POLITECNICO DI MILANO

Faculty of Civil and Environmental Engineering

Master of Science in Civil Engineering for Risk Mitigation

EMERGENCY MANAGEMENT INFORMATION SYSTEMS:
EVOLUTION OF THE COMMUNICATION PARADIGM THROUGH NEW MEDIA

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Academic Year 2011-2012

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ACKNOWLEDGEMENT

Foremost, We would like to express our sincere gratitude to our advisors Prof.ssa Ouejdane Mejri and Scira Menoni for the continuous support of MSc study and research, for their patience, motivation, enthusiasm, and immense knowledge. Their guidance helped us in all the time of research and writing of this thesis.

Besides our advisors, We would like to thank the rest of the people who were actively involved on our thesis development: the CENAPRED Director Roberto Quaas Weppen, the IEPC Chihuahua Director Luis Luján Peña, CENAPRED Diffusion Director Tomás A. Sánchez Pérez, Mitzi Liszt, Rita Varga and Negar Taheri, for their guidance and insightful comments.

We take this opportunity to express our profound gratitude from the deep of our hearts to our beloved parents, siblings, niece and nephew, for their love and unconditionally support throughout our life, encouraging words and shared laughs.

We thank our friends, for all the co-working and fun we have had in these two years in Italy.

Last but not the least, We thank each other, for the stimulating discussions, for the hard work before deadlines, and for all the moments we cherish.

ABSTRACT

Nowadays, the importance of communication in the management of emergencies has emerged as a core function that if effectively practiced, it can lead to significant enhance of timely decision making, action response, interoperability, organization, and public awareness and engagement. In this work, the complex elements of the communication process are analyzed through three case studies of different disasters in Mexico, focusing in the evolving role of traditional media and new media including social networks, and the interactions between Mexican government, civil protection authorities and public through these channels of communication. In this work, we model the evolution of information sharing flow underlining the new modalities of information exchange. The newly proposed Emergency Communication Model shows the public as a potential information producer suggesting a new system of emergency communicators in which stakeholders feeds each other with individual and collective knowledge. This approach will help the emergency managers not to become masters and possessors of nature, but owners of advanced technology which can provide powerful knowledge. A final conceptualization of the Emergency Management Information System contents is presented in a comprehensive Ontology that may be used further as a unique platform for emergency managers in designing their communication processes.

INTRODUCTION

Are technological advances enough to prevent forces of nature from impacting societies? René Descartes believed in *"develop practical knowledge in order to become masters and possessor of nature"*, France, 1637. Nevertheless in 2010 Iceland ash crisis, according to Olafur Grimsson, *"we learn from childhood that forces of nature are stronger that ourselves and they remind us who are the masters of the universe"*. While nature, as Grimsson stated, have the potential to cause extensive damage to life and property; Descartes asserted at stating that knowledge is power and while disaster's impact cannot be avoided, it can surely be managed. Technological advances have an increasing potential to support how emergency managers handle disasters by enhancing emergency communication; which in turn will improve timely decision making, action response, interoperability, organization, and public awareness and engagement. However, the Information and Communication Technology (ICT) revolution have risen a whole new set of challenges for emergency managers: Will technology perform accordingly in crisis? Will the information sharing through technology meet crisis needs?

Nowadays, the importance of communication in the management of emergencies has emerged as a core function that if effectively practiced, it can lead to significant enhance on the interagency response coordination and cooperation. In this work, the entire communication process will be analyzed through three case studies of different disasters happened in Mexico. The analysis focuses on the evolving role of traditional media and new media including social networks, and the interactions between government, civil protection authorities and public through these channels of communication. To begin with, two types of predetermined criteria of country case selection exist, the first is risk prone aspects while the second is technological developing level. The case studies selection meant to be as representative as possible; Mexico, as chosen country, is exposed to different natural phenomena that can cause large amount of damage and which is extensively discussed in the first Chapter. In fact, Mexico's territory covers almost two million square kilometers and its estimated population overpasses the 113 million, it is also considered one of the world's largest economies, a newly industrialized upper-middle income country, and an emerging power.

According to the preliminary analysis presented in Chapter 1, the identified characteristics enable Mexico to constantly improve its technological infrastructure, and therefore a perfect candidate for this research. Important to notice that the reason for which a technological developing country was chosen is because it does not represent a perfect scenario (for instance, Iceland where emergency preparedness is presented and technology is widely available) nor the most primitive scenario. The second step in the disasters case selection, is related to the different phenomena in different period of time throughout Mexican history; specifically, the 1985 Mexico City Earthquake, 2007 Tabasco and Chiapas Flooding and the 2012 Popocatépetl crisis that will be analyzed in Chapters 2, 3, and 4, respectively. Comprehensively, the case studies will be deeply

examined focusing on the communication process through time representing the modalities of information exchange. Actually, the former information that was shared through media during the chosen catastrophes will be studied and will become the input to reconstruct the communication model existing at the time. Moreover, Chapters 2, 3 and 4 will cover issues related to the unique characteristics, impact and direct consequences of the different phenomena, the historical and recent emergency management activities in order to understand the different circumstances of each disaster. More particularly, the governmental and civil protection authorities emergency response and the public reaction to crisis, the interactions and means of communication between these stakeholders during the emergency management, the media normal and crisis use during the different contingencies. The main objective is to enhance the overall the evolving communication reality in Mexico during crisis.

J.L. Orihuela's eCommunication claims that *"the digital age arrives with a set of big communication challenges for traditional mainstream media: new relations with audiences (Interactivity), new languages (Multimedia) and a new grammar (Hypertext). But this media revolution not only changes the communication landscape for the usual players, most importantly it opens the mass communication system to a wide range of players".* [79] Indeed, remarkable changes in the communications field due to the convergence of new media and telecommunications have revolutionized the modalities of information production, diffusion and reception. More importantly, alterations on the information sharing dynamics have occurred; allowing other mediated inter-relational modalities that are interactive, dialogic, real time and personalized. In new Emergency Management Information Systems (EMISs), where new media plays a pervasive role in the way public act and react to the world, reshaping the way of public respond to crisis. In such context, it is crucial for emergency managers to adapt and take advantages for what the new media has to offer. On contrast, it was observed that the emergency management agencies mainly rely on the classical communication process, that is to say, on a static one-way communication process, failing to account for the dynamic features of an evolved communication process.

In Chapter 5 entitled Evolution of Emergency Management Communication will be discussed that for several decades now, the instrumental and pragmatic vision present in the communication theory that gave rise to the Lasswell communication paradigm is in crisis by the multiplicity and richness of the current communication process in crisis context. Not accounting for the changes that are occurring by the introduction of the new media in the communication processes represents a fatal mistake consisting of failing to capture the crucial information being shared by public through new media, especially mobile phones and internet based platforms, in the aftermath of large-scale emergencies. The Lasswell communication model, named Classical Persuasion Model, will be implemented to the case studies with modifications for the sake of accounting a complete representation of the case studies evolving emergency communication. In detail, the case studies emergency communication will be analyzed in terms of who (Information Producer, Stakeholder), says what (Message Content), through what communication mean

(Information Channel/Intermediate Source), to whom (Information Consumer, Stakeholder), at what time (Emergency Stage), and in which kind of crisis (Scenario). The developed information sharing flow suggests a system of emergency communicators in which stakeholders feeds each other with individual and collective knowledge, helping the emergency managers not to become masters and possessors of nature, but owners of advanced technology which can provide powerful knowledge.

Finally for the sake of this powerful knowledge, the case studies constructed evolution of information sharing flow will be used to create a realistic general Ontology for defining initially the information contents and extending the representation of the stakeholders in the emergency communication process. This will be done by extracting and conceptualizing the case studies communicated information objects and structuring them in the Ontology presented in Chapter 6, which can be communicated and understood by the different actors of the emergency management process in order to better respond to disasters.

1 CHAPTER: DISASTER RISK IN MEXICO

1.1 Introduction to Disaster Risk in Mexico

Mexico, which as a consequence of its federal constitutional system is officially known as the United Mexican States, comprising 31 states and a Federal District (capital city, D.F.). Its territory covers almost two million square kilometers, placing the Mexican Republic on the fifth largest country in the Americas, and on the thirteenth largest independent nation in the world. Its estimated population overpasses the 113 million, placing Mexico on the eleventh most populous country (2011 estimate). [1] Important to notice, that Mexico City Metropolitan Area (MCMA) concentrates 18% (around 21.1 million) of Mexico's population on a surface of around 0.3% of the national territory[2]. Furthermore, Mexico has one of the world's largest economies, and it is considered an upper-middle income country by the World Bank, a newly industrialized country and an emerging power. In addition, Mexico ranks sixth in the world and first in the Americas by number of UNESCO World Heritage Sites, becoming in 2007 on the tenth most visited country in the world with 21.4 million tourists per year. [1] The population criticality in Mexico forces the government to take conscience of the exposure and vulnerability that the national territory faces. For this reason and the diversity of languages caused by tourist, it is vital for the information releases before, during and after emergency state to be in other languages besides Spanish.

1.2 Born of Civil Protection in Mexico

Throughout human history, efforts had been done in order to protect society from dangerous phenomena. Such actions include: avoid exposed zones, identify predisposing signs, develop and improve protective measurements against natural and technological disasters. [3] For instance, Mexico "first attempts to protect population... were when a group of civil servants called serenos inspected streets and alerted inhabitants in the case of fire. "Serenos were replaced in 1890 by policemen". [4] Later, programs and firefighters were created not only to protect population against fires but also against floods and earthquakes. The next step, "under the ruling of President Porfirio Diaz, the Fire Fighting Service was institutionalized and the Mexican Red Cross was created". [4] Singularly during World War II, while Mexico was in need of protection from enemy air bombing, the army became the agency in charge of coordinating the emergency assistance and sheltering. [4] For such reason, it can be noticed that today Civil Protection is strongly linked to the army.

Moreover, the event that finally shaped Civil Protection at national levels (federal, states, and municipalities) was the devastating earthquake that Mexico City experienced on September 19, 1985. At federal level, the government established The National System of Civil Protection (Sistema Nacional de Proteccion Civil, SINAPROC) in 1986 as the main mechanism for interagency coordination for disaster efforts. The SINAPROC is headed by the Minister of Internal Affairs (Secretaria de Gobernacion, SEGOB), who reports directly to the President of the Republic. The SEGOB is a member of the President's cabinet and responsible to guaranteeing

order, peace and safety to all Mexican citizens. The General Coordination of Civil Protection (GCCP) which belongs to the Minister, delegates functions in its three general directions: Fund for Natural Disasters (Fondo de Desastres Naturales, FONDEN), the National Center for Disaster Prevention (Centro Nacional de Prevencion de Desastres, CENAPRED) and General Direction of Civil Protection (GCP). [4]

To begin with, the CENAPRED is a scientific and technologic research center located on the National Autonomous University of Mexico (Universidad Nacional Autonoma de Mexico, UNAM) founded in 1990. This institution develops knowledge and promotes the application of technologies to prevent and mitigate disaster. Also, provides professional training and communicate preparedness and auto-protective measures to people exposed to disaster prone zones4. In essence, the CENAPRED serves as a link between research on natural disasters and policymakers, and it is involved in information dissemination.

On the other hand, the FONDEN was created in 1998 providing a nationwide complementary fund to respond for outstanding calamities effects, principally whenever Mexican state or municipalities (State System of Civil Protection and Municipal System of Civil Protection) resources are insufficient. The legal procedure to be fund by the FONDEN goes as follow: in the light of a potential emergency, governors request that SEGOB issue a 'disaster declaration' (declaracion de desastre) in order to obtain financial aid. More importantly, only the Minister along with the President of the Republic are legitimate entitle to officially and legally declare emergency state to channel FONDEN economic resources to assist disaster-affected people and regions. Funds are mainly targeted to vulnerable groups: children, women, elderly, handicapped and low income people. [4]

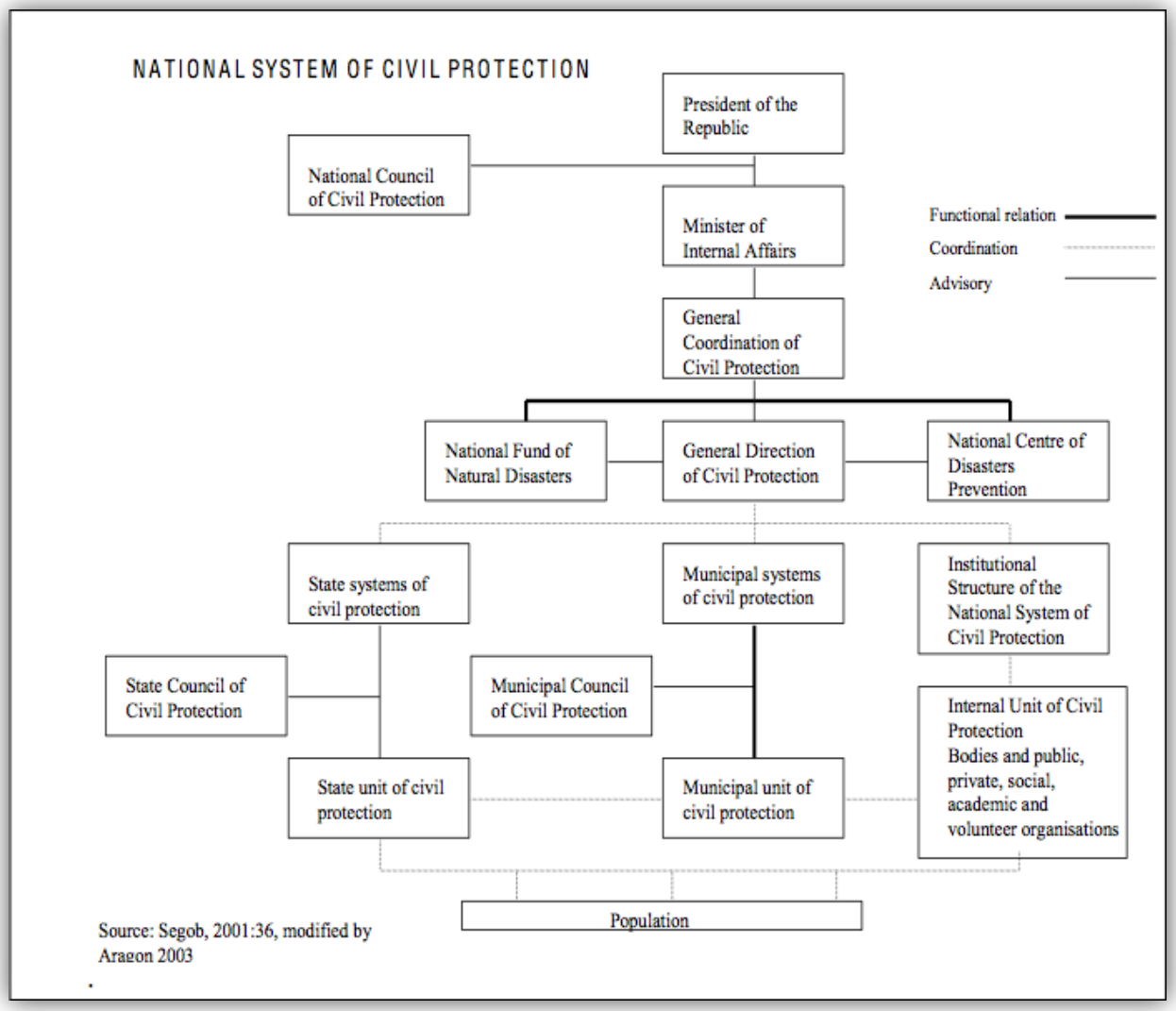

Figure 1 National System of Civil Protection (SINAPROC) [4]

Figure 1 illustrates the authority and coordination levels among the National System of Civil Protection. In its initial stage, the SINAPROC manage only emergency states meaning the actions perform after the catastrophe for rescue and relief purposes. Nowadays, the SINAPROC has changed its reactive policy into a preventive one where actions for risk identification are taken in order to tackle disaster impact. Equally, the SINAPROC has recognize the importance of a global approach where not only the scientific and technological aspects with relation to the phenomena are considered, but also to design in advance the operative plans to support the citizens with organizational measures for the people to be prepared and respond properly at the sight of danger.[3] In addition, policies have been "established to channel governmental efforts and to provide the means to preserve the population's lives, goods, and services in the face of vicissitudes and risks and therefore, to contribute to the progress of Mexico". [4] From all above, it can be noticed the explicit commitment of the Mexican government to invest in prevention,

emergency and restoration. The Fund for Natural Disasters (Fondo de Desastres Naturales, FONDEN) and Fund for Natural Disaster Prevention (Fondo para la Prevencion de Desastres Naturales, FOPREDEN) were created and implemented for the sake of such duty [4].

1.3 Risk Profile

Particularly, the Mexican geo-location makes the national territory to be exposed to different phenomena that can cause disaster. The SINAPROC has classified disasters according to the origin causing the event. Such classification is divided as following: geological, hydro-meteorological, technological, sanitary and socio-organizational. [3] During the development of this Chapter only the first three phenomena will be discussed, since these are the most relevant for this work.

1.3.1 Natural Disasters

1.3.1.1 Geological Phenomena

To begin with, Mexico is positioned along the Pacific Ring of Fire with strong seismic and volcanic activity. [3] As indicated in Figure 2, two thirds of Mexico's surface has a significative seismic risk while Figure 3 illustrates the swarm of past earthquakes occurred in the national territory, which on average were about 1000 earthquakes per year. However, in the last four years the seismic activity has dramatically increased as provided in Table 1. [5] Couple with Mexico's outstanding seismic activity, whose epicenters are usually located near the Mexican Pacific Coast. The most dangerous tsunamis often caused by big enough earthquakes may impact the Pacific Coast as displayed in Figure 4. [3]

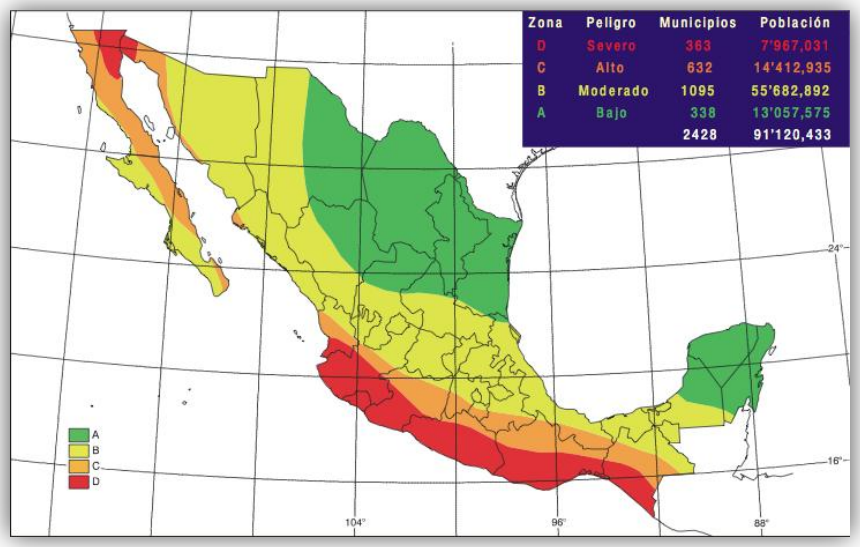

Figure 2 Seismic Zones and Regions [6]

Zone A (green): No historic records, nor major earthquakes in the last 80 years and where the soil acceleration are expected to be lower than 10% of the gravitational value.
Zone D (red): Have frequently occurred major earthquakes and the soil acceleration are expected to be greater than 70% of the gravitational value.
Zone B and C (yellow and orange, respectively): intermediate zones between A and D, in other words, the soil acceleration will not surpass 70% of the gravitational value.

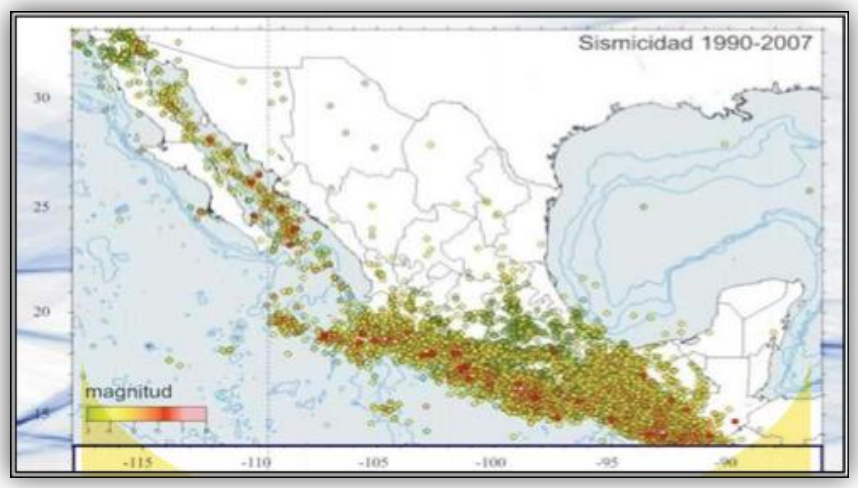

Figure 3 Seismicity in Mexico [5]

Table 1 Seismicity in Mexico [5]

Year	Earthquakes	Year	Earthquakes
1990	792	2001	1344
1991	732	2002	1688
1992	613	2003	1324
1993	917	2004	945
1994	622	2005	847
1995	676	2006	1077
1996	790	2007	1823
1997	1019	2008	1815
1998	1023	2009	2205
1999	1097	2010	3436
2000	1052	2011	3362

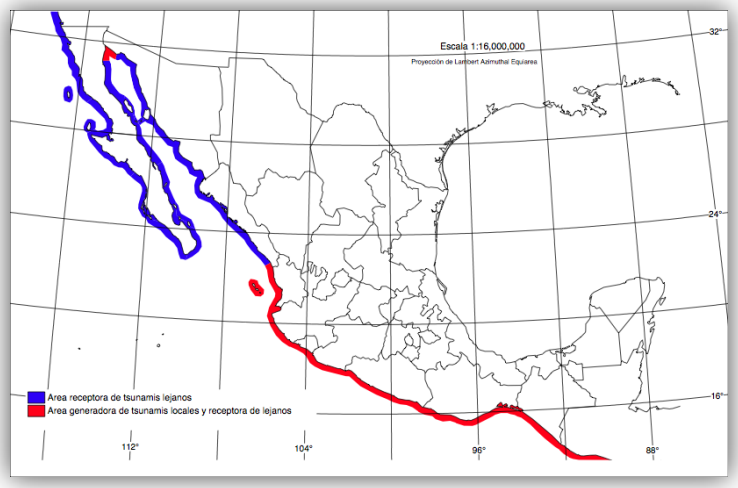

Figure 4 Local and Distant Tsunamis [3]

In the coasts of Baja California, Sonora and Sinaloa the maximum expected height of the tsunamis waves are of 3 meters; for the rest of the occidental coast the tsunami's waves might be up to 10 meters

Tsunamis are classified by the CENAPRED according to Figure 4 into three categories: local (red zone) meaning the arrival site is located in or near to the generated zone, regional (blue zone) meaning the arrival site is located to no more than 1000 km away from the generated zone, and distant (blue and red zones) meaning the generated zone takes place to more than 1000 km away. [3]

In addition, the Mexican Republic is known for its great amount of volcanoes where more than 2000 volcanoes had been part of the Mexican volcanic history. Nowadays, the primary active volcanoes are: Tres Vírgenes in Baja California Sur, Bárcena and Everman in Islas Revillagigedo, Ceboruco and Sangangüey in Nayarit, La Primavera in Jalisco, the Colima

Volcano in the border between Jalisco y Colima, Paricutín y Jorullo in Michoacán, the Xitle in D.F., the Popocatépetl in the states of México and Puebla, the Humeros and Pico de Orizaba in the states of Puebla and Veracruz, San Martín Tuxtla in Veracruz and the Chichón and Tacaná in Chiapas. There are other volcanoes, from which there is very few information known about their activity. [7] In brief, the average volcanic activity in Mexico during the last 500 years is reported to be of 15 eruptions per century. Figure 5 and 6 show the active volcanoes in the Mexican Republic. [3]

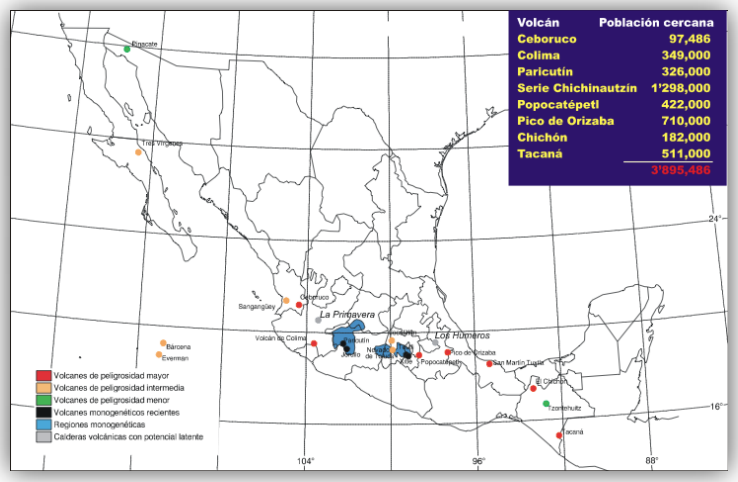

Figure 5 Active Volcanoes in Mexico (Trans-Mexican Volcanic Belt) [6]

Mexican Volcanoes that have erupted in historic times. Please note that some of the volcanoes (Xitle, Jorullo and Paricutin) are monogenetic. Also, some of the most important volcanic boilers are included, even though no recent activity has been shown.
Red: Volcanoes with high danger level; Orange: Volcanoes with intermediate danger level; Green: Volcanoes with low danger level; Black: Recent Monogenetic Volcanoes; Blue: Regional Monogenetic; Gray: Volcanic Boilers with latent potential

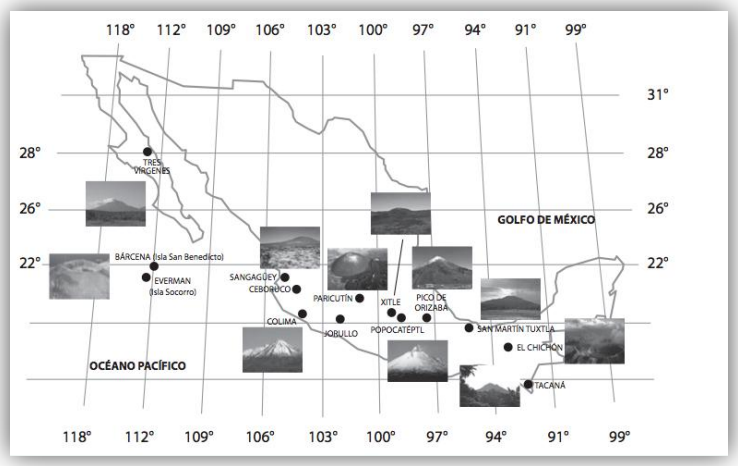

Figure 6 Mexican Volcanoes with Recent Eruption History [7]

The slope instability, occurrence of mud flow and debris, and regional and local settlement can affect almost all the national territory. Such geological phenomena have worsened as consequence of the deforestation, corrosion, erosion and by the alteration of the conditions of drainage and original equilibrium. The slope instability is mainly present on mountainous zones for which around 18% of the national territory is exposed to the occurrence of collapses as represented in Figure 7 [6]. The main triggering factor for mud flow and debris is the intensive rainfall which saturates the ground provoking such phenomena. Furthermore, intensive rainfall will be discussed later on this Chapter as a major problem in Mexico, making of concern the effect that this incident causes. On the contrary, the underground water extraction is the main triggering factor causing regional settlement. Normally this complication is presented on the regions with drought tendency and where water is crucial for the regional economy usually based on agriculture, urban or industrial activities. The local settlements are generated by the existence of underground cavities (either naturals or made by human activity for instance mining) provoking the collapse of the surface. This collapses are characterized for being sudden and devastating [3].

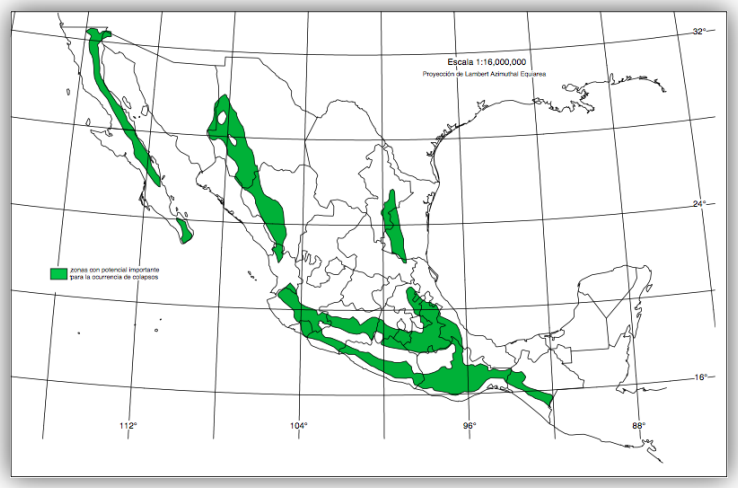

Figure 7 Slope Instability [3]

1.3.1.2 Hydro-Meteorological Phenomena

With attention to the inter-tropical region, Mexico is prone to hurricanes generated in the Pacific as well as the Atlantic Ocean. Such phenomena cause not only swells and strong winds along the Mexican Coasts, but the intensive rainfall induces floods and rock falls in the national territory. In the same way, floods and rock falls can be triggered by the intensive rainfall during rainy season; Figure 8 illustrates the flood tendency in the Mexican Republic. Likewise, Mexico experiences on average four cyclones per year penetrating on Mexican land and causing severe damages, Figure 9 emphasizes the cyclones risk distribution. Moreover, hailstorms and snows can affect the agricultural sector, drainage system and infrastructure of the country. On the other

hand, drought affects not only the agriculture, cattle raising and economy sectors, but also it increases the intensity with which wildfires impact and produce extraordinary losses. Figure 10 and 11 represent the frosts and drought records, where it can be seen the dramatic increase in drought recurrence. [3]

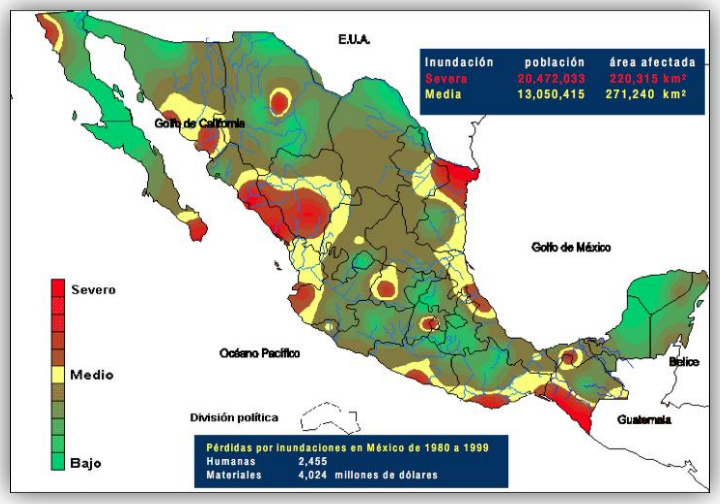

Figure 8 Flood Risk Distribution [6]

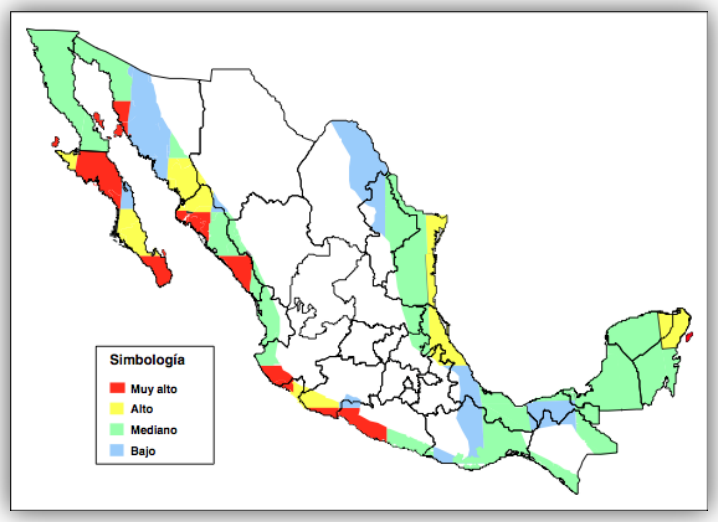

Figure 9 Tropical Cyclones Risk Distribution [3]

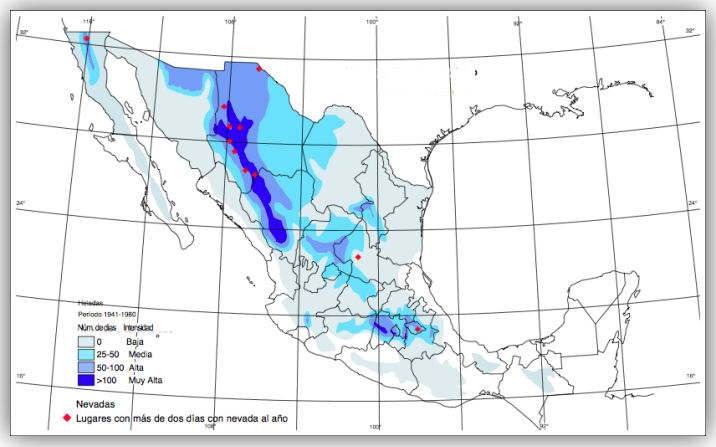

Figure 10 Frosts Records [3]

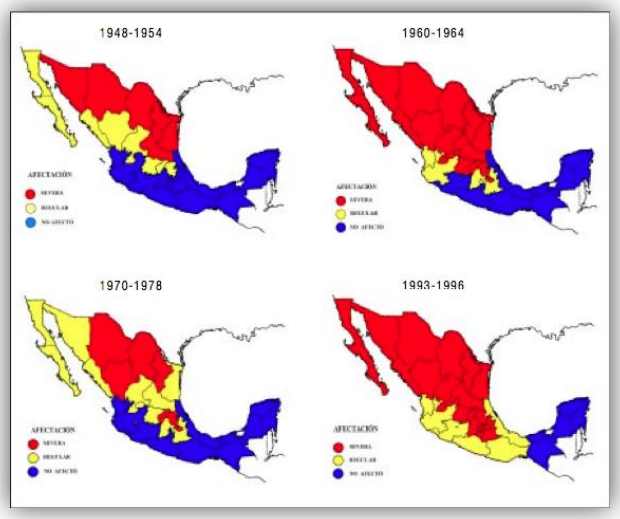

Figure 11 Drought Records [3]

To conclude, the CENAPRED gives the following quantitative losses caused by natural disasters. The economic damages generated for geological phenomena during 1980-1999 were of US$4,560 millions of dollars and 6,100 deaths, from which US$4,431 millions of dollars and 6,050 deaths were caused by earthquakes. On the other hand, the economy losses for hydro-meteorological phenomena during 1980-1999 were of US$4,547 millions of dollars and 2,800 deaths. Other hydro-meteorological annually significant facts are: 300 millions of cubic meters are dredge from rivers and ports, 1.1 billion of cubic meters of capacity are lost on dams, and 270 millions of dollars are generated on economic deficit by rivers erosion. It is extremely important to remark that the risk and effects of disrupting events are increased by illegal settlements where low income people are the main target [6].

1.3.2 Technological Disasters

Nowadays, the progressively increase of industrial activity in Mexico and the socioeconomic deficiencies had increased the number of accidents related to the industrial management. Industrial activity requires the storage, transformation, transportation and handling of raw products. The use of chemical substances are needed for the transformation of some products, which generate toxic and non-toxic residues that if not properly handle will pollute the soil, water and air. The transportation process represents a challenge to the industrial enterprises since it implies a risk for leaking, fire, explosion or spills that will affect people and the environment. For this purpose, it is crucial to know the chemical substances involve in industrial processes, the residues produced, routes for transportation, storage locations, and other important hazard properties. All of these, in order to minimize the risk for a technological disaster. [3]

In short in Mexico, the industrial zones are distributed throughout the whole land, but mostly concentrated in the center of the country. The principal industries are those related to the food, textile, wood, graphic arts, organic and inorganic chemistry, basic metallic and non-metallic sectors and assembly factories. More importantly, there is a disturbing deficiency related to centers for processing and confinement of industrial residues and waste water treatment plants. Finally the CENAPRED reports that the economic losses generated during 1980-1999 were of US$1,283 millions of dollars and 1,250 deaths. Table 2 reports the worldwide human lives lost as consequence of technological disasters and the Mexican contribution to those. [6]

Table 2 Human Lives Lost for Technological Disaster, 1970-1998 [6]

Year	Worldwide (deaths)	Mexico (%)
1970-1979	1432	10
1980-1989	6169	9.6
1990-1998	4179	12.6

2 CHAPTER: MEXICO CITY EARTHQUAKE OF 1985

2.1 Case Study, Mexico City 1985

Mexico City has been, and still is one of the largest urban area in the world, possessing diverse and complex characteristics. The MCMA, because its particular geographic location, has suffered several catastrophes throughout history, such as frequent seismic shaking at 4 or higher magnitudes on Richter scale. For instance, a major disaster occurred in the middle '80s when 18.4 million inhabitants were concentrated in MCMA. As Figure 12 shows, the interaction of the Cocos and the North American plate generated two earthquakes. The earthquake hit Mexico City at 7.18am on the 19th of September, 1985 with a magnitude of 8.1 on the Richter scale. The epicenter was 230 miles away from the city, but the impact of the tremor was amplified because of the geomorphologic structure of the ground.

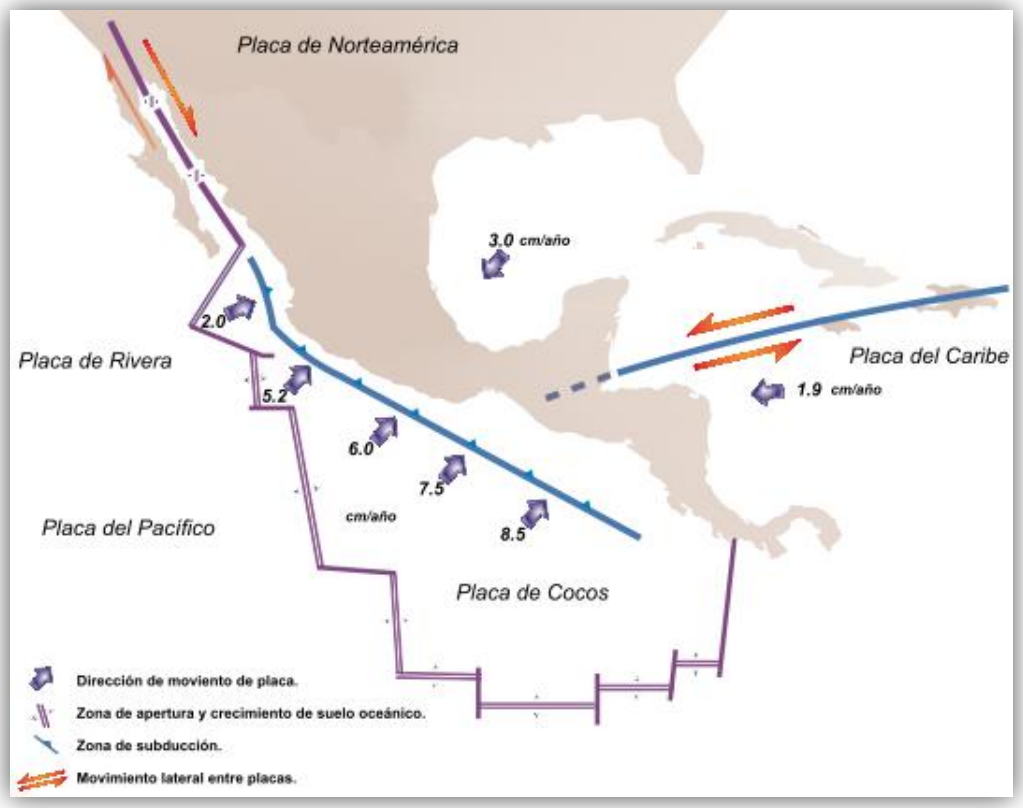

Figure 12 Movement of tectonic plates [3]

With exception of the Baja California peninsula, the national territory is content in the North American plate. Among this, the Pacific, Rivera, and Cocos and del Caribe plates interact. Figure 12 shows the displacement direction for each tectonic plates as well as the lateral motions and the relative velocities in cm/year. These velocities are not constant, the values had been determined taking into account the plates' average mobility during long periods. Most of the earthquakes are produced on the borders of such plates, primarily on the subduction zone, where the Cocos plate is forced below the edge of the North American one, and along the San Andres Fault, also between the North American and Pacific plates. During major earthquakes, great displacements had occurred between plates; some of them has displaced few meters.

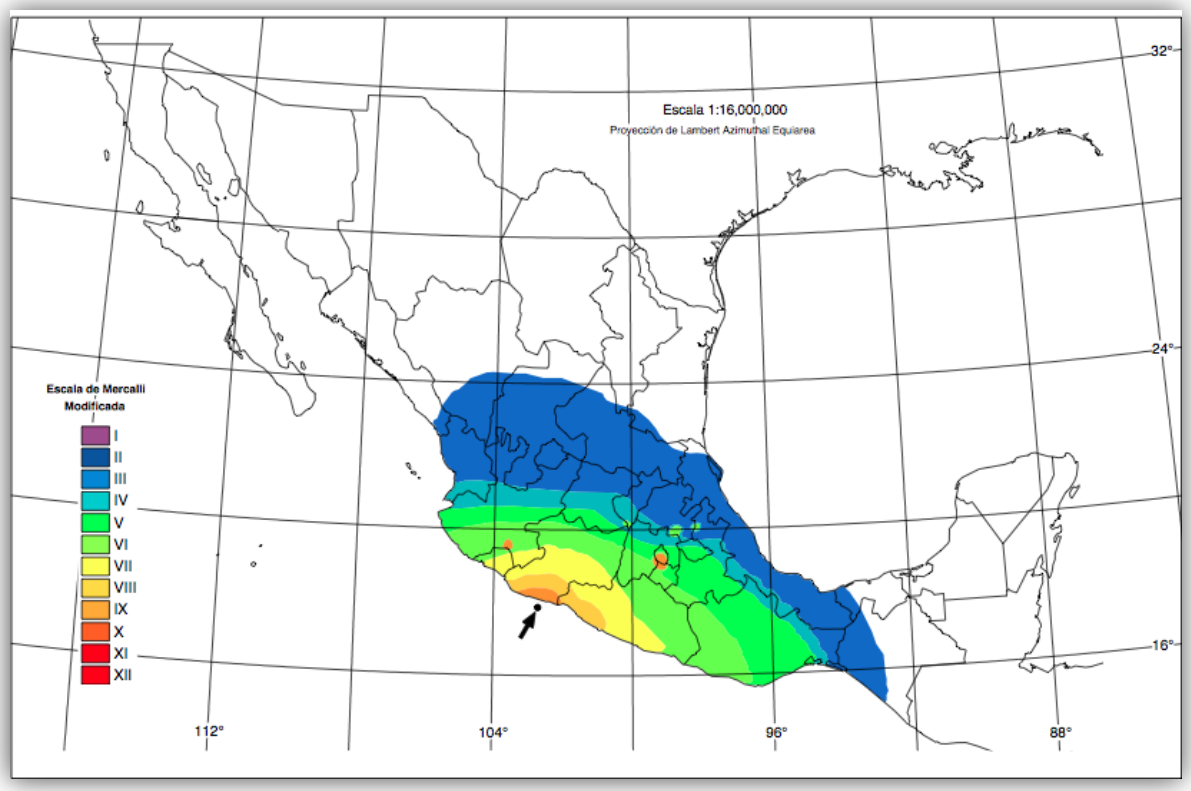

Figure 13 Isoseismal map of September 1985 earthquake [3]

The different levels of the Modified Mercalli Scale are represented by colors on Figure 13. The earthquake's epicenter is shown with an arrow on the Michoacan Coast. From the epicentral zone, the damages and effects produced by the earthquake decreases with the distance. However, it can be observed that distant zones (Mexico City and City of Guzman), where the damages and effects, produced by the soil particular properties, were similar to those on the epicentral zone.

The city is exposed to a high seismic risk because it was built on the deposit of the ancient Texcoco Lake, which provides an insecure foundation. As Figure 13 explains, the landfill is soft clay which amplifies the intensity of the ground shaking and increases the duration of it, even if the epicenter is not so close to the city. Additionally, Mexico City is highly vulnerable as consequence of the enormous population growth in the last two decades.

Furthermore, accurate estimations of losses about the '85 earthquake are missing because of the huge extended metropolitan area. Figure 14 shows the chronological territorial extension of Mexico City through time. The red zone illustrates the old center which was the most affected due to the earthquake. The main reason for which the city center was the most hit is because it lies on the ancient lake bed, while the rest of the territory has no serious soil problems, so it remained intact. Accordingly, the majority of Mexico City population was directly impacted in terms of everyday life, even if there were some inhabitants on the intact locations who were not aware of the incident up to 12 hours. For them it was recommended to stay at home by the authorities. Around 20,000-35,000 people died (however, the number of found bodies is about

5000) and many other thousands injured. 3000 buildings collapsed and at least a 100,000 building units were damaged, mainly caused by foundation failures. The most affected parts were residential areas in the historic center, for which many thousands people became homeless. As a side effect of the earthquake millions of dollars were lost in the tourist trade.

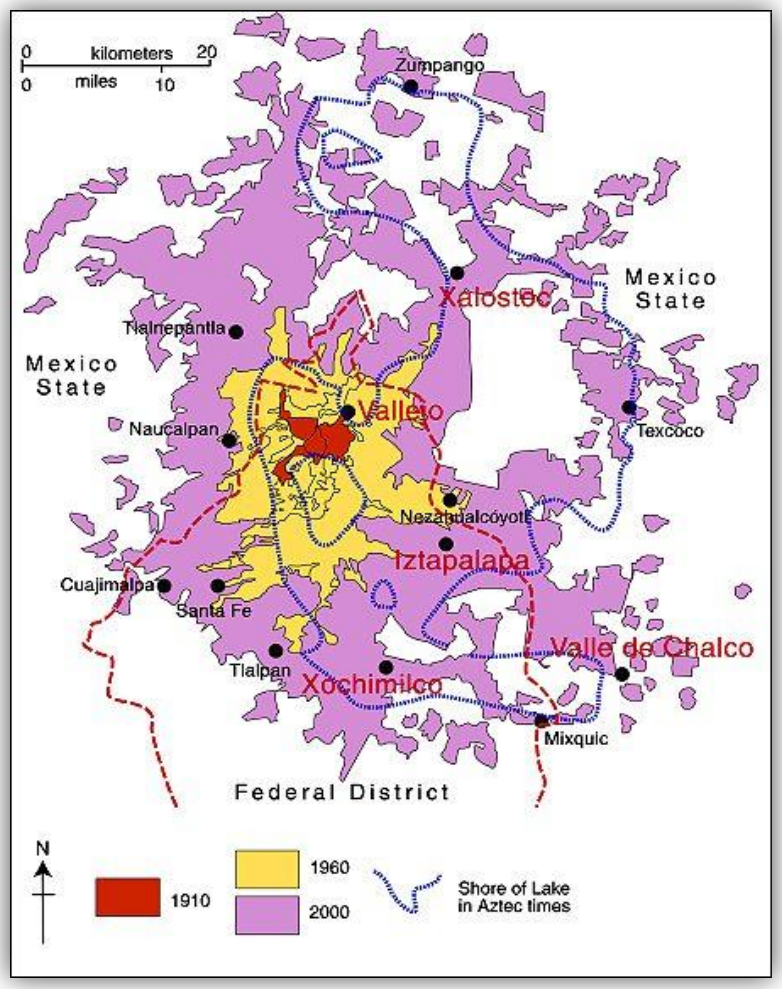

Figure 14 Mexico City map [12]

The Red zone, which is the old center and surroundings were the most affected. The map shows the expansion of the city through time, as well as the shore of the Lake in Aztec times.

Apart from the physical damage and death toll, almost all the national and international communication lines were not operating and 14,500 local lines were cut due to the disruption of Telephones of Mexico (TELMEX), which was very severe because of the collapse of the headquarter building. Additionally, about fifty trunk networks were extensively cracked, and 750 multiplex equipment units were destroyed. Moreover, six communication operations centers for long distance operations, six telecommunication buildings, and all manual operation centers were ruined. Public services and power generating substations could not function properly which caused by the disruption of electrical power. Nearly half of the city faced electrical shortcuts or

total loss of electricity. Over 800 transformers, 28 kilometers of high tension lines and 32 kilometers of low tension lines were broken. The water system suffered significant damage as well. Thousands of leaks were formed in the piping system and water distribution was gone in the most heavily disrupted districts. More than half of the households had no phone connection, water supply and were missing other basic utilities. The rescue activities were hampered due to destroyed and damaged hospitals. The rescue labor was being performed mainly by the police department, fire fighters, red and green cross, emergency services and the marines. The main governmental presence was the army, who were not performing rescue activities but maintaining order. Three of the largest hospitals in the city were not possible to use and about 30 percent of all hospitals capacity was lost. The earthquake had negative socioeconomic effects, such as children without schools, and people without jobs. The historical center contained the most important business, political and commercial districts, and its collapse enabled the working capacity producing massive unemployment. Most of the governmental functions failed because plenty of institutional buildings were destroyed and had to be evacuated. The time of the impact happened so early that people were still at home and not at their daily working or educative facilities, which buildings were located at the most affected area. The overall calculated damage was around five billion US dollars. [1][9]

Figure 15 The collapsed transmission tower of Televisa [14]

2.2 Organizational and Individual Behavior

2.2.1 Governmental Structure

As the largest urban community, Mexico City is the political headquarter of the Mexican nation; furthermore, it is the cultural, medical, educational and social core of the country. Consequently,

the main industrial and commercial enterprises, health facilities, economic and financial institutions, science departments and mass media outlets are found together in the MCMA. The Federal District Department of Mexico City (DDF) is a political autonomy for the city as it is not a part of any state of Mexico, and which is a part of the federal organizational structure.

The DDF is really complex, because it is subdivided into 16 governmental units according to geographical areas of the city. These delegations are autonomous which contain subunits as local departments with their own services and organizations, such as public works, water, housing, etc. As consequence of these additional specialized divisions into subunits, the daily governmental activity of Mexico City is remarkably decentralized. [8]

2.2.2 Disaster Planning

It is known that before the ’85 disaster the federal government had a disaster plan for the Mexican army, the DM-III-E document, which contained the general emergency response activities. According to the polity, the army was responsible for all the coordination and control of the crisis situation while it had a great involvement in civil life as well.

On the contrary, the DDF had no overall formal system wide planning for catastrophes, but only small, individual developments or preventions for operations of different departments or subunits. Merely a Unit for Civil Protection (SIPROR) had been founded within the Mayor’s Office, but guiding only normal firemen and police actions.

