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Importance of OSINT/SOCMINT for Modern Disaster Management Evaluation - Australia, Haiti, Japan

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Abstract

In today's world, open-source intelligence is an essential factor, and its market growth is relevant for various types of research. This report describes the importance of open source or social media intelligence for evaluating disaster management. It also gives an overview of the government work in Australia, Haiti, and Japan for disaster management using various OSINT tools and platforms.

Introduction

Since ancient times, the world has had to overcome many natural disasters that kill an average of 45,000 people annually globally [25]. With the advancement in information and technology, it has become necessary to consider Open Source or Social Media Intelligence for disaster management evaluation.

Open Source Intelligence is the information extracted from publicly available sources to apply intelligence over the data. In this context, "open source" means publicly available information can be used without permission or approval. This can be any public-related sources such as social media platforms, well-known websites, public forums, reports or books in public libraries, or articles in a newspaper. OSINT also involves data gathered through other ways of communication, such as webinars, videos, public speeches, graphics, and conferences.

Social Media Intelligence (SOCMINT) is a subdivision of OSINT that involves collecting information from social media platforms such as Facebook, Instagram, LinkedIn, and Twitter and applying intelligence to these data to extract relevant insights. The data on social media websites can be either public or private. Hence the primary difference between OSINT and SOCMINT is that OSINT is about publicly available content, whereas SOCMINT refers to private or public. SOCMINT includes private data accessible only to restricted or specific groups as per the imposed regulations by the users. The data accessible on social media can be categorized as the content posted by the user and the metadata related to the original content.

The first section of this report briefly describes the importance of OSINT/SOCMINT for evaluating modern disaster management. Section 2 explains some of the tools relevant to disaster management. Section 3 provides information about the measures taken by the Australian, Japanese, and Haiti governments for managing a disaster.

Natural Disasters and Social Media

Natural disasters have a significant impact on humans and the well-being of the affected populations. Figure 1 illustrates the number of natural disasters per year from 1970 to 2019 based on the different types of disasters [24]. Humans suffer from the damage caused to their lives, personal infrastructure, and property. The death rate from natural disasters can highly fluctuate yearly. According to Statista reports 2022 [23], in 2021, there were approximately 10,000 fatalities produced by natural disaster events globally. The count of deaths per year due to natural disasters from 2007 to 2021 is depicted in Figure 2 [23]. The growth in the number of deaths can be minimized significantly through prior prediction, flexible infrastructure, emergency preparedness, and quick response systems. The information shared between the public and the affected population is relevant to making effective decisions in the future in case of natural disasters such as earthquakes, floods, and hurricanes. Over the years, social media platforms have contributed efficiently, which helps in preparing for emergencies and providing effective responses. Governments and organizations could use this data to organize their response strategies, distribute resources in essential areas, and notify the public in real-time. The after-effects of the Haiti earthquake in 2010 have proven that social media plays a significant role as a data-generating source for disaster relief operations and management. Disaster management teams developed a geographic map of the impacted areas using location-based apps and social media platforms to provide information related to the critical areas of emergency services. It can be for the essential resources wherever needed or helping the public to get out of the affected areas. Since the Haiti earthquake disaster, social media tools have proven to be an efficient measure for the government during emergencies.

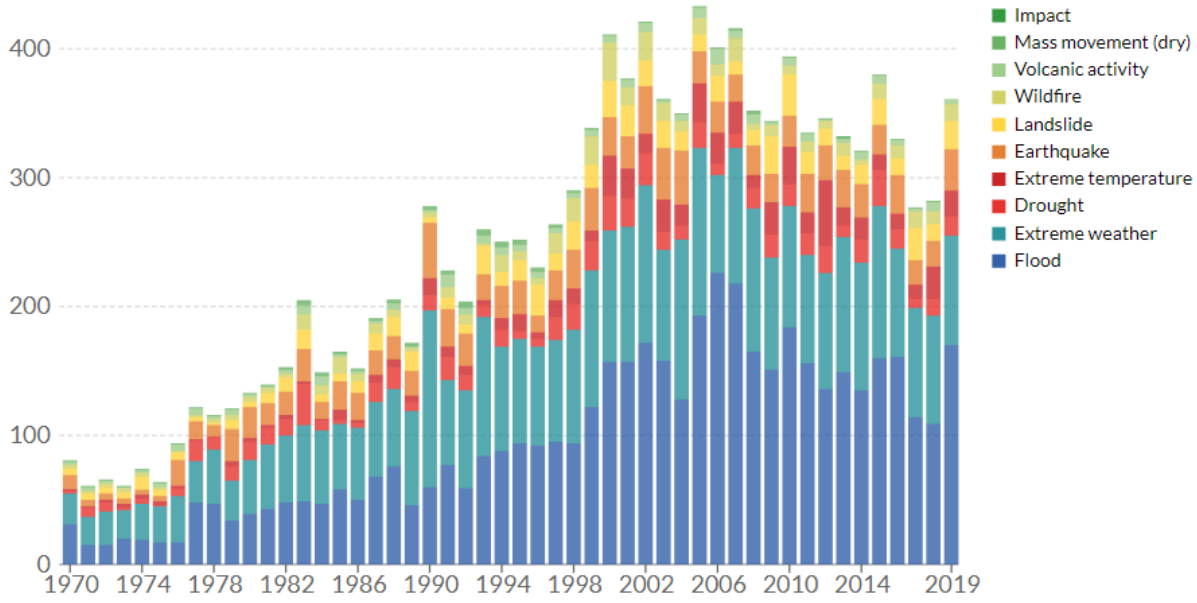

Figure 1. *Number of natural disasters per year based on the type [24]*

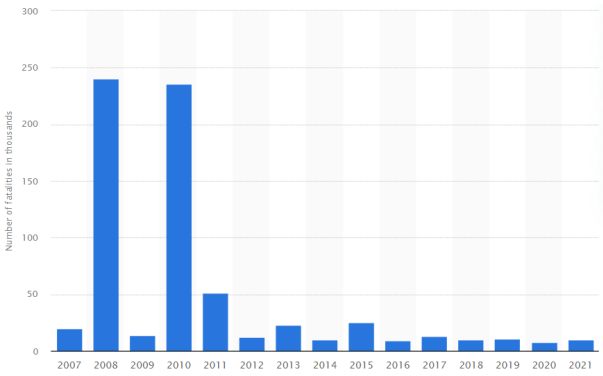

Figure 2. *Number of deaths per year due to natural disasters [23]*

In the case of unexpected events, such as natural disasters, users can respond in real-time by sharing or uploading photos, comments, videos, and audio recordings. The amount of data generated due to these events would be high. These immediate and vigorous reactions of users give an overview of the severity of the events. They could help to realize the current or potential factors that could worsen a crisis. Hence, gathering information related to the crises is essential, and social media websites provide insights into the status of natural disasters. They act as an open-source intelligence manifesto for early warnings.

