Multi-Platform E-Locator for Disaster Risk Reduction and Management System for the Vulnerable Population of Biliran Province

Homer Ricacho Ampong

Abstract: ***The primary goal of this study is to develop and evaluate a multi-platform e-locator for disaster risk reduction management system for the vulnerable population of Biliran province which will serve as reference among search and rescue units in the prioritization of preemptive and forced evacuation. This study was participated by 15 BDRRMC members and evaluated by 10 IT Experts.***

Findings revealed that the overall extent of compliance of the developed system on multi-platform e-locator for disaster risk reduction management system for the vulnerable population of Biliran Province in terms of: functional sustainability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability as very high.

The developed system is very responsive and useful to the needs of the BDRRMC team during preemptive and forced evacuation, compliant to ISO 25010 standards for software quality, ready for deployment to its intended user, and recommended for replication to other municipalities in the Province of Biliran

Keywords: e-locator, DRRM application, preemptive evacuation, vulnerable groups

I. INTRODUCTION

The Philippines is prone to various climate/weather-related hazards because of its location in the tropics, along the path of typhoons, monsoons and El Nino-La Nina. Every Filipino has a story of misery and victory in every own geographical location. Recount of one's experience varies from the degree of affectation, age and exposure. Various attributions, scientific findings and research have been made with the extent and impact of disaster to humankind, like climate change, global warming and all forms of human abuses to the environment. With all these forms of catastrophes all over the country, according to the 2016 World Risk Index (University, 2016) revealed that Philippines ranked 3rd as the disaster prone areas in the world.

This provides government officials at the barangay level mechanism which will lessen damages brought by natural disasters. Overtime, search and rescue operations has been intensified, however, lacking mechanism that integrates technology to hopefully reach targets and goal of zero casualty (Reyes, 2008).

Through the years, advocacy on resiliency has been conducted to the people. Resiliency is an important ability that a person or an entity must possess in order to recover from adverse effects of events experienced like effects of a natural or manmade threat (Bassett, Chosak, Driscoll, & Zakrajsek, 2013).

Resiliency in the Philippine setting is evident in the enactment of Republic Act 10121 otherwise known as the Philippine Disaster Risk Reduction and Management Act of 2010 which has laid the basis for a paradigm shift from just disaster preparedness and response to disaster risk reduction and management. Resilience therefore encapsulates the capacity of a system, community or society that are potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure (RA10121, 2010).

The National DRRM Plan serves as the national guide on how sustainable development can be achieved through inclusive growth while building the 5 adaptive capacities of communities; increasing the resilience of vulnerable sectors; and optimizing disaster mitigation opportunities with the end in view of promoting people's welfare and security towards gender-responsive and rights based sustainable development (Philippine-Government, 2011).

This enabling law is a broad regulatory cum institutional development framework encompassing all aspects of disaster risk reduction and management. The Local Government Code mandates every Punong Barangay [Section 389 (b)(6)], Municipal Mayor [Section 444 (b)(viii)], City Mayor [455 (b)(vii)], and Governor [Section465 (b)(vii] to carry out emergency measures during and in the aftermath of a man-made and natural disaster or calamity. Pursuant to Section 29 of the Local Government Code, supervisory authority over component cities and municipalities is lodged with the Provincial Government through the Provincial Governor.

Eastern Visayas, home to 4.1 million people, and tagged as the "geographical backbone" of the Philippines, was the location of the worst disaster to affect the country in recent decades. Moreover, the region's geographic location, facing the Pacific Ocean makes it prone to all known natural hazards, aggravated by climate change effects (Pernia, 2017).

The November 2013 Typhoon Haiyan, known in the Philippines as Yolanda, greatly affected Biliran, Southern Leyte, Northern Samar, Eastern Samar and Leyte Provinces. In the city of Tacloban alone (within Leyte Province), one of the areas hardest hit, 90% of all structures were destroyed, killed more than 7,000 people, affected 25 million, and caused 520 billion pesos in estimated economic losses (UNDP, 2014).

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On December 16, 2017, another horrible disaster struck the Eastern Visayas Region, particularly in the Province of Biliran. Its heavy rains triggered widespread flooding and massive landslide in one of the country's smallest provinces with a population of only 171,612, less than the number of people in Tacloban City, the regional capital.

