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Comparative Analysis of Emergency Management Systems in Higher Education Institutions Worldwide: Lessons for the National and Kapodistrian University of Athens and Higher Education Institutions in Greece

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Abstract

The present study primarily focuses on the extent of Emergency Management (EM) preparedness at the National and Kapodistrian University of Athens (NKUA), benchmarking best practices from leading Higher Education Institutions (HEIs) internationally. Methodologically, it has applied: (a) a systematic literature review over frameworks and international standards of EM; (b) seven international HEI comparative analyses based on available public plans, organizational structures, and EM protocols; and (c) empirical assessment that includes NKUA plus thirteen Greek HEIs through qualitative semi-structured interviews together with a quantitative questionnaire answered by 53 administrative plus technical staff having operational responsibilities in EM. The results expose major structural-operational deficiencies at Greek HEIs. There is no centralized EM directorate, interoperability with public authorities is limited, preparedness drills and emergency planning are conducted in fragmented ways, while systematic provisions for vulnerable groups are absent. In comparison, the international HEIs we studied - UC Berkeley, UBC, the University of Oxford, UCL, the University of Sydney, the University of Tokyo, and the University of Canterbury have integrated mature EM systems based on regularly revised Emergency Operations Plans (EOPs) as well as: multi-channel alerting systems, physical & cyber security 24/7, institutionalized drills and accessibility measures for Persons with Disabilities (PwDs).

Considering all the above, a six-pillar organizational model is proposed specifically for Greek HEIs including: 1) institutionalized EM governance, 2) integrated 24/7

physical and cyber security, 3) preparedness drills and training programs on a constant basis, 4) ISO-and FEMA compliant interoperable EOPs (inclusive EOPs covering all functions and operations aligned with both international standards and best practices), 5) digital multi-channel emergency alerting and 6) formal cooperation framework with external authorities via Memoranda of Understanding (MoUs). This proposed organization for Greek HEIs is depicted in Figure10 through an Emergency Management Directorate and more specifically targeted policy recommendations listed inTable3. This study provides a framework for EM in HEIs, proposing preparedness and resilience measures thus adding to the existing relative literature. The flexibility of the proposed framework allows its implementation even in HEIs with fragmented governance environments or under resource constraints. A necessity for a transition from a reactive crisis response to proactive preparedness is highlighted by the findings of the study, aiming at structuring safe, resilient and sustainable HEIs.

Keywords: *Emergency Management (EM), Civil Protection (CP), Higher Education Institutions (HEIs), Preparedness and Resilience, Emergency Operations Plans (EOPs)*

Περίληψη

Η παρούσα μελέτη εστιάζει κυρίως στον βαθμό ετοιμότητας Διαχείρισης Έκτακτων Αναγκών (ΔΕΑ) στο Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών (ΕΚΠΑ), συγκρίνοντας βέλτιστες πρακτικές από κορυφαία Ιδρύματα Ανώτατης Εκπαίδευσης (ΙΑΕ) διεθνώς. Μεθοδολογικά, έχει εφαρμοστεί: α) συστηματική ανασκόπηση της βιβλιογραφίας σχετικά με τα πλαίσια και τα διεθνή πρότυπα της ΔΕΑ, β) συγκριτική ανάλυση επτά διεθνών ΙΑΕ, βασισμένη σε διαθέσιμα δημόσια σχέδια, οργανωτικές δομές και πρωτόκολλα ΔΕΑ, γ) εμπειρική αξιολόγηση που περιλαμβάνει το ΕΚΠΑ και δεκατρία ελληνικά ΙΑΕ ακόμη, μέσω ποιοτικών ημιδομημένων συνεντεύξεων μαζί με ένα ποσοτικό ερωτηματολόγιο στο οποίο απάντησαν 53 διοικητικά και τεχνικά στελέχη που έχουν επιχειρησιακές ευθύνες στη ΔΕΑ. Τα αποτελέσματα αποκαλύπτουν σημαντικές δομικές-λειτουργικές αδυναμίες στα ελληνικά ΙΑΕ. Δεν υπάρχει κεντρική Διεύθυνση ΔΕΑ, η διαλειτουργικότητα με τις δημόσιες αρχές είναι περιορισμένη, οι ασκήσεις ετοιμότητας και ο σχεδιασμός έκτακτης ανάγκης διεξάγονται με αποσπασματικό τρόπο, ενώ απουσιάζει συστηματική πρόνοια για τις ευάλωτες ομάδες. Συγκριτικά, τα διεθνή ΙΑΕ που μελετήσαμε – το UC Berkeley, το UBC, το Πανεπιστήμιο της Οξφόρδης, το UCL, το Πανεπιστήμιο του Σίδνεϊ, το Πανεπιστήμιο του Τόκιο και το Πανεπιστήμιο του Κάντερμπερι – διαθέτουν ολοκληρωμένα συστήματα ΔΕΑ, βασισμένα σε τακτικά αναθεωρούμενα Σχέδια Αντιμετώπισης Έκτακτων Αναγκών (ΣΑΕΑ), καθώς και: συστήματα ειδοποίησης πολλαπλών καναλιών, 24ώρη, καθημερινή, φυσική & στον

