UDC – 004.042:621.377.6

ORGANIZING INFORMATION COLLECTION IN THE CONTEXT OF DISASTER: APPROACHES BEFORE, DURING AND AFTER EMERGENCIES

Eleonor T. Harutyunyan
European University of Armenia
10 Davit Anhaght Street, Yerevan 0037
Armenian State University of Economics
e-mail: eleonorharutyunyan@gmail.com
ORCID iD: 0009-0009-0744-4433
Republic of Armenia

https://doi.org/10.56243/18294898-2024.1-82

Abstract

This article examines the challenges and strategies associated with collecting critical information during different types of disasters. The use of technology and specialized tools to collect data on various natural disasters, such as natural events, industrial accidents, and health crises, is examined. It also emphasizes the importance of cleaning this data to remove unnecessary information. It is shown that by mastering these data collection techniques, more informed decisions can be made and disaster management can be improved.

Keywords: emergency situation, man-made disaster, natural disaster.

Introduction

An important task for making decisions in a particular area is providing input data. As research shows, the data collected varies depending on the subject of the study. For example, they are different during man-made and natural disasters. A feature of man-made disasters is that they can occur as a result of a combination of several events or as a result of random accidents. The latter is difficult to predict. To eliminate them, regulatory measures are provided to reduce the likelihood of these events occurring.

Applying machine learning techniques to data analysis will provide the opportunity to identify patterns, trends and impacts of natural disasters (NDs) that may influence future actions.

Improving decision readiness of systems through pre-security data storage and processing is critical as it provides vital information for risk assessment, planning and early warning systems.

During emergency situations (ES), to support and respond to emergency situations, there is often a need for technologies for collecting and storing data in real time.

Post-security data analysis and long-term storage technology provides stakeholders with the necessary tools to analyze important information. This includes any emerging trends related to ES and by storing this information in a secure database system, society can learn from the mistakes of the past.

The use of a particular data collection and processing technology depends on the nature of the disaster.

As practice shows, the information received is accompanied by noise. Therefore, it is important to consider special methods by which this information is cleaned and only the part that is useful is retained.

The choice of hardware and software for organizing the receipt of information and its processing is important, and in this regard, the article provides their classification by purpose.

Let's consider the proposed technologies for collecting and storing the necessary data before, during and after ES [1].

Conflict Setting

The goal of the task is to propose an integrated approach to the classification of disasters for the simultaneous collection, purification and analysis of parameters characteristic of disasters.

Research Results

To organize data collection before ES, it is proposed to use complex tools such as sensor networks, which allow organizing constant monitoring of critical data. Environmental, medical, seismic, and environmental sensors can be used as sensors. Drones equipped with various types of sensors can be used to collect data. To organize the storage and appropriate processing of data for decision-making, it is necessary to select or develop software using elements of artificial intelligence, which will improve the quality of informed decision-making and proactive measures. Among other things, it is necessary to use software for remote sensing, environmental modeling and geographic information systems (GIS).

We divide ES into the following: Technogenic or anthropogenic, natural environmental disasters, Socio-economic crises compared to biomedical wars. Each type of ES has its own unique characteristics, which take different forms and pose specific challenges[2]. This means that it is necessary to have knowledge of how to properly collect and separate information in order to effectively manage various Ess[3].

The proposed structure of the technology for collecting data before a disaster is presented in Fig. 1.

Thanks to mobile apps, remote sensing tools, and Internet of Things (IoT) gadgets, such information can be collected, analyzed, and stored faster, thereby enhancing situational awareness for resource allocation as well as decision-making in dynamic environments. Mobile apps are user-friendly designed for both first responders and members of the public who would like to report cases or incidents, share information in real time or request assistance in times of crisis, facilitating rapid data collection and transfer data.

