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Article

Effectiveness to the Emergency Management in Public Organizations: A Paradigm from a European Civil Protection Mechanism

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Abstract: Every state's priority is public safety. In the modern world, that often needs them to work with other States. This study assesses the role of civil protection mechanisms in effective emergency management operations in public organizations based on the European perspective. Data was collected from 392 different technocrats from government civil protection agencies in Greece using an online questionnaire. The study revealed that civil protection experts positively influence effective emergency management operations in public organizations. The results revealed that early warning systems have an influence on effective emergency management operations in public organizations. Disaster risk forecasting has a positive influence on effective emergency management operations in public organizations. According to the study, crises and catastrophes have compelled the EU to improve civil protection coordination throughout the continent and its ability to conduct operations both inside and outside of Europe. It's not clear whether these cooperative EU agreements are going to succeed because national civil defense organizations aren't always similar and there isn't always enough trust between the organizations involved. This is especially true in light of recent global crises in the EU, such as the refugee crisis, terrorist attacks, and natural. It is important for public organizations across Europe to focus on enhancing early disaster warning systems, the enhancing of civil protection experts and improving disaster planning to promote effective management of emergencies.

Keywords: Civil Protection Mechanisms; Emergency Management Operations; Disaster Preparedness; Early Warning Systems; Disaster Risk; Rapid and Effective Recovery

1. Introduction

1.1. Background to the Study

Despite several efforts to understand disaster risks, how to manage them, and international agreements to enhance resilience, natural disasters continue to devastate developed and poor nations. Natural disasters may be mitigated, but not eliminated. Early warning systems (EWS) teach people about natural risks, offer us warning information, and allow us time to act to prevent unintended

effects. In the 73 nations studied, most individuals are not covered by civil protection based early warnings, and only 40% have multi-hazard EWS [1–3]. The increased incidence of catastrophes and their humanitarian consequences have necessitated a framework that addresses States' and other international actors' duties in disaster contexts to provide humanitarian aid to the afflicted people [4, 5]. Unlike military conflicts, there are no global, legally enforceable disaster response rules. Thus, International Disaster Response Law (IDRL) revealed that countries have a role to play in the response to different disasters and their management [3, 6–8]. In recent decades, many universal, regional, and bilateral disaster response treaties have been adopted, but Greece uses Civil Protection mechanisms to protect vulnerable people in emergencies. These include shelters, evacuation, first aid, and catastrophe preparation and countries are obliged to emphasize these four civil protection mechanisms and how they are employed in disaster management strategies to safeguard the most vulnerable [9–11].

Civil protection relates to government or NGOs (Non-Government Organizations) efforts to shield citizens from war and natural catastrophes [12]. Emergency management systems have been designed to react to different disasters that endanger lives and health. Civil Protection Mechanisms are the most successful in protecting life, health, property, and public order during disasters [13–15]. Civil Protection Mechanisms are authorities that promote people' rights during emergencies [2, 16–18]. The degree and quality of protection of the physical environment, social functions, human life, and dignity determines a society's resilience to emergencies. Greece manages any crises that might harm society. Emergency management protection techniques include social, economic, legal, and environmental protection [19–22]. Social protection ensures that refugees and internally displaced people can access their basic needs such as shelter, healthcare and food. Emergency economic policies limit availability of goods to minimize waste and shortages. Protection, particularly in emergencies, is one of society's biggest issues. The capacity to defend ourselves and other living things against harm [20, 21]. The kind, intensity, and frequency of life-threatening incidents will affect the efficacy of each component. With limited resources, preparing for big events may require developing new facilities [23, 24].

Figure 1 outlines the relationship between two key types of variables: independent variables and dependent variables. It serves to illustrate how different civil protection mechanisms can influence the effectiveness of emergency management operations.

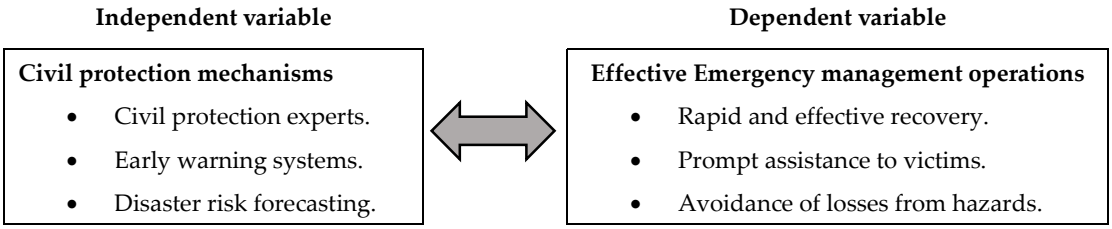


Figure 1. Orientation map.

The figure suggests that the effectiveness of emergency management operations is dependent on the implementation of robust civil protection mechanisms. Specifically, having trained experts, reliable early warning systems, and accurate risk forecasting can lead to more effective and efficient recovery processes, quicker assistance to those in need, and reduced losses from various hazards. This framework emphasizes the importance of preparedness and proactive measures in managing emergencies and mitigating their impact. Greek civil defense and emergency management operations

are linked to citizen protection. This structure ensures proper survival circumstances and capabilities. This paper discusses its preventive, mitigation, response, and recovery actions and pillars that are all embedded in civil protection. Earthquakes, diseases, and environmental catastrophes cause long-term harm to humanity and the environment [20, 25, 26]. Population density, fragmentation, and exposure increase these effects. Lack of infrastructure increases vulnerability, which can lead to social and political instability due to public service collapse, crop destruction or loss, life safety threats, public health hazards, and increased economic costs due to huge losses from agriculture production evictions.