Related Works

Recently, many researchers have done various studies to understand the scope of open-source or social media intelligence in the field of disaster management [31] [32] [33] [34] [35]. In [31], the authors have developed different solutions to design a multi-layer crisis map using social media. They proved how social media information could be applied to build a practical approach to providing significant crisis maps in disaster management operations. They have chosen the Twitter platform for their experiments. The researchers in [32] have developed an earthquake detector for Australia and New Zealand. The system is developed using the Emergency Situation Awareness (ESA) platform, which gives all disaster-related information. They gathered, filtered, and analyzed this data from Twitter. The Joint Australian Tsunami Warning Centre receives email notifications in case of any earthquake evidence, and the detector takes data from Twitter Tweets. Emergency Awareness is a tool to explore social media as an open source for disaster-related information. In [33], the authors researched the benefits of social media forums for gathering intelligent information about disasters and could provide warnings to the public in advance. The study conducted experiments to identify the active social media platform, the most occurring type of disaster, and the disaster locations. From their inference, as in Figure 3, Twitter is the most widely used social media website, and flood, earthquake, and hurricanes contribute to almost 50% of the disaster type. In [35], the researchers analyzed social media for disaster management, especially for the East Japan earthquake. They analyzed the Twitter dataset for the number of tweets before and after the disaster, and the results are in Figure 4.

Role of OSINT / SOCMINT

Figure 5 depicts the Global Open Source Intelligence market by source [13]. According to Verified Market research statistics as in Figure 3, among other sources, the Media plays a vital role in communicating with the public, followed by the Internet.

As depicted in Figure 6, as of January 2022, the number of users on social media substantially increased from 1.4 billion to 4.6 billion over the last ten years [17]. As the statistics in the figures explained, the significance of OSINT or SOCMINT is evident for modern disaster management evaluation as most people

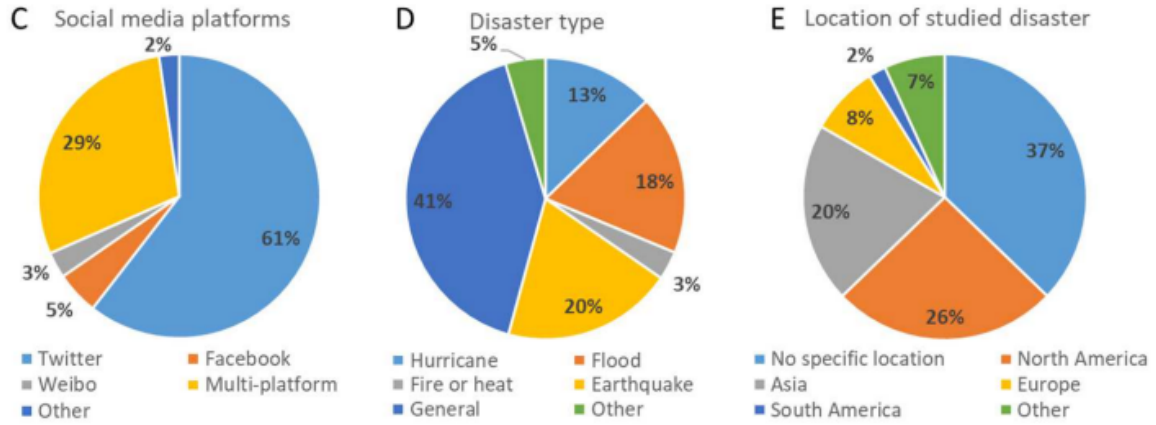

Figure 3. *Study to analyze social media forums [33]*

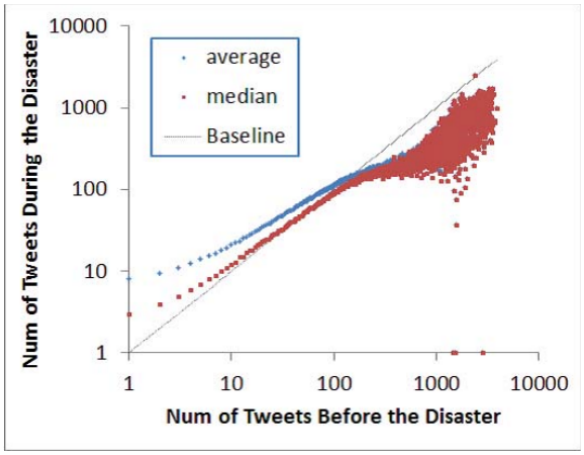

Figure 4. *Number of tweets before and after the Japan Earthquake [35]*

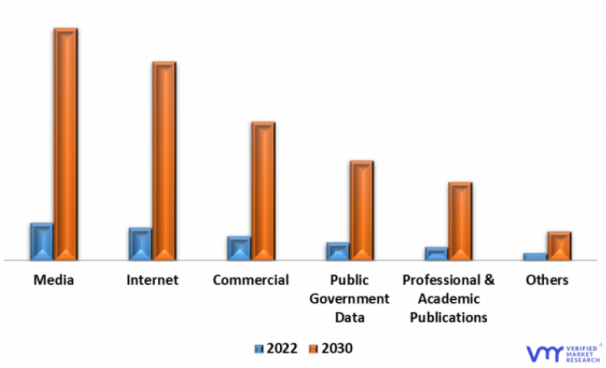

Figure 5. *Global OSINT market [13]*

worldwide rely on the internet on a large scale. Indeed, online or public platforms are the primary sources for an early update and response after a crisis. So, merging this data with intelligence sources could provide a faster response.

Data and Intelligence play a vital role in disaster management [2]. The security and emergency management teams could use open-source data to discover threats and correctly evaluate the risk levels. There are different ways in which data and intelligence collected using OSINT can be used. Some of them are explained below [2]:

- Better Situational Awareness – Photos, commentary, and videos posted online by media and the public could save time and lives.
- Misinformation Management – Manage the spread of false information before it reaches the public and creates lives at risk by wasting their time and resources.
- Improved Agency Collaboration – Understand how other agencies act during a crisis or disaster to manage situations effectively.
- Geo-targeted Risk Assessment – Be vigilant for unusual disruptions, such as terrorist threats or extreme weather conditions to occur near the areas of a planned event.

Sources to Understand the Impact of a Disaster

Public-related data

The "open source" trend, i.e., sharing data from private and public organizations in machine-readable and searchable formats, is a productive step in understanding the impact of a crisis. In most countries, the government relies on these open sources for evaluating emergencies, and it's relevant to find the primary sources that provide proper information related to the situation. Other public data which can be helpful during a crisis is collected from government or municipal offices. This typically involves birth and death certificates, personal data, census data, and socio-economic data. The traditional way of gathering this type of data was through paper-based surveys. Recently, due to the growth in digital technology, there are different mobile application-based tools to collect, cluster, and analyze data. Open Data Kit is an open-source tool that makes it easier to collect such information.