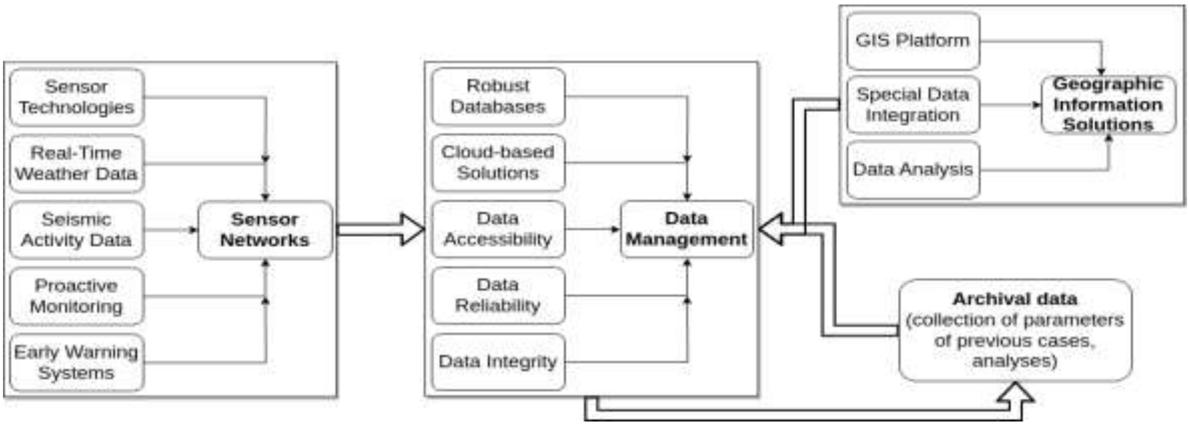

Fig 1 Pre-disaster technology structure

Remote sensing and imaging technologies are the application of high-resolution imagery or video from satellites, drones, and aerial surveillance to aid in damage assessment, resource allocation, or situational awareness [4].

The proposed structure of the technology for collecting data before a disaster is presented in Fig. 2.

Therefore, after a disaster occurs, it is necessary to use real-time data collection technologies, which leads to enhanced capabilities of emergency response services based on the acquired data that they need to effectively manage situations. This improves coordination among citizens who can exchange information among themselves and also seek help when needed. It is critical that remote sensing solutions provide visual evidence of resource destruction and deployment. In addition, these remote information collection devices are always on, providing important information about the environment and existing structures.

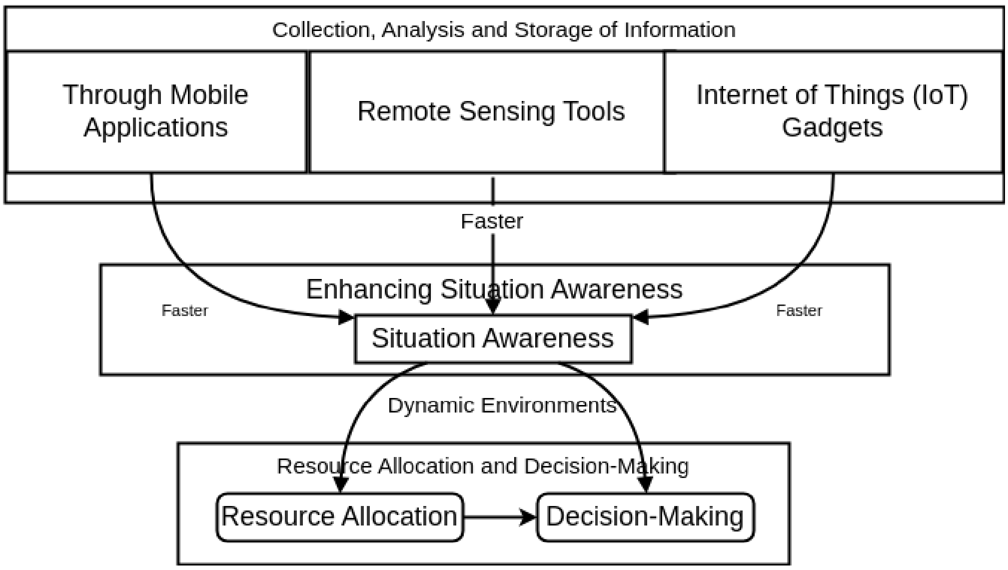

Fig.2 During disaster technology structure

In other words, through these techniques, awareness can be increased, thereby encouraging timely response, ensuring efficient allocation of resources, ultimately leading to improved disaster management and hence reducing its impact [5]. Archiving and saving data is important here. To protect critical information on disaster-related issues for subsequent research, it is important to use cloud-based redundant systems.

A structure for the technology for collecting data after a disaster has been proposed, which is presented in Fig. 3.