1.2. Study Objective

This study assessed civil protection mechanisms in effective emergency management operations in public organizations, from a European perspective. The study also focused on different specific objectives listed below.

(1) To establish the influence of activities of civil protection experts on effective emergency management operations in public organizations.
(2) To examine the relationship that exists between elements of early warning systems and effective emergency management operations in public organizations.
(3) To examine the influence of disaster risk forecasting on effective emergency management operations in public organizations.

1.3. Research Questions

- What is the influence of the different activities of civil protection experts on effective emergency management operations in public organizations.
- What is the relationship that exists between elements of early warning systems and effective emergency management operations in public organizations.
- What is the influence of disaster risk forecasting on effective emergency management operations in public organizations.

1.4. Research Hypothesis

- H1: Activities of civil protection experts positively influence effective emergency management operations in public organizations.
- H2: There is a positive relationship between elements of early warning systems and effective emergency management operations in public organizations.
- H3: Disaster risk forecasting has a positive influence on effective emergency management operations in public organizations.

2. Literature Review

2.1. Theoretical Departure Points

Crisis is characterized as a danger to essential values, urgent action, and uncertainty. Managers, decision makers, and interested organizations must collaborate to handle a crisis [27–29]. Several emergencies transcend organizational, sectoral, geographical, and jurisdictional boundaries, necessitating the coordination and interaction of several entities, sometimes irregularly and other

times for extended periods of time, in different sectors and at numerous levels of government [3, 30, 31]. The EU has built national and EU capacity to handle civilian and military emergencies due to legislative commitments like the solidarity clause. The EU's civil protection framework and operational center, the ERCC (Emergency Response Coordination Center), help nations respond to civilian disasters [11, 19, 32, 33].

Numerous studies have looked at how and why the EU organized itself, as well as how well it anticipated and responded to various crises. While Kaldor et al. [34] looked at the EU's ability or capacity to handle different international crises, Christensen et al. [28] analyzed the civilian crisis management cooperation frameworks of six European nations. On the contrary, data on the area of civil protection as well as crisis management at both national and EU levels from 17 EU member states, revealed that civic protection helped to reduce catastrophes [35, 36]. According to Šakić Trogrlić et al. [30], civil protection is normally very effective when it is based on four "performative dimensions", which relates to the ability to resolve or address conflicting problem definitions in ambiguous situations. The four "performative dimensions" include collaboration, coordination, and communication—as well as an increase in capacitance [37, 38].

The national organizations used for this study by Parker et al. [39] are Union Civil Protection Mechanism (UCPM) national contact points and manage national civil protection. The cases are representative of EU member states in terms of size, income, time spent as members of the Union, and geographic location. Research on civil protection and crisis management in the EU has shown considerable differences across national systems in terms of administrative duties, legal frameworks, and operational processes [27, 40–42]. Decentralized and regional bottom-up federal systems are present in Germany and Austria. With significant but varying centralization, the Czech Republic, Finland, Ireland, and Sweden all have bottom-up, usually decentralized systems, two examples of countries with semi-centralized systems include France and Croatia [39, 43, 44].

Most nations and organizations have some fundamental traits despite their diverse organizational structures, and institutional arrangements [24, 45, 46]. The nations and organizations are EU members and UCPM participants. They all have major civil protection duties and lead EU civil protection cooperation [2, 32, 39, 47]. Many nations do comparable civil protection duties. In order to ascertain if structural and cultural variables significantly affect views of crisis or disaster management efficacy inside different national civil protection agencies and at the EU level, surveys with personnel from these organizations are relevant [39, 48, 49]. Only opinions on the effectiveness of structural and cultural components may be gathered using this method. This should be verified in more impartial studies, which are beyond the scope of this assessment [18, 50–52].

2.2. Civil Protection Experts

According to European Commission [53], states, and UCPM-trained professionals collaborate to make the Union Civil Protection Mechanism successful. During Mechanism missions, experts coordinate, evaluate, or give technical knowledge. Their exercises and missions augment our training courses, which the Mechanism values most. They construct a worldwide civil protection expertise network. They may also be sent by the Emergency Response Coordination Center (ERCC) to disaster sites to assist crisis management decision makers [24, 54]. EU Civil Protection Teams (EU CPT) are made up of multi-national professionals and occasionally an ERCC Liaison Officer [6].

The Mechanism and its structures (experts, modules, ERCC, etc.) are valuable actors and facilitators of civil protection coordination and operation (short-term missions, up to some weeks), but they could also be important players in humanitarian assistance missions (long-term assistance, months or years), which are much longer than civil protection missions [24, 54]. Civil protection and humanitarian assistance both aim to save lives, but civil protection is short-term and focuses on life-saving operations, while humanitarian assistance is long-term and prioritizes basic needs [54]. A disaster may frequently cause or worsen a humanitarian situation. Thus, mechanism resources might fit longer inside the UN Humanitarian Response Coordination System [27, 55].

2.3. Early Warning Systems

Early warning systems that entirely are focused on the needs of people are organized around risk data, warning services, distribution and communication, as well as response capability (Figure 2) [1, 18].