Crowd-sourced data

Another active data retrieval method is the crowdsourcing method. Crowdsourcing refers to the combination of crowd and outsourcing wherein the organizations tackle the efforts of a crowd to perform specific tasks with the help of advanced internet technologies. In crowdsourcing, applications seek knowledge from many users about specific events or topics. In crowdsourcing, jobs or tasks are outsourced to the general public and not

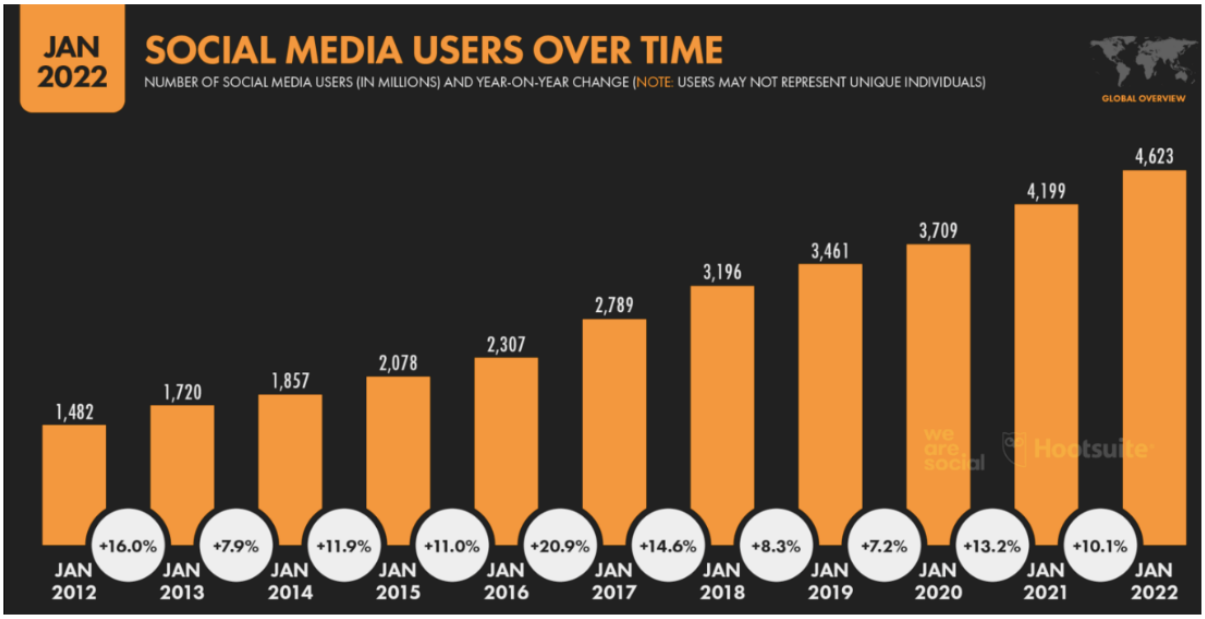

Figure 6. *Social media users over a 10-year period [17]*

to any particular organization or professional. Therefore, crowdsourcing generally integrates digital technology, human generosity, and skills, and it can be used to gather data from various sources such as blogs, social media updates, text messages, etc. In particular, social media plays a remarkable role in providing better opportunities for disaster relief efforts based on the data extracted from these sites. This data can be analyzed and synchronized in mapping disaster-struck regions and can help start the search operations. Hence, this technique has been widely used in most emergencies.

The Importance of Evaluating Risks Appropriately

The accuracy in evaluating an emerging threat situation's risk level depends on the data volume — the more information and data, the better the results. The signal can be used to set up real-time alerts in case of some crises like spreading wildfires. This can help continuously monitor and decide when or the need to take action to ensure the public is safe. Anyhow, there should be a perfect balance between over and under-protection.

Risk of Over-Protection

Over-protection is when the responses are initiated too extreme or too early. The personal interpretation of risk level frequently causes it and less information or data to give an accurate assessment. This can be a good idea for protecting people but can be cost-inefficient.

Risk of Under-Protection

Under-protection could impede the effectiveness of disaster management response. This can harm people unnecessarily by not appropriately responding to threats. The consequences of under-protection are way too higher than the associated costs. To avoid under-protection, measures such as providing clear guidance to monitor risk levels, repeatedly assessing the emergency threat landscape, and updating the alert levels accordingly could be taken. Whether it's a public health crisis, natural disaster, or terrorist attack, OSINT could provide insights to the intelligence team with the below points [4]:

- Location, impact, and consequences of a crisis,
- Need for resources,
- Response of other countries,
- Information essential for the public and other public sector organizations.

OSINT Tools for Disaster Management Evaluation

Disaster management is about applying strategies to help an entity deal with significant and sudden adverse events that can threaten them. Crisis management is not the same as crisis response. It is an extensive process that should be practiced before a crisis. Disaster management measures are done before, during, and after a crisis. Different crisis management stages are involved during the crisis management process, as shown in Figure 7.

Below are some OSINT platforms and tools useful for disaster management evaluation.

1. Ushahidi

Ushahidi is an open-source platform that uses user-generated reports to produce live, interactive maps [16]. This platform can form a crisis map by combining crowd reports with mapping and visualization tools [16]. Ushahidi tool utilizes the crowdsourcing concept, which is frequently used for crisis response [17]. This has been used for the first time as a humanitarian needs assessment tool after the Haiti earthquake in 2010 [16]. The crisis mapping of affected regions using the Ushahidi tool has been given in the upcoming sections.

2. InaSAFE

InaSAFE is open-source software that gives disaster management teams an overview of the real-time hazard impact sce-

Figure 7. *Crisis management stages [5]*

narios so that they can prepare, plan and make response activities. It provides a simple and diligent way to integrate data from local governments, scientists, and communities to yield insights that could be helpful for future disaster events. This software is developed by Indonesia, the Australian government, and the World Bank [6].

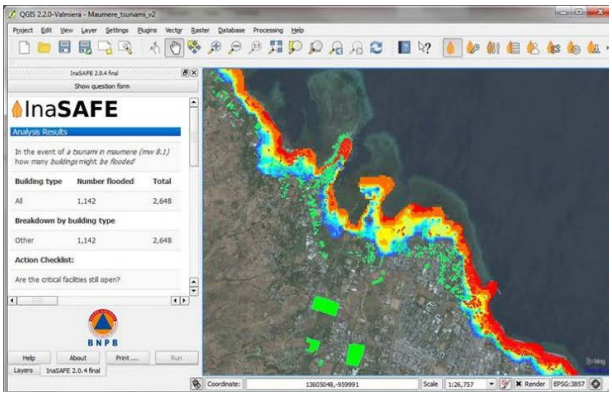

Figure 8. *. InaSAFE information about buildings [6]*

The new version, InaSAFE 2.0, can work with road data to directly download roads from OpenStreetMap, an online mapping tool [7]. This data is integrated with InaSAFE and could work in planning evacuation and emergency response routes. Figure 8 explains the buildings or regions where the flood got affected, and Figure 9 describes the information about the resources.