Biliran, the most economically improved province in the region with a poverty incidence of only 17 percent as of 2015, suffered the brunt of slow moving Tropical Storm Urduja a week before Christmas in 2017. Urduja left a massive trail of destruction as landslide buried dozens of houses, cut water and power supplies, and isolated Naval town, the provincial capital as major bridges collapsed. In the entire Province, the calamity killed more than 50 people. Profile of dead persons ranges from Senior Citizen to a 5-year-old kid in the Municipality of Biliran and Caibiran, Province of Biliran. (OCD, 2014)

When typhoon Urduja struck the Province there were many casualties due to the laxity in the enforcement on the preemptive and forced evacuation, lack of equipment, low number of search and rescue volunteers, absence of database of the vulnerable groups and non-systematic execution of preemptive efforts.

In the preemptive and forced evacuation efforts of the Barangay, Municipal and Provincial Governments, aimed for a zero casualty at all times. All those living in the danger zone must evacuate prior to the occurrence of the event. With the, challenges confronting the Local Government Units at all geo political levels, thus, this proposal to adopt prioritization in the evacuation of constituents. The vulnerable groups must be given top priority in the preemptive evacuation because these are the people who are handicapped to transfer themselves to a safer zone, susceptible to all harm, no capacity to evacuate because of its poor economic condition and physical attributes (IRIN, 2010).

While, the Local Government Units have done gigantic efforts in upgrading and professionalizing all of their disaster preparedness efforts in terms of its human resource, policies, plans, equipment, capability building program and all forms of coordination and linkages, thus, this paper is an addition to their initiatives.

Systems are in place, initiatives are continuously being conducted but the need to give more emphasis of the vulnerable groups during preemptive evacuation thus providing a map locator of these groups for the guidance of the Barangay Disaster Risk and Reduction Management Committee.

The need to devise a system that will aid our government agencies such as MLGU, DILG, MDRRMO, DSWD, Provincial government on the location of the vulnerable groups such as senior citizen, pregnant women, children aged 0 to 5 years old, and persons with disability so that prioritization of necessary actions could be undertaken immediate to minimize, if no, zero the casualty. (DILG, 2017)

There are eight (8) municipalities and 132 barangays in the entire province of Biliran, it is therefore timely to formulate electronic mechanism or computer aided mechanism that will hasten the rescue operations during calamities. Hence this study was conducted.

Conceptual Framework

There are many factors that explains people's behavior during evacuation in times of natural disaster. Among these factors, experience and trust are suggested to be among the most important factors explaining evacuation (Bubeck, Botzen, & Aerts, 2012) (Huang, Lindell, & Prater, 2015) (Kehl, Knuth, Hulse, & Schmidt, 2015)even though researchers depends how traumatic the aftermath of the disaster. For this study, the researcher adapted the Social Identity Theory that explains shared social identity determines social behavior during evacuation (Siversab, et al., 2016) (Mawson, 2005). With the help of the theory, the researcher was able to establish the social identification of vulnerable groups mainly Person with Disability (PWD), Senior Citizens, Children 0 to 5 years old and Pregnant Women in the evacuation procedure.

On the other hand, the other problem in the management side are coordination and the location of the identified vulnerable groups (Bimal, Kanti, & Paul, 2005)during disaster. Thus, to provide greater insights, the process of self-categorization determines norms within the crowd and influences how people behave during evacuation situations (Siversab, et al., 2016). Hence, as to secure that the identified vulnerable groups has evacuated the area, crowdsourcing and used of newer technology can be utilized for enhancement and effectiveness of the evacuation process, thereby, reducing casualty.

In the Information, Communication and Technology (ICT) side, system applications generated new landscape of emergency and disaster response systems by allowing affected citizens to generate georeferenced real time information on critical events (Poblet, 2014)(Casanovas, Poblet, & Garcia-Cuesta, 2014). This marks another solution to socially identify vulnerable groups using ICT. Figure 1 is an illustration that shows the social identity theory of this study.