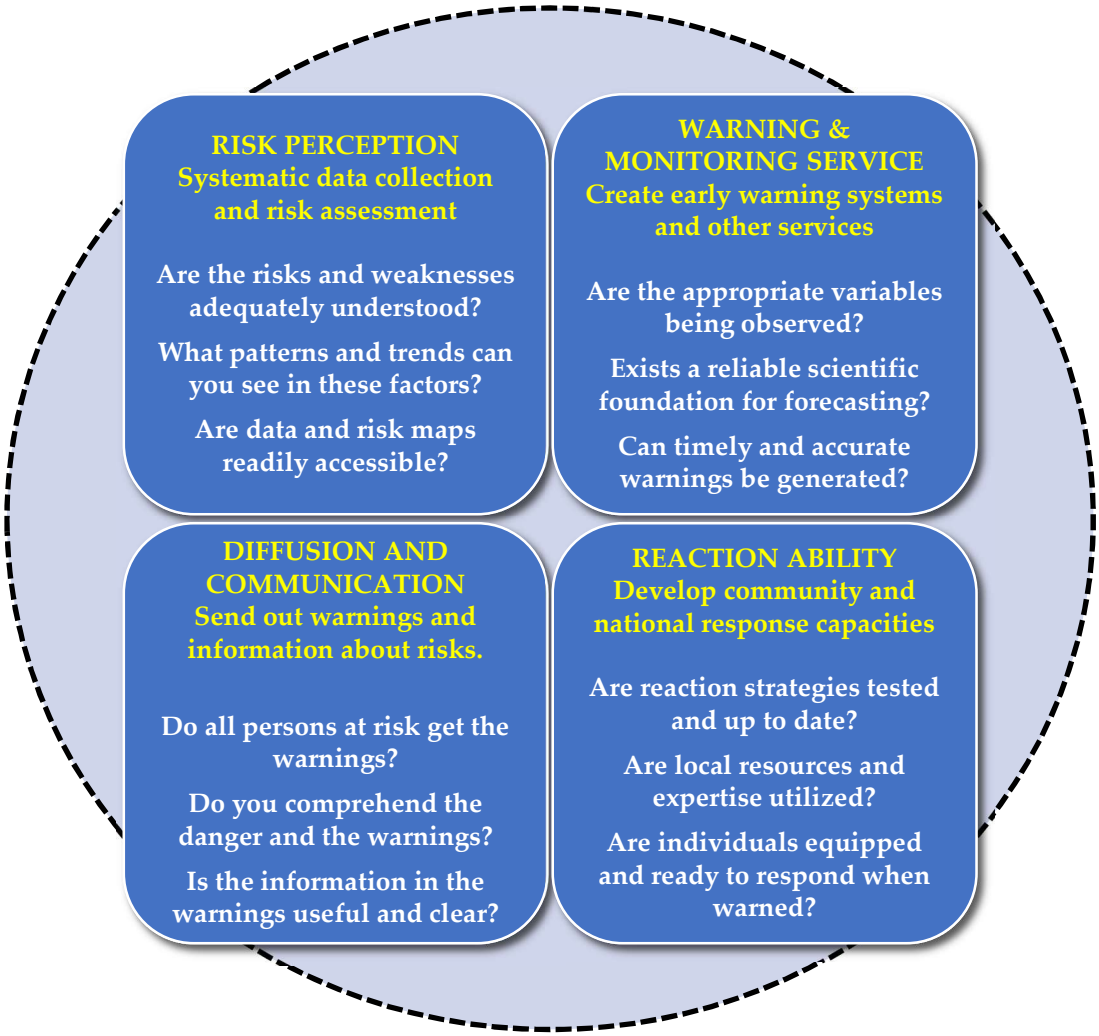


Figure 1. Four Elements of People-centered early warning system (Source: [1, 18]).

From Figure 2, risk perception is a process by which quantitative as well as qualitative information is gathered and analyzed to determine threats and weaknesses existing in a particular society. This component ensures that the risks and weaknesses are well explained to allow the identification of pattern and trends that may be useful when undertaking risk assessment [47]. Risk

maps and data are crucial for disaster risk reduction practices and disaster preparedness strategies. Such an understanding enables public organizations to allocate resources and efforts towards managing the realized risks. The warning and monitoring service component is aimed at the constant observation of the state of hazard indicators and the use of scientific evidence to issue warnings. It entails the tracking of key variables to predict possible calamities correctly and to produce timely and effective alarms [50]. This component is crucial for allowing public organizations to secure funding and prevent the effects of disasters.

Warning and information involve disseminating comprehensible and actionable information on threats to all the vulnerable individuals. It helps in making sure that the public understands the warnings they are being given and that the information given is easily understandable [18]. The communication strategies are relevant for making sure that people know the risks involved and the precautions they should be taking. This component emphasizes the need to convey messages effectively to different stakeholders and populations, especially the hard-to-reach populations.

The reaction ability relates to the capacity of communities and institutions to respond to the warnings received. It involves maintaining and revising reactions plans, employing local personnel and material, and arming people with enough information and things to do when alerted [50]. This component focuses on the practiced emergency response procedures and the need to promote awareness and preparedness among the community. These components are important in the research because they are the building blocks of a good civil protection system. Therefore, when these elements are well developed and synchronized, improvement in the emergency management operations of public organizations can be enhanced. The study highlights the fact that risk knowledge, monitoring, communication, and response capacities are essential components of early warning systems and help in reducing the effects of disasters in order to improve the overall efficiency of emergency management in public organizations [53].

Since the notion of early warning systems was launched, mobile technology and personalized information have expanded. Thus, people-centric warning systems are becoming more important as risk-specific alerts become feasible. This indicates that people need to be better aware of any risks and it is also vital for warning systems to complement impact projections so at-risk people can fully comprehend the implications and measures they need to take [56].

Brazzola & Helander [3] revealed that risk knowledge forms a great part of the part of warning systems in regard to emerge management. Location-specific hazards and vulnerabilities create risks [27, 50]. The dynamic nature of risks and vulnerabilities brought on by urbanization, rural land use change, and the entire degradation of the environment, as well as climate change should be taken into consideration throughout the risk assessment process [57, 58]. Risk evaluations and maps encourage individuals, prioritize early warning system requirements, and direct catastrophe preparations [59, 60].