3. ShakeMap

ShakeMap is an open-source software system developed by the USGS Earthquake Hazards Program [14]. It automatically produces near-real-time maps and products that characterize strong ground motion's geographical extent and distribution following consequential earthquakes [15]. Figure 10 illustrates the ShakeMap of the Haiti region after the deadly earthquake in 2021.

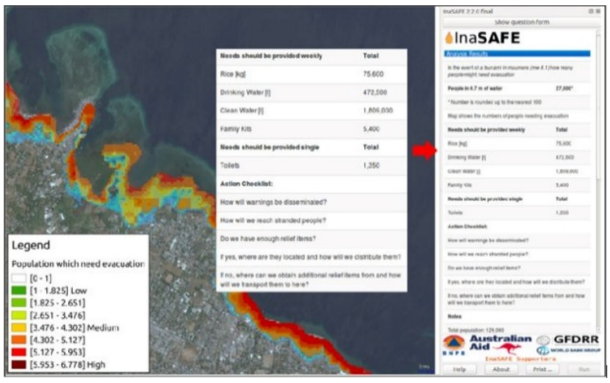

Figure 9. *ShakeMap for Haiti earthquake in 2021 [15]*

4. Sahana Eden

Sahana Software Foundation is an organization that develops open-source software for emergency and crisis management. Sahana Eden is their primary product designed to provide effective solutions for crucial humanitarian needs before or during a crisis [18] [19]. The features of Sahana Eden are designed to assist the Crisis and Emergency management teams to alleviate better, prepare, respond, and recover from the crisis more efficiently and effectively [18]. Japan used this platform for disaster management during the Earthquake, and Tsunami hit in 2011.

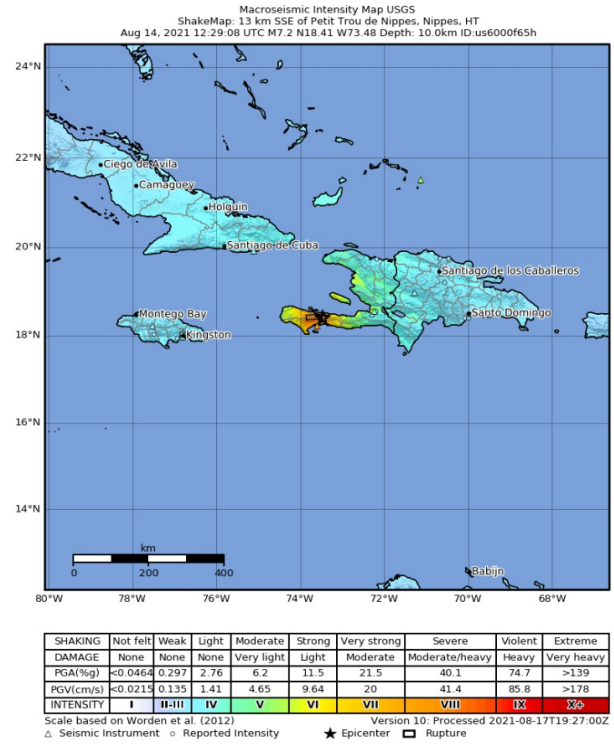

Figure 10. *ShakeMap for Haiti earthquake in 2021 [15]*

5. Talkwalker Analytics

Talkwalker analytics tool efficiently analyzes social media data from various social media platforms such as Facebook, Twitter, online forums, blogs, etc. As mentioned, these channels can serve as essential disaster management information sources. Figure 11 represents how Talkwalker analytics helps monitor social media networks. This analytics tool can identify valuable insights in real-time by analyzing text and visual data using image recognition technology. It automatically generates reports and dashboards, which could ease the task of crisis management teams. It can be used to perform sentimental analysis, as in Figure 12, during a disaster and could contribute effectively to the field of crisis management.

Disaster Management in Australia, Japan, and Haiti

Australia

Australia's Emergency Situation Awareness (ESA) system uses a data-oriented approach that depends on processing and mining unstructured raw data from various social media sources, such as Instagram, Twitter, Facebook, etc., to make early alerts. Nowadays, social media is overwhelmed with a large amount of data wherein the emergency and disaster management teams can attain real-time awareness of critical situations. But, this could be possible only with the help of valuable tools which could extract the relevant information concerning the situations. Some of the critical features of ESA are listed below:

- It could identify unusual or unpredicted incidents, possibly ahead of other alert systems.
- Categorize and analyze significant messages during a crisis that gives priority to acting quickly.
- Analysis of an incident has been done by investigating social media content before, during, and after a disaster situation

Haiti

Australia's ESA platform quickly alerts users if it detects any unusual behavior in the Twitter stream. ESA uses data mining techniques such as text classification, geo-tagging, burst detection, and online clustering [20]. Figure 13 shows the dashboard captured on June 23rd, 2021. The dashboard describes the details of Australian tweets analyzed by ESA, and prominent alerts could be visible.

A glimpse of Australia's tweets analyzed by ESA for Earthquakes is shown in Figure 14.

The details about Victoria's bushfires in 2009, as in Figure 15, were detailed in real-time on social media networks. However, this was not visible to federal disaster or state response agencies [20]. This shows the importance of social media intelligence for evaluating disaster management. Table 1 summarizes the usage of social media tools and services during the 2011 Japan earthquake and tsunami [30].

They have developed a model using 'Spark,' an open framework that can be used for predicting bushfire spread. This makes it simpler for them to control the spread, initiate warnings, and plan for disaster management operations. Spark could read weather data such as temperature, wind, and humidity features from meteorological forecasts to predict the spread using fire models. Other geographical factors like land slope, vegetarian areas, and water bodies could also affect the fire spread. All this information could be helpful in accurately predicting the bushfire models.

Australian Government Crisis Management

The Australian Government Crisis Management Framework (AGCMF) defines the approach of the Australian Government to prepare for, respond to, and recover from disasters. The main aim of the AGCMF is to prepare for a disaster and make quick crisis response and disaster recovery arrangements in advance. The framework is executed through a series of disaster plans describing a disaster's preparation, response, and recovery stages.