Concluding the previous sections, before the ’85 earthquake Mexico City was demonstrated as an extreme organizational complexity, with a relatively decentralized metropolitan political system, and without a complete disaster plan. Beside the prior situation, it was disposed with significant human and material resources and with variously localized federal agencies, which could be applied and operated in mass emergencies. [8]

2.2.3 Mass Media Related Communication Behavior

Immediately after the impact of the earthquake, the local television was not working since the main building and communication towers collapsed. Anyhow, reporters continued working to transmit the collected information as soon as any of the communication outlets were reestablished. Three hours from the earthquake the media was broadcasting also citizen information before filtering it, but by stating that it was not a relying source and for such reason had to be confirmed. Media was transmitting through mobile units which were placed in critical locations, meanwhile, many of the real time videos were coming from citizens. The media was reporting the need for equipment to remove debris, which it can be deduced that either communication between field teams and operational center was failing or there were not enough resources.

According to University of Delaware research which was made two weeks after the disaster, a big part of the metropolitan population had access to broadcasting during and after the earthquake. The research study provides detailed information about the spread and custom of traditional media usage. The high level of access might mean that Mexico either own advanced technological system for news broadcasting, even if it is listed between the developing countries, or the local news network was redundant. In general, Mexico City had substantial availability to mass media outlets, as Figure 16 indicates. Like reported by the completed surveys, radio sets were especially widespread and also two third of the population had black and white or colored television sets. The spread of newspapers were also high, but due to illiteracy only 20% of the population got information through journals.

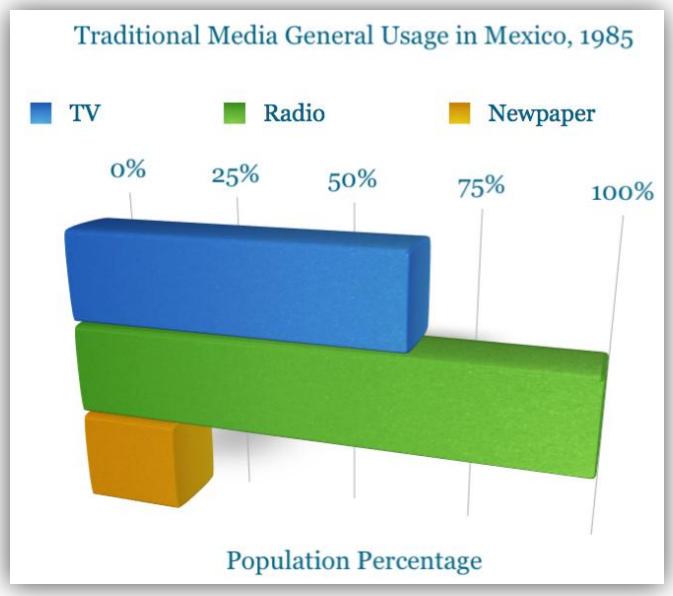

Figure 16 Traditional Media General Usage in Mexico [10]

Figure 17 shows the distribution of television sets at the year of 1985 and 1986. In 1985, 67.1% had at least one black and white television and 41.1% had at least one colored TV set. Interestingly, a year after the ownership of black and white TVs increased more than 10%, while the colored ones only 0.6%, which possibly means that the price of colored TVs were still not commonly affordable.

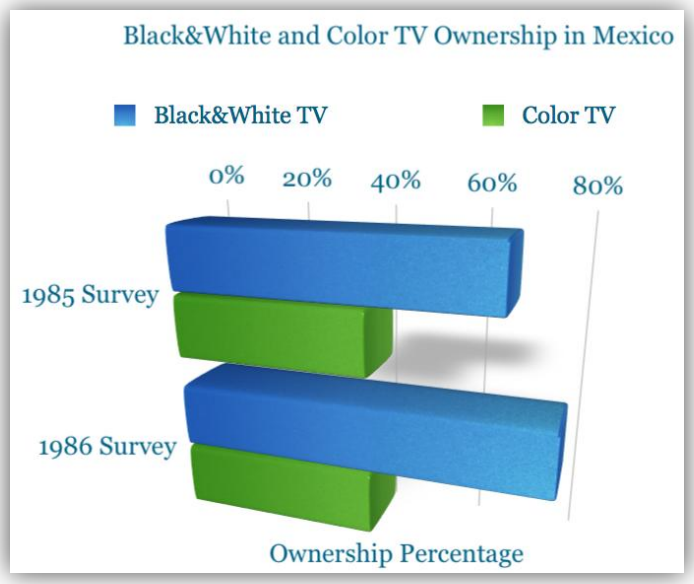

Figure 17 Black & White and Color TV Ownership in Mexico [10]

There were 7 television stations and generally most of them were continuing transmitting, except from some private companies. Besides, 57 radio channels and several newspapers were available. Specifically, the usage of mass media was heavy on the day of the earthquake, as Figure 18 points out. Only about 37.2% did not listen to any radio channels, some of this due to the loss of electricity. Curiously, more than half of the people, 54.7% switched on their television that day. While the radio listeners were very varied in choosing a radio channel, the television viewers watched one or maximum two television channels. Only a low percentage, 16.4% read newspaper that was not far from the daily norm, but paying attention on multifarious types of papers.

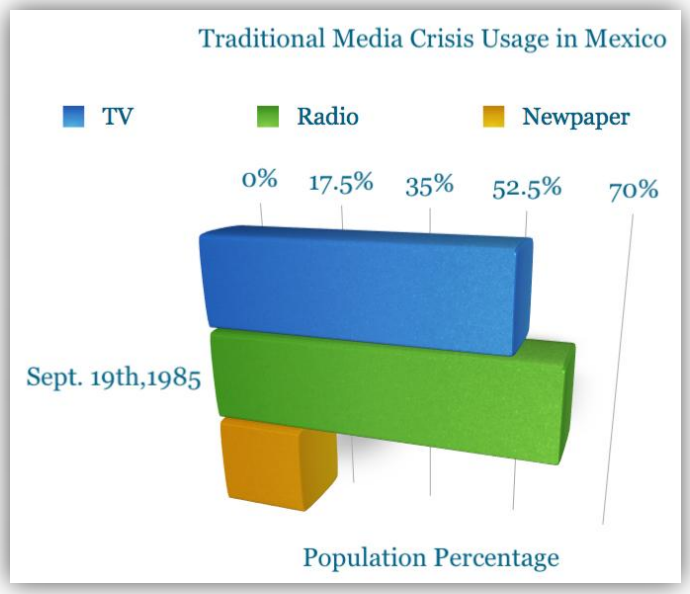

Figure 18 Traditional Media Crisis Usage in Mexico [10]

Some part of the radio and TV audience followed the broadcast more than eight hours that day. Also after the impact, the usage of the various mass media sources to depict the earthquake was impressive, affecting a mass assault on the mass communication outlets.

The research examined the attitude toward the information that the television broadcasted. According to Figure 19, one third of the population found the reporting about the earthquake complete, while one fourth stated that it was incomplete, and the rest was in between.

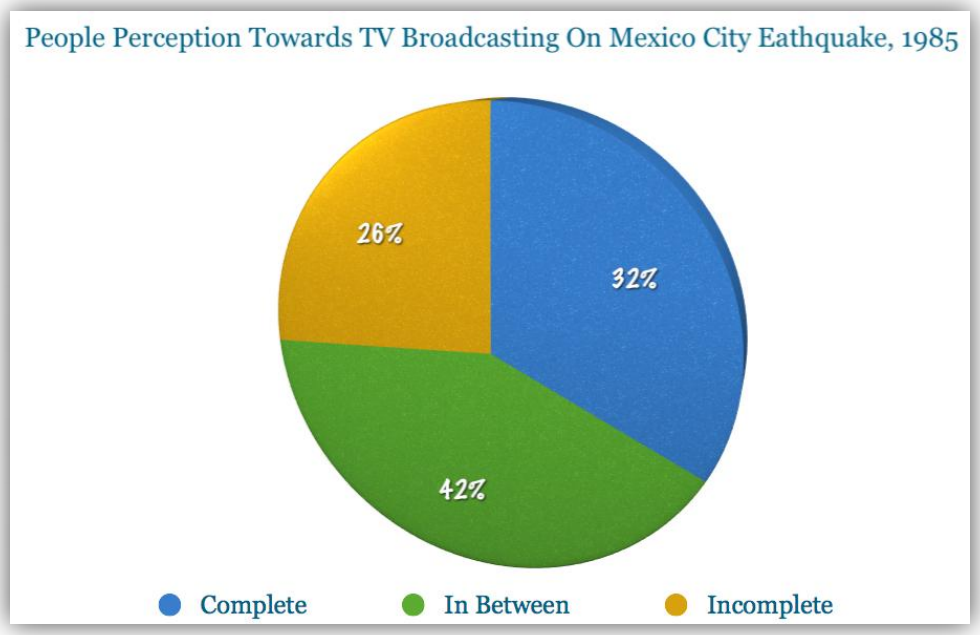

Figure 19 People Perception Towards TV Broadcasting On Mexico City Earthquake [10]

There was only small difference between the coverage of the private or governmental transmission, however 30% of the surveyed people indicated that most of TV telecasts didn't provide appropriate emergency guidance or directive. This public opinion was barely affected by social, gender, or age differences. The little distinction was between frequent and non-frequent TV users, such as moderate and high users thought the telecast were more complete. Moreover, upper class responders found it rather sensationalized, while middle class individuals saw television as less directive and providing less guidance comparing to other social classes. Women and younger responders evaluated the TV as directive comparing to men, who found it more sensationalized.

Figure 20 illustrates, most affected people believed that the television coverage proved more orientation than those who were slightly or not at all victimized. Correspondingly, 38.3% compared with 25.9% and 22%, due to the fact that the major victimized population needed the most guidance.

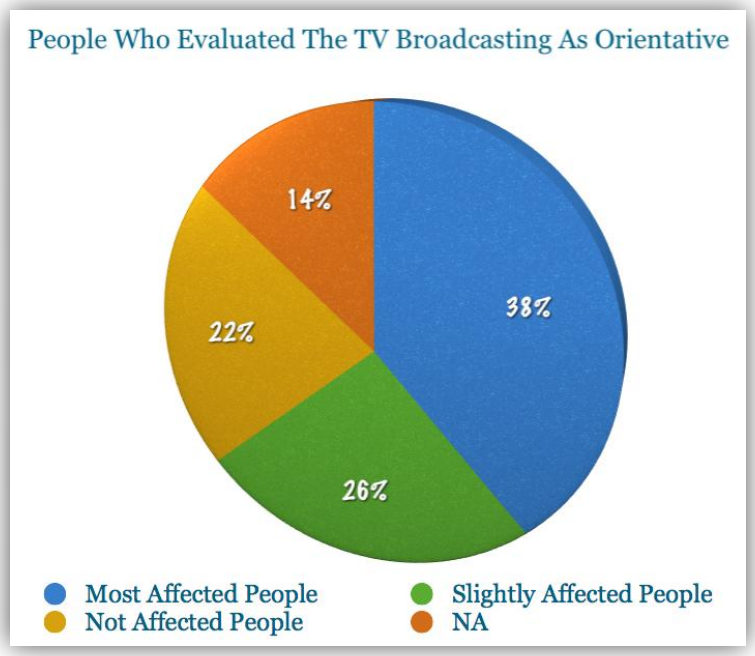

Figure 20 People Who Evaluated the TV Broadcasting As Orientative [10]

It can be summarized that both, victims and non-victims attitudes about television reports after the earthquake were similar, meaning they were not dissatisfied with the information received. The radio was defined to be the major source of mass media communication, since victims more likely listened to radio than watch TV. It can be observed form Figure 21 and Figure 22, which represent the post impact usage of radio and television, that in practice the percentage of radio listening by most and slightly victimized citizens exceed the percentage of television watchers by those.

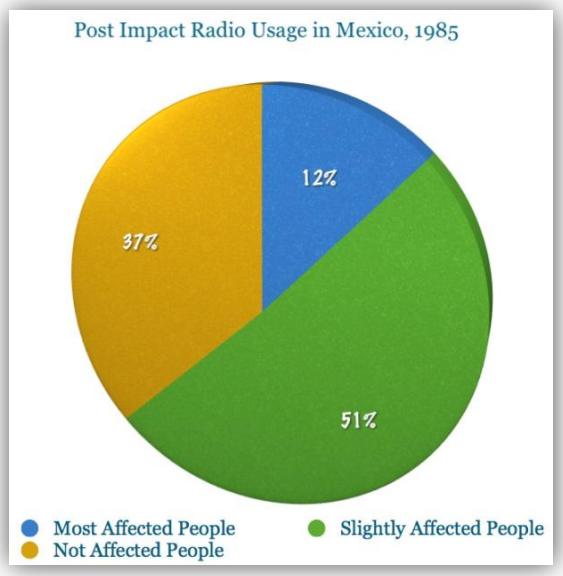

Figure 21 Post Impact Radio Usage [10]

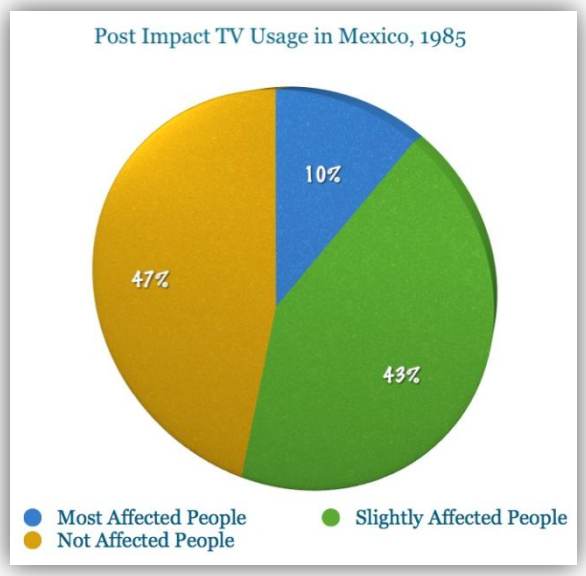

Figure 22 Post Impact TV Usage [10]

In certain crisis situation the mass media provides disaster content which the general population either find satisfying and helpful or worthless or exaggerated. Aside from this fact, the people who experienced the major calamity still used the information released by the functioning news network. [10]

2.2.4 Social Class Differences

Mexico City is enormous, not just regionally speaking, but the social class differences and population distribution have also wide range. It can be distinguished between upper, middle and lower class inhabitants, according to a 1985 survey, which were randomly made on choosing Mexican residents who were directly affected by the earthquake. It can be stated that upper class persons were less affected comparing to middle or lower class persons. But contrary with the expectations, middle class persons suffered more than lower level society. The reason is that the middle class were concentrated closer to cultural, social and political centers of the city; such places were nearer to the ancient lake bed, where the major disruptions occurred. Also because of the great poverty of the lower class and since these people were living in already cracked and ruined houses, thus further damage caused by earthquake was barely visible. As discussed, the social status was an important differentiating factor in the victim's attitude during the disaster and it requires more attention in managing the crisis situation.

2.2.5 Volunteer Behavior

In the immediate aftermath of the disaster there was massive volunteer activity. Almost one of every eight adult residents of Mexico City was participating in the citizen emergent actions, mainly in search and rescue activities, which is an enormous number taking into account the extent of the population. In addition, a wide range of different tasks were undertaken, for instance, procurement and processing of supplies, transportation assistance, shelter and housing aid, building inspection, medical/psychological help, blood donation. The average volunteering work was four or more days per week granting nine operating hours per day. In general, mostly the upper and middle class residents took part, from young adults to middle age, who lived relatively close to the impacted zones. For managing the huge number of volunteers, the main difficulty was the determination of skills and the utilization regarding to the administration, validation of legitimacy as well as the overall guidance and briefing of the crowd from organizational point of view.

2.3 Organizational and Individual Response during the Emergency Period

In this section, the organizational and individual response to the emergency crisis will be analyzed during the first three days according to surveys were made on organizations and the population in 1985, two weeks after the earthquake by the University of Delaware. On one hand, the reactions were uncoordinated, duplicative, conflicting, and chaotic. On the other hand, the response included appropriate and useful activities by different agencies and departments from

the national, Federal District, and delegations levels. In addition, a variety of private organizations, volunteers and citizen groups joined to the action.

2.3.1 Initial Governmental Actions

An immediate response was not conceived during the event's aftermath; however after a couple of hours of earthquake, the President of Mexico Miguel de la Madrid provided federal aid and ordained to struggle against the disaster with all governmental potency and resources. To begin with, the national military disaster plan was partially implemented by mobilizing the army, marine and navy units. About 7000 people from the military were involved in the highest priority activities, especially in search and rescue and provision of aid. However, it was soon observed that the DN-III-E plan was not adequate in the case of Mexico City, because it was developed for rural areas or small cities. Furthermore, the total responsibility of the military to respond the disaster was not feasible due to the magnitude and high complexity of the event. Hence, the role of the military was limited to provide security and control at danger zones, while the overall disaster management was replaced by the Mayor's Office in the DDF. During the first two-three days, two improvised operational committees were established by the President. The first one was the National Emergency Commission (CNE), which was working outside the capital, and the second one was the Metropolitan Emergency Commission (CME), which was headed by the Mayor in the center of DDF. The main problems with this emergent management system were the lack of prior planning and the delay of the beginning of operations, which caused ineffective coordination in early response measures. Moreover, the initial coordination by the government was kept back due to destroyed official buildings and offices, as well as, the criticality of damage assessment and information collection, which caused the lack of quick overview of the situation and decision making. Therefore, during the first three days, the ad hoc committees were processing and developing operational plans and activities to respond the emergency case properly. By the third day the CME established an Emergency Operation Center (EOC) at the National Palace, where officials held meetings throughout the emergency period, but still without a well centralized communication and decision-making system that would provide continuous supervision of the events. [8]

2.3.2 Initial Response of Other Organizations and the Public

Even though the official response of DDF was in late, during the first three days collective and individual steps were taken in order to coordinate the messy situation. Public and private organizations were formed and tried to fight against the crisis by fulfilling public and social demands with the help of volunteers, as Figure 23 verifies it as well. The established groups were facing problems of search and rescue, medical care, urgent sheltering, canteen needs, crowd control and handling corpses. The damaged sites were spread across a wide area and all of them required a specific response to the urgent problem. The lack of local planning design provoked that the participating organizations gave immediate response to the areas where they were presented in a spontaneous way.

Figure 23 The collapsed famous Hotel Regis in the city center, which was an important meeting point for politicians and journalists while surrounded with volunteers and rescue teams [14]

2.4 Analyzing Communication Failures throughout Some Examples

In the following section, the actions of some public organizations will be introduced during the initial response period. Interviews were made with the different agencies that were presented in the previously introduced case study of University of Delaware. Then some examples were taken from the surveys and were analyzed and evaluated the communication methods and their failure.

2.4.1 The Response at the Level of Delegations

The observed delegation's office was placed in one of the most severely damaged quarters. As the workers arrived to the office on the morning of the calamity, the first task that they had to face was the acquisition of information about the magnitude of the devastation and the extent of activities that had to be completed. According to a staff member, it was said during an interview:

"We organized ourselves and volunteers into brigades to go and bring back information about what had to be done. But when the brigades came back, the information we received was of duties that were impossible to carry out; there was simply too much to do. The sub-delegation of works went out with their trucks and shovels, but it was overwhelming." [10]

More importantly, the lack of interaction and coordination with other delegations made the task of information collection very difficult. In the beginning, this unit was informed about the implementation of DN-III-E plan, in turn, no message arrived from any sources that would confirm the presence of the completion. An employee of the delegation mentioned the next:

"I wondered what had happened to the DN-III-E plan. It was second day, and still no one had come. We were told to relax, that the plan would go into effect and that their people would come, but they did not. I don't think people even knew about the plan, or maybe they thought it was already in effect. Anyway, no one came." [10]

This means that there was hierarchical failure on the communication between the organizations at different levels in the first days, most importantly with the DDF. For instance on the first day, communication equipment arrived to launch a link for the delegation to the DDF, but still no policy making or guidance had arrived from the Mayor's office. An interview respondent said the following:

"There was no coordination with the Department. On the first two or three days the delegation was not able to carry out its duties, but the DDF did not take over, either. There was a complete absence of a line of authority or coordination. Supposedly by that time the D-III-E plan should have gone into effect, a desk established for sending out directives, a camp of action, a hierarchy, and there was none. So many of the efforts were in vain, because everyone – like a hundred institutions, education, universities – went out to the streets doing things without any direction."

However, efforts for performing miscellaneous tasks were taken by the different departments of the delegation, such as clearance of debris, reparation of water supplies, distribution of food, construction of temporary morgue and producing census data of the affected people. The army restricted the access of severely damaged spots and denied the entry of delegation workers, which set back the creation of the list of missing and dead persons. Moreover, the staff members couldn't gain access to LOCATEL, which is the missing persons' bureau. The obstructed and missing information caused overlapping of problems, as shown in the following statement:

"The information I had, I received from the radio. I got hold of a radio; because it was the only thing to do…We had an enormous difficulty with communication and the movement of vehicles. On one side, vehicles were not being permitted to pass. On the other side, vehicles could not pass because of fallen buildings. So there were many areas, houses, buildings, where help was truly needed. But there was no census really to say which were the requirements for salvage. Some areas went for many days without having a brick turned over." [10]

2.4.2 Supply and Aid Managing

Many times unsolicited aid arrived to delegations offices in the form of food, clothing and medicines. Plenty of these materials were congregated and their distribution was assisted by individual volunteers, however, there was no coordination of this effort.

Most of the drugs were not requested and could not be used because none of the boxes, which they were packed into, was classified. Many of the drugs boxes were opened and in many case the instructions were in foreign languages. Volunteers applied to select and classify these boxes one by one and organize them the best they could.

Spontaneous shelters were arranged at major locations at community and sport centers, where social workers and volunteers undertook the coordination of sheltering activities, including the transfer of supplies from the offices to the field. Though, for the reason that no connection or any communication functioned between these teams, a lot of times the required or needed aid didn't reach the aimed destination or just became wasted on the wrong places.

"One minute we would have no food, and the next it was piled so high that we couldn't store it. We would distribute it immediately to an area, and when we arrived to give out the food, other private agencies would be there. There was no coordination of this activity during the initial period."[10]

"We never really had a shortage of food, in fact, it was the opposite. Tons of food arrived from restaurants, institutions, whatever. The shelter people would come with a truck of food, and in an instant, there would come another truck. People just took what they needed."[10]

2.4.3 Absence of Connection between Delegations

It was a typical reaction that the mostly damaged delegations received outside help from other, less harmed delegations from the district. Nevertheless, even if their involvement was necessary, complications appeared between these previously autonomous units. Besides not knowing each other, the different agencies had different equipments and way of working which had to be introduced quickly during the emergency, generating more problems.

"On the second day, people from other delegations, where nothing had happened came to support us. Apparently, they were ordered to come by the DDF, but it was difficult, because we did not know each other. The rest of us had been working together. They were asking what to do, where is this and that? The help was not very defined with regard to equipment or personnel. There was little order or chain of command." [10]

2.4.4 External Support

2.4.4.1 The Response of PEMEX

PEMEX is the national petroleum company of Mexico, which is employing thousands of personnel and owning broad extension of resources. PEMEX could participate in the immediate post impact period, because it did not suffer any major damages. Pursuant to the magnitude of the disaster, the company's Director decided to reflect on search and rescue emergency task, headed for extract the greatest number of live people owing to proper facilities and equipments. PEMEX decided to work independently from other organizations; the only involved representatives were from the army to consult about different work sites and account for the found properties or dead bodies. The advantage of this arrangement was to be self sufficient and accomplish specific tasks with their own available resources which work in fact was very efficient and valuable, even if the company avoided collaboration with other disorganized institutions. On the contrary, while the

great autonomy was beneficial to PEMEX, the lack of interaction and communication with other organizations had negative consequences.

"I think that during the first two days there existed an emergency in which you could say there was chaos, there was disorganization, and anguish. This was true both in our relationships with the army and internally…You see, whenever the army needed an action from us, they would get in touch with our security chief and tell us. But there was much disorganization and lack of coordination. Why? Because there had never been a chance to work in a situation like this." [10]

"I think that is bad (the lack of integration). Because a system should be demonstrated that, in another situation of emergency, could be implemented quickly so that we all could collaborate."

2.4.4.2 Response of Lifeline Organizations

As it was mentioned before, communication lines, electricity and water system were the most affected lifelines. The principal response of these organizations was focusing on the restoring of their own system, which in some cases was remarkably effective. For example, the electrical service repaired the majority of the mostly damaged areas within 72 hours. The transportation organizations experienced less damage, such as highways, railways, ports and airports. For instance, the airport services were suspended only for 19 minutes or the subway system was operating with full capacity by the second day. The exception was the bus service, since the lines were disrupted by the scattered debris.

The various lifeline agencies gave complex responses, starting from the damage assessment and information gathering, incorporating federal, district and local delegations levels. The correlated agencies, which generally provide day-to-day operations, during the first days tended to act independently. This leaded to miscommunication and it happened that workers from different levels arrived to the same place to fix the same problem.

While the first step for all damaged agencies was to repair and restore as much services as quickly as possible, other organizations joined to emergency activities that were out of their original responsibilities. As an outcome of the lack of centralized organization, these agencies established several command centers on their own and were trying to deal with the new duties. Apparently, problems appeared during accomplishing the new emergent tasks, such as prior knowledge about the routine and implementation, numerous equipment failures and an applicable communication method with the venturesome workers and volunteers.

"The arrival of people and volunteers was enormous, but it turned out to be a source of difficulties for us. People started pouring in from all different states, and they came without tools or equipment of any kind. Before they could be assigned and sent to a post, providing for the food and equipment they needed proved to be very problematic." [10]

2.4.4.3 International Disaster Assistance

Equipment, supplies, rescue workers and money arrived from fifty-two nations and four international organizations to assist the disaster relief effort in Mexico City. The question was how much of this aid was requested and needed by the Mexicans, which was really complex to understand and make appropriate decisions under uncertain conditions and with incomplete information. The actual results of international rescue and relief operations had a relatively minor effect but not at all negligible comparing to Mexican participating in this task. The reason was the problem of integration that the Mexican government could not undertake enough rapidly, also because of the disruption of international telecommunication facilities. The President of Mexico, Miguel de la Madrid Hurtado declared the first priority for the government and its people to be search and rescue of survivors trapped in the damaged buildings. Thus, international teams arrived from France, West Germany, Israel, Italy, Spain, Switzerland, UK, US and Venezuela, to share the responsibilities and help to handle the task with new technologies and applications that were mediated by the media as well. The adaptation of the international rescue teams' performance was problematic because of the wide disaster environment and the delayed official decision making about allocation and implementation of the assistance caused by the non-continuous information flow. The national embassies located in Mexico City served as a kind of communication between the searching teams. The primary assets to develop for the future integration are the form, content and mode of communication, in other words, patterns, styles, technologies and language has to be structured in a more coherent way. However, an example in Hospital Juarez showed how the collective performance was working even though the different nationalities. [11]

"Let's organize ourselves in groups of 10 and try to get inside the building! We'll do the hard work! When you hear sounds of life then we'll call the French rescue team. The main object is to remove the debris so we can get into the center of the building! Listen to me. I'm an architect. The last quake did no further damage..so lets try harder. Lets find those who are still alive!"[13]

2.4.5 Establishment of Morgue

Locating and identifying the dead bodies was one of the most stressing tasks. A baseball stadium, which is shown on Figure 24, was used for this reason and most of the bodies were brought there. The bodies were captained in icebergs for 72 hours to allow relatives and friends the opportunity to identify them. With time or because of the damage of earthquake the identification became harder for searchers. After 3 days the unidentified or unclaimed bodies had to be buried in common graves. The word of people resounded: „No incineration, no mass burials, we demand bodies!" It was a really unpopular measure from the political leadership. The presence of corpses caused further anxiety. Many of the affected population and many rescuer workers believed that the decomposing bodies could cause epidemics. This unfounded fear let to the implementation of symbolic steps to calm the public. This same miff let people to demand to vaccinations against any conceivable type of disease. There were voluntary groups who injected these vaccines until

health agencies could explain to the news media that epidemics do not arrive spontaneously in such cases and that mass vaccination was an unnecessary waste of resources. [13]

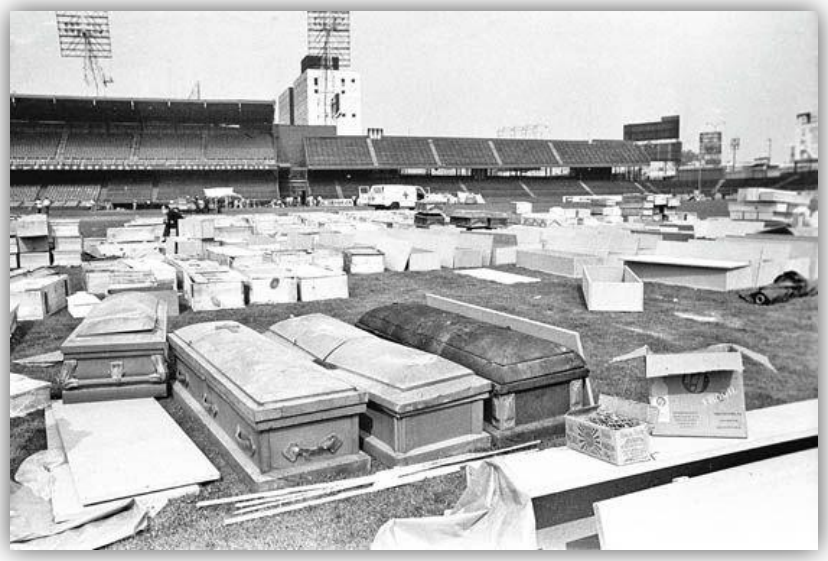

Figure 24 Establishment of morgue [14]

2.4.6 Considerations about Communication Failures during the Emergency Period

The significance of the previous examples is the verification that there was no hierarchical interaction among the organizational structure of Mexico, which induced some degree of inter-organizational conflicts and disagreements. Neither any vertical or horizontal communication existed between these agencies, meaning that the performed operations generally were autonomous from other organizations and occasionally contradictory information released causing confusion. During the emergency period, the operative groups didn't know about being a part of any integrated response or communication system to carry out their related activities, until the President of Mexico asserted through the mass media that the one, "who was in charge" to control the emergency response was/would be the DDF. The previous sentence expressed the consequence of misleading media messages and political corruption which is lowering the efficiency of treating the crisis. The response was certainly decentralized, however many of the critical tasks were undertaken correctly and successfully in the immediate aftermath of the catastrophe.

2.5 Organizational and Individual Response during the Rest of the Emergency Period

One year later, in 1986, another survey was made by the university around the anniversary of the earthquake, thus subsequent political movements showed up and longer run problems appeared.

After the initial three day crisis, when the government established the committees and the official EOC came into being, then better coordination, more comprehensible task allocation, and consideration of longer term problems took place at the distressed area. As the earliest chaos period extended over the weekend, on Monday the first government ministries, agencies, banks, public transit systems and many businesses started to reopen, while schools and some delegations remained closed. The synchronization of activities improved with the growing reinstatement of communication facilities and more complete and precise knowledge of the level of the devastation. Some organizations continued to operate autonomously, while some of them started to integrate various units, but still there was no centralized "command and control" model of emergency management. The role of the DDF and CME was more like contributing in the ongoing organizational activities than commanding all the responses generating fragmentation, which is explicable by the broad scale of the event, the widespread difficulties that it created and the complicacy of the inclusion at the federal, district and delegation levels.

The disruption of utilities happened immediately after the earthquake, but some services had difficulties to function in the following year as well. Even though Mexico City residents used to have some irregularities in the operation of services, therefore they weren't especially unsatisfied. The restoration of water supply and phone services were handled very quickly by the government, while the housing problem, unemployment and reconstruction of schools and hospitals were not solved properly, causing the increase of the economic crisis and radicalization of the lower class in Mexican society. The weakest evaluated tasks that the government undertook were the handling of foreign aid and donation, and informing the public about the recovery phases. However, the majority believed that the government had control over the post-disaster activities.

For a period of time, over two million people left their house because of severe damage or unsafe feeling, even if there was no serious physical necessity of move. These people mainly moved to some relatives or friends, only lower class took place in public shelters. A year after, still a hundred thousand people was without permanent homes. As a positive social aspect of the earthquake, it can be mentioned that family relationships were strengthened and the trust in other citizens increased between people.

In the following, the illustration of some problematic tasks and their completion is shown during the full emergency period.

2.5.1 Distributing Information

No doubt that the earthquake occurred without warning. Immediately after the impact, both organizations and the public demanded for all-important information about damages, available facilities, well-being of relatives and friends, reopening of services, the possibility of further earthquakes, safety of water, and locality of aid and assistance. There was no controlled distribution of information, but intense search for any useful references or data. Interpersonal

networks and the mass media were the most important information mediators. People were asking each other about the situation and what was happening. Beside the citizens, organizational officers became consumers of the mass media, particularly the television and the radio, and relied heavily on the broadcasted information. A representative of a delegation said:

"What I learned, I got from the radio. The media people were coming to me and asking for information, but all I really had was what I had just heard from them."[10]

Certainly, information was propagated for the public regarding to seek after any kind of help services, but sometimes these outputs of instruction were conflicting. A health sector official described the following:

"The Secretary needed information. We sought information about the number of injured, dead, victims, trapped persons, and so on. There was some confusion that we noted in the management of information. For example, the Red Cross indicated that they alone had transported around 10,000 cadavers; this never appeared in any later data…We thought that various organizations were withholding information, so we had to look for different ways to get it."[10]

The major problem was the widely varying damage accounts. The collected numbers were all different in the newspapers from the official ones. Nobody had an exact idea or a close approximation about the real magnitude of the calamity. It also happened, because mass media relayed personal messages and stories to their audiences. These became rumors and spread through the networks of interpersonal relationships as well. A bunch of improvised news flourished, like rumors about another earthquake, or the likelihood of an epidemic.

In point of fact, the main goal for the DDF was the centralization the information flow in the Public Information Officer. The delegations were ordered not to spread public announcements, in order to allow DDF to be in command of all official information. Nevertheless, this attempt was not successful because the above mentioned office, as all other organizations had no proper knowledge of what was occurring all over Mexico City and it was not possible to take the overall direction of the extended metropolitan area. During the rest of the emergency period, further improvements were implemented to develop more formal sources of official communication across the CME and DDF. The information utilization was continued by the mass media and the citizens for further understanding of the crisis situation.

The immediate broadcasting abroad about the earthquake and its treatment showed quite negative evaluation from international perspective point of view. The reporting of the news in Australia, the TVO Brisbane Australia Eyewitness News said the following:

"Mexico City one of the world largest cities tonight devastated after a massive earthquake which is claimed at least 3 thousand lives. The entire city center crumbled when the quake, registering 7.9 on the Richter scale, hit during the city's early morning rush hour. More than a hundred of

Australians are exposed to danger in Mexico, including a 56 year old man who has to stay in a badly damaged hotel." /Reader Des McWilliam/

"For month scientists of the University of California had predicted a powerful earthquake in Mexico. But the Mexican government didn't act on the information because earthquake planning and preparation is expensive. So authorities in the world huge capital were completely unprepared for the case of such a disaster." /Reader Kay McGrath/

The BBC Radio 4 channel in Canada transmitted the following by Alistair Cooke on Friday 27 September, 1985 21:00:

"So what did we hear and see? What Canada saw from the news, how the President reacted on the accident. The broadcast is very critical in the sense what was transmitted to abroad. Nothing else could be seen just destroyed buildings, crying people and rescue workers…and back to the star, about a normal studio speech, isn't it awful. The only good thing was stressed not to send food or blanket but money. Short run help by a check, in a long run in business economy crises already existed, what will be in the future?"

What can be observed from these recordings, is that media tries to find responsible for the incident. But as a side effect of the earthquake, the question appears, whom to blame in an act of God? Intellectuals, writers and architects charged the government or the developers who violated the building codes. Also people, who became mad when something went wrong, were citing professionals. A possible cure to this problem is to emphasize to the community that with moving into the dangerous area they took the risk of living there, and instead of fight against each other, working together can provide a forward and safer situation. Also, less attention should be paid for distorted information of the media.

2.5.2 Missing Information in Emergency Activities

After the shaking plenty of organizations started to work in damage assessment with their own resources and capabilities, which resulted that the prepared damage assessment reports, including essential information, were incomplete, sometimes inaccurate and not well-shared. Within time passing, the CNE and CME received additional updates, which facilitated to build up a more accurate picture about the earthquake impacts. The government created a special line for citizen to report damages, in addition to the permanent emergency line.

As well as the previous task, search and rescue activities began immediately with a great amount of participants and different kind of abilities. After an initial collective informal response, coordination of groups and system of strategies and techniques were applied. Problems of logistics, integration and disagreements appeared, also with the arriving foreign rescue teams. Due to the enormous expansion and complicated circumstances of the earthquake, it was not possible to have an overall control of these efforts.

The health sector was severely affected by the tremor, but there was no shortage of hospital capacity or medicines by reason of the large enough system to absorb the losses. There was difficulty in transporting victims, locating the sufficient resources and mainly with the lack of triage. Other parts of the problems were coming from the lack of prior planning and interaction among units.

"The problems were in knowing those in charge of handling disaster medical aid, because we did not know them before. There wasn't any pre-disaster communication. We knew that each institution had its department for emergency response, but we were ignorant of many contacts, and of many decisions being made."[13]

There was no overall collection about the data of missing persons and victims, but the different organizations began assembling their own lists. Also informal notices written by citizens were found in public areas.

"We were gathering information in selected areas. Much of it was done through the mass media. It was at first locally done. For example, in Juarez Hospital and General Hospital, they put down persons "that were working in the quake." Also, there was a list of for persons "that didn't appear," and that had not returned home. Additional lists for those "people who were found and identified, "identified cadavers, and "unidentified cadavers". So, sometimes there was information, but it was localized from that center. The Secretary of Health did not at that time have a specified department to give out and concentrate this information." [13]

2.6 Conclusion

Finally, it can be concluded that the key for future emergency situations is preparedness and more emphasizing, the incredible strength lies in the communication process! After the tremor, the residents of Mexico City didn't leave the areas which were recognized as dangerous, meaning that individuals didn't learn much on how to prepare for future disasters, even if they experienced the devastation of the earthquake. The organizations learned few from the experience of undergoing a disaster which can be put down as a failure from preparedness point of view. In addition, in information sharing and communication processes, the phenomenon of looping is potentially observed. As it was mentioned in the examples, many times the official personnel was gathering information from the mass media transmission, which information was obtained from the public or other interviewed organizations and then broadcasted by the media. Then, the collected data was returned back again through the media without filtering due to the lack of official mediation. Thus, the quality of such information was questionable, as well as the fact that there was no other source of official information but the media. Even if the overall evaluation of disaster management was positive comparing to the extension of the devastation and the development of the era when it happened, the accurate and reliable information flow was missing from the response scheme, which is crucial in effective and quick decision making. As an improvement, future planning activities should be based on formulating measures to coordinate

the initial response in order to avoid a considerable period of decentralized organizational actions. The previous Chapter showed the main type of difficulties that can occur in case of lack of developed emergency and communication plan. In the next Chapter, we are going to show the process of improving communication systems during emergency which assumed to optimize the undergoing of a crisis situation and be able to cope with a new disaster in a better way.

3 CHAPTER: TABASCO AND CHIAPAS FLOODING OF 2007

3.1 Description

Water resources comprising of surface water (river and lakes), ground water and marine and coastal waters, support all living things in Mexico and the world. The country has a mean annual rainfall of 780 mm, about 27% of which becomes runoff ensuring about 410 billion m3 river flows per year. Renewable groundwater is estimated at 63 billion m3 per year, 48 billion from natural recharge and another 15 billion from deep infiltration associated with irrigation projects. Additionally, there are an estimated 110 billion m3 of non-renewable groundwater that could be available for one-time use because of the lack of natural recharge. Due to the dimension of Mexico, climatic zones vary greatly from tropical rainforests with over 3000 mm of annual rainfall in the south, to arid deserts with less than 100 mm in the north. As well as, runoff discrepancy is from over 2 million m3 per km2 per year in the wettest areas to essentially zero in the driest. Consequently, Mexico suffers from droughts, particularly in the northern part of the country. In the dry periods that may last from one to four years, rainfall and runoff may be reduced by 40 percent. Mexico is also subjected to flooding depending on the characteristics of the source, such as flash flood, general flood or costal flood. Floods induced by heavy rainfalls, hurricanes or tsunamis occur almost every year in some states. The permanently appearing, devastating flooding can cause soil erosion, landslides, and severe damage to housing, agriculture, livestock and public infrastructure. Floods are rarely inflicted only by rainstorms but deforestation, inadequate agricultural productions, and growing urbanization can all increase the risk of flooding. The relief map of Mexico, shown in Figure 25, puts in evidence the main flood plans, such as the basin surrounded by mountain chain, the south-east and the north-west part of the country. Mexico City, which is lying in the basin, is also at risk because of a lack of proper drainage system, thus it is exposed to flash floods inferring great amount of losses. Other Mexican states often affected by the torrential rains are Tabasco, Chiapas, Veracruz, and Oaxaca on the south and Baja California on the north. The presence of flooding is propagating in flood plain areas that have been urbanized, as changes in land use broaden the capture of rainfall, producing flows that the natural river basin cannot cope with. In contrast, in several regions of the country, the main use of water from these intense rainfall events is the filling of the storage reservoirs. The problems of the water resources management are on one hand, to capture and store as much water as possible for future exploitation during dry periods, on the other hand, to maintain a part of empty storage capacity to provide flood protection. Further utilization of water is about 85 billion m^3 of which agriculture accounts for over 80 percent leaving the rest for domestic and industrial uses. Therefore, water use in Mexico is focusing on irrigation to sustain agricultural production as an important element of economics, where avoiding either floods or droughts requires major attention. [15][19]

Figure 25 River Basin Map of Mexico [16]

3.2 History

Mexico lies in the climate zones of tropics and sub-tropics and it is described as a climatically sensitive country experiencing severe drought and flooding as well. The present day distribution of precipitation throughout the year is influenced by seasonal shifts, such as a monsoon-type circulation between April and October with the main rainfalls, and a dry period, canícula, which length is very important in determining whether rainfall is above or below the average for any particular year. Past sources of climate information in Mexico is available through lake level fluctuation during historical period due to the data collected from lake basins settlement. Whenever prolonged rains occur, lake levels rise and low lying areas of the Basin of Mexico are inundated. For instance, Mexico City was often severely flooded that it remained inundated for years. In the 17th century it was suggested by a Spanish that founding a city in such a flood prone area had been a mistake (Cepeda de Carrillo, 1637). During both the pre- and post-Conquest periods efforts were made to reduce the impacts of flooding in the Basin of Mexico in the form of flood protection system and diversion of water. Since the Aztec period, when the best known Mesoamerican cultural nation settled down in the Basin around 1345, the documentation of weather conditions has fine quality. For example, in ca. 1386, it was found that the Tlatelolco town (now a suburban area of Mexico City) was inundated for four years as a consequence of heavy raining. An extreme wet season was deduced between 1440 and 1450, which destructed a part of Tenochtitlan that nowadays is the metropolitan area of Mexico City. After overwhelming flooding in 1449, the Aztecs built dykes to protect the unsafe area. The wet years were followed by severe drought with other abnormal weather conditions, such as snow storms and frost. The water level rising restarted again at the time of the Conquest around 1512, thus Cortez had to use boats for the attack of Tenochtitlan. As well, in the state of Michoacan, Lake Patzcuaro stood at a

very high level in 1522 that has not been reached at any other time following the Conquest. For the period of the 1500s dry and wet weather conditions were changing widespread. The return of the aqueous period was in the first decade of the 17th century in the occasions of 1604, 1607 and 1629, where Mexico City was under water for almost five years. Other extreme events happened in the 1770s and 1780s, then following the War of Independence (1821) several times. The peak records were registered in the period of 1966-70, and so on.

As the previous records demonstrate, Mexico, as a whole country suffered several drought incidents, while there is the evidence of rather wet intervals referring to the implementations of flood protection schemes during the Aztec period (1345-1522). After the Conquest, in the period of 1521-1640, the climate was very various with short but severe droughts intermittently with harsh overflows. Under the interval of 1640-1915 aridity became more dominant and affected intensively the population with famine and other hardships. Since 1915, the weather conditions turn out to be wetter containing series of wetter years with drier episodes. Generally speaking, the climate in Mexico is highly variable due to the factor of seasonality of monsoons that indicates tropical storms and wide spatial and temporal distribution of precipitation. Currently, there are also significant differences between the climate of the North, South and Central Mexico. The northern area is desert or semi-desert, with very cold winter and very warm summer, aside from the coastal areas which are disposed to floods. Central Mexico is surrounded by mountains, where the climatic zone is changing according to the altitude, and the torrential water from the mountains tends to provoke floods in the mid basin. While the southern zone, the lowland on the Caribbean coast is classified in the tropics and the wettest part of the country, thus it becomes the most prone to flooding. The following Table 3 summarize the threatening flood events from 1900 to 2012 with the number of killed and affected people, as well as, an estimated number of US$ of losses according to the accessible registered events. [17]

Table 3 Summarized Table of Floods Accordingly to Its Type in Mexico from 1900 to 2012 [18]

Flood Type	# of Events	Killed	Total Affected	Damage (000 US$)
Unspecified	18	2664	361545	336400
Average/Event	-	148	20085,8	18688,9
Flash Flood	12	245	364227	-
Average/Event	-	20	30352,3	-
General Flood	26	465	3355696	3159000
Average/Event	-	18	129065,2	121500
Storm Surge/Coastal Flood	4	912	746060	1054000
Average/Event	-	228	186515	263500

3.3 Recent Activity

Events like hurricanes, derivatives of heavy rains, floods and landslides occurred in the new millennium as well. In Table 4 the most recent examples are shown and highlight the seriousness of the consequences of hydro-meteorological phenomena. Heavy rainfall can cause intense flowing water in rivers, streams with sediment in mountain slopes, mass movements carrying mud, rocks, sand, trees, and other objects that can destroy houses, bridges and break sections of roads. Also hailstorms can produce damages in the growing areas, obstructions and damage to drainage structures in urban areas. Even if the number of dead people is not massive, the quantity of affected people and the related economical loss is too high in the frequently appearing events.

Table 4 Recent Flooding Activity from 2007 to 2012 [18]

Dates		Geo	Disaster	Numbers of People	
Start	End	Location	Type	Killed	Tot. Affected
08/09/2012	10/09/2012	Tabasco, Veracruz, Oaxaca	General Flood	12	60000
23/08/2011	07/09/2011	Cuantitlan	General Flood	74	40000
18/07/2011	18/07/2011	Tzhuantepec	General Flood	3	190000
20/10/2011	20/10/2011	Tabasco State	General Flood	-	250000
20/09/2010	20/09/2010	Oaxaca, Guerrero, Veracruz	General Flood	25	1000000
26/01/2010	13/02/2010	Central Mexico	General Flood	41	20000
14/07/2009	16/07/2009	Oaxaca	General Flood	11	80000
02/10/2009	02/10/2009	Ecateped, Coacalco	General Flood	10	13014
01/11/2009	12/11/2009	Tabasco State	General Flood	-	107670
10/09/2009	19/09/2009	Xalapa, Huatsco, Cordoba	General Flood	3	18000
01/09/2009	10/09/2009	Tlenepantla de Baz	General Flood	4	1500
06/07/2008	11/07/2008	Tamaulipas, Hidalgo, Veracruz	Flash Flood	12	20000
28/10/2007	16/11/2007	Chiapas, Tabasco	General Flood	22	1600000

3.4 Warning System

It is interesting to observe that in Mexico, the location of population and economic activities are not reasonably related to the territories where water is available. Most of the country's largest cities, industrial facilities and irrigated lands are located where less than a third of total runoff occurs. Accordingly, surface runoff and groundwater are not sufficient to satisfy the needs of development and economic growth. Climate change and water pollution are just increasing the problems of potential water usage, which beget political and social conflicts. For instance, only 2% of water for Mexico City comes from local aquifers, while the remaining 98% comes from various sources in the State of Mexico.

On the contrary, excessive precipitation has a negative impact on Mexican society that can be observed in the northern semi-arid regions as well as in the southern tropical regions of the country. The number and intensity of storms in most states of Mexico become more severe explained by climate change. Tropical easterly waves and tropical cyclones induce a great amount of precipitation, mostly over northern Mexico due to the mountain range that distinguish the rainfall characteristics on the east and west side. The Intra Americas Seas (IAS, i.e., the Gulf of Mexico and Caribbean Sea) and the north eastern tropical Pacific are among the most active zones for hurricanes in the world, that generate extreme events. A major threat of flooding and landslides is often redounded by the heavy rainfalls, which makes Mexico particularly vulnerable by reason of its multifaceted topography and the existence of urban settlements in risky areas. In pursuance of governmental declaration, almost 90% of natural disasters correspond to extreme hydro-meteorological events, mostly droughts and floods. The economical cost of treating these situations is enormous and if the climate change effects grow to be more serious, the cost will continue to increase. During 1980-1999, hydro-meteorological extreme events eventuated in more than 2700 deaths and around 4.5 billion US$ economic losses. An individual tropical cyclone, such as hurricane Wilma in 2005, or the flooding event during 1999 had an approximate cost of the order of 250 million US$.

It can be observed, that the number of natural disasters in Mexico is greater in the recent years than before, not only because of alterations in the weather regimes, but mostly because of the enhanced vulnerability of society. Due to Mexico's geographic location, it is subjected to a range of meteorological phenomena which result intense rainfall that frequently leads to severe flooding in rural and urban areas as well, which can cause major economic, social and environmental damage and loss of life. Therefore, Civil Protection has to focus on the development of Early Warning Systems and reduction of vulnerability to protect life. Civil Protection interacting with scientific experts from CENAPRED, the National Weather Service and FONDEN have considered the establishment of a number of policies to face natural disasters including hydro-meteorological risk. The mitigation and vulnerability reduction of hurricanes and severe storms effects requires structural and non-structural measures, and therefore up-to-date meteorological and hydrological forecasting services, excellent coordinated flood warning systems and considerable floodplain planning are needed. In Mexico, number of actions has been

taken in order to deal with a catastrophe, but only one Early Warning System for Tropical Cyclones exists to alert civil protection authorities and inhabitants. The Early Warning System monitors and predicts the evolution of tropical cyclones and grants warnings, alerts, or emergency calls to take a preventive action. The system provides information to the population about the characteristics of the risk, such as severe weather, intense precipitation associated with hurricanes, and the actions made by federal, state and municipal authorities. The system is working well and the number of casualties due to storms has decreased significantly. Since 2000, the number of deaths during the hurricane season has lowered from hundreds to only a few. However, flash floods, cold waves or drought still threaten the population and socioeconomic sectors, and there is no prevention system yet to diminish their negative impacts that requires further developments and implementations. Limited funds by the government obstruct the evolution of better strategies. [20]

3.5 Case Study, Tabasco and Chiapas 2007

After the 1985 devastating earthquake, the flooding in Tabasco in 2007, which was also partly covering Chiapas, is considered the second most expensive disaster in recent Mexican history. Fortunately, this event didn't take a great toll on lives, but it was chosen to analyze due to the severe economic consequences and vast extension of damages.