Regarding monitoring and warning services, predictions and warnings must be based on science and be readily available. Accurate alerts need continuous monitoring of danger characteristics and precursors. To maximize institutional, procedural, and communication networks, danger warning services should be coordinated. A multi-hazard early warning system that incorporates stakeholder demands can do this [61]. Most civil protection experts have traditionally supplied warning information directly connected to their hydro meteorological predictions, but the effect of heavy rains, for example, would vary across a particular catchment region based on various variables that make

people vulnerable [24, 62]. Some are in life-threatening circumstances, while others are not. Informing and protecting at-risk individuals is crucial. Targeting at-risk individuals improves reaction and lowers warning fatigue and false alarms [30, 63].

Dissemination and communication include delivering warning about disasters and general preparation information in an intelligible way to those responsible for acting and to those at risk, especially the most vulnerable. EWS literature typically groups distribution and communication [54, 64]. To prepare for dangers, individuals need accurate, personalized warning information [49, 65]. To reach everyone, especially the most vulnerable and marginalized, warnings must first be recognized and a broad variety of distribution channels chosen [66]. Risky people need warnings. Clear communications with straightforward, relevant information allow effective reactions that protect lives as well as livelihoods [27]. To reach the most individuals, eliminate channel failure, and reinforce the warning, numerous communication channels are needed [59, 67].

Response capacity is a community's risk awareness, ability to act on warnings, and knowledge on how to evacuate [24]. People and institutions must have reliable, timely, and clear warning information before a catastrophe to react and act. A comprehensive early warning system delivers alerts and allows action [19]. Response capacity includes the ability to react to early warning information before the danger occurrence and successfully respond thereafter. Stakeholder resources, skills, and networks enable response. It requires defined authority and different decision-making processes, exercises and various practice scenarios, and national-to-community norms and procedures [19, 49, 63].

Long-term planning and preparation should enable users to act on warning information before a crisis. Local and national knowledge and capabilities must inform preparedness planning. Warning response strategies must be developed [65, 68]. Training and education must familiarize those plans [59, 69]. People need safe places to go, safe routes to get there, and other resources to react. Communities must grasp threats, appreciate the warning service, and respond. Education and readiness are crucial [6, 69]. Disaster management strategies must be tested and practiced. Safe conduct, evacuation routes, and property damage prevention should be well-publicize [49, 59, 70].

2.4. EU Civil Protection Mechanisms

The 2006 Report on "A European Civil Protection Force" by Michel Barnier and the amendments to the Lisbon Treaty served as the impetus for the commission's operational and legislative civil protection initiatives. In order to assess the legal framework in collaboration with pertinent parties, it published a communication in 2010 titled "Towards a stronger European disaster response: the role of civil protection and emergency assistance" [19, 71]. Consequently, the Commission submitted a proposal for a decision on the establishment of a Union Civil Protection Mechanism in December 2011. This proposal for a decision was finally accepted by the Council and Parliament on December 17, 2013 (Decision 1313/2013/EU), finalizing the "institutionalization" of EU civil protection. Decision 2014/762/EU, which establishes the EU Civil Protection Mechanism, was approved on October 16th, 2014 [36, 67].

Decision 1313/2013/EU permits the new Union Civil Protection Mechanism to be activated for any serious natural or man-made disaster that affects people, the environment, or cultural heritage within or outside the EU [36, 67]. The Mechanism covers environmental or cultural heritage concerns without human casualties [2]. Due to their extensive reach, EU civil protection and humanitarian

assistance programs were merged into one Directorate General European Civil Protection and Humanitarian Aid Operations (DG ECHO), which was headed by a single Commissioner for "International Cooperation, Humanitarian Aids and Crisis Response" [67]. The Mechanism now covers all aspects of civil protection, including prevention, preparedness, immediate response, and recovery [24, 72]. The Mechanism prepares national risk assessments and risk management plans, reference scenarios, maps current capacity and develops contingencies, and promotes catastrophe information exchange [42]. It also lets member nations exchange best practices and educate their civil protection forces to better react to catastrophes [20, 59].

Civil protection support includes humanitarian materials, knowledge, intervention teams, and specialized equipment from participating States. The Mechanism deploys needs assessment and coordinating experts [27]. The Monitoring and Information Centre (MIC) was superseded as the operational hub of the Mechanism by the Emergency Response Coordination Centre (ERCC). It monitors global crises 24/7 and coordinates the reaction of member nations to the Mechanism in the event of a significant crisis at the request of any government, the UN, its agencies, and certain international organizations [30, 69].

2.5. Civil Protection in Management of Crises in the EU

According to Perchinig et al. [59], we should define the EU's expanding crisis management as well as civil protection role before operationalizing our variables and interpreting our findings. In a society that is increasingly interconnected, disasters like earthquakes, disease outbreaks, and industrial mishaps, and these may quickly cascade across borders and have significant local and global effects [27]. The EU manages crises because of transboundary occurrences like these or national catastrophes that a single nation cannot handle. The Treaty of Lisbon's Solidarity Clause specifies that the EU must help member states during significant crises [3, 67]. The solidarity clause in the Treaty on the Functioning of the EU and the Treaty of Lisbon, which mandate that the Union support and coordinate its Member States' civil protection systems, have increased the level of cooperation among EU member states in crisis management [36, 71]. The UCPM, established in 2001, facilitates cooperation between European civil protection organizations [31, 73]. Later, in December 2013, EU Civil Protection Act was updated with the goal of encompassing the fields of disaster prevention, readiness, and response [67, 70].