Figure 16 shows the Australian Government Disaster Management and Recovery Continuum of November 2020. The Australian Government's continuum includes seven stages of disaster management and recovery. In some disaster situations, all seven phases may not be included. The seven phases are described below [26]:

- Preventive measures to remove or minimize the severity of a disaster,
- Preparing for arrangements to make sure that if a crisis happens, there will be enough resources and services to be deployed,
- Response actions should be taken during or immediately after a disaster to ensure that its after-effects are reduced, and those affected should be given support quickly,
- Relief meetings to arrange required needs of water, food, communications, energy, and medicines for the public affected by a disaster event,
- Recovery measures, either short or medium-term, are taken to restore or enhance the health, livelihoods, physical, eco-

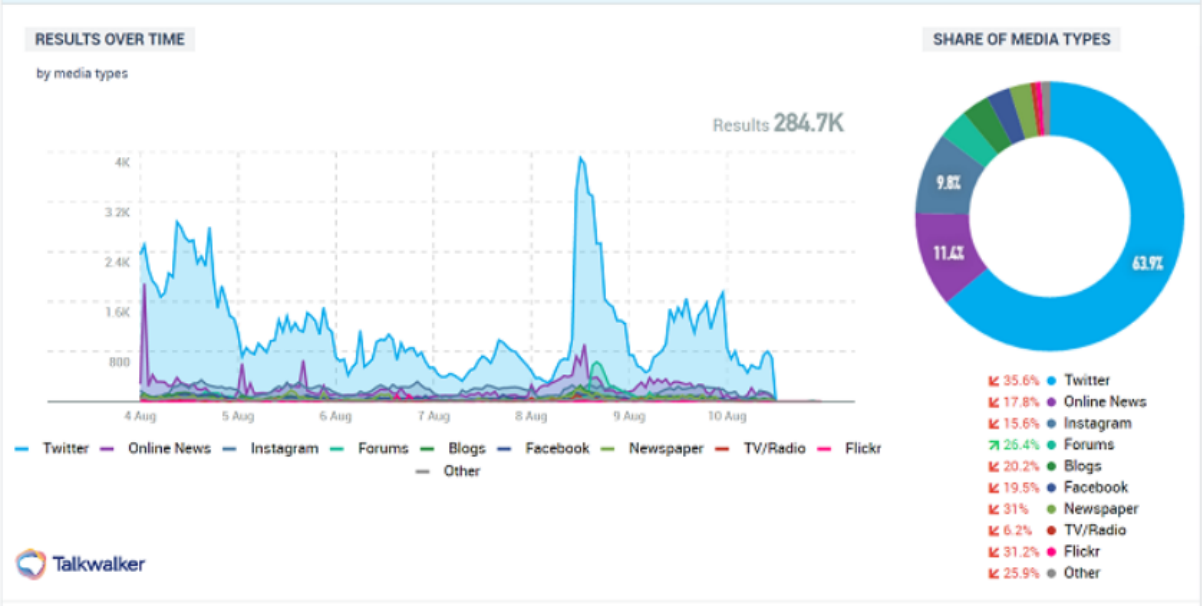

Figure 11. *Talkwalker analytics tool for social media analysis [19]*

Figure 12. *Talkwalker for sentimental analysis [19]*

nomic, social, environmental, and cultural assets, activities, and systems of a disaster-affected society or community,

- Reconstruction phase where long-term strategies should be implemented post-disaster event to build better from a disaster,
- Risk reduction to minimize future risks and understanding strategies that can be taken to minimize disasters' impact.

Social Media for Disaster Management in Australia

As already discussed, in recent times, social media has been widely used by disaster management teams to give alerts to the public and coordinate plans for immediate response and recovery. In Australia, most disaster risk reduction (DRR) awareness strategies are delivered by the territory and state disaster emergencies. Some outstanding examples of non-government and government organizations' programs incorporating social media are Harden Up (Green Cross Australia) and Get Ready Queensland (Queensland Government).

The Victorian Government executes a Summer Fire Campaign, which starts in November and ends by February or March every year, depending on the fire season length. The campaign uses social media platforms (Facebook, Twitter), digital information channels, and advertisements on radio, TV, digital channels, and newspapers, stimulating the crowd to leave early in case of fire threats.

Plenty of messages are passing through social media forums, and the government receives more campaign messages through Facebook pages and Twitter feeds. Figure 17 illustrates the number of social media posts on the fire topic throughout 2013-2014 during the Victoria fire season.

In 2010, when Haiti was affected by an earthquake, the traditional humanitarian relief system was not effectively functioning [9]. Unlike the traditional approach of using one-to-many relations, the open nature of the Ushahidi tool gathered data from various sources and established a many-to-many approach. The Ushahidi Haiti project in 2010 sent thousands of collected text messages to a crisis reporting system.

They translated the messages, categorized and geotagged them by a volunteering team, and then transferred the information to the humanitarian responders. Thus, through this crowdsourced data, Ushahidi could provide crisis maps with information related to food requests and affected regions, which helps facilitate relief efforts. Using these maps, the government could organize resource distribution and form better decisions per their crowdsourced data analysis.

Also, in Figure 18, some final reflections as part of the Ushahidi Haiti project can be seen in the crisis mapping.

Japan

Japan Meteorological Agency (JMA) is a leading National Meteorological Service responsible for collecting and reporting forecasts and weather data for the public. It also provides marine and aviation weather-related information. The other responsibilities of JMA involve warnings for earthquakes and volcanic eruptions. It is also responsible for naming, distributing, and forecasting warnings for tropical cyclones. The open-source data collected from JMA, which contains information about the number of earthquakes, is in Figure 20.