Figure 26 Location of Grijalva River Flowing Through Tabasco and Chiapas

The climate in Tabasco and Chiapas is subtropical with maritime influence and with a rainy season from June to October. The Grijalva River shown on Figure 26 is 480km long and flows from Chiapas to Tabasco. The Grijalva River Basin is 134,400 km2, one of the biggest basins in Mexico with a river delta at the Gulf of Mexico, collecting streams from the Chiapas and Guatemala mountain chain. Along the Gulf of Mexico, in the summer and autumn of 2007 there were several precipitations events related to 37 tropical depressions, 3 cold fronts and the hurricane Dean (22nd August) and Noel (28th October). According to the National Meteorological Service (SNM), only in three days around 17% of the average annual rainfall hit the region. Heavy rains are expected in this region, but the extent of the destruction wasn't within the historical norm. The great amount of accumulated water from the strong rainfalls increased

the water levels of the river system and dams in the basin causing severe flooding and landslides starting from 28 October 2007.

3.5.1 Tabasco

The most important city of Tabasco is Villahermosa, with a strongly developing economic activity. The rapid growth of population changed the surroundings of the capital city with the removal of the vegetation from the surface to build urban areas closer to the water, along the flood plain. Villahermosa is at great risk of flooding, hence in order to protect it, levees, barriers and dykes were constructed in the '50s which changed the dynamics of the Grijalva River. Later studies pointed out that the flood risk increase if the water levels overpass the channels and levees that retaining the water. These constructions were reviewed after the devastating 1999 flood, consequently restitutions and improvements of the current infrastructures were considered, but still some implementations stayed unfinished. Also some of the infrastructures were ruining the natural drainage system of the basin that regulated the amount of water coming from upper areas. The flushing flood of 2007 covered all urban and plain areas including the 80% of Tabasco State. The total volume of overflow was around 1,800 million of m3 for a return period of 100 years. The heavy rainfall continued impending the recession of the water, thus the city of Villahermosa was underwater for weeks and in some cases other inundated areas for months. The soils were highly saturated which resulted other flooding in the rainy season, 2008 but with less impact on the economy. As a consequent of inundation of low-lying alluvial plains that were filled to allow urban developments, plenty of residential and non-residential properties were destroyed, and jobs, agricultural goods lost. Thousands of people from rural communities were isolated and 126,580 people were displaced. More than 227 school buildings have been affected and about 44 of these have been used as shelters. Moreover, the main economical activities have been halted; i.e. schools were closed; hospitals, electricity, communication systems, water supply, etc. have been affected. The total damage was estimated around US$ 5 billion and over 1.5 million people were affected by the flood, making it the largest natural disaster in recent Mexican history. According to the state census, ca. 164,100 houses were cut off and left without basic services, and of these, ca. 150,900 suffered structural damages which overall estimated rehabilitation was approximately US$ 750 million. 30,000 families had to been relocated because they lived in high-risk zones. Most of the harvests have been completely destroyed and the damages to corps were accounted as US$ 480 million. [21]

3.5.2 Chiapas

Chiapas shares a border with the state of Tabasco on the north. The heavy rainfall which caused flooding in Tabasco also fell on Chiapas. Although Chiapas experienced some flooding, damaged homes, broken bridges, damage to roads and mudslides, it escaped widespread flooding like that in Tabasco. As the state was less severely impacted, less attention will be paid during the evaluation of the case study. The number of affected people was around 330,000, 4350 houses were damaged and over 5000 people were displaced. The floods induced 220 landslides which

demolished more roads, bridges, public utilities and agriculture. A large landslide buried the village of Juan de Grijalva, in the northwestern part of the Chiapas, municipality of Ostuacán. 1,700 people were evacuated due to a gigantic landslide that blocked the River Grijalva resulting even greater flooded area around the landslide. Moreover, 16 bodies have been found and 9 people were missing and presumed dead. The village is located on the edge of the Grijalva River, at a low elevation, not far from the Peñitas Dam. That dam was too full and had to discharge water into the Grijalva River, which flows to the northeast through the city of Villahermosa, and eventually into the Gulf of Mexico. That discharge of water added to the flooding in Tabasco State. One month after the unblocking of the river, the evacuated population still could not return to the area because the flooded land didn't recede naturally, thus the affected communities had to be permanently relocated. The estimated funds for the reconstruction were US$ 650 million which included new settlements for the allocated people as well. [21]

Figure 27 Eighty percent of Tabasco State was under water [47]

3.5.3 Organizational and Individual Response during the Emergency Period

3.5.3.1 Initial Governmental Actions

By this time the resources of the Mexican government at national and state levels in addition to the Mexican Red Cross and the local non-governmental assistance organizations were badly stretched. The Mexican President, Felipe Calderón ordered to put into operation the disaster emergency plan with requesting funds from the FONDEN and activating the Operational Emergency Committee of Tabasco on 27 October. The National Water and Electricity Commission decided on 28 October to partially open the floodgates of dams because water levels threatened to undermine the dams structurally. On October 29th, the local governmental

authorities requested the population to build physical barriers, and also the evacuation of people living in the flooded areas started. The next day civil protection and the military also have been working for the reinforcement of the physical barriers that have been built, mainly sandbags in order to contain the flood. However, the continuing heavy rainfall caused the overflow of surrounding rivers and floods much of the state of Tabasco and portions of Chiapas by 1 November. According to the first estimation, Tabasco's Governor announces that 80% of the state was under water and warned that many evacuees will not be able to return for months. The flood caused 19 confirmed deaths, hundreds to go missing and left hundreds of thousands homeless and overall estimated number of affected people was 400,000. Next day, the Mexican President toured the affected area and addressed the nation on television to report on the gravity of the situation:[22]

"The situation is extraordinarily serious; it is one of the worst natural disasters in the country's history. At this time, I would ask Tabascans to remain calm. It is vital that that you do not become discouraged, that you organize with the neighbors and coordinate with the authorities."[24]

The initial response after the disaster was based on communication messages from the government of Tabasco through mass media channels. The main aim was to encourage the population to leave their houses and move to temporary shelters run by local authorities and civil protection agencies of the government. The response of the federal government consisted of the implementation of the national disaster plan DN-3, as it shown as well in the broadcasted presidential speech:

"I have instructed the armed forces, the army, the navy and the Federal Preventive Police to contribute the greatest possible number of officers to help guarantee security for the population."[24]

Army and navy units were mobilized to the flooded zone in order to protect the affected areas from looting. Around 8,000 military personnel, 3,000 marines and over 2,000 policemen were sent to the affected areas to give assistance and relief, as well as, other national actors in the public and private sector joined to the supporting emergency activities. In this particular case the federal government avoided the normal decentralized model of disaster response, in which the state and departmental officials independently decide about the initial response, and only if needed involve the federal coordination. The federal response was necessary due to the rate of the devastation, but there were conceive of doubts about inadequate discussions preceding the government's call in this matter. The priority was given to search and rescue activities supplemented in some cases by boats going to the flooded zones and helicopters searching for isolated persons. The navy provided three military helicopters and the police provided smaller helicopters which were performing between 4 and 5 missions a day distributing supplies and performing scattered rescue operations. After the third visit of the Mexican President, he

announced a plan for the state including the cancellation of tax payments and electricity bills and was keeping asking for help and donation:

"…That is why I would invite you all to help the people of Tabasco, as much as you can. Times like these test Mexicans' patriotism and nationalism… The support required can either be in kind or cash. You can send your contributions to the collection centers set up in various cities throughout the country. Please contact the State Civil Protection System, the National DIF or your local Red Cross department to know where to take your contributions."[24]

3.5.3.2 Failure of Disaster Planning

Many issues required governmental action. The Grijalva is one of Mexico's most important rivers. Its hydroelectric dams generated about one quarter of the country's electricity. Yet federal and state governments have invested little to protect residents from flooding or to enforce zoning regulations to prevent people from building in areas prone to flooding. Indeed, money denoted after the 1999 floods to pay for flood protection programs either went missing or was misspent. Therefore, the response from the community in this disaster in general could be interpreted as one whose level of preparedness was high but where the quality of emergency planning at the institutional level must be improved to take advantage of the local knowledge and the resources.

The lack of preparation from governmental side can be categorized as structural and non structural planning. From constructional aspect there was insufficiency of flood defenses to control the floods. For example, the hydraulic system to drain Villahermosa was poor. Moreover, the Building and Planning Permission codes required that all residential buildings have to be located a minimum distance of 20 m from a river bank. However, it was obvious that many irregular housing constructions didn't meet the requirement. The Integrated Flood Control Project (PICI), which proposed completion date was 2006 and contained the construction of 177km of embankments and 193km of drainage canals along the Grijalva, Carrizal and Samaria rivers, has been suspended at the time of the flood and it meant that several of key infrastructure building protecting urban areas have been delayed or cancelled. local authorities claimed that the PICI project failed to be completed because of the lack of resources. However, it is believed the money was mismanaged by the people in charge of the project. [26]

Raúl Fraga, who heads investigative reporting at Mexican business daily El Financiero, said, *"Tabasco had a corrupt political system, although Granier is somewhat different from the others, and he was governor for barely a year when the flooding began. It's very obvious that money from the federal government to prevent the effects of the flooding on the population has not been spent according to plan."*[25]

Elías Sánchez, a member of Asociación Ecológica Santo Tomás, said, *"There were a series of meetings in which it was agreed to improve the security of the people. In 2003, a flood control plan was announced which would be implemented through 2007 with money from the federal*

government. But the money did not arrive in time, and the program was extended to 2008. The implementation of some projects was done badly, a few were done well, and others were not done at all."[25]

In additionally to structural measures, there were deficiencies of communication of flood warning and emerging before and during the flooding, therefore residents didn't know how to react to the flooding and cooperate with officials. The population and its property were exposed to the floods but there was no existence of an integrated monitoring system to monitor the rainfall and river levels in order to combine with data from the National Meteorological Service (SMN) that could have helped to provide local area forecasts on the possibility of flooding and its likely severity. No plan consisted for monitoring the capability of the flood defenses, flood warnings, evacuation procedures and as a consequence there were not enough shelters and adequate evacuation routes at the time of the flooding. Preliminary collection and data analysis in relation to flood risk assessment may have helped to establish the nature and scale of the existing flood risk and identify the types of hazards and their likely social and economical impact.

It can be concluded that the local government, local civil protection and other authorities did not learn from previous floods, such as the most recent occurred in 1999, thus the physical and non-physical flood defenses were not ready to operate at the time of the flooding. [26]

3.5.3.3 Initial Public and Volunteer response

Interestingly, it has to be emphasized; that the enormous participation and responsibility share of the public was greatly relevant. People acted immediately even if the governmental response was in late. An increasing sympathy between people can be observed from social side that cannot be neglected anymore. In 2007, neighborhood groups of the impacted states started taking an active role. During the first days after the disaster, the individual and organizational response showed volunteer groups in search and rescue and emergency sheltering activities. Moreover, the population had an active role during the next weeks; flooded homes were cleaned out and were lived in once again. It was identified that 33 percent of the population who were affected by the flood were volunteering motivated by solidarity to help other people and friends. In the rescue activities fishermen or sail or row boats on the river for tourists worked and transported rescued people to the homes of family members and friends. The shelter found did not have enough covered space and access to water and sanitation services and social facilities. People found shelter in the houses of relatives, friends and neighbors which had two floors or were located in safe areas. Households were shared by two families of 4 or 5 members each. The space was insufficient but they managed to set up temporary beds and toilets were shared by both families. Schools and churches also provided shelter for almost 150 or 200 people, where communal toilets were set up by members of the local community to provide acceptable sanitary conditions.

Some people remained in the flooded area. There was an absence of actors and mechanisms of security in hotspots and aid distribution points on the field. The resources and aid for affected

people were limited or insufficient. There were acts of looting, such as theft between members of the community and robbery from the aid supply chain. The habitants of the community developed schemes to prevent acts of looting or acts of theft in their neighborhoods. The schemes were based on shifts and a rotating schedule. People who worked or had experience with security were in charge of these activities. They were sitting on the roof of a two-storied house looking over the surroundings. They were provided with lamps and radios to communicate with other members of the community. After, they identified someone trying to steal or attempting to go inside one of the houses, they called the police station. Furthermore, the community used lists to identify the people presented in the area, which allowed them to detect intruders or people attempting to steal. The army, with the help of the community, set up a provisional bridge connecting the flooded area with the non-flooded area. The bridge was used to send aid to those in the flooded zones who were affected the most. Some grocery stores were not affected by the flood and remained open during the emergency, thus people were buying food in this stores.

From this point and until 2 weeks after the flood, the main concerns were related to access to food, water quantity and quality and, less commonly, the control of sanitation diseases. In these cases, there were no efficient emergent reactions. The community tried to access services and aid to survive that was provided by the local authorities and army in the emergency response. Many groups of people volunteered to participate actively in inventorying, collecting, and pre-packing aid, but the distribution of it was controlled by the local civil protection authorities of Tabasco. The exclusion of members of the community generated thoughts of distrust of inequitable and unfair distribution that had to be improved during the response to the disaster. Conflicts broke out during food aid distribution because of competition of resources. Thus the distribution of aid took place inside local churches where volunteering women were put in charge of sharing it, which improved the security of distribution points as well. The Catholic Church plays an important role in Mexican culture as it is a sacred place and the predominant religion of the community, therefore people believe in its reliability also in emergency situations. The motivation for volunteer pattern was described by one of the people interviewed as follows: [27]

"I decided to volunteer because I am used to helping other people, the pastor from the church that I frequent assigned tasks to everyone, the shifts for each one and the materials to perform our activities."[27]

Around 20% of the population evacuated quickly without anyone's assistance because of their awareness of various communication channels and appreciation of the importance of being informed. This observation shows that there was heavy dependence on mass media before and during the emergency period. It can be inferred that those who had access to a radio set, television and newspapers agreed to leave their homes and went directly to the official shelters or relatives right after the messages from an imminent flood were spread in the whole state. On the other hand, the rest of the community did not evacuate on time. The reason was of a general disengagement about the flood warning provided by the government. This was attributed to the

fact that the messages seemed to be confusing and the real magnitude of the disaster was not transmitted. Past experiences have also contributed to this disengagement as a member of the community described in one of the interviews. [27]

"My family didn't evacuate because that happened before and the maximum level that the water reached was half meter. I decided to not evacuate based on my past experiences but this time the water started to go inside the main floor of my house reaching almost 3 meters". [27]

Disengagement was not the only reason for not evacuating. 10% of that 80% of the community who decided to remain in the flooded area, because they feared that their belongings could be stolen.

Figure 28 Unofficial volunteer working [48]

Interestingly, next to saving lives with boats in the context of the unofficial rescue activities, it can be observed that even in poor and rural areas the use of satellite dishes for television are not rare.

3.5.3.4 Initial Response of Organizations

The major official responders were the army and the SINAPROC, who were undertaking the most important emergency operations during the early phase, long term and recovery periods. However, plenty of other civil protection authorities joined and cooperated with the civil protection to assist their work. The SINAPROC was the main intermediary of disaster information and communication supervisor to maintain the connection between officials and other national and international participants. Though, the integration of committees and interconnection of their leadership requires over thinking of civil protection plans, in order to enable the civil protection authorities to be in an increasingly good position to cope with the situation.

3.5.4 Analyzing Communication Failures throughout Some Examples

In the following section, the actions of the government and other organizations will be introduced and analyzed during the emergency response period. Research were made on interviews, videos and reports about the flooding, and through some presented examples, the communication methods and their failure were evaluated.

3.5.4.1 The Response at the Level of Government

National and local authorities faced several major problems in responding to the flood. First, even though they provided support for people who were affected by the flood, the aid in some cases was significantly delayed. This is evidenced by the fact that at least 20,000 people in Tabasco continued to live in their flooded houses despite recommendations by the government and thousand were facing a desperate situation due to a lack of food, water, and shelter. In addition, some of the problems faced during the first week of the disaster such as lack of planned strategies for gaining access to some geographically inaccessible areas as well as misinformation led to prolonging the desperation of the thousands affected by a week of tragedy, many of whom remained isolated in communities surrounded by water. Another challenge the government faced was that people did not want to leave their homes, even though they did not have adequate living and sanitation conditions, because they feared having their belongings stolen. All of these problems limited the early response actions by the government as it was necessary to spend more time and resources on search and rescue activities for two weeks. The delay of the rescue activities brought some other difficulties such as estimating the number of items and the amount of aid that was required in the shelters and flooded areas as it was very difficult to know how many people were evacuated or were still trapped in the flooded areas. As a result, there were discrepancies in the estimates of the local government and the federal government on how much aid is needed. The lack of information delayed their response even further. As a result of the missing information, many people weren't rescued from the flooded area by local authorities, the government, but a number of them managed to leave the place. The next problems that affected people faced that there were no enough shelter available provided by the government or the shelters were inappropriate for even for temporary living. The residents, who have been relocated to shelters, complained about the inadequacies in the distribution of aid and facilities to achieve minimum hygiene standards. Food shortages were reported at the shelters, as partly consequence of looting shops and aid carrying vehicles.

"We are without potable water and there are no trucks to distribute the purified water….the supplies are running out and there have already been purchases due to panic and very little remains, but it cannot be stocked for obvious reasons. For those that still have things on the shelves, take advantage of the situation with exaggerated prices. I don't understand the long lines to fill up on gasoline, if we are all surrounded by water and no one can leave."[25]

The flood taking a store: *"I have lost everything I had. All my stock has gone, and it wasn't even mine. I bought it all on credit. Who's going to help me now?"*[25]

3.5.4.2 Absence of Connection between Organizations

There was a serious lack of open and frank communication amongst the key organizations which hampered the supervision of supporting activities. For instance, the CONAGUA and local governments, such as state and city authorities blamed each other of the consequences of the flood disaster, instead of finding quick solutions for the wide-ranging problems.

3.5.4.3 The Response at the Level of Different National Organizations

One third of the population mentioned that the army's response was quite good which correlates to the number of people who received help from the army. The complexity of the operations, the inaccessibility of some of the flooded areas, the high demand for aid needed in a very short time period, and the huge number of activities in which the army had to intervene were complicating factors. However, not everybody is satisfied with the actions of the army. An affected person interviewed:

"...the government absolutely lied, they said to send security forces from the neighborhood but there are no soldiers no boats nothing. Others just trying to get along with their lives as they wait for the flood waters recede, - my children are suffering from fevers and rushes because of lack of water."[29]

Only 5% of the community was rescued by the Red Cross and NGOs, thus their contribution was significantly lower than would be expected. The low rate was due partially to the complexity of the rescue activities required and partially to the lack of strong NGOs in the area. The lack of national NGOs may be attributed to the fact that in recent years there has been an increase of funding for large international NGOs, thus displacing smaller local ones. This means that local NGOs from Tabasco with their limited resources have not developed enough knowledge of the local situation from the past floods to be able to provide aid effectively. Therefore, the army focused on rescuing people with the greatest need, especially those who were located in areas where the water level had reached 7 meters, while the NGOs were trying to provide them assistance but with fewer resources. The initial reaction from this part of the population to their situation was described by one of the interviewees as follows:

"Our first reaction was to pick up our belongings and move them to the second floor. As the water was flowing gradually inside our house, we had enough time to move the light furniture to the second floor and then the heavy ones. After that we talked with our relatives and we moved to their homes. We left the area with their assistance as the streets were totally flooded". [29]

As it was mentioned before, the low perception from the contribution of Red Cross at the beginning of the response obeys to two main problems that they faced during the first two weeks.

The first one was due to the fact that damage assessments were provided until the third week of the disaster, by that time the community managed to cover their basic needs with the support from their families or by the local civil protection authorities. The second was due to logistic problems to transport aid items to Villahermosa from outside of Tabasco as Villahermosa's airport does not have the capacity to receive heavy airplanes.

On the other hand, even if the organization started to work with a delay, they were satisfied with their activities in a certain point, as the following interview confirms it. A less intense flood in Tabasco in 1999 killed more than 600 people. In 2007, the number of fatalities reduced, according to Marco Franco, a member of the Mexican Red Cross team in Villahermosa, stating that they have learnt from the past:

"We've been perfecting our plans for years. We live in a country that has a high risk for natural disasters, and we always have to be prepared for something like this. We have stocks prepositioned that are ready to go. We have vehicles. We have our teams. We use the intranet and e-mail to monitor and manage these resources for maximum efficiency." [28]

The Mexican Red Cross was also ready with teams that flew in from Mexico City; The International Federation of Red Cross and Red Crescent Societies sent in relief supplies that had been prepositioned in Panama. At the local Red Cross headquarters, weeks after the disaster first struck, a three-man team was coordinating the organization's relief effort. The coordinators were linked to teams in the field and to the international Red Cross network by cell phone and wireless laptops connected to the organization's intranet. [28]

The Caritas of Tabasco was working with logistics and managing canteen. The organization was operating on the field mainly distributing ready food, because people were not able to cook because of the flooded kitchens. At the rural areas, apart from losing crops and poultry, the farming tools were lost as well. Caritas provided new tools to grow food again. A worker of Caritas described the situation as followed: *"Initially, we had no idea what was happening,"* said Gutierrez. *"It was our responsibility to help the poorest families face the floods. Also, the hidden poverty that isn't usually so evident became visible."*[30]

Furthermore, external support arrived from private sectors as well. "We wanted to contribute to the recovery and to mark our presence there," said Eduardo Jiménez Granados, corporate security manager for northern Latin America at Procter & Gamble Mexico. Other companies, such as Coca-Cola, also took similar opportunities to help the local population.

3.5.4.4 Initial Response of International Agencies

The disaster subsidy from international agencies located in the country arrived quickly to the dangerous spots. The ministry of Foreign Relations requested supplementary international assistance on the 4th of November which was a remarkably unusual step. The Mexican government hadn't released any formal requests for wide-ranging international aid since the

overwhelming Mexico City earthquake of 1985, even if plenty of calamities threatened the country. The country's response system could manage crisis successfully and the external help was only complementary element of the national exertion. However, reaching the proper destination of the flowing in aid and assist was very complicated since the United Nations (UN), The United Nations Children's Fund (UNICEF) and other international humanitarian Non Governmental Organizations (NGOs) were not presented in the country. Thus, after arrival to the disaster site, both the government and outside agencies had to learn how to work together in a short time and under great pressure because of the lack of previous mutual working experiences.

The state and federal governmental entities, as well as, the civil society groups and private enterprises responses of Mexico were strong, and underestimated by the international community. After the earliest call for assistance, the international NGOs arrived well trained and prepared for the situation, and came directly to the flood areas on tourist visas, without prior negotiation with the government concerning its priorities. As a matter of fact, the supplies that NGOs brought were available on site or obtained locally form the surroundings. NGOs were primarily coordinated to work on rural areas which were not reached yet by the government, and later on the evaluation of their performed operations was positive. The UN system team started to act in the emergency when the proportion of the flood increased largely. As many of the supplies were already in place, the international material that was actually needed was less than it was previously anticipated. Despite of this fact, the international expertise and skills were very important in order to support the national and local authorities and ensure to pass resources to the critical outside zones. [21]

"UNICEF has stocks ready and is preparing to provide families with emergency and education supplies to support the national relief efforts," said UNICEF Deputy Representative in Mexico Daniel Camazón. "UNICEF has also offered assistance in terms of psychosocial recovery of children, and support to local authorities in order to ensure classes resume as promptly as possible and in the best possible conditions."[23]

3.5.4.5 Health Care Problems

As the water receded, health problems arose, thus a rapid immunization campaign against infections was implemented. The local government with the military forces was trying to ward off any serious epidemic. Hepatitis, Dengue Fever, Malaria, Tetanus, Flu, stomach sickness and others were a real danger that were picked up by wading in fetid water, mainly causing a severe problem for small populations in areas which were difficult to access.

Figure 29 Extremely poor rural areas were inundated as well [44]

3.5.4.6 Logistics Center

Andrés Granier, Tabasco's governor established a logistics center in Villahermosa in order to handle the donations that poured in from all over Mexico. After the arrival of loads on trucks, volunteers sorted through the piles of food, clothes and medicines, which were distributed to crowds of people. To help people locate missing family members and neighbors, the government installed electronic kiosks outside of the palace. The kiosks provided a way for people to use a touch screen to access a Web-based listing of the estimated 80,000 people in official and unofficial shelters. A state employee was there to assist anyone unfamiliar with touch screens or navigating Web pages. Even though the center was working well in the city people still had unsatisfied necessities and many also could not find family members. Moreover, after people were allowed to leave the shelters, many of them, found all their property, and their schools and working places, destroyed. [25]

3.5.4.7 The Call of Government

The government's call was delayed because of the deficiencies of flood warnings. Many people in Villahermosa said official warnings came too late and gave no indication that the flooding would be so severe. Moreover, there was no evidence that the population received practical advice on what to do before, during and after the flood, as a result of a flood risk assessment. It seemed that all were left to improvisation. A foreign official at the Red Cross International Federation said:

"We could tell the situation was getting bad well before the government started warning people. We could get our warnings just by monitoring the NOAA Web site and watching the Weather Channel. There was no mystery or surprise about what would happen, that there would be a lot of flooding."[25]

A government inquiry found that six official alerts were given, the first on October 13, two weeks before flooding began, but few paid any attention. The federal water and electric utilities allowed water to rise to critical levels at the Peñitas dam despite the warnings. The problem may be the way alerts were worded.

"If one looks at the bulletins from the national meteorological service, they never said anything about the magnitude of the [forecasted] rains," said Víctor Magaña Rueda, a researcher at Mexico's National Autonomous University's atmospheric sciences center. "By tradition, it errs on the safe side, using ranges that are very wide. Before Tabasco, it just warned people that it would rain a lot, giving a rainfall range of 70-400 millimeters."[25]

3.5.4.8 Lifeline Organizations and Networking

Basic services were brought back online very slowly as the flooding receded. Private sector managers said they were left by the poor performance of government-owned utilities and private telecommunications networks. Companies had most of their IT infrastructure - PCs, monitors, servers, cabling, and telephone gear - destroyed by the floodwaters. When the waters receded, they were able to bring in replacement equipment and hook it up to corporate networks, but they could not get operations fully up and running until power and communications systems returned to normal.

One cellular carrier's main transmission center in Villahermosa was almost completely submerged. Comisión Federal de Electricidad, the government-owned electric company, cut off supplies to the city for safety reasons. It only restored partial power days after the rain stopped and the waters began to recede. This hampered the ability of banks and other critical businesses to resume normal service. The head of security at one Mexican company said:

"Avantel, which is our cellphone carrier, and Telmex, which is the landline provider, were underwater, literally, and they could not provide service even once we were back and ready to operate. So what kind of contingency planning do they have?"[25]

"Poor communications made it hard to reach out to staff", said Juan Carlos Camacho Martínez, head of physical security and civil protection at Citibank in Mexico City. "The immediate priority was to locate our employees in Villahermosa. We needed to make sure everyone was okay, see who needed help, maybe to rescue them from their homes or to provide food and clothing."[25]

Not all the blame rested with the government or major utilities. Private companies other than banks had few plans in place. They had to improvise their responses and took longer to recover.

3.5.4.8.1 Unipack

"The roads from Mexico City out to the Yucatán peninsula were cut for days, and we could not get through. We redirected our trucks through the south, which disrupted deliveries and increased delays," said Jorge Uranga Valdez, corporate security coordinator at Mexican-owned logistics company Unipack. Fortunately, Villahermosa is not a major economic center, and Unipack only operates a distribution center and a warehouse in the city.

Carlos Pineda, a Unipack employee, said, *"I'd say our emergency plan was pretty focused on preserving our IT systems but that was as far as it went. I'd say that apart from that, we basically made it up as we went along. We were improvising the whole time."*[25]

It was especially important for Unipack to recover quickly, because it had a critical logistical role to play. It had to be ready to distribute some of the emergency supplies flowing in from Mexico City and the rest of the country. To that end, as soon as the roads were open, a group of Unipack workers was sent from Mexico City to help local employees. They rescued those who were cut off by the water or who needed help in obtaining basic supplies. Once their immediate needs were met and missing employees had been located, Unipack workers began cleaning up their offices and warehouse.

3.5.4.8.2 Bank

A clear lesson from the most recent incident was that companies need to audit their suppliers and service providers more carefully when they claim to be able to provide service rapidly after an emergency, said Walter M. Farrer, corporate security manager at 3M Mexico.

Citibank's Camacho said it also recognized the need to better analyze what it needed to have on hand to handle a disaster. *"We didn't have any boats in Villahermosa. That seems obvious now. We have boats at other locations, but not in Villahermosa."*[25]

A post crisis analysis of lessons learned carried out for Hugo Raúl Montes Campos, the bank's regional executive director for security that can be also used for other organizations. It included the following recommendations: The bank should ensure that its Villahermosa branches be equipped with a launch, four-wheel drive vehicles, and individual first-aid kits for employees. The bank's medical department should improve its emergency health support, such as providing immunizations for staff. The bank should also improve the resilience of its communications network as well, since its Villahermosa branches all relied on a single carrier. A final recommendation was that the bank should strengthen relations with local and federal government emergency agencies, such as civil defense and the armed forces, to reduce response times in a crisis.

3.5.4.9 Manmade "Natural" Disaster?

Tabasco and neighboring Chiapas State were suffering from floods more than a month. President Felipe Calderón oversaw the circumstances during his touring of the affected zones. As his secretary of state, Humberto Mayans Canabal, gave a detailed description of situation to the public—focusing on the fact that Villahermosa had no potable drinking water—an exasperated President Calderón snapped at him, saying, *"concentrate on the most urgent issues,"* according to the Mexican daily La Jornada.

The President repeatedly reminded the victims of the flood to obey civilian and military orders.

Although the local newspaper, Tabasco Hoy, reported only scattered looting, the President declared, *"I will establish and authorize to the limit of my constitutional and legal powers the maximum authority of the secretaries of Defense and the Marines, so that they may preserve order and punish those that engage in looting."* Francisco Ramirez Acuna, the secretary of governance, later pointed out that anti-looting patrols had to be reconsidered because emergency sandbagging of the Grijalva River forced a change in plans. [31]

The Los Angeles Times, the Washington Post and many other international magazines widely reported about the previously mentioned wasted and misspent money for the flood-control infrastructure and the extremely corrupt governors. However, one of the infrastructure projects due for improvement was a network of dams which comprised a large-scale system of hydroelectric production. Las Penitas dam, as part of the system, could add 2,000 cubic meters per second to the network of rivers snaking through Tabasco as part of its production process. This system exacerbated Tabasco's natural risk of flooding, and clearly required a careful policy for flood prevention, which was not in place.

La Jornada reported that Las Penitas may have accumulated dangerous quantities of water and then quickly released it into the rivers. This, in conjunction with heavy rainfall, would have significantly contributed to the bursting of the river banks.

Carmen Aristegui, an anchor woman for CNN en Español, commented, *"…without a doubt they quickly released more water than they should have."*

Tabasco Governor Granier said that the opening of the Las Penitas dam "contributed enormously" to the flooding and demanded that the federal government implement a comprehensive plan for the management of the hydroelectric projects in Tabasco instead of the piecemeal management that has existed to date. He said that the federal government provided sufficient resources for the project, "there would have been damages, but not the catastrophe we are living through.... We want Penitas to operate and generate energy and wealth for Mexico, but in a way that we can live with." [31]

Figure 30 The situation in Villahermosa after the water receded [44]

3.5.5 Later Response and Long Term Problems

Dealing with long-term recovery issues and preventing future disasters is another thing from emergency management.

"For instance, we need to have a policy that discourages people from building in high-risk areas, which does not really exist at the moment," said Salvador Alcantara, CPP, a consultant based in Villahermosa. [25]

The role of the army in planning and response to a major catastrophe was still really essential in Mexico. Since 2007, invests in risk reduction of vulnerable areas were more emphatic and the flood prompted several states to develop longer range strategies for prevention. The funding for reconstruction and recovery activities came from federal and state governments and partly from UN and United States Agency for International Development (USAID) agencies as well.

The state government so far has indicated that it would stay the course, providing assistance until the area was back on its feet. Almost 22,000 small firms registered with the state for financial support, and officials have promised US$430 million in soft loans to companies that qualify for aid. It has also promised US$8 million in financial assistance for 10,000 local companies. Federal officials said they would invest in tourist promotion and to rebuild the state's hotel and transportation infrastructure to kick-start the state economy. Ariel Cetina Bertruy, head of Invitab, the state government's housing agency, told a Tabasco newspaper that he would rebuild 300,000 homes affected by floods at a cost of about US$600 million. The State government conducted a census in December to identify those most at risk, and it has started to relocate about 40,000 families away from areas most exposed to flooding. It was also planned to

purchase 600 hectares of private land in a safer area where homes could be built to house the people being relocated. The first homes were meant to be ready in March 2008, but Alcantara said that by August work had not begun. About 1,000 people were still living in shelters while others had built makeshift homes on the floodplains, areas at risk of further floods in the future.

One resident who did not want to give his name said, *"The problem is what comes after everyone has forgotten about Tabasco and all the things that happened to the people of Villahermosa. What will happen to us when the help ends? People are spending this money on surviving, and they cannot prepare for the time when there will be no more help. The owners of businesses will not be able to keep employees if no one is buying their products. And don't forget that Tabasco is a poor state. We were poor before, and now we have become even poorer."*[25]

Alcantara said private companies and the public sector must take crisis planning more seriously. For example, government agencies should have improved early warning and communications capabilities. In addition, power and telecommunications providers needed to improve the resilience of essential systems, and companies needed to consider how vulnerable their supply chains and basic services were in an emergency. Tabasco is still under a great risk of flooding, thus the application of a prevention and recovery based plan for sustainable environment would be indispensable. According to a Mexico City daily, Tabasco's 2008 Hydrological Plan was still only approximately 50% complete, as of July 2010. As it can be observed, the implementation of such a plan is still incomplete which is proved by severe flooding in 2012.

3.6 Analyzing Communication Channels in 2007

3.6.1 Overall Situation in 2007

In 2007, Mexico had a relatively well developed media market, with more than 350 daily newspapers and 1,400 radio stations. The television broadcasting market became dominated by two powerful companies, Televisa - the largest Spanish media company in the Spanish-speaking world - and Azteca, additionally 236 television stations (excluding repeaters), plus 906 complementary stations were operating regionally in the country. 93.3% of Mexico´s 25 million households had a television, and more than 95 percent of those had access to both TV Azteca and Televisa leading network stations. 93.9% of the population had radio access, which was higher than the number of television users. As Figure 31 represents, the main source to possess information was still the TV and radio, while about 24% of the population had internet access. In 2002, new freedom-of-information laws in Mexico had made possible for citizens and journalists to make operations of government and business more transparent and to hold people accountable.

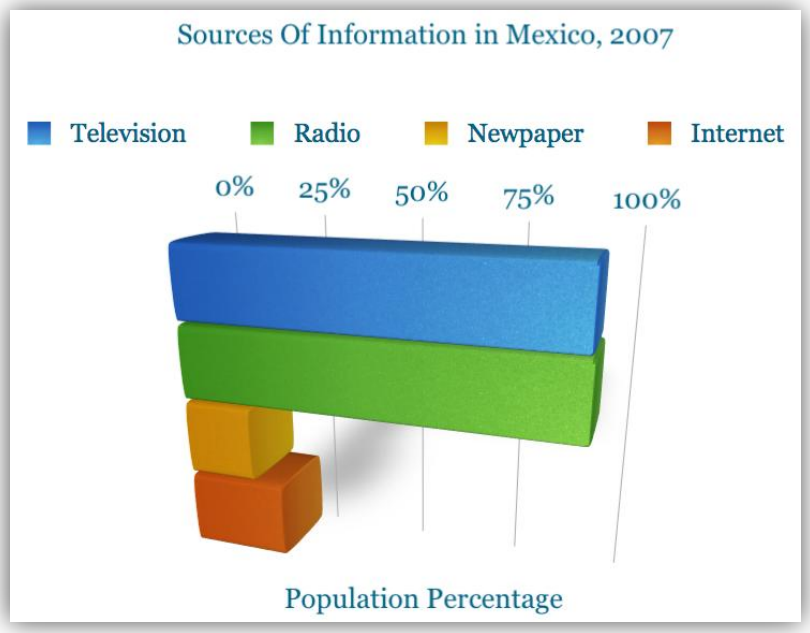

Figure 31 The Main Sources of Mexico in 2007 [32]

Communications in Mexico were regulated by the Secretariat of Communication and Transportation (Secretaría de Comunicaciones y Transportes or SCT in 1891), a federal executive cabinet ministry and by the Federal Telecommunications Commission (Comisión Federal de Telecomunicaciones or COFETEL). Mexico's communication services market was, and still among the largest in Latin America, liberalized in the 1990s, with the landmark privatization of Teléfonos de México (Telmex) a previously state-owned monopoly. Since then, new operators, such as mobile line providers have entered the market in a large number, but Telmex still remained a dominant player. In Mexico, as in many other countries, there was a clear tendency for technology to be located in areas where social development was higher. Mobile phones have the advantage of reaching all areas at a lower cost, due to reduced investments in required infrastructure, and the total number of mobile lines in Mexico was three times that of landlines, with an estimated 57 million lines. It can be also noticed from Table 5 that half of the population had access to mobile services. [1]

Table 5 Number of People Using Different Telecommunication Devices [1]

Telephone Land Lines	19.8 million (2006)
Mobile Lines	57 million (2006)
Internet Users	22.7 million (2007)
Population	105.791 million (2007)

Due to the enormous geographical extension and diversity of Mexico, the country is subdivided into states according to spatial locations. The states have great deviations in socioeconomic levels, and as a consequence, there are large differences in the availability of communication

means as well. Figure 32 represents the accessibility to fix and mobile phone lines, to TV and to Internet detailed by population with different incomes. The poorest population, whose monthly income was US$102 has barely had internet access in 2007, while the access for middle income people with average US$218 was close to the national average. The highest income population had much higher accessibility to communication means than the national average. The state of Chiapas was ranged in the lowest level and Tabasco in the middle level resulting strong marginalization. [34]

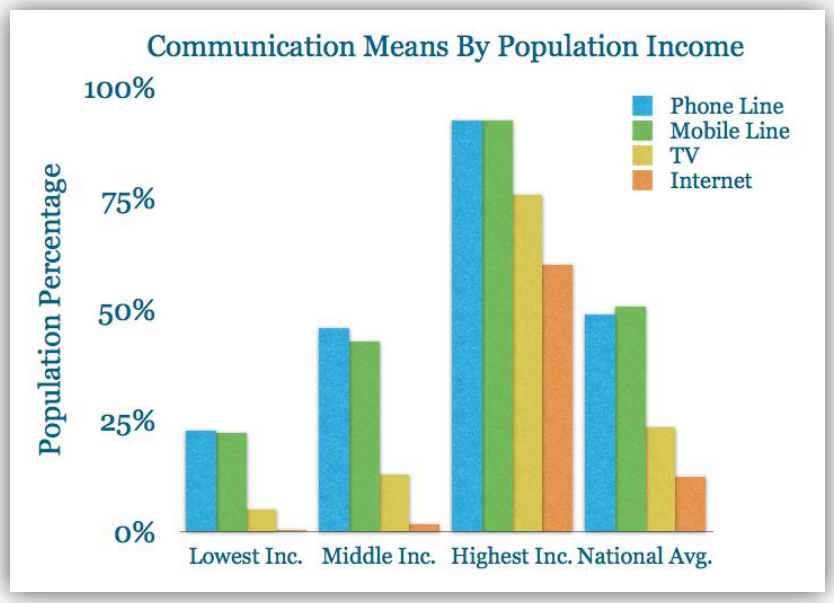

Figure 32 Communication Means by Population Income [34]

3.6.2 The Situation after the Disaster

The media infrastructure was also affected by the floods. Printed, electronic and internet communication was partially interrupted. There was partial running of the local media, otherwise the national media was well functioning.

The main coordination and logistic hub for the emergency was Villahermosa in Tabasco. The Telecom Situation (TSF) was described in the following. There has been a blackout for 2 days after the emergency, but after all 4 GSM providers, such as Avantel, Telcel, Movistar, and Nextel, were fully available. Telmex providing the fix line phones was fully operating. Internet was broadband available everywhere, for example, hotels, cyber-coffees, and telecenters. Internet was also accessible via GPRS. The telecoms were being reestablished in less than two weeks, and a call centre was established for people to call for information, and 87 free phones were set up in 40 shelters servicing 26,000 people as well as 10 free internet centers.

Huitiupan was a badly flooded, small municipality of Chiapas where the Telecom Situation was really poor. GSM was not available even before disaster! Telmex for the fixed lines was fully operational. Dial-up internet was accessible through telephone lines.

The main coordination and logistic hub for the emergency was San Cristobal in Chiapas. The Telecom Situation was described in the following; all 4 GSM providers and Telmex were available. As the same way in Tabasco, internet was broadband available everywhere and via GPRS as well. [21]

3.6.3 Face-to-Face Communication

The most common way for communication is real connection between persons creating human interaction. In any kind of disaster, interpersonal communication is fundamental for sharing information. Accordingly, during the flood, the President, governmental personnel, several organizations, as well as, the public cooperated actively between each other in order to cope with the crisis.

3.6.4 Traditional Media

3.6.4.1 TV & Radio

The usage of radio and television was widespread in Mexico, as well as during and after the flooding. Tabasco State had thirty three radio stations and thirteen television states, nine of which are repeaters for programs from Mexico City. The two local stations were Televisión de Tabasco and Canal 9.

The incidence of the flood was broadcasted worldwide, but the distribution of broadcasted national and international news was much different. After the initial interest, the international news media was silent about the topic. In the contrary, the national news was really widespread. The national radios, the televisions and the printed media prioritized the information about the happenings in the capital of Tabasco and the situation of the large number affected people, while all the other news was left on the secondary places. Through the mass media the number of dead people was also reported.

According to a Daily Kos blog writer from America, the story of the flooding was under-reported, partly because similar event was happening in south of the Rio Grande, as well as, the interest about Mexican and Latin American events were really slight in America. After the first news, there were really few diarists who continued to write about the topic, which was also confirmed by our research.

"I'm upset about this disaster. I don't think this story is getting the exposure it deserves in the traditional media. I suspect that in part that is because the comparisons of Tabasco's flood with Katrina and New Orleans are inescapable."[36]

3.6.5 New media

3.6.5.1 General Situation of Telephone Service

Telephones, both fixed lines and mobile lines, are very important information medium. In general, the telecommunications industry was mostly dominated by Telmex which had diversified its operations by incorporating Internet service and mobile telephony. Due to the fact that the country is crossed by high altitude mountain ranges providing landline telephone service at remote mountainous areas was expensive, and penetration of line-phones per capita was low compared to other Latin American countries, with 20 million lines. Thus, the global system for mobile communications was improved rapidly providing good cellular services, which caused quick wide range coverage of the cell phones on the population.

According to 2007 data, it can be observed that fixed telephony penetration was poor in Mexican states where the human development index scores were lower than 70 (Guerrero, Oaxaca, & Chiapas). The penetration of mobile telephony was much more dynamic than it was for fixed, but it reinforced the tendency toward disproportionate access to technology. As seen in Figure 33, states such as the Federal District, Nuevo León, and Jalisco have greater levels of mobile penetration, close to 100%, while states whose HDI is low, such as Chiapas, Oaxaca, or Guerrero, have penetration levels close to 40%. [34]

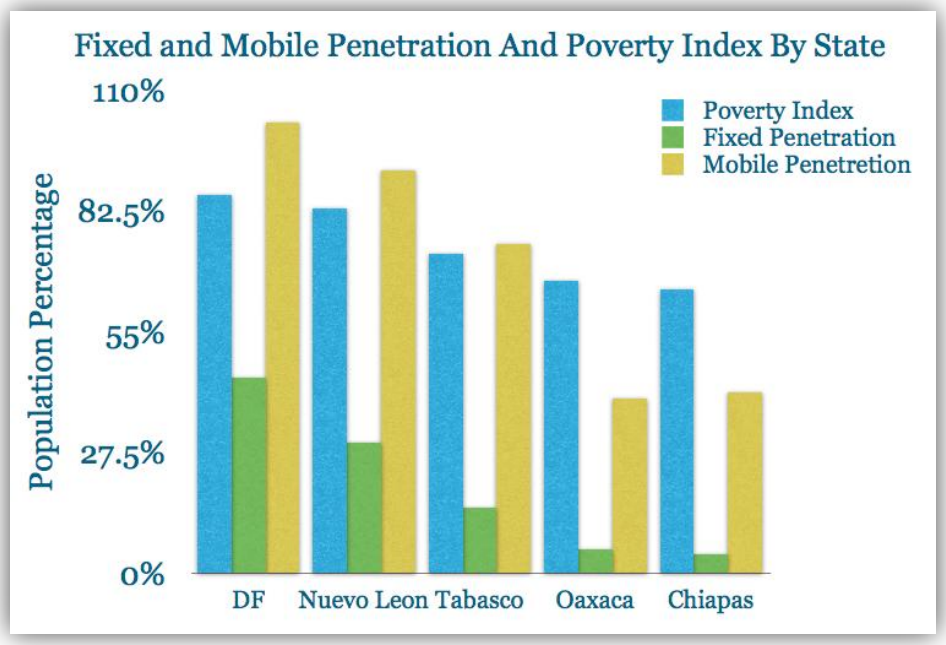

Figure 33 Density of Fixed and Mobile Telephones (2007) and Poverty Index (2007) for Several States [34]

*HDI has been multiplied by 100 in order to have similar scale for comparison

3.6.5.2 Examples for Usage of Telephone Services during Flooding

Telcel has restored around 70 percent of its cellular coverage in the city of Villahermosa and in other towns and cities following the recent floods in the state. The recovery of the coverage was due to work to implement emergency power supply and the re-activation of a cellular base station in Villahermosa which was flooded. The main delay in restoring the other 30% of coverage was due to the lack of power supply and due to flooded base stations. Telcel's technical staff and the authorities were also working to replace damaged equipment with energy equipment in isolated areas of Villahermosa which had no cellular coverage. The rest of Telcel's network on other regions of Mexico was working normally.

Telmex set up helpline for Tabasco flood victims. The helpline offered information in where to stay. All of Telmex's public phones in Tabasco operated for free for local and national calls during the emergency. The company had also installed eight computers with Infinitum software in the hostel located in the Villahermosa convention centre. Telmex had also started the shipment of 150 tons of humanitarian aid. [21]

3.6.6 General Usage of Internet

The Mexican government implemented a program, called the National e-Mexico System in 2000 in order to provide shared access to Internet to numerous communities in Mexico. The program included the integration of system, content and connectivity to give a necessary tool for society to become active users of ICT services. The program had positive impact but limited due to the widespread lack of digital abilities in the whole population.

Class differences were still marked in Mexico and were expressed in numerous ways, for example with the disposition of telecommunication facilities. A clear example of the unequal distribution of access to ICT was the percentage of Internet users by socioeconomic level. As can be seen in Figure 34, approximately 37% of Internet users belonged to high socioeconomic level. In comparison, only 15% of Internet users were from that part of the population that belongs to the lowest socioeconomic levels. [34]

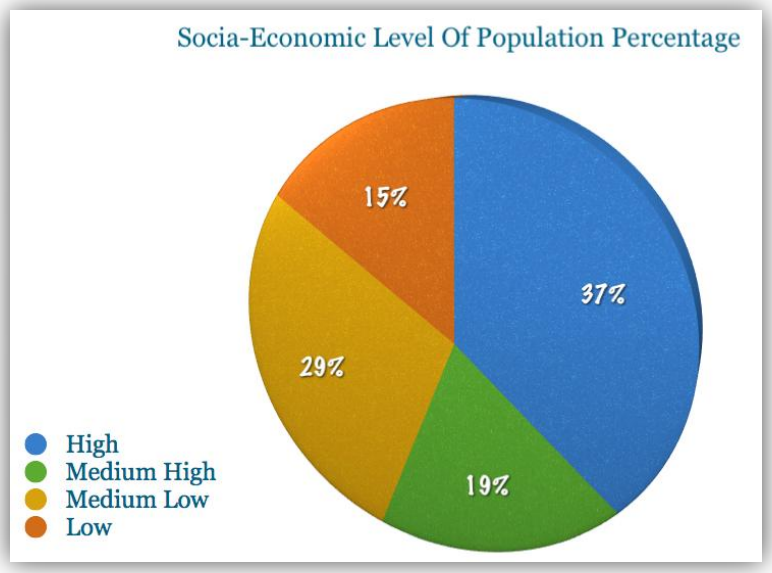

Figure 34 Internet Users by Socioeconomic Level (2008) [37]

These disparities in access to ICT between groups of differing socioeconomic levels represented a social problem, given that ICTs, when adopted effectively, were a key tool for addressing the economic and social exclusion of marginalized communities. As Figure 35 displays, only 34% of the population had access to internet at home, while 66% were connected outside of their home. One of the ways in which different social groups have managed to gain access to ICTs has been through shared access points, particularly cybercafés, telecenters, government community centers, and those operated by NGOs. Official statistics state that close to 27% and 42% of Mexican computer and Internet users, respectively, make use of this technology through some form of public service.

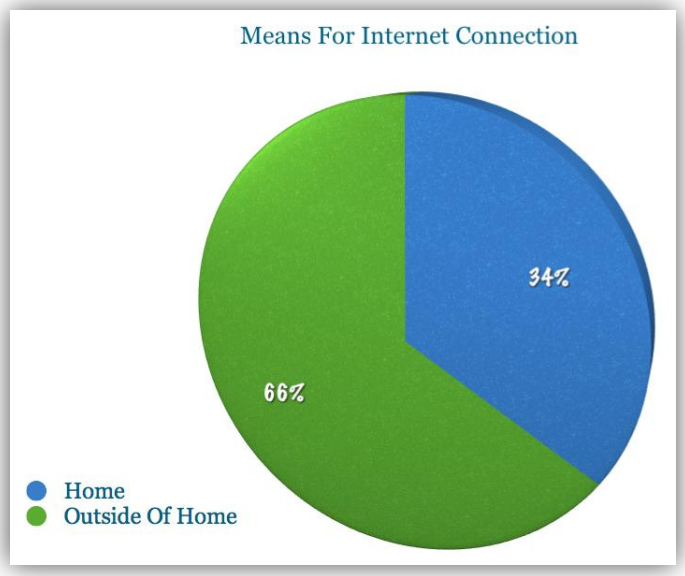

Figure 35 Internet Access at Home or Outside of Home [32]

There were close to 60,000 public access centers (CAPTs in Spanish) in Mexico, 17% of which were governmental. This differs from access in other countries, where more than 50% of CAPTs were provided by government, which is seen on Table 6. The number of potential users of CAPTs was also estimated. Their estimations show that Mexico had only 1,300 users per CAPT, whereas, in Brazil, the number of users was 8,143 per CAPT, respectively. It appears that unmet demand was higher in Mexico. The government-sponsored information technology access points should have wider focus and their use should be expanded and promoted in rural communities to bring access to information and communication technologies, however often found significant obstacles in the high cost of connectivity, low digital literacy in the community and high maintenance costs, and were thus forced to shut down. [34]

Table 6 Public Access Centers in Latin America (2006) [38]

Country	Government CAPT	Private CAPT	Total CAPT	Overall Proportion of Government CAPT	Net Users for Each CAPT*
Argentina	9,555	20,647	30,202	32%	889
Chile	2,476	587	3,063	81%	3,454
Brazil	9,976	1,178	11,154	89%	8,143
Mexico	10,034	15,164	60,189	17%	1,300
* Net Users= (Total Population (5-65 yrs) - User Population)/Total Number of CAPT					

The installation of governmental CAPT is still under development. In 2007, the number of governmental Digital Community Centers (DCCs) under the e-Mexico System had reached 9,200, distributed across 5,691 locations in order to integrate and connect the society where "knowledge and information constitute the fundamental sources of well being and progress". There were four basic services provided by DCCs: computers and software use, Internet access, file printing and diverse training on ICT basic skills. As shown in Table 7, DCCs were mainly placed in states with the greatest levels of social and economic backwardness throughout the country. Close to a quarter of all DCCs are located in Chiapas, Guerrero, Oaxaca, and Tabasco, which are states that face high index of marginalization scores.