The ERCC, the main platform for crisis monitoring and collaboration inside the EU, disseminates information, issues alerts, and coordinates member state responses [36]. The ERCC, which took over for the MIC, keeps track on catastrophes around-the-clock and reacts by offering information, updates, knowledge, money, and volunteer pool resources [72, 74]. The ERCC coordinates EU reaction to the solidarity clause. CECIS (Common Emergency Communication and Information Systems), a web-based alert and warning system, helps the ERCC share real-time information with member states. In October 2014, the "voluntary pool" EERC was improved. Experts, relief teams, and equipment from Member States are pre-committed to the EERC [15]. To transition from reactive and ad hoc coordination to "a pre-planned, pre-arranged and predictable system", the voluntary pool of pre-committed talents was formed [6, 53].

According to Singh & Masuku [60], the UCPM has monitored over 400 catastrophes and activated over 250 times [3]. During the 2017 forest fires, the UCPM dispatched firefighters, vehicles, and planes to Portugal, France, Italy, Montenegro, and Albania. These formal agreements will only

have value and legitimacy if they fulfill their obligations and deliver on the help they have committed to, and to do this, organizations must be created and managed that can interact, work together, and take action with crisis management organizations located in many countries with different kinds of organizations and structures [67]. Parker et al., [39] revealed that different civil protection mechanisms have become a basis of EU hub's dependability and effectiveness in a crisis. We operationalized this study's variables and utilized data to measure civil protection mechanisms and emergency management operations.

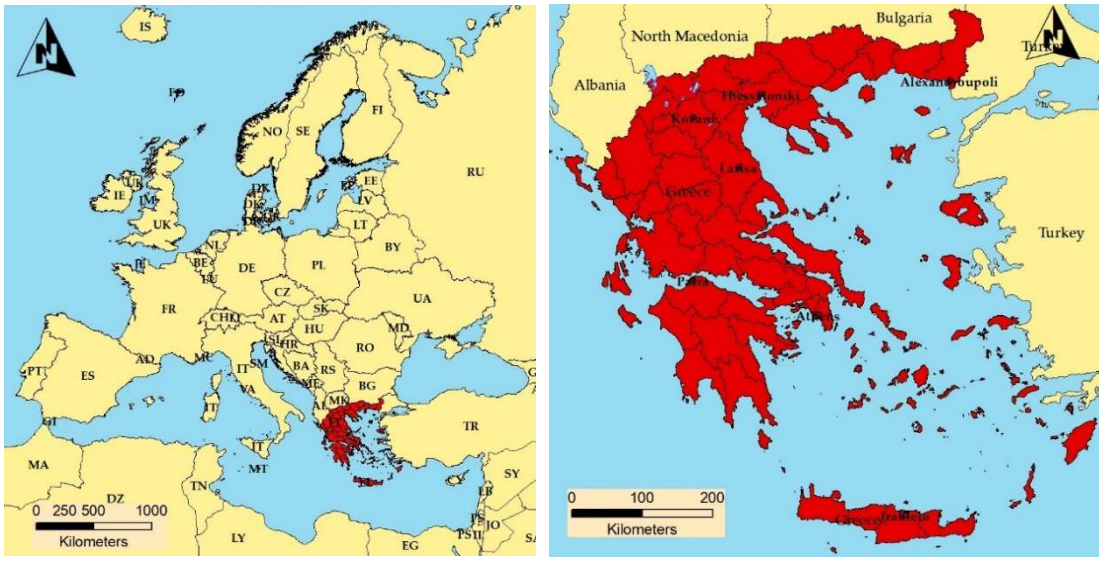
3. Materials and Methods

3.1. Research Design

The study was quantitative since it used a cross-sectional research approach. The study methodology made it easier to gather and analyze quantitative data to identify a particular phenomenon in light of recent trends, occurrences, as well as connections that exist between different study variables. The researcher was able to effectively generalize the numerous study results to a larger leadership population in Greece because to the cross-sectional survey research technique, which also offered data on the study's issue.

3.2. Study Population

Regarding the study's target audience, it concentrated on the various Greek government officials and leaders since it is thought that they have in-depth understanding of civil protection systems and efficient emergency response in government and nonprofit organizations. Greek technocrats were chosen because they serve as a representative of the populace and are knowledgeable about civil defense systems and efficient emergency management operations in governmental institutions. It was wise to use leaders as the research population since they are often chosen by the general public and also dwell in Greece (Figure 3), providing more accurate data to make significant findings for the study.



Europe — Greece—study area

Figure 2. Maps of Europe, Greece.

3.3. Sample Size

To choose the best sample for the research, the population was used as a foundation. So, based on a research population of 20,000 distinct technocrats throughout Greece as a representative of all of Europe, a sample size of 392 civil protection employees in Greece was chosen. As shown in Equation 1, the sample size was determined using Yamane's (1973) method [60, 75].

The research population (20,000) is obtained if it is estimated that 3-4% of the employees in local self-government organizations of the A' and B' degree (80,000) work in the Civil Protection Departments. To this number are added the politicians who deal with civil protection, the agrotechnicians, the economists, the civil engineers and administrative officials and the operators of the machines who are inevitably involved. Also, from the total number of employees in the central government (500,000) 1.5 - 2% belong to the above categories of employees involved in the subject of civil protection [76].

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Equation 1. Calculation of the minimum sample of respondents.

where:

n is the preferred sample size,

N is the study population,

e is the significance level, and

1 is the constant applicable for thus sample determination.

Basing on a 5% (0.05) significance level, the preferred sample size was determined as:

$$n = \frac{20{,}000}{1 + 20{,}000\ (0.05)^2} \Leftrightarrow n = 392$$

where n = 392.