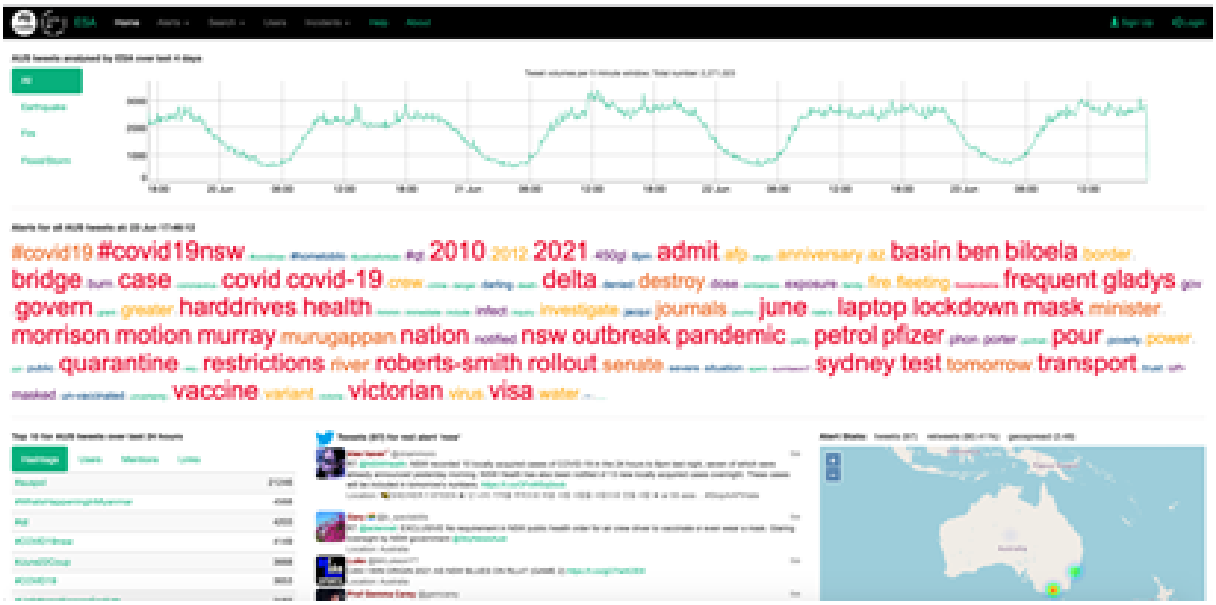

Figure 13. *ESA dashboard captures on June 23rd 2021 [21]*

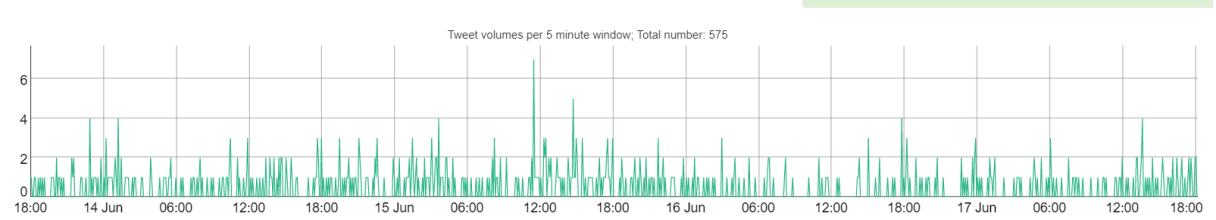

Figure 14. *Australian tweets for earthquakes analyzed by ESA [22]*

Figure 15. *Victoria's bushfires [20]*

Japanese Disaster Management System

The Japanese Disaster Management System comprises a Minister of State appointed to the Cabinet. The Disaster Management Bureau proposed a proposal with the basic policies and plans for disaster management and coordinated plans for large-scale disasters. The responsibilities taken by the Cabinet office according to the risk levels of a disaster are depicted in Figure 21.

Social Media for Disaster Management in Japan

During the Tsunami and East Japan Earthquake in 2011, social media (especially Twitter and Facebook) as a beginner tool acted as a source of information sharing, connecting to affected individuals, and a channel to participate in the disaster management process. Among the social media platforms, Twitter was the most dominant tool for exchanging information regarding the earthquake during this period. In addition, Facebook played a vital role in communicating worldwide after the disaster, and the public was aware of the disaster and could provide donations to the relief. Open-source maps like Google Earth and Google maps were vigorous tools when combined with other data for disaster management. With the help of the Ushahidi platform, an open-source tool, crisis mapping was done using these open-source mapping services. It could provide information related to areas for shelter, where electricity or evacuation is needed, and the essential resources.

They conducted a survey post the disaster event in which different types of social media tools to extract information during a disaster are illustrated in Figure 22. It is based on different types of senders in which web pages and social networks contributed more to sharing information.

Figure 23 shows the most reliable source of disaster information based on different locations. From the figure, it is clear that in most areas inside and outside Japan, people depended mainly on

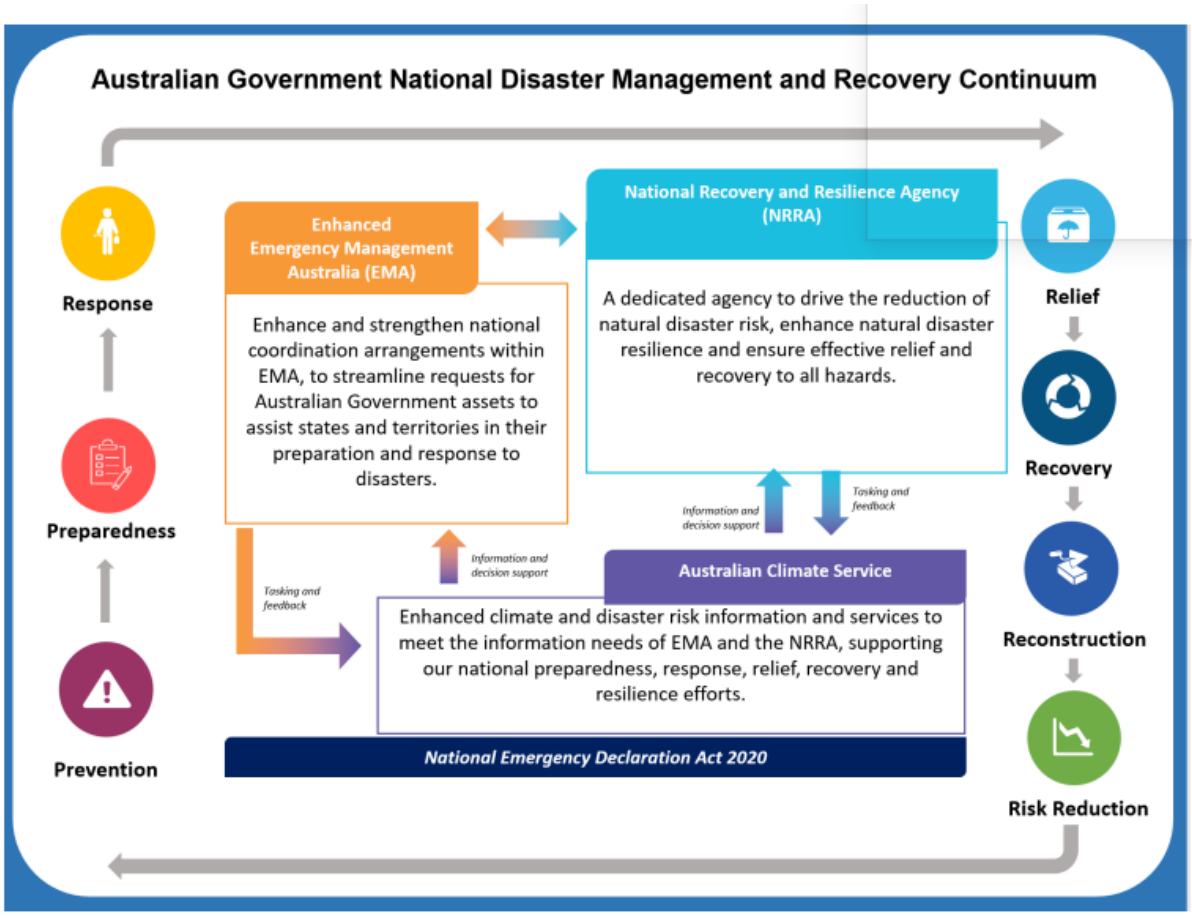

Figure 16. *Australian Government Disaster Management and Recovery Continuum [26]*