Table 7 Digital Community Centers by State and Marginalization Index [34]

State	Total Number of Locations With DCCs, 2007	Number of DCCs by State, 2007	Marginalization Index (CONAPO, 2005)
Chiapas	285	433	2,32
Guerrero	193	315	2,41
Oaxaca	551	930	2,12
Tabasco	353	505	0,46
Veracruz	544	739	1,076
DF	14	51	-1,5

However, with regard to the complexity of use, broadband connections were very poor at these centers. Many of the users stated that the Internet connection was really bad, thus they avoid the usage of such instruments. It would be extremely important that the DCCs are able to offer broadband services in order to increase the penetration of applications with a certain degree of complexity and might give the possibility to use the centers in emergency management communication.

Even if the governmental centers were not commonly used, people tended to seek for internet access. Table 8 represents the most and less popular places to find internet connection. Both from very low and very high level, the most frequently visited places were internet coffees or other commercial facilities. Additionally, school and work places were still important in usage, but the privilege to use internet at home was only for rich states. Interestingly, people never went to other person's house. As an example, the Federal District and Nuevo Leon is disposed of very low poverty index, while Tabasco and Veracruz have high poverty index, and Chiapas and Oaxaca are registered as very high poverty index states.

Table 8 Access to Internet by Location and Poverty Index [33]

Access To Internet And Poverty Index					
	Very Low (%)	Low (%)	Medium (%)	High (%)	Very High (%)
Home	34.2	12.1	11.1	12.9	0.0
Work	18.4	11.4	8.9	11.2	0.0
School	6.0	5.9	7.1	12.9	27.9
Cyber-Coffee	36.8	49.1	65.0	59.5	72.1
Government Public Center	1.7	2.5	4.0	2.0	0.0
Public Center With Cost And Restricted Access	0.7	16.7	0.6	1.2	0.0
Public Center Free Of Charge And Restricted Access	0.3	0.1	1.9	0.0	0.0
Other Person's Home	0.0	0.0	0.0	0.0	0.0

Additionally, the differentiation between social classes can be observed from the complexity of internet usage. As shown in Table 9, users who belong to lower socioeconomic levels exhibit less complex use of the Internet. More than 50% of all socioeconomic levels have visited pages like Google or Hotmail, which require very basic Internet skills. Likewise, individuals with low socioeconomic status had less expertise using the Internet to access more complex pages like Wikipedia or YouTube.

Table 9 Complexity of Use by Socioeconomic Level (2008) [34]

% Users Who Admitted They Know These Pages				
Socio-Economic Level	**Google**	**Hotmail**	**Wikipedia**	**YouTube**
High	88	80	48	68
Medium High	94	88	69	75
Medium Low	88	88	32	48
Low	72	67	33	44

3.6.7 Internet Usage during the Disaster

3.6.7.1 Official websites

The Mexican Red Cross (MRC) and the International Federation of the Red Cross and Red Crescent dispatched two information officers to the state of Tabasco and one reporting Regional Intervention Team to Mexico City. Communication activities targeted five main target audiences: the media, the Red Cross Movement, beneficiaries, local civil protection authorities and donors. Seven reports have been published on this emergency on the Federation's internal Disaster Management Information System (DMIS) website. Information on the emergency was published on the following web sites: http://www.cruzrojamexicana.org.mx/, www.cruzroja.org, www.ifrc.cruzroja.org and www.ifrc.org, including press releases, articles and photographs from the field published on the NS website. Press releases, containing information on the Red Cross response to the emergency as well as requests assistance from the private sector and the general public, were drafted and sent to the media on a daily basis during the first month of the operation. Over 114 interviews were conducted in English and Spanish in local, national and international media. Finally, a short film was made and broadcast by TV Azteca on the MRC's and ICRC's work in re-establishing family links. The MRC also established an emergency phone line for national and international queries on the emergency. [28]

Official information was published from the level of state and federal government through their certified websites. The official governmental website of Tabasco, http://www.tabasco.gob.mx/ was mainly used to offer links to donation sites and account numbers for monetary donations. The website was available only in Spanish, although it provided information about road accessibility, also reachable for tourist. The official website of the President,

http://en.presidencia.gob.mx, was publishing all presidential speeches providing fundamental information about the crisis management in Spanish and in English as well.

3.6.7.2 Mapping Services

The Center for Satellite Based Crisis Information (ZKI) of DLR provides a 24/7 service for the rapid provision, processing and analysis of satellite imagery during natural and environmental disasters, for humanitarian relief activities and civil security issues worldwide. The ZKI supported the Mexican civil protection (CENAPRED) with satellite image maps of the Tabasco floods. The DLR radar satellite TerraSAR-X, which was launched in June 2007 and was still in its commissioning phase, proved to be highly suitable for the assessment of flood events again. Independently from cloud cover or daytime, TerraSAR-X was able to deliver high resolution imagery with a resolution of up to one meter. Figure 36 represents one of these satellite maps that were used by the relief organizations. [39]

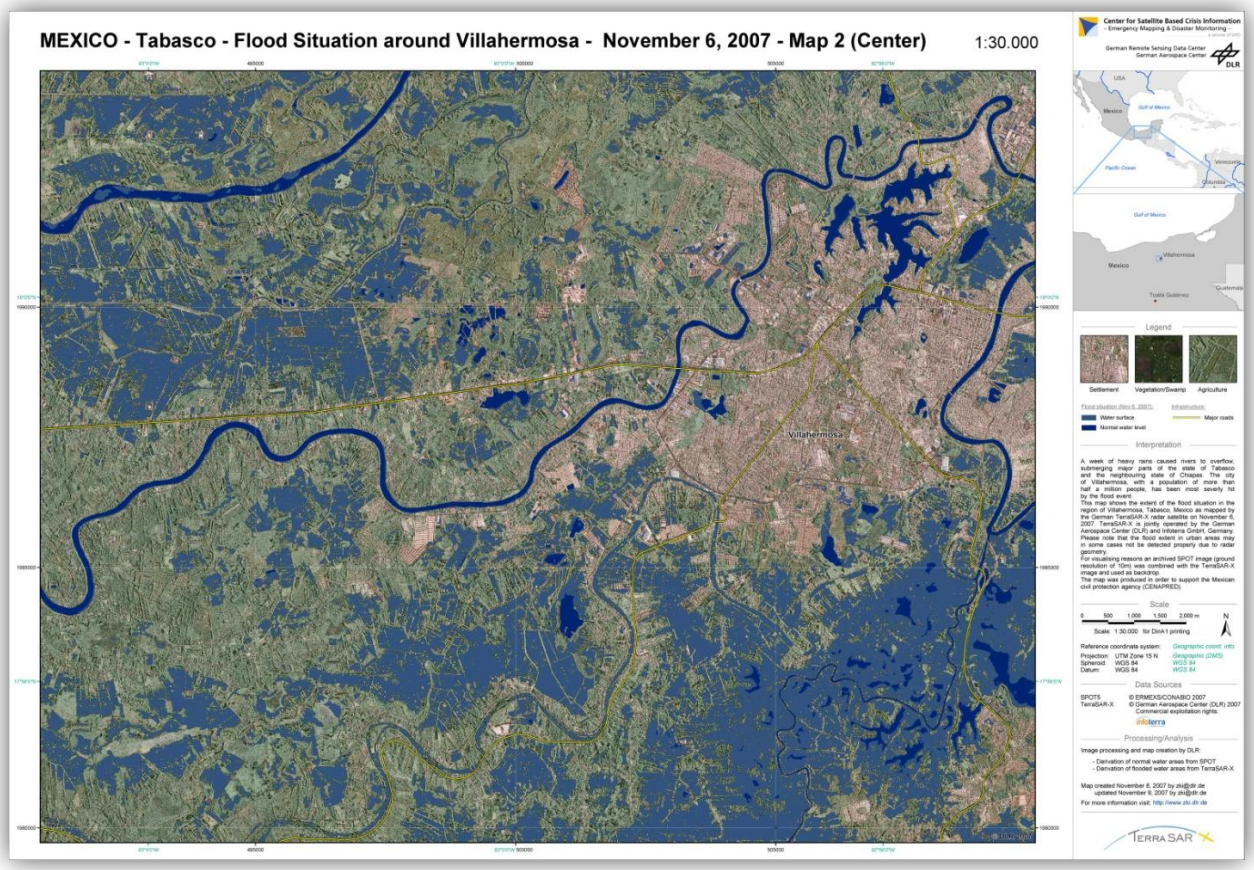

Figure 36 Satellite Map of November 8, 2007 19:41 CET – last update on November 9, 2007 14:30 CET [39]

Another map producer also collaborated in Tabasco flood through their website, named MapAction. MapAction is unique, the only non-governmental organization with a capacity to deploy a fully trained and equipped humanitarian mapping and information management team anywhere in the world, often within a few hours of an alert. In the aftermath of a disaster

thousands of people can suddenly find themselves battling to save lives and livelihoods. Before aid agencies can help them, the first requirement is information sources, needs and locations. MapAction is working 365 days a year with a volunteer group of GIS specialist trained in disaster response to deliver this vital information in mapped form, from data gathered at the disaster scene. The Map Catalogue provided operational picture also during Tabasco flooding, which was crucial for making informed decisions and delivering aid to the right place quickly, for example, the road closure as shown by Figure 37. As a UN disaster coordination manager said: *"Mapping support during the early phases of a response is critical...Without MapAction, the capacity to provide what is needed often simply doesn't exist."*[40]

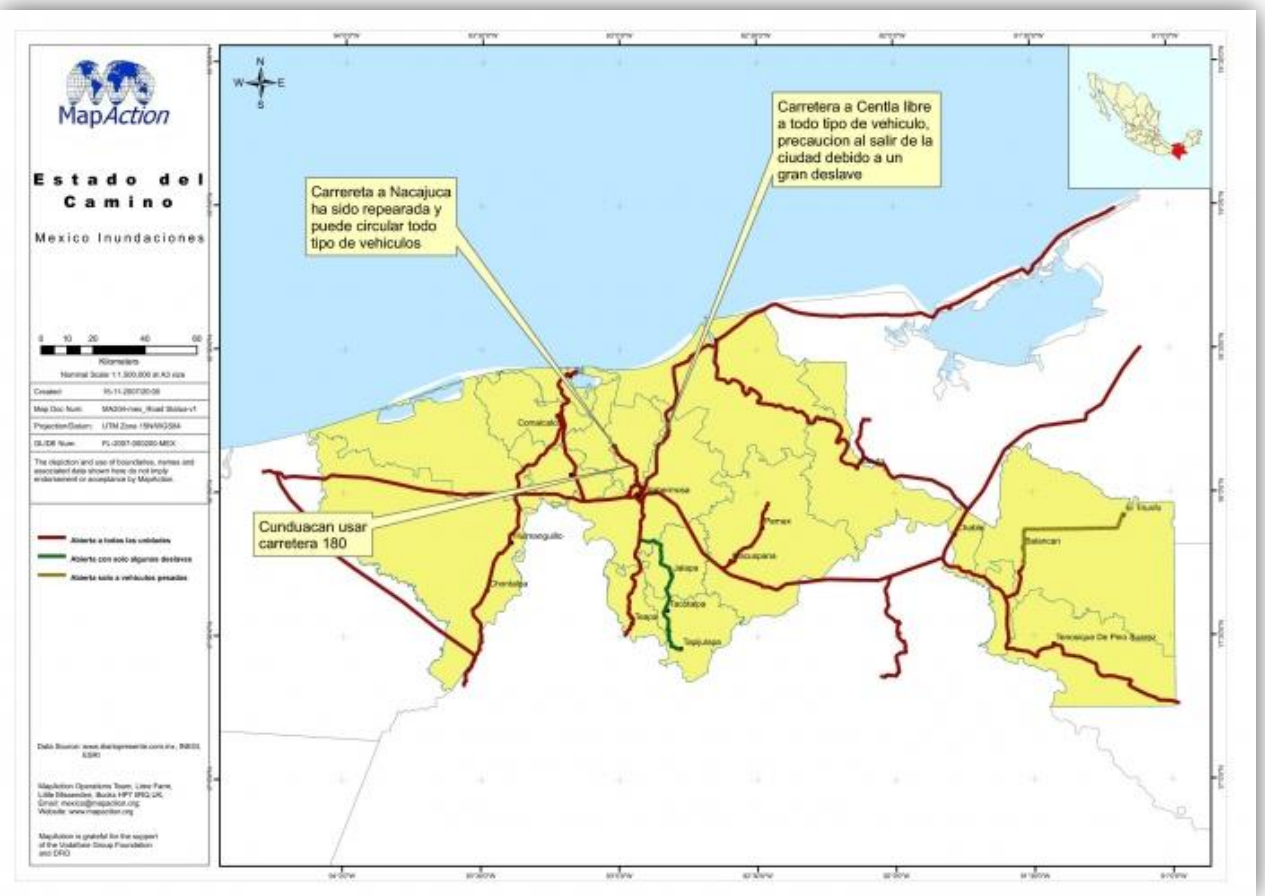

Figure 37 Road Closures in Tabasco State November 15, 2007 [40]

3.6.7.3 Blogs

Blogging is a web service for publishing blogs and connect people from all over the world. A blog is a discussion or informational site published on the web and consisting of posts typically displayed in reverse chronological order. In 2007 blogs were usually the work of a single individual, occasionally of a small group, and often were themed on a single subject; however an increase of blog traffic was noticed after 2009 with the appearance of social media networking.

During the flooding blogging was a really efficient tool to spread information about the crisis and its management. For example, Mexicans who lived out of Mexico were publishing requests of family members, emphasizing again the lack of international broadcasting:

"The situation in Tabasco is extremely serious," says Winnipegger Jorge Leon, whose extended family is among those hardest hit by the disaster. *"Even though the news media have stopped covering the story, many people need our help to cope with shortages of food, drinking water, clothing and medicines."*[41]

Plenty of other blog web pages were active in the same period. One of them was run by Richard Alleyne who was in Mexico to assist with UNICEF's reporting on the Tabasco flooding and its effect on children. He was posting to Fieldnotes.org when his schedule permitted. Even if there were many followers of the blog, only one comment existed on the blog: *"Keep up the work, Richard"*.[42] As a consequence, it can be stated that in 2007 the population was surfing on the web searching for information about the disaster, but didn't interact with other users sharing their opinion.

3.6.7.4 Help from the Public

An American Fresno pastry chef has turned her website on baking into part of a worldwide relief effort. The Mexican government was the leader in the flood relief effort, but the consulate in Fresno was helping channel donations to Tabasco. A native of Tabasco and her husband who lived in Fresno were also doing a lot to help and they've attracted international attention. The flooding was one of the worst natural disasters to hit Mexico and the hardest hit was the capital of Tabasco, where Sol Hernandez grew up.

"We're talking about 1 million people affected and half a million people that have been left without their homes," said Selene Barcelo, Mexican Deputy Consul. *"When I saw the news, I feel sad. I feel angry. I don't feel any energy when I see all the people under the water. It's my people, and they need my help now,"* said Sol Hernandez.

Sol Hernandez was a pastry chef and she had an internet blog where she talked about cooking and recipes. With the help of her husband Pablo Orozco, it became something more. *"We just turned this blog, which is a pastry and cupcake blog, into a relief effort,"* said Pablo Orozco. The blog was loaded with news, pictures and personal accounts of the flooding. The BBC broadcasted a story on it, and donations started to arrive to the affected areas from around the world through the blog.

"But also the main thing was having a list of different websites where the blogging community can log on and click and put in their credit card information and make a donation that way," said Pablo.

The donations could be directed to any of a number of charities like the Red Cross and Save the Children. In addition to helping everyone else, Sol and Pablo were doing what they could to help Sol's family. Her parents, grandparents, brothers and sisters were crowded into one house, along with all the neighbors whose homes were destroyed. *"The food they have now is going to last one week because they have 30 people in their house," said Sol.* The Mexican government said it will be weeks until the water subsides and will take months until life is anywhere near normal. Until then, instead of cooking tips, this blog offered ways to help. The blog was called Rootcoffee.blogspot.com. Donations were made to charities through the site. The Mexican government had also set up bank accounts accepting donations for the relief effort at Wells Fargo and Bancomer USA banks. [43]

3.6.7.5 YouTube.com

YouTube is a video-sharing website, created by three former PayPal employees in February 2005, on which users can upload, view and share videos. The company provides technology to display a wide variety of user-generated video content, including movie clips, TV clips, and music videos, as well as amateur content such as video blogging and short original videos.

Most of the content on YouTube has been uploaded by individuals, although media corporations including CBS, the BBC, and other organizations offer some of their material via the site, as part of the YouTube partnership program. Unregistered users can watch videos, while registered users can upload an unlimited number of videos.

YouTube video reporting started to be very important after the severe flooding. People wanted to show to the world what the real situation on the field was and they were asking for help.

An interview with a woman who went back to her house after the flood: *"…we need help, even if we can move back to our houses, a lot of people didn't come back, we have to travel a lot to get aid, and there is no job."*[29]

Other citizens were interviewed and they were telling their real opinion about the emergency response: *"Not a specialist but as a journalist and flood victim like all other tabasquenos, I observe great negligence from the authorities. I don't know if they are thinking of genius solutions, or trying to come up with lifelong solutions but they are not aware that they don't solve anything, but make matters worse!"*[29]

Also asking journalists to record the reality with actual problems and seeking for official information to answer their questions: *"I'd like to know if you can film my corn crop because its flooded. So you witness what a farmer looses with the flood that now affects us…"*

"…a new fish arrived with the flooding that I have never seen before in this area, we need information from the government for what to use it? Or if it is eatable or not."[29]

Additionally, acting and filming during a severe disaster can be also propaganda for some organizations. An interview with a worker from Western Union was published on YouTube saying that the company participated in the response with emergency actions and donations, thus employees can feel not just working for a company, but working for the world – our world, our family.

The first records that were appearing on Euronews then later on YouTube were videos from helicopter filming some rescue activities, without any comments and voices. Later, short and longer news from the TV were uploaded in Spanish and English language as well. It was observed that the updates of the videos are still continuing, and it is possible to find resident records which were uploaded late after the 2007 flood next to more recent flood videos. It was also noticed that there were really few or no comments on the 2007 videos from other citizens, meaning that the interaction between the public through the new media was low level. YouTube was mainly used for reporting the situation; while for chatting different sources were used.

3.6.7.6 Flickr.com

Flickr is an image hosting and video hosting website, web services suite, and online community that was created by Ludicorp in 2004 and acquired by Yahoo! in 2005. In addition to being a popular website for users to share and embed personal photographs, the service is widely used by bloggers. Photos and videos can be accessed from Flickr without the need to register an account but an account must be made in order to upload content onto the website.

Photo sharing was already active during the flood of Tabasco. Official pictures from the Red Cross, as well as, pictures from Mexican and international individuals were uploaded showing the event and personal experience. The interactive behavior, such as commenting on the pictures, was barely observed, even so, as an international website, it made available information to all over the world. According to a user from US:

"Thank you for sharing this information. I didn't know about what happened in Tabasco, the related news is really bad."[44]

Also, under the pictures important descriptions were added by bloggers to inform people, ask for help and mediate requests and needs. The following description was attached to a photo, but as it was mentioned before, the photo stayed without other users' comments:

"Some families are surrounded by water because they chose to stay and keep their belongings, water level is up in a moment over huge distances, because water floods caused by dams. Three quarters of sweet water of the whole country cross over Tabasco state, Tabasco provides natural gas and petroleum for Mexico, Tabasco produces meat, banana, cocoa, pineapple and a lot of crops that are lost at this time...Many families lost their whole patrimony from one day to the other, today those families doesn´t have anything but the clothes they are wearing. The shelters are already full and some people have been evacuated because the water flood is arriving to

shelters. If is your desire, you can cooperate with 1, 2 or 10 dollars, but if you don´t have any money you can cooperate with a tuna tin, or a tin of milk formula and take it to the depot centers of aid. The depot centers of aid are requesting for: Tin meals (easy open), can openers, diapers , sanitary towels, instantaneous soups, batteries, medicines, blankets , clothes, milk formula. Keep that the words do not remain in that, convert them in actions."[44]

3.6.7.7 Google and Wikipedia

Google Search is the most-used search engine on the web and the main purpose of it is to hunt for text in publicly accessible documents offered by web servers. After the flooding several thousand of queries were received through its various services. Wikipedia is a free, collaboratively edited, and multilingual Internet encyclopedia. The millions of articles have been written collaboratively by volunteers around the world. Almost all of its articles can be edited by anyone with access to the site. The topic of 2007 Tabasco flood was created on November 6, 2007 (UTC) by an administrator on the English Wikipedia. After that the article was expanded by different editors, and the latest modification on the page was made September 14, 2012. [1]

3.6.7.8 Top coverage for the Flood on the Internet

In summary, the internet was primarily used for information seeking about the disaster. The main categories of topics that were pursued on internet are the following:

- Donation to the flood victims through official websites (Red Cross, governmental)
- Multiple flood videos on YouTube
- Satellite images and maps of the flooding (Map Catalog)
- "News in Pictures" reporting (Flickr)
- Situation reports to keep up to date (Relief Web, OHCA)
- Articles about the reasons corruption might be to blame for the flood

3.6.7.9 Social Media Coverage

In 2007, the internet penetration through the country was still low, but exponentially growing year by year. 29% of the population had internet access on their mobile phone, but only 7% among them knew how to use it. Social media employ web- and mobile-based technologies to support interactive dialogue and mediate human communication. Till the year of 2007, social media didn't achieve the original purpose of socializing, entertaining and communicating between individuals and communities. This fact refers back to the previously described missing of interactions and relations between populations through new media. Figure 38 represents the very low percentage of social media users in Mexico in 2007. [32]

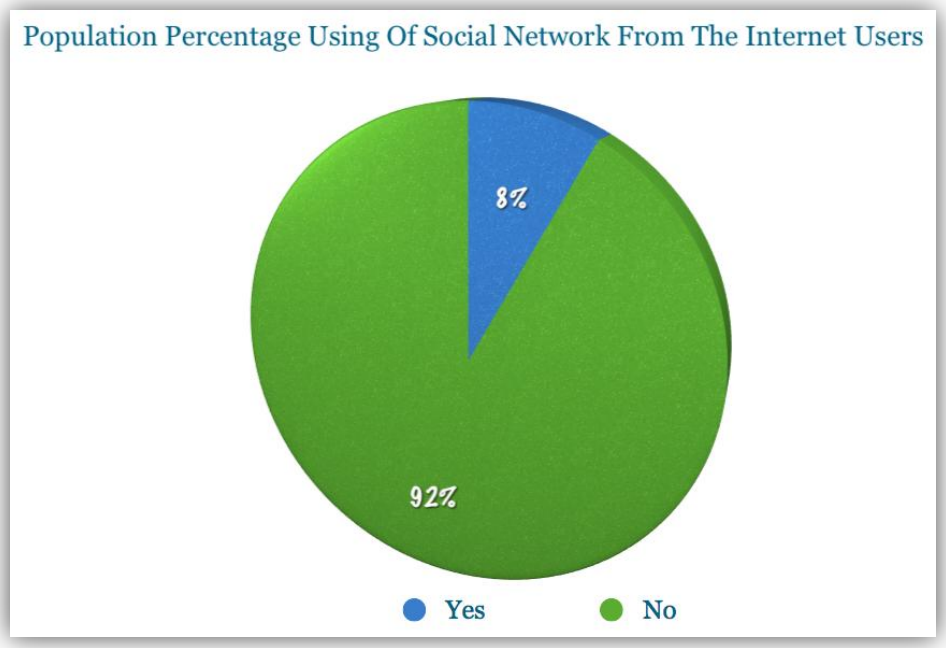

Figure 38 Social Media Usage in 2007 [32]

From the low percentage of social network users, the most popular ones are shown on Figure 39. As the social network purposes were not satisfied yet, people more likely were using these pages for distributing information.

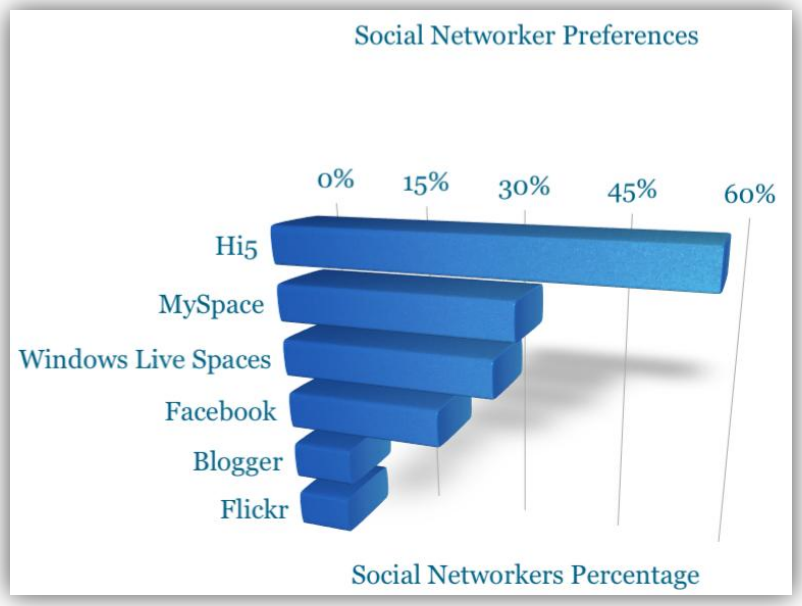

Figure 39 Social Network Preferences by the Mexican Population [32]

Due to the bad internet access at rural areas where the flood happened and the social level dispersions between the complex usages of internet, the activity of social networking was really infrequent in the inundated states. Thus, only few examples were available, mainly from international sources but from people with Mexican background, such as photo and video sharing or donation requiring on Myspace, still without much reactions of commenting and posting.

The Myspace blog of J. So: M.R. Rep about the Tabasco crisis was the following: *"As some of you may know there has been mass flooding in Tabasco Mexico. They're seeing flood similar to what happened after Katrina. I've looked into the Mexican Red Cross and received this information. If you'd like to help, here it is. Along with donations, they're also asking for supplies. Here's a list of some of them: bottled water, new blankets, any canned goods, salt, sugar, coffee, cooking oil, powdered chocolate, diapers."*[45]

As a confirmation of previously mentioned low level of social media usage, the result of a study about YouTube is introduced. Table 10 shows YouTube statistics of the data collected distributed over some Latin American countries. The numbers shown in parenthesis represents the average measurement per active user. Brazil, Mexico, Argentina and Chile had the largest number of YouTube users. In Latin America, users from Brazil and Mexico have contributed with the largest fraction of videos to YouTube. In terms of uploads per user, Argentina leads the rank with 7.8 uploads/user. In terms of traffic, measured by the number of watched videos, Brazil and Mexico generate the largest portion of YouTube traffic from Latin America. It has to be noted that the number of watched videos are including both complete and incomplete views. From the Table 10 it can also be noticed, that the users have an average of 22 favorite videos. Based on the collected data, it seems that Latin American users didn't make heavy use of the available features of social networking. The average number of friends of active users was much lower than the number observed in other social online communities. Mexican users had average only 2 or 3 friends. The observations above suggested that Mexican users were not exploiting all the social features available at YouTube in 2007. Most part of the users has uploaded few videos, didn't have a large number of friends and sent few responses and comments. It can be concluded that YouTube was used only for watching videos. [35]

Table 10 YouTube Statistics of Some Latin American Countries In 2007 [35]

Country	# Users	Total Number (average number of the active users)					
		Uploaded Videos	Watched Videos	Favorite Videos	Friends	Responses	Comments
Argentina	38,300	146,748 (7.8)	15776606 (417.0)	440420 (22.3)	21213 (2.7)	305 (1.7)	129471 (4.1)
Chile	32,736	95,772 (6.1)	14979434 (461.3)	401696 (22.8)	10980 (2.2)	158 (1.5)	108053 (3.8)
Brazil	132,710	479,458 (6.7)	56305678 (429.6)	1885369 (23.3)	100716 (2.6)	1215 (2.1)	315312 (3.3)
Mexico	72,506	228,655 (7.2)	40947662 (570.0)	1132289 (25.7)	52475 (2.6)	486 (1.6)	272651 (4.7)

3.7 Conclusion

In a paradox way, Mexico is suffering alternately from droughts and floods. This means that the country acquires great resources, but they should know how to use and deal with these variable conditions. It was predicted in recent climate change reports that *"more frequent and intense tropical cyclones and hurricanes will occur because of climate change, bringing more flooding with them."* [46] Moreover, it can be stressed that *"floods are among the most predictable, expected and announced natural hazards."* According to Salvano Briceno, director of the United Nations International Strategy for Disaster Reduction the floods in Tabasco could have been avoided in many different ways, all of them economically feasible and ultimately cheaper than the cost of the current disaster. Furthermore, for the last 25 years, Tabasco has received a larger budget for development than any other state in Mexico. It can be stated that the destruction of Tabasco was not just a natural disaster. Resources, scientific analysis and technology were readily available to deal with such events. Like the tsunami that ravaged Sri Lanka and the hurricane that swamped New Orleans, the flooding of Tabasco could have been successfully mitigated with minimal loss of life and resources. Instead, the broad interests of society were subordinated to governmental corruption and pursuit of profits, with tragic results.

From another point of view, the comprehensive response of Mexico to the flood was evaluated as enough well-handled. The main problematic task, as in any kind of disasters, is maintaining a steady flow of timely and accurate information between the field and other major stakeholders, as well as the public. Proper information sharing is vital for fundraising, advocacy and carrying out emergency operations. During an operation, communications between affected populations and authorities, as well as with the media and donors, is an essential mechanism for effective disaster response and the basis to promote greater quality, accountability, and transparency.

Moreover, disaster events in Mexican history are important examples of how cooperation by civil society can find solutions, acquire valuable knowledge and use effective and improvised tools and strategies for resolving unforeseen circumstances. In crisis condition people keen to help each other regardless of the prevailing socio-political context and the different sets of socio-cultural values and beliefs. The identification of successful practices, such as social media could be seen as a window opportunity for improve the response to disasters.

However, one must be aware of the dangerous site of using mass media channel for communicating with the public. Once the media itself, especially television, becomes central to the promotion of charity and documenting the arrival and distribution of donated materials, they are less able to monitor and report on the situation. They have become invested in a process that they can celebrate but have no interest in criticizing and providing necessary information for recovery. A review of the news images developed and circulated by Televisa and TvAzteca confirmed the notion of a disaster as promotion.

Finally, it can be concluded that some positive behavior became visible during the crisis, promising a better future. A 52 years old man were interviewed about rebuilt of the town:

"I have seen a number of big floods but I have also seen how my town's people never give up. I am reporter a critic and a poet." He was introducing his poem, namely The Water In Tabasco: *"The angry water took our harvest, but left us fertilized. The water wiped out our homes, but left us jobs. The water flooded our schools, but left us homework. The water took our anxiety, leaving us with solidarity. The water took our sadness and left us strength. The water wiped out roads, but left us new destinations. The water washed away our negativity, and left us friendship. The ruthless water cleared the dirt, to uncover our dignity!"*[29]

4 CHAPTER: POPOCATÉPETL, THE SMOKING MOUNTAIN

4.1 Description

The name Popocatépetl comes from the Nahuatl words popōca 'it smokes' and tepētl 'mountain', meaning Smoking Mountain. The volcano is also referred by the Mexican people as “El Popo”, which comes from the mountain's association in the lore of the region with St. Gregory (San Gregorio). "Goyo" being a nickname for Gregory, and accordingly for the Popocatépetl as well. [49] The Popocatépetl, shown on Figure 40, is an active Mexican volcano classified as an andesitic-dacitic stratovolcano, located 60 km southeast from Mexico City and 45 km west from Puebla City, in Central Mexico. At 5,452 masl (meters above sea level), it is the second highest peak in Mexico (after Pico de Orizaba at 5,636 masl) lying in the eastern half of the Trans-Mexican volcanic belt. The Popocatépetl volcanic edifice covers an area of 500 km^2 and a 900 m diameter crater with approximately 200 m depth, reaching the states of Puebla, State of México and Morelos. Historically and geographically the Popocatépetl is linked to the Iztaccíhuatl volcano, historically by a Nahuatl legend, and geographically to the north by the high saddle known as the Paso de Cortés. Mainly, the Popocatépetl is one of the most active volcanoes in the country. More importantly, the 25 million people living at not less than 100 km from the crater, makes the Popocatépetl one of the most dangerous volcanoes in the world. [50]

Figure 40 The Popocatépetl

4.2 History

Throughout history, the Popocatépetl has shown recurrent activity, for instance similar eruptions differing in magnitudes as listed on Table 11. In the past, major explosive eruptions have been recorded which severely affected the existing towns at the time. The CENAPRED reports that

according to a volcanic morphological analysis and the geological evolution, the Popocatépetl has been active for more than 500 000 years during which it has shown several growing stages. Such growing stages had formed at least three previous volcanoes which were destroyed by outstanding eruptions. To begin with, the V. Nexpayantla more than 400,000 years ago, the Ventorrillo about 23,000 years ago, and El Fraile 14,500 years ago. In essence, the existing volcanic cone is built over the remaining of these previous volcanoes. [51]

Table 11 A Brief History of Popocatépetl Volcano [51] and [52]

Year	Description
>430,000 (a)	Large Bezimianyi-type eruption destroys Nexpayantla volcanic edifice
23,655 to 22,000 (a)	Large St. Helens-type eruption destroys Ventorrillo volcanic edifice
14,430±190 to 12,900±40 (a)	Large Plinian eruption destroys El Fraile volcano producing ash and pumice falls on the Valley of Mexico
14,000 to 5.000 (a)	Several minor eruptions, and at least four large eruptions
3,000 (b)	Large eruption
200 (b)	Large eruption
800 (c)	Large eruption Since the last eruption, activity at Popocatépetl has been moderate. During the last 1200 years, may episodes of activity similar to the current one have occurred. Some of them are well described.
1354 (c)	Minor eruption
1363 (c)	Fumaroles
1509 (c)	Major eruption
1512 (c)	Fumaroles
1519 to 1530 (c)	Moderate eruption followed by fumarolic activity.
1539 to 1549 (c)	Moderate eruption. Episodic explosions produce ash and pumice emissions
1571 (c)	Ash emissions
1592 (c)	Fumaroles and ash emissions
1642 (c)	Fumaroles and ash emissions
1663 to 1665 (c)	Moderate eruption. Episodic explosions produce ash and pumice emissions
1697 (c)	Fumaroles
1804 (c)	Mild fumarolic activity
1919 to 1927 (c)	Moderate eruption. Episodic explosions produce ash and pumice emissions. A small lava dome grows on the crater floor on 1924. Several people died inside the crater during sulphur extraction works.

(a) Years before present
(b) Before Christ
(c) After Death

4.3 Recent Activity

After seventy years of inactivity, a gradual increase of the Popocatépetl fumarolic occurrence was noticed, formally restarting its activity on December 21st, 1994. According to the CENAPRED, the Popocatépetl started with moderate volcanic activity changing to significant seismic and fumarolic occurrences, which produced gas emissions, ash fall, lava extrusion, and even pyroclastic flow during the erupting event on May and June, 1997. Since then, the Popocatépetl has had effusive and explosive behaviors related to the growing and destructive stages of the lava domes in the interior of the crater. The most noteworthy lava dome grew on the crater floor taking 20% of its capacity. Some ash fall events reached important cities like Puebla and Mexico, D.F. and even further cities like Querétaro and Veracruz. The incandescent fragments produced by explosions reached distances of almost 5 km away from the crater, and about 3.5 km of the volcano's nearer towns. Also, pyroclastic flow and lahars were presented in two occasions, reaching Santiago Xalitzintla, State of Puebla, the nearest town to the volcano. Moreover, 5 people were killed close to the crater rim during an explosion in May, 1996. In brief, the Popocatépetl's recent activity can be summarized as moderate eruptions with episodic explosions that produced ash and pumice emissions. [51]

4.4 Warning System

Ideally, societies should not settle in the vicinity of volcanoes, however and as mentioned on Chapter 1 Disaster Risk in Mexico, the Mexican territory is vastly populated by volcanic mountains which forces people to coexist with them. The damages generated by volcanoes always act in function of the type of eruption and magnitude, and the level of preparedness from the civilians living in risky zones. [53] and [54] For this reason, it is fundamental for the population to recognize risks to life and property through the exposure to volcano hazards. Furthermore, residents of risky zones must be aware and committed to the existing procedures to guarantee civil protection. For instance, the evacuation protocol developed by the CENAPRED in conjunction with the SINAPROC for public safety, hereunder Figure 41 exemplifies evacuation communication between the emergency management agency and the population. In essence, the CENAPRED and the SINAPROC aims for a strategic goal of protecting lives, resources, and property by making information available to communities to use in developing volcano hazard mitigation, preparedness, and avoidance plans.

Hereinafter, the President of Mexico, Felipe Calderón Hinojosa, recognizes the importance of evacuation signage: *"Clearly, the Governors are going to do it, and I reiterate and ask them, to put extremely clear signage for the shelters' location and the evacuation routes. I know that there is already signage, but it would be safer to recheck."* [60]

Figure 41 Evacuation Signals [53]

Fortunately, volcanoes usually possess already known predisposing signs, that is to say the anomalies with respect to the reference levels, which have to be monitored in order to prevent disasters. [54] For this sake, the CENAPRED, SEGOB and the UNAM Geophysics and Engineering Institutes with collaboration from U.S. Geological Survey Cascades Volcano Observatory have developed an alerting system based to an extent on the experiences of Mexico and other countries, from which it was deduced that one of the main causes of disasters is the lack of criteria on decision making and communication during the occurrence of a potentially destructive phenomena. [55] According to the Journal of Volcanology and Geothermal Research:

> *"The Volcanic Traffic Light Alert System (VTLAS) is a basic communication protocol that translates volcano threat into seven levels of preparedness for the emergency management authorities, but only three levels of alert for the public (color coded green–yellow–red). The changing status of the volcano threat is represented as the most likely scenarios according to the opinions of an official scientific committee analyzing all available data. The implementation of the VTLAS was intended to reduce the possibility of ambiguous interpretations of intermediate levels by the endangered population. Although the VTLAS is imperfect and has not solved all problems involved in mass communication and decision-making during a volcanic crisis, it marks a significant advance in the management of volcanic crises in Mexico."*[56]

The VTLAS reduces as far as possible the uncertainty factors that might arise on the decision making and communication process. [55] Table 12 emphasizes the VTLAS levels in a detail form, as the expected scenarios forecasted by the Scientific Committee (SC) and accordingly seven levels of preparedness for the SINAPROC, but mainly three levels for alerting the public. On the other hand, Figure 42 illustrates the distributed VTLAS posters by SEGOB, SINAPROC and CENAPRED for the population.

Table 12 Alert Level Indications for General Public and SINAPROC by Analogy to VTLAS [56]

Alert level: communication SC-SINAPROC	Expected scenarios	Actions recommended to SINAPROC	Alert level of the public. Recommended actions
Green. Phase 1	– The volcano is quiet – Sporadic seismic signals	– Develop preparedness plans – Promote education programs – Maintenance of monitoring devices	Green. Normality – Keep informed – Learn about volcanic phenomena
Green. Phase 2	– Low-level seismic activity recorded only at nearest stations – Some fumarolic activity – Minor changes in temperature of fumaroles – Minor changes in the composition of spring waters, that do not affect significantly its quality for agricultural and public use	– Increase monitoring – Promote more frequent meetings of the SC. – Increased communication between SC and SINAPROC – Review of emergency plans – Increase dissemination of volcano information to the public	– Memorize signals: — Evacuation routes — Meeting sites — Shelters – Attend information meetings – Join exercises and drills – Promote relocation of vulnerable property
Yellow. Phase 1	– Increase of low-level local seismicity – Gas or steam fumaroles, and/or light ash emissions – These manifestations may cause acidification of meteoric rain and light ashfalls on towns surrounding the volcano. Some of them may pose a slight threat to air traffic	–Promote more frequent meetings of the SC and joint meetings with SINAPROC. –Recommend specific studies on the volcano. –Check availability of staff, equipment and vehicles required for evacuations. –Ask the SC to define criteria limiting access to the volcano –Issue warnings to the aircraft controllers.	Yellow. Alert – Keep well informed. Pay special attention to official spots – Keep valuable documents in an easy to carry envelope – Try the evacuation routes to meeting sites, security areas and shelters – Listen and obey instructions from authorities and remain alert
Yellow. Phase 2	–Low to intermediate eruptive activity (VEI ≤ 2) –This level of activity may produce moderate explosions ejecting debris around the volcano crater. –The explosions may eject ash and produce light to moderate ashfalls on nearby towns, and farther cities if wind is strong. –The ash in the air may pose an important threat to aircrafts. –Low-level pyroclastic flows and mud flows (lahars) may develop without reaching populated areas.	–Communicate the change of alert level to authorities in the three levels of government: municipal, state and federal, and to all involved officials. –Keep shifts of emergency staff. –Increase area of restricted access around the volcano according to the recommendations of the SC. –Issue warnings to the air navigation systems	– Be prepared for a possible evacuation
Yellow. Phase 3	–Phreatic or magmatic eruptive activity of intermediate to high explosivity (VEI 2–3) –Growth of lava domes and increased probability of magma ejection. –Possibility of explosions of increasing intensity ejecting hot debris to significant distances (several kilometers). –Conspicuous ashfall on towns and cities.	–Keep the public and the media well informed about the situation and the measures taken. –Prepare staff and equipment for shelter operation. –Implement specific measures in most vulnerable areas. –Start preventive measures against ash and debris falls and against lahars in highly vulnerable areas. (this may include some evacuations).	

Alert level: communication SC-SINAPROC	Expected scenarios	Actions recommended to SINAPROC	Alert level of the public. Recommended actions
	–Possibility of larger pyroclastic flows and lahars, not reaching populated areas. –Increased risk to aircrafts and light effects on airports.	–Further increase of restricted area around the volcano –Alert all systems of air traffic and navigation.	
Red. Phase 1	– Intermediate to large explosive eruptions (VEI 3–4) producing eruptive columns capable to reach the stratosphere	– Selective evacuations according to criteria of the SC defined by the development and intensity of the eruption – Inform and promote about auto-evacuations in selected areas	Red. Alarm – Keep well informed. Pay full attention to official spots and obey instructions
	– The explosions may eject considerable amounts of ash and fragments reaching the nearest towns	– Implement specific preventive measures against ash and fragment falls in the regions near the volcano defined by the SC	– Take with you valuable documents in an easy to carry envelope and go to meeting sites, security areas and shelters according to the instructions of the Civil Protection officials
	– Production of large-scale pyroclastic flows and mud flows capable to reach nearest towns and beyond	– Implement specific preventive measures against pyroclastic flows, surges and lahars in the regions defined by the SC	– If you can leave a hazardous area by yourself, do not hesitate
	– Important ashfalls in towns at intermediate distances capable to produce roof collapses. Significant ashfalls in large cities around the volcano	– Implement preventive measures against moderate to intermediate ashfalls in metropolitan areas of proximal large cities – Implement emergency plans to protect and maintain communication lines and water and food supply	– Keep informed about the evolution of the eruption
	– Serious threat to aircrafts over large distances. Serious effects on airports	– Nation-wide and international warnings to all aircrafts and airports	
Red. Phase 2	– Large to extreme eruption (VEI>4)	– Extensive evacuations according to criteria of the SC defined by the evolution and intensity of the eruption	
	– Production of volcanic very large-scale clouds to the stratosphere	– Inform and promote about auto-evacuations over extended areas defined by the SC	
	– Possibility of massive sector collapse of the volcano producing extensive debris avalanches	– Implement specific preventive measures against intense ash and fragment falls in the regions defined by the SC	
	– Massive pyroclastic flows	– Implement specific preventive measures against massive debris flows, pyroclastic flows, surges and lahars in regions defined by the SC	
	– Massive lahars reaching distances beyond the extent of the Hazards Map		
	– Devastation of the regions defined in the Hazard Map	– Implement preventive measures against intermediate to large ash and fragment falls in metropolitan areas of proximal large cities, including anti-panic measures for total blockage of sunlight	
	– Intense ashfalls and fragment fall on metropolitan areas in cities within a radius exceeding 100 km		
	– Maximum threat to all aircraft nation and continent-wide	– Implement emergency plans to protect and maintain communication lines and water and food supply	
	– Serious threat to airports nation-wide	– Nation-wide and international warnings to all aircrafts and airports	

Figure 42 VTLAS Advertisement Poster [56]

4.5 Monitoring and Communication Protocol

It was declared by the CENAPRED that the Popocatépetl's recent activity which at the moment has shown similar behavior to the volcanic episode in 1919-1927 (and to other 13 resemblance episodes documented during the last 450 years), if maintain, it might continue by indeterminate time and possible finish without major consequences. However, the fact that in ancient times great eruptions of destructive character have been registered (the last one happened about 1100 years ago); it indicates that the Popocatépetl has a potential risk that cannot be ignored. [55] For this sake, to address the growing national risk from volcanic activity, the CENAPRED must monitor all hazardous volcanoes in real time so data can be acquired, processed, interpreted, and disseminated rapidly.

Volcanic monitoring implies the recognition and interpretation of the precursor signs for the sake of disaster prevention. In spite of perceiving and evaluating a volcano's state of activity and associated risk, visual and instrumental methods must be implemented by means of systematic observation and monitoring. A continuous monitoring is required, thus when an anomaly is detected, the existing protocols to assure civil life and property might be executed. Basically, monitoring is meant to enhance public safety and reduce losses from volcanic events through effective forecasts and warnings of volcanic hazards based on the best possible scientific information. [50]

Particularly, the recently established Popocatépetl monitoring system is an excellent example for appropriate operating surveying systems. Au fond, the Popocatépetl monitoring system is composed by a complex system of sound-ranging observation with an acquisition power station and data processing located in the CENAPRED facilities. The Popocatépetl monitoring system consists of four types of monitoring methods that have been set up in the volcano: visual, seismic, geodesic and geochemical, from which the most important is seismic. [50]

VISUAL METHOD: Inspection to track external morphological changes on the volcano. Video cameras, aerial and satellite images are used.

SEISMIC METHOD: Inspection to detect the seismic activity associated to the magma and gas movements, and rock cracking inside the volcano.

GEODESIC METHOD: Inspection to detect deformations on the volcanic edifice produced by supercharging pressure inside the volcano. In addition, this data provides with crucial information on the possible feeding of new domes.