To get the most relevant results from our research, we employed a method called stratified random sampling. There is still another way for defining the sample, which results in a smaller sample, however this approach was not used since the number of people willing to participate in this study was substantial [77, 78].

Probability sampling techniques were used in this investigation, including stratified and straightforward random sampling. The final sample in this instance was generated using a stratified random sampling procedure from the strata from which the goal sample had been collected. Especially noteworthy is the benefit of simple random sampling, which produces samples that are remarkably typical of the population.

3.4. Data Collection and Analysis

Data collection was undertaken using a well drafted online questionnaire distributed to Greek technocrats. A questionnaire quickly covers many respondents, costs less money, and enables respondents to answer different challenging questions with ease. For this reason, the online survey questionnaire helped to gather reliable data for assessing the effectiveness of civil protection systems in public organizations' emergency management operations. The scale for the research variables employed a normative scale. Additionally, the coded and transmitted quantitative data from the pre-selected research participants was analyzed in SPSS. Tables with the findings were shown, and

percentages and frequencies were used to understand them. Using Pearson's rank correlation test, a connection between the study variables was found. A civil protection mechanism's contribution to efficient emergency management operations in public organizations was also studied using regression analysis. In this instance, Equation 2 was used to create a multiple regression model to get the different anticipated values [79–82].

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (2)$$

Equation 2. Multiple regression model to get the different anticipated values.

where:

Y represents effective emergency management operations in public organizations,

β_0 is the constant,

X_1 Represents the activities of civil protection experts

X_2 Represent the elements of early warning systems,

X_3 Represents the aspects of disaster risk forecasting, and

ε This represents the error term present in the multiple regression model.

$\beta_1 \ldots \beta_3$ demonstrates how the regression coefficient for the independent variables may be used to predict changes in emergency management operations in public organizations

The study's hypotheses were put to the test, and the 0.05 significance level was used to determine whether to accept or reject them. A significance level of 0.05 is appropriate because it minimizes both the likelihood of committing a Type I error (false positive) and a Type II error (false negative). Decreasing the Type I error rate (for example from 0.05 to 0.01) will increase the chances of a Type II error and thus result in a possibility of failing to detect an actual effect in the research study. However, if the significance level were to be set higher (for instance, at 0.10), the chances of Type II errors would reduce while those of Type I errors would rise.

According to ethical standards, the information provided by the responders was handled privately and in confidence. Because respondents were free to interpret the different opinion questions, it was simpler to gather thorough responses to certain issues.

4. Results

The interpretation of the various findings following data analysis from the chosen research participants is presented in this section.

4.1. Demographic Characteristics/Bio Data

Results concerning the different biodata features of the selected respondents are in Table 1.

Most study participants were male (54.4%), and 45.6% were female. Most respondents (35.7%) were in the age bracket of 30-40 years, and only 5.6% were below 30 years. More than half of the participants (57.4%) had spent 5-10 years with civil protection activities, and only 14.8% had spent less than 5 years with civil protection activities.

4.2. Descriptive Results

The results on the different activities of civil protection experts are shown in Table 2.

The result show that activities of civil protection experts majorly include ability to formulate emergency preparedness plans (27%), followed by ability to establish early warning systems (21.9%), then ability to forecast disaster risks (20.2%), and capacity to educate people on emergency management operations (13.5%). A small section of respondents (6.9%) also showed that collection and storage of emergency items is among the activities of civil protection experts.

Table 1. Biodata of the respondents.

Characteristic	Frequency	Percentage (%)
Gender		
Male	213	54.4
Female	179	45.6
Age bracket in years		
Below 30	22	5.6
30-40	140	35.7
41-50	184	46.9
Above 50	46	11.8
Years spent in Civil Protection activities		
Below 5	58	14.8
5-10	225	57.4
Above 10	109	27.8

Source: Survey (2023).

Table 2. Results for activities of civil protection experts.

Characteristic	Responses	
-	Frequency	Percentage (%)
Ability to forecast disaster risks	79	20.2
Ability to establish early warning systems	86	21.9
Capacity to educate people on emergency management operations	53	13.5
Ability to formulate emergency preparedness plans	106	27.0
Collection and storage of emergency items	27	6.9
Ability to plan for safe evacuation	41	10.5
Total	392	100

Source: Survey (2023).

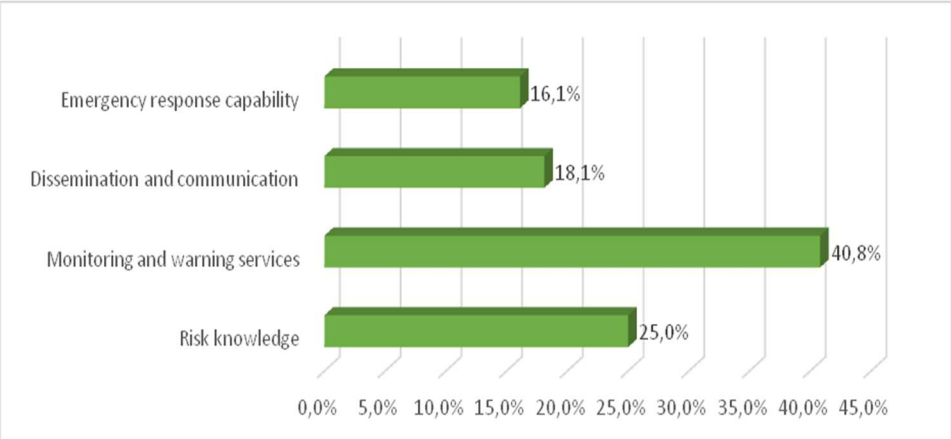


Figure 3. Results for elements of early warning systems (Survey (2023)).