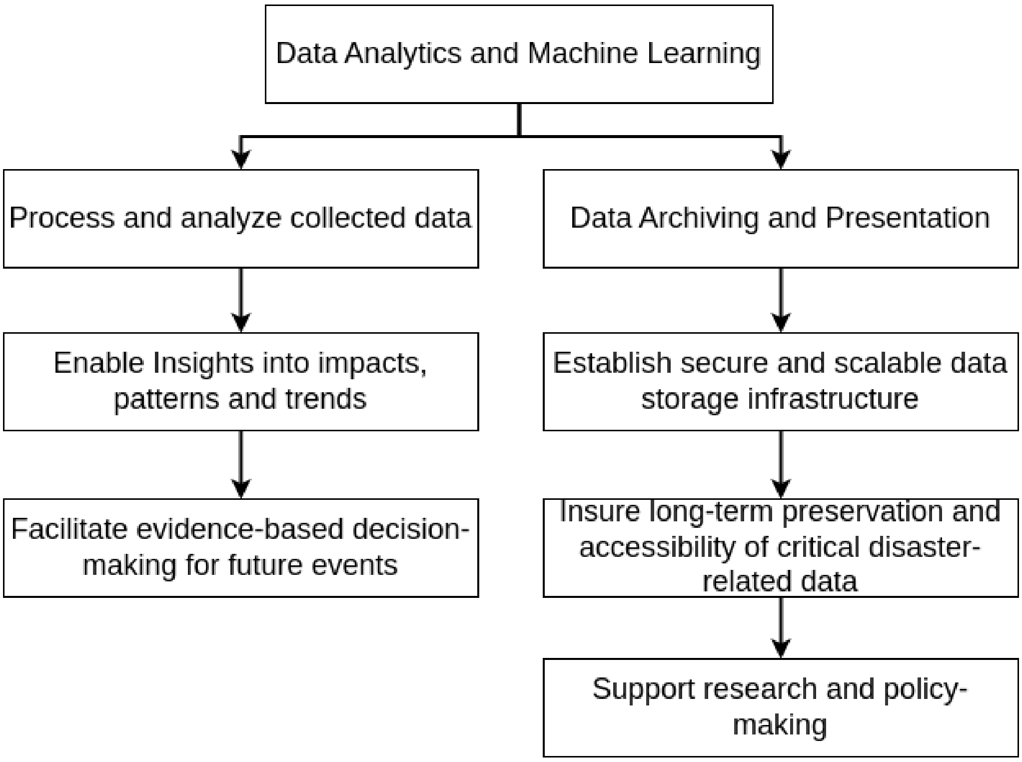

Fig 3 Post-disaster technology structure

We are dealing with different classes of disasters and, therefore, information.

We divide disasters into: man-made, natural environmental, socio-economic, biomedical and military disasters.

Disasters come in many forms, each with their own unique characteristics and challenges. This requires knowledge of how to effectively collect and separate information in order to manage the NDs that arise in all their diversity.

Technology, collection and processing equipment are given in Tab. 1.

Information collection focuses on tracking disease spread, hospital capacity, vaccine distribution and public health data.

In the field of ND management, there is nothing more important than accurate and reliable data. However, data collection sometimes suffers from what we call "information noise," which refers to irrelevant or incorrect information that can distort the decision-making process. Given the importance of the task, various methods are used to clean data and are required to be clear, reliable and not distracting during emergencies. For this purpose, the following classification of methods and mechanisms for cleaning data from information garbage is proposed.

Table 1.

Collection and Processing Equipment

Class ES	**Technology Collection of information**	**Collection information with ardware**	**Processing software Information**	**Hardware and software: processing information**
Technogenic or anthropogenic	Sensor networks Drones	Sensors - gas leaks - chemical spill - structural integrity Cameras and sensors	DBMS in real time	Geographic Information Systems (GIS)
Natural and ecological catastrophes	Meteorological monitoring data: Monitoring level of pollution	Sensors: - level of liquid in wells - seismometers - presence of radon - water quality - air quality	requires real-time data collection for early warning software systems remote sensing, software modelling of the environment. Forecasting the spread of pollution. Geospatial tools that help map and estimate ecological destruction.	Satellite systems Drones: To assess the impacts of ES
Biomedical and military catastrophes	Diagnostic Devices, Remote Patient Monitoring, Autonomous Ground Vehicles	Medical sensors for tracking trends in vital signs and spreading diseases. Special equipment for disease testing and sample analysis.	Electronic medical record software (EHR) for monitoring patient information. Software epidemiological modeling	High-Performance Computing (HPC) Clusters, Field-Deployable Servers, Data Analytics Platforms, Cybersecurity Solutions

Advanced filtering algorithms as data filtering algorithms help identify and remove outliers and anomalies or small deviations that do not correspond to expected values.

Follow strict validation as data verification and quality control’s processes to combine high-quality data sets so that they meet predefined standards set by their owners, such as variable range checking, variable type checking, consistency checking.

When studying information, contextual analysis should always be understood in its situation, otherwise known as contextual analysis, where differences may arise. By taking into account the information around it, one can easily determine the existence or non-existence if any inconsistencies within it, thus discarding any extraneous details.