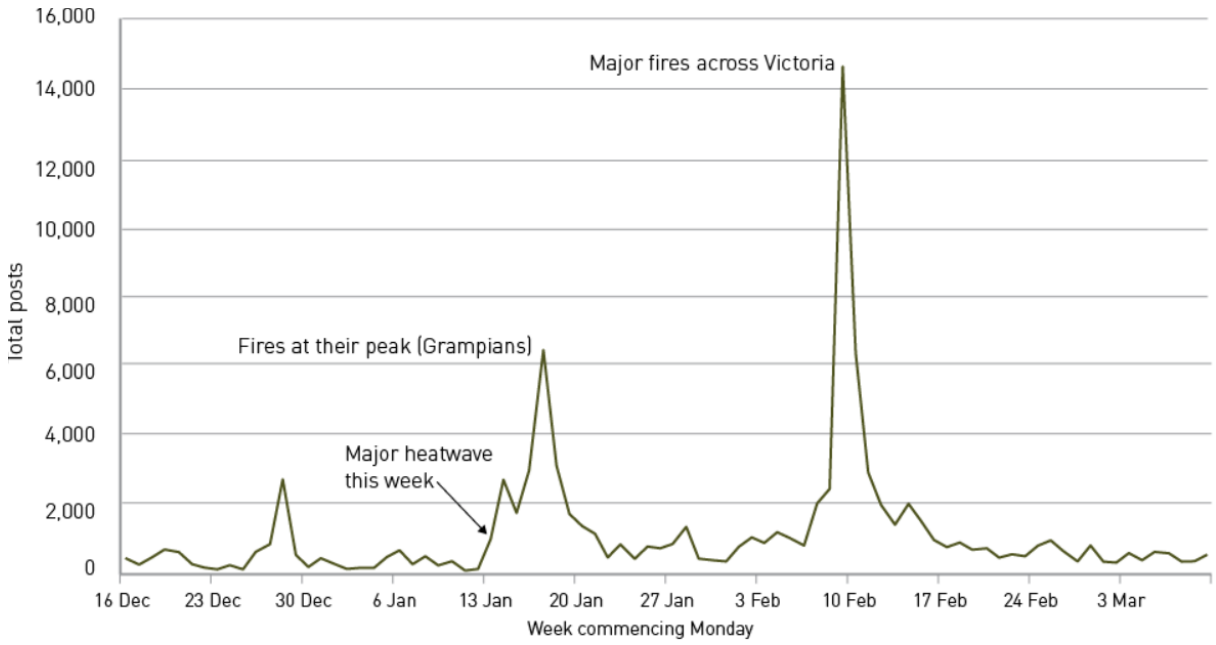

Figure 17. *Social media posts on the fire topic within the 2013-2014 period [27]*

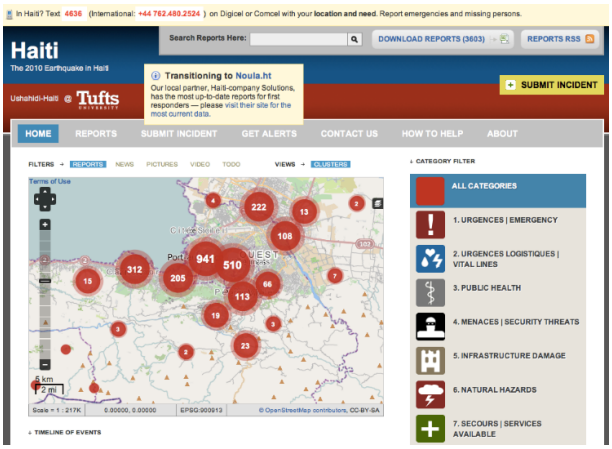

Figure 18. *Ushahidi Haiti project [10]*

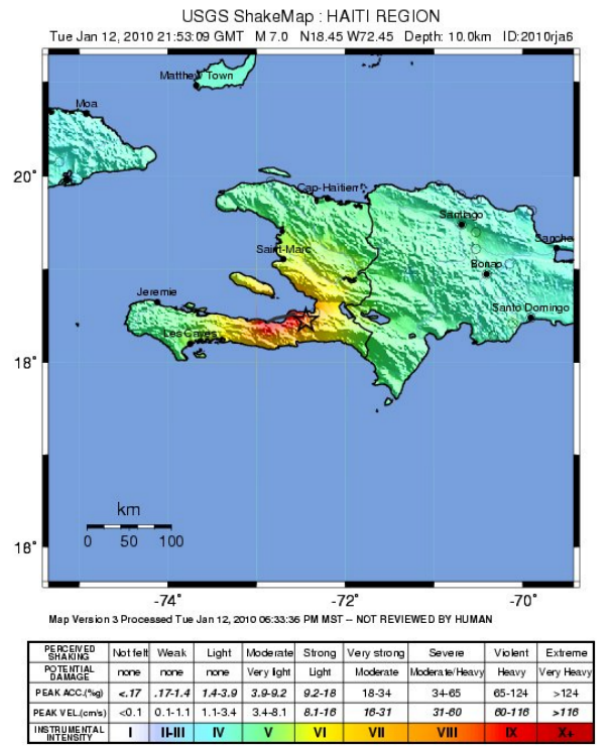

Figure 19. *ShakeMap tool for crisis mapping for Haiti earthquake 2010 [15]*

the internet and social media to get information about disasters.

Figure 24 describes some reasons for using social media as a tool during the 2011 earthquake to receive information related to disaster management.

Conclusion and future work

Natural disasters tend to happen anytime, anywhere in the world, and sometimes they could have a lasting impact on our society. Hence, it is crucial to have access to the latest information to analyze the details and scope of the situation and to provide necessary actions in time. With the wide range of available open sources like blogs, web feeds, radio stations, and TV to social

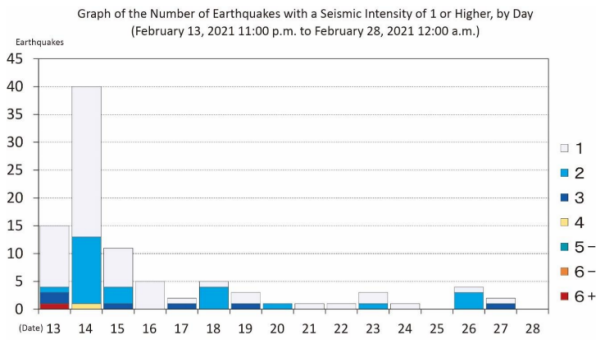

Figure 20. *Australian Government Disaster Management and Recovery Continuum [26]*

Services and tools used	Features
Twitter	is highly public and popular in Japan. Brief and quick information is easily shared.
Facebook	Popular among foreign communities, good for group networking
Mixi	Japanese language is popular during disasters for sharing information
Email	Information is shared but more difficult than social networks
SMS	It was used mainly to collect donations outside Japan
Wikis	Data related to the crowd-sourcing concept
Maps	Integrating with other data to develop crisis maps useful for disaster management

Table 1. Summary of Social Media Tools and Services [30]

media platforms, disaster management respondents and government agencies can inform and respond quickly. In this report, the importance of OSINT/SOCMINT is well-explained, covering some OSINT tools for modern disaster evaluation. The report summarizes that open sources are an efficient way to assess disaster situations which could lead to better decisions in the future. The strength of social media sources is an added advantage to the standard disaster management approaches. The other sections of the report describe how the government of Australia, Haiti, and Japan has taken measures regarding the disasters in their areas and the framework built by them to deal with disaster events in the future.

