Design of a Data Build-up Framework and Development of a Dashboard Derived from Natural Disasters' Historical Data for the Philippines

Remedios G. Ado, Rosicar E. Escober, and Agnes J. Masbate

Abstract—**This study aimed to design a data build-up framework and develop a natural disasters' dashboard for the Philippines. Specifically, it sought to know the respondents' ranking on the severity of the identified natural disasters in the Philippines; identify the respondents' level of agreement on the most credible sources of disaster data, perception on the existing Philippines' disaster website, level of agreement on the advantages of having a natural disasters historical database for the Philippines; distinguish the attributes for the historical database that will serve as input for the natural disasters dashboard; and recognize the ideal query process, query references, and query Graphical User Interfaces of the natural disasters' dashboard.**

The respondents of the study provided valuable inputs specifically on the aspect of having a natural disaster website to provide worldwide access to disaster-related information.

The system is dependent on the inputs and it is dependent on how it is appropriately managed by the Administrator.

Index Terms—**Dashboard, data build-up framework, disaster, information sharing, Philippines' disaster website.**

I. INTRODUCTION

Disaster is a sudden occurrence that causes serious devastation to any place that it goes through. It usually brings about famine, massive destruction of properties including homes, commercial establishments and agricultural lands, and most of all, death of victims.

The Philippines is one of the most disaster-stricken countries in the world. Being located in the Pacific Ring of Fire, it makes the country vulnerable to thunderstorms, volcanic eruption, and earthquakes; and also being in the typhoon belt, the country experiences an average 20 typhoons and dangerous storms every year. Because of these, disaster risk reduction has become everybody's responsibility, and requires a wide range of political and professional collaborations and partnerships, but due to the

challenges faced by the different sectors during disasters, efforts have been made to improve disaster preparedness, response and recovery. This is made possible through efficient use of Information and Communications Technology (ICT) in communication and information sharing, thus ICT has been recognized as key enablers in achieving the Millennium Development Goals as a specific target for 2015.

To lessen the impact or disasters in the Philippines, different disaster awareness tools are formed to inform the citizens about incoming disasters so that they can prepare and thus avoid casualties in their families.

The convergence of telecommunications, computing, and multimedia have further opened new potential for its use in disaster risk reduction and other aspects of development. Mobile phones nowadays are not only used for phone calls and messaging, but also to capture and distribute images and videos, and download music and news from the Internet. With these new developments, the social media has provided an unprecedented level of user control and interactivity. With the advancement of ICT, offers of assistance have been extended to the global community in creating online platforms for information sharing and coordination of activities on site. This is best exemplified during the aftermath of typhoons Ondoy and Pepeng in 2009 where a group of volunteers set up website using Google Maps to document flood updates and persons needing rescue [1].

The reviewed books and other references provided additional building blocks in the development of the concept of establishing disaster dashboard as a reporting tool. These reference materials significantly improved the outcome of this thesis in the following areas:
- ICT as a main tool in developing a system that will provide more updated information in relation to disasters.
- Use of social media in reporting the damages/casualties of a disaster in a certain area.
- Disaster risk reduction and management can't be done by a single agency alone; it is in fact a collaborative effort of different agencies and individuals concerned.
- The NDRRMC and the OCD as Secretariat, can serve as the central repository of the different databases managed by different government agencies involved in disaster management [2].
- Community-based disaster preparedness and risk reduction, which observes best practices as supported by the "Zero Casualty" advocacy in the province of Albay [3].

Remedios G. Ado is with the Polytechnic University of the Philippines College of Engineering, Philippines (e-mail: rgado@pup.edu.ph).

Rosicar E. Escober is with the Information Systems Department, National Grid Corporation of the Philippines, Philippines (e-mail: rose_escober@yahoo.com).

Agnes J. Masbate is with the Management Information System Service, Department of National Defense, Camp Gen. Emilio Aguinaldo, Philippines (e-mail: ajm_dnd@yahoo.com).

Disasters are both a humanitarian and economic issues. The cost of relief, rehabilitation, and reconstruction comes in addition to the human and economic loss caused by a disaster. Reduction of disaster risks and vulnerability are key components for sustainable development [4]. The costs created by disasters are extra burden, particularly in hazard-prone countries; this can put extra financial pressure on the government's mitigation and preparedness activities, which often constitute the poorer nations [5].

In light of the growing use of technology, an application of dashboards runs across industries such as telecommunications, aviation, manufacturing, services, and public organizations as well as in departments of an organization such as sales, marketing, finance or logistics [6]. A visual interface of performance dashboards is just the tip of an iceberg [7]. Nowadays, companies produce a massive amount of transactional information which requires integration and manipulation in data warehouses to be displayed. Most dashboards are powered by business intelligence (BI) and data integration technology that is able to deal with this challenge. Performance dashboards are information systems for decision support. According to [8], performance dashboards are related to decision support systems (DSS).

This research focuses on using ICT as a main tool in establishing the data build-up framework of natural disasters' historical data in which the dashboard is based. The framework provides the structure of the natural disasters database which includes all the necessary information relating to disasters such as type of disaster, location, impact, casualties, and damaged properties. These pieces of information will help the government determine the needs of the affected persons/families. Meanwhile, the Disaster Dashboard offers comprehensive updates of upcoming disasters through its **announcements** page to inform the citizens to make them prepare for it. It provides different statistical reports which are presented in graphical form for easy understanding and better analysis. The following are some of the types of statistical reports produced by the disaster dashboard system:

- List of Recorded Disasters by Date
- List of Recorded Disasters by Casualties
- List of Disasters by Affected Citizens
- List of Recorded Disasters by Damaged Properties

A. Government Information Sharing Framework

Information sharing (IS) is a key capability required for having a one-stop and networked government responding to a variety of intra-organizational, inter-organizational or cross-organizational needs like sharing service-related information between parties involved in the delivery of seamless services, or sharing information on available resources to enable whole-of-government response to emergencies, etc. [9] Although it is not common due to technical, organizational, and cultural barriers, it is a challenging task to develop the Government IS capability because it requires government-wide coordination, explicit policies and strategies, and concrete implementation frameworks. Hence, the government information sharing initiatives attempt to "unlock" data on fragmented information technology infrastructure spanning multiple agencies to address the difficulty of reconciling the differences. The context for information sharing ranges from intra-organizational (from within a single government agency) through inter-organizational (delivery of seamless services involving cross agency processes) to inter-governmental (exchange of data among neighboring countries).

The government IS practice adopts a holistic view of understanding interoperability initiatives and highlights the main areas for policy intervention which consequently provides policy makers and government managers with conceptual clarity on the GIS problem.

This model below illustrates a learning cycle of government agencies involved in the IS practices. It depicts how a sharing experience is triggered by a pressing problem suitable for an IS based solution. While the participants enter the experience with their own perceptions of potential benefits and risks, the sharing experience is shaped by the underlying policy and management frameworks of the organization concerned. In turn, the sharing produces insights that help improve the framework.

However, in his article [10] states that trust plays a vital role in establishing the conditions for effective coordination among separate organizations in the humanitarian relief environment. He added that the challenges involved in interagency cooperation are both to ensure an accurate rendering of needs and to mobilize the appropriate organizations or portions of organizations in the humanitarian network to respond rapidly and effectively to those needs.
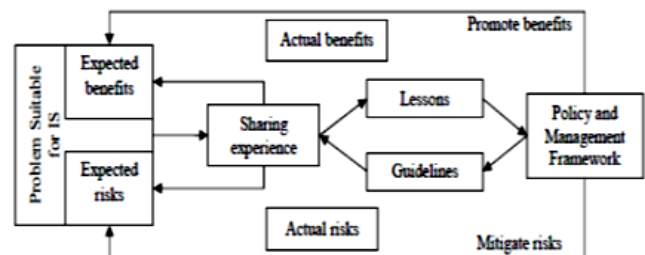

Fig. 1. Theoretical model for government information sharing.

II. System Design And Development Methodology

Disaster Dashboard offers comprehensive and informative delivery of latest announcements about current disasters so that citizens can prepare for it. Aside from that, it also records all of the disasters that happened in the country including all of the necessary information such as, type of disaster, level of impact, location, casualties, and damaged properties that can help our government in determining the impact of the disaster in the affected locations.

A. Software Development Methodology

The method used in the development of the system is the agile method because of its flexibility [11]. It is based on the principle of having close and continuous communication between the customer and the developer. This communication is necessary to ensure that the developer is able to meet the requirements of the customer as well as their satisfaction of the product that is being developed. The agile methodologies also emphasize having adjusted planning, incremental development and delivery, a time-

boxed iterative approach and a promoted rapid and flexible response to changes in the development environment. Fig. 2 illustrates the agile development life cycle.
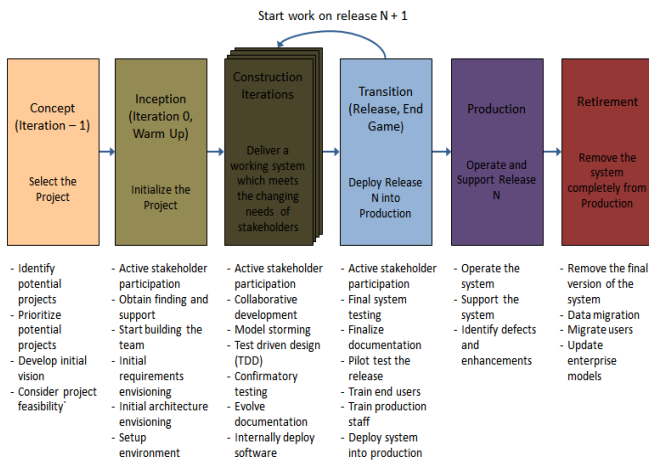

Fig. 2. Agile software development life cycle.

Agile approaches are typically used in software development to help businesses respond to unpredictability.

Other tools used were Unified Modeling Language and Open Source technologies.

B. Disaster Dashboard Process Model

Fig. 3 shows the process model of the flow of the disaster dashboard system: it is divided into two main components: the Administrator and the front-end user.
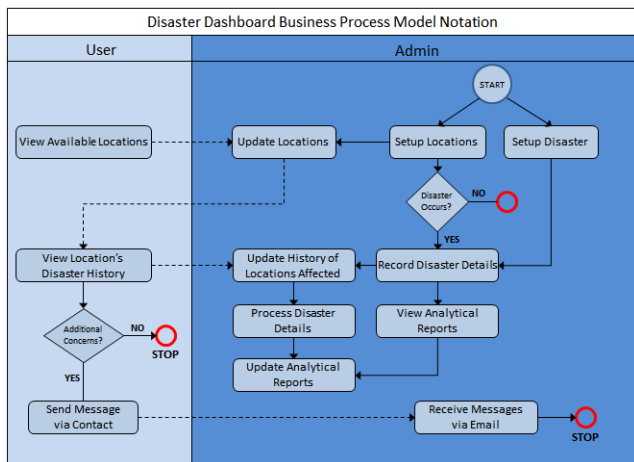

Fig. 3. Disaster dashboard process model.

The Administrator is responsible for the configuration of locations and disasters that may occur in a certain place. It has a log in page. Meanwhile, the front-end user refers to the general public who can access the website in order to see disaster information. The user has a view only access to the website but can also send messages such as comments and suggestions for the improvement of the website.

C. Query Process, Query References, and Query Graphical User Interfaces of the Natural Disasters Dashboard

The development of the dashboard has two interfaces: one for the system administrator, and the other for the front-end user. Fig. 4 shows the screen navigation diagram for the system administrator, while Fig. 5 shows the screen navigation for front-end users.
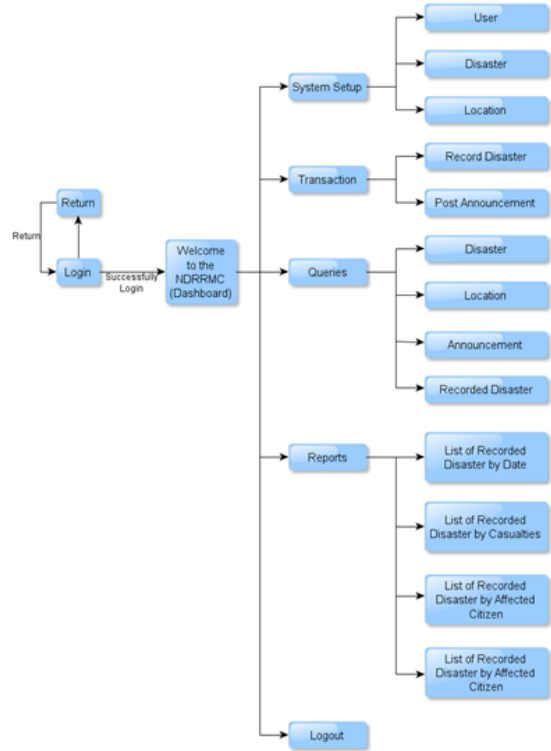

Fig. 4. Screen navigation diagram – administrator.

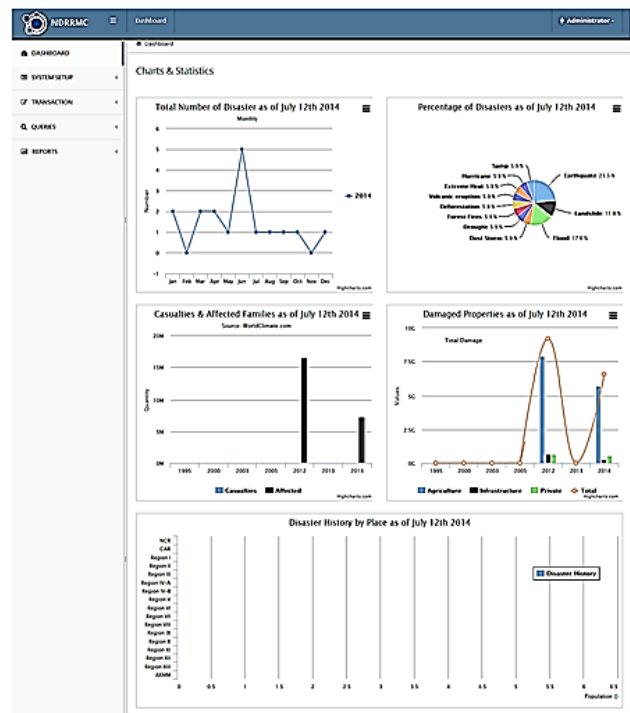Fig. 5. Screen navigation diagram — front-end user.

Fig. 6. Natural disasters dashboard.

Fig. 6 shows the dashboard page. It is a graphical presentation of information of the different disasters and it is divided into four parts showing different kinds of reports. The dashboard shows real-time updates of data entered into the database.

The Disaster Dashboard has a portal-like design for a user friendly Graphical User Interface which does not require expertise before anyone can view its contents.

The administrator side of the dashboard provides a log in screen to make sure that only authorized users are able to access the database of the system. Upon logging in, the system shows the main form which consists of four main options in the menu as shown in Fig. 7.

III. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The perceptions of the respondents made it clear that there is already a need to reengineer the existing disaster website in order to be responsive to the changing needs of the general public. Without any doubt, the Filipino people are keen on having a centralized natural disasters' historical database to allow worldwide to access that will make them aware of the global disasters.

The system relies on the inputs and it is dependent on how it is appropriately managed by the administrator.

The dashboard is designed using a graphical user interface to make it more user-friendly that does not require expertise before it can be opened.

B. Recommendations

1) The study recommends reengineering of the existing disaster website in order to be responsive to the changing needs of the general public.

2) The study supports the clamor of the Filipinos worldwide to have a centralized historical database of natural disasters and make it more organized and properly maintained. In addition, the study recommends that the concerned agency be tasked to further study the data requirement of a more complete database.

3) Through the study at hand, the researcher would like to bring it to a greater complexity to involve the public in gathering disaster data by employing a mechanism that will filter the data.

4) The mechanism can be in a way that it accepts data from the public which would mean additional attributes for the disaster database. This will require a thorough analysis of the database structure.

5) A "free format" structure of the reporting scheme and a mobile display can be made possible for future enhancements of the system.

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Remedios G. Ado is a doctor in educational management graduate of the Polytechnic University of the Philippines (PUP). She was a financial scholar of the same university when she graduated with a bachelor of science in computer engineering. She took up her master in computer engineering from the Pamantasan ng Lungsod ng Maynila. She was likewise a colombo plan scholar of Sendai College, Japan. She is a consistent Outstanding Faculty of the PUP College of Engineering and has received prestigious academic awards from different award giving bodies especially in the field of research. She is at present an associate professor and concurrently the assistant director of the ICT Office of the Polytechnic University of the Philippines (PUP). She was a former chairperson of the MSIT program and the Computer Engineering Department of the Polytechnic University of the Philippines.

Rosicar E. Escober is a PhD in business management graduate of the Manuel L Quezon University. At present she is taking her PhD in information technology at St. Paul University, Philippines. She obtained her MS in information technology from De La Salle University in 1993. She likewise graduated in systems engineering course in 1991 as a scholar from the Center for International Cooperation for Computerization in Japan. She is a cum laude when she graduated in bachelor in computer data processing management from PUP. She is an associate professor V of PUP on a part-time basis handling ICT and business courses. She was the first chairperson of the MSIT program of the PUP Graduate School. Currently she is the IS head of the National Grid Corporation of the Philippines.

Agnes J. Masbate is a graduate of the Polytechnic University of the Philippines master of science in information technology with specialization in management information system. She graduated cum laude when she took up bachelor of science in education major in mathematics and minor in physics from the Bicol University. She took up computer programming from the Systems Technology Institute, Naga City and graduated with honors. She is at present an information technology officer II, designated as acting chief in Systems Analysis Section of the Systems Analysis and Network Management Division and as a Training officer of the management information system service at Department of National Defense.