Disaster Response Management and Monitoring System

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CERTIFICATION

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ABSTRACT

The immediate response of Department of Social Welfare and Services (DSWS) during and after a disaster is sufficient to cater the needs of the victims including settlement in evacuation areas, and food assistance. However, delay in the succeeding processes have been reported. This study takes a look at improving the management of disaster relief and support of DSWS through technology: cases in point are automation, barcode data-collection technology, and GIS mapping. A mobile application was developed to automate the registration of affected families, to use barcode data-technology for the capturing the assistance received by each registered family, and to use geo-tagged maps of the affected area to speed-up the validation process. A web application was also developed to provide a monitoring system of all the information collected during the registration, validation and distribution process. In general, the system was well-accepted by the personnel of DSWS who are incharge of field works related to registration of victims and distribution of relief assistance.

Keywords: ***disaster response, qr code, monitoring system, automation***

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Fire disasters result to devastating impacts on property and individuals, causing casualties or affecting a number of homes leaving its residents with traumatic experience or at worst cases, leaving them homeless. Worldwide, thousands of fire incidents took place in a year, and hundreds of them happened in the Philippines. In 2016, there had been 77 residential fire incidents that affected 16,195 families (73, 226 individuals) in which 10,485 of these families were left homeless which settled in evacuation centers provided by the government (Philippine Statistical Yearbook, 2017). These number of fire victims were assisted by the government by providing them possibly all the assistance they need. The Bureau of Fire Protection (BFP) has conducted several fire prevention seminars and their response to fire disasters has also improved. However, the number of fire incidents nationwide is still

uncontrollable. This leads to the continuous application of disaster management which aims to reduce, or avoid, the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery.

Most disaster management plans/cycle in most countries have four phases: mitigation, preparedness, response and recovery. One of these will be discussed in this study, i.e. response phase. A goal of disaster management is to assure prompt and appropriate assistance to victims of disaster which is achieved during the response phase. For any disasters including fire, the Philippine government has prepared a National Disaster Response Plan (NDRP) that prescribes relevant activities on how the disaster response shall be conducted, and the assignment of roles, tasks and responsibilities for each sectors or departments of the government, preparing them whenever a disaster occurs. The main purpose of disaster response is to provide immediate assistance to maintain life, improve health and support the morale of the affected population. Such assistance includes limited aid like food, health kits, relief packs, and temporary shelter like evacuation areas. The focus in the response phase in disaster management is meeting the

basic needs of the people until more permanent and sustainable solutions can be found. Per NDRP (2014), the Department of Social Welfare and Development (DSWD) is responsible in meeting these needs. At present, these responsibilities have already been passed to its sub-department, Department of Social Welfare and Services (DSWS). In Cebu City, DSWS is responsible for these disaster response activities.

The immediate response of both DSWD and DSWS during and after a disaster is sufficient to cater to the needs of the victims including settlement in evacuation areas and food assistance. However, delay in the succeeding processes have been reported. Some of these delays include the distribution of food packs and the distribution of financial assistance. For instance, the fire victims in Barangay Pusok, Lapu-Lapu City have to wait until their local government unit has requested for food packs from DSWD-7. According to DSWD-7 spokesperson Leah Quintana, there's a delay on the distribution of the food packs because they are still waiting for Barangay Pusok to submit their request for food assistance and the final list of the fire victims before they can distribute the food packs intended to augment the supply of the local government (The Freeman, 2017). The delay on the distribution of

financial assistance, on the other hand, is due to the delay of the validation process of the affected families as well as the delay on the processing of necessary documents. An example for this situation is the distribution of financial aid from the Cebu City government to those left homeless after the fire in Barangay Duljo-Fatima. According to Niñoza Pesania, Department of Social Welfare Services distribution officer, the distribution of the financial assistance is going smoothly, the only delay is when they have to verify whether or not a potential beneficiary is indeed a fire victim (The Freeman, 2019). In addition, it's stated in the executive order imposed by the Cebu City Mayor Tomas Osmeña that the delay in processing the financial assistance hinders the purpose of the financial assistance which is immediate amelioration of the conditions of the fire victims. To ensure the immediate assistance to the fire victims, Osmeña ordered all offices involving the process of the financial assistance to fire victims and other crisis situation to prioritize the documents of affected individuals. According to him, the document processing shall be treated first regardless of queuing and shall not be left untreated upon receiving of the said offices and departments (The Freeman, 2019).

These problems or challenges are attributed to procedural delays that can be readily resolved through technology. Utilizing technology to perform repetitive tasks can speed-up its completion without the human-induced errors brought by exhaustion. A case in point is the barcode data-collection technology, which is an effective way to improve the bottom line and meet the competitive challenges an organization faces everyday. With a barcode data-collection solution, capturing data is faster and more accurate, costs are lower, mistakes are minimized, and managing inventory is much easier (Datalogic Scanning Inc., 2017).

This study takes a look at improving the management of disaster relief and support by automating the fire victims' registration and validation, using barcode data-collection technology on the listing of distributed assistance, and by providing a real time monitoring system for a quick access on important data.

1.2 Research Objectives

1.2.1 General Objective

The main objective of this study was to improve the disaster response of DSWS by minimizing the delays on the distribution of relief assistance to the fire victims through automation, barcode data collection technology, and GIS mapping technology.

1.2.2 Specific Objectives

This study specifically aimed the following:

1. To analyze the processes pertaining to relief assistance distribution spearheaded by DSWS.
2. To design a management system built around QR Codes as a primary identification for recipients of DSWS assistance.
3. To develop applications using technologies available to DSWS personnel.
4. To evaluate functionality and usefulness of the management system.

1.3 Scope and Limitation

Fire incident is a worldwide problem affecting millions of properties and individuals. This study mainly focused on assisting the current assistance distribution process employed by the Department of Social Welfare and Services in Cebu City. The assistance distribution processes include the following: registration of affected families, validation process (whether or not the potential beneficiary is indeed a fire victim), and distribution of available assistances to the registered victims.

1.4 Significance of the Research

The delays on the disaster assistance distribution greatly affects the effectiveness of the disaster response of DSWS. Providing a more efficient and more effective disaster response will be beneficial not just for fire victims but also for DSWS. Most of the victims who have nowhere to go just settle in evacuation areas for a longer time and become dependent to the assistance given to them by the government or from other private donations. DSWS have to cater all the basic needs

of these fire victims as early as possible. In order to do this, it is important for DSWS to have a good management on each of the processes of their response system.

Through the automation of the registration process, the application of GIS mapping in the validation process, and implementation of barcode data technology to the distribution of assistance, this study is significant as it helps in minimizing the overall delay in the disaster response of DSWS. It benefits the fire victims who greatly need the assistance as early as possible. The digitalization of registration process provides a faster and more convenient registration process. It allows DSWS personnel to provide more than one registration area not worrying of duplication problems, as this study helps control multiple registration of the same family heads or family members. This study also helps in the validation of these victims. During the registration process, DSWS personnel are allowed to validate them, as this study provides maps of the affected areas. Through the maps, the fire victims can locate their houses and the personnel can then tag them as validated. Through barcode data technology, this study also provides a more efficient distribution process. The victims will use QR-

coded IDs in claiming their assistance. This way provides a faster distribution process since personnel only need to scan these ids. It also helps prevent the duplication of giving specific assistance to each registered family. Lastly, this study allows the DSWS personnel to monitor all the data collected during these processes through a monitoring system. This allows them to access needed information and needed documents for the processing of the next assistance and other processes. The data provided by the monitoring system can be the basis of DSWS in planning for their next response processes, thus, this study gives significance to DSWS as it will help provide an efficient response management system improving their disaster relief and support system.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Fire Disaster

Fire is often described to occur naturally or is normally used in controlled ways for productive purposes. Uncontrolled fire can be considered as a "disaster" when it destroys structure or property, when it causes direct or indirect death, injuries or other health damage to caught up in their occurrence, or when an uncontrolled fire causes broader economic and other impacts on individuals and society as a whole (Woodrow, 2012). Fire disasters can be classified into two: natural disasters which are fires caused by natural forces, and "anthropogenic disasters" which are fires caused by human actions such as negligence or errors. Also, fire destruction, as with most other natural disasters, is usually aggravated by anthropogenic activities; thus the fire hazards which are part of nature often turn into disasters due to human actions or inactions. Worldwide, actions are already implemented for fire disaster prevention, preparation, and even its management. But despite advances in knowledge and technology, fire disasters' vulnerability and risks have been rising in both the developed and developing countries. These risks and vulnerability to fire disasters have resulted from changes of people's lives socially, economically, culturally, politically and environmental contexts partly due to development as well as lack of development processes (Nasimiyu et al., 2017).

One common anthropogenic fire disaster is the residential structure fire. As used in fire data analysis, the term "residential" includes properties commonly referred to as "homes," whether one-, two-, or multifamily properties. Residential refers to a type of property—whether it is a building or other type of structure, or whether the property is the land or real estate itself. The term "residential structures" refers to all built structures (buildings and other non-building) on residential properties. The vast majority of residential fires, deaths, and injuries occur in buildings, and that is where prevention efforts are targeted most often (FEMA, 2018).

A yearly report on fire statistics has been published by Center of Fire Statistics (CFS) which includes statistics on numbers and rates of fires, deaths and injuries due to fires, and on-duty firefighter deaths and injuries whether sustained at fires or not. Table 2.1 below shows an overview on the fire incidents in the world in 2012-2016. It is evident that the number of fire incidents worldwide has increased in 2016 compared to the previous years. The statistics also shows a big increase in the number of deaths in the same year.

Table 2.1. Total reported fire statistical data, by country, 2012-2016
World Fire Statistics, Center of Fire Statistics 2018

Year	Number of countries	Total population, bln.inh.	Number of fires, mln.	Number of fire deaths, thous.	Average number of fire per 1000 inh.	Average number of fire deaths	
						Per 100000 inh	Per 100 fires
2012	35	1.1	3.1	23.7	2.8	2.2	0,8
2013	31	1.1	2.5	21.7	2.3	2.0	0.9
2014	32	1.1	2.7	20.7	2.5	1.9	0.8
2015	31	1.0	3.5	18.4	3.5	1.8	0.5
2016	39	1.1	3.0	18.0	2.7	1.6	0.6
Average	39	2.5	3.7	43.2	1.5	1.7	1.2
Total			18.5	145.7			

2.2 Fire Incidents in the Philippines

According to Velasco (2013), fires are the most expensive preventable emergency in the Philippines, but are relatively unstudied. For the year 2018, the Bureau of Fire Protection or BFP started promoting fire safety among school children and is now conducting

house-to-house campaign to teach household members basic knowledge about fire and how to deal with it. The Fire Prevention Month in the Philippines is a yearly activity observed for over 5 decades now under the Presidential Proclamation 115-A (FO1 Bautista, 2018). But even though the BFP, together with the government, is promoting fire safety and advancing their technologies, fire incidents in the country is still a problem.

For the year 2015 and 2016, an official statistics of the fire incidents was recorded and was published by Philippine Statistics Authority on its 2017 Philippine Statistical Yearbook. Table 2.2 below shows the statistics of the damages caused by man-made disasters which includes fire incidents. The data for these incidents are highlighted by the red bordered box.

Table 2.2 Damages Caused by Man-made Disasters
Philippines Statistical Yearbook, 2017

Disaster	Number	Casualties			Affected		Evacuated		No. of Evac.	House Damaged		Cost of Damages
	of Incidents	Dead	Injured	Missing	Families	Persons	Families	Persons	Centers	Totally	Partially	(in Million pesos
2016												
Grand Total	248	393	5,725	26	378,673	1,736,985	61,556	274,100	352	5,028	3,031	14,326,286
B. Human induced Incidents												
Air Accident	2	0	0	2	0	0	0	0	0	0	0	0.00
Ambush/ Shooting Incident	2	2	2	0	0	0	0	0	0	0	0	0
Armed Conflict	10	10	70	0	14,557	69,295	5,278	24,990	12	0	0	0
Civil Disturbance	2	0	0	0	0	3,000	0	0	0	0	0	0
Collapsed Structure	2	4	9	0	0	0	0	0	0	0	0	0
Disease Outbreak	9	62	4,575	0	0	0	0	0	0	0	0	0
Drowning	7	7	0	4	0	0	0	0	0	0	0	0
Fire Incidents	77	28	124	1	16,195	73,226	10,485	48,327	45	4,641	449	90,555
Food Poisoning	6	1	184	0	0	0	0	0	0	0	0	0
Grenade/Bomb Explosion	11	19	199	0	0	0	0	0	0	0	0	0
Pest Infestation	1	0	0	0	152	742	0	0	0	0	197	0
Maritime Accident	7	10	69	3	0	0	0	0	0	0	0	0
Missing Person	1	0	0	9	0	0	0	0	0	0	0	0
Oil/Chemical Leak	4	0	40	0	0	0	0	0	0	0	0	0
Burning Soil	1	0	0	0	0	0	0	0	0	0	0	0
Vehicular Accident	38	203	362	0	0	0	0	0	0	3	0	
Sub-Total	180	346	5,634	19	30,904	146,263	15,763	73,317	57	4,644	646	90,555
2015												
Grand Total	302	276	3.862	59	1.606.990	7.579.504	61.053	300.011	199	3.614	2.899	14.447.873.00
Air Accidents	2	2	6	0	0	0	0	0	0	0	0	-
Ambush Incidents	1	2	3	0	0	0	0	0	0	0	0	-
Armed Conflict	27	33	22	1	39,293	197,818	18,849	94,624	62	45	3	19,410
Caving Incidents	1	1	0	0	0	0	0	0	0	0	0	-
Civil Disturbance	1	0	7	0	0	0	0	0	0	0	0	-
Collapsed Structure	6	14	16	0	0	0	0	0	0	0	0	-
Disease Outbreak	3	0	101	0	0	0	0	0	0	0	0	-
Drowning	9	13	0	1	0	0	0	0	0	0	0	-
Electrocution	2	3	5	0	0	0	0	0	0	0	0	-
Fire Incidents	101	67	131	1	11,746	56,492	7,112	33,264	20	3,319	1,472	424,515
Food Poisoning	14	1	2,945	0	0	0	0	0	0	0	0	-
Grenade/Bomb Explosion	16	12	130	0	0	0	0	0	0	0	0	-
Hostage Taking	1	1	0	0	0	0	0	0	0	0	0	-
Maritime Accident	12	5	14	30	0	0	0	0	0	0	0	-
Mining Incident	1	0	2	0	0	0	0	0	0	0	0	-
Oil/Chemical Leak	5	0	15	2	0	0	0	0	0	0	0	-
Train Accident	1	0	70	0	0	0	0	0	0	0	0	-
Vehicular Accident	30	51	327	0	0	0	0	0	0	0	0	-
Sub-Total	233	205	3,794	35	51,039	254,310	25,961	127,888	82	3,364	1,475	443,925

The table clearly shows that the number of man-made fire incidents in the Philippines is higher in 2016 affecting 16, 195 families than in 2015 which affected 11, 746 families.