In the future, there is extensive scope to explore and utilize more open-source tools and relevant platforms for efficient and modern disaster management during a natural disaster. Also, the importance of social media intelligence in disaster management gives ideas to explore the usage of social media data. This can be attained by traversing the strategies used by countries other than those mentioned in this report.

Response by the Cabinet Office according to the level of a disaster

Level	Severity	JMA Seismic Intensity	Response by the Government
Level 5 (Emergency)	Devastating	Central Tokyo: 6 Lower Other area: 6 Upper	・Start procedure of establishment of Extreme/Major Disaster Management Headquarters ・Dispatch of Government Investigation Team
Level 4 (Prepare for Emergency)	Severe	Central Tokyo: 5 Upper Other area: 6 Lower	・Holding a conference on disaster management with relevant Ministries and Agencies ・Dispatch of Government Investigation Team
Level 3 (Warning)	Considerable disaster occurs or expected to occur	Central Tokyo: 5 Lower Other area: 5 Upper	・Holding a conference on disaster management with relevant Ministries and Agencies (if needed) ・Dispatch of Government Investigation Team (if needed)
Level 2 (Alert)	Beware of occurrence of a disaster	Other area: 5 Lower	
Level 1 (Normal)	Need to keep watching		

Figure 21. *Responsibilities taken by Japan Cabinet office based on disaster level [29]*

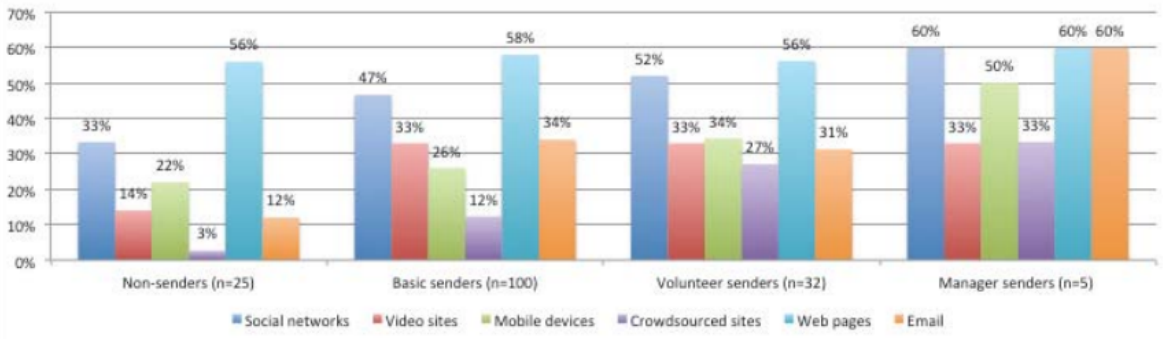

Figure 22. *Social media tools used during a disaster [30]*

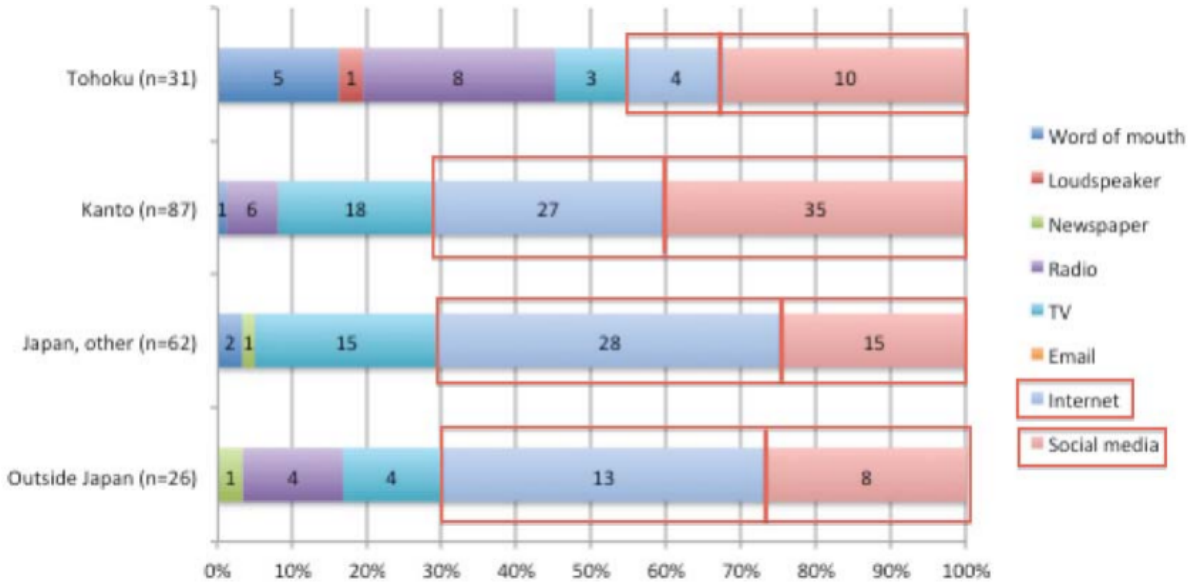

Figure 23. *Most relied source location-wise [30]*

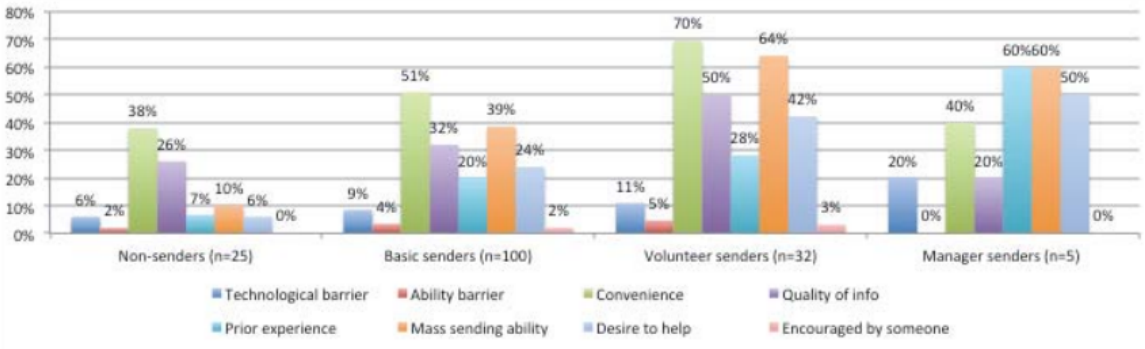

Figure 24. *Responsibilities taken by Japan Cabinet office based on disaster level [29]*

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