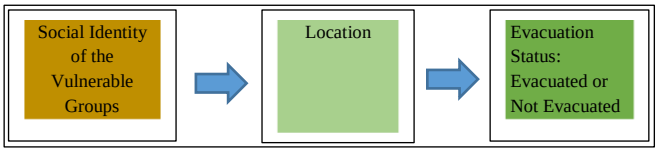


Figure 1. Social Identity Theory

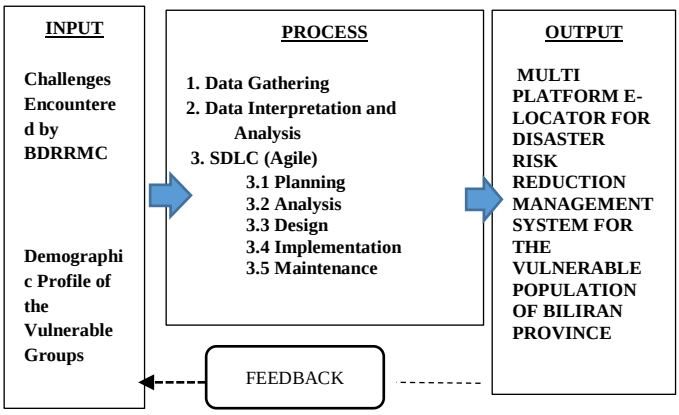


Figure 2. Conceptual Paradigm of the Study

Focus Group Discussion (FGD) was conducted in order to identify the challenges met by the BDRRMC. Available secondary data of the vulnerable groups were used as test data for the system development. After the data preparation and data gathering, the system was developed using agile software development life cycle. After the development of the system, it was subjected to evaluation by IT professionals using the ISO 25010 standards for software quality tool.

Statement of the Problem

The primary goal of this study is to develop and evaluate a multi-platform e-locator for disaster risk reduction management system for the vulnerable population of Biliran province which will serve as reference among search and rescue units in the prioritization of preemptive and forced evacuation.

Specifically, it seeks to achieve the following.

1. What are the challenges encountered by the DRRM participants as regard the guidance and prioritization in the enforcement of the preemptive and forced evacuation?
2. What proposed application can be developed to enhance the existing preemptive and forced evacuation practices?
3. What is the extent of compliance of the developed application to ISO 25010 Software Quality Standards in terms of:
   3.1 functional suitability;
   3.2 performance efficiency;
   3.3 compatibility;
   3.4 usability;
   3.5 reliability;
   3.6 security;
   3.7 maintainability;
   3.8 portability.
4. What are the strengths and limitations of the developed system?

II. METHODOLOGY

Research Design

This study utilized a descriptive-evaluative research designs using developmental methodology. To gather data for knowledge requirements, a qualitative research approach was used through Focus Group Discussion (FGD) for the identification of the challenges met by the Barangay Disaster Risk Reduction Management Committee (BDRRMC). The developmental design was deemed necessary as it responds to the need of the target community. While descriptive-evaluative was used to assess and describe the extent of compliance of the system based on ISO 25010 standards for software development prior to the deployment of the system to its intended user.

Participants of the Study

The subjects of this study were the fifteen (15) members of Barangay Disaster Risk and Reduction Management Committee in the Municipality of Biliran, Biliran. The BDRRMC is composed of one (1) Punong Barangay, seven (7) kagawads, (1) Sanguniang Kabataan (SK) Chairman, three (3) members of Civic Society Organization (farmer, fisherfolk, community volunteer), one (1) Senior Citizen, one (1) representative of the Congressman and one (1) representative from the Department of Education. Ten (10) information technology experts who evaluated the system following the ISO standards in terms of: functionality, usability, reliability, efficiency, maintainability and portability. The IT experts were composed of one (1) system administrator, one (1) web administrator, one (1) computer-based information manager, one (1) system programmer, one (1) senior programmer and five (5) ICT Instructors.

Instrumentation

The study adopted the purposive sampling technique. It was considered important since the challenges met by the Barangay Disaster Risk and Reduction Management Committee were the basis for the development of the system.

With regards to the IT experts who evaluated the system, purposive sampling also was done by the researcher to ensure that only competent professionals could evaluate the system based on standards set by ISO.

Set of self-made questions were used as guide for the Focus Group Discussion (FGD). Meanwhile the other instrument was focused on the evaluation of the developed system which was adopted from ISO 25010 standards for software quality. It consisted of eight (8) significant areas such as: functionality sustainability, performance efficiency, compatibility, usability, reliability, maintainability, security, portability.