Another data from FO1 Bautista, the number of fire incidents nationwide reached a record high of 14, 197. This record includes all types of fire incidents. As shown in Table 2.3 is a summary of the fire incidents nationwide in 2017. This includes the amount of damages caused by the incidents and the number of individuals being affected by it.

Table 2.3. Fire Incidents Summary, 2016-2017
FO1 M.F., Bautista, Bureau of Fire Protection

	2016	2017	%
Fire Incidents	19, 292	14, 197	-26.41
Structural	8, 884	7, 886	-11.23
Non-structural	9, 387	5, 313	-43.40
Vehicular	1, 021	998	-2.25
Damages	Php 3, 079, 545, 138.04	Php 7, 861, 505, 751.04	155.28
Civ Dead	285	304	6.67
Civ Injured	894	835	-6.60
BFP Injured	93	54	0.00
BFP Dead	0	0	-41.94

These fire statistics nationwide includes fire incidents occurred in Region 7, specifically in Central Visayas which is the scope of this study. Data of BFP shows that Central Visayas saw 1,246 reported fire cases in 2015, up to 28 percent from 2014's 977. In these figures, 627 and 578 happened in Cebu province in 2015 and 2014, respectively. Most of the fire incidents were structural in nature. There were 1,568 structural fires logged in 2014 and 2015 and 1,072 of these fires occurred in residential areas affecting hundreds of families (The Freeman, 2016). The statistics of BFP 7 showed there were 622 fire incidents in 2017, which was 26.13 percent lesser from 842 fire incidents in 2016 (Sunstar Philippines, 2018).

2.3 National Disaster Response Plan (NDRP)

The Philippine government has prepared an official document where their response to hydro-meteorological hazards are written. This document is entitled National Disaster Response Plan (NDRP) and will be revised/updated accordingly by the Office of Civil Defense (OCD) in partnership with the Department of Social Welfare and Services (DSWD). The NDRP promotes the appropriate activities on how the disaster response shall be conducted as augmentation or assumption of response functions to the disaster affected LGUs. It also includes identifying roles and responsibilities of organizations/institutions during disaster phase. Table 2.4 shows the eight response clusters under NDRP and their respective objectives.

Table 2.4. Response Clusters under NDRP
National Disasters Response Plan, 2014

Cluster	Objectives
Food and Non-food Items (FNI)	aims to provide augmentation of food and non-food items to the affected LGUs in cases where pre-positioned resources are used up during disaster period.
HEALTH (WASH, Health, Nutrition and Psychological Services)	aims to provide support for a timely and appropriate public health services to the affected population.
Protection Camp Coordination and Management (PCCM) (Previously, Camp/IDP Management, Emergency Shelter and Protection)	aims to provide assistance and augment all requirements for the management and evacuation of individual's families affected by disasters.
Logistics	aims to provide an efficient and effective logistics coordinating structure that will harmonize the activities of all clusters and encourage regular info-sharing among all stakeholders and other partners.
Emergency Telecommunications (ETC)	aims to strengthen ICT capacities at the national level down to local levels to prepare for, respond to and recover from the impacts of disasters by providing a timely, resilient and predictable
Education	aims to ensure safety of learners and DepEd personnel. It also aims to provide continued access to quality of education to all affected learner.
Search, Rescue and Retrieval (SRR)	aims to provide support for an effective, timely, organized and systematic search, rescue and retrieval operations to affected areas in all emergencies to further minimize loss of lives and casualties, including the hand-over of casualties to the Health Cluster for proper treatment and management
Management of the Dead and the Missing (MDM)	aims to provide assistance in the proper identification and disposition of the remains in a sanitary manner with cautions to prevent negative psychological and social impact on the bereaved and the community.

Figure 2.1 shows the flows of how response is implemented. The response to be given is based on situation on the disaster area. Analysis

will be done in order to assess the level and type of response each clusters must implement. After analyzing the situation, planning and strategizing will follow. After that, each clusters will be assigned to certain tasks for their response and finally, implement the response. The process will be a cycle and each implementation will require feedbacks. Feedbacks will be used to improve their processes.

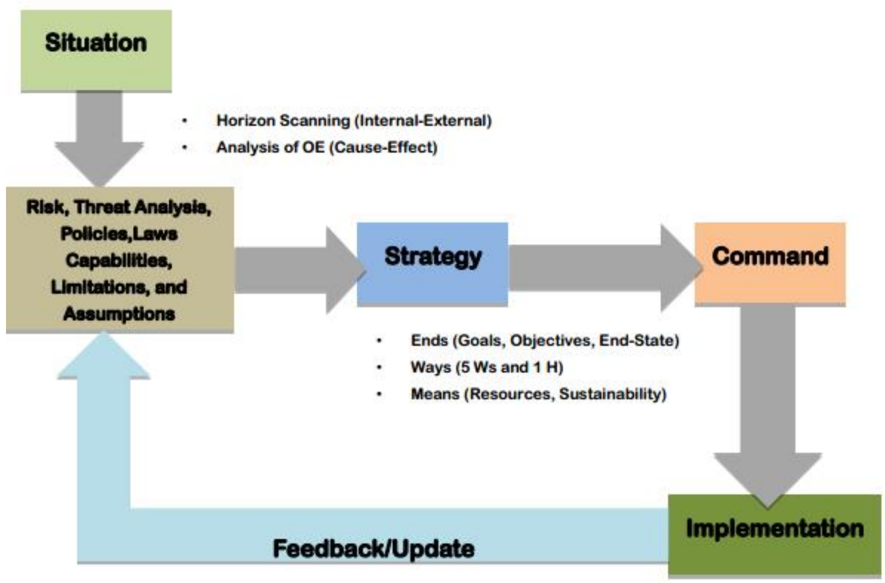


Figure 2.1. Concept of Operations of NDRP
National Disaster Response Plan, 2014

Fire is one of the disasters considered in the NDRP. An article by International Federation of Red Cross and Red Crescent Societies (IFRC) presented an emergency plan of action for Manila fire incident. The methods done for the response is closely the same to the concept of operation of NDRP. The emergency plan assisted around 9000 people (1800 families). The emergency plan of action has three parts: (1) Situational analysis, (2) Operational strategy and plan, and (3) Detailed Operational Plan. The situational analysis includes the providing of description of the fire disaster, summarization of the current response and analysis on the needs, beneficiary selection, risk assessment, and scenario planning. After the analysis is operational strategy planning. This operational plan is fully in line with current Philippine Red Cross (PRC) and IFRC policies, procedures, and commitments, and seeks to provide immediate support to families most affected by the fire. Lastly is to provide a more detailed plan based on the analysis and strategies being discussed and planned (IFRC, 2015).

2.4 Emergency Assistance for Fire Victims

As stated the NDRP (2014), Department of Social Welfare and Development (DSWD) through the Disaster Risk Reduction Operations Office will head and lead the coordinating functions of the cluster in implementing the operational concept of NDRP. The responsibilities of

DSWD at each disaster phases can be seen in Appendix C. These response plan under DSWD mainly focuses on the disaster victims.

The response provided by DSWD during pre-disaster phase is purely for preparation purposes. In during disaster phase and post disaster phase, DSWD's response aims to provide, if possible, all the needed assistance of the disaster victims. They provide evacuation areas, call for volunteers for the preparation and distribution of food and non-food items, and preparing the needed assistance of the victims including financial assistance.

A fire that hit Barangay 20, Zone 2, District 1, Tondo, Manila last February 2017, the DSWD through its field Office (FO) in the National Capital Region (NCR) immediately extended assistance to 2,057 families or 8,055 individuals affected by the incident. The DSWD-FO NCR gave 3,000 family food packs (FFPs), 12,000 bottled water, 3,000 mats and 3,000 blankets to the local government of Manila for distribution to the affected families (DSWD, 2017). Another fire incident last April 2017, DWSD provided family food packs and non food items to families affected by a recent fire in Banana Compound, Basas II, Barangay Zapote, Las Piñas City. According to Ruth Anonuevo, LGU worker, the fire affected an estimated total of 300 families, of which 194 are currently staying inside the Zapote Elementary School which now serves as an evacuation center (DSWD, 2017). Another fire incident in Mandaluyong City affected 1,800 families. 603 families who lost their homes due to the fire received P3,500 each today as financial aid from the DSWD. There were delays in the distribution of the P3,500 cash assistance because it first had to be ensured that the validated families had been first given relief packs. The affected families received P4,094,030.00 worth of assistance from the DSWD-NCR, which includes: 3,000 Family Food Packs (FFPs), 12,000 pieces of malong, 6,000 pieces of plastic mats, 15,000 bottled water, and 100 pieces of used clothing. Aside from the financial aid and relief goods, the Department also started the registration for affected residents who are interested to join the DSWD Cash-for-Work (CFW) Program (DWSD, 2016).

Fire victims assistance provided by DSWD doesn't only apply in NCR but also extends to the whole country. Even fire victims in Cebu province are given these type of response. 80 families affected by fire in

Barangay T. Padilla, Cebu City last July 9, 2018 received assistance from the government and a private foundation. Each of the 500 individuals affected by the fire was given food packs from DSWD containing six kilos of rice, canned goods, and coffee. There were also kitchen utensils from the foundation. DOLE-7 enrolled the fire victims to the agency's cash for work program wherein they are paid P366 a day for 10 days to clean their surroundings. Last August 1 2018, at least 221 families who have been displaced by fire that hit two neighboring barangays in Cebu City received relief goods from the national government. Of the victims, 149 families are from Sitio Kauswagan in Barangay Basak Pardo, while 72 families are from Sitio Sto. Niño in Barangay Kinasang-an Pardo. The city Mayor assured to give each family P20,000 cash and housing materials to help them start rebuilding their homes. But delays on the distribution of some of these assistance occur in some affected areas. DSWD still have to wait for barangay to submit their request for food assistance and the final list of fore victims before they can distribute the food packs intended to augment the supply of the local government. There's also a delay on the distribution of financial assistance because it first had to be ensured that the

validated families had been first given relief packs. Delays on the preparation of some documents also causes delays on the distribution of assistance, which are supposedly needed to be distributed as soon as possible. According to DSWD's "Disaster Response Operations Guidelines" (2015), Figure 2.2 below illustrates in greater detail the weaknesses of their disaster response system in 2015 that might be the reason for these delays.

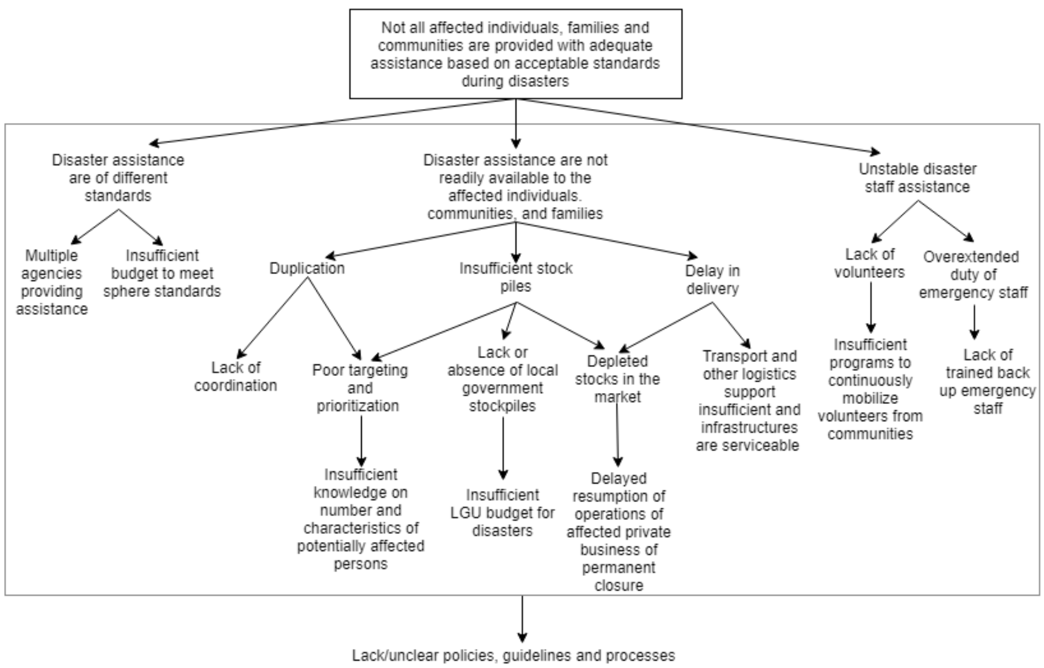


Figure 2.2 Problem Tree Analysis of DSWD's Disaster Response in 2015

This problem tree was developed based on the findings of focus group discussion participated by representative's from DSWD's central

and field offices involved in the planning, programming, management, implementation and funding of the department's disaster response operations.

Other than providing the needed assistance of the disaster victims, in concomitant to the DSWD's disaster operations, is also the accountability and/or transparency on the utilization of resources, especially considering the inflow of donations from local and international donors for the affected populace. In partnership with Inter-Faith Groups (Catholic Bishops Conference of the Philippines (CBCP), the National Council of Churches in the Philippines (NCCP) and the Philippine Relief and Development Services (PHILRADS)), it is their responsibility to provide operational guidelines in the monitoring of disaster relief distribution, institute transparency and accountability in government's disaster relief operations consistent with existing policies on equitable distribution, maximize utilization and ensure equitable distribution of resources during disaster relief operations, encourage participation of non-government organizations (NGOs), civil society and other stakeholders in disaster relief operations, and to identify problems and recommend workable solutions for the

enhancement of disaster relief operations (AO 008, s.2006). Figure 2.3 below shows the flowchart for disaster relief distribution monitoring.

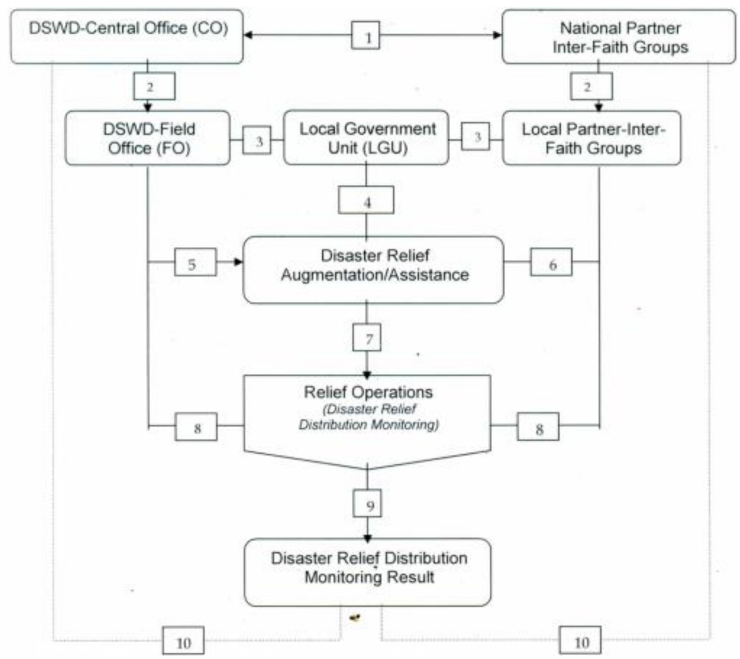


Figure 2.3 Disaster Relief Distribution Monitoring Flowchart

As shown in the figure, the relationships between involved offices and activities in the disaster relief distribution monitoring are labeled with numbers. Table 2.6 shows the description of these numbered relationships.