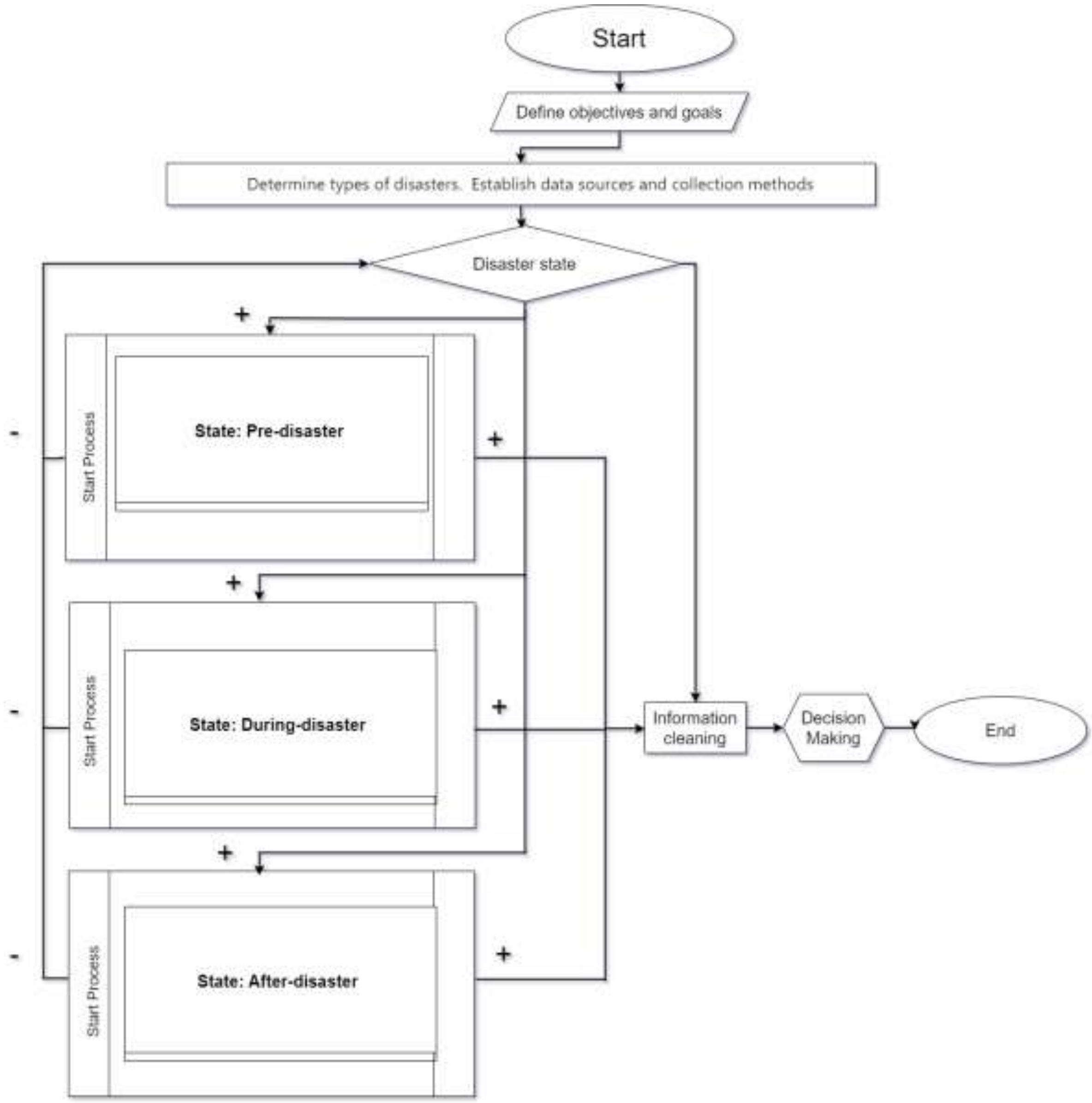

Fig 4 System's proposal structure from disaster state view point

In some cases, using crowdsourced data from various individuals or sources is useful in verifying that individual pieces of data have been entered correctly into the system. This is especially true for real-time data verification during natural disasters.

The use of machine learning algorithms in data analysis helps to identify patterns in information, as well as distinguish between relevant and irrelevant. These algorithms improve with use and become better at filtering out noise.

The noise can be determined by an expert familiar with the subject. Thanks to their knowledge in certain areas, they are able to distinguish between reliable and erroneous figures.

To check consistency or inconsistency, compare recent data obtained from current disaster management situations and historical records. Old records can serve as a criterion for determining the reliability of incoming facts.

Analyze metadata associated with data sources to determine how reliable and valid they are. Unreliable sources are always indicated by suspicious circumstances surrounding them, indicating potential sources of noise.