GEOCHEMICAL METHOD: Inspection to determine the sulphur dioxide and carbon dioxide concentrations emanating from the crater. In addition, this data provides with important information about the volcano's internal state, its eruptive potential and gas emissions possible effects. [50] and [53]

At the moment, the Popocatépetl monitoring network consist of 25 remote stations, installed around the volcano at altitudes between 2,500 and 4,450 masl (the nearest at 2.1 km away from the crater). Among the remote stations, there are 15 stations with short period seismometers (in addition, 3 broadband seismometers will be soon installed), 5 stations with clinometers, 4 hydrometric and flow detection stations, 1 station with radar, and finally 1 station with video camera as arranged in Table 13. Aforesaid, this assembly of visual, seismic, geodesic and hydrometric instruments generates more than 60 signals which are transmitted continuously, the 24 hours of the day, towards the CENAPRED and UNAM by a complex telemetry net through radio. For the sake of instruments preservation from the environment, particularly severe in higher stations, special structural facilities were constructed. Also, the facilities are meant to protect the personnel in charge of the instruments operation and maintenance. [57]

Table 13 The Popocatépetl Monitoring Network [57]

Type of Instrument	Number
15	Short Period Seismometer
3	Broadband Seismometer
5	Clinometer
4	Hydrometer and Flow Detection
1	Radar
1	Video Camera

Regarding the video camera station, the image is presented with a 640x480 pixels resolution and is updated every minute approximately. The video camera can be controlled by remote from the CENAPRED facility, and so the video camera might perform approaches and movements in behave of the analysis. Additionally, the video camera also allows observing the volcano at night accordingly to its technical characteristics. An interesting fact is that the main national, Televisa, news network donated the video camera station at the Altzomoni hill, ensuring first-hand news about the Popocatépetl behavior. [58]

To conclude, the information flow hierarchy is described hereunder. Whenever an anomaly on the volcanic activity is detected, the communication protocol goes as follow, an acoustic alarm system is activated and auto dial messages are sent to particular phone lines, mobiles and pagers of the surveying team. From the analysis of the information, the recommendations regarding the warning alert level are taken by the Technical Scientific Adviser Committee, integrated by eminent investigators of the UNAM and the CENAPRED. By means of special reports, authorities of the SEGOB and SINAPROC are informed periodically about the volcanic activity level. Concerning public information, a telephone mailbox with updated messages (POPOTEL), e-mail mailbox for messages (POPO e-mail), and daily reports publish on the internet (CENAPRED homepage) are available with information related to the Popocatépetl activity. [50]

4.6 Case Study, Popocatépetl 2012

In particular, the Popocatépetl has had memorable events during the last 17 years, from which the April 2012 incidents will be analyzed below. In particular, the information has been obtained by special reports performed by the CENAPRED, altogether with an extensive scientific bibliography generated ever since the Popocatépetl's activity restarted. The CENAPRED did not intent to record all and every exhalation the volcano has ever made, but to highlight and illustrate the most remarkable activity captured by the monitoring system and CENAPRED personnel as well as civilians. [51]

4.6.1 April 2012 Occurrences Chronology

To begin with, early on April 2012, moderate exhalations together with gas and vapor emissions were observed in the Popocatépetl, during the night, it was possible to distinguish incandescence in the crater. Occasionally, low magnitude episodes of tremor were recorded, especially on April 6th, 12th and 15th, such episodes' durations did not surpass 17 minutes per day, with the exception of April 15th with 17 hours time span. In addition, volcano-tectonic events were registered, like those on April 8th, 10th, 11th, 12th and 14th. Likewise, on April 9th, 13th, 14th, 15th and 16th a constant incandescence along with plumes was observed in the Popocatépetl, reaching, the most outstanding, up to 2 km from the crater. [59]

Importantly, on April 12th, a train exhalations lasting approximately one hour was registered, from which anomalies on the gas emission readings were identified, as well as a considerable amount of ash. Similarly, on April 13th, great amplitude of spasmodic tremor was recorded, within which multiple exhalations took place. As consequence, ash fall warning reports were received in the town of San Pedro Benito Juárez, where the roar of the explosion was listened. On April 14th, the Popocatépetl registered a signal of medium amplitude spasmodic tremor which lasted 25 minutes. Moreover, throughout April 13th to 15th, explosions threw incandescent blocks up to 800 m distances along the volcanic slopes, which remained burning by a lapse of 10 minutes. Within the frame of April 14th events, ash fall warning reports were received in San Pedro Benito Juárez with a thickness of 1.5 mm, Santiago Xalitzintla, San Juan Tianguismanalco, Atlixco, City of Serdán, Atzinzintla, Atecamachalco, Cholula, Huejotzingo and the capital city in the State of Puebla. As well as in Amecameca, Ecatzingo and Ayapango in the State of Mexico, and Tetela del Volcán in the State of Morelos. Furthermore, a volcano-tectonic earthquake of magnitude 3.6 was recorded in the environs of San Pedro Nexapa. [59]

In the main, the Popocatépetl presented a remarkable activity increase on April 16th, with an amplification of the seismic signals of the train exhalations. Ash fall warning reports were received in the airport of City of Puebla, and in other localities of the Eastern sector. Due to the aforementioned activity increase, and to the possibility of medium to high explosive activity, growth of domes and possible lava extrusion, explosions with increasing intensity and ash rains covering volcano's nearest towns; it motivated the authorities of civil protection to declare an

increase in the level of the volcanic alert and to define security radius of 12 km. Also daily reports updates begun to be issued 3 times a day. The activity continued with ash discharges, micro-earthquakes and low magnitude episodes of harmonic tremor until the end of the month. By virtue of the relative Popocatépetl's calmness at late April, on the 27th the daily reports updates returned to be issued 2 times a day. Nevertheless, base on the information later observed and analyzed by the Scientific Committee of the Popocatépetl and the authorities of Civil Protection, the level of volcanic alert decreased to Yellow Phase 2 until September 1st, 2012. [59]

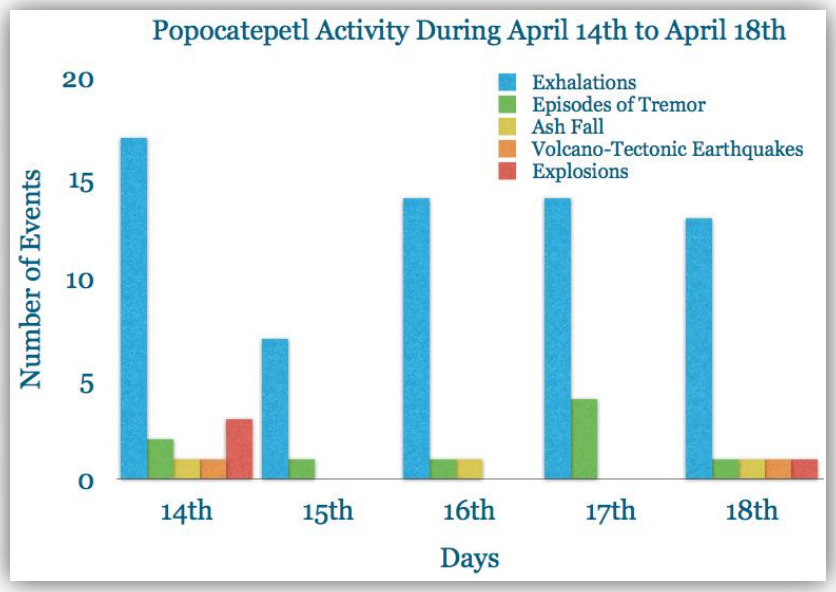

Figure 43 Occurrences during April 14th to 18th

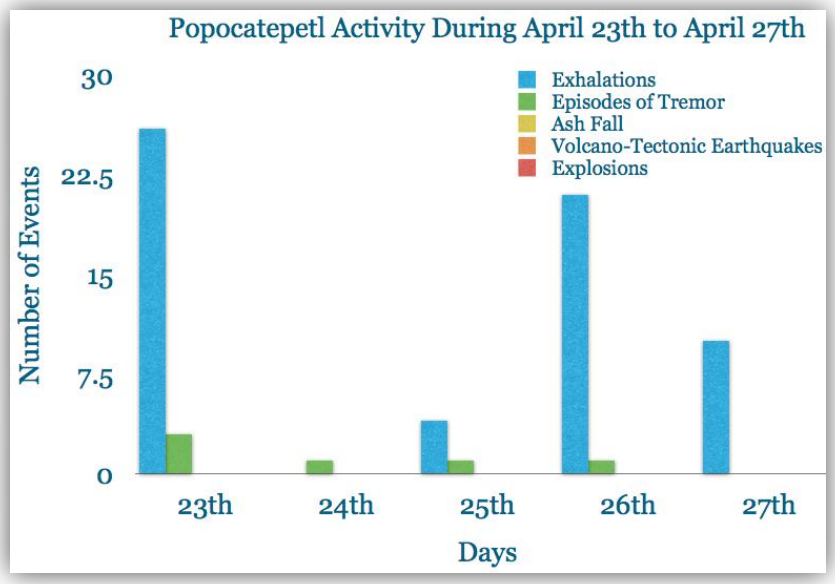

Figure 44 Occurrences during April 23rd to 27th

In summary, it can be said that from April 13th, the Popocatépetl entered in a more intense cycle, as it can be observed from Figure 43, where the construction of a new dome through exhalations took place, that is to say, with great ash clouds formation and gas emissions, and by throwing fragments on the crater slopes. Seismic activity of the order of 3.4 (Richter scale) appeared inside the volcano, indicating a cracking in the magmatic chamber, down the volcano to 5 or 6 km of depth. Whenever the internal pressure exceeds the dome's own weight, this dome is violently destroyed. In this way, the monitored parameters were exceeded and the VTLAS changed proportionally to the possible scenario. Following, a quieter period ensued that can be noticed from Figure 44. The Popocatépetl changes continuously its behavior, between calmness and eruptive phases, reason for which is extremely dangerous. It was known by volcanoes nature that the actual dome, with a one million m^3 volume would be destroyed, which might happen by degas and forceful fluid spilling or by releasing the pressure in a gradual manner, thus destroying the dome. Significantly, the main aspect in a volcano is not the phenomena itself, but the impact in life and property. The Popocatépetl as aforesaid is extremely dangerous, for instance, if a circle of 100 km from the crater to the surroundings would be drawn, it will encompass around 25 million inhabitants as shown in Figures 45 and 46. By now, the Popocatépetl is continuing discharging ash and gas emissions, along with exhalations of an explosive character. [60]

Figure 45 Popocatépetl Reach to the Surrounding States [61]

It can be noticed from Figure 45, the critically that Federal District faces against the Popocatépetl by being encompassed by the 100 km radio. As consequence, Federal District becomes extremely vulnerable, accordingly to its vastly population density.

Figure 46 Popocatépetl Reach to the Surrounding Cities [61]

State of Mexico: Chalco, Amecameca, Ozumba, Ecatzingo, Tepetlixpa and Atlautla.
State of Puebla: San Nicolás de los Ranchos, Santiago Xalitzintla, San Baltazar Tetela, Tochimilco, San Pedro Benito Juárez.
State of Morelos: Ocuituco, Yecapixtla, Zacualpan de Amilpas, Temoac y Tetela del Volcán

4.6.2 Early Governmental Response

It is fundamental to understand that the Popocatépetl is an ongoing emergency crisis, that is to say the crisis becomes normality, the Popocatépetl's changeable character makes particularly difficult, mostly unpredictable to determine the main impact. Therefore, the civil protection authorities, in conjunction with the government, are in constant emergency and alerting state. As publicized in Figure 47, by April 20th 2012, the President of Mexico, Felipe Calderón Hinojosa, met in State of Morelas with the Governors from the states of Puebla, State of México, Tlaxcala and for effect Morelos, along with Morelos' local authorities, the Secretariat of National Defense Secretary (Secretaria de la Defensa Nacional, SEDENA), the army, the SINAPROC (state and federal authorities), the CENAPRED, and other authorities. The so called, Evaluation Meeting for the Occasion of the Change of the VTLAS (Reunion de Evaluación con Motivo del Cambio de la Alerta Volcánica del Popocatépetl). This Emergency Committee discussed about the measurements and actions to be taken in order to mitigate the Popocatépetl effects on the population.

Figure 47 Tweeted by the Minister of Internal Affairs

1. The Popocatépetl Scientific Committee determined this Monday to increase the VTLAS from Yellow Phase 2 to Yellos Phase 3.
2. Live: The President is meeting on the occasion of the Popocatépetl alert change.

For instance, during the meeting Laura Gurza, SINAPROC Director, requested the population to participate and interact in evacuation practices conducted by the SEDENA. Evacuation is the primary protective action utilized in volcano disasters, and for such reason, it is essential to optimize the evacuation time by becoming an active citizen. Couple with, be prepared for evacuation by packing the most important documents in a single case in order to be ready to leave if required. Next, be precocious by knowing how to cut the gas and electrical power supplies for the sake of minimizing damage if disaster occurs. When leaving residential or public buildings, all doors and windows must be properly secured, the air conditioned/heating outlets must be sealed with humid rags to limit dust entrance, a white sheet must be placed on the property to signify the building's evacuation, and keys must be assured before departing. On an evacuation alert issued by SINAPROC, it is considered indispensable to leave in favor of population's well-being. If alert happens, the first response to the initial evacuation warning is to keep calm and seek further instructions from authorities, to validate the given information about the threat and not to spread rumors, and to assure that family is presented in the evacuation point. [54] and [60]

Additionally, Laura Gurza, recommended to pay special attention to the accumulated ash on ceilings, generating extra loading which considerably increases if the ash becomes damp or wet. Concerning to ceiling failure, the ash must be swept and stored in bags since to throwing it to the street causes serious obstructions problems to the drainage, and so a potential sanitary hazard. On the other hand, the ash bags might be used later for gardening purposes accordingly to its beneficial properties. The ash by itself is not toxic, nevertheless, it is formed by very fine rock

fragments similar to ground glass, which is the reason it is erosive and irritating. As a rule, the contact, aspiration and ingestion of ash must be avoided. [55] and [60]

In addition, the General and SEDENA Secretary, Guillermo Galván, described the federal government response through the Mexican army, consisting on the implementation of the Popocatépetl Operative Plan (from Plan DN-III-E, national disaster plan) by now in its preventive phase. The Mexican army and Air Force mission is to support the civil protection authorities, in order to help the civil populace living in risky zones, whenever the Popocatépetl's activity increases or evacuation in risky zones has been issued, for the purpose to preserve life and property.

"By means of the accomplishment of preventive and aid actions, pawning the Force of Task "Popocatépetl", integrated by five groups of aid ("Puebla", "Morelos", "Mexico", "Tlaxcala" and "Federal District"), as well as, the military units that are provided in support. We are working in close coordination with civil protection authorities, participating in the state and municipal meetings, patrolling and verifying the evacuation routes maintenance state, mainly in high risk zones... Updating the censuses in high and medium risk communities, the location and facilities for shelters, centers for storing, sanitation, canteen purposes etc, and the closely following of the volcanic activity through the Popocatépetl's room".[60]

On the other hand, before the meeting, the President of Mexico toured one of the shelters that were being prepared to take care of the population, in case the Scientific Committee determines an evacuation. Later, he performed a supervision overfly, passing through the nearest towns to the Popocatépetl's crater, and flew as near as possible to the crater itself (Figure 48). Afterwards, he addressed the Emergency Committee and stated (scene captured and transmitted by the most watched TV channel, Televisa): [60]

"I am convinced that the co-responsible work in the matter of civil protection authorities, as much as the federal, state and municipal governments, will be as always, key to safeguard the physical integrity, patrimony and tranquility, mainly, of the families living in the Popocatépetl's bordering zones". [60]

Figure 48 Tweeted by President of Mexico, Felipe Calderón Hinojosa

"I am in a supervision flight on the Popocatépetl volcano. in a moment, we will have the evaluation meeting".

In essence, it can be noticed that the early governmental response was based on communication messages from the government and civil protection authorities through mass media. Further on, the governmental and civil protection authorities actions for this distinct crisis will be described, with special emphasis to the media influence and usage on such urgent situation, largely as an information sharing platform.

4.6.3 Traditional Media Influence on April 2012 Occurrences

As far as Mexico concerns, the main sources of information remain steady, still relying among the traditional media. According to the Open Society Foundation study, The Digital Media: Mexico (Los Medios Digitales: Mexico), 95.5% of the population watch television, compared to 87.3% that listens to radio and hardly 16.1% that reads newspaper as shown in Figure 49. These tendencies are the result of social and economical aspects, as limited broadband access to internet in poor zones, where it is easier and more accessible to consume news through open television. [62]

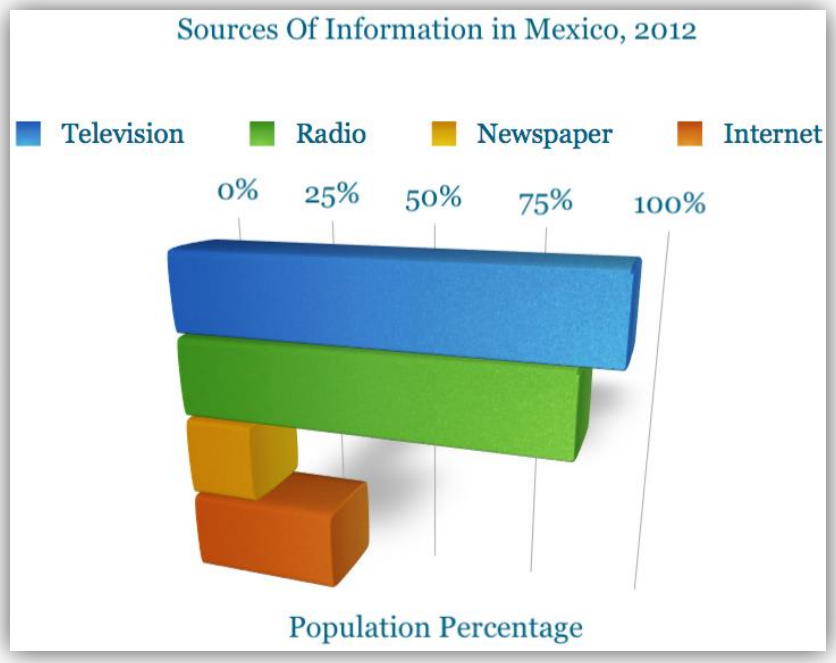

Figure 49 Traditional Media Consumption in Mexico [62]

4.6.3.1 Face-to-Face/Peer-to-Peer Communication

Substantially, the communication process is the principle for any information sharing in emergency management, where oral expression is one of the key factors for the official information diffusion. Information sharing might happen through face-to-face processes such as speeches, interviews, press conferences, meetings, surveys etc. During the Popocatépetl's April 2012 occurrences, the Governors from the states of Puebla, State of México and Morelos attended personally to manage the crisis, and visited the most vulnerable town as reported by the Governor of Puebla, Rafael Moreno Valle Rosas.

"I went already to three communities, from Tuesday on, we were speaking with the population."[60]

Moreover, civil protection authorities performed a survey in order to understand the learning process through the information shared between the different State Institute of Civil Protection (Instituto Estatal de Proteccion Civil, IEPC) from the Popocatépetl crisis involved states and the public. Hereunder from Figures 50 to 54, the survey results of the information exchange between civil protection authorities and 800 surveyed people from the localities threatened by the Popocatépetl. These results were published by "La Prensa" national newspaper on April 24th, 2012 on the Mexico City issued units; newspapers play a fundamental role as a communication bond between the government, civil protection authorities and public, which performance will be

analyzed on Chapter 4.6.3.2 Newspapers/Printed Means. In detailed, Figure 50 and 53 reveal that most of the exposed population have developed awareness to the volcanic risk (working VTLAS), recognizing risk to life and property, thus increasing the likelihood to commit to the existing procedures to guarantee civil protection. On the contrary, it is important to highlight that even-though the public is aware of the volcanic risk and have a strong likelihood to commit to the civil protection protocol, by now, it can be noticed by Figure 52 that they are not truly engaged since they do not look for further information through civil protection authorities. [63]

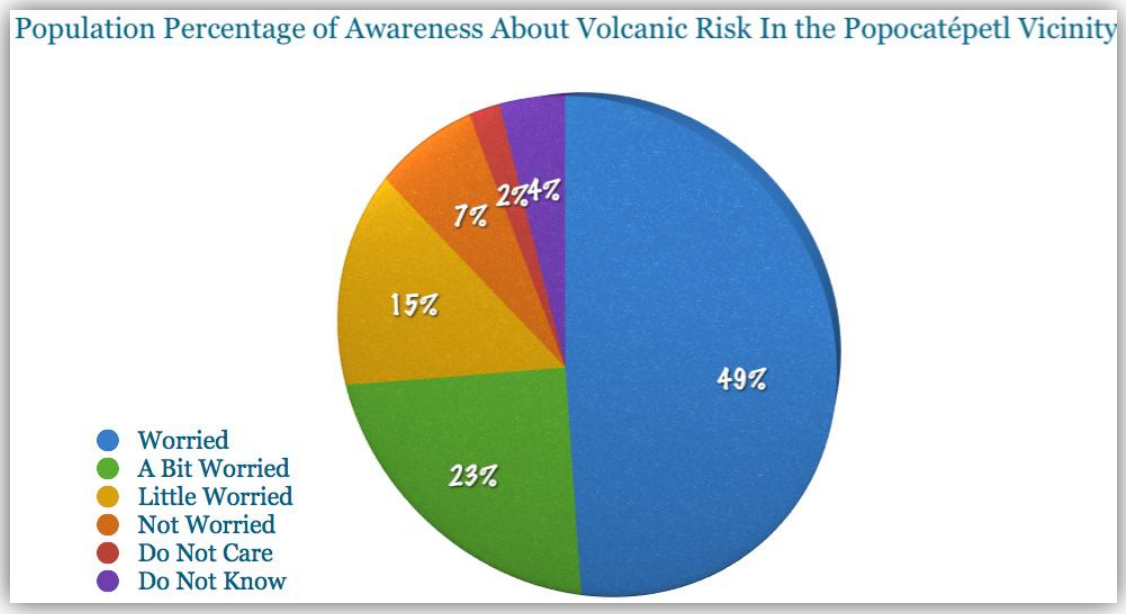

Figure 50 Population Percentage of Awareness about Volcanic Risk in the Popocatépetl Vicinity [63]

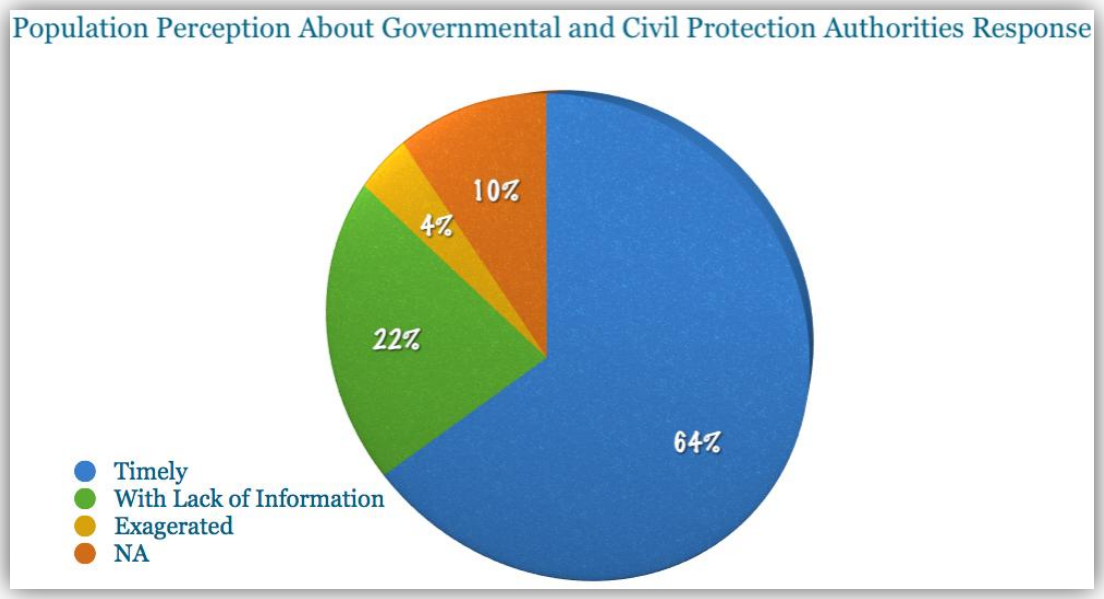

Figure 51 Population Percentage about Governmental and Civil Protection authorities Response [63]

Meanwhile, Figure 51 illustrates the perception about the government and civil protection authorities response, which the majority of the public has given a positive feedback. Finally, Figure 54 clearly shows that instructions and orientation given by the SINAPROC and CENAPRED were not understood, this communication failure might be attributed to the poor education level of people living in risky zones (rural areas). [63]

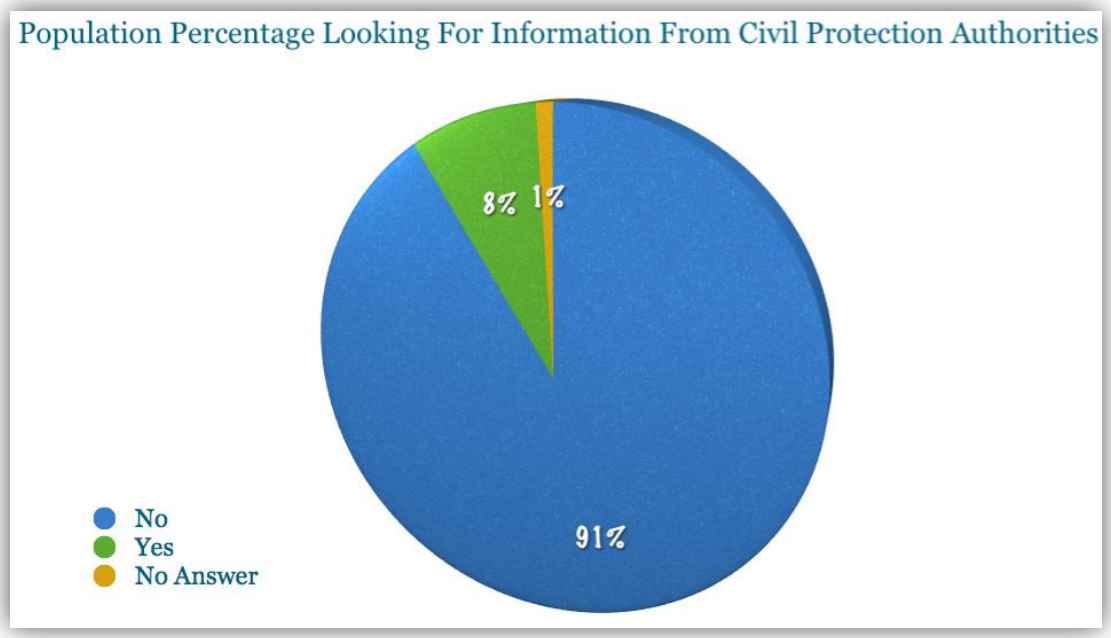

Figure 52 Population Percentage Looking for Information from Civil Protection authorities [63]

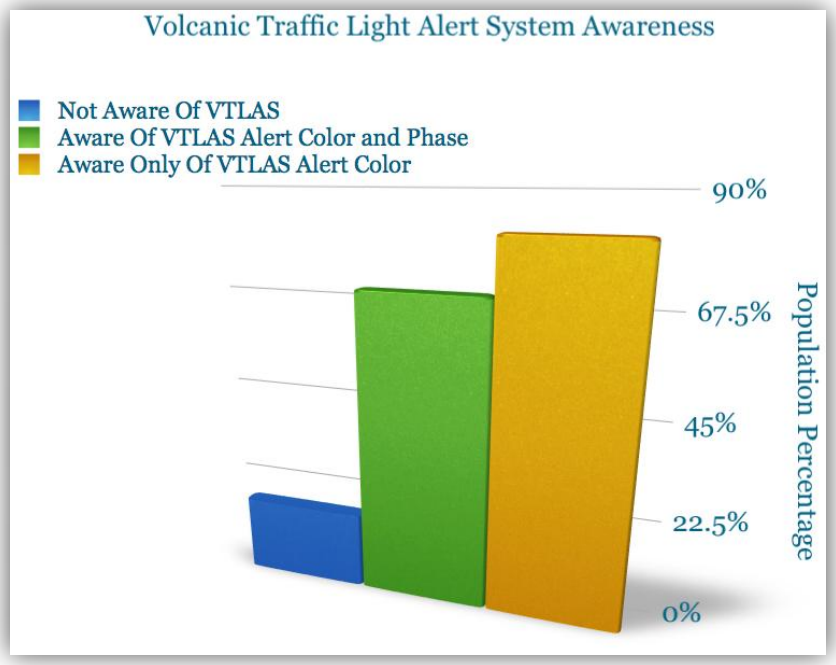

Figure 53 Volcanic Traffic Alert System Awareness [63]

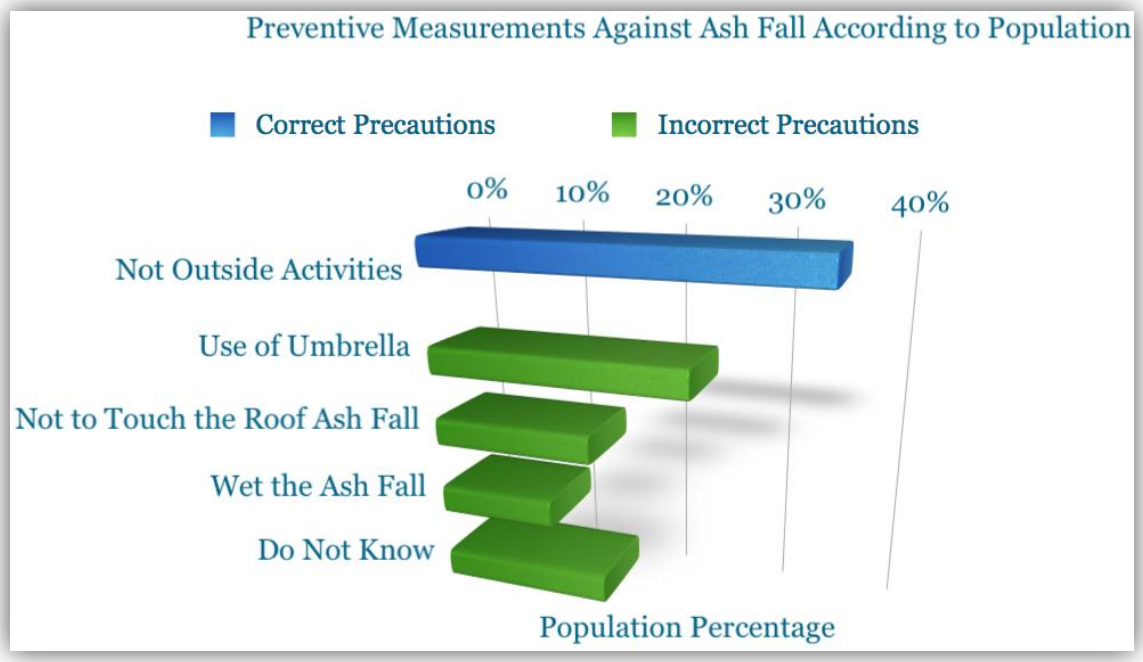

Figure 54 Preventive Measurements against Ash Fall According to Population [63]

However, most of the information sharing between government and public happened indirectly through the mass media. Basically, the government and the mass media were communicating through face-to-face processes, and then use traditional media, for instance television, radio and newspaper, to inform the public. Below, the President of Mexico, Felipe Calderón Hinojosa, exhorts to reinforce this communication system.

"Maintain high level of attention to the official information, and in addition to the aid that mass media is providing us, I ask to them, to spread the official information." [60]

Information sharing through oral expression might also take place through peer-to-peer processes whose most basic function is to allow two people separated by large distances to talk to each other. The enabling for this communication process might occur by the use of devices such as telephone or two way radio. During the Popocatépetl's April 2012 occurrences, the Governor from State of Mexico, Eruviel Ávila Villegas, implemented, in addition to the permanent emergency number 060, an informative line for the sake of citizens' knowledge.

"As benefit of the population, the 060 number for emergency, in furtherance of orientation, also a phone line, 018007134147, so that people can request information and be informed about these eventualities." *[60]*

In the same way, "La Prensa" published, on an article dedicated to the Popocatépetl's most recent activity, the civil protection authorities contact information in the State of Morelos. For the sake of civil information, the article read as following, *"For information requests, please*

communicate to 017771000515 and 017771000517 of the IEPC Morelos, where trained personal will be taking care of the population inquiries". [63]

At last but not least, not to forget the communication protocol on the Popocatépetl monitoring system, manage by the CENAPRED, where auto dial messages are sent to particular phone lines, mobiles and pagers of the surveying team in order to analyze the irregular information. The analyzed information might be access by the public, in crisis phase as well as normal state, by means of a telephone mailbox with updated messages (POPOTEL, 5552051036 for Federal District and MCMA, and 018001235050 for the rest of the national territory) with 24 hrs service for information related to the Popocatépetl activity. [50]

4.6.3.2 Television and Radio (Point - to – Multipoint Communication)

According to the Open Society Foundation study, from the 95.5% of the Mexicans watching TV, an overwhelming majority, 96.3%, uses the television to follow the news. Namely, the annual survey for consumption means, performed by "Reforma" newspaper, claimed that in the case of the TV and radio, the news programs are preferred by the population with a 49.5% and 48.6% respectively. Despite that, the penetration of new Information and Communication Technologies (ICTs) has modified to a certain extent the habits of consumption between the public, in the sense that ICTs have diversified the means for information sharing. In particular, the mobiles/smartphone are revolutionizing the way audio-visual content is consumed. Yet, with an immature internet penetration, Mexico still orients its preferences towards traditional media, as the main sources for news consulting whose experience in broadcasting is outstanding as stated by Roberto Quaas Weppen, CENAPRED Director. [60] and [62]

"Popocatépetl's exhalations are being transmitted towards the population by the mass media with authority."[60]

The Popocatépetl broadcasting by mass media included government and civil protection authorities speeches, interviews, press conferences, meetings, as well as army's preventive actions video recordings. For instance, the broadcast of a virtual simulation, that is to say a simulation where public does not participate, which was performed by the SEDENA in conjunction with the government and civil protection authorities in the State of Puebla in the nearest towns to the Popocatépetl, San Nicolás de los Ranchos, Santiago Xalitzintla and San Pedro Benito Juárez, and in the State of Morelos in Tetela del Volcán. The intention was to precise the logistics and to measure the evacuation time, in the face of a contingency. Interestingly, it can be noticed by the broadcasted declarations of civil protection authorities and government, hereunder summarized, in comparison with the broadcasted public interviews that there was a clear communication failure between these 3 stakeholders. According to Cadena Tres (News Channel) at least in Tetela del Volcán, the virtual simulation was not notified to the population, as consequence, it caused uncertainty by the speculation of a real evacuation. [64]

"It has been determined to perform a virtual simulation, it is important to highlight that we are not going to mobilize people, the population has been warned so they do not fear, so that they do not fright by these activities that have been doing, because finally it is a simulation without people" by Basilio Miranda, IEPC Morelos. [64]

"In order to achieve a successful evacuation, three virtual simulations had been carried out, where the population have been informed. In any case, for a real evacuation, the bells of the church would ring and the evacuation issued would be broadcasted by the mass media" by a civil protection authority from State of Puebla. [63]

"I consider virtual simulation an asset with an effectiveness of 100%, indeed, for that reason the simulations are carried, as far as I know, the simulations are not new development, they are carried out periodically" by Marco Antonio Barron, General of the 25th Military Zone. [65]

As mentioned before, the initial governmental response focused on communication messages from the government and civil protection authorities by means of the mass media. Thus, the mass media acted as an indirect link between the government and public. As well known among the national territory, and also declared by the Open Society Foundation study, the national television market in Mexico is extremely centralized and concentrated, TV Azteca and Televisa duopoly is overwhelming. [62] The Popocatépetl broadcasting by these two great partnerships in the television market, not only included the government and civil protection authorities messages and response actions, but also real time videos about the volcano activity. Not to forget, as introduced on Chapter 4.5 Monitoring and Communication Protocol, Televisa donated the video camera station at the Altzomoni hill, for the aim of ensuring first-hand news about the Popocatépetl behavior. "La Prensa" reported that "the television network transmitted images of apparent rocks and incandescent gases that flowed near the crater". [63] Concluding, the shared interests among the government, civil protection authorities and mass media facilitate information sharing, which in consequence, benefits the communication process civil populace.

Besides the TV broadcasting, in the Valley of Mexico, in average, 10 million people listen to radio in a normal day. In other words, the Federal District and the eastern part of State of Mexico are the main market for the radio in the national territory, becoming a significant mean for broadcasting the Popocatépetl crisis. The Open Society Foundation reports the following radio preferences among the Mexican people. The majority tunes the FM frequency, and only 22% listen to the AM stations. News programming has an important ranking between the public preferences, positioned in the second best place, only after the pop music programming. The highest rating news programming are those broadcasted during the morning, listened at home, followed by the nocturne schedule, listened at work or while driving. [62] Considering, that in Mexico many TV journalist broadcast as well in radio stations, it can be deduced that the information reported by the radio during the Popocatépetl crisis was for the most part the same as the information shared by the TV network.

4.6.3.3 Newspapers/Printed Means

Due to the geographic coverage, penetration and socioeconomic factors, Mexico does not count with a real national press. Therefore, newspapers exist with broad circulation, low index of readers and solids revenue levels due to publicity, as stated by the Open Society Foundation study. To put it differently, Mexico is a country with many newspapers, but few readers. This same study shows that between newspapers, "La Prensa" and "La Reforma" have the greater paid circulation, with around 244,200 and 146,300 units respectively. Furthermore, the most popular subjects in Mexican newspapers are, in sequence of importance, sports, the local news of crime, news, spectacles and news of political character. [62] Likewise as the television and radio, the newspaper serves as a bridge for the government and civil protection authorities with the public for communication purposes, in essence, the newspaper reinforces the same given information by the television and radio media, such as government official notices, actions taken by the SEDENA, preventive measurements recommended by the SINAPROC and the CENAPRED, the VTLAS status, etc. Below, examples of informative measurements are shown from the government to the public, for the sake of adversity mitigation, in the face of a contingency.

"In the next days, Mr. President, we will engage ourselves, the Secretary of Public Safety, here present, and the IEPC Mexico Director, to turn in to the people these evacuation routes pamphlets, so people have in detail where to go" by Eruviel Ávila Villegas, Governor of State of Mexico. [60]

"The government of the State (Puebla) also turned in pamphlets to the municipal authorities of the different localities, so that these pamphlets orient as well the inhabitants about the steps that they must follow in case of a contingency" by a "El Periodico Digital" (Internet TV Channel and Newspaper) TV Journalist. [65]

4.6.4 Information and Communication Technologies Usage in April 2012 Occurrences

As stated in Chapter 4.6.3 Traditional Media Influence on April 2012 Occurrences, in the last years, the principal sources of information have remained among the traditional media, few changes have taken place on the diversity of the most popular sources for information searching. The primary reason for this fact is that in Mexico the use of internet and ICTs continues to be low. Nevertheless, internet is one of the fastest growing markets in the country. The Study of Habits of Internet Users in Mexico 2012, performed by the Open Society Foundation, claimed that the number of internet users in Mexico is of 34.9% meaning 40.6 million people, showing a growth of 14% from previous year as shown in Figure 55. [66] The amount of news and information sharing in these platforms has increased considerably, mainly through the social networks. [62] The annually report of the Internet Mexican Association (Asociación Mexicana de Internet, AMIPCI) revealed that from the total surveyed people, 92% access a social network, the other 8% that do not participate in these online communities have for reason the lack of interest,

data protection, not to have time or know how it works, and to have canceled the account (Figure 56 and 57). [68]

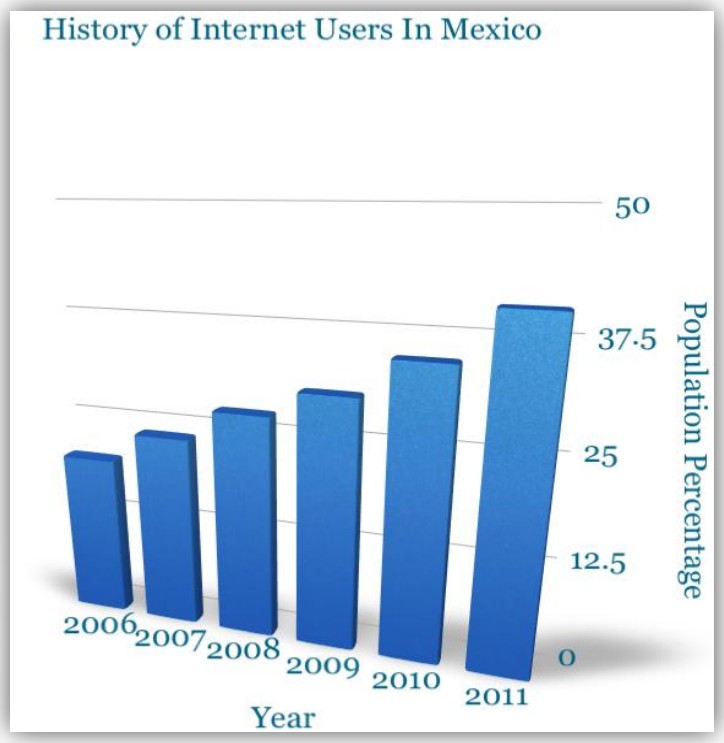

Figure 55 History of Internet Users in Mexico [67]

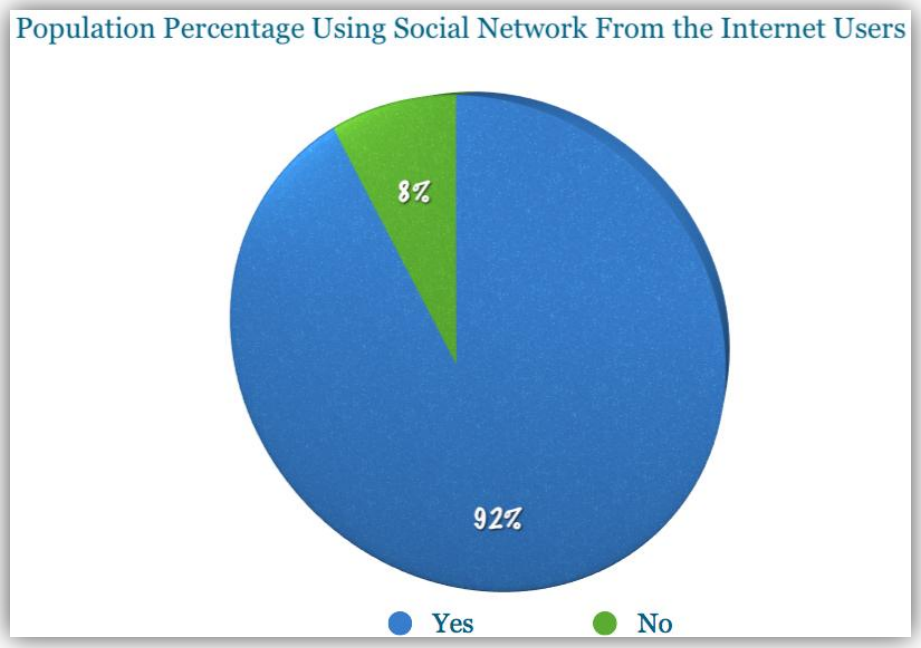

Figure 56 Population Percentage Using Social Network from the Internet Users [67]

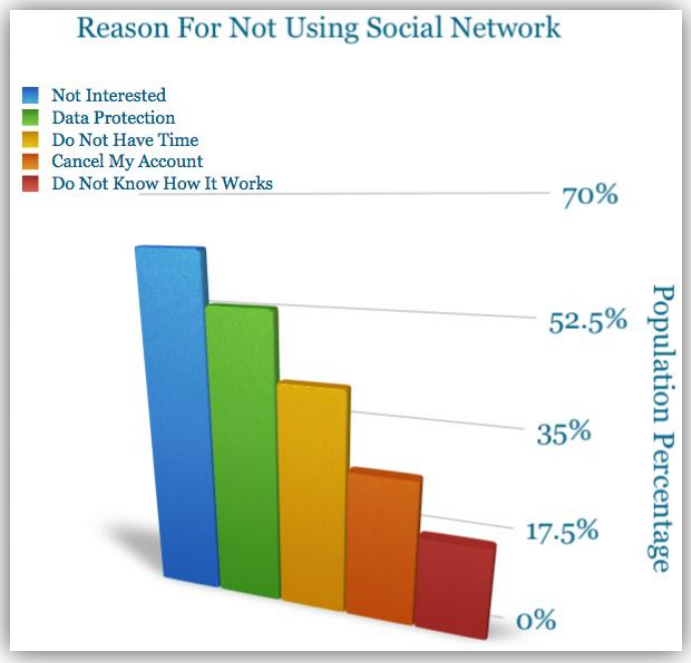

Figure 57 Reason for Not using Social Network

From the social network users, 19% are members for at least 1 year ago and 65% are members for more than 3 years ago as represented in Figure 58. In average, the Mexican population is subscribed to 4 social networks. Finally, Figure 59 displays the most popular social networks in Mexico, to be discussed further on, being Facebook with 90%, YouTube with 60%, Twitter with 55% and Google+ with 34%. [68]

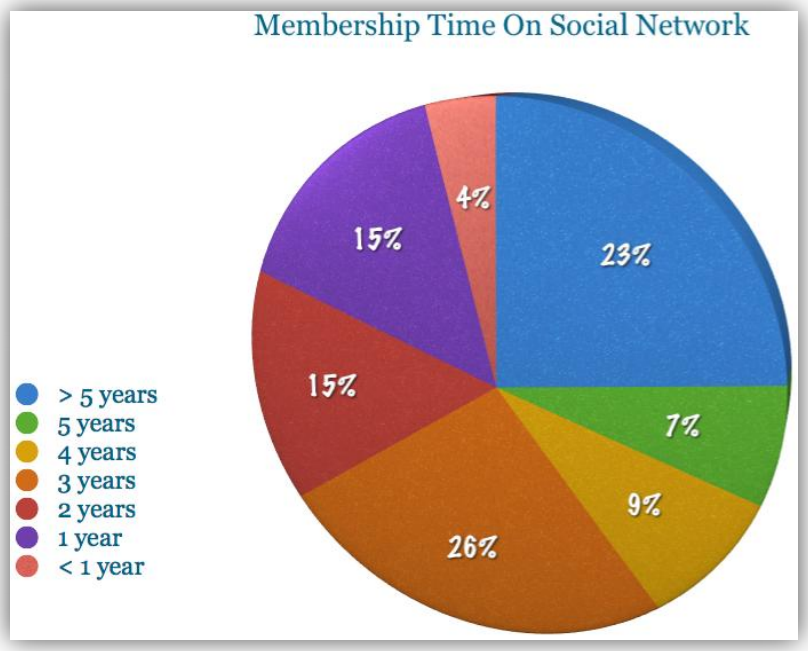

Figure 58 Membership Time on Social Network [67]

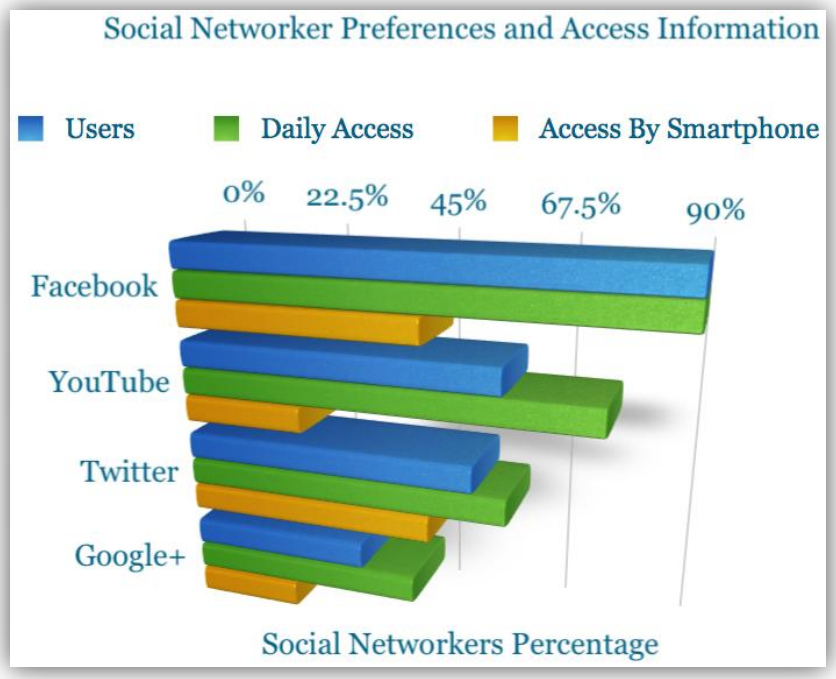

Figure 59 Social Networker Preferences and Access Information [67]

4.6.4.1 Mobile / Smartphone / Tablet

In Mexico the estimated mobile connections in 2011 were of 94.6 million, such information was calculated by the Federal Commission of Telecommunications (COFETEL). Furthermore, 42.6 million of those mobile connections were concentrated in Federal District with 21.3 million connections, and the states of Jalisco with 6.9 million connections, Veracruz with 5.6 million connections, Nuevo Leon with 4.7 million connections, and Puebla with 4.1 million connections. eMarketer predicted that mobile connections in Mexico will reach 98 million in 2012, making it the second largest market in Latin America, positioned just after Brazil. Being that, it can be noticed that the internet is not the only outstanding market in Mexico, the smartphone and tablet supporting internet expansion have a penetration rate of 45% and 16% respectively, outpacing the US (44% and 14% respectively) and Canada (28% and 12% respectively) (December 2011 global study by Universal McCann, "The Business of Social: Social Media Tracker 2012"). However, early adopters in Mexico can be assumed to be some of the highest earners in the country. [66]

Under those circumstances, for this case study, it is crucial to have in mind that most of the exposed towns are rural areas, and as contrary as Federal District and State of Puebla, the rest of State of Mexico and the State of Morelos posses limit technology penetration. Interestingly, the portable devices have made that internet becomes more accessible, and so an increasing use of the net. [69] This close relationship between internet accessibility and portable devices shows that mobile phones, tablets and other non-computers connected devices represent 58%, 28% and 14% of Mexico's mobile internet traffic, respectively. Nevertheless, in Mexico in 2012, Wi-Fi hotspot

usage in urban areas is driving smartphone uptake and mobile internet traffic, but not necessarily mobile broadband adoption. As a matter fact, the rural smartphone users, especially second-hand devices owners who have no credit cards or cannot afford a data plan, use Wi-Fi hotspots networks to access the internet, primarily via smartphone. [66] In short, the social network popularity is not the only factor to caused that more people feel attracted by the virtual environment, likewise, Fernando Gutiérrez, Director of the Communication Department of the Technological Institute of Superiors Studies of Monterrey (Instituto Tecnológico de Estudios Superiores de Monterrey, ITESM), explains as following that social networks are not the unique reason that impels the growth of these platforms. [68]

"Nowadays, a considerable increase in the use of portable devices exists which allows the access to Internet, in the face of this, the telecommunication companies are reacting by emphasizing the data services offers as their market strategy, which facilitates the use of social networks." [68]

4.6.4.2 Internet /Google

From the previous Chapters and sections, it can be extracted that even-though in Mexico the use of internet and ICTs is still low, the penetration rates for these platforms is growing exponentially, thus modifying and diversifying the habits of consumption between the public. Nowadays, the search pages and social networks are the sources where internet users usually search for information among the net. [69] President of Mexico, Felipe Calderón Hinojosa, since the beginning of his term, has strongly promoted the use of internet and ICTs as a communication bridge between the government and civil protection authorities with the public. During the Popocatépetl's April 2012 occurrences, a pronounced use of new media by the government was conceived (Figures 60). The governmental initial response focused on communication messages from the government and civil protection authorities by means of not only the mass media, but also the new media. Hence, the new media in the same way as the mass media acted as an indirect link between the government and public. For instances, the Evaluation Meeting for the Occasion of the Change of the VTLAS was also accessible through the Mexican Republic governmental page. The President of Mexico exhorted to reinforce the new media communication with the following meeting closure statement (scene captured and transmitted by the traditional and new media).

"I give some internet pages where people might, as well, follow this information: www.cenapred.gob.mx, CENAPRED. Also, www.proteccioncivil.gob.mx. Both sites might be access from the governmental official page: www.segob.gob.mx. In addition, the CENAPRED homepage might additionally access from the UNAM homepage, which is: www.cenapred.unam.mx. Then, let's take those precautions; we will continue informing through the Minister of Internal Affairs official page."[60]

Figure 60 Minister of Internal Affairs Homepage [60]

Follow us at: YouTube, Facebook, Twitter, RSS (Rich Site Summary) and Flickr

By the same token, the CENAPRED analyzed information related to the Popocatépetl activity might be access by the public, in crisis phase as well as normal state, by means of an e-mail mailbox for messages (POPO e-mail), and daily reports publish on the internet (CENAPRED homepage). [50] For instance, "La Prensa" on April 14th, 2012 on the Puebla City issued units, dedicated an article to the Popocatépetl's most recent activity stating the following. [63]

"The ash rains, that even continued falling this morning, are product of the Popocatépetl train exhalations, according to the CENAPRED data, published on its homepage, where it informed that the volcano registered yesterday night and today dawn at least 11 exhalations lasting around 4 hours and 20 minutes. Through its official page, the Minister of Internal Affairs informed on the monitoring, that is being performed altogether with the UNAM." [63]

In essence, the new media not only reinforces the information broadcasted by traditional media, but it revolutionizes the journalist broadcasting. Especially in recent years, the effectively distributed informative messages by the new media have been denominated as modern journalism. In turn, competition between information providers and diversity of the most popular sources for information searching have increased. Finally, creating, modifying and expanding to a certain extent the new platforms for information sharing between the public.

4.6.4.3 Social Network: YouTube

As previously noticed from Figure 59, YouTube penetration in Mexico is of 60%, clearly consistence with ComScore indicating that Mexican people have *"an evident appetite for multimedia activities, especially the video"*. Statistically speaking, Mexico is placed below Canada and the United Kingdom with respect to the population percentage visiting YouTube. In December 2012, the Garritz Online Media and ComScore report "Online Video Consumption Study, Mexico 2012" found that 86% of online video viewers watched video on YouTube. Overall, in Mexico the video advertising and video consumption through social media are particularly interesting areas of engagement. [66]

As far as YouTube concerns, the search results about the Popocatépetl listed videos from national and international broadcasted news, documentaries about the Popocatépetl, public occurrences etc. Most of the national TV News Network were uploaded directly from the TV Azteca and Televisa YouTube Channel, broadcasted, as described in Chapter 4.6.3.4 Television and Radio (Point-to-Multipoint Communication) issues related to the governmental official notices, public but mainly governmental interviews, actions taken and instructions given by the government and civil protection authorities, actual warning and alerting system, tour to exposed areas, etc. While the international TV News Network, discussed a more general background such as, the Popocatépetl history and description, governmental response, public and local authorities interviews etc. Most important for this Case Study, the public uploaded videos showed real time videos about the Popocatépetl activity. For instance, the April 13th, 2012 listened roar of the Popocatépetl explosion (video firstly uploaded in YouTube, but also transmitted nationally through the traditional and new media), mentioned on Chapter 4.6.1 April 2012 Occurrences Chronology. Another example is a video uploaded in YouTube, where an excursionist group tried to climb until the Popocatépetl's crater (some of them were extremely close to the crater already), when suddenly the Popocatépetl erupted, throwing an impressive amount of huge incandescent blocks. [70] To close up, a closer look at these last YouTube developments, clearly showing that the information sharing did not start through governmental authorities by means of traditional or new media, but through the public by means of social media, later broadcasted by the traditional and new media.