κυβερνοχώρο ασφάλεια, θεσμοθετημένες ασκήσεις και μέτρα προσβασιμότητας για Άτομα με Αναπηρία (ΑμεΑ).

Λαμβάνοντας υπόψη όλα τα παραπάνω, προτείνεται ένα οργανωτικό μοντέλο έξι πυλώνων ειδικά για τα ελληνικά ΙΑΕ, το οποίο περιλαμβάνει: 1) θεσμοθετημένη διακυβέρνηση ΔΕΑ, 2) ολοκληρωμένη 24ώρη, καθημερινή, φυσική & στον κυβερνοχώρο ασφάλεια, 3) ασκήσεις ετοιμότητας και προγράμματα εκπαίδευσης σε σταθερή βάση, 4) διαλειτουργικά ΣΑΕΑ συμβατά με τα πρότυπα ISO και FEMA (συμπεριληπτικά ΣΑΕΑ που καλύπτουν όλες τις λειτουργίες και επιχειρήσεις ευθυγραμμισμένα τόσο με τα διεθνή πρότυπα όσο και με τις βέλτιστες πρακτικές), 5) ψηφιακή ειδοποίηση έκτακτης ανάγκης πολλαπλών καναλιών, 6) επίσημο πλαίσιο συνεργασίας με εξωτερικές αρχές μέσω Μνημονίων Συνεργασίας. Αυτή η προτεινόμενη οργάνωση για τα ελληνικά ΙΑΕ απεικονίζεται στο Σχήμα 10 μέσω μιας Διεύθυνσης Διαχείρισης Έκτακτων Αναγκών, και, πιο συγκεκριμένες, στοχευμένες προτάσεις πολιτικής αποτυπώνονται στον Πίνακα 3. Αυτή η μελέτη παρέχει ένα πλαίσιο για τη ΔΕΑ στα ΙΑΕ, προτείνοντας μέτρα ετοιμότητας και ανθεκτικότητας, συμβάλλοντας έτσι στην υπάρχουσα σχετική βιβλιογραφία. Η ευελιξία του προτεινόμενου πλαισίου επιτρέπει την εφαρμογή του ακόμη και σε ΙΑΕ με περιβάλλοντα κατακερματισμένης διακυβέρνησης ή με περιορισμένους πόρους. Τα ευρήματα της μελέτης υπογραμμίζουν την αναγκαιότητα για μια μετάβαση από την αντιδραστική διαχείριση κρίσεων στην προληπτική ετοιμότητα, με στόχο τη δόμηση ασφαλών, ανθεκτικών και βιώσιμων ΙΑΕ.

Λέξεις-κλειδιά: *Διαχείριση Έκτακτων Αναγκών (ΔΕΑ), Πολιτική Προστασία (ΠΠ). Ιδρύματα Ανώτατης Εκπαίδευσης (ΙΑΕ). Ετοιμότητα και ανθεκτικότητα, Σχέδια Αντιμετώπισης Έκτακτων Αναγκών (ΣΑΕΑ)*

1 Introduction

In times where both natural and man-made disasters such as earthquakes, fires and public health crises increase in intensity and frequency, Civil Protection (CP) mechanisms within tertiary education sector require strengthening (Alexander 2002; Kapucu et al., 2010). Student, faculty and administrative staff safety alongside smooth running of institutions brings about a need for the development of effective EM systems placing emphasis on institutional resilience (Rodin, 2014). In this context, risk management and operational readiness of Higher Education Institutions (HEIs) are considered critical factors regarding protection of life, property, and academic function (Perry and Lindell, 2003; Kapucu, 2012). The National and Kapodistrian University of Athens (NKUA), being the oldest and among the largest HEIs in Greece, maintains

numerous and diverse facilities which makes particularly complex the organization of EM (OECD, 2019). Furthermore, a field for comparative assessment is offered by the differences that other HEIs of the country present in terms of size, location and level of institutional preparedness. The Greek legal framework explicitly states that HEIs are obliged to plan and implement CP measures. That renders the present study timely and significant in identifying best practices applied in HEIs worldwide (Casajus Valles, et al., 2020).