Data Gathering Procedure

A written request prepared by the researcher and noted by the adviser was crafted and sent to the municipal mayor seeking permission to conduct the study in the municipality of Biliran, Biliran and seek assistance for the provision of the necessary data needed for this study.

Approved communication was then secured by the researcher from the office of the municipal mayor to proceed with the study. An assembly of the Barangay Disaster Risk and Reduction Management Committee through the Municipal Disaster Risk and Reduction Management Officer (MDRRMO) with approval of the mayor was scheduled for the abovementioned purpose.

Through a focused group discussion, the researcher asked the BDRRMC probing questions leading to challenges encountered during preemptive and forced evacuation.

Results of the FGD was then the basis for the researcher to come up with a design for the developed system tailor-fitted in the need of the BDRRMC.

Another communication was prepared by the office of the municipal mayor to the Punong Barangays to provide the secondary data needed by the researcher in the development of the system. The researcher personally went to the eleven (11) barangays to solicit available secondary data which could be included in the system.

When all the requirements were met, the researcher started to develop the system fitted to the need of the BDRRMC and the MDRRMC for three (3) months started on

the last week of November 2018.

After the development of the system, it was subjected to evaluation by IT professionals using the ISO 25010 standards for software quality tool.

Results of the evaluation was tallied, collated, and subjected to statistical analysis to obtain meaningful results which could be very beneficial for the improvement of the developed system.

Data Analysis

Descriptive statistics such as frequency count, percentage, and weighted means were used to describe the characteristics of the system in terms of its extent of compliance to ISO 25010 standards.

Table 1. Qualitative Interpretation of House Structure and House Location

House Location	House Structure	Degree of Prioritization
Unsafe	Light Materials	Very High Extent
Unsafe	Semi Concrete	High Extent
Unsafe	Concrete	Moderately Extent
Safe	Light Materials	Low Extent
Safe	Semi Concrete	Very Low Extent

Table 2. Evaluation Rating using Likert Scale

Rating scale range qualitative description		
5	4.20 – 5.00	Very High Extent
4	3.40 – 4.19	High Extent
3	2.60 – 3.39	Moderately Extent
2	1.80 – 2.59	Low Extent
1	1.00 – 1.79	Very Low Extent

III. RESULTS AND DISCUSSION

The main objective of the study is to develop a Multi-platform e-locator for Disaster Risk and Reduction Management (DRRM) System for the vulnerable population of Biliran province. Its specific objectives include determining the challenges encountered by DRRM personnel in regard the guidance and prioritization in the enforcement of the preemptive and forced evacuation; to develop a proposed application to determine extent of compliance of the developed application to ISO 25010 Software Quality Standards; and to identify the strengths and limitations of the developed system.

1. Challenges Encountered

The researcher has conducted a Focus Group Discussion (FGD) to know the challenges encountered by the members of the Barangay Disaster Risk and Reduction Management Committee.

Table 3. Challenges Encountered by the Participants

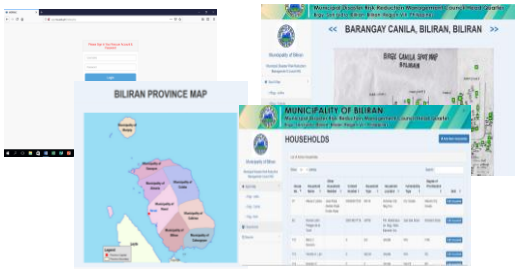
Challenges Encountered	F	Rank
No prioritization of vulnerable groups	14	1.0
No data of vulnerable groups in every household	13	2.0
Hardheaded, some do not evacuate immediately	11	3.0
Ineffective deployment scheme	8	4.5
No available data on household members in every barangay	8	4.5
With the limited number of handheld radios, only few rescuers were provided	5	7.0
No prioritization of household members lying on unsafe areas	5	7.0
No prioritization of vulnerable groups especially in unsafe areas	5	7.0
Cannot maximize their resources and strategies	4	9.0
No automated system in the operation center	2	10.0

This implies that it is relevant and timely to develop a system with salient features that could cater to the needs of the Barangay Disaster Risk and Reduction Management Committee during preemptive and forced evacuation.

2. Multi – Platform E-Locator for Disaster Risk Reduction and Management System for the Vulnerable Population of Biliran Province

The figures below are illustrations of the main page and web pages of the developed system basing from the results of the conducted Focus Group Discussion (FGD).