Figure 61 Public Appears as Producers of Information

Now, we broadcast the news! (Televisa and TV Azteca vs. Facebook, Twitter and YouTube)

4.6.4.4 Social Network: Twitter

In particular, the social networks in addition of its communicative, socializing and entertainment purposes, have turned into an informative source that internet users utilize the most, just after searching pages. [69] In the case of Twitter, the "Vanguardia" newspaper published that in only a year, the number of members went from 4.1 million accounts to 10.7 million accounts. Mexico being on the top 10 countries with the greater number of Twitter accounts, such as the United States, England Japan and Brazil. On top of that, Mexico is also positioned on top places in regards to volume of tweets. In the same article, "Vanguardia" interviewed Guillermo Pérezbolde, Digital Mind (Mente Digital) Director, who referred that although the official launch of Twitter was on March 2006, *"the boom occurred in 2009, that year our first study revealed that there were 40,000 accounts, the growth has been exponential since then, by 2010 the accounts rose to 140,000, and in 2011 the accounts jumped to 4.1 million"*. From these accounts, more than 50% are active, in other words, those users who have used their membership in the last 60 days. Pérezbolde called attention to the factors that have driven the growth of Twitter are the constant technological improvement, an increasing understanding on the part of the users and the importance that the media have shown for this new platform. [68] As previously declared, the President of Mexico, Felipe Calderón Hinojosa has strongly tendency to not only supporting, but also promoting the use of internet and ICTs in Mexico, mainly as a communication bridge between the government and civil protection authorities with the public. During the Popocatépetl's April 2012 occurrences, the President of Mexico was informing the public about the government official notices, actions taken by the SEDENA, preventive measurements recommended by the SINAPROC and the CENAPRED, the VTLAS status, etc by Twitter as exemplify below (Figure 62).

"In my case, we are going to try through the government social network accounts, I personally will ask to the SINAPROC to send me the warnings twits that are relevant for this emergency, so I will be able to re-twit them, even from my own account" by Felipe Calderón Hinojosa. [60]

Figure 62 Tweets by President of Mexico, Felipe Calderón Hinojosa

"I share with you the last CENAPRED report about the Popocatépetl activity".
"It is important to be calm. We are closely monitoring the Popocatépetl activity. I will be sharing information through my account".
"In case of evacuation, have prepared: important documents, battery radio, lantern, prescribed medicines".
"The population near the Popocatépetl must identify the Civil Protection Authorities, be aware and follow the recommendations".
"Slight increase on seismic and fumarolic activity of the volcano. Sporadic exhalations, tremor and gas plumes with ash. Incandescence".

Other results of the GlobalWebIndex study confirmed Twitter's relevance, where 44% of users in Mexico shared personal photos via Twitter (mainly through Instagram, making it another promising platform). [66] Another study of Guillermo Pérezbolde, "Twitter in Mexico", claimed that around 47% of the accounts are used through smartphone, which reflects the importance of this type of devices in the penetration of this platform. Pérezbolde called attention to the factors that have driven the growth of Twitter are the constant technological improvement, an increasing understanding on the part of the users and the importance that the means for communication have shown. [68] For instance, in order to follow the volcano activity, share information, photographies and event joke telling about the Popocatépetl, Twitter users created two accounts named "Don Goyo" and "Popocatépetl". As soon as the government revealed that the VTLAS have increased to Yellow Phase III, that Monday night on April 16th 2012, the social networks, in particular Twitter, shifted and increased the normal Twitter use in order to discuss about the volcano, more popular known as "El Popo". Hereunder, some of the tweets on that Monday night.

@rodorore: *"Don Goyo demands a human sacrifice, throw him a President candidate";* @LJEsmelin: *"Don Goyo is angry with so many tremors";*

@Thestupid_Lamb: *"It appears to me that the Popocatépetl already found out who are the President candidates…!"*

Singularly, it is interesting to call attention to the increased activity on Twitter caused by the change in the VTLAS, this fact emphasizes the shift that people gives to social media original purpose of communication, socializing and entertainment during normality for information sharing during crisis. Importantly, pay attention to the information being talked about, whenever people interact in ways that generates stories, twits can reach an audience beyond their users existing account. Even more important is to analyze the content from the information being shared, the above tweets for example, people are indeed talking and interactively sharing information but in which way? With which information content? Is it usable? Is it a reliable and constant source? Another example for quality in the information content being produced by public is here-following described, in Twitter from Thursday April 19th 2012, an image began to circulate as a spectacular picture that belonged to the Mexican volcano activity "Popocatepetl". Nevertheless, it was discover by the NASA page (www.nasa.gov) that it did not belong to "El Popo" but to Sarychev Peak volcano in northeast Japan (Figure 63). At the same time, Roberto Quaas Weppen, CENAPRED Director, insisted to the Puebla inhabitants to ignore rumors on a presumed Popocatépetl explosion. Finally and as expected by the government, the Secretary of the Interior, Alejandro Poiré Romero, urge to maintain high level of attention to the official information and to seek further instructions from authorities, in order to validate the given information about the threat and not to spread rumors avoiding panic.

Figure 63 Sarychev Peak

"Be aware of the official information issue in this respect (Popocatépetl), in case of any change in the VTLAS, the information will be generated by CENAPRED; such change will be emitted to

all civil protection authorities and all the tasks related with the population will be activated. It is very important to stay informed and be wary of rumors and speculations. Simply follow the instructions given by the authorities in this regard!" [60]

4.6.4.5 Social Network: Facebook

On the other hand, Facebook is currently leading the social landscape in the national territory with a 90% penetration. Mexico being the fifth country with the greater number of Facebook accounts, just below the United States with 166 million users, followed by Brazil with 58 million users, India with 55 million users, Indonesia with 47 million users and Mexico, that adds 38 million members in that social network. [66] and [71] Among the Mexican people, Facebook not only is the most used social network, but the Mexican Facebook members are highly engaged on this platform. According to the AMIPCI and Figure 59, 100% of Facebook users in Mexico access their account daily, while 48% does it several times a day, and a 46% access by means of smartphone. [67] Similarly to Twitter, Facebook represents an important platform where public follows the volcano activity, shares information, photographies and even jokes about the Popocatépetl through Facebook fan pages. The shared personal photos via Facebook also happens mainly through the Instagram application, confirming the promising future of this platform for emergency management information sharing, as already mentioned on Chapter 4.6.4.4 Social Network: Twitter. Equally as Twitter, the same issues concerning the shifted and increased activity to the normal Facebook use during crisis, the information content quality and reach, etc still exist for this platform. An interesting fact is that on the contrary as Twitter, the government does not take advantage and ignores the importance of this platform by not providing relevant information on their Facebook pages. Concluding, the penetration rates for Twitter and Facebook are growing exponentially, thus modifying and diversifying the habits of information sharing.

Nowadays, the social networks are sources where internet users often search or produce information, hence, representing a potential mean for communication during emergency crisis that cannot be ignored.

4.7 Conclusion

To conclude, during Popocatépetl's April 2012 Occurrences, it was noticed that the main mean for communication from the government and civil protection authorities to the public still is the traditional media, closely followed by the new media, but for the effects of this case study, more important by the social media. This tendency is the result of social and economical aspects, where the Popocatépetl exposed areas are still underdeveloped, with exception of the Federal District and State of Puebla, limiting the technological penetration. Nevertheless, internet is one of the fastest growing markets in the country, and interestingly, the leading reliable source for information, where search pages take the first position, followed by social networks and at last mass media. Special emphasis on the fact that public is no longer only an information consumer, but an information creator that shares knowledge. Having this in mind, social media users are the

new input that revolutionizes the information sharing between the government, civil protection authorities and the public itself. In other words social media is the community driven interactive variable into the new information sharing platforms during emergency communication processes. As last thought and having in mind the long ongoing volcano crisis, overall, it appears that the preventive alerting and educational communication between the respective authorities and public is primarily working, but in case of a contingency, would it really work? Has Mexico properly prepare according to the given instructions? Will Mexican people properly respond under the stress environment of crisis? Will the evolved communication fulfill the demands of such disaster?

5 CHAPTER: EVOLUTION OF EMERGENCY MANAGEMENT COMMUNICATION

5.1 Communication during Emergency

To begin with, the previous discussed case studies have shown the complexity of the communication during emergency crisis, which highlighted the multidisciplinary, multidimensional and evolving nature of this process. Calling attention to the importance of this type of conveyance, where government, civil protection authorities and public communicate with each other in order to protect civil life and property. Timely, necessary and appropriate information is crucial to safeguard the physical integrity, patrimony and tranquility of the population exposed to hazards. An effective communication between the main stakeholders (for this research, the government, civil protection authorities and public, not forgetting the media as intermediate source) must establish and maintain network relationships, consequently, achieving comfort level among the various actors. Moreover, a good communication during emergency crisis helps in a way that effectively supports emergency management, and develops trust between the stakeholders. In short, crisis communication is fundamental for crisis managers in order to mitigate destruction to buildings and infrastructure, casualties and much disruption to social, economical and political activities.

Furthermore, these case studies not only show the complexity of the evolving communication process during crisis, but emphasize the importance of being aware of the different hazards and their unique impacts, so proper communicative and action strategy plans might be designed. First of all, Mexico City Earthquake of 1985 was extreme events whose emergency preparedness was inexistent, and so government failed to produce an appropriate emergency response (please notice that the first institutional emergency management agency in Mexico was founded in 1986 as consequence of the lessons learned during this 1985 devastation). In other words, the absence of a monitoring and warning systems communication addressing the imminent threat halted the government to inform and prepare for the earthquake, to then act accordingly to mitigate the impact. On the other hand, the Popocatépetl ongoing crisis character cannot be ignored for the communicative and action strategy plans implementation. In the course of April 2012 Popocatépetl occurrences, the government and civil protection authorities have correctly enabled a hazard awareness program. The program sought to increase public concern by promoting appropriate protective behavior by those living in risky zones. However, the government and civil protection authorities needed the feedback from citizens, in spite of civil perception and understanding. For this singular event and as raised on Chapter 4 Popocatépetl, the Smoking Mountain, the questions still remain, has Mexico properly prepared according to the given instructions? Will Mexican people properly respond under the stress environment of crisis? Will the evolved communication fulfill the demands of such disaster? Lastly, the Tabasco and Chiapas Flood Incident of 2007 falls on the in between of these two communicative strategies, particularly for Mexico's annually floods, it is of the utmost importance to acknowledge that public attention

declines significantly as time passes. Basically, exposed population failed to implement protective actions because of their tendency to forget, and therefore, to misperceived the risk. To end up, the "Risk Perception and Communication" study concludes that:

> *"The dichotomy between imminent and long-term threats does not imply that two completely different theories are needed to guide risk communication. In fact, most of the same theoretical principles are relevant to both situations, so a single theoretical model can account for short-term warning response and long-term hazard adjustment. Nonetheless, each of these situations requires specific modifications of the overall model."*[72]

5.2 Stakeholders and Channels of Communication

As described in the case study chapters, the government, civil protection authorities and public were chosen as the main actors, whose communication evolution has been analyzed. Formerly, emergency communication should be an information sharing process about concerning issues between the stakeholders, in which feedback is needed for deducing the communicative processes efficiency among the audience. As found from the case studies, the audience often reported back whether the message sent was understandable or not, or explained whether the message sent satisfied their information needs or not. For the sake of this interactive information sharing, the roles of information source, channels or intermediate sources by which the information is broadcasted and the individual differences among message receivers cannot be ignored. On this respect, the "Risk Perception and Communication" study exemplifies:

> *"Receivers differ in their perceptions of source credibility, access to communication channels, prior beliefs about hazards and protective actions, ability to understand and remember message content... The affects of a message on a receiver include attention, comprehension, acceptance, retention, and behavioral change."* [72]

Therefore, giving prominence to the fact that public shapes the information sharing process, that is to say, the selection of a given channel is determined by the public accessibility and preference for it; also, the amount of feedback is determined by the public willingness and ability to provide it. Reason for which in Chapter 5.3.1 Comparison Between Case Studies Evolving Communication, the public interrelationships with the government and civil protection authorities will be discussed further than interagency connections such as Authorities/Authorities, Authorities/Government and Government/Government. Table 14 illustrates the different actors among the main stakeholders in a detail form. With respect to the public, three main categories were noticed, Affected, Not-Affected Public and citizens who helped on the emergency respond, which were denominated as Unofficial Public Volunteers. Point out that Unofficial Public Volunteers do not exist so far for the Popocatépetl crisis, it might have to do with the fact that no main impact has happened. In the case of the authorities, seven main categories were extracted, International and National NGOs, Lifelines and Private Companies, Official Volunteers, Police

and Fire-Fighters. Please notice that the SINAPROC and CENAPRED were found after the 1985 Mexico City Earthquake, as consequence, their presence is not taken into account for such event. Finally, the government has five main categories, federal and municipal government, army, foreign governments and public institutions. The absence of state government in the 1985 event might have been caused by the fact that the Federal District as administrative division manage all the nation-wide resources, and so no further help might have been needed.

Table 14 Stakeholders by Case Studies

Stakeholders / Event	Public	CP Authorities	Government
Mexico City Earthquake 1985	Affected Public, Not Affected Public and Unofficial Public Volunteers	International and National NGOs, Lifelines and Private Companies, Official Volunteers, Police and Fire Fighters	Federal (DDF) and Municipal (Delegations) Government, Army, Foreign Governments and Public Institutions
Tabasco/Chiapas Flood 2007	Affected Public, Not Affected Public and Unofficial Public Volunteers	SINAPROC, CENAPRED, International and National NGOs, Lifelines and Private Companies, Official Volunteers, Police and Fire Fighters	Federal, State and Municipal Government, Army, Foreign Governments and Public Institutions
Popocatépetl Volcano Crisis 2012	Affected Public and Not Affected Public	SINAPROC, CENAPRED, International and National NGOs, Lifelines and Private Companies, Official Volunteers, Police and Fire Fighters	Federal, State and Municipal Government, Army, Foreign Governments and Public Institutions

With respect to the available channels by which the emergency information is broadcasted include face-to-face, peer-to-peer, traditional media, new media and social media. In detailed, face-to-face communication encompasses interactions through personal conversations and public meetings, for instance, informal conversations, speeches, interviews, press conferences, meetings, surveys etc. peer-to-peer communication encompasses devices that allow two people, separated by large distances, to talk to each other such as telephone or two way radio. Traditional media communication refers to television, radio and print media such as newspapers, magazines, pamphlets or brochures, signage etc. new media communication comprises smartphone and internet use like home pages, search pages and e-mail. Social media communication includes platforms for interactive dialog such as Facebook, YouTube and Twitter. Briefly, the distinctions among these information channels are important because they differ in the ways they accommodate the information processing activities of receivers.

5.3 Case Studies Data Analysis by Classical Persuasion Model

For the sake of the evolution of emergency management communication analysis, the Lasswell (1948) communication model, named Classical Persuasion Model, was implemented to the case studies with modifications that are described below. According to Lasswell, all communication should be analyzed in terms of who (Source), says what (Message), via what medium (Channel), to whom (Receiver), and at what kind of change (Effect). The modification goes as following, the case studies emergency communication were analyzed in terms of who (Information Producer, Stakeholder), says what (Message Content), through what communication mean (Information Channel/Intermediate Source), to whom (Information Consumer, Stakeholder), at what time (Emergency Stage), and in which kind of crisis (Scenario). According to McGuire (1985) in the "Risk Perception and Communication" study:

> *"Messages vary in their content, especially the information about a hazard, impact characteristics (eg., magnitude, location, and time of impact), potential personal consequences (e.g., likelihood of casualties, property damage, and social disruption), alternative protective actions (e.g., evacuation, sheltering in-place), and the attributes of those protective actions (e.g., efficacy, safety, cost, and requirements for time and effort, knowledge and skill, tools and equipment, and cooperation from others)."* [72]

Again, the modification as far as messages' content goes as following, information about emergency preparedness (e.g., planning, warning and alerting systems), direct consequences (e.g., magnitude, location, time of impact, casualties, property damage), operational processes (e.g., evacuation, sheltering in-place, requirements for time and effort, knowledge and skill, cooperation from others), resources management (e.g., cost, tools and equipment), and relief or crisis information (e.g., social disruption, efficacy, safety). With the respect to the scenario, for the sake of the case studies comparison, the scenarios focus on similar communication asset and failure consequences posed by these three events. Thinking in term of these common scenarios is more helpful to perceive the evolution of emergency management communication through time, the case studies chronology. For example, the monitoring, warning and alerting systems implementation, to begin with, in 1985 Mexico City Earthquake these systems were inexistent; while for the 2007 Tabasco and Chiapas Flood, the uncertainty of these systems prevented the government and civil protection authorities from releasing a proper alert about the possible severity of the event; lastly for the Popocatépetl crisis, the complex operating surveying system enabled the government and civil protection authorities to be timely warned, and so issued an opportune alert to the public. To conclude this example, Table 15 illustrates the built up analysis according to the developed Emergency Communication Model (modified Classical Persuasion Model) explained above. The complete analysis of all three case studies is displayed in Appendix A: Tables of Emergency Communication Analysis by the Modified Classical Persuasion Model (Lasswell).

Table 15 Alerting Between Governmental and Public

Public/Government	Trad. Media					
		Emergency Preparedness		-		Lack Of Alerts
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
						Broadcasting Information Without Filtering
		Operational Processes		NA	NA	President Speech For Governmental Aid Activation
						Instructions And Orientation By Authorities
		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Reporting Relief Information When Government Failed To
						Spreading Rumors Or Misleading Messages

1985 Mexico City Earthquake

Public/Government	Trad. Media					
		Emergency Preparedness				Delay Alert Without Emphasizing The Severity
		Direct Consequences				Functioning Mass Media Transmissions
		Operational Processes				President Speech For Governmental Aid Activation
						Instructions And Orientation By Government
		Resource Management				Reporting Request For Resources And Needs
		Relief Information				Governor Official Notices
						Reporting Relief Information
						Functioning Mass Media Transmissions
						International News Broadcasting

2007 Tabasco and Chiapas Flood

Public/Government	Trad. Media					
		Emergency Preparedness			?	Instructions and Orientation by Government For Evacua
					?	Alerting System (VTLAS) Status
		Direct Consequences			?	Increasing Alert System (VTLAS) Status
					?	Broadcasting About Volcano Crisis
		Operational Processes			?	Instructions and Orientation by Government In Case of
					?	Implementation of the Popocatépetl Operative Plan (fro
					?	Virtual Simulation For Evacuation
					?	Encouraging Volunteering Work
		Resource Management	-	-	?	
		Crisis Information			?	Urging People to Be Aware of Official Information
					?	Reporting Contact Information
					?	Mass Media Still Fundamental For Information Sharing
					?	Contradictorily Declarations
					?	Confirming Uploaded Public Information
					?	International Broadcasting
					?	President Speech and Governors Notices About the Volc

2012 Popocatépetl Crisis

5.3.1 Comparison between the Case Studies Evolving Communication

After applying the Classical Persuasion Model from Lasswell on the case studies for the sake of analyzing, comparison was made between the different stakeholders' communication processes during the events in order to follow their evolution in time and space. To conclude, the found conceptions are categorically summarized in the following sections.

5.3.1.1 Face-to-Face Communication (Between Public and Public)

There is a clear evolution, observed through the case studies, regarding to emergency preparedness communication between the public. In the first case, 1985 Mexico City Earthquake, as no earthquake monitoring or warning systems existed; there was no alerting communication to notify the government, civil protection authorities or public from such event. In 2007 Tabasco and Chiapas Inundation, it was observed that the stakeholders didn't learn from previous events, public still hopes that great floods would not arrive again which can be related to the low level of education in rural areas. As stated before, people tend to forget previous devastations caused by floods, giving a fake sense of relief in peaceful periods and so a flood risk misperception. While for the Popocatépetl, as an always present ongoing crisis preventing people to forget, there is a volcano risk awareness which is always on topic. Namely, as the active volcano comprises the landscape, the thought of readiness for a contingency is implemented in the people's mind which provokes continuous discussions and learning processes.

Starting from the 1985 incident, the importance of interpersonal communication was remarkably pronounced, especially between the population, therefore, becoming a fundamental way for information sharing during the emergency crisis. Due to the earthquake's great destruction and the decentralized communication, communal disorder was formed between the population leading to the fact that people didn't know what to do or where to go. Similarly, in the case of the 2007 Flood happening, a strong interpersonal communication was observed due to the flood extension in poor areas. On one hand, the Mexican people have great solidarity, empathy and national feelings which facilitated the communication processes through unofficial volunteer works. The sympathetic crowds were helping each other as much as they could; interestingly, the help not only included family members and friends but also strangers in need. On the other hand, due to the high level of poverty and unsatisfied essential needs, such as potable water; looting and confrontation happened during the aid distribution causing mistrustful attitude between the population. While for the April 2012 Popocatépetl occurrences, the population, who has grown up through generations at volcano's edge, was always talking about the Popocatépetl and Iztaccíhuatl legends as well as the past and current happenings of the mountain. Thus, it can be concluded that, even if sometimes as shown in the Tabasco and Chiapas Flood, face-to-face communication is conflicting, human discussions will be always the prior way of building connections and pass on the flowing information.

5.3.1.2 Face-to-Face Communication (Between Public and CP Authorities)

After the 1985 Mexico City Earthquake's impact, authorities failed to provide proper information to the public due to the decentralized communications, which also leaded to aid and supplies mis-coordination, halting the fulfillment of the public need. However, interpersonally information sharing was still essential to known the operational activities and to comprehend each other in order to cooperate together. For the case of the 2007 Tabasco and Chiapas Flood, decentralization disappeared enabling a better interagency organization, which resulted in a highly improved field communication, also between authorities and public. Still, sometimes authorities failed to make available enough information or to collect needs requests, since the civil protection authorities were also experiencing proper information misses due to the impenetrable dimension of the flooding. Moreover, the order that aid distribution has to be performed by authorities, omitting the volunteer work from this process give rise to untrustworthiness from public to authorities with relation to equal aid distribution. As an observation about the evolution of the communication between authorities and public, it can be mentioned that during the Popocatépetl crisis, civil protection authorities gave instructions and orientation in case of contingency for the population to be protected and prepared. In addition, surveys were carried out in order to understand people's awareness about the risk and perception about the government and civil protection authorities actions. To put it differently, the surveys were meant for evaluating if people comprehend or not the sent informative messages; from this feedback acquisition data was collected with the purpose of implementing necessary improvements to prevent public misinterpretation. Noticeable, authorities were paying more attention to the communication process with the public than in previous events, nevertheless, while performing a virtual simulation the civil protection authorities still failed on the information notification to citizens.

5.3.1.3 Face-to-Face Communication (Between Public and Government)

Interpersonal connection between the government and the public is important from the governmental interest in order to ensure the political power and keep public reliance. For the 1985 Mexico City Earthquake governmental response, the President of Mexico, Miguel de la Madrid Hurtado, was touring the damaged zones to manifest provision and to assess the seriousness of the catastrophe. During the Tabasco-Chiapas Flood and April 2012 Popocatépetl occurrences, Felipe Calderón Hinojosa ruled the nation as President of Mexico and who is limited to a single six-year term, called a sexenio, banning re-election. On emergency manager respect, Felipe Calderón Hinojosa managed several destructive events, being the Tabasco-Chiapas Flood and the Popocatépetl crisis the most distinctive, and inevitably learning from these previous experiences. Felipe Calderón Hinojosa also toured the disasters' affected areas and risky zones, respectively, for both incidents. In essence, the current President of Mexico accompanied by other federal, state and municipal governors were taking care of public needs in an increasingly developed way, the experienced catastrophes assisted the evolution for a definite and centralized response for the sake of such eventualities.

On the other hand, the army's aid implementation was different in the case studies. During the 1985 Mexico City Earthquake aftermath, the first response actions were erroneously applied to the hazard impact and its unique consequences, and therefore unsuccessful, mainly because the DN-E-III Plan was designed for rural areas and not for urban areas such as Mexico City. Consequently, the governmental leaders understood the project's failure, and so the army's role was switched onto security aims. However, communication issues still existed between the army and the public, data management about missing people were not being properly shared due to strong governmental restrictions, thus many people were impeded from finding information about relatives. With respect to 2007 Tabasco and Chiapas Flood, the army's operational activities were evaluated as sufficient by the public, this might have to do with the correct DN-E-III Plan implementation in a rural area and the government special care for missing people information provision. The government make use of ICT devices for the missing people information sharing, where trained personnel was available for the sake of the population guidance in the use of the digital lists. Finally, in 2012 Popocatépetl crisis, from the increased alert, census surveys were made on the population to have up-to-date data and avoid later appearing problems in case of a contingency. Proper planning progressively develops communication processes.

5.3.1.4 Peer-to-Peer Communication (Between Public and Public)

The telecommunication infrastructure failure largely affected the national and international peer-to-peer communication processes for information exchange. For example, during the 1985 Earthquake and 2007 Flood first instances, the communication devices were not working which hampered the connectivity between friends and families, and also to organize any activities or aid. While during the Popocatépetl crisis, various technological devices for peer-to-peer communication were widely available and used, basically sharing the same information that was identified previously in face-to-face communication between citizens.

The peer-to-peer emergency communication has had an outstanding evolution due to the increase of ICT penetration in the country. In 1985 Mexico City Earthquake, fixed telephone lines were the most essential means for communication with relatives inside and outside the country, later, with the highly increased mobile lines penetration, new methodology appeared and became extremely widespread. For the 2007 Tabasco and Chiapas Flood, due to the Mexican geography which is vastly populated by mountains and makes more expensive and difficult to place-in the landlines infrastructure, mobile phones quickly overshadowed the use of these non-portable devices. Nowadays, the Telecommunication Companies have increased the accessibility and availability of the mobile phone service, also for rural areas, thus currently turning out to be the most common peer-to-peer communication between friends and families. For the Popocatépetl crisis, the use of mobiles continued to grow even more with the introduction of internet, expanding the possibilities for communication. In short, the use of ICTs affected the means for communications, nevertheless and especially in emergency conditions, the knowing a relatives' well-being will always be the primary and most important information shared among public.

Moreover and as illustrated on the case studies chapters through examples, the peer-to-peer communication used on the unofficial volunteer work started to grow and became more organized, comparing to the 1985 Earthquake, in order to perform operational activities in rescuing. In addition in the Popocatépetl crisis, the government promoted volunteer work, nonetheless no main feedback from public was obtained; such circumstance might have to do with the fact that the Popocatépetl have not produce a main eruption. Mainly, it can be observed that the community has more power and participation in information sharing, transforming the public into a promising information producer and consumer that must be used to improve the emergency response in a future crisis.

5.3.1.5 Peer-to-Peer Communication (Between Public and CP Authorities)

Please note that the telecommunication infrastructure breakdown affected the emergency operations on the 1985 and 2007 tragedies. In the 1985 event, it was mainly caused due to physical damage (building collapses), while in 2007 due to the lifelines supply failure (power shortage). As about previously mentioned about the hazards' unique consequence, the kind of failure present in these events depended on the type of disaster, independently of the efficiency on the telecommunication reinstallation, planned resilience according to the most probable risk can prevent the infrastructure breakdown from happening. Furthermore, in addition to the permanent emergency number in 1985 Mexico City Earthquake, a new informative line was established in order to assist information providing to the public. At that time, the government and civil protection authorities organization was characterized by decentralization; while for the 2007 Tabasco and Chiapas Flood and the April 2012 Popocatépetl occurrences, with the establishment of the first institutional emergency management agency (SINAPROC), a hierarchical organization was conceived and the emergency communication was completely reformed. During the 2007 Flooding, civil protection authorities took over the communication task, supplemented with the help and equipment of NGOs. For instance, specialized emergency call centers were established on the field, with the purpose of making available communication services to affected people, who either asked for official information or private calls as well. In the Popocatépetl crisis, the appearance of a well-functioning government in close conjunction with the civil protection authorities (mainly SINAPROC and CENAPRED) has enabled a hazard awareness program accordingly to the type of hazard to be face in case of a contingency. The Popocatépetl ongoing crisis character has forced the CENAPRED to run the POPOTEL which is a permanent line to obtained information about the VTLAS. Even if theoretically the POPOTEL is properly functioning, performed surveys have shown that the public do not look for information by themselves, it might have to do that during April 2012 no main eruption happened and so public have not feel the need for information regarding the magnificent volcano. Anyhow, another way should be provided to show information directly to the exposed population, which might be through the use of internet or social media.

5.3.1.6 Peer-to-Peer Communication (Between Public and Government)

Peer-to-peer communication between government and public is only true through official informative phone lines. During the 1985 Earthquake aftermath, the previously mentioned permanent and established informative lines were operated through the consensus of the government and the civil protection authorities. While in the 2007 Flood inundated areas, emergency lines were established and ran by the municipal government, next to the civil protection authorities call centers. In turn, the Popocatépetl crisis, as soon as the VTLAS was increasing to Yellow Phase III, state governmental instructive lines for the state of Puebla, State of Mexico and Morelos were added next to the permanent emergency line, and to the POPOTEL run by one of the civil protection authorities. It can be concluded that throughout these catastrophic events the government have implemented measurement in order to keep the population informed about the hazard risk.

5.3.1.7 Traditional Media Communication (Between Public and Public)

Mexican people had a really heavy mass media usage for all three case studies, it can be said and which will be explained in detail on the following sections that the traditional media presence has been constant since the 1985 Earthquake to the 2012 Popocatépetl crisis. Traditional media became a crucial mean for communication between public thanks to its redundancy properties. Precisely, while the telecommunication infrastructure failed to provide service during the aftermath of the 1985 Earthquake, the local news channel (in this case, also the national news network, at the time Televisa) offered service within hours of the impact; the main building was totally collapse which forced the use of a secondary facility for the broadcasting. Appropriately, Televisa grew up to be the main relief information transmitter; again this situation was due to the lack of formal information providers. Consequently, people had no other choice but to rely on the Televisa broadcasted updates, on the contrary, for the 2007 Tabasco and Chiapas Flood and 2012 Popocatépetl crisis, the national news network turned into an intermediate source between public and public. Interestingly, during the 1985 and 2007 events, public appeared as the mass media information source and consumer. Subsequently, for the 2012 occurrences, the citizens transformed into interactive information source, producers and consumers through new and social media, an information which again the traditional media broadcasted and spread. The communication platform modification through the case studies can be easily observed, the new technologies penetrated and expanded in the national territory, taking over the untouchable traditional media place. As it was noticed on Chapter 4 Popocatépetl, the Smoking Mountain, the mass media shared interest has brought upon its existence a bad reputation about spreading rumors, sensationalizing information, and even managed information in all kinds of happenings (sports, crime, spectacles, politics, catastrophes etc). On the other hand, the mass mediums has pioneering be one of the most important mean for information searching, reason for which people still continued watching TV, listening to radio and/or reading newspaper for the sake of enlightenment receiving about the critical circumstances. During the calamities, national and international mass media broadcasting focuses on reporting about crisis and relief information,

including hazard features, damages, response actions, instructive measurements, needs etc. During the 2007 Tabasco and Chiapas Flood, after its early stage, there was few international broadcasting because of Mexico external happenings, thus for this event, the new media overtook again the place of traditional media.

5.3.1.8 Traditional Media Communication (Between Public and CP Authorities)

As previously stated and later to be better explained, traditional media reporting relief information when authorities failed to since the beginning of the 1985 Mexico City Earthquake's aftermath. Traditional media journalists took over the duty for information searching through field interviews to civil protection authorities and public; nevertheless, most of the relief information came from the public itself, and with the government and civil protection authorities obstructed communication, these emergency management authorities started to use the broadcasted information by the traditional media (whose, important to restate, main source was the public) for operational processes. Subsequently and as it should be expectable, throughout the Tabasco and Chiapas Flooding in 2007, the improved civil protection authorities organization and coordination proved to be good enough to prevent relying on outside information sources or channels, for instance the public or mass media respectively, and so overcoming the decentralized communication. However, not enough official information was ensured by the civil protection authorities, provoking confusion among the public. In addition, alerts were not efficiently broadcasted and neither the weather forecasting was enough detailed to understand the seriousness of the impact. The broadcasting during the emergency response focused on the phenomena direct consequences, which in turn were sensationalized, instead of relief information for the sake of instructions and orientation. An accounted success of the traditional media during this event was reporting formal civil protection authorities contact information and tried to keep people informed. On its behave and learned lessons from previous experience, the civil protection authorities emergency preparedness communication planning cannot be negligible in the sense that its implementation empowered the emergency management authorities to properly communicate emergency response and relief instructions. By the Popocatépetl occurrences, announcements started to appear with respect to emergency preparedness such as preventive measures and efficient alerting system; significant of the hazard awareness program was spotted, educating the people about the volcanic risk and encouraging volunteer work. Moreover, civil protection authorities performed a survey in order to understand the learning process through the information shared between the different IEPC from the Popocatépetl crisis involved states and the public, and whose results were published on local newspapers. Importantly, traditional media was still elemental for confirming information by civil protection authorities in 2012, important to highlight that the rumors increased with the introduction of the new and social media for which the traditional media might be taken as an official intermediate channel for confirmation. Nevertheless, for the Popocatépetl emergency response, problems still arose while applying operational processes, while performing the virtual evacuation, the civil protection authorities failed notifying the public in some municipalities as the following example shows. According to

the civil protection authorities, the public was properly informed about the virtual evacuation practices to be performed; on the other side, the population stated that no notifications about such practices were received. Such circumstance might have to do with either, the communication effectiveness, the civil protection authorities and public indifference or dishonesty, corroboration that the emergency communication from CP Authorities to Public and vice-versa must still be improved and reinforced.

5.3.1.9 Tradition Media Communication (Between Public and Government)

A remarkable aspect observed during the 1985 Mexico City Earthquake was the delay in decision making; it can be assumed that as the emergency management concept was new for the government, the response was characterized by lack of coordination, instruction given and uncertain decision making. As consequence, the mass media whose broadcasting started hour apart from the Earthquake's impact, released unfiltered information coming from questionable information sources, in order to fulfill the nation demands for information. However, taking into account the absence of emergency preparedness and massive devastation, the overall governmental response can be perceived as appropriate, even by the Mexican people. As far as the 2007 Tabasco and Chiapas Flood goes, the inappropriate alerting communication, in addition to the lack of transparent information with relation to the human made causes that increased the event's criticality ("Las Penitas" dam), resulted in inadequate information given for the population to properly prepare against the tropical cyclone's impact. The Tabasco Governor tried to overcame the emergency communication failure with frequent official notices during the emergency response, nevertheless, the relief and instructive information was still confusing for the Mexican people. In contrast for the 2012 Popocatépetl crisis, the lessons learned about emergency from these previously mentioned events among others permit the government to pertinently put into action the Popocatépetl Operative Plan. The Popocatépetl Operative Plan has correctly enabled a hazard awareness program, increasing volcanic concern among the exposed population. In completion for the hazard awareness program, the government has taken the action to promote appropriate protective behavior and volcanic risk education by those living in risky zones through the mass media, which in turn has efficiently broadcasted the VTLAS changing alert status where it is a fact that no major hit has happened yet. Anyhow, this significant emergency communication evolution has reflected to a proper communication background between government and civil protection authorities, which at last is finally being transmitted to the population through the traditional media acting as channel.

Importantly, the Presidents of Mexico at the different catastrophes, as supreme authority gave speeches about aid activation in all case studies, even if with late appearance. This appearances are extremely important, the President must assured a safety feeling that the government is taking care and accordingly responding to the faced contingency; for this communication developments, the government strongly used the mass media for crisis information updating throughout the three case studies. As aforementioned, Felipe Calderón Hinojosa manage several destructive events

during his six-year term, including the Tabasco-Chiapas Flood and April 2012 Popocatépetl occurrences, increasing the President experience and capability for speeches regarding emergency communication.

Finally concluding that the traditional media information quality has increased remarkably, calling attention to the fact that the traditional media evolution has been pushed by the public demands. For instance, during the 1985 Mexico City Earthquake, the lack of intermediate source diversification forced the public to conform with questionable and rumor spreading information. During the 2007 Tabasco and Chiapas Flood, the introduction of new media prevented the public to rely in a unique channel of information; still the poor use of the new media platform forced the public to conform with sensationalized and managed information focused on government response advertisements, donations, etc. instead of reporting relief information. The evolved traditional media at the 2012 Popocatépetl occurrences proved to have improved on the information content properties, achieving a higher quality of information which is confirmed by the government prior broadcasting. Again, this traditional media evolution has been mainly caused by the modifications on the communication habits of consumption by the public, imposing the intermediate sources to transmit useful and worth consuming information. Moreover, traditional media is not anymore a communication medium for official information (Government and CP Authorities information producing), but it builds an interactive bridge between the government and civil protection authorities with the public. Nevertheless, Mexican people are urged to be aware of official information; meaning information directly given by the accordingly authorities or information already confirmed by the appropriate authorities. Also, making governmental contact information available supports hierarchical communication, and so diminishing erroneous information and decentralized communication.

5.3.1.10 New Media Communication (Between Public and Public)

The appearance of internet brought a new dimension in emergency communication, not only by building a bridge between people and vanishing great distances, but by modifying the way of information could be consumed. Internet offered not only diversified information availability, but a brand new way for information consuming which was not subjected to program scheduling. Although, the 2007 Tabasco and Chiapas Flood, put into evidence that the country was still not prepared to use new media in emergency communication due to the poor technological infrastructure, the public adequate understanding of the platform and the lack of support from traditional media. In other words, even when the new media infrastructure did not fail during this event, the use of internet was halted by its low penetration in rural areas. Nonetheless, with time, the digital mass media turned into a decisive channel of communication for information searching and sharing, in which mass media was not anymore the only information transmitter but neither the most reliable. It is important to understand that the new media was not used by the public regarding emergency communication before the impact of an event, which is the input that unties the new media emergency information sharing.

Even-though the use of new media in Mexico in 2007 was not remarkable, as soon as the tropical cyclone hit Tabasco and Chiapas, the internet immediately started to be used for emergency relief coordination. Even low, the use of cyber coffees and newly established internet centers, in Tabasco and Chiapas rural areas, helped the public to obtained information and sent instant messages to family and friends, basically to kept contact with relatives. People were reporting online through blogs for donations, and through photo and video sharing; still the role of population as information producers can be neglected because the presence of online activities were minimum, and mainly coming from high penetration areas or from out of the country. On the contrary, during the Popocatépetl crisis the new media usage highly increased, nowadays in Mexico, internet is commonly used between higher and medium social classes. More importantly, Wi-Fi hotspot usage in urban and rural areas is driving smartphone uptake and mobile internet traffic, but not necessarily mobile broadband adoption. As a matter fact, the use of Wi-Fi hotspots networks to access the internet happens primarily via smartphone. At the Popocatépetl occurrences, the population became active new media users which leaded them to act as important information sources, producers and consumers by means of the internet webpages.

Analyzing the traditional media at international level by taking into account that an enormous amount of Mexican people migrates to the United States of America, as a result, the international broadcasting is extremely important. Explicitly, the international mass media performance in the 2007 Tabasco and Chiapas Flood was poorly for the fact of prioritizing other international issues; this under broadcasting of the emergency stage let the new media to take over the flooding event information sharing. Instead, the Popocatépetl crisis, specially the ash crisis, was heavily broadcasted since surrounding countries interest were, and still are at stake.

5.3.1.11 New Media Communication (Between Public and CP Authorities)

The appearance of new media not only changed the communication between the different communities, but it provided a new way of connection between officials and the public. During the 2007 Tabasco and Chiapas Flood event, the digital mass media was still underused not only by the public but by the civil protection authorities, who failed to issue appropriate alerts through any medium of communication. The context of the information shared through traditional media and new media was quite similar at the early stage; yet the new media efficiency was higher since the information could be accessed at anytime, despite this, the most utilized platform for information sharing was still the traditional media. Again as before, this fact was caused by the internet penetration problem but as a governmental effort to make available information, internet centers were established along with guidance personnel and so public had the opportunity and means to acquire first hand information given by the civil protection authorities. Exceptional evolution can be noticed in comparison with the 2007 Tabasco and Chiapas Flood and the Popocatépetl crisis. With the launch of new media, development of the civil protection authorities official website also arrived, the use of this channel was greatly promoted and information became easily available. The VTLAS was constantly updated through the website; furthermore,

the public is able to send feedback and observations by email to the civil protection authorities, in particular for the volcano case to the Scientific Committee branch. In essence, the 2007 Flood event showed no major interaction between the civil protection authorities and the public, but as new media expanded, then the civil protection authorities started to take advantage of the opportunities that this platform offers regarding emergency preparedness and crisis communication with the public. Nowadays, people don't have to be tacked in front of the television to prevent from missing the news programming, instead with the new media official information can be accessed anytime, from anywhere, and as many time as it is necessary. The problem about the new media expansion in rural areas is still presented, but according to present analysis and future predictions the internet penetration rate is growing and will continue to grow exponentially; it might be worth it to mention, taking into account the great new media embracement in Mexico, therefore, such expectations might overgrow the future predictions. This prediction is backed up by the increasing widespread use of portable devices at risky zones on the Popocatépetl surroundings. Restating previous mentioned fact, even low income people with no broadband internet adoption, still can connect at Wi-Fi hotspots, and search for the desired information primarily via smartphone.

5.3.1.12 New Media Communication (Between Public and Government)

The use of the new media between the public and government was similar to the one with the authorities, and similar deficiencies were found. During the flooding, the official pages were mainly used for information sharing in a less interactive way. Online reporting was working well to provide relief information, and donations were also managed from the governmental webpage. For the period of emergency new ICTs were rapidly implemented in order to facilitate and speed up emergency processes also in the rural areas, while during the volcano crisis technology was already available and implemented for emergency management. As the same President was governing in both cases, the same official governmental pages were available, where instructions and orientations were published, following with online reports about the governmental activities. The presidential webpage was used for receiving public comments as well, but not in an interactive way.

A final interesting fact, public information arrived to the government through already developed web applications for emergency management, such as MapCatalog, whose introduction was during the 2007 Tabasco and Chiapas Flood and which can be considered as a new way of unofficial volunteering. According to previous observations, it has to be emphasized that the public started to expand its power in communication through the new media as well and cannot be neglected anymore.

5.3.1.13 Social Media Communication (Between Public and Public)

With the arrival of new media, the eclat of social media was exceptionally successful and broadly spread, growing to be an instrument for communication, socializing and entertainment. With the

rise of social media, news traveled faster than ever; consequently, the role of social sedia communication in crisis response should be highly considered. Same as the new media, even if social media sites already existed in 2007, the networking and interacting on them was minimal on the Tabasco and Chiapas Flooding catastrophe. Chapter 3 Tabasco and Chiapas Flooding of 2007 showed that during this calamitous event, mainly people with Mexican origins but living outside Mexico were using social networking. However, for later disruptive events such as the Popocatépetl crisis, social media developed very quickly to the main public interactive hub for discussing emergency preparedness and alerting topics, as well as, becoming fundamental for the information sharing and online reporting. Even-though in Mexico exists a large gap between social classes and educational levels, social media is not anymore a privilege for higher class citizens, but also the lower class population is adopting this communication innovative platform. Recently, the technological infrastructure has been improving considerably which makes social networking widely accessible; moreover, the increasing understanding on the part of users and the social push for these networks impels the growth for these connections as well. Specially true for the Popocatépetl crisis, it can be stated that people turned out to unofficially be information producers mainly through Twitter and YouTube; important to clarify that while this might be theoretically true for other countries apart from Mexico, this conclusion was extracted from the case studies which are based on Mexico. Above all, officials refused the new information configuration where citizens themselves are creators of information and still attached to the classical ways of information finding; even-though important information is being socially circulated, meaning crucial information for emergency management can be found outside the official protocol. This social phenomena in which important information sharing happens outside officials' working comfort zones, creates sometimes an unfamiliar sense and so resist embracing this information sharing. More importantly, this power as information producers is already in the hand of the people and it cannot be easily controlled, referring back to the major problem of questionable information circulation. The traditional media and new media have showed notable interest for the social media, thus encouraging this new information sharing configuration and standing out the importance of its use.

5.3.1.14 Social Media Communication (Between Public and CP Authorities)

Erroneously, civil protection authorities do not make use of social media halting an important connection between the public. On positive bases, civil protection authorities began innovative by the strong application of new media for mass communication, which successfully have improved between these two stakeholders communication during emergency management; nonetheless, the innovation applied during the New Mediums' revolution has fallen behind at the social media introduction. For the Popocatépetl crisis, even if civil protection has correctly created social network accounts, the use applied to them is highly inappropriate since no emergency alerts, updates, instructions or any emergency management information is being shared. In essence, civil protection authorities capability regarding new media has been superb; nevertheless, the same

outstanding capacity and understanding should be also applied to the social media field and so to take the most that this promising platform has to offer.

5.3.1.15 Social Media Communication (Between Public and Government)

Great contradiction exists among use of social media by the government and civil protection authorities, no matter the strong relation these two agencies have, strong differing regarding the vision of possible advantages of the social media as an intermediate source of information sharing is noticed by the selection of channels of communication during emergency management. In detail and as explained before, while civil protection authorities do not make use of social media, the government is not only strongly active in this platform but it cheerfully supports and advertises the use of it. The different departments of the government and even the President of Mexico itself frequently provide alerts, updates, instructive or any emergency management information, also speeches, interviews, press conferences, meetings, surveys, etc. by the different social networks (please notice that this same governmental activity is observed on the new media). The circulating public produced information via social networking has a feedback from the government at the official accounts, for the sake of rumors filtering and confirming valid information. The opportunity to interact with the President of Mexico or any other governmental personnel is mainly given via social media like Twitter.

5.3.1.16 Communication between CP Authorities and CP Authorities, CP Authorities and Government and Government and Government

From the beginning of the 1985 event, the importance of interpersonal communication arose and became fundamental between all the stakeholders in order to manage the crisis for the sake of transmitting knowledge. In the other case studies, even-though more effective communication means existed, face-to-face communication was still important between stakeholders to share the most important matters, obtaining official information from colleges and so reliable information. As already stated on the 1985 Earthquake's aftermath, the first emergency management agency was established, to later evolve as the civil protection authorities. Nowadays, a Scientific Committee forms parts of to the emergency management agency and focuses not only on the emergency preparedness but the technological development as emergency communication improvement; also regular sessions are hold for the occasion of emergency evaluations or general meetings which in practice helps to the interagency personnel interaction and coordination.

Regarding to the emergency preparedness communication, a quick look on time shows that firstly no monitoring, warning and alerting systems existed (Case Study of Mexico City Earthquake 1985); later, these system were introduces but its efficiency on communication emergency preparedness failed, for instance, alerts lacked precise information about the hazard and the information was confusing (Case Study of Tabasco and Chiapas Flooding 2007); nowadays, the monitoring, warning and alerting system follow a strict apparently working communication protocol (Case Study of the Popocatépetl crisis). To begin with and as extracted from Chapter 4

Popocatépetl, the Smoking Mountain whenever an anomaly on the volcanic activity is detected, the communication protocol goes as follow, an acoustic alarm system is activated and auto dial messages are sent to particular phone lines, mobiles and pagers of the surveying team. From the analysis of the information, the recommendations regarding the warning alert level are taken by the Technical Scientific Adviser Committee, integrated by eminent investigators of the UNAM and the CENAPRED. By means of special reports, authorities of the SEGOB and SINAPROC are informed periodically about the volcanic activity level. Thus, the evolution of monitoring, warning and alerting system through the case studies is evident.

A noteworthy communication evolution was between civil protection authorities and private companies co-work. Firstly, decentralization communication and uncoordinated actions characterized the emergency response (Case Study of Mexico City Earthquake); later, it can be concluded that the lessons were not learned from the 1985 devastation since the information flowing was obstructed by the lack of emergency planning (Case Study of Tabasco and Chiapas Flooding 2007); nowadays, pre-planning the interagency and private companies cooperation proved to be crucial overcoming the early stage emergency response, asserting on sheltering managing and equipment provision that were also offered by private companies (Case Study of the Popocatépetl crisis).

With respect to redundant systems which are fundamental for covering emergency preparedness issues. During the 1985 Earthquake's aftermath, in addition the inexistent emergency preparedness, one of the causes that drove the decentralized communication was the infrastructure failure at the early phase, thus and as explained above, the mass media took the task to act as an interagency communication bridge. Traditional media was able to act as intermediate source, even-though its own main building was collapse, due to the redundancy on its communication network enabled Televisa to use another facility building located outside the affected areas. As far as interagency data management, while for the 1985 happening the information handling was truncated by the overload or lack of input, for the 2007 Tabasco and Chiapas Flood the interagency data management improved by means of the new media. However during the 2007 incident, distribution and collection of information through mass media was avoided, emergency management agencies started to rely mainly on official sources for the most part, because operative information between interagencies should not be discussed on mass broadcasting. Finally during the Popocatépetl crisis, the emergency preparedness activated an appropriate interagency communication planned in advance, therefore covering important aspects to be faced during a contingency. Likewise, the connection between the government and civil protection authorities was noticeably improved, the data management was not anymore functioning decentralized and the communication process and inter-organization evolved to hierarchical. The agencies were as expected, following the Popocatépetl Operative Plan, an added Chapter to DN-E-III Plan which certainly prevents mis-coordinations for the specific operative actions for a Popocatépetl crisis as the DN-E-III Plan Chapter name describes.

Even-though the interagency communication between these two agencies remarkably evolved, the lack of honest communication or disagreements in information releasing and misspent or corrupted money hampers the efficiency of emergency communication. Mainly, politics will always influence the emergency response to a catastrophe, the negative effects are unavoidable because of the shared interests between the stakeholders, and harmfully delaying decision making are taken instead of time accurate and productive choices, which causes real anxiety from the side of emergency responders.

Importantly, international aid requests by the government had a significant role throughout the three case studies. The 1985 Earthquake was the first incident in Mexican history when the government asked for international help. After twenty years of appropriately handling disasters, the Mexican government asked again for international relief at the 2007 Flood; at first the government refused to seek for external help, but at the sight of the devastation, it had to be admitted that the assistance was strongly needed. As far as the Popocatépetl does not erupt, the necessity for international assistance for the volcano crisis remains an open question; nevertheless, it has to be kept in mind that in case of eventuality, the state of affair can turn out to be emphatic in Mexico, moreover, perhaps in a great part of the world as well. To conclude, the focus of the research was the evolution of communication processes involving mainly the public for the sake of understanding the new information sharing configuration; consequently, the interagency communication or classical emergency communication had no further analysis since information about the inclusion of new and social media is not available.