User feedback mechanisms are necessary to ensure quality processing of any form of data available on the Internet, either automatically or manually through human intervention processes to ensure timely correction before the situation worsens.

Combine multiple sources of information together, cross-checking their content using merging techniques; this will help check some information in different data sets if they are consistent, thereby completely removing background noise.

Establish control systems that monitor data quality over an extended period of time, thereby maintaining expected standards along the way to improve decision-making purposes. This makes it possible to immediately identify as well as correct any events leading to undesirable data quality in a given case where such problems arise unexpectedly within a short period of time, leading to unpleasant consequences for the desired results due to the incorrect definition of the time frame itself.

Below you can see Fig. 4, which presents the systematic proposal of the above process sequences within this work.

Conclusion

1. Based on an analysis of information collection technologies, recommendations are given for their use depending on the nature/class of the safety system and time (before, during and after disasters).

2. Structures of information collection technologies are proposed that increase the quality of decisions made.

3. The classification of filtering methods made it possible to organize the selection of the necessary mechanisms for “garbage cleaning” in the collected data.

4. Recommendations are given on the use of types of sensors when collecting information.

References

1. Creswell, John W., Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (2009) // SAGE Publications, page 42-51.
2. Batini C., Scannapieco M., Ceri J, Data Quality: Concepts, Methodologies, and Techniques, (2006) //Springer ISBN: 978-3-540-33172-8, pp. 97-124. DOI:10.1007/3-540-33173-5

3. Wegmann Martin, Leuter Benjamin, Remote Sensing and GIS for Ecologists: Using Open Source Software, (2016) // Pelagic Publishing; Illustrated edition, ISBN 9781784270223
4. Olsen, W., Data Collection: Key Debates and Methods in Social Research, (2012)// SAGE Publications Ltd, Print ISBN:9781847872562, Online ISBN:9781473914230, pp. 314-401
DOI: https://doi.org/10.4135/9781473914230
5. Tomaszewski, B., Geographic Information Systems (GIS) for Disaster Management, (2020)// Routledge ISBN 9781138489868 DOI:https://doi.org/10.4324/9781351034869

ՏԵՂԵԿԱՏՎՈՒԹՅԱՆ ՀԱՎԱՔԱԳՐՄԱՆ ԿԱԶՄԱԿԵՐՊՈՒՄԸ ԱՂԵՏԻ ՀԱՄԱՏԵՔՍՏՈՒՄ՝ ԱՂԵՏԻՑ ԱՌԱՋ, ԸՆԹԱՑՔՈՒՄ, ՀԵՏՈ

Է.Տ. Հարությունյան
Հայաստանի Եվրոպական Համալսարան

Բերված են տարբեր տեսակի աղետների ժամանակ կարևոր տեղեկատվության հավաքագրման մարտահրավերների ու ռազմավարությունների ուսումնասիրությունների արդյունքները: Դիտարկված են տեխնոլոգիաների ու մասնագիտացված գործիքների օգտագործումը տարբեր աղետների վերաբերյալ տվյալներ հավաքելու համար, ինչպիսիք են բնական աղետները, արդյունաբերական վթարները և առողջապահական ճգնաժամերը: Կիրառելով տվյալների հավաքագրման առաջարկվող տեխնիկան, հնարավոր կլինի կայացնել հիմնավորված որոշումներ և բարելավել աղետների կառավարումը:

Բանալի բառեր: արտակարգ իրավիճակ, տեխնածին աղետ, բնական աղետ:

ОРГАНИЗАЦИЯ СБОРА ИНФОРМАЦИИ В КОНТЕКСТЕ БЕДСТВИЯ. ПОДХОДЫ ДО, ВО ВРЕМЯ И ПОСЛЕ ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЙ

Э.Т. Арутюнян
Европейский Университет Армении

Представлены результаты исследований проблем и стратегий сбора важной информации во время различных типов стихийных бедствий. Рассматривается использование технологий и специализированных инструментов для сбора данных о различных стихийных бедствиях, таких как стихийные бедствия, промышленные аварии и кризисы в области здравоохранения. Применяя

E.T. Harutyunyan
ORGANIZING INFORMATION COLLECTION IN THE CONTEXT OF DISASTER: APPROACHES BEFORE, DURING AND AFTER EMERGENCIES

предложенные методы сбора данных, можно будет принимать обоснованные решения и улучшить управление стихийными бедствиями.

Ключевые слова: чрезвычайная ситуация, техногенная катастрофа, стихийное бедствие.

Submitted on 12.01.2024
Sent for review on 12.01.2023
Guaranteed for printing on 25.03.2024