MULTI-PLATFORM E-LOCATOR FOR DISASTER RISK AND REDUCTION MANAGEMENT SYSTEM FOR THE VULNERABLE POPULATION OF BILIRAN PROVINCE



3. Extent of Compliance

Table 12. Summary Evaluation of the Developed System

Area of Evaluation	Mean	Description
1. Functionality Sustainability	4.57	Very High Extent
2. Performance Efficiency	4.63	Very High Extent
3. Compatibility	4.35	Very High Extent
4. Usability	4.66	Very High Extent
5. Reliability	4.55	Very High Extent
6. Security	4.66	Very High Extent
7. Maintainability	4.60	Very High Extent
8. Portability	4.53	Very High Extent
Overall Mean	**4.57**	**Very High Extent**

As depicted in Table 12, it is interesting to note that all the areas were rated as very high extent of compliance with means ranging from 4.35 – 4.66. It had an overall mean of 4.57 labelled as very high extent.

This implies that the system had met all the standard requirements set by ISO for system development. This implies further that the system is indeed operational in nature and ready for utilization.

4. Strengths and Limitations

During the evaluation of the IT experts, the researcher was able to deduce certain strength and setbacks of the developed Multi-platform e-locator for Disaster Risk and Reduction Management (DRRM).

The strength of the system is that it resulted highest functionality with its usability and security. Meanwhile, compatibility has been concluded to be one limitation of the study.

For its strength, the usability factor of the system or describing the effectiveness of the user's experience when interacting with it. In this part, learnability becomes its strength or the system effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use. The other strength of the system, is its security or controlling access to the system. As such, integrity becomes its asset since the system, or component prevents unauthorized access to, or modification of, computer programs or data.

From the result of the evaluation presented in the above paragraph, the researcher has asked further inputs from the evaluator and found out that the system is tailor-fitted to the needs of the BDRRMC. The BDRRMC has concluded that the system provides functions useful to the DRR management principle. It can be accessed online using mobile data and that location and profile of the vulnerable groups can be easily accessed online. Moreover, data provided in the system can be updated anytime. It is a Browser-based system - computer tools and applications which run on a web browser via the Internet without accessing the operating system of any individual computer. Applications are accessed through web pages. Using a web browser (commonly referred to as a browser), a software application for accessing information on the World Wide Web.

IV. SUMMARY OF FINDINGS

The following are the salient findings of the study.

1. Among the challenges encountered by the BDRRMC, prioritization of vulnerable groups is the most encountered problems during the pre-emptive and forced evacuation phase.

2. The researcher was able to develop a system with user account for rescuer, PDRRMO and administrator. For the rescuer account, it reflects household that evacuated during occurrence of disaster, for the PDRRMO account, it monitors the conduct of evacuation, and for the administration are disaster risk reduction management related information.

3. The developed system has complied to ISO 25010 Software Standards to a “very high extent”.

4. Based from the results of the system evaluation, the strength of the developed Multi-platform e-locator for Disaster Risk and Reduction Management (DRRM)is usability, security and compatibility.y

V. CONCLUSION

The development of the Multi-platform e-locator for Disaster Risk and Reduction Management (DRRM)is noted as a need requirement in the operation center especially in locating vulnerable groups during the pre-emptive and force evacuation phases.

Therefore, the developed system is a useful tool in helping the BDRRMC and MDRRMC in locating vulnerable groups such as senior citizen, pregnant women, children aged 0 to 5 years old, and persons with disability so that prioritization of necessary actions could be undertaken immediate to minimize, if no, zero the casualty.

VI. RECOMMENDATIONS

1. It is the task of the Barangay Disaster Risk Reduction and Management Committee (BDRRMC) that data entry should be periodically updated and provided for data reliability.

2. It is the responsibility of the Municipal Disaster Risk Reduction and Management Officer (MDRRMO) that internet connectivity should be fast and stable in order to maximize usability of the system during the preparedness phase.

3. Future researcher should conduct further research relevant to the system enhancement so that it will help lessen cases of casualty in disaster prone areas.

4. The study may be presented to the Municipal Disaster Risk Reduction and Management for utilization.

5. Develop a mobile app for the developed system.

6. A map direction showing the shortest path going to the evacuation center should be incorporated in the future researches as an added feature in updating the system.

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