5.4 Conclusion of the Case Studies Evolving Communication Findings

Peculiarly and as previously mentioned, emergency communication should be an information sharing process, in which feedback is needed for deducing the communicative efficiency among the audience, that is to say, the consumer's perception. With special emphasis on the fact that audience is no longer only an information consumer, but an information producer that shares knowledge. On this respect, the "Risk Perception and Communication" study claims:

> *"The classical persuasion model provides an incomplete representation of the risk communication process... They contend the feedback loop in the model implies a dyadic relationship that is limited to contact with the original information source. However, extensive research shows people engage in information seeking activities that are directed to other sources as well. More generally, risk communication should be represented by a network in which multiple sources are linked to intermediate sources who received information and relay it to the ultimate receivers. The original sources could be linked to few or many intermediates or could even be linked directly with some of the ultimate receivers. Similarly, the intermediates could be linked to few or many of the ultimate receivers and the ultimate receivers could be link to each other".* [72]

Having this in mind, the Classical Persuasion Model was also modified in order to provide a complete representation of the case studies evolving emergency communication. For instance, the intermediate sources or channels' presence and confidence from the public started changing as consequence of the modification of the habits of consumption, the ICT era diversified the means for information sharing, and so the range for audience preferences. Nowadays, information consumers are not expected to rely in a unique information source, but to chose to trust a given information producer by means of a channel selection; moreover, to compare and be critical about the broadcasted information since manipulation might occur. Table 16 represents the intermediate sources presence evolution through time, it can be noticed from the case studies how new and social media have been gaining importance on the public preferences, while the traditional media maintains a constant high presence. It can be assumed that the new media low presence start (in Tabasco and Chiapas Flood) was caused by the immature internet penetration in the country at the time. However, the factors that have driven the growth of new and social media are the constant technological improvement, an increasing understanding on the part of the users and the importance that even traditional media have shown for these new platforms. Inevitably concluding, a current high traditional and new media presence, and a fast growing presence from the social media were observed in the Popocatépetl crisis.

Table 16 Intermediate Sources Presence

Media / Event	Traditional	New	Social
Mexico City Earthquake 1985			
Tabasco/Chiapas Flood 2007			
Popocatépetl Volcano Crisis 2012			

 High presence  Medium Presence  Low Presence

On the other hand, Table 17 represents the public confidence in intermediate sources evolution through time, it can be noticed from the case studies how new and social media have overtaken credibility on public trust comparing to traditional media. It can be assumed that the decrease on the traditional media confidence was caused by Televisa and TV Azteca sharing interest with the government, and therefore, manipulated information. Consequently, the nowadays leading trustable sources for information are the new media with searching pages on first place, followed by social media and at last traditional media with TV and radio broadcasting.

Table 17 Public Confidence in Intermediate Sources Reliability

Media / Event	Traditional	New	Social
Mexico City Earthquake 1985			
Tabasco/Chiapas Flood 2007			
Popocatépetl Volcano Crisis 2012			

As a conclusion for the case studies analysis, the developed Information Sharing Cycles shown in Figure 64, 65, and 66 were designed by modifying the Classical Persuasion Communication Model, and so obtaining an implementation of an interactive Information Sharing Cycle. According to the analysis findings, the media, which is a human-invented technology that extends the range, speed, or channels of communication, is an enormous promising platform for further developments in emergency communication. Traditional media being all the old means for communication and expression that have existed since before the advent of the new medium of the internet; it is a closed system which provides one-way conversation, controlled communication, and a pre-produced or scheduled information based on top-down strategies,

allowing passive involvement for the public. Even if traditional media has limitations, it remains crucial after the innovation of internet, due to the fact that the migration to the World Wide Web is still not fully developed. However, internet is reshaping every aspect of life, as well as emergency management. The new media technological breakthrough opened a new episode in emergency communication, combining innovative features from its predecessors such as bridging great distances and reaching mass audiences. The pioneering idea was born in 1967, written by McLuhan & Fiore in the book of "The Medium is the Massage: An Inventory of Effects", stating that *"we shape our tools and thereafter our tools shape us"*.

Moreover, society has embraced the digital revolution and let social media to redefine communication by removing the barriers of previous communication methods. Social media is an open system, which guarantees two-way conversation, unstructured communication, and real time created information based on bottom-up strategies which allows active involvement for the public. The social media unique qualities let stakeholders to interact and create in an exceptionally important way for emergency communication. Also, social media is a free platform for community decision making via informal language, but moreover, emphasizes the participation of official groups which halt the relative anonymity afforded to users. In return, this participation generates reliable and easily available information which is essential in case of crisis. An original idea was formulated by Ramon DeLeon, a Marketing Mind at Domino's Pizza, that can be related for the use of social media at the official site: *"The only way to put out a social media fire is with social media water!"* .Meaning, if public is using social media during a crisis event, the emergency management agencies have to reply back through the same source of communication. Social media democratized the creation, publishing, distribution and consumption of media content, thus it has to be used as a tool when dealing with stakeholders in a 21st century crisis situation.

A final conclusion to the built up Information Sharing Cycles with respect to the developed Emergency Communication Model based on case studies. Figure 64, 65, and 66 display the general interpretation of case studies' findings through the evolution of the ways of sharing information and participation of stakeholders with different roles.

In 1985 Mexico City Earthquake, the Information Sharing Cycle, shown on Figure 64, was at its simplest form which created a particular information sharing looping where the information creator was not only the government as a producer, but the traditional media as intermediate source whose main information source was the public, and whose receivers were again the public as well as the government and the traditional media itself. Aside from the particular properties of the 1985 Earthquake, generally speaking, the Cycle represents a closed system which provides one-way conversation, controlled communication and pre-produced or scheduled information based on top-down strategies, allowing passive involvement for the public.

In turn, in the Tabasco and Chiapas Flood, where a hierarchical governmental organization was already established, as return, the government and civil protection authorities were the main

information producers. On the contrary as the Information Sharing Cycle (simplest form) based on the general interpretation of 1985 Mexico City Earthquake, the generalized Information Sharing Cycle of 2007 Tabasco and Chiapas Flood, displayed on Figure 65, takes into account the new media contribution based on the same methodology explained before, but diversifying the means for information sharing (as intermediate source as well as information producer) where the main receiver was the public. Important to highlight that by 2007 some social networks were already launched, but whose use in Mexico can be neglected because of the low internet penetration at the time (also, most of the users, even-though Mexicans, were taking advantages of this platform in foreign developed countries like United States of America).

Finally in the 2012 Popocatépetl crisis, the communication evolution from the Tabasco and Chiapas Flood Information Sharing Cycle is the introduction of the social media as an interactive information producer and receiver, creating a network in which various sources are connected to different channels who broadcast the information to the ultimate receivers, who in return reply back through the different channels with a feedback. The general interpretation of the Popocatépetl crisis illustrates an Information Sharing Cycle, shown on Figure 66, representing an open system which guarantees two-way conversation, unstructured communication and real time created information based on bottom-up strategies, allowing active involvement for the public. Principally, the alterations on the information sharing dynamics that were introduced through the Cycles, lastly allow other mediated inter-relational modalities that are interactive, dialogic, real time and personalized.

To conclude the evolved Information Sharing Cycles, it is important to have in mind not only the stakeholders are acting as information source, producer, medium or consumer, but to the data, information and knowledge that also is being encompassed by the Information Sharing Cycles. In one side, data must be interpreted and take on a meaning to become information, information requires continual feedback for vitality and value in order to not decay over time, and then being shared and experienced in such a way that perceptions are distinguished, transforming information into knowledge. As final though, NASA Team Collaboration expresses the following about knowledge sharing:

> *"Knowledge and information decay as they become widely known and used, new ideas build upon them, and new ways of thinking emerge. All of us have heard the expression "knowledge is power". And, indeed, in our culture we are often rewarded for our expertise. But in the new knowledge world, hoarders of knowledge have limited value to the organization. In fact, they, themselves become the primary cultural barriers to the learning organization. Knowledge is one of those rare things you can give away and still have. In fact, as you share it, and through reciprocal sharing, innovation springs into being. This sharing relationship is built on a foundation of trust." [73]*

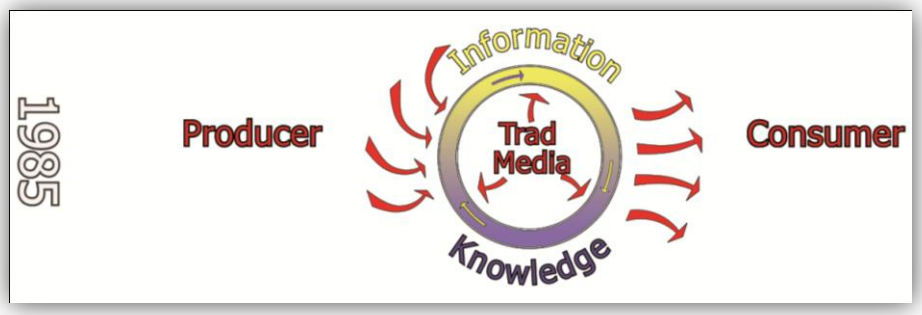

Figure 64 Information Sharing Cycle in 1985 based on Mexico City Earthquake Case Study

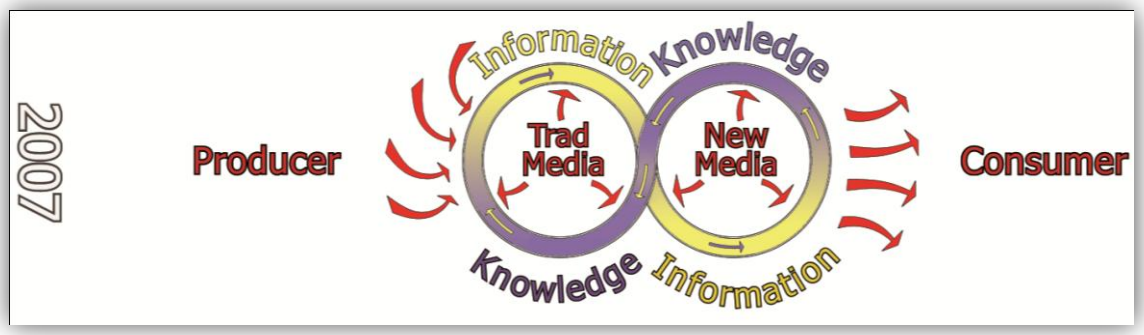

Figure 65 Information Sharing Cycle in 2007 based on Tabasco and Chiapas Flooding

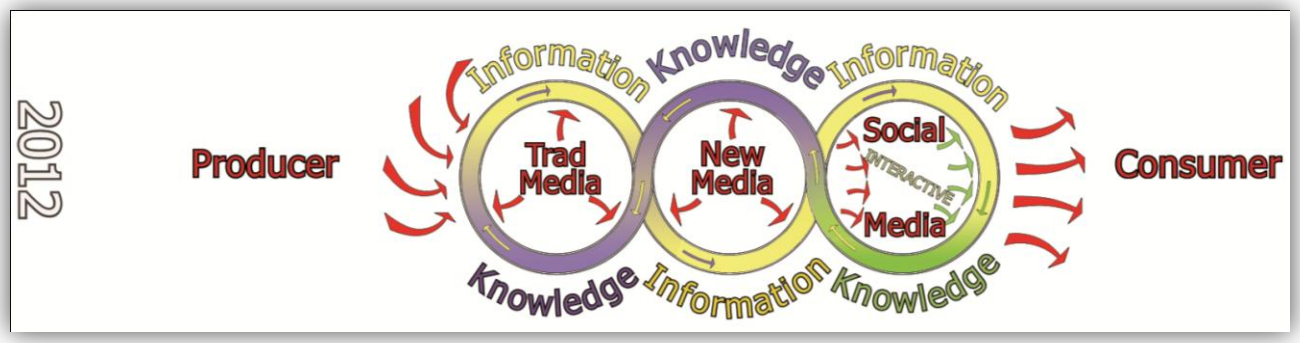

Figure 66 Information Sharing Cycle in 2012 based on Popocatépetl Crisis

To conclude, the previously introduced stakeholders' interaction in the Information Sharing Cycles through media is summarized in Table 18. As it can be noticed, the Mexico City Earthquake 1985 situation was particular due to the looping of the information. However, the main observation that has to be made is the evolving role of the public from a simple source to an important information producer. The new media configuration empowers the public with a new pervasive role that cannot be ignored, nowadays, public is no longer only an information consumer, but an information creator that shares knowledge; the public has become the new interactive variable that the new media configuration gives the means to participate as a potential communicator that redefines the information sharing between the government, civil protection authorities and the public itself. Moreover, as the public turned into information producer, the media itself became a consumer, exploiting the input of public information through its own channels.

Table 18 Evolution of Stakeholders Interaction in the Information Sharing Cycle through the Media

Stakeholders / Event	Source	Producer	Consumer
Mexico City Earthquake 1985	Government, CP Authorities and Public	Government, CP Authorities and Media	Government, CP Authorities and Public
Tabasco/Chiapas Flood 2007	Government, CP Authorities and Public	Government, CP Authorities and Media	Public
Popocatépetl Volcano Crisis 2012	Government, CP Authorities and Public	Government, CP Authorities, Public and Media	Government, CP Authorities, Public and Media

6 CHAPTER: AN ONTOLOGY FOR EMERGENCY MANAGEMENT

6.1 Introduction to Emergency Management Information Systems

In Chapter 5 Evolution of Emergency Management Communication the relationship between human behavior, information and communication technology was studied. The technical, social and information aspects of earthquake, flood disasters and volcano crisis were examined, including how ICT connects people with each other and the information they seek. The focus was on matters of communication development through media for both official responders and members of the public alike with the attention of sector on disaster response. The main finding of the case studies analysis that has to be emphasized is the use of new media as an emergent, significant, and often accurate form of public participation and backchannel communication complementing traditional media. [74] According to Lagadec, instead of avoiding connections with the media, *"one should allocate time, resources and tools to accommodate the media within the entire process of emergency management"* in order to provide dynamic and transparent flow of critical emergency information, as well as due to the fact that media is already better equipped to transfer information to people. Emergency managers tend to use well-tried but ordinary procedures for information processing without disentanglement of new information sources. However, the turn up of new media and its related technologies liberalized the way of information exchange, which requires the reformation of information content assessment in emergency response. Emphasizing, new media created the opportunity of having real time information systems including public involvement in the information production and exchange process.

Clearly, new media are changing the way people communicate not only in their day-to-day lives, but also during disasters that threaten public good. Involving and using emerging new media for critical information extraction, with special attention to social media that is including as well the information generation and dissemination activities by individuals of the public, may place the emergency management community in a better position to respond to disasters. ICT through internet enables people – disaster survivors, curious observers, and those who wish to help victims – to connect to one another and to participate in events, including seeking and providing information. Since new media becomes more pervasive in communication, and social interactions between all human emergency responders have established extremely wide variety of information networks, their use has significant implications for emergency management practice and policy before, during, and after disasters.

How this new source of information can be implemented into emergency management? The professional role of an emergency manager is to combine uncertain expectations with already well-defined standards for successful performance during an emergency. The perceived effectiveness reclines in individual qualities in the areas of communication, organization, human relations, and self-control in stressful situations, which has to meet the criteria of powerful use of

background technologies, carefully focusing on the implementation of innovative technologies. Decision makers should increase the sources of their search for information, instead of shutting down some channels of communication and relying on familiar or formal information and channels. Manmade and natural disasters have the potential to cause extensive amount of damage to property and life. The unpredictable nature of a disaster demands that emergency managers have to be always prepared for the worst combining preparedness with great adaptability of ad hoc appearing non-regular circumstances. A significant degree of that preparation lies in the ability to have appropriate and flexible coordination and communication solutions for information sharing in case of contingency. The key obstacle for proper communication solutions is the accessibility of relevant data, even if emergency managers have to face extreme uncertainty during information production in a crisis. Random samples of information subsequently have to be integrated as identified factors in an information system for the understanding of emergency response workflow. Emergency Management Information Systems (EMISs) facilitate this procedure in order to provide categorized samples of data sets for disaster response that allow for the dissemination of the right information to the right people at the right time. The goal of these systems is to ensure that emergency organizations are effectively able to manage the consequences resulting from a wide range of disastrous events through connecting response planning to unique concerns. Moreover, EMISs require an efficient information supply chain for the smooth operations of emergency management processes providing flexibility and interoperability. However, the breakdown of this information supply chain due to the lack of consistent data presents a significant problem. To avoid the failure of relevant information flow, the conceptualization of information content is desired in order to assemble precisely the pieces of reality and acquire the actual overview of the crisis situation. The role of this work is to represent the content of an Emergency Management Information System, so called Ontology that is to symbolize categorized information, *'which can be communicated and understood'*. The development of the EMIS response model is adopted to prescribe a comprehensive set of '*informations*' for emergency management to better address the challenges of information. Concluding, Ontology permits to build specific knowledge bases, which describe specific domains with factual knowledge dimensions providing knowledge about the objective realities, such as objects, properties, relations and states in the domain of interest. These properties may be combined with Web Services interconnecting flexibility, reusability and universal access by different stakeholders that typically typify a Web Service, that is to say, offering the construction of a resilient EMIS. [77]

Closing, Figure 67 displays the basic idea of Ontology construction. The different types of fishes, distinguished by the colors, represent different types of information dispersed in the environment, while the big black fish stands for the illustration of a catastrophe. Pieces of information are always presented and obtainable withal their possession has the value of gold during crisis. However, the overloading or lack of these information objects in a critical event can cause chaos among emergency managers. The brilliant idea to avoid panic is the organization of such information in order to overcome and mitigate the critical situation, which is symbolized by the

group of organized fishes according to their type (colors). More precisely, the scheme of Ontology contains the conceptualization of the information according to its content and properties in a system wherewith the context of a disastrous situation can be comprehensible and better handled.

Figure 67 Symbolization of the Ontology concept

6.2 Implementation of an Ontology for Emergency Management

The main focus of the research was the interpretation of unique natural disaster scenarios in Mexico, as a background of the context analysis of emergency communication to construct a general Ontology for defining initially the information contents and extending the representation of the stakeholders in the emergency communication process, namely, the government, civil protection authorities and the public during crisis events. This information system, which was generated by the adaptation of various scenarios in order to obtain a wide overall vision of the changing crisis situations through time, is useful for the development of emergency response applications by annotating datasets, supporting natural language understanding, integrating information sources and semantic interoperability. [77] Moreover, it facilitates decision making and allows a quicker, more effective response by enabling users to easily gather, analyze, search and share information. Three different types of phenomena environed by shifting technological era through the passage of time were circumspectly built up concentrating on information created, shared and communicated. This information was particularly coming from traditional media and new media information providers during the unique phase of emergency response. The

information substances were extracted from the communication processes between stakeholders to discover, compare and then unify the communicated information objects. Consequently, specific classes of information objects for the emergency management field were captured, and the relations that exist among them were represented. With the encoding of the information flow from reality, a shareable and conceptualized knowledge base was formed about the exploited information and its use during emergency response in order to support components and functions of the EMIS. The proposed Ontology permits to conceptualize information produced and accessed by different stakeholders during contingency management creating a common emergency information vocabulary regardless of the kind of cause or effects of a disaster. [77]

As it was mentioned before, the information content assessment needs reformation due to the evolving modalities of information exchange. The designed conceptual structure of Information System has to be evolving with the technological improvements, which opened a new path for information source, such as new media comprising even more social media, and created a new input for the system that cannot be neglected and omitted from the analysis. The System of Information Objects were composed by pieces of information from the case studies that were obtained through the communication channels of traditional, new and social media. The Ontology is utilizing and summarizing all the information objects that were shared and shaped by the different modalities during the disasters. The created structure of information system, which is shown in Appendix B, represents a general conceptualization of emergency management information shared during the response phase by many of cooperating and sometimes competing stakeholders of an emergency. Emphasizing, the Ontology design takes into account the information arrived from the new sources.

The domain Ontology was developed through taxonomy of classifications for a given set of objects introducing the hierarchy of the containment of information. [77] The information needed by stakeholders during emergency response is related to the main features of the disaster impacted area, the consequences of the calamity, relief information for logistics and resource requests and availability. Thus, the produced Ontology of Emergency Management Information is divided into four main categories, such as Hazard Information, Consequence Information, Logistics Information, and Resource Information. These four parts of the Ontology was graphically represented separately due to transparency, as it can see in AppendixX, but all of them together illustrate the whole body of the EMIS. Consequently, the communication aspects were further analyzed in order to refine the development of the categories and obtain a specific, individual information object, with a particular attention to follow the concept of the model that was stated by Mejri Ouejdane, *"the degree of granularity of the ontology needs to be generic and application independent as possible for share-ability and interoperability and expressive as possible to define a precise conceptualization"*. [77] The next level of division for Hazard Information was into Alert Information and Hazard Impact Information; for Consequence Information was into Natural-, Direct-, and Indirect Consequence Information; for Logistics Information was into Evacuation-, Security/Safety-, Official Emergency Contact-, Reinstallation

of Damages-, Census Report-, and Survey Information; for Resource Information was into Human and Physical Resource Information. Further classification was continued, that can be observed detailed on the Ontology presented in Appendix B. The Ontology presents the classification of information identified during emergency response through IS-A relationships. As Figure 68 shows, the first classified categories are the fathers of an IS-A relationships which were obtained by applying the back-step method to the shared information on the EMIS environment. Further levels of the Ontology were implemented introducing the more detailed information objects as sons connected to fathers by IS-A relationships. In detail, Resource Information is the father of Human Resource Information, and the Operational Staff Information, Technical Specialist Information and Logistics Staff Information are the sons of Human Resource Information. Some of the information objects have properties defined through particular relationships, for instance, Human Resource Information HAS-Skill and HAS-Availability Information attributes.

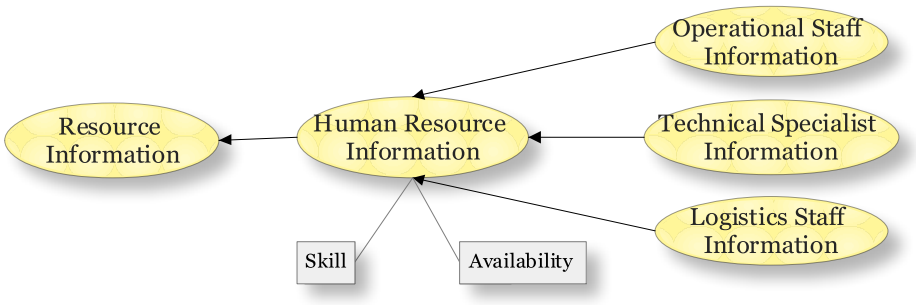

Figure 68 Part of Human Resource Information Ontology

Additionally, the created Ontology was not only representing the information content of emergency communications and their relations, but it was also extended to introduce the origin of the information. Specifically, it provides an insight to the possible sources of information using coloring in order to identify the different sources, such as the government, civil protection authorities and the public. The proposed colored model emphasizes the presence of public information in the emergency communication context and shows the main parts of interference where this information appears. Moreover, the function of colors gives fresh guidance to emergency managers where to seek for the desired information and points forward to the aspect of implementation of the new source into the information producing process. The proper use of information arriving from public could expand the range of possibilities in information sharing embracing the whole process of emergency communication.

Through the structuring of the demonstration of information sources, the colors were represented as following, red for the public, yellow for civil protection authorities, while blue is for the government. The mixture of these colors was also used for the illustration of common sources, such as; purple for public and government, orange for public and civil protection authorities, green for civil protection authorities and government and black if all actors indicated as sources.

Subsequently, an example is explained on Figure 69 for the sake of understanding the method of coloring. Formal evacuation information is an Evacuation Information, which is a Logistics Information, which can arrive from the government or civil protection authorities (green), in detail, information of evacuation routes, meeting points, time and duration. However, another category was distinguished, namely Self-Evacuation Information, which apparently is coming from the population (red) in the form of information about routes, location, time and duration. Thus, the category that summarizes these two elements, Evacuation Information, is black due to the fact that all stakeholders share this basic information but with a different content.

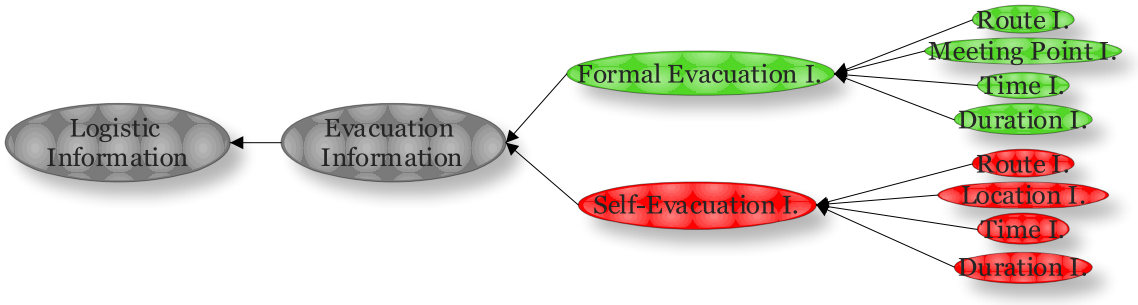

Figure 69 Part of Logistic Information Colored Ontology

Furthermore, the colors represent timely input for the information, showing that the first instance of the disaster aftermath who are the main information producers. It can be observed from the Ontology of Hazard Information, that the origin of alert information is the civil protection authorities, which message will be further broadcasted by different stakeholders through different channels of media. It is also interesting to draw attention to the Hazard Impact Information, where the first instant public information significantly enters to the system, such as reporting the main features of the hazard that was first hand experienced by the population, sometimes providing information even earlier than official sources. The government mainly uses these information sources to produce official information and apply it to respond the disaster properly.

Besides, the most important category where the incoming information of public is the mostly relevant is the Consequence Information. Even if it is coming unofficially or through unofficial channels, the Consequence Information, such as, Natural Consequence, Direct Consequence and Indirect Consequence Information, describes the damage and destruction that people live through. Most importantly, this information could be matched with the Resource Information in an EMIS which could help to combine the unsatisfied needs and demands with the available resources. The sources of Resource Information are the Government and civil protection authorities who are accounting for the supplies and aids.

At last but not least, public information blends into Logistic Information as well, while producing essential information through their reaction to the instructions and obligations that can be used as input information for planning the emergency response activities and operations.

Emphasizing, the proposed Ontology makes visible the occurrences of information flowing from the public into the information system, and suggests the consideration of further use in emergency management communication process.

6.3 Application of Ontology based on the Case Studies

After the proof of the existence of public information source and its implementation in the information system, the final conceptualization of the Emergency Management Information System contents that presented in the comprehensive colored Ontology may be used further as a unique platform for emergency managers in designing their communication processes.

In fact, the developed model of this general Ontology can be used not only for the description of emergency response circumstances but also for preparedness and recovery stages. The information read, produced, modified, memorized and shared is crucial for the entire workflow of contingency management and can be reused between the different phases of emergency, as there are important junctions in the required information for planning, operating and accomplishing relief actions.

A further possible classification of crisis information through mass media consists of dividing it in official and unofficial information referring to its source and mean of communication. [76] The source of official information, which is considered to be trustworthy by the population, is institutional and broadcasted through reliable medium; on the contrary, unofficial information is arriving from the citizens through open channels, such as public media-sharing platforms. The official information spread by mainstream media during crisis can be differed or confirmed by unofficial information. However, the visibility and accessibility to everyone of unofficial information is very fast through new media, thus it can forego and compete with official information. The basic content of this produced and diffused information fulfills the instant demands of emergency information, when official information is absent, even though it is not certified and may lead to the distribution of inaccurate description of the situation due to the lack of proper analysis. There is obvious difference between the quality and availability of official and unofficial information but they have to be treated and analyzed together in order to complete the deficiency of information from both sides. Thereby, it can be understood, that the contextualization in time and space of unofficial information together with official information is essential for coping with disasters and served both as an input for the Information System model.

Through the use of previously introduced Emergency Management Information Ontology, the conceptual structure of informational function can be implemented for contingency management workflows, moreover, for extending the use of new media in emergency. Analyzing the entire workflow of emergency management, significant intersection of concepts can be identified. In the following, some examples will be presented about its use in new media through the phases of preparedness, response and recovery.

Networking sites can help members of the public, communities, and agencies to share emergency plans and establish emergency networks. Integrating these networks into a community's preparedness activities for crisis could allow building community resilience, helping both professional responders and ordinary citizens at risk to use familiar new media networks and tools for receiving attention and providing necessary services. These tools can also be used to improve preparedness by linking the public day-to-day use to quickly released real time information about an emergency situation. Location-based (GPS) service applications offer the opportunity for improving preparedness and response, by enhancing people's awareness of crisis situations in their geographic area and share information about their immediate surroundings with a specific location. Monitoring the information through the same media channels during an actual disaster may help responders verify whether certain facilities are overloaded and determine which ones are needed. The extensive reach of new media is also becoming vital to recovery efforts after crises, when infrastructure must be rebuilt and needed resources must be rapidly connected with the requests. Information linked to timelines and interactive maps can tell a cohesive story about a recovering community's capabilities and vulnerabilities in real time. Different organizations have helped with recovery by matching volunteer emergency responders with distressed areas through open source software for disaster management. (MapcCatalog, USAID, SAHANA) [75] and [78]

As with any new technology, many barriers remain between current use and optimal exploitation of new and social media. It is important to recognize the technology's limitations in reaching vulnerable populations at-risk, although these media are used by people of both genders and an expanding range of ages. Furthermore, users' relatively anonymity calls in question the shared information accuracy. Even if false messages that are broadcasted widely are often rapidly corrected by other users, it is often difficult to separate real signals of a crisis or a material need from background noise and opportunistic scams. Attention must be paid on privacy issues and the problem of who should and for what monitor data from new and social media. Reflections are needed as well to evaluate the reliability and validity of information communicated through new media. Further question remains the evaluation of the capabilities or effectiveness of new media in emergency communication and how its integration would affect the costs, quality, or outcomes of a proper disaster response. [75]

Evidently, new media cannot and should not supersede current approaches to disaster management communication, such as face-to-face, peer-to-peer and traditional media communications, but if leaded strategically, they can be used to highly support current systems. Innovative technologies must be deployed while developing meaningful standards for evaluating their effectiveness, accuracy and usefulness of the information they provide. New media enhance systems of communication, thus significantly increasing capability to prepare for, respond to, and recover from catastrophic events.

CONCLUSION

Concluding, this work extensively researched the complexity of communication in the management of emergencies, highlighting the multidisciplinary, multidimensional and evolving nature of this process. Calling attention to the importance of this type of conveyance, where government, civil protection authorities and public communicate with each other in order to protect civil life and property. In this work, the effective emergency communication is viewed as the basic function, that if the adequate ICT variable is properly applied, can give rise to a revolutionized EMIS where timely decision making and response will take place, the interoperability and organization will become agile, and the public interaction and engagement will increase. For the development of this work, three Mexican disasters were chosen as case studies, the case selection criteria took into account the high risk likelihood and technological development of Mexico among with the vastly phenomena impacts throughout its history; namely the 1985 Mexico City Earthquake, 2007 Tabasco and Chiapas Flooding and the 2012 Popocatépetl crisis. The research focused on the evolving role of the existing channels of communication at the different case studies, mainly the face-to-face, peer-to-peer, traditional media and new media including social media; and the interactions between government, civil protection authorities and public through these channels of communication.

To begin with, the 1985 Mexico City Earthquake findings showed a completely lack of emergency preparedness caused by the absence of an emergency management agency, which resulted decentralized emergency communication where late decision making and governmental response was observed. By this time, only the face-to-face, peer-to-peer (telecommunication instruments) and traditional media (mass media) channels of communication were presented, and from which at the early stage only the face-to-face and traditional media were taking over the task for information sharing. The analysis showed the vulnerability of the telecommunication infrastructure where if not for the proved traditional media redundant network, the only mean for communication would have been the face-to-face channel. Following, the 2007 Tabasco and Chiapas Flooding findings showed an improved emergency preparedness consciousness caused by the foundation of the National System of Civil Protection (SINAPROC), which resulted hierarchical emergency communication model where an improved interagency interoperability and organization was observed. Nevertheless, the emergency preparedness was still naive and poor effective on monitoring, warning and alerting systems which prevented the government and civil protection authorities from providing adequate information to the public. Moreover, politics interest manifested to be a major problem while releasing official information with relation to the phenomena characteristics and direct consequences, provoking interagency disagreement and dishonesty. By this time, only face-to-face, peer-to-peer, traditional media and new media channels of communication were presented. Also in this case, at the early stage the peer-to-peer communication failed but which reinstallation activities were extremely effective. In detail, face-to-face communication proved to be crucial for the emergency management, the national traditional media broadcasting was outstanding while the international traditional media did not treat the subject. The new media operated outstandingly but its penetration rate on the country

prevented from being massively used (it was mainly used by emergency management agencies). Finally, the 2012 Popocatépetl crisis findings showed remarkable emergency preparedness improvement caused by the lesson learned from previous experiences, which resulted in a mighty hazard awareness program implementation and a timely decision making and strongly response by the government and civil protection authorities with the activation of the Popocatépetl Operative Plan. Nevertheless, still emergency communication faced some difficulties such as the exposed population understanding from official instructions and the government and civil protection authorities notifications to public. By this time, all accounted channels of communication were presented (face-to-face, peer-to-peer, traditional media, new media including social media). In detail, face-to-face communication were crucial for the emergency managers decision making and response while peer-to-peer acted as a critical medium for the timely monitoring, warning and alerting communication. traditional media superlative performed for information sharing, new media (including social media) with an exponentially growing population penetration rate, increasing technological improvement in the country, better understanding of the end users and the importance that traditional media showed for this platform had a great impact on the emergency management communication.

Moreover, several information sources were put together and built up the environment and complexity of communication processes, approaches, principles, strategies and techniques presented in the case studies, where the new modalities of information exchange were extracted. The particular constructed evolution of the emergency management communication on the case studies guided this work to the modification of the Classical Persuasion Model from Lasswell. The newly proposed Emergency Communication Model analyzed the case studies emergency communication in terms of who (Information Producer, Stakeholder), says what (Message Content), through what communication mean (Information Channel/Intermediate Source), to whom (Information Consumer, Stakeholder), at what time (Emergency Stage), and in which kind of crisis (Scenario). Furthermore, the common messages content and scenarios were defined and analyzed for the sake of the evolution of emergency management communication comparison between the case studies, producing a summary table. The case studies comparison throw interesting results in which the new and social media have gained importance on the public preferences, while the traditional media have maintained a constant high presence. In other words, the emergency communication evolution showed current high traditional and new media presence, and a fast growing presence of information coming from social media in both official and unofficial exchange. Also, the case studies comparison throws unexpected results in which new and social media have overtaken credibility on public trust, while the traditional media have lost status on this matter. In other words, the leading trustable sources for information are the new media with searching pages on first place, followed by social networks and at last traditional media with TV broadcasting.

Basically, the results of the proposed Emergency Communication Model are the input for the construction of an interactive Information Sharing Cycle that pays special emphasis on the

convergence of new media (including social media) and traditional medial which revolutionizes the modalities of information production, diffusion and reception. The first Information Sharing Cycle based on a general interpretation of 1985 Mexico City Earthquake represents a closed system which provides one-way conversation, controlled communication and pre-produced or schedule information based on top-down strategies, allowing passive involvement for the public. The second generalized Information Sharing Cycle based on the 2007 Tabasco and Chiapas Flooding represents the same methodology explained before, but with the introduction of the new media. To end up, the general interpretation of the 2012 Popocatépetl crisis illustrates an Information Sharing Cycle representing an open system which guarantees two-way conversation, unstructured communication and real time created information based on bottom-up strategies, allowing active involvement for the public. Basically, this work found that the alterations on the information sharing dynamics allow other mediated inter-relational modalities that are interactive, dialogic, real time and personalized. This work claims that the new media configuration empowers the public with a new pervasive role that cannot be ignored, nowadays, public is no longer only an information consumer, but an information creator that shares knowledge; the public has become the new interactive variable that the new media configuration gives the means to participate as a potential communicator that redefines the information sharing between the government, civil protection authorities and the public itself.

Furthermore, the case studies constructed evolution of the emergency management communication developed a comprehensive Ontology that represents the EMIS contents conceptualization. According to Mejri Ouejdane *"the degree of granularity of the ontology needs to be generic and application independent as possible for share-ability and interoperability and expressive as possible to define a precise conceptualization"*. Having these Ontology characteristics, the case studies identified information objects were categorized into four main generic, independent and expressive categories such as Hazard Information, Consequence Information, Logistic Information and Resource Information. Importantly, these categories are the fathers of an IS-A relationships which were obtained by applying the back-step method to the shared information on the EMIS environment. Further levels of the Ontology were implemented introducing the more detailed information objects as sons connected to fathers by IS-A relationships. Into the bargain, the comprehensive Ontology was colored in order to represent the information objects' main source, namely, the government, civil protection authorities and the public, reiterating and illustrating the public shifted role as an active communicator on the EMIS environment. Briefly, the Ontology confirms that the new media configuration has enabled the public to no longer be an information source and consumer but an empowered participant (mainly via social networks), in other words, the new media has allowed the public to grow up and become an information producer.

Although this research was carefully prepared, there are still some limitations and shortcomings to be aware. First of all, some constrains are related to the availability and accessibility on the case studies research. For instance, generalized information was found with relation to the former

events of the 1985 Mexico City Earthquake and 2007 Tabasco and Chiapas Flooding, and which prevented a complete reconstruction of the EMIS at the time. In addition, the case studies research also encountered restricted information for all three disasters, particularly governmental and official emergency management agencies' restriction caused by the privacy and security agreements. Lastly, this work intends to corroborate the statement in which new media can potentially support how emergency management agencies coordinate crisis; however, these findings and developments also question the existing emergency management views. The new media era arrives with great emergency communication possibilities but also with a big set of challenges for emergency managers: How are they currently using new media to communicate or to collect valuable information? How can they make appropriate use of this promising platform? How can they overcome the privacy, liability and reliability of information issues? Will new media improve awareness and trust within the EMIS environment? All these are issues that should be faced in further works.

APPENDIX A

Emergency Communication Analysis by the Modified Classical Persuasion Model

Well Working Not Well Working Not Working

Table 19 Emergency Communication Analysis by the Modified Classical Persuasion Model (Lasswell) for the 1985 Mexico City Earthquake

Between Who	Through What	For What	Early Stage	Long Stage	Recovery	Scenario
Public/Public	Face-to-Face	Emergency Preparedness	-	-	-	
		Direct Consequences				Interpersonal Network Became Fundamental For Information Sharing
		Operational Processes			**NA**	Unofficial Public Volunteer Work
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Interpersonal Network Became Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness	-	-	-	
		Direct Consequences				National and International Communication Lines Failure
		Operational Processes	**NA**	**NA**	**NA**	Unofficial Public Volunteer Work
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Family And Friends Communication
	Traditional Media	Emergency Preparedness	-	-	-	
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
		Operational Processes	**NA**	**NA**	**NA**	Unofficial Public Volunteer Work
		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Spreading Rumors Or Misleading Messages
Public/ Authorities	Face-to-Face	Emergency Preparedness	-	-	-	
		Direct Consequences	-	-	-	
		Operational Processes				Decentralized Communication

		Resource Management			NA	Unable To Comprehend Due To Foreign Languages
						Mis-Coordination On Supply And Aid Management
		Relief Information				Interpersonal Network Became Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness	-	-	-	
		Direct Consequences				National and International Communication Lines Failure
		Operational Processes				Decentralized Communication
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Establishment Of Informative Line In Addition To The Permanent Emergency Number
	Traditional Media	Emergency Preparedness		-	-	Lack Of Alerts
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
						Broadcasting Information Without Filtering
		Operational Processes				Instructions And Orientation By Authorities
		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Reporting Relief Information When Authorities Failed To
						Spreading Rumors Or Misleading Messages
Public/ Government	Face-to-Face	Emergency Preparedness	-	-	-	
		Direct Consequences				President Touring The Affected Area
		Operational Processes				Decentralized Communication
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Census And Missing People Data Was Restricted By The Government
						Interpersonal Network Became Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness	-	-	-	
		Direct Consequences				National and International Communication Lines Failure

		Operational Processes				Decentralized Communication
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Census And Missing People Data Was Restricted By The Government
						Establishment Of Informative Line In Addition To The Permanent Emergency Number
	Traditional Media	Emergency Preparedness		-	-	Lack Of Alerts
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
						Broadcasting Information Without Filtering
		Operational Processes		**NA**	**NA**	President Speech For Governmental Aid Activation
						Instructions And Orientation By Authorities
		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Reporting Relief Information When Government Failed To
						Spreading Rumors Or Misleading Messages
Authorities/ Authorities	Face-to-Face	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Alerts
		Direct Consequences				Interpersonal Network Became Fundamental For Information Sharing
		Operational Processes				Decentralized Communication
						Lack Of Coordination and Interaction
						Collaboration Between Authorities And Private Companies
		Resource Management			**NA**	Unable To Comprehend Due To Foreign Languages
						Mis-Coordination On Supply And Aid Management
		Relief Information				Overload/Lack Of Information For Decision Making
						Relief Information Was Being Obtained Through The Mass Media
						Interpersonal Network Became Fundamental For Information Sharing

	Peer-to-Peer	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Warning System
				-	-	Lack Of Alerts
		Direct Consequences				National and International Communication Lines Failure
		Operational Processes				Decentralized Communication
						Lack Of Coordination and Interaction
						Collaboration Between Authorities And Private Companies
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Overload/Lack Of Information For Decision Making
						Relief Information Was Being Obtained By The Mass Media
						Damage Assessment Sharing Information Between Agencies
						International Assistance And Donation Management
	Traditional Media	Emergency Preparedness		-	-	Lack Of Alerts
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
						Broadcasting Information Without Filtering
		Operational Processes				Instructions And Orientation By Authorities
		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Reporting Relief Information When Authorities Failed To
						Spreading Rumors Or Misleading Messages
Authorities/ Government	Face-to-Face	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
		Direct Consequences				Interpersonally Network Became Fundamental For Information Sharing
		Operational Processes				Decentralized Communication
						Lack Of Coordination and Interaction

		Resource Management			NA	Unable To Comprehend Due To Foreign Languages
						Mis-Coordination On Supply And Aid Management
		Relief Information				Overload/Lack Of Information For Decision Making
						Census And Missing People Data Was Restricted By The Government
						Relief Information Was Being Obtained By The Mass Media
						Interpersonal Network Became Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Warning System
				-	-	Lack Of Alerts
		Direct Consequences				National and International Communication Lines Failure
		Operational Processes				Decentralized Communication
						Lack Of Coordination and Interaction
						DDF Failed Contacting Authority Leaders
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Overload/Lack Of Information For Decision Making
						Census And Missing People Data Was Restricted By The Government
						Relief Information Was Being Obtained By The Mass Media
						Damage Assessment Sharing Information
						International Assistance And Donation Management
	Traditional Media	Emergency Preparedness		-	-	Lack Of Alerts
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
						Broadcasting Information Without Filtering
		Operational Processes		NA	NA	President Speech For Governmental Aid Activation

		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Reporting Relief Information When Government Failed To
						Spreading Rumors Or Misleading Messages
Government/ Government	Face-to-Face	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
		Direct Consequences				Interpersonal Network Became Fundamental For Information Sharing
		Operational Processes				Decentralized Communication
						Plan DN-III-E Implementation
						Lack Of Coordination and Interaction
		Resource Management			**NA**	Unable To Comprehend Due To Foreign Languages
						Mis-Coordination On Supply And Aid Management
		Relief Information				Overload/Lack Of Information For Decision Making
						Census And Missing People Data Was Restricted By The Government
						Relief Information Was Being Obtained By The Mass Media
						Interpersonal Network Became Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Warning System
				-	-	Lack Of Alerts
		Direct Consequences				National and International Communication Lines Failure
		Operational Processes				Decentralized Communication
						Plan DN-III-E Implementation
						Lack Of Coordination and Interaction
						DDF Failed Contacting Delegation Leaders
		Resource Management				Mis-Coordination On Supply And Aid Management

		Relief Information				Overload/Lack Of Information For Decision Making
						Census And Missing People Data Was Restricted By The Government
						Relief Information Was Being Obtained By The Mass Media
						Damage Assessment Sharing Information
						International Assistance And Donation Management
	Traditional Media	Emergency Preparedness		-	-	Lack Of Alerts
		Direct Consequences				Functioning Mass Media Transmissions By Redundancy
						Broadcasting Information Without Filtering
		Operational Processes		**NA**	**NA**	President Speech For Governmental Aid Activation
		Resource Management				Reporting Requests For Resources And Needs
		Relief Information				Reporting Relief Information When Government Failed To
						Spreading Rumors Or Misleading Messages

Table 20 Emergency Communication Analysis by the Modified Classical Persuasion Model (Lasswell) for the 2007 Tabasco and Chiapas Flooding

Between Who	Through What	For What	Early Stage	Long Stage	Recovery	Scenario
Public/Public	Face-to-Face	Emergency Preparedness				Slight Few Learning Process From Previous Floods
		Direct Consequences				Interpersonal Network Is Still Fundamental For Information Sharing
						Family and Relatives Communication For Sheltering
		Operational Processes				Unofficial Public Volunteer Work
		Resource Management				Mis-Coordination On Supply And Aid Management
						Family and Relatives Communication For Supplies
		Relief Information				Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness	-	-	-	
		Direct Consequences				Family and Relatives Communication For Sheltering
						National and International Communication Lines Failure
		Operational Processes				Unofficial Public Volunteer Work
		Resource Management				Mis-Coordination On Supply And Aid Management
						Family and Relatives Communication For Supplies
		Relief Information				Family And Friends Communication
	Traditional Media	Emergency Preparedness	-	-	-	
		Direct Consequences				Functioning Mass Media Transmissions
		Operational Processes				Unofficial Public Volunteer Work
		Resource Management				Reporting Request For Resources And Needs
		Relief Information				International News Broadcasting
						Spreading Rumors Or Misleading Messages
	New Media	Emergency Preparedness	-	-	-	

		Direct Consequences				Functioning Digital Mass Media Transmissions
		Operational Processes				On-line Reporting
		Resource Management				Donations By Internet Through Blogs, Flickr and MySpace
		Relief Information				International News Broadcasting
						Blogs, Flickr, MySpace and YouTube
			NA	**NA**	**NA**	Map Catalog
Public/ Authorities	Face-to-Face	Emergency Preparedness		-	-	Preventive Instructions Given By Authorities Such Structural Measures And Evacuation
		Direct Consequences				Lack Of Information Sharing By Authorities
		Operational Processes				Instruction And Orientation By Authorities
						Interpersonal Network Is Still Fundamental For Information Sharing
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information				Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness				Resilience Of Communication Network
		Direct Consequences				Lack Of Information Sharing By Authorities
						National and International Communication Lines Failure
		Operational Processes				Instruction And Orientation By Authorities
						Unofficial Public Volunteer Work
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information	-			Establishment Of Call Center
	Traditional Media	Emergency Preparedness				Weather Forecast
		Direct Consequences				Functioning Mass Media Transmissions
		Operational Processes				Instructions And Orientation By Authorities
		Resource Management				Reporting Request For Resources And Needs

		Relief Information				Reporting Relief Information
						Functioning Mass Media Transmissions
						International News Broadcasting
	New Media	Emergency Preparedness				Weather Forecast
		Direct Consequences				Functioning Digital Mass Media Transmissions
		Operational Processes				Instructions And Orientation By Authorities
						On-line Reporting
		Resource Management				Reporting Request For Resources And Needs
		Relief Information	-			Establishment Of Internet Center
						International News Broadcasting
						Red Cross Homepage/Website
						Map Catalog
Public/ Government	Face-to-Face	Emergency Preparedness	-	-	-	
		Direct Consequences				President Touring The Affected Areas
						Lack Of Information Sharing By Government
		Operational Processes				Instruction And Orientation By Government
		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information	-			Touch Screen Web Based Missing People List
						Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness	-	-	-	
		Direct Consequences				Lack Of Information Sharing By Government
						National and International Communication Lines Failure
		Operational Processes				Instruction And Orientation By Government

		Resource Management				Mis-Coordination On Supply And Aid Management
		Relief Information	-			Establishment Of Call Center
	Traditional Media	Emergency Preparedness				Delay Alert Without Emphasizing The Severity
		Direct Consequences				Functioning Mass Media Transmissions
		Operational Processes				President Speech For Governmental Aid Activation
						Instructions And Orientation By Government
		Resource Management				Reporting Request For Resources And Needs
		Relief Information				Governor Official Notices
						Reporting Relief Information
						Functioning Mass Media Transmissions
						International News Broadcasting
	New Media	Emergency Preparedness	-	-	-	
		Direct Consequences				Functioning Digital Mass Media Transmissions
		Operational Processes				President Speech In The Mexican Republic Governmental Page
						On-line Reporting
		Resource Management				Reporting Request For Resources And Needs
		Relief Information	-			Touch Screen Web Based Missing People List
			-			Establishment Of Internet Center
						International News Broadcasting
						State Governmental Homepage/Website (Only In Spanish)
						Map Catalog
Authorities/ Authorities	Face-to-Face	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Confusing Alerts

		Direct Consequences	**NA**	**NA**	**NA**	
		Operational Processes				Collaboration Between Authorities And Private Companies
		Resource Management				Mis-Coordination On Facility Centers
		Relief Information				Lack Of Information For Decision Making
						Damage Assessment Sharing Information Between Agencies
						Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Effective Warning System
						Resilience Of Communication Network
				-	-	Confusing Alerts
		Direct Consequences				National and International Communication Lines Failure
		Operational Processes				Coordination With International Agencies
						Collaboration Between Authorities And Private Companies
						Coordination And Interaction
		Resource Management				Mis-Coordination On Facility Centers
						Mis-Coordination On Supply And Aid Management Between National And International Agencies
		Relief Information				Lack Of Information For Decision Making
						Damage Assessment Sharing Information Between Agencies
						International Assistance and Donation Management
	Traditional Media	Emergency Preparedness		-	-	Confusing Alerts
		Direct Consequences				Functioning Mass Media Transmissions
		Operational Processes	-	-	-	Interagency Communication Should Not Be Discussed On Mass Media (Out of Our Research Reach)
		Resource Management	-	-	-	

		Relief Information	-	-	-	
	New Media	Emergency Preparedness	**NA**	**NA**	**NA**	Not Enough Information About the Use For New Media Communication
		Direct Consequences				Functioning Digital Mass Media Transmissions
		Operational Processes				Coordination And Interaction
						On-line Reporting
		Resource Management				Monitor and Management Of Resources
		Relief Information				Red Cross Homepage/Website
						International Assistance and Donation Management
authorities/ Government	Face-to-Face	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
		Direct Consequences				Lack Of Honest Communication (Dam Man Made Disaster?)
		Operational Processes				Preventive Instructions Such Structural Measures And Evacuation
		Resource Management				Mis-Coordination On Facility Centers
		Relief Information				Lack Of Information For Decision Making
						Damage Assessment Sharing Information Between Agencies
						Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Effective Warning System
						Monetary Resources Were Misspent (Corruption) For Structural Measures
						Resilience Of Communication Network
				-	-	Confusing Alerts
		Direct Consequences				Request For International Aid
						Lack Of Honest Communication (Dam Man Made Disaster?)
						National and International Communication Lines Failure