The present study aims to assess the level of organizational preparedness of Greek HEIs in EM issues and, through this assessment, provide support to other HEIs in other countries similarly lacking EM issues. A comparative analysis is therefore conducted between EM systems implemented at selected HEIs from countries including the USA, UK, Japan, and Australia (UNISDR, 2015). The intended outcome of such comparison shall be used for developing strategic directions aimed at enhancing the existing framework in Greece. The main areas/pillars-of-focus are: (a) current organization structure & plan documentation; (b) infrastructure/technical preparedness measures; (c) human resource development/training initiatives; (d) collaboration with external agencies; (e) use of technology tools; and finally, (f) comparative evaluation between NKUA & other HEIs. For clarity, Table S1 in the Supplementary Materials presents the acronyms and abbreviations used throughout the article.

2 Theoretical Framework and International Trends in HEIs Emergency Management

Emergency Management is complex involving many dimensions and aspects. It has evolved over recent decades from a predominantly response-oriented model to comprehensive risk management that includes prevention preparedness, response and recovery. EM therefore finds heightened relevance in HEIs which emulate the structure of small - scale cities with high population density, complex infrastructures and varied activities (Kapucu and Garayev, 2011), while student experiences highlight additional requirements for preparedness (Skoulidas, et al., 2024).

2.1 Evolution of the Civil Protection Concept

Civil Protection originated under the term ‘Civil Defense’ with a primary focus on protection of the civilian population against military threats, and later was redirected towards natural and technological hazards in a four-stage cyclical model (Alexander, 2013):

- Prevention / Mitigation: structural & non-structural measures (e.g., anti-seismic regulations, green infrastructure).
- Preparedness: plans, training, drills, early warning capabilities.
- Response: immediate rescue, first-aid, incident management.
- Recovery: return to normalcy + “build-back-better” approaches.

Today, CP involves climate change, pandemics and cyber threats with a new approach of resilience and multi-level governance as prescribed by the Sendai framework, European guidelines and the OECD Recommendation on the Governance of Critical Risks (Comfort, 2007; OECD, 2014; UNISDR ,2015; Casajus Valles et al., 2020) Resilience is still taken to be response capacity but now also comprises coping and adaptive capacities that allow for a fuller assessment.(Parsons et al., 2016).

2.2 Institutional Framework and Legal Obligations in Greece

The Civil Protection framework in Greece is primarily governed by Law 4662/2020 (National Mechanism for Crisis and Risk Management), which defines the responsibilities and obligations of all involved parties, subsequently reformed by Law 5075/2023 and other relevant circulars of the General Secretariat for Civil Protection (GSCP). The obligation of HEIs to implement CP measures stems from a 1974 legislative decree (Legislative Decree 17/1974), in which they are included among the Public Independent Institutions (P.I.I.s) that are obliged to implement its provisions. Guidelines defining organization for EM according to the latter legislative decree, were issued in 1991, by the Ministry of Public Order (Document Protocol No 107/1/158/17-04-1991).

Furthermore, the most recent legislation concerning their operation provides for the establishment of an independent service in every HEI, named the "Security and Protection Unit" (Law 4957/2022 as reformed by Law 5224/2025). Its responsibilities include, inter alia:

- the design of programs, actions, seminars, drills, and related initiatives, in collaboration with public sector bodies or social agencies, aiming to raise awareness among the academic community, regarding response to emergency situations
- the drafting of safety, evacuation, and disaster response plans, in collaboration with the competent public authorities as well as
- the drafting of safety, notification, and evacuation plans for Persons with Disabilities (PwDs) during emergency situations.

Concurrently, the Law provides for the establishment of a Security and Protection Committee of the HEI, which functions as an advisory body. Its mission is the continuous monitoring of issues related to the security and protection of the HEI, the members of its community, and its infrastructure, as well as the formulation of proposals for policy-making on matters within its scope. The responsibilities of the Committee include, inter alia:

- The proposal on forming a Crisis and Disaster Management Team as well as a Fire Protection Team in collaboration with the Fire Service or competent services of the Ministry of Climate Crisis and Civil Protection.
- It provides a draft internal regulation on disaster management covering natural, technological, and anthropogenic hazards to be approved by the Senate of the HEI.
- The supervision of the compilation and execution of studies on active fire protection and the installation of necessary fire protection measures and means, in collaboration with the Fire Service or the competent services of the Ministry of Climate Crisis and Civil Protection.
- The planning and organization of readiness drills/exercises, in cooperation with the Rector or the competent Vice-Rector of the HEI.

In addition