The results on the different elements of early warning systems are presented in Figure 4.

The results in Figure 4 show that the most essential element of early warning system is monitoring and warning services (40.8%) followed by risk knowledge (25%), and 16.1% showed that early warning systems also encompasses the aspect of emergency response capability.

The study established the different aspects of disaster risk forecasting, and the results are presented in Table 3.

Table 3. Results for aspects of disaster risk forecasting.

Characteristic	Responses	
-	Frequency	Percentage (%)
Disaster risk forecasting using qualitative techniques	91	23.2
Forecasting using time series analysis and projection	167	42.6
Disaster risk forecasting based on causal models	103	26.3
Forecasting disasters based on past occurrences	31	7.9
Total	392	100

Source: Survey (2023).

The results in Table 3 show that one of the major aspects of disaster risk forecasting is Forecasting using time series analysis and projection (42.6%) followed by Disaster risk forecasting based on causal models (26.3%), then disaster risk forecasting using qualitative techniques (23.2%), and then 7.9% for forecasting disasters based on past occurrences.

The study also established the different aspects of effective emergency management operations in public organizations and the results are in Figure 5.

Figure 4. Aspects of effective emergency management operations (Survey (2023)).

The results in Figure 5 show that effective emergency management operations in public organizations is majorly associated with proper disaster mitigation plans (30.4%) followed by rapid and effective recovery (22.7%), then proper communication of emergency management techniques (18.8%), prompt assistance to victims (14.8%), and the least number of participants (13.3%) showed that effective emergency management operations in public organizations is associated with avoidance of losses from hazards.

4.3. Correlation Analysis

The relationship between the different variables in this study was established using correlation analysis and the results are given in Table 4.

Table 4. Cross-tabulation results.

Correlation	Emergency management operations in public organizations	Activities of civil protection experts	Elements of early warning systems	Aspects of disaster risk forecasting
Emergency management operations in public organizations	1 (0.000)			
Activities of civil protection experts	0.731* (0.000)	1 (0.000)		
Elements of early warning systems	0.621* (0.020)	0.649* (0.000)	1 (0.000)	
Aspects of disaster risk forecasting	0.647* (0.000)	0.521* (0.000)	0.546* (0.000)	1 (0.000)

* Show, respectively, statistical significance at a 5% level of significance. Standard errors in parentheses.

The results show a positive correlation between activities of civil protection experts and effective emergency management operations in public organizations (r = 0.731). There was a positive correlation between elements of early warning systems and effective emergency management operations in public organizations (r = 0.621), significant at 0.05. This shows that general availability of monitoring and warning services, and proper dissemination and communication of disaster management to general public is essential in enhancing the effectiveness of emergency management operations in public organizations across Europe. Aspects of disaster risk forecasting gave a positive correlation with effective emergency management operations in public organizations (r=0.647), showing that disaster risk forecasting using qualitative techniques or methodologies helps to enhance the general effectiveness of managing emergencies in public organizations across Europe.

4.4. Diagnostic Tests

4.4.1. Heteroscedasticity Test

The Heteroscedasticity test in this study helped to find out the error components associated with the data for this study especially concerning whether it is correlated across the different observations in the study. It was assumed that heteroscedasticity is not an issue with the data since the p-value is greater than 5%. This was not ruled out at the threshold p-value of 0.05 according to the reported result of 0.7241>0.05. The data were not heteroscedastic consequently. With a p-value of 0.7241, the findings in Table 5 show that the constant variance null hypothesis is not disproved.

Table 5. Model Summary.

Test for heteroscedasticity by Breusch and Pagan	
Ho: Constant variance	
Variable: Different fitted values of effective emergency management operations in public organizations	
chi2(1) =	0.7300
Prob > chi2 =	0.7241

Predictors: Activities of civil protection experts, Elements of early warning systems, Aspects of disaster risk forecasting.

4.4.2. Autocorrelation Test

It was essential to verify whether the dependent variable is independent. The Durbin-Watson (d) test was used. In this test, a value of d=2 denotes the absence of autocorrelation. The findings of the investigation showed 1.032, which suggests that the residuals are not autocorrelated, see Table 6. The value of (d) always ranges between 0 and 4, where 0 reveals that autocorrelation and above 1 implies the residuals are interdependent.

Table 6. Durbin Watson test.

Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate	Durbin-Watson
-	0.593	0.568	0.581	0.261	1.032

Predictors: (Constant). Activities of civil protection experts, Elements of early warning systems, Aspects of disaster risk forecasting.

In Table 6, the adjusted R-square value is 0.559, which indicates that after accounting for the number of predictors included in the model, variation in effective emergency management operations in public organizations can be explained by the activities of civil protection experts, elements of early warning systems, and aspects of disaster risk forecasting to the extent of 55.9%.

4.5. Regression Test

4.5.1. Fitness of Model

The results presented in Table 7 show model fitness in this study. The different aspects of civil protection mechanisms (Activities of civil protection experts, elements of early warning systems, Aspects of disaster risk forecasting) were satisfactory in explaining effective emergency management operations in public organizations. The adjusted R-square value of 0.559 means that the model fits 55.9% of variance in the dependent variable given the number of predictors considered. This adjustment helps to justify the introduction of more predictors and increases the value of the model.

Table 7. Model Fitness.

R	R-Square	Adjusted R-Square	Std. Error of the Estimate
0.538	0.568	0.559	0.261

Predictors: (Constant), Activities of civil protection experts, Elements of early warning systems, Aspects of disaster risk forecasting.

4.5.2. Regression of Coefficients

The results in Table 8 show the regression coefficients based on the study's independent variables.

The coefficients of regression shown in Table 8 present the level to which Activities of civil protection experts, Elements of early warning systems, Aspects of disaster risk forecasting, predict effective emergency management operations in public organizations. Regression coefficients showed that there was a substantial correlation between the various aspects of civil protection mechanisms and effective emergency management operations in public organizations.

The p-value for activities civil protection experts was 0.010 and we accepted hypothesis H1 which meant that activities civil protection experts positively influence effective emergency

management operations in public organizations. The p-value of elements early warning systems was 0.007 hence H2 was accepted and therefore There is a positive relationship between elements early warning systems and effective emergency management operations in public organizations. The p-value of aspects of disaster risk forecasting was 0.018 which is less than 0.05 hence H3 was accepted. Therefore, disaster risk forecasting has a positive influence on effective emergency management operations in public organizations.

Table 8. Coefficients.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.528	0.261	-	5.186	0.035
Activities of civil protection experts	0.263	0.041	0.354	4.431	0.010
Elements of early warning systems	0.192	0.137	0.451	2.596	0.007
Aspects of disaster risk forecasting	0.073	0.083	0.158	1.1284	0.018

Dependent Variable: Effective emergency management operations in public organizations.

5. Discussion

This research examined how civil protection systems work in public organizations in Europe to make sure they can handle emergencies well, using Greece as an example. The findings revealed that parts of early warning systems are linked to better emergency management in public institutions. The research also found that the different parts of disaster risk forecasting make it easier for public organizations to handle emergencies well. It was confirmed that having well-established early warning systems for disasters helps organizations improve the effectiveness of emergency management. This can be done by communicating well, knowing about the risks, and making sure the warning systems are available.

The interesting results of this study showed that the work of civil protection experts has a positive effect on how well public organizations handle emergencies. It's clear that people who work in civil protection value national and EU-level institutions more if they are structured in a way that follows rules and encourages a culture of trust and professionalism [39, 83]. There are different ways for authorities in civil protection and crisis management to judge performance based on the organization's structure and culture. Civil protection agencies at the national level, staffed by skilled professionals, make emergency management a lot easier [24, 49, 67].

International coordination of resource sharing is needed for the EU Civil Protection Mechanism to work, which helps with crisis management [11, 63]. Redundancy (using extra resources when the main ones aren't working or are missing) and resourcefulness (seeing problems, setting priorities, and getting resources together when things are about to go wrong) are both improved by having a lot of flexibility and spare capacity [57, 59, 71].

People all over the world have tested the idea of improving global civil protection through the European Union Civil Protection Mechanism. It has worked to help the affected country's coordination and response [39, 55]. The system deals with disasters like floods and terrorist attacks [63, 84]. During the 2010 floods in Poland, units from 11 different countries helped Polish authorities.

Because it works with the UN and the Red Cross/Red Crescent organization, the Mechanism is a global player [2, 85, 86].

The study makes it clear that disaster risk forecasting has a big impact on how public organizations handle emergencies. Predicting the risk of disasters helps the most vulnerable people who could die in disasters. It also helps with disaster relief. Complex disaster risks are caused by physical dangers and people, assets, and systems that are easily damaged. Manage and lower the risk of disasters by knowing where and when they happen [19, 66, 87].

If it is planned, built, and run correctly, an EWS could lower the chances of disasters happening, encourage people to get ready and act quickly, and protect weak groups. To get the benefits of warnings, they need to be understood, used, and accepted [88, 89]. An EWS needs long-term funding and involves lots of people, like local communities, government agencies, businesses, the media, and people in the region [56]. Communication and involvement of the community are just as important as the technical parts of an EWS. For EWS to reach its full potential, a number of systemic changes need to be made. These include giving more money and attention to areas that need it, and getting more at-risk communities involved.

6. Conclusions and Implications

It is clear from this study that civil protection mechanisms help to enhance effective emergency management operations in public organizations. Additionally, activities of civil protection experts, the different elements of early warning systems, and aspects of disaster risk forecasting have a positive influence on the level of emergency management operations in public organizations.

Our results are relevant to future EU civil protection talks. Since the EU is not a standalone organization, every initiative to improve central EU collaboration must also strengthen national cooperation. The system's institutional design must also include the cultural variables we identified to be beneficial. RescEU is a new European Commission initiative to improve natural disaster response. Instead of a more decentralized network or a hierarchical system with DG ECHO as the network lead organization, the EU has proposed strengthening civil protection cooperation across all levels and boarders.

The bottom-up concept proposes subsidizing member states' asset and resource upgrades to strengthen national capabilities. Since 2001, over 100 EU activations have helped member states react to fires, floods, and other emergencies. The rescEU strategy to strengthen national and EU competences reflects the increased need for different mechanisms to address risks. The efficacy of emergency management operations has increased thanks to the rescEU's dual approach of boosting the operational agency of the EU while enhancing the ability of the national component elements of civil protection-based cooperation. The rescEU plan would make the EU more autonomous, hierarchical, and influential in civil protection professionalization and standardization in Europe via training programs and advise on state preventative policies without making it a network lead organization. This approach may strengthen national and EU civil protection if adopted by member states.

6.1. Contribution of the Study

The study findings will provide new knowledge regarding the activities of civil protection experts, the different elements of early warning systems, disaster risk forecasting and emergency management operations in public organizations.

6.2. Areas for Future Research

This study focused on the different civil mechanisms and how they influence emergency management operations. However little focus was put on how government policies play a role in the relationship between civil protection and emergency management. Future research ought to explore the mediating role of government policies in the relationship between civil protection and effective emergency management operations.

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