		Operational Processes				Preventive Instructions Such Structural Measures And Evacuation
						Coordination And Interaction
						Coordination With International Agencies
		Resource Management				Mis-Coordination On Facility Centers
						Mis-Coordination On Supply And Aid Management Between National And International Agencies
		Relief Information				Lack Of Information For Decision Making
						Damage Assessment Sharing Information Between Agencies
						International Assistance and Donation Management
	Traditional Media	Emergency Preparedness		-	-	Confusing Alerts
		Direct Consequences				Lack Of Honest Communication (Dam Man Made Disaster?)
		Operational Processes	-	-	-	Interagency Communication Should Not Be Discussed On Mass Media (Out of Our Research Reach)
		Resource Management	-	-	-	
		Relief Information	-	-	-	
	New Media	Emergency Preparedness	**NA**	**NA**	**NA**	Not Enough Information About the Use For New Media Or Social Network For Interagency Communication
		Direct Consequences				Functioning Digital Mass Media Transmissions
		Operational Processes	**NA**	**NA**	**NA**	Not Enough Information About the Use For New Media Or Social Network For Interagency Communication
		Resource Management	**NA**	**NA**	**NA**	
		Relief Information				Red Cross Homepage/Website
						State Governmental Homepage/Website (Only In Spanish)
						International Assistance and Donation Management
Government/ Government	Face-to-Face	Emergency Preparedness		**NA**	**NA**	Funds Request From FONDEN
						Lack Of Planning Causing Delay In Decision Making
		Direct Consequences				Hierarchical Communication Between Federal And State Government

		Operational Processes				Activation And Function Of The Operational Emergency Committee
						Plan DN-III-E Implementation
						Lack Of Coordination and Interaction
						Disagreement In Decision Making Causing Delay Of Action
		Resource Management				Mis-Coordination On Facility Centers
		Relief Information				Lack Of Information For Decision Making
						Damage Assessment Sharing Information Between Agencies
						Releasing Information Disagreement
						Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness				Lack Of Planning Causing Delay In Decision Making
				-	-	Lack Of Effective Warning System
						Monetary Resources Were Misspent (Corruption) For Structural Measures
				-	-	Confusing Alerts
		Direct Consequences				Hierarchical Communication Between Federal And State Government
						Request For International Aid
						National and International Communication Lines Failure
		Operational Processes				Plan DN-III-E Implementation
						Coordination With International Agencies
						Lack Of Coordination and Interaction
		Resource Management				Mis-Coordination On Facility Centers
						Mis-Coordination On Supply And Aid Management Between National And International Agencies
		Relief Information				Lack Of Information For Decision Making
						Damage Assessment Sharing Information Between Agencies

						International Assistance and Donation Management
	Traditional Media	Emergency Preparedness		-	-	Confusing Alerts
		Direct Consequences				Lack Of Honest Communication (Dam Man Made Disaster?)
		Operational Processes	-	-	-	
		Resource Management	-	-	-	Interagency Communication Should Not Be Discussed On Mass Media (Out of Our Research Reach)
		Relief Information	-	-	-	
	New Media	Emergency Preparedness		-	-	Confusing Alerts
		Direct Consequences				Functioning Digital Mass Media Transmissions
		Operational Processes	**NA**	**NA**	**NA**	
		Resource Management	**NA**	**NA**	**NA**	
		Relief Information				State Governmental Homepage/Website (Only In Spanish)
						International Assistance and Donation Management

Table 21 Emergency Communication Analysis by the Modified Classical Persuasion Model (Lasswell) for the 2012 Popocatépetl Crisis

Between Who	Through What	For What	Early Stage	Long Stage	?	Scenario
Public/Public	Face-to-Face	Emergency Preparedness			?	Family and Friends Communication About Alerting System (VTLAS)
		Direct Consequences			?	Interpersonal Network Is Important But Not Fundamental For Information Sharing
		Operational Processes	-	-	?	
		Resource Management	-	-	?	
		Crisis Information			?	Interpersonal Network Is Important But Bot Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness			?	Family and Friends Communication About Alerting System (VTLAS)
		Direct Consequences			?	Contacting Is Important But Not Fundamental For Information Sharing
		Operational Processes	-	-	?	
		Resource Management	-	-	?	
		Crisis Information			?	Contacting Is Important But Not Fundamental Information Sharing
	Traditional Media	Emergency Preparedness			?	Transmitting Public Interviews About Preventive Action
		Direct Consequences			?	Broadcasting About Volcano Crisis
		Operational Processes	-	-	?	
		Resource Management	-	-	?	
		Crisis Information			?	Confirming Uploaded Public Information
					?	Transmitting Public Interviews About Volcano Crisis
	New Media	Emergency Preparedness	-	-	?	
		Direct Consequences			?	Digital Broadcasting About Volcano Crisis
		Operational Processes			?	On-line Reporting
		Resource Management	-	-	?	
		Crisis Information			?	Use of Internet for Information Sharing

					?	High Use of Internet Among Upper and Medium Social Class
					?	Low Use of Internet Among Low Social Class
					?	Public Becoming Producers of Information
					?	Public Reporting Not Reliable Information and Spreading Rumors
	Social Network	Emergency Preparedness			?	Family and Friends Communication About Alerting System (VTLAS)
		Direct Consequences			?	Social Network Became Fundamental For Information Sharing
		Operational Processes			?	On-line Reporting
		Resource Management	-	-	?	
		Crisis Information			?	Use of Social Networks for Information Sharing
					?	High Use of Social Network Among Upper and Medium Social Class
					?	Low Use of Social Network Among Low Social Class
					?	Public Becoming Producers of Information Mainly Through Twitter and YouTube
						International Public Becoming Producers of Information Mainly Through Twitter and YouTube
					?	Public Reporting Not Reliable Information and Spreading Rumors
					?	Social Network Became Fundamental For Information Sharing
Public/Authorities	Face-to-Face	Emergency Preparedness	-	-	?	
		Direct Consequences	-	-	?	
		Operational Processes			?	Instructions and Orientation by Authorities In Case of Contingency
					?	Authorities Performed Survey About the Information Sharing Between Them
					?	Virtual Simulation For Evacuation
		Resource Management	-	-	?	
		Crisis Information	-	-	?	
	Peer-to-Peer	Emergency Preparedness			?	Informative Permanent Line (POPOTEL)

		Direct Consequences	-	-	?	
		Operational Processes			?	Instructions and Orientation by Government In Case of Contingency
		Resource Management	-	-	?	
		Crisis Information			?	Public Looking For Information
					?	Virtual Simulation For Evacuation
	Traditional Media	Emergency Preparedness			?	Instructions and Orientation by Authorities For Evacuation (Signals and Pamphlets)
					?	Alerting System (VTLAS) Status
		Direct Consequences			?	Increasing Alert System (VTLAS) Status
					?	Broadcasting About Volcano Crisis
		Operational Processes			?	Instructions and Orientation by Authorities In Case of Contingency
					?	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	Encouraging Volunteering Work
		Resource Management	-	-	?	
		Crisis Information			?	Results of Survey About the Information Sharing Between Authorities and Public
					?	Reporting Contact Information
					?	Mass Media Still Fundamental For Information Sharing
					?	Virtual Simulation For Evacuation
					?	Confirming Uploaded Public Information
					?	International Broadcasting
	New Media	Emergency Preparedness			?	Alerting System (VTLAS) Status (Official Homepage/Websites)
					?	Informative Permanent e-mail (POPO e-mail)
		Direct Consequences			?	Increasing Alert System (VTLAS) Status
					?	Digital Broadcasting About Volcano Crisis

		Operational Processes			?	Instructions and Orientation by Authorities In Case of Contingency
					?	On-line Reporting
		Resource Management	-	-	?	
		Crisis Information			?	Informative Report Status (Official Homepage/Websites)
					?	Public Looking For Information (Internet Penetration In Rural Areas and Public Interes)
					?	Virtual Simulation For Evacuation
					?	Use of Internet for Information Sharing
					?	High Use of Internet Among Upper and Medium Social Class
					?	Low Use of Internet Among Low Social Class
					?	Public Becoming Producers of Information
					?	Public Reporting Not Reliable Information and Spreading Rumors
					?	Confirming Uploaded Public Information
					?	International Broadcasting
	Social Network	Emergency Preparedness			?	Alerting System (VTLAS) Status (Twitter and YouTube)
		Direct Consequences			?	Increasing Alert System (VTLAS) Status Through Social Media
		Operational Processes			?	Instructions and Orientation by Authorities In Case of Contingency
					?	Virtual Simulation For Evacuation
		Resource Management	-	-	?	
		Crisis Information			?	Use of Internet for Information Sharing
					?	High Use of Internet Among Upper and Medium Social Class
					?	Low Use of Internet Among Low Social Class
					?	Public Becoming Producers of Information Mainly Through Twitter and YouTube
					?	Public Reporting Not Reliable Information and Spreading Rumors

					?	Confirming Uploaded Public Information
Public/Government	Face-to-Face	Emergency Preparedness	-	-	?	
		Direct Consequences			?	Governors Touring the Risky Zones
		Operational Processes			?	Instructions and Orientation by Government In Case of Contingency
					?	Virtual Simulation For Evacuation
					?	Census Survey
		Resource Management	-	-	?	
		Crisis Information			?	Governors Taking Care of Public Needs
	Peer-to-Peer	Emergency Preparedness			?	Permanent Emergency Number 060
		Direct Consequences	-	-	?	
		Operational Processes			?	Instructions and Orientation by Government In Case of Contingency
					?	Virtual Simulation For Evacuation
		Resource Management	-	-	?	
		Crisis Information			?	Establishment of Informative Line In Addition to the Permanent Emergency Number
	Traditional Media	Emergency Preparedness			?	Instructions and Orientation by Government For Evacuation (Signals and Pamphlets)
					?	Alerting System (VTLAS) Status
		Direct Consequences			?	Increasing Alert System (VTLAS) Status
					?	Broadcasting About Volcano Crisis
		Operational Processes			?	Instructions and Orientation by Government In Case of Contingency
					?	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	Virtual Simulation For Evacuation
					?	Encouraging Volunteering Work
		Resource Management	-	-	?	

		Crisis Information			?	Urging People to Be Aware of Official Information
					?	Reporting Contact Information
					?	Mass Media Still Fundamental For Information Sharing
					?	Contradictorily Declarations
					?	Confirming Uploaded Public Information
					?	International Broadcasting
					?	President Speech and Governors Notices About the Volcano Crisis
	New Media	Emergency Preparedness			?	Alerting System (VTLAS) Status (Official Homepage/Websites)
		Direct Consequences			?	Increasing Alert System (VTLAS) Status
					?	Digital Broadcasting About Volcano Crisis
		Operational Processes			?	Instructions and Orientation by Government In Case of Contingency
					?	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	Virtual Simulation For Evacuation
					?	President Speech About the Volcano Crisis
					?	On-line Reporting
		Resource Management	-	-	?	
		Crisis Information			?	Informative Report Status (Official Homepage/Websites)
					?	Use of Internet for Information Sharing
					?	High Use of Internet Among Upper and Medium Social Class
					?	Low Use of Internet Among Low Social Class
					?	Public Becoming Producers of Information Mainly Through Twitter and YouTube
					?	Public Reporting Not Reliable Information and Spreading Rumors
					?	Confirming Uploaded Public Information

					?	President Speech About the Volcano Crisis In the Mexican Republic Governmental Page
					?	On-line Reporting
					?	International Broadcasting
	Social Network	Emergency Preparedness			?	Alerting System (VTLAS) Status (Twitter and YouTube)
		Direct Consequences			?	Increasing Alert System (VTLAS) Status Through Social Media
		Operational Processes			?	Instructions and Orientation by Government In Case of Contingency
					?	Virtual Simulation For Evacuation
					?	On-line Reporting
		Resource Management	-	-	?	
		Crisis Information			?	Use of Internet for Information Sharing
					?	High Use of Internet Among Upper and Medium Social Class
					?	Low Use of Internet Among Low Social Class
					?	Public Becoming Producers of Information
					?	Public Reporting Not Reliable Information and Spreading Rumors
					?	Confirming Uploaded Public Information
Authorities/ Authorities	Face-to-Face	Emergency Preparedness			?	Effective Early Warning and Alerting System
		Direct Consequences			?	Evaluation Meetings for the Occasion of the Change of the VTLAS
					?	Hierarchical Communication Between Agencies
					?	Interpersonal Network Is Still Fundamental For Information Sharing
		Operational Processes			?	Implementation of the Popocatépetl Operative Plan Preventive Phase
					?	Collaboration Between Authorities
					?	Coordination And Interaction
		Resource Management			?	Organizing Possible Resources Needs

		Crisis Information			?	Scientific Committee Analysis
					?	Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness			?	Monitoring System
					?	Effective Early Warning and Alerting System
		Direct Consequences			?	Acoustic Alarm Detected by the Monitoring System, Auto Dial Messages Sent
					?	Increasing the VTLAS Status
					?	Hierarchical Communication Between Federal, State and Municipal Government
		Operational Processes			?	Implementation of the Popocatépetl Operative Plan Preventive Phase
					?	Coordination and Interaction
		Resource Management			?	Organizing Possible Resources Needs
		Crisis Information			?	Monitoring System
	Traditional Media	Emergency Preparedness			?	Instructions and Orientation by Authorities For Evacuation (Reports)
		Direct Consequences			?	Broadcasting About Volcano Crisis
		Operational Processes	-	-	?	Interagency Communication Should Not Be Discussed On Mass Media (Out of Our Research Reach)
		Resource Management	-	-	?	
		Crisis Information			?	Ensuring First-Hand News by the Mass Media Through the Video Camera Donation
	New Media	Emergency Preparedness	**NA**	**NA**	?	Not Enough Information About the Use For New Media Or Social Network For Interagency Communication
		Direct Consequences	**NA**	**NA**	?	
		Operational Processes	**NA**	**NA**	?	
		Resource Management	**NA**	**NA**	?	
		Crisis Information	**NA**	**NA**	?	
	Social Network	Emergency Preparedness	**NA**	**NA**	?	
		Direct Consequences	**NA**	**NA**	?	

		Operational Processes	**NA**	**NA**	**?**	
		Resource Management	**NA**	**NA**	**?**	
		Crisis Information	**NA**	**NA**	**?**	Use of Social Networks for Information Sharing
Authorities/ Government	Face-to-Face	Emergency Preparedness			**?**	Instructions and Orientation by Authorities For Evacuation
		Direct Consequences			**?**	Evaluation Meetings for the Occasion of the Change of the VTLAS
		Operational Processes			**?**	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	President Touring the Shelters Being Prepare In Case of Evacuation
					?	Coordination And Interaction
		Resource Management			**?**	Organizing Possible Resources Needs
		Crisis Information			**?**	Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness			**?**	Instructions and Orientation by Authorities For Evacuation (Reports)
					?	Effective Early Warning and Alerting System
		Direct Consequences			**?**	Increasing the VTLAS Status
		Operational Processes			**?**	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	Coordination and Interaction
		Resource Management			**?**	Census Report and Facilities Inspection
					?	Organizing Possible Resources Needs
		Crisis Information			**?**	Reports (Volcanic Activity, Evacuation Status, Facility Centers Info. etc)
	Traditional Media	Emergency Preparedness			**?**	Instructions and Orientation by Authorities For Evacuation (Reports)
		Direct Consequences			**?**	Broadcasting About Volcano Crisis
		Operational Processes	-	-	**?**	Interagency Communication Should Not Be Discussed On Mass Media (Out of Our Research Reach)
		Resource Management	-	-	**?**	
		Crisis Information			**?**	Ensuring First-Hand News by the Mass Media Through the Video Camera Donation

	New Media	Emergency Preparedness	**NA**	**NA**	**?**	
		Direct Consequences	**NA**	**NA**	**?**	
		Operational Processes	**NA**	**NA**	**?**	
		Resource Management	**NA**	**NA**	**?**	
		Crisis Information	**NA**	**NA**	**?**	Not Enough Information About the Use For New Media Or Social Network For Interagency Communication
	Social Network	Emergency Preparedness	**NA**	**NA**	**?**	
		Direct Consequences	**NA**	**NA**	**?**	
		Operational Processes	**NA**	**NA**	**?**	
		Resource Management	**NA**	**NA**	**?**	
		Crisis Information	**NA**	**NA**	**?**	Use of Social Networks for Information Sharing
Government/ Government	Face-to-Face	Emergency Preparedness			**?**	Instructions and Orientation by Government For Evacuation
		Direct Consequences			**?**	Evaluation Meetings for the Occasion of the Change of the VTLAS
					?	Hierarchical Communication Between Federal, State and Municipal Government
		Operational Processes			**?**	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	President Overflying the Risky Zones
					?	Coordination And Interaction
		Resource Management			**?**	Organizing Possible Resources Needs
		Crisis Information			**?**	Interpersonal Network Is Still Fundamental For Information Sharing
	Peer-to-Peer	Emergency Preparedness			**?**	Instructions and Orientation by Government For Evacuation
		Direct Consequences			**?**	Hierarchical Communication Between Federal, State and Municipal Government
		Operational Processes			**?**	Implementation of the Popocatépetl Operative Plan (from Plan DN-III-E) Preventive Phase
					?	Coordination and Interaction
		Resource Management			**?**	Organizing Possible Resources Needs

					?	Census Report and Facilities Inspection
		Crisis Information			?	Reports (Volcanic Activity, Evacuation Status, Facility Centers Info. etc)
	Traditional Media	Emergency Preparedness			?	Instructions and Orientation by Authorities For Evacuation (Reports)
		Direct Consequences			?	Broadcasting About Volcano Crisis
		Operational Processes	-	-	?	Interagency Communication Should Not Be Discussed On Mass Media (Out of Our Research Reach)
		Resource Management	-	-	?	
		Crisis Information	-	-	?	
	New Media	Emergency Preparedness	**NA**	**NA**	?	Not Enough Information About the Use For New Media Or Social Network For Interagency Communication
		Direct Consequences	**NA**	**NA**	?	
		Operational Processes	**NA**	**NA**	?	
		Resource Management	**NA**	**NA**	?	
		Crisis Information	**NA**	**NA**	?	
	Social Network	Emergency Preparedness	**NA**	**NA**	?	
		Direct Consequences	**NA**	**NA**	?	
		Operational Processes	**NA**	**NA**	?	
		Resource Management	**NA**	**NA**	?	
		Crisis Information	**NA**	**NA**	?	

APPENDIX B

Ontology for Emergency Management

Ontology of Emergency Management Information

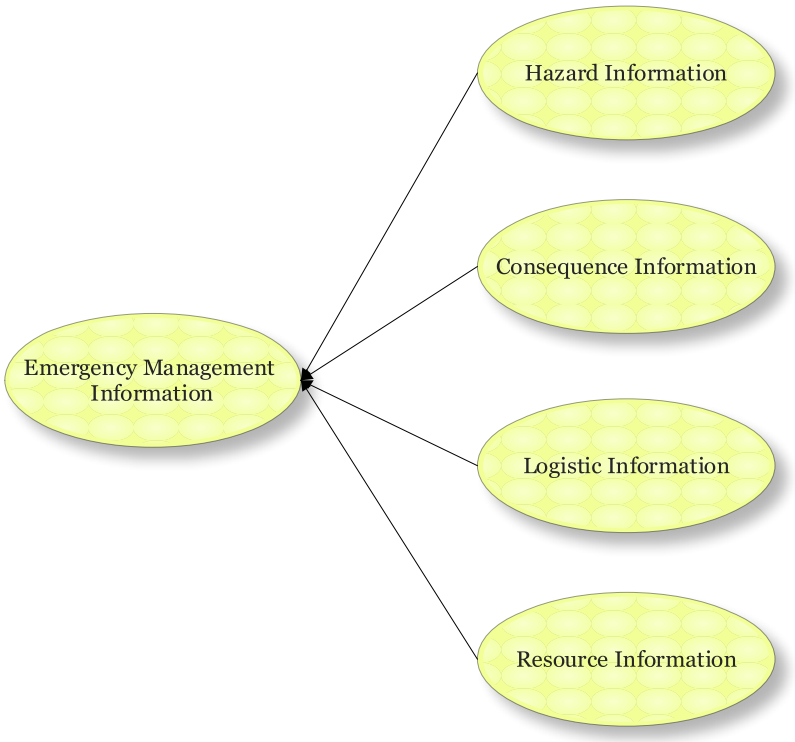

Figure 70 Ontology of Emergency Management Information (Main Categories)

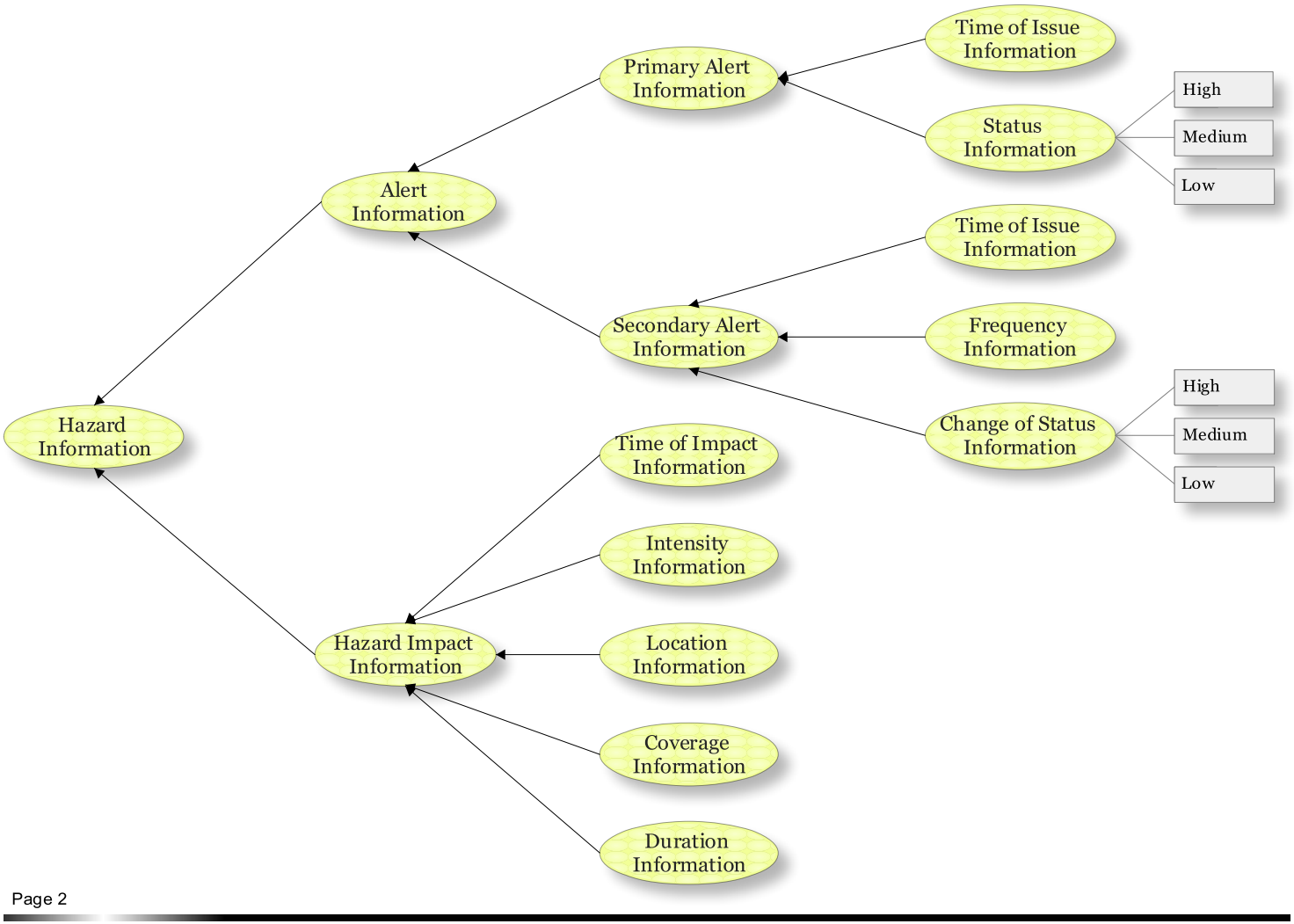

Figure 71 Ontology of Hazard Information

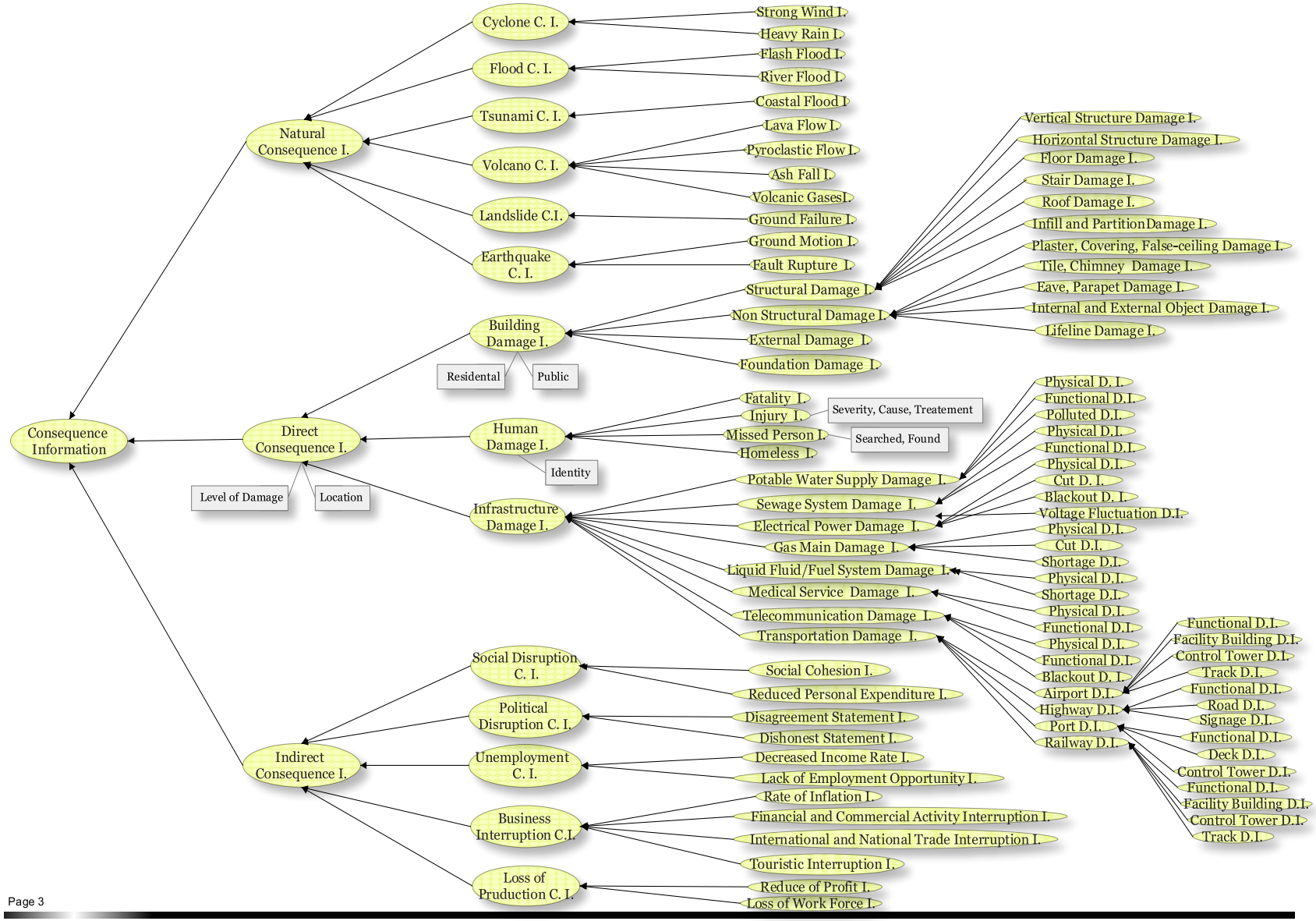

Figure 72 Ontology of Consequence Information

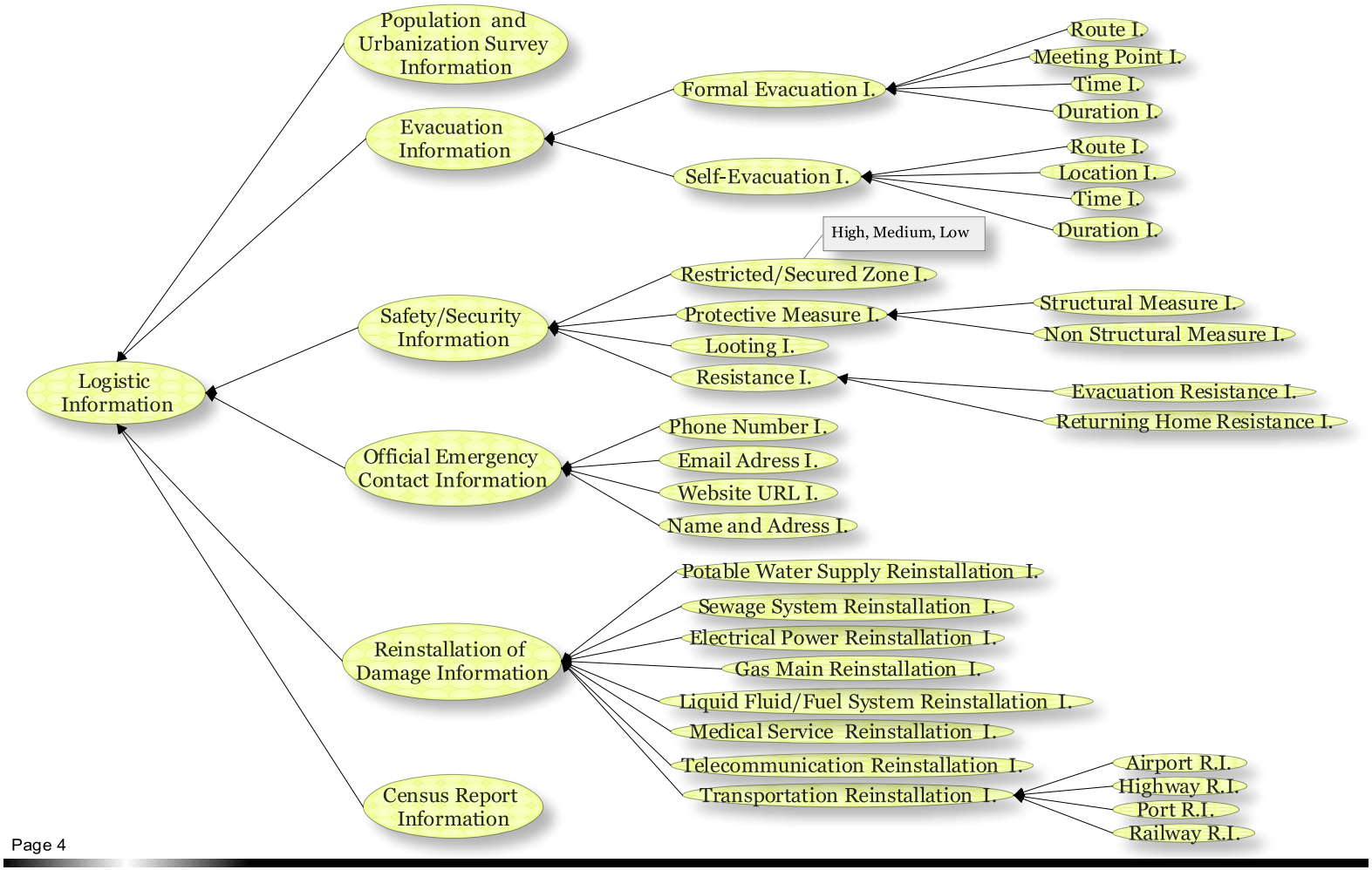

Figure 73 Ontology of Logistic Information

Ontology of Resource Information

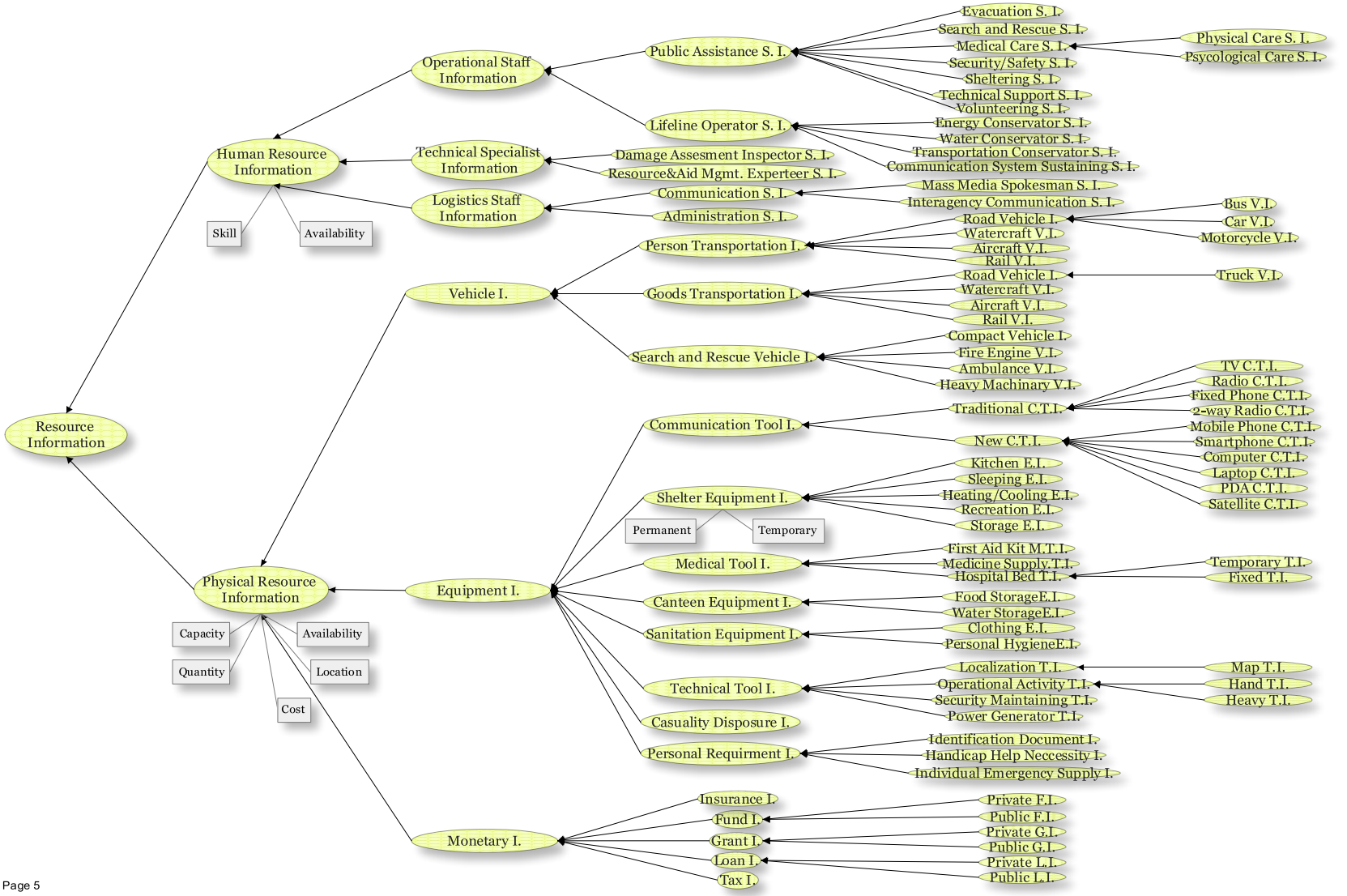

Figure 74 Ontology for Resource Information

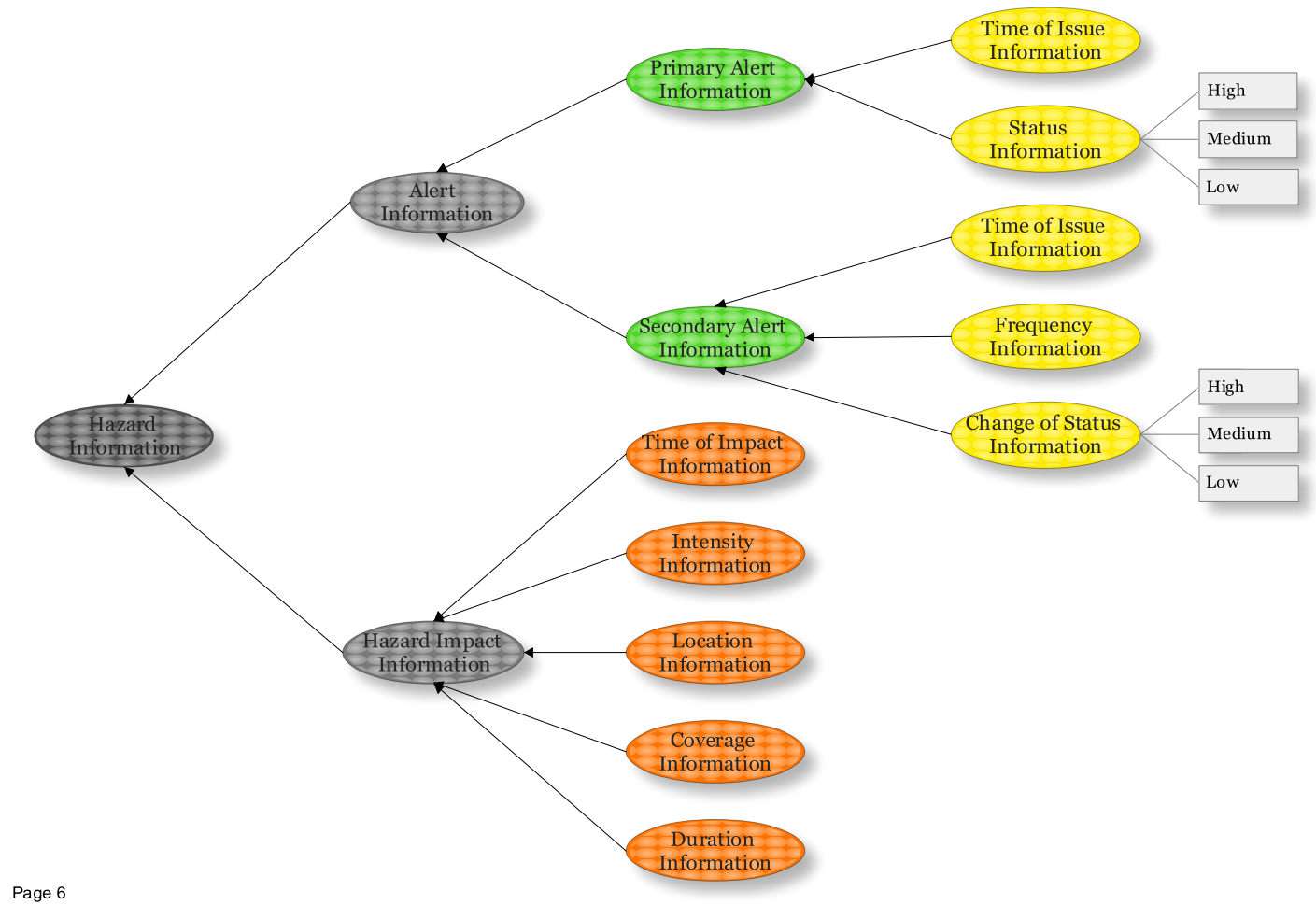

Figure 75 Colored Ontology of Hazard Information by Source

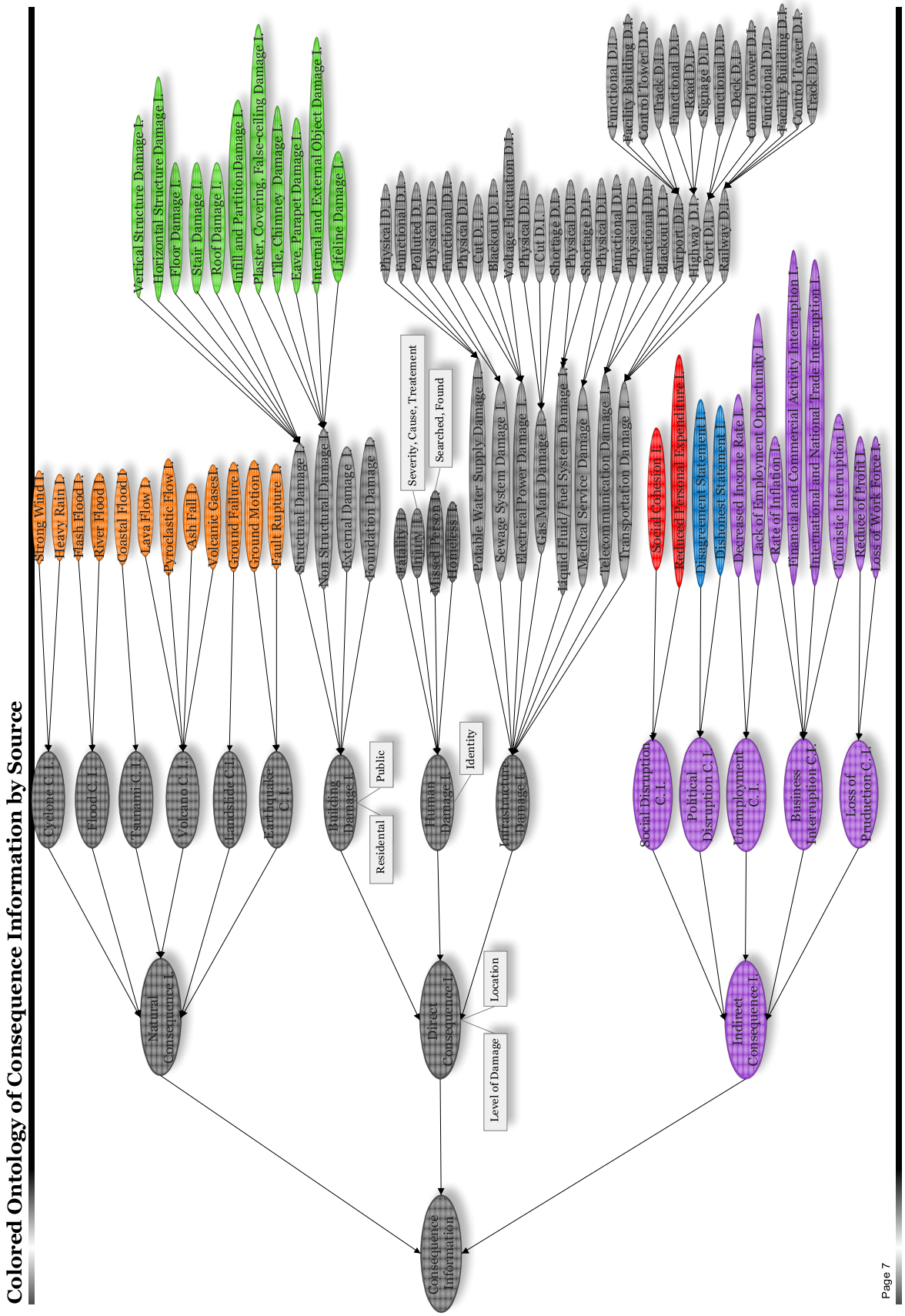

Figure 76 Colored Ontology of Consequence Information by Source

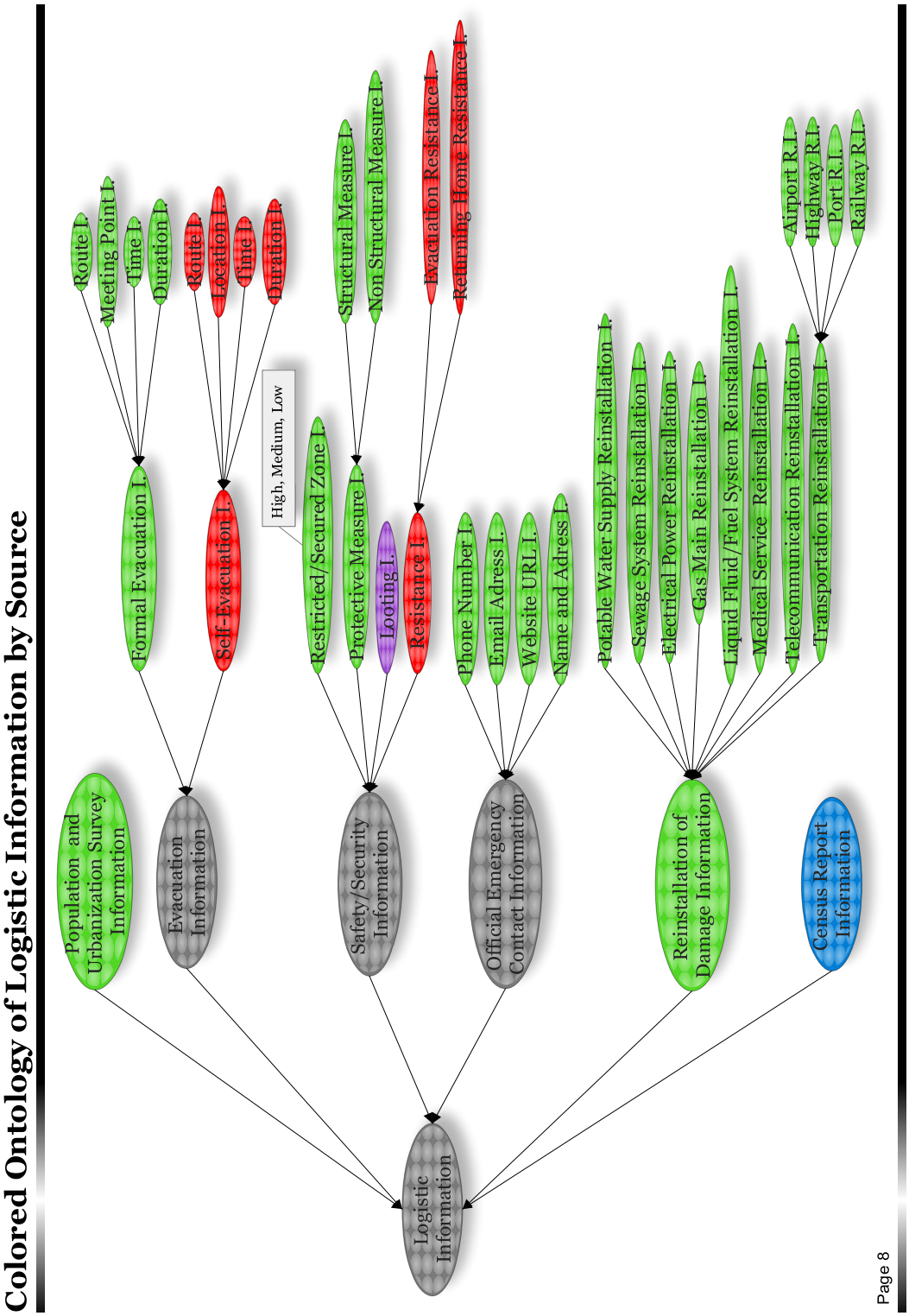

Figure 77 Colored Ontology of Logistic Information by Source

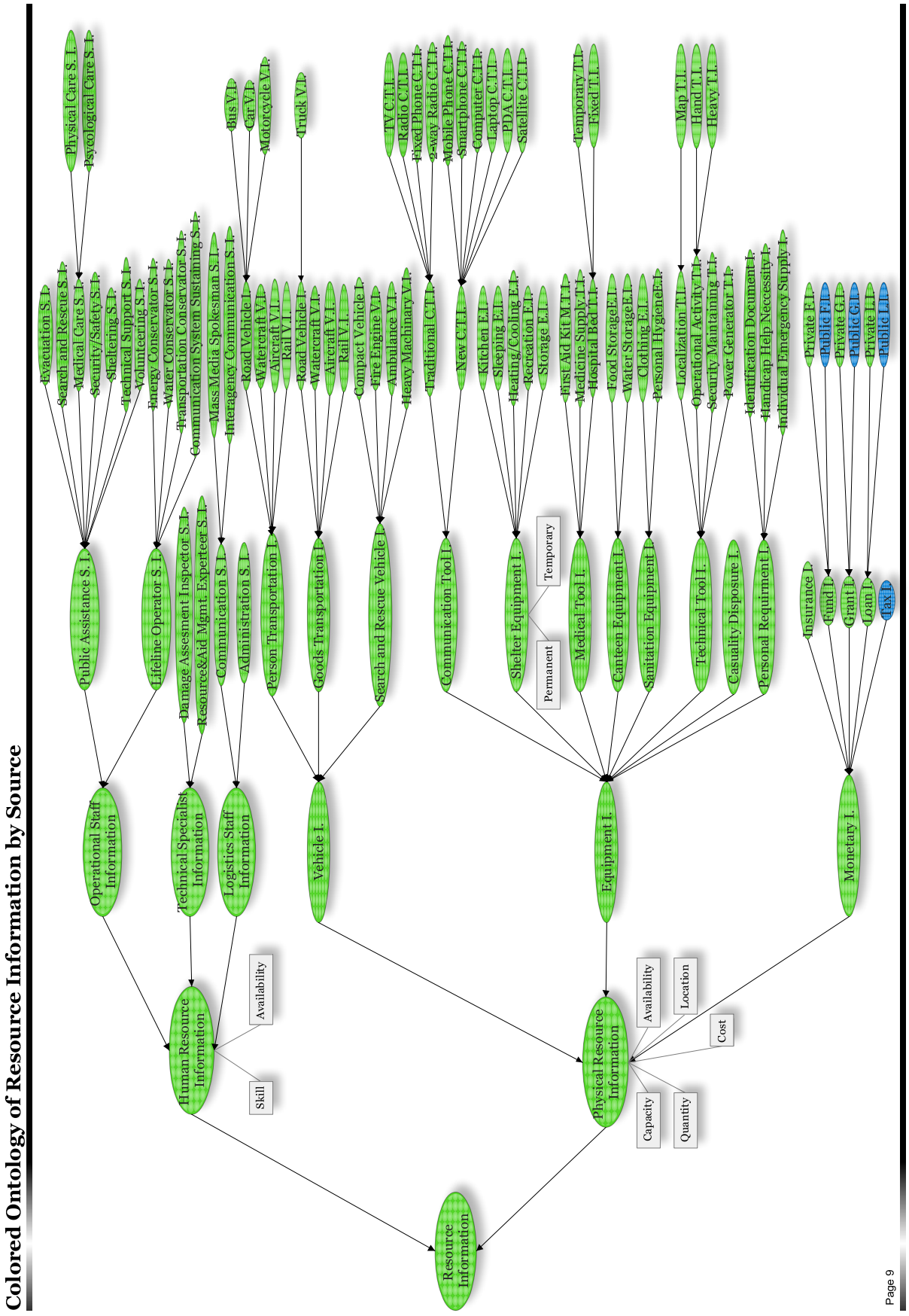

Figure 78 Colored Ontology of Resource Information by Source

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