Table 2.5 Disaster Relief Distribution Monitoring Flowchart Description

Number	Description
1	Close and continuing coordination between the DSWD-CO and the National Partner Inter-Faith Groups in the disaster relief distribution monitoring efforts.
2	The DSWD-FOs and local inter-faith partner groups take direction from their corresponding central and/or national offices.
3	The DSWD-FOs, local inter-faith partner groups and the LGUs establish close coordination in the disaster relief distribution monitoring efforts.
4	The LGUs receives relief/augmentation from the DSWD-FOs.
5	The DSWD-FOs extend relief augmentation/assistance for disaster affected LGUs.
6	The local inter-faith partner groups are informed on the release of augmentation/assistance to disaster-affected LGUs for relief distribution monitoring.
7	The LGUs takes the lead in disaster relief operations with support from national agencies, non-government organizations (NGOs) and other stakeholders.
8	The DSWD-FOs extend technical assistance to the LGUs in the relief distribution efforts.
9	The local inter-faith partner groups conduct disaster relief distribution monitoring and come up with independent findings on the relief distribution efforts
10	The local inter-faith groups submit its findings/reports to the DSWDFOs, copy furnished the DSWD-CO and national inter-faith partner groups on the disaster relief distribution monitoring. Reconciliation, discussion and resolutions of issues, concerns and/or clarifications undertaken with corresponding recommendations and workable solutions.

2.5 Application of Technology to Disaster Management

Most countries are using geographic information system (GIS) and remote sensing (RS) technologies in their disaster management process. Both are useful in disaster management applications, decision making, mitigation strategies and preparedness plans. GIS is used for hazard zone mapping and allows mitigation of people possible using these maps during emergency conditions. It is also very useful in modeling disaster risks and human adaptations to hazards. GIS provides information that is beneficial to disaster management involving the affected disaster victims. These information includes planning of evacuation and operation, management of rehabilitation and post-disaster reconstruction, suitable locations identifying scientifically for construction of houses and shelters, and hospitals and medicine facilities identification for injured people (Pore, 2013). In the Philippines, GIS became a complementary tool to remote sensing for providing spatial information, decision makers, and other users. Both GIS and RS technologies are now used for typhoon monitoring and also improved weather forecasting activities that provided vital information for damage mitigation and disaster management as well as to improve the welfare of a greater number of people in the society (Santos, 1999).

Other than GIS and RS, some developed countries also used other disaster management systems to provide support to disaster victims. In

USA, there are a lot of systems available to the people, more specifically for fire disasters, such as training tools, incident command systems, firefighter rehab system, and mass casualty incident system. One example of these is the "All Risk®: Wristband Triage Tag with Linked Patient Association Receipt System". The wristband triage tag developed by Disaster Management Systems provides first responders with a tool to identify process and triage contaminated patients. The tag also provides rescue personnel with a means of tag and identity clothing and personal property. The system's standard features include blast injury indicator, applied tourniquet, airway management, glasgow coma scale indicator, and known allergies area. The Link-enabled extension of the system has the following features: three linked receipts with barcodes, create multiple links for any patient, writing area for descriptive notes, adhesive back to fix to objects ot tags, form into loop for fastening to collars, and high visibility that patients is linked (Disaster Management Systems, Inc., 2018) In simpler terms, this technology is used by injured fire victims to easily determine their current conditions. This allow rescuers to easily identify what are the needs of the victims.

According to Nace (2017), one of the most useful tools when it comes to responding to disaster is their phones. Numerous applications are now available which targeted toward saving people's lives during an emergency. Two of these examples are providing medical ID's and the FEMA (Federal Emergency Management Agency) app (Nace, 2017). Medical ID is a feature of Health apps on Iphones that helps first responders access the critical medical information of a victim from the Lock screen, without needing its passcode. In this ID, information can easily be seen such as allergies and medical conditions as well as who to contact incase of an emergency (Apple, Inc., 2018). The second application is the FEMA app. FEMA app allows its user to receive real-time alerts on upcoming disasters; learn emergency safety tips for over 20 types of disasters, including fires, flooding, hurricanes, snowstorms, tornadoes, volcanoes and more; locate open emergency shelters and disaster recovery centers in their area where the user can talk to a FEMA representative person; prepare for disasters with customizable emergency kit checklist, emergency family plan, and reminders; and connect with FEMA to register for disaster assistance online (FEMA, 2018).

The systems and applications above are effectively used in most developed countries. Technology in the Philippines, on the other hand, is more focused on disaster preparedness and risk reduction. The government's response to disasters is quick but in most cases, all these responses and actions are done through manpower. It is undeniable that the technologies in the Philippines that focuses on managing the victims are still unadvanced.

2.6 Barcode Data Collection Technology

According to Datalogic Scanning Inc. (2017), a barcode refers to an "optical Morse code" where series of black bars and white spaces of varying widths are printed on labels to create unique identity to items. These barcode labels are read with a scanner, wherein reflected light is being measured and codes are interpreted into measures numbers and letters that are passed on to a computer. In most applications of barcodes, they are designed to eliminate manual entry and error. In the modern technology, barcodes can already be scanned using software barcode scanners. To generate barcodes, one must use a barcode font,

component, or application. Once the barcode is created, data can be seen by connecting the scanner to a computer device, open an application, and scan the barcode. In the case of the database entry search, the scanner simply places the data into a particular field that is used for a search. The application handles the data it receives (IDAutomation.com, Inc., 2012).

Barcodes these days are used for data collection. This kind of technology is called barcode data-collection technology, which is an effective way to improve the bottom line and meet the competitive challenges an organization faces every day. Barcode data-collection solution is designed to capture data in a faster and more accurate way, lower costs, minimize mistakes, and makes managing inventory much easier. Barcode data entry has many benefits. Firstly, it is a fast and reliable feature for data collection. It allows recording data to be faster with 10,000 times better accuracy. It's second benefit is that it reduces costs. Labor costs are reduced since in many cases, this cost savings pays for the entire data-collection system. It also reduces revenue losses resulting from data collection errors. Using barcodes is also one of the best ways to reduce inventory levels and save on capital costs. Keeping

a tight handle on inventory can save significant amounts of money as it improves the data management. It is a factor of better decision making. A barcode system provides ease of gathering information, allowing manager make fully informed decisions that can affect the direction of a department or company. The barcode system can also be used for faster access to information (Datalogic Scanning Inc., 2017).

A term used in barcode technology called barcode symbology is a protocol for arranging the bars and spaces that make up a particular kind of barcode. There are two major symbology types: linear barcodes and two-dimensional (2D) barcodes. Linear barcodes are barcodes representing data in the widths (lines) and the spacing of parallel lines such as Code128, Code 39, and UPC. It holds less than 85 characters (symbology specific character limit) and creates a wide barcode. On the other hand, two-dimensional (2D) barcodes such as Data Matrix, PDF417, and QR Code, may have patterns of squares, dots, hexagons and other geometric patterns. 2D barcodes can hold hundreds of characters which also requires a 2D barcode scanner. With the same data, 2D barcodes creates a smaller barcode than linear (IDAutomation.com, Inc., 2012). The scope of this study includes data

gathering from fire victims. With the advances of technology and benefits of barcode data-collection technology, the researcher believes that using barcode data-collection technology is best for the data collection of the system.

A type of two-dimensional barcodes namely QR Code will be used in this study. QR Codes or Quick-Response codes, are barcodes that are easily readable that when scanned with a QR decoder can translate the code into URL, telephone number, a bit of text, or other data (http://www.nyu.edu). With the current technology, QR codes are popular with mobile phone users as the barcode can be used to store addresses and URLS. QR codes can be scanned using a camera-enabled smartphone which has been coded to do things like display text, provide contact data or even open a webpage in the browser on the smartphone. By using standards, it ensures QR Code software can correctly read the code (Várallyai, 2012).

Today, 2D barcodes are commonly used because it is considered more secure, as the information they store is easily encrypted and allows for less room for error. QR codes also claims that they bridge the gap between the digital and physical worlds. In 2006, nearly 100% of the mobile users are already using smartphones that are capable of scanning QR codes providing unprecedented opportunities for brands to connect and share information with consumers or users (Stazzone, 2018).

2.7 Related Studies

QR codes are already used for a variety of applications including transport ticketing, entertainment, commercial tracking, product labeling/marketing, ecommerce marketing, operational instructions, facilities management, and so on (Stazzone, 2018). It can also be used to store personal information for use by government (Philippines National Bureau of Investigation where clearances now come with a QR Code). As of today, the number of QR codes uses are expanding.

QR codes are not only used in marketing or industrial aspects, but is also now used for agriculture. A study of Várallyai (2012) on how they want to change their barcode identification system to QR codes is an example for this. According to Várallyai (2012), the main goal of using QR codes in agriculture in most cases is the traceability or monitoring of the system. In this case, the study is more focus on the point of view of horticulture. For advanced gardeners, things like growing hybrids and/or a special genus of plants can be remarkable and also educational process. It is becoming a more common site to go to botanical gardens and find a QR Code identifying the plant that a customer is admiring. Some plants are poisonous and adding a QR Code that explains the potential hazards of dangerous plants, people can educate themselves on the proper identification, use, and handling of these plants. By adding a QR Code near price tags, it can give potential customers recipes, preparation tips and allergy information, instantly. By describing allergy symptoms and advices what to do if it occurs to customers the peace of mind of knowing that they are safe. The contents, which can be seen on the QR code are the followings: common name of the plant, the Latin name and pronunciation, zone information, size dimensions, bloom time, sun and soil preferences. Later they can put pictures about the flowers on it and so on. Using this new technology, the partners can be monitored and traced the appropriate and bought flowers during and after the transportation (Várallyai, 2012).

QR codes is also now used in check-in systems which is a basic module being used in almost every company, school or organization in order to take note the diligence level of their workers or students. Viet Quan Mai (2014) of Frankfurt University of Applied Sciences created one of those check-in systems using QR codes. According to Mai (2014), one-dimensional barcodes works perfectly with laser scanner, while QR codes are friendly with cameras. QR codes are encoded to pixels, thus camera can well-recognize and decode. Normal barcode can work with camera if we can set a very thin "Region of Interest" (ROI), which is our own "laser". But to perform such a small ROI for recognizing barcode needs too much work and research, it becomes senseless to combine Barcode with Camera. Therefore, since Mai (2014) wanted to build an Image Processing System with camera, he proposed that QR code is a good solution. Mai (2014) created a simple check-in system where in every attendance would have an identity card. Information on the card would be name, his basic info and a distinctive QR-Code. Every time a person walks through the door, the camera will catch the code on the card and decoding. If data on the code has registered for the

course, the name will be check-in and a check-in photo will be saved. The photo name contains the name that being read on the code.

In Mai's project, used three important subjects: routine - QR code, programming language - LabVIEW, and database keeper - SQL Server. His project is consist of two parts: the QR code detection part and the database processing part. Figure 2.4 shows a flowchart of the initial system planning of his project. It is the base to build the system of the project comprises by the QR code detection phase and database processing phase.

QR code detection is the first thing that Mai (2014) pointed out in his project because it is the heart of the system, the core before doing any next step. He showed the technique to read images from a camera, basic of image processing based on experiments for a better image input, and finally QR Code reader, which are all programmed on the software he used called LabVIEW.

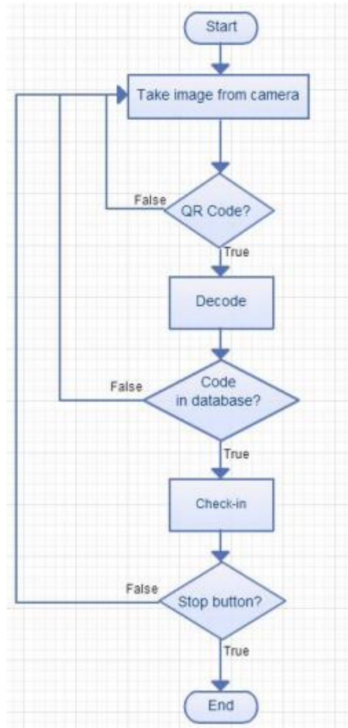


Figure 2.4. Check-in System Initial Planning
(Mai, 2014)

The QR code detection part of the development has 3 components: the camera, image processing, and the QR code reader. These three are combine to detect and read the QR code all programmed using LabVIEW. The second part of the development is the database processing part. The database will be used to store and check the data being scanned from the QR codes. Mai used a software named SQL Server Management Studio 2012. This part has also three subparts which are (1) building the database, (2) data processing from LabVIEW, and (3) accessing the database using TCP/IP. The programmed QR

code detector in the LABVIEW will be connected to the SQL Server for data processing.

Another study of Ansingkar et. al (2015), the Smart Shopping application, which presents the methods on collaborating ease in online shopping and the sense of security money wise as well as for customer satisfaction while doing shopping offline. This project is implemented using an Android application. In Offline mode, the customer needs to physically pick up his purchase, carry cash, credit/debit cards along with them and wait in the long queue to make payments. In this application, the barcodes of the products will be read and be added to its shopping cart. The application also provides an edit list where the customers can change the quantity of the products they purchased. At the same time, the application will notify its customers of the store's ongoing offers. Payment can be according to customer convenience. In the proposed work, the user will scan the item which he wants to purchase with the help of scanner provided by the application. After scanning an item, a web service will get called and it then creates a connection with the database of the shop. As the connection is established, the user will be synced with the database and information

related to that item is provided to the user. In the whole procedure the overall time of scanning of individual items is saved and thus reducing the time of the shopping. As a requirement for this system, the shop must have Wi-Fi facility and that the users have installed the application. On the client side, a Web Service and a database are required. Smart Shopping application uses an architectural style, REST (Representational State Transfer) protocol, as a web service for the app. REST is a set of guidelines for creating web services. The shop's database is designed using MYSQL workbench. The shop's database is consists of six tables: the inventory system, item table, shoppers details, shopper session, store details, and final order table. The Smart Shopping has the following features: (1) reduces scanning time, (2) personalization of items, (3) maintains history of purchased products, (4) Provides information regarding discounts and offers (Ansingkar et. al, 2015).

In this project, a mobile application was created with related features that the Smart Shopping application has. The difference of the Fire Victims Assistance application and the Smart Shopping application is that the Fire Victims assistance app uses QR codes instead of linear barcodes. Using the study of Mai (2014) and Ansingkar et. al (2015),

methodologies were combined in order to create the features needed for the fire victims assistance data recording and monitoring with the use of QR codes, given than in the modern technology, the use of QR codes has more benefits compared to using the traditional barcodes.

CHAPTER 3

METHODOLOGY

This study aimed to develop two outputs: a mobile application for the registration and validation of fire victims and the recording of the distributed assistance that each registered family receives; and a web application for the monitoring system of all the data collected during the disaster response activities and other functionalities such as generating QR coded IDs and printable lists of available data. This chapter presents the details of the development of these core outputs.

3.1 Research Design

To implement this project, an iterative model of software development life cycle (SDLC) was used. Figure 3.1 below is an iterative model by Powell-Morse (2016) which was the basis of the project development.

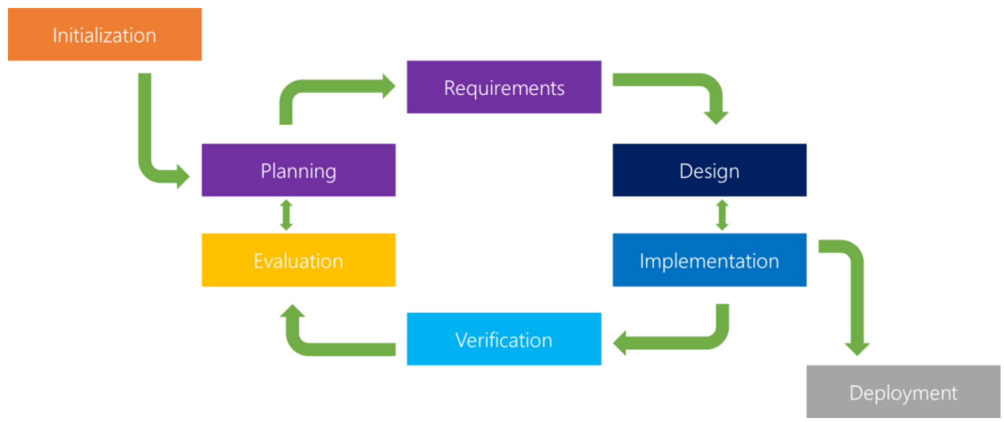


Figure 3.1. Iterative Model by Powell-Morse (2016)

The iterative model allowed a cyclical process in the development of the system in which stages were repeated over and over resulting to different versions that were incrementally improving in every iteration. Planning and requirements gathering were done to better understand the current system that DSWS is using and to gather requirements that might be included as functionalities of the project. Next was the analysis and design, which completely pictured out how the project would look like. In this phase, the system flow and the project functions were identified. The implementation process then followed, where the mobile and web applications were developed. The bidirectional connector between Design and Implementation processes in Figure 3.1 means that the design of the system is changeable based on the results of the implementation process. Testing and evaluation were done after the

development/implementation process. This part assessed the the project output and identified what to improve for the next iteration.

The implementation or coding process in the project life cycle was composed of three parts, one was for the development of the mobile application; the second one was the development of the web application; and lastly was the linking the mobile application to the web application. Figure 3.2 below is the detailed process flow of the software development cycle of the project containing the three parts under the implementation process.

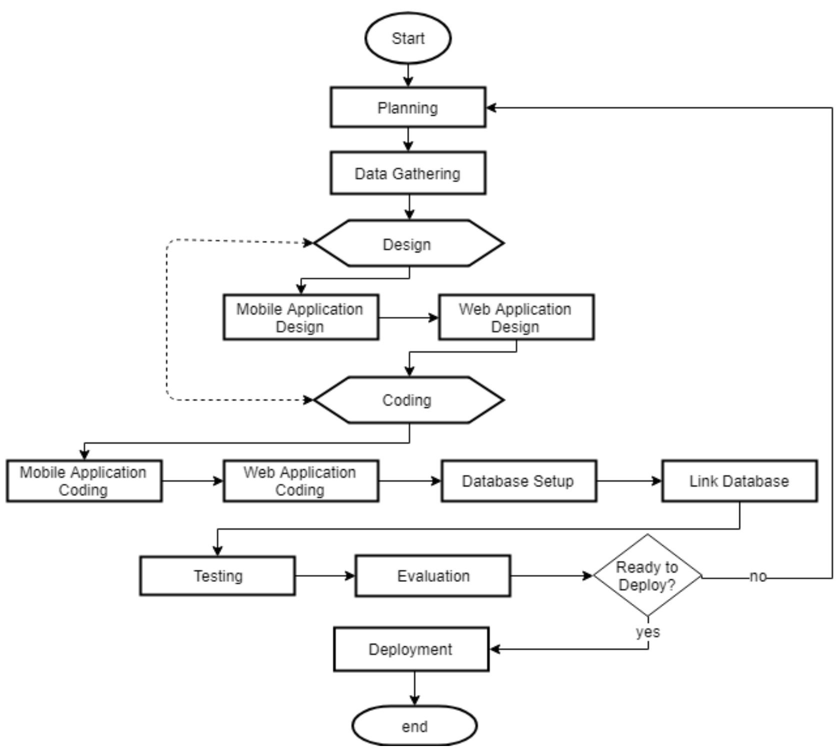


Figure 3.2. Project Development Process Workflow

3.2 Data Gathering

In gathering the system requirements, the researcher conducted an interview with Ms. Marietta Archeo, a DSWS' head for the fire victims assistance distribution. The interview aimed to collect information such as the list of all the available assistance that the fire victims could avail, required information in registering the fire victims, process flow of their current distribution system, documents required before the assistances were distributed, and the technology they were using for the distribution management. These information were very important requirements before the implementation of the project even starts. These were the basis for the mobile and web application functionalities.

The other requirements were collected during the reviews conducted with DSWS personnel at each iteration.

3.3 System Design

The mobile and web application design were highly dependent on the data being collected from the interview. These data were the basis for the mobile application's input to the database, and also the basis for the database's output to the web application. The deliverables of the design phase included the system flow starting from the registration of fire victims to distribution of the assistance, and the mobile and web application functionalities or features.

3.3.1 Proposed System Design

Figure 3.3 below was the proposed architectural design of the system. It describes the process flow of the system and external actors (DSWS, fire victims) and their interaction with one another. This architecture was the basis for the implementation of both mobile and web applications.

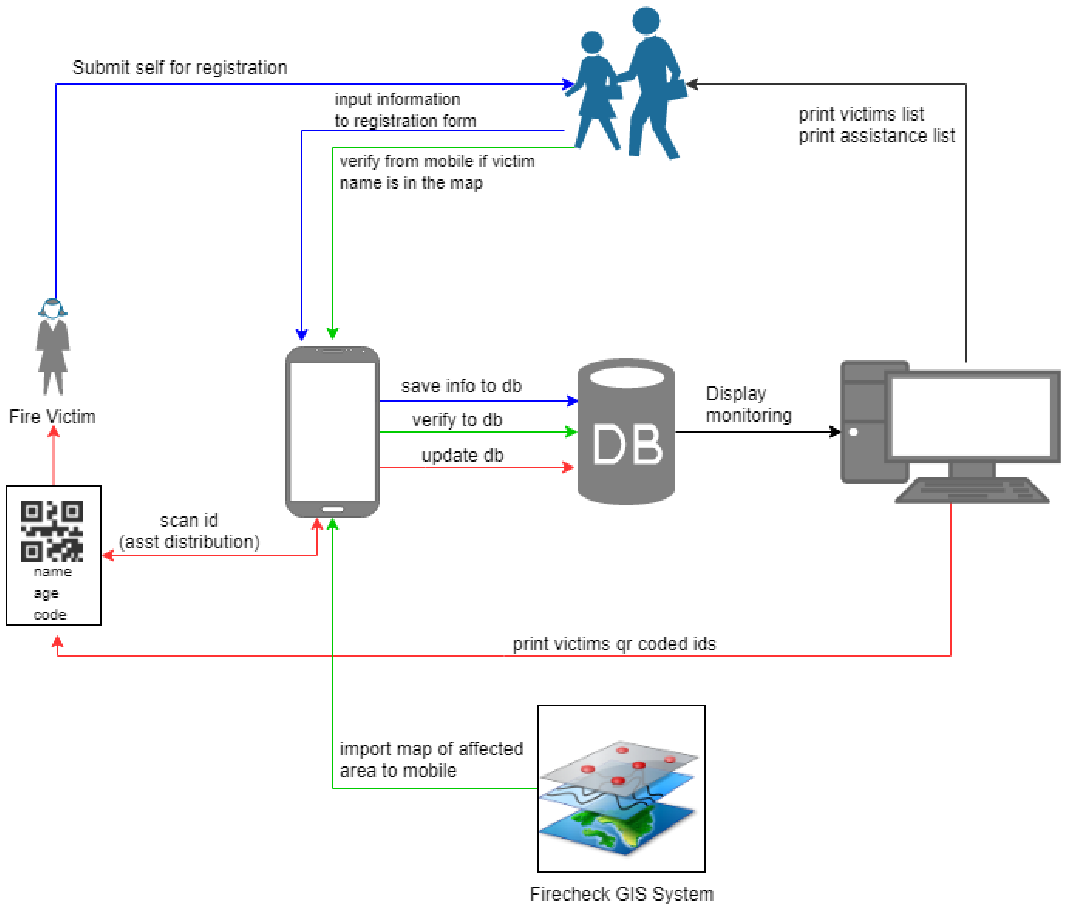


Figure 3.3. System's Architectural Design

Once the fire victims have settled to the provided evacuation areas, the response operation of DSWS will then start. Personnel will disperse inside the evacuation areas to commence the registration process. Before the registration starts, a new instance of fire incident will be created through the mobile application. At the same time, Firecheck will be sending access tokens for the map of the affected area of the fire incident. Here, a personnel can simply add a new table of fire incident, input necessary information as well as the access tokens given by Firecheck to get the map that will be imported to the mobile application for the validation. Once added, the field worker can then proceed to the registration of victims validation of registrants, and distribution of assistances through the mobile app. A special feature makes use of a geo-tagged map to speed up the validation of fire victims.

Each family from the victims will have one representative, the family head, and submit themselves for the registration of their family. The registration and validation of the fire victims will happen in one place at one time. Once a family head has submitted for registration, the personnel can automatically validate if they are really affected by the fire by scanning through the map, looking for their house, and checking if the name found in the map matches to the name of the registered family head or can be related (e.g. husband or wife, brother or sister, etc). These validated victims will then be added to the final list of fire victims. If a family attempts to register and is not found in the map, their names will still be added in the final list but with specification of "Not validated". This specification will be added to the database for DSWS to keep track. The field workers can then validate these families separately. Once the final list is complete, the DSWS will provide IDs to these victims for the distribution of relief packs. The IDs will be generated by the web application and the personnel will just print them from it. Once the IDs and relief packs are ready, DSWS will then distribute them. During the distribution process, the field workers will only need to just scan the IDs of the victims using the mobile app. Once scanned, the data about the receipt of the relief packs is stored and can be monitored in the web-based monitoring system. The real-time update of the monitoring system will help DSWS control and monitor the status of the distribution of relief packs or other assistance from time to time.

3.4 Software Development

This phase has three parts: the mobile application development, web application development, and the database linking. Based on the system design, the mobile application will be used during the registration, validation, and distribution processes of the disaster response, and the web application will display a monitoring system of all the data collected during these processes as well as allowing DSWS personnel to print necessary printables like IDs, list of victims, and other basic documents.

3.4.1 Mobile Application Development

The mobile application caters the following disaster response activities: the registration, validation, and distribution activities. It has 4 major functions: one is the creation of new fire incident data; second is the digitalised registration system; third is validation of victims through the maps provided by Firecheck; and lastly, the scanning of QR coded ids during the distribution of specific assistance to the victims.

The mobile application was developed using the Android Studio IDE (Integrated Development Environment). The navigation pages (termed as activities) as well as the registration form was completed using basic xml layouts. In accessing the map provided by Firecheck, Mapbox, an open source mapping platform for custom designed maps, was used to load the map to the mobile application. A shape file of the map of the affected area was uploaded as a dataset on Mapbox. A dataset is an editable collection of GeoJSON (a file format for map data e.g. names of house owners) features of the map. The dataset was then converted into a tileset, a collection of raster or vector data broken up into a uniform grid of square tiles. These tilesets are used to show the map of the incident area in the mobile device. A map ID was also generated together with the conversion of the dataset to a tileset. This map ID was used to display the map into the mobile application.

The QR code scanner on the other hand, was done using ZXing library, a barcode image processing library implemented in Java. Figure 3.4 and Figure 3.5, and Figure 3.6 are the code snippets used to create the QR code scanner using ZXing library.

```
import me.dm7.barcodescanner.zxing.ZXingScannerView;
import static android.Manifest.permission.CAMERA;

public class Scanner extends AppCompatActivity implements ZXingScannerView.ResultHandler {
```

Figure 3.4 Required imports and interface

Figure 3.4 is a code snippet of the needed library imports for the scanner implementation. The activity also needed to implement the interface shown in the figure to access static constants and abstract methods to be used in the implementation. Figure 3.5 below, shows the creation of the QR code scanner view. In order for the application to scan QR codes, it must access device's camera. The camera captured the QR code as an image and ZXing library is the one responsible for reading the content of the code. Figure 3.6 is the code snippet of how the application accesses the device's camera.

```
ZXingScannerView scannerView = new ZXingScannerView( context: this);
setContentView(scannerView);
int currentApiVersion = Build.VERSION.SDK_INT;

if(currentApiVersion >=  Build.VERSION_CODES.M)
{
    if(checkPermission())
    {
        Toast.makeText(getApplicationContext(),  text: "Permission already granted!", Toast.LENGTH_LONG).show();
    }
    else
    {
        requestPermission();
    }
}
```

Figure 3.5 Creating a scanner view

```java
public void onRequestPermissionsResult(int requestCode, String permissions[], int[] grantResults) {
    switch (requestCode) {
        case REQUEST_CAMERA:
            if (grantResults.length > 0) {

                boolean cameraAccepted = grantResults[0] == PackageManager.PERMISSION_GRANTED;
                if (cameraAccepted){
                    Toast.makeText(getApplicationContext(), text: "Permission Granted, Now you can access camera", Toast.LENGTH_LONG).show();
                }else {
                    Toast.makeText(getApplicationContext(), text: "Permission Denied, You cannot access and camera", Toast.LENGTH_LONG).show();
                    if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.M) {
                        if (shouldShowRequestPermissionRationale(CAMERA)) {
                            showMessageOKCancel( message: "You need to allow access to both the permissions",
                                    new DialogInterface.OnClickListener() {
                                        @Override
                                        public void onClick(DialogInterface dialog, int which) {
                                            if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.M) {
                                                requestPermissions(new String[]{CAMERA},
                                                        REQUEST_CAMERA);
                                            }
                                        }
                                    });
                            return;
                        }
                    }
                }
            }
            break;
    }
}
```

Figure 3.6 Permission for camera access

In handling the result of scanning a QR code, the simple code snippet shown in Figure 3.7 was used.

```java
Log.d( tag: "QRCodeScanner", result.getText());
Log.d( tag: "QRCodeScanner", result.getBarcodeFormat().toString());
```

Figure 3.7 Handling result

Figure 3.8 below is an example code snippet showing how the maps of the fire incident area are loaded into the mobile application using Mapbox. The vector source shown in the figure is the tileset format of the map. It is here where the provided map ID and the source layer name were used.

```java
Mapbox.getInstance( context: this, getString(R.string.access_token));
setContentView(R.layout.activity_gdata);

mapView = findViewById(R.id.mapView);
mapView.onCreate(savedInstanceState);
mapView.getMapAsync( callback: this);
```

```java
Gdata.this.mapboxMap = mapboxMap;
vc = new VectorSource( id: sourceLayerName + "-data",  url: "http://api.mapbox.com/v4/" + mapID
                                                    + getString(R.string.access_token));
mapboxMap.setStyle(Style.SATELLITE, new Style.OnStyleLoaded() {
    @Override
    public void onStyleLoaded(@NonNull Style style) {
        style.addSource(vc);

        final String[] str = {"fire-map-data"};
        FillLayer basak_data_fill = new FillLayer( layerId: "fire-map-data",  sourceId: "fire-map-data");
        basak_data_fill.setSourceLayer(sourceLayerName);
        basak_data_fill.setProperties(
                PropertyFactory.fillOutlineColor(Color.parseColor( colorString: "#ff69b4")),
                PropertyFactory.fillColor(Color.parseColor( colorString: "#3BFF69B4"))
        );
    }
});
```

Figure 3.8 Importing map from Mapbox

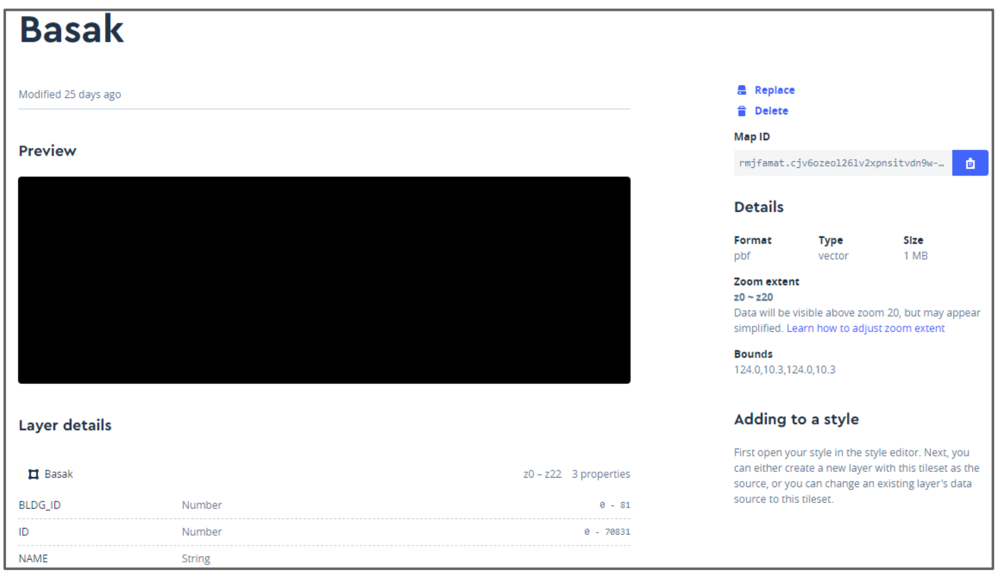


Figure 3.9 Sample map in Mapbox

Figure 3.9 is a sample map used in the development of this application where "Basak" is the source layer name and the map ID is located on its right section. Also, at the bottom part of Figure

3.9 shows a list of layer details. These details are the map feature properties that includes the "NAME" property, which contains the name of the owner of each house found in the map. These names were the basis of DSWS for the validation process.

Finally, all the functionalities of the mobile application couldn't be implemented without its dependencies and the device's access permissions. Figure 3.10 below shows the overall dependencies that were needed and the access permissions that were used in implementing the mobile application.

```
<uses-permission android:name="android.permission.CAMERA" />
<uses-feature android:name="android.hardware.camera" />
<uses-feature android:name="android.hardware.camera.autofocus" />
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE" />
<uses-permission android:name="android.permission.INTERNET" />
<uses-permission android:name="android.permission.ACCESS_WIFI_STATE" />
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
```

```
dependencies {
    implementation fileTree(include: ['*.jar'], dir: 'libs')
    implementation 'com.android.support:appcompat-v7:28.0.0'
    implementation 'com.android.support.constraint:constraint-layout:1.1.3'
    implementation 'com.android.support:support-v4:28.0.0'
    testImplementation 'junit:junit:4.12'
    androidTestImplementation 'com.android.support.test:runner:1.0.2'
    androidTestImplementation 'com.android.support.test.espresso:espresso-core:3.0.2'
    implementation 'com.android.support:support-annotations:28.0.0'
    implementation 'me.dm7.barcodescanner:zxing:1.9'
    implementation 'com.google.android.gms:play-services-maps:16.0.0'
    implementation 'com.android.volley:volley:1.1.0'
    implementation 'com.android.support:recyclerview-v7:28.0.0'
    implementation 'com.android.support:cardview-v7:28.0.0'
    implementation 'com.android.support:design:28.0.0'
    implementation 'com.mapbox.mapboxsdk:mapbox-android-sdk:7.3.2'
    implementation 'com.jakewharton.timber:timber:4.7.1'

}
```

Figure 3.10 Application Dependencies and Access Permissions

3.4.2 Web Application Development

The web application has three major functions: to display a monitoring system of the the collected data during the registration, validation, and distribution processes, to generate QR coded IDs, and to allow the printing of basic needed documents. The printable documents include list of the names of the victims, their QR coded ids, and relief distribution monitoring sheet. This was developed using Laravel, a web application framework that simplifies web development by easing common tasks such as authentication, routing, sessions, and caching. The structures of this application was created using the standard markup language for creating web pages and web applications, Hypertext Markup Language (HTML). The interface design was improvised with the help of Bootstrap, and some were done through native CSS. In handling data and the application's functions, PHP was used. The print function was done by producing pdf file version of the data being displayed.

All data in the monitoring system were extracted from the database using PHP scripts and were displayed using tables. In generating QR codes, Simple QR-Code, an easy to use QR-Code generator wrapper for the Laravel framework based on the work provided by Bacon/BaconQrCode (a port of QR code portion of the ZXing library**), was used. Figure 3.11 below shows the simple code snippet used in generating the unique QR codes for each registered family head.**

```
<img ng-src="data:image/png;base64,
           {!! base64_encode(QrCode::format('png')
                       ->size(100)
                       ->generate($class->name, '../public/img/img-' . $class->id . '.png'))!!}">
```

Figure 3.11 Generating QR Code

Another wrapper for Laravel was used in implementing the print function of the web application. In order to get a printable file of any data displayed in the monitoring system, DOMPDF wrapper for Laravel was used. This wrapper allows conversion of html string into a printable pdf file. DOMPDF wrapper was activated after "barryvdh/laravel-dompdf" package was installed through the composer and the package was configured to the

Laravel app (this web application). Figure 3.12 below shows a sample code snippet of how html codes are exported into pdf files.

```
function pdf(Request $request)
{
  $code = $request->input('codename');
  $pdf = \App::make('dompdf.wrapper');
  $pdf->setPaper('legal', 'portrait');
  $pdf->loadHTML($this->convert_victimsdata_to_html($code));
  return $pdf->stream();
}
```

Figure 3.12 Export html codes to pdf

Here, "convert_victimsdata_to_html()" is the function that returns a string of all the html codes that will be loaded into the pdf file.

3.4.3 Database Setup and Linking

Database is the most important element of this project. All the information collected during the registration, validation, and distribution processes were stored into the database. The database is the middle ground between the mobile and the web application of the project. The mobile application collects the fire victims' information and stores them to the database. The stored captured data will be displayed in the web application as useful, meaningful information

Database Setup

This project used MySQL, an open source relational database management system (RDBMS), known for enabling the cost-effective delivery of reliable, high performance and scalable Web-based and embedded database applications. The storing of data used an RDBMS type of database, meaning data will be stored in tables. Each row of the table contained all the information of the registered victims.

Before setting up the database, prerequisites were checked first (e.g MySQL version, other platforms needed). Once ready, installing and configuring of MySQL server then followed. After all of this, the server was opened and then a database entitled "dswsdata00" was created and set up.

Database Linking

The linking of the mobile and web application to the database needs server code scripts that provide logic for saving, listing, updating, and other types of data handling. In linking both mobile application to the database and database to web application. PHP scripts were used. PHP scripts handled the data from the database as well as the different functions in the mobile and web application that involved the database.

3.5 Testing and Evaluation

This project was presented to personnel from DSWS who are incharge of registering fire victims and distributing relief assistance. The project goals and system design were presented first and then followed by a demonstration of the project's output. While demonstrating, an open discussion of their feedbacks and suggestions also took place. Finally, an evaluation form was given to assess the usability of the system in their field of work.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents the results of the methods undertaken in this study. It is divided into three parts: the mobile application results, web application results, and the testing results and discussions.

4.1 Mobile Application

The mobile application is composed of two sections, the first one is the "New Fire Incident Data" section and the second one is the "Update Existing Data' section. The first section allows a DSWS personnel to create a new instance of fire incident. The second section, on the other hand, allows a DSWS personnel to update an existing set of data. The existing sets of data refer to all instance of fire incidents that were created. It is where the registration, validation, and distribution activities happen.

4.1.1 New Fire Incident Data

In this section, the application redirects the personnel to a form that asks to input the date, time, region, province, municipality, baranggay, and the sitio where the fire incident happened. In order to access the map of the fire incident area provided by Firecheck, the form also contains fields that are asking for the map ID and its source layer name (from Firecheck) located in Mapbox. All the fields in the form must be completed so the personnel can create a new fire incident instance. Figure 4.1 below shows an example of the transition of the activities under this section. Here, a sample new fire incident is created.

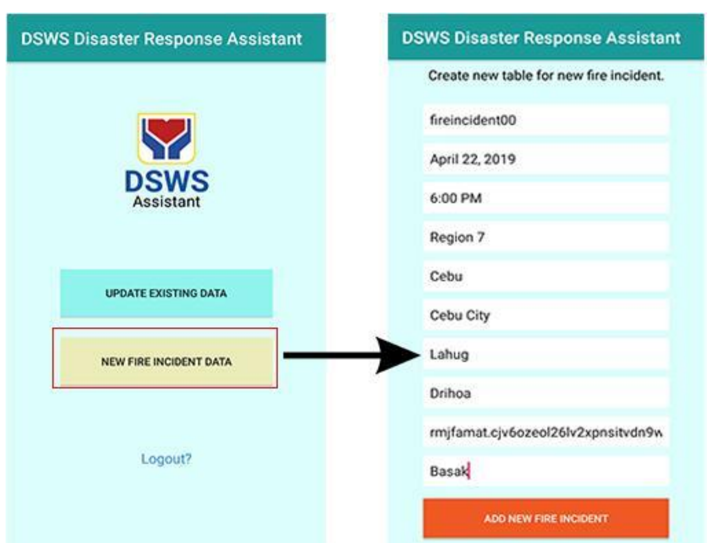


Figure 4.1 Creating New Fire Incident Data

4.1.2 Update Existing Data

This section redirects the personnel to a page consisting all the existing fire incidents data. The application asks the personnel to choose what data will be updated. After choosing, the application then redirects to its main functionalities. The update section consists of 3 subsections: the registration through map, manual registration and the QR code scanner for the assistance distribution. Figure 4.2 below shows an example where the personnel chooses to update an existing data.

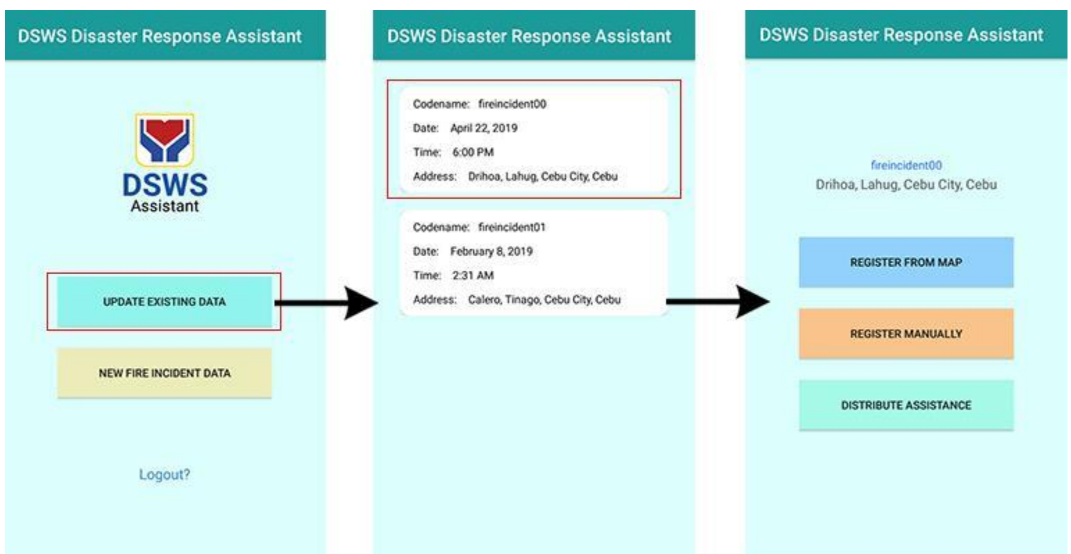


Figure 4.2 Update Existing Data

The "registration through map" section displays the map of the fire incident area where the personnel can ask the victims to locate their houses. In this section, the personnel can register a family head and can tag them as validated if their house are found in the map. Figure 4.3 below shows the map of the affected area. When the victim finds their house and click on it, the application then pops the house owner's name based on the Firecheck data. When the name of the family head matches to the name mentioned in the map (or can be related family member), this helps the personnel to ensure that he validated the right house owner.

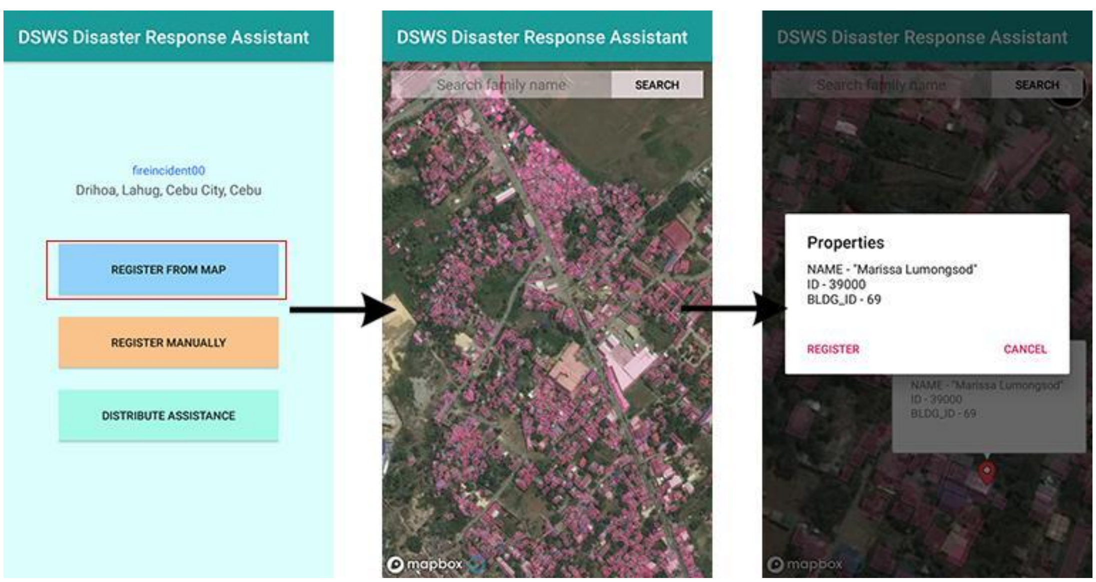


Figure 4.3 Map of the Fire Incident Area

If the personnel choose to register, the application redirects to the registration form. Figure 4.4 below shows and example of the registration form.

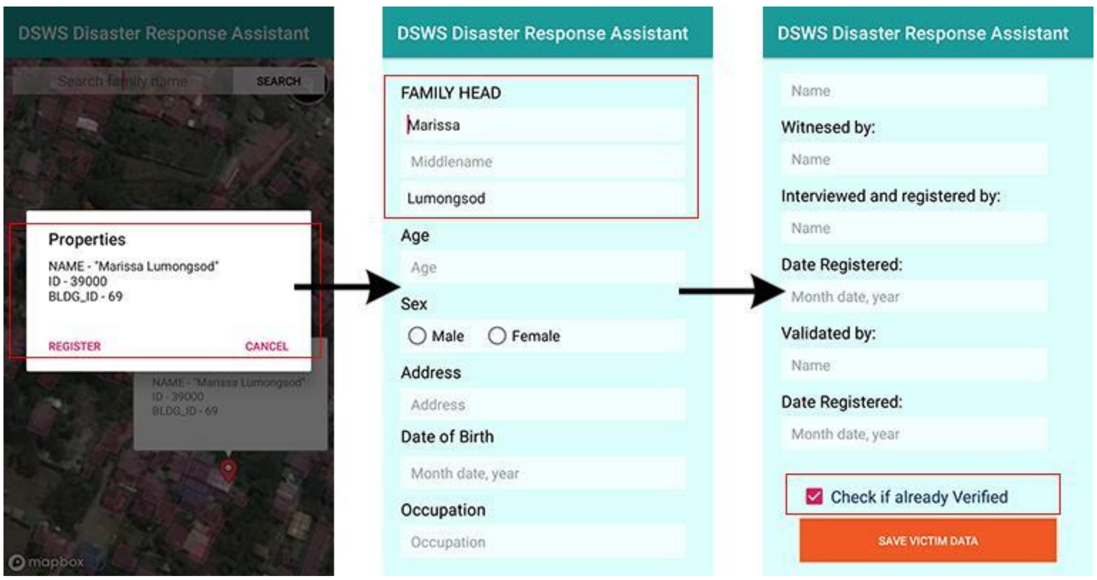


Figure 4.4 Registration from Map

When the victim is registered based from the map, the checkbox that indicates if the victim is validated or not automatically gets checked. This means that the victim is tagged as validated. Appendix B shows the full registration form for the victims. This registration form is also used in the "register manually" section. In cases that the victim's house is not found in the map. the personnel can still register them through this section. The only difference between this section and the "register from map” section is that, the checkbox indicating that the victims is validated is unchecked, stating that the victims is tagged as not yet validated.

After the registration, QR-coded ID will be given to the registered victims. These IDs will be used in the distribution of assistances. Using the third section of the mobile application, the QR code scanner, the IDs will be scanned every time the family head claims an assistance. Figure 4.5 below shows an example where relief packs are distributed to the fire victims.

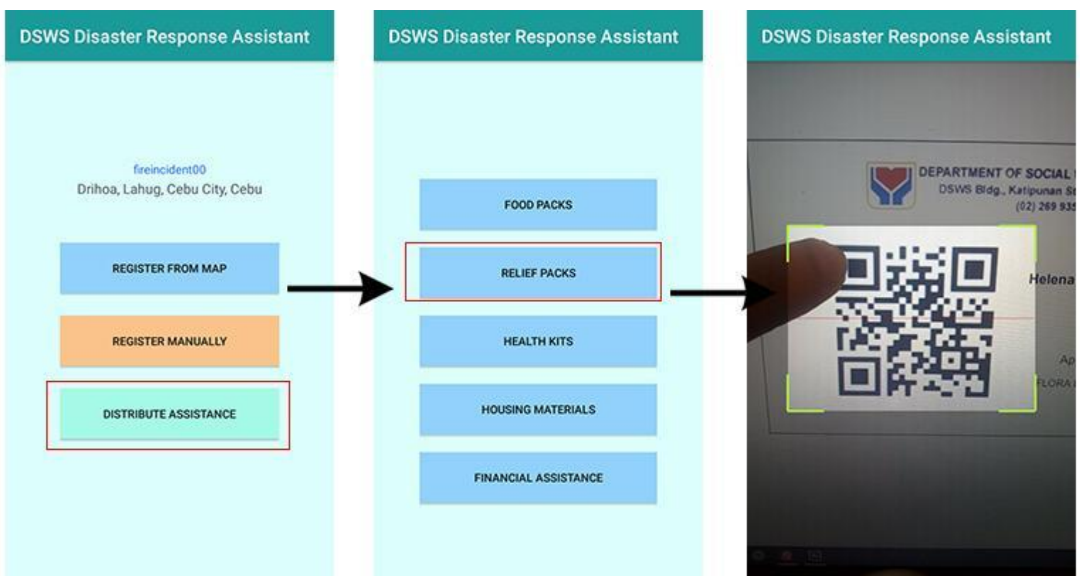
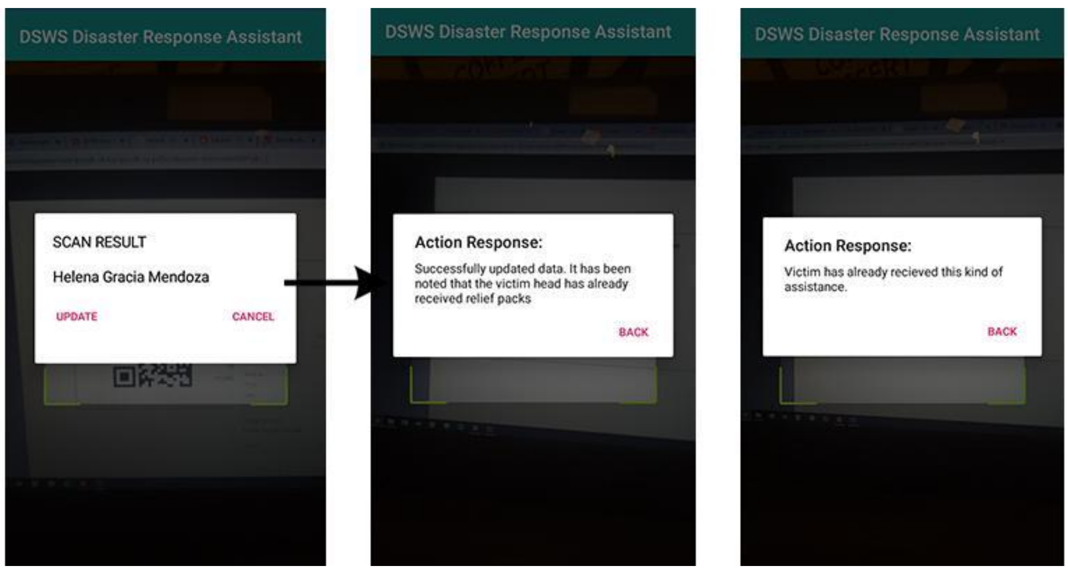


Figure 4.5 Relief Packs Distribution

Figure 4.6a below shows the output of the scanner after scanning a QRcode from the victim's ID. When the personnel choose to update, the application will automatically indicate of the victims has already received a relief pack or not (Figure 4.6b). This way, the application prevents the claiming of more than one relief pack. Figure 4.6c is the application's output when the same QR code is scanned twice under the same assistance type.



(a) (b) (c)

Figure 4.6 Scanner Result and Database Update

4.2 Web Application

As mentioned, the web application has three major functionalities: one, it displays a monitoring system of the victims information and recorded distributed assistance; two, it generate unique QR codes for each registered family head; and three, it allows printing of documents such as victims' generated IDs, list of the victims' names and assistance distribution monitoring sheet.

As the personnel logs in, the application will direct to a home page with a "View Fire Incidents Data" button. Just like in the mobile application, when the button is clicked, it will first direct to a page containing all the fire incident instances created by the mobile application. Figure 4.7 below shows the page of the reported fire incidents.

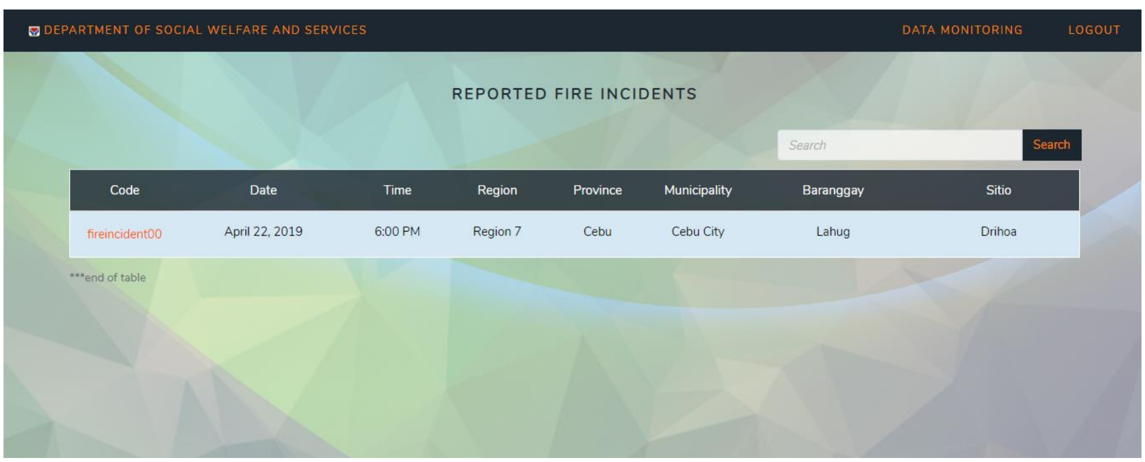


Figure 4.7 Reported Fire Incidents Page

The personnel can choose what set of data to display. For example, "fireincident00", when clicked, this will direct to a monitoring page of the registered victims' information. A sample monitoring page is shown in Figure 4.8.

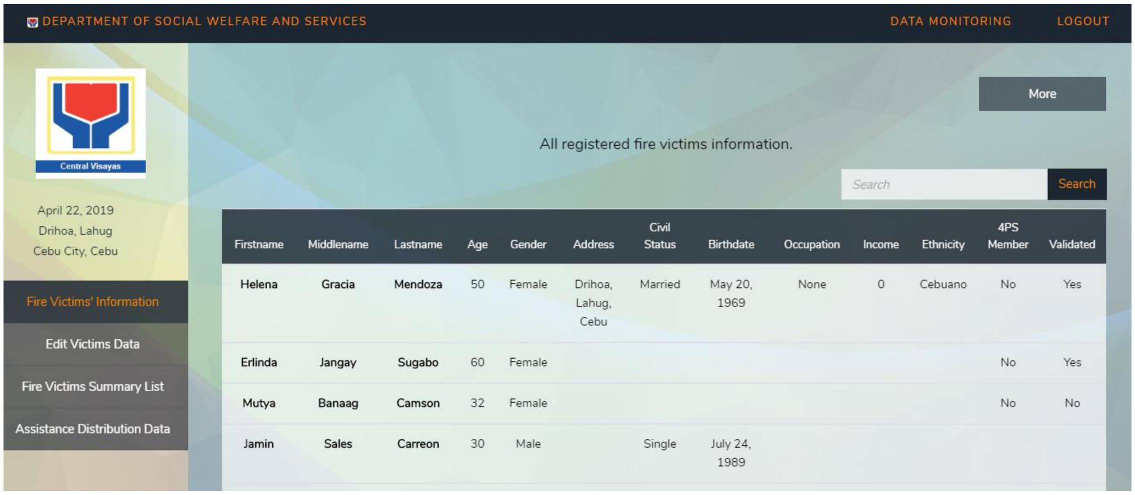


Figure 4.8 Registered Fire Victims Information

A "More" button is provided to display the information that are not displayed on the first page. The application allows the personnel to search or filter the set of data being displayed. Also, the application allows deleting, editing and updating a victim's information. Figure 4.9 below shows the "Edit Victims Data" page.

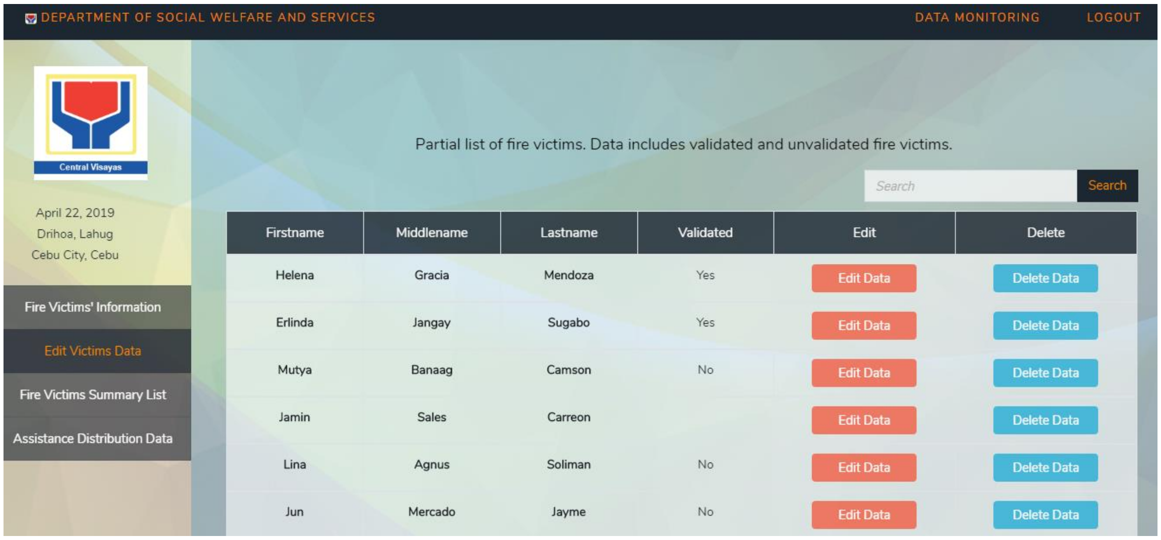


Figure 4.9 Delete, Edit, Update Victim's Information

Another page contains a summary table of the registered fire victims: the partial list and the final list tables. The partial list is consist of all the registered victims and the final list is consist of all validated victims only. The page also contains a "QR Coded IDs" button that redirects to another page of the generated unique QR codes for each registered victim. Figure 4.10 below shows the page where the QR codes are displayed. These QR codes are used to generate the ids of the victims. As shown in the figure, there's a "Print IDs" button that will perform the conversion of the generated ids into a printable pdf file. Figure 4.11 shows an example if the printable ids.

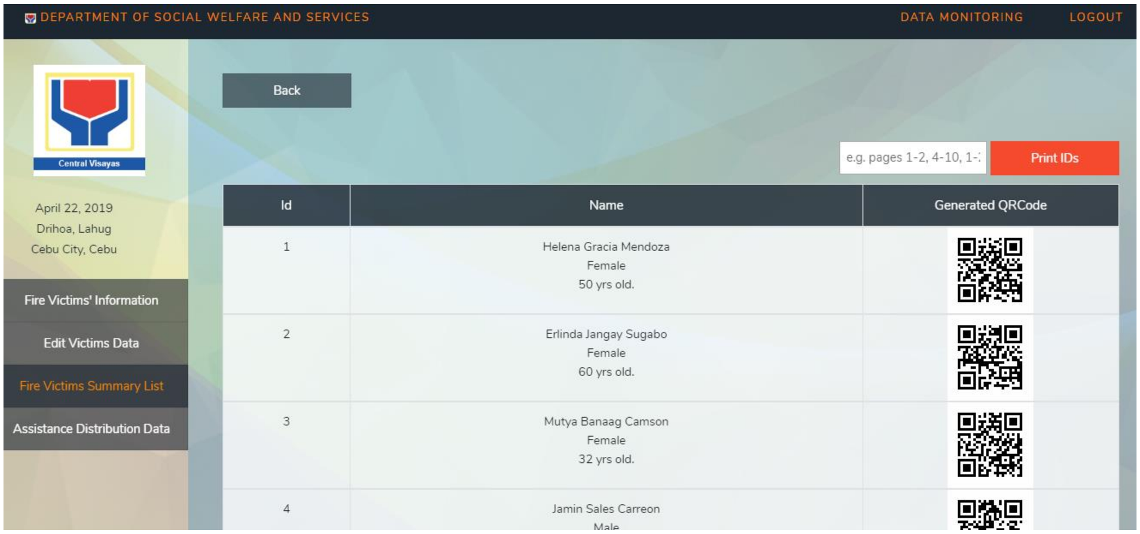
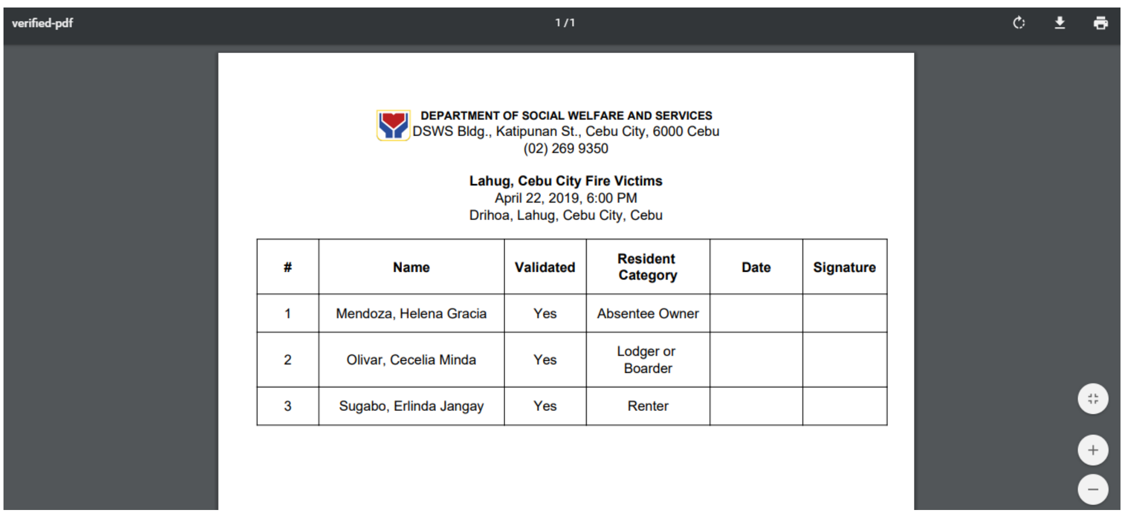


Figure 4.10 QR Codes Table

Figure 4.11 Victims' IDs in Pdf File

This page also allows printing documents such as list of victims. Here, the personnel are given options on what document to print based on categories. Figure 4.12 and Figure 4.13 below shows an example of printing a specific document. Here, for example, printing The validated victims.

Figure 4.12 Print Categories



DEPARTMENT OF SOCIAL WELFARE AND SERVICES
DSWS Bldg., Katipunan St., Cebu City, 6000 Cebu
(02) 269 9350

Lahug, Cebu City Fire Victims
April 22, 2019, 6:00 PM
Drihoa, Lahug, Cebu City, Cebu

#	Name	Validated	Resident Category	Date	Signature
1	Mendoza, Helena Gracia	Yes	Absentee Owner		
2	Olivar, Cecelia Minda	Yes	Lodger or Boarder		
3	Sugabo, Erlinda Jangay	Yes	Renter		

Figure 4.13 Validated Victims List in Pdf File

Lastly, the assistance distribution monitoring feature. This page simply displays all the registered victims and the assistance they already received. Here, '✓' victims already received the assistance and '✕' means not yet received. Figure 4.14 below shows the assistance distribution monitoring and Figure 4.15 shows the pdf file of the monitoring sheet.

Figure 4.14 Assistance Distribution Monitoring Page

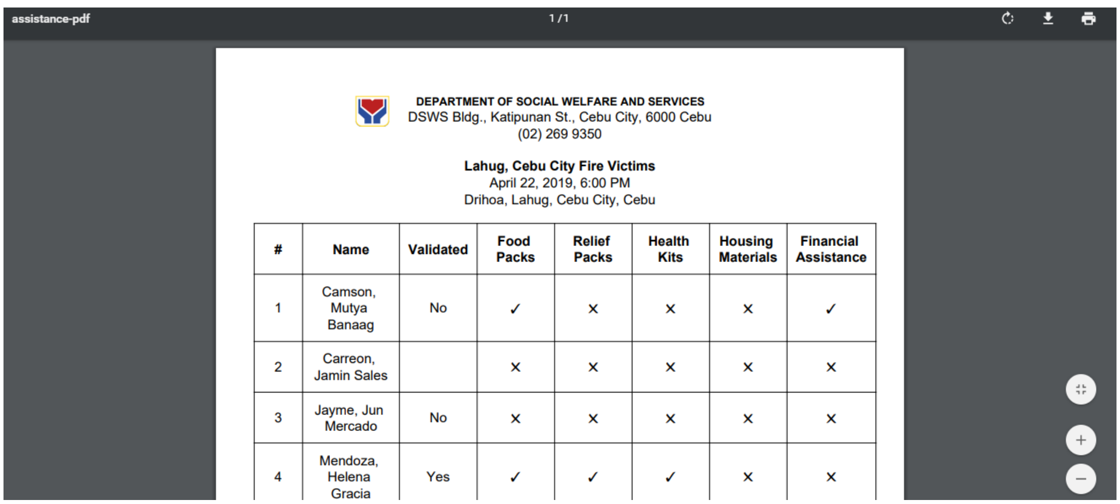


Figure 4.15 Assistance Distribution Sheet Pdf File

4.3 Testing and Discussions

The personnel were able to evaluate the project based on given criteria. Figure 4.16 below shows a summary of their evaluation. The detailed descriptions of the criteria in the graph are shown in Table 4.1.

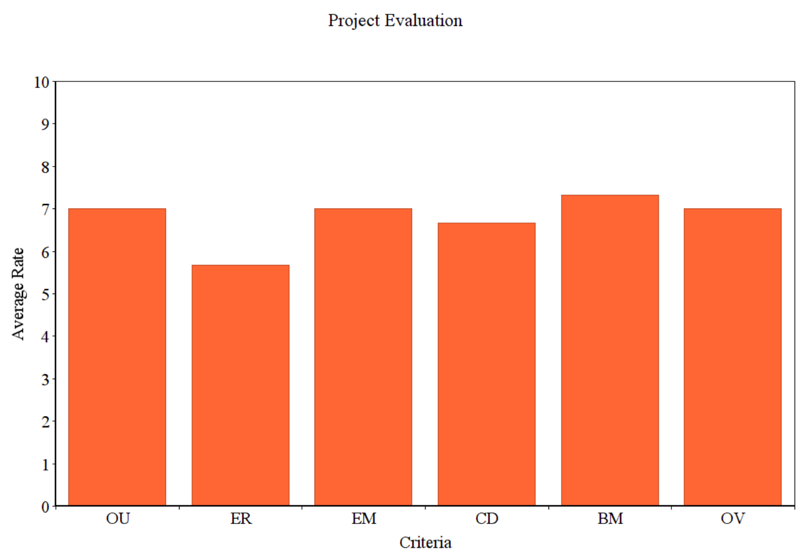


Figure 4.16 Project Evaluation Results

Acronym	Description
OU	The usefulness of the project to the current system of DSWS
ER	Effectiveness of the project in minimizing the delays in the current registration process of DSWS
EM	Efficiency of the Firecheck map in the validation process
CD	Convenience that the personnel experienced in suing QR coded data collection technology in the distribution process
BM	The monitoring system meets the needs of the data monitoring department
OV	Overall usefulness and effectiveness of the project in minimizing the delays in the entire process of disaster relief assistance distribution

Table 4.1 Description of Criteria in the Graph

The graph shows that out of 10, the average rating of the personnel to the effectiveness of the automated registration process is at 5.6, while the average rating for the efficiency of the map from

Firecheck for validation is 6.7 and exactly 7 for the convenience of the QR code scanning in the distribution process. The monitoring system on the other hand, got a higher rate reaching approximately 8. For the overall usefulness and effectiveness of the project in minimizing the delays in the entire process of disaster relief assistance distribution, the evaluators' average rating is 7.

In general, the DSWS personnel expressed that they wanted the system. They believed that automating the registration process will help them collect the list and victims' information in a faster manner as well and the QR code based distribution process will give them an easier and more reliable distribution process. The validation through Firecheck maps is also helpful to them, not just in validating the victims during the registration period, but the maps can also be their guide if they wish to validate onsite.

Among all functionalities of the project, the web application got the highest rating. The personnel found the monitoring system and the printing feature very helpful to them in terms of data banking and ease of access to specific data and documents.

As discussed during the demonstration and testing, the personnel were hesitant in accepting the project. Although they liked it and they believe that the project is helpful to their system, there are still problems that hinders its implementation. First, the department is not technologically ready. DSWS has no internet connection in their offices, computers and printers are not functioning well, and the personnel may not technologically ready. Second, the disaster relief distribution process of DSWS has sub processes that involves higher offices (e.g. City Hall, Commision on Audit). DSWS suggested that for the project to be implemented, it must also be presented to the higher offices to avoid conflicts in their processes.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

This study aims to improve the disaster response of DSWS by minimizing the delays on the processes of the distribution of relief assistance to the fire victims through automation, barcode data collection technology, and GIS mapping technology. A mobile application was developed to automate the registration of fire victims, to display a map of the fire incident area that will be used in validating the victims, and to provide a QR code-based system that automates the recording of distributed assistance to the fire every registered victim. A web application was also developed to provide a monitoring system of all the information collected during the registration, validation, and distribution process. The application was also used in printing basic documents such list of fire victims, generated victims QR code-based ids, and the assistance distribution monitoring sheet.

The automated registration process allows a faster collection of the list of fire victims and their personal information. The QR code based distribution process provided DSWS an easier and more reliable distribution process. The validation through Firecheck maps were also helpful in validating the victims during the registration period. These maps could also be used as guides if the personnel wish to validate onsite.

As a conclusion, this project was found to have a potential to improve the management of disaster response by minimizing the delays in the registration, validation, distribution processes. However, considering that the disaster management is a system participated by other related agencies in the local government units, a more complex disaster management system needs to be developed. Moreover, the capacity of the department to shirt to technology also needs to be considered.

5.2 Recommendations for Future Work

Based on the results gathered from the testing and evaluation, the applications are helpful in minimizing the delays on the registration, validation, distribution processes of DSWS' disaster response. However, there are still areas where the applications can be improved on:

5.2.1 Mobile Application

First, since application has access to the device's camera, the researcher recommends for an inclusion of the family head's photo in the registration. The photo can be attached to their generated IDs. This will help the personnel to ensure that the IDs are used by their owners only. Second, the researcher recommends for a search feature in the map of the fire incident area. This will help the victims to easily locate their house, thus results to faster validation. Lastly, the researcher recommends for the mobile application to be available for offline saving of information. This will be helpful at times when the fire incident is located at areas with poor network connection.

5.2.2 Implementation Plan

Before implementing this project, it is a requirement for the DSWS to be technologically prepared. This project will require the department to have an internet access, well-functioning computers and printers, and mobile devices with Android version higher than 4.0 (e.g. Android 4.1, 4.2, 4.3, etc). It is also highly recommended that these mobile devices have good camera resolution. These technologies will support the applications' functionalities. It is also very important for the personnel to know how the system works.

As discussed earlier, a key element to the success of the system is the involvement of other agencies in its implementation. It is therefore, recommended, that a more comprehensive study and re-design of the system should be conducted. As the system poses a radical shift to how DSWS processes will be carried over, it is advised that its implementation meets organizational approval.

APPENDIX A

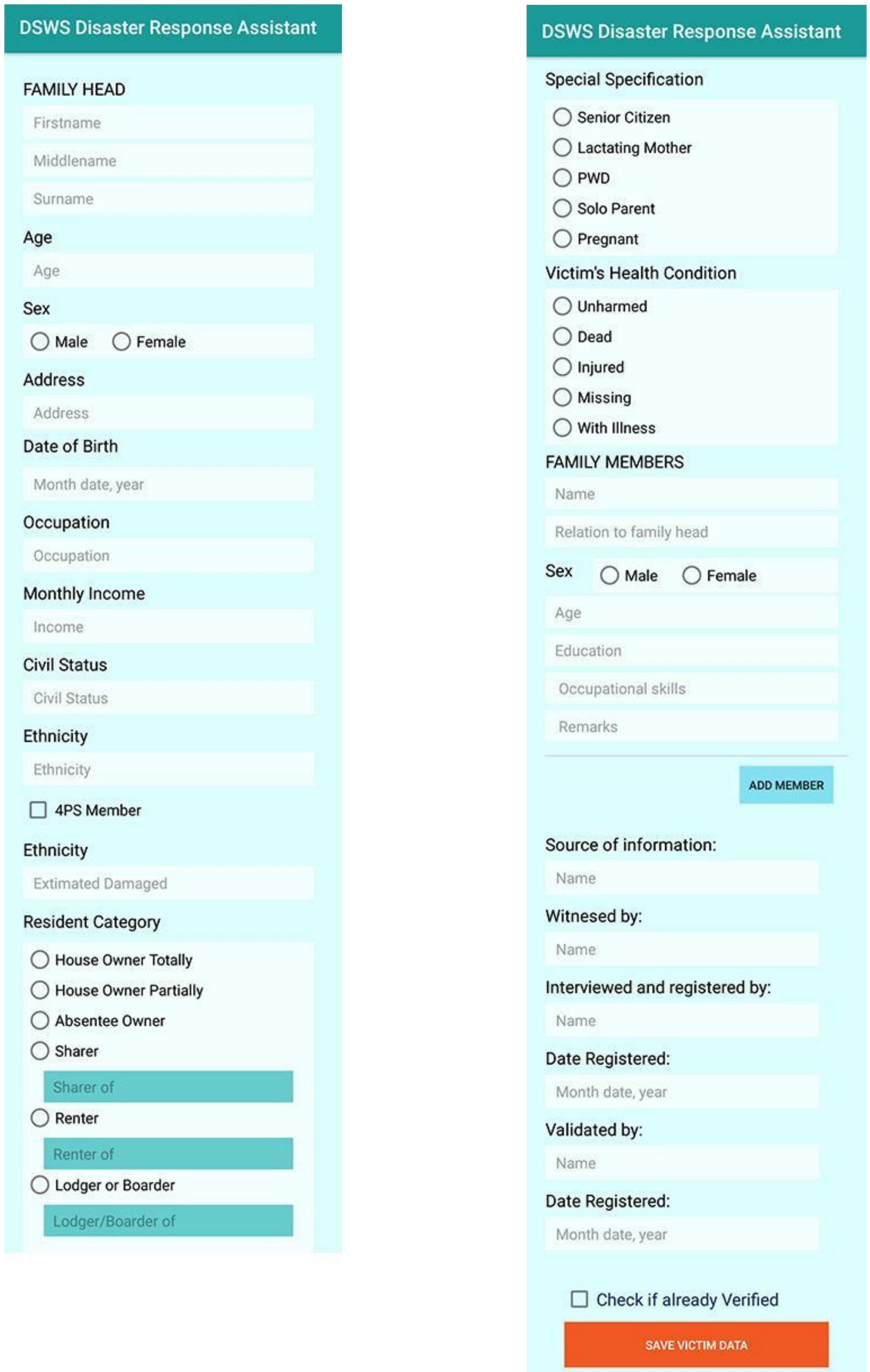
Table A.1 DSWS Relief Management and Monitoring System

Name: ______________________________(optional)
Position\Department assigned to: __________________.

1. Rate from 1-10 (10 as the highest), the usefulness of this project to your current system. **2. Rate from 1-10 (10 as the highest), the effectiveness of the mobile application project's goal of minimizing the delays of the registration process.** **3. Rate from 1-10 (10 as the highest), the efficiency of the FireCheck map in the validation of fire victims.** **4. Rate from 1-10 (10 as the highest), the convenience you experienced using the QR code data technology in the distribution of assistance to fire victims.** **5. Rate from 1-10 (10 as the highest). Does the monitoring system (web application) achieves the basic needs of the data monitoring department?** **6. Rate from 1-10 (10 as the highest), the overall usefulness and effectiveness of this project to minimizing the delays on the entire process of disaster relief assistance distribution.**	
What do you think are the features that must be included in order to enhance this project? **With your overall experience in testing this project, do you find the project very useful to your current system?** **What are your other recommendations that you think will improve this project?** **Other comments:**	

APPENDIX B

Figure B.1 Disaster Assistance Family Registration Form



APPENDIX C

Table C. 1 Responsibilities of DSWD on Disaster Response National Disaster Response Plan, 2014

Disaster Phase	Responsibility
Pre-disaster Phase	1. Activation of Quick Response Team (QRT) as first responders. 2. Validate all prepositioned resources at all Field Offices as well as from the Provincial and City/Municipal levels. 3. Submit a Status Report on all prepositioned resources to the NDRRMC.
During Disaster Phase	1. Activate pool of volunteers for stockpiling, monitoring and distribution of food and non-food items. 2. DSWD shall coordinate with internal and external donor donation agencies for their capacities taking into consideration occurring disaster situations. 3. Provision of Disaster Assistance Family Access Card (DAFAC) to facilitate on-time, frequency and type of assistance provided to disaster victims. 4. 24/7 operation of Disaster Response Operations and Monitoring and Information Center (DROMIC) at Central Office and Field Offices.* 5. Continues disaster response monitoring and mobilize instrumentalities and entities of the LGUs, CSOs and private groups and organize volunteers for response. 6. Provision of emergency relief (food and non-food items), medical supplies, inside and outside evacuation center. 7. Allocation of QRF at the Field Office level. – to indicated pre disaster phase. 8. Conduct of Rapid Assessment using the DSWD tool to validate information provided by local stakeholders to determine the extent of damage either partially or totally, specifically for food and non-food, for funding requirements.(For augmentation-actual and factual local response need to identify/reflect in the report as basis for response) 9. Set protocols of information and reporting to account relief activities of all partners, local and international NGOs and media groups. 10. Set guidelines when to terminate relief, response and evacuation center management. 11. Secure accurate data from the LGUs needed for request of augmentation of assistance and dissemination of report to cluster members/agencies.
Post Disaster Plan	1. Shall conduct Rapid DANA and Post DANA w/ other partner agencies under coordination of NDRRMC and RDRRMC(s) concerned. 2. Develop a post-distribution monitoring system. Evaluation of the quality, sufficiency, effectiveness and timeliness of distributions help to improve the overall distribution system and approach. 3. Establish complaints mechanisms, so camp residents can ensure a way to verify entitlements and services. In case of fraud, theft or abuse, camp residents/families must be able to voice their complaints and know that lead and coordinating agency including service providers will take action. 4. Shall provide "Pabaon Package" (provision of food packs) and BalikProbinsya to IDPs 5. Shall provide continuing relief assistance when needed.

REFERENCES

Ahrens, M. (2017). *Home Structure Fires.* National Fire Protection Association. Retrieved September 2017. Available at: https://www.nfpa.org/-/media/Files/News-and-Research/Fire- statistics/Occupancies/osHomes.pdf

Ahrens, M. et. al (2018). *World Fire Statistics.* International Association of Fire and and Rescue Services, Center of Fire Statistics of CTIF 2018, No. 23. Available at https://www.ctif.org/sites/default/files/2018- 06/CTIF_Report23_World_Fire_Statistics_2018_vs_2_0.pdf

Ansingkar, M. et al (2015). *Smart Shopping - An Android based Shopping Application.* International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue 3, March 2015. Available at http://ijarcet.org/wp-content/uploads/IJARCET-VOL-4-ISSUE-3-874-878.pdf

Datalogic Scanning, Inc. (2007). *All About Barcodes.* Datalogic Scanning, Inc., 2001-2007. Retrieved from https://www.ahearn.com/pdf/WP/WP_All_About_Bar_Codes_Datalogic_Scanning.pdf

DMS (2018). *Disaster Management Systems: Keeping America Prepared.* Disaster Management Systems, Inc. Available at http://www.triagetags.com

DSWD (2017). *DSWD sends aid to Tondo fire survivors.* Department of Social Welfare and Services, Disaster Response Operations, February 10, 2017. Retrieved from https://www.dswd.gov.ph/dswd-sends-aid-to-tondo-fire-survivors/

DSWD (2017). *DSWD to provide relief aid to Las Pinas Fire victims.* Department of Social Welfare and Services, Disaster Response Operations, April 9, 2017. Retrieved from https://www.dswd.gov.ph/dswd-to-provide-relief-aid-to-las-pinas-fire-victims/

DSWD (2016). *DSWD, LGU distribute relief assistance to Mandaluyong Fire victims.* Department of Social Welfare and Services, Disaster Response Operations, November 17, 2016. Retrieved from https://www.dswd.gov.ph/dswd-lgu-distribute-relief- assistance-to-mandaluyong-fire-survivors/

DSWD (2016). *DSWD starts distribution of cash aid to Mandaluyong City Fire victims.* Department of Social Welfare and Services, Disaster Response Operations, November 20, 2016. Retrieved from https://www.dswd.gov.ph/dswd-starts-distribution-of-cash-aid -to-mandaluyong-city-fire-victims/

DSWD (2015). *Disaster Response Operations Guidelines.* Department of Social Welfare and Services, Disaster Response Operations, Administrative Order 003, s.2015. Retrieved from https://www.dswd.gov.ph/issuances/AOs/AO_2015-003.pdf

FEMA (2018). *FEMA Mobile App.* Department of Homeland Security, January 2018. Retrieved from https://www.fema.gov/mobile-app

FEMA (2018). *Residential Structure and Building Fires.* U.S. Fire Administration. Retrieved October 2017. Available at https://www.usfa.fema.gov/downloads/pdf/publications/residential_structure_and_building_fires.pdf

FO1 Bautista, M.F. (nd) *Consolidated Fire Incident in Metro Manila.* Retrieved from http://www.asppi.org.ph/files/public/publication/Consolidated%20Fire%20Incident%20in%20Metro%20%20Manila%20OSCH.pdf

Gov.ph (2013). *Cash Assistance to Toledo Fire Victims.* Gov.ph, Province of Cebu. Retrieved from https://www.cebu.gov.ph/news/cash-assistance-to-toledo-fire-victims/

IDAutomation.com, Inc. (2012). *Barcode Educational Guide.* IDAutomation.com, Inc. and Benjamin Johnson, Technical Support & Development. Retrieved from https://www.idautomation.com/barcode-faq/barcode-educational-guide.pdf

IFRC (2015). *Emergency Plan of Action (EPoA) Philippines: Manila Fire Incident.* International Federation of Red Cross and Red Crescent Societies (IFRC). Retrieved from http://adore.ifrc.org/Download.aspx?FileId=72348

Lagunda, K. (2017). *BFP-Central Visayas Records 34 deaths in 2016.* SunStar Philippines, Article 128962. Retrieved from https://www.sunstar.com.ph/article/128962

Mai, V.Q. (2014). *QR Code Check-in System.* Frankfurt University of Applied Sciences. Retrieved from http://users.metropolia.fi/~anttikp/activegames2014/attendance/QR-CODE %20CHECK-IN%20SYSTEM.pdf

Nace, T. (2017). *How Technology is Advancing Emergency Response and Survival During Natural Disasters.* Forbes Media LLC, December 2017. Retrieved from https://www.forbes.com/sites/trevornace/2017/12/15/how-technology-is-advancing-emergency-response-and-survival-during-natural-disasters/#3701a1e19cc8

Nasimiyu, M.L., Omuterema, S., Wakhungu, J.W. (2017). *Fire Disaster Preparedness and Response among the Residents and Sugarcane Farmers in the Mumias Sugar Belt Zone in Western Kenya.* International Journal of Scientific and Research Publications, Volume 7, Issue 11, pp: (552-560) November 2017, Available at http://www.ijsrp.org/research- paper-1117/ijsrp-p7168.pdf

New York University (nd). *QR Codes: Explained.* Retrieved from http://www.nyu.edu/content/dam/nyu/studentAffairs/images/Explained/qr_code.pdf

NDRP (2014). *National Disaster Response Plan for Hydro-Meteorological Disaster.* National Disaster Risk Reduction and Management Council, June 2014. Retrieved from https://www.ndrrmc.gov.ph/attachments/article/1334/NDRP_Hydro_Meteorological_Hazards_as_of_2014.pdf

Palaubsanon, M. (2018). *Cebu City fire victims receive aid.* The Freeman, August 1, 2018. Retrieved from https://www.philstar.com/the-freeman/cebu-news/2018/08/01/1838558/ cebu-city-fire-victims-receive-aid

Pore, M. (2013). *Use of GIS and RS Technology in Disaster Management.* ESDS Software Solutions. Available at https://www.esds.co.in

PSA (2017). *2017 Philippine Statistical Yearbook.* Republic of the Philippines, Philippine Statistics Authority ISSN-0118-1564. Available at http://www.psa.gov.ph/sites/default/files /PSY_2017_Jan%2016%202018.pdf

Santos, V.S. (1999). *Space Technology Applications in the Philippines: Transforming Challenges into Opportunities.* Cooperation in Space, Euro-Asian Space Week, Volume 430, pp: (91-95) February 1999, Available at http://adsbit.harvard.edu//full/1999ESASP.430...91S/0000091.000.html

Stazzone, S. (2018). *Guide to Barcodes vs. QR Codes: In-Depth Comparison and Analysis of Both Label Types.* Retrieved from https://www.mpofcinci.com/blog/barcode-vs-qr-code/

SunStar Philippines (2018). *March, hardest month in 2017: BFP 7 fire record.* SunStar Philippines, Article 421550. Retrieved from https://www.sunstar.com.ph/article/421550

The Freeman (2016). *Fire Department, public feel the heat this March.* The Freeman October 1, 2016. Retrieved from https://www.pressreader.com/philippines/the-freeman/20160301/281492160398417

The Freeman (2017). *Fire victims in Labangon get assistance from DSWD.* The Freeman, May 22, 2017. Retrieved from https://www.philstar.com/the-freeman/cebu-news/2017/05/22/1702782/fire-victims-labangon-get-assistance-dswd

The Freeman (2018). *T.Padilla Fire Victims get help .* The Freeman, July 17, 2018. Retrieved from https://www.philstar.com/the-freeman/cebu-news/2018/07/17/1834303/ t-padilla-fire-victims-get-help

The Freeman (2019). *Duljo fire victims get financial aid.* The Freeman, January 30, 2019. Retrieved from https://www.philstar.com/the-freeman/cebu-news/2019/01/30/1889395/duljo-fire-victims-get-financial-aid

The Freeman (2019). *Cebu City moves to hasten release of disaster assistance.* The Freeman, February 28, 2019. Retrieved from https://www.philstar.com/the-freeman/cebu-news/2019/02/28/1897453/cebu-city-moves-hasten-release-disaster-assistance

Várallyai, L. (2012). *From Barcode to QR Code Applications.* Journal of Agricultural Informatics. 2012 Vol. 3, 2:9-17. Retrieved December 2012. Available at https://core.ac.uk/download/pdf/42934628.pdf

Velasco, G.N. (2013). *Epidemiological Assessment of Fires in the Philippines, 2010-2012.* 12th National Convention on Statistics (NCS). October 1-2, 2013. Available at http://nap.psa.gov.ph/ncs/12thncs/papers/INVITED/IPS-06%20Health%20and%20Nutrition%20Statistics/IPS-06_2%20Epidemiological%20Assessment%20of%20Fires%20in%20the%20Philippines,%202010%20%E2%80%93%202012.pdf

Woodrow, B. (2012). *"Fire as Vulnerability": The Value Added from Adopting a Vulnerability Approach.* World Fire Statistics Bulletin No. 28. Retrieved October 2012. Available at

https://www.ifv.nl/kennisplein/Documents/201210-ga-world-fire-statistics.pdf