better information sharing, on the other hand, can lead to improved coordination of disaster responses, and provide an improved outlook for recovery in the long term.

Reports following the Indian Ocean Tsunami in 2004, Hurricane Katrina and the Haiti Earthquake in 2010 provide powerful examples and inform the need for a common information sharing platform for disaster relief management. In the Sri

Lankan context, the need for a common disaster management platform has been highlighted by academics, the humanitarian community, and the media (Pathirage et al., 2008; Yates & Paquette, 2011)

Mostly, in south Asian countries, the responsibility of distributing disaster relief information lies with the national government. In some countries, the humanitarian community made up of local and international NGOs, and UN agencies (Humanitarian Community) are restricted from collecting and disseminating data due to security reasons. Currently, in Sri Lanka, all the donor agencies must rely on the Disaster Management Centers' website to access information during and after a disaster and also use it as points of validation for requesting of international funds. In this backdrop, the Humanitarian Community has to rely on government information which is sometimes difficult to access and/or not updated with the ground-realities and also with the real-time data. When faced with an emergency, both managers and responders face a high volume of information which can easily result in cognitive overload at an individual level. Collecting and managing the real-time information and directing that to the relevant decision-makers is vitally important in terms of identifying the real problems and needs, to set priorities accordingly, and also to forecast the future situation (Cheng, 2013).

## **3. Opensource Technology as a Solution**

Open source technology has become the most affordable and attractive solution in the modern world to address and tackle some of the issues facing the world today (Walle, 2007). Open source refers to the source code of software made publicly available with little or no intellectual property restriction. Open source software's source code is freely available for inspection, study and further modification (Mesquita, 2011). Since the software provides the basic instructions for digital networking and making the source codes more widely available encourages more efficient and rapid development and innovations bringing new products to the market through individual efforts or collaboration. Clearly, open source software technology has done a revolutionary change in software development for the betterment of the human society.

FOSS model has become an essential driving force in finding solutions for different social

issues. Using open source software for disaster management and coordination has become increasing over the past few years. The use of Free and open source software in disaster management and coordination is fast gain momentum in the world (Pandey, Tyagi, & Pathak, 2013). Although the value of the FOSS is no questionable, the practically and the sustainability of open source software applications in disaster management sectors remains a concern. The ultimate end use of the open source development is to build interactions with the society. Therefore, the human aspects of the software development is an area that should pay serious attention to the practical use and also for the sustainability of the open source software (Matusita, 2007).

#### **4. Open Source Developments for disaster information coordination**

Even though the natural disasters are increasing at an alarming rate, the core preparedness for the post-disaster responses is still in developing stages. With the new boom of FOSS communities, few initiatives have been introduced in regards of disaster information coordination and relief distribution.

Sahana Disaster Management System development was initially introduced after the Tsunami, 2004 by few Sri Lankan volunteers. At the peak hour of emergency, Sri Lankan government authorized the system as part of the official portal for the centre of national Operations: the main body of relief coordination. The system contained, organisation and people registries, the Camp registry and request Management system, inventory management, messaging and situation mapping. Thereafter, Sahana was officially deployed in response to the October 2005 Pakistan earthquake, the 2006 Philippine mudslides, and the Yogyakarta earthquake in Indonesia (Bensam, Nouali-Taboudjemat, & Nouali, 213).

Ushahidi is another open source disaster management system introduced in 2007. The platform has been deployed in Kenya, Mexico, Afganistan, Haiti, Syria, Venezuela and other places. The app allows integrating data from different sources such as phones, web applications, emails and social media. Ushadi is not only used for disaster management coordination but also used in many other ways such as sexual harassment reporting, election violence reporting.

#### **5. Multilevel governance and power relationships**

The theory of Multilevel governance is originated in the fields of political science and also in the public administration. It expresses the idea of interaction between different authority structures. Working with different agencies in a disaster situation creates multi-level relationships among different level of agencies. Understanding how multi-level governance work, therefore, is essential when introducing an online platform to work collaboratively especially in a disaster situation. Multi-level governance theory allows picturing the complexity at and between different levels. Jorgensen and Molokken (2004) stressed multilevel governance as an additional burden on introducing information systems development and deployments. In international economic development, multi-level governance is viewed as the multiple levels of governance and participation in the development process. In other words, it is a system of continuous negotiations between different agencies.

Multi-level governance can be formed in two ways: horizontally and vertically. Horizontal dimension refers to co-operation between the same level of institutions and entities. Vertical governance always refers to above and below co-relation among different levels of agencies and organisations. When it comes to IT development, governance between different political entities (national level, sub-national level) and also between different ministries shows an imbalance. It always relays on the complex nature of interdependency. To better functionality of an online platform, there needs to be better governance and flexibility among the agencies.

When it comes to working with the multi-level agencies, one of the aspects that should pay attention to is the power relationship between these agencies. Humanitarian agencies working in developing countries represent a different level of power and authority depending on their wealth and human power. In a hierarchical structure, these agencies can use their power to restrict information flow and block the involvements at the ground level. However, as Foucault (1997) mention, the power can flow in any direction. As a free flow power can come top to bottom and well as bottom to top. In this sense, the ground level small agencies also can act as gatekeepers to block the activities and information flow during a disaster. Therefore, it is essential to view the

power relations between different agencies to reduce the complexities that can arise during the implementation stage of a disaster relief coordination platform.

## 6. Socio-Cultural Aspects

Information and knowledge sharing is identified as one of the main bottlenecks faced in the disaster relief community, which hinders information dissemination and effective utilization of available knowledge, which is sometimes even withheld by organisations for profit. For the effective management of the information platform, it is essential to review the societal, economic and political forces that might influence the functioning of the mechanism, to mitigate risks and avoid unexpected interruptions on the ground level.

During a disaster, multiple organizations with different capacities and agendas often act simultaneously at the ground level. This involves a complex network of interdependent agencies. Which involves numerous and unpredicted interactions between agencies which can be unique to each situation (Bigley See Bahaorsa). At a sudden disaster, there won't be a central body to direct and connect each of the agencies who are working on the ground. Instead, there can be a powerful organisation who comes into the actions and takes the lead in the disaster coordination. All of these actions should be predetermined or mutually agreed. However, the agencies who have more power and wealth can dominate the information management system and direct the interactions according to the manifestos which will lead to blocking the other agencies performances and also the credit that they should have for their performance on the ground. This situation could lead to competition among organisations. More fundamentally, governance across organisations, across hierarchal levels, and even across technologies could act as barriers to the free flow of information; especially in developing countries, IT governance plays an important role in the functionality of the free flow of information through the internet.

Disaster relief information management involves multi-level governance across and within organizations. These linkages can extend vertically or horizontally: the 'vertical' dimension refers to the linkages between higher and lower level of institutions, regarding their institutional, financial and information aspects. The

'horizontal' dimension refers to cooperation between regions and agencies. The hierarchical structures of these agencies impact the flow of information – for instance, it determines who has the authority to access databases (Maldonado & Maitland, 2010).

During the crisis period itself, how ground-level actors coordinate their work may depend on authority, power and hierarchical structures, depending on the organization's reputation and scale within the given country. Issues of power and control over the information management may also be intertwined with organizational politics. Thus, managing power aspects, politics and the organizational context of information sharing will be vitally important to the success of the information management system.

In a crisis situation, different agencies can work according to their private agendas even though a system provides them with the directions on the needs and the priorities. INGOs and NGOs who are working on the ground level may have different visions and priorities according to their portfolios. Such organisations can prioritise their donations according to going out of the common intentions. This situation can be worst when it comes to a multi-ethnic environment where different ethnicities segregated in specific locations. As a common platform can not tag an organisation and direct them to collaborate, it is questionable whether a system could work smoothly as predicted.

Lastly, collaboration with multiple organizations is essential to the effective management of an information exchange database. While the overarching goal of all humanitarian agencies is to help citizens, the goals of individual organizations, sub-units of organizations and individual stakeholders may not be aligned. Conflicting goals of interpersonal interests could create issues on the ground, blocking information sharing and any other collaborative work. Humanitarian aid workers also often face severe issues related to time pressure and information overloads. Such complex, rich information easily results in cognitive overload at an individual level.

Resistance to change from the traditional methods of sharing information is a major challenged facing by the FOSS movement (Ariyabandu, 2009). With ground-level experience in Sri Lankan context, it is hard to move from the traditional paper-based method to



a new online system. The feasibility and the need assessment therefore should be the first step before introducing a new online system.

In conclusion, while moving towards to a new phase of humanitarian information sharing, it is vital to review organizational structures, governance structures, multi-organizational relationships, and power and control dynamics among different units, to ensure the effectiveness and the sustainability of the information sharing platform.

## **7. Discussion: Overcoming barriers to better information coordination during a disaster**

With the introduction of opensource software, it is evident that the new technological change countries and their traditional structures, management system, and flow of information. It is obvious that some countries are not at the same level of accepting new technological changes.

The culture of free and opensource software relies heavily on community collaboration. The assessment of willingness to change the traditional methods is vital before introducing any technological solution for countries. In this sense, social scientists pay a key role in combining the social and cultural aspirations with the modern software development. Participatory planning tools such as community consultations, surveys, focus group discussions and interviews are essential in understating the people's view to incorporate their perceptions with the development.

When it comes to information sharing the government rules and regulations should be considered as the disaster relief agencies have to work accordingly to the national level legal framework. Without proper governmental support, it is hard to introduce such information sharing platforms. Therefore, national level information sharing strategy should be formulated

and enforce before the emergency. In this case, not only the non-government agencies, but also

The better management of the disaster always relies on the better understanding of the overall situation and also better coordinating with each other. However, during a crucial situation, agencies can limit their attention to only on their area of interest without paying much attention to the bigger picture. This makes the agencies less aware of and interest in other activities and not responding to the urgent needs. To overcome this issue, Baharosa (2010) suggests an incentive system where the agencies get feedbacks and appreciations.

Information sharing can be considered highly private and confidential in some countries sometimes during special periods, such as war situation. This can act as a barrier in sharing information even though an opensource software provided the facility to share information.

Most developing countries face physical ICT challenges when using FOSS, especially within government organisational capacities. Most of the time, the lack of physical ICT infrastructure facilities, low capacities remain as barriers in using information management systems. Therefore, the right assessment of the countries IT capacity is needed before introducing such platforms.

To know the ground level realities and also to make arrangement to overcome these obstacles, there should be an interaction between the software development and the society. Therefore, the sociology as a science which explores the society can provide a better overview of the interaction between the society and the software development and guide the process to have a sustainable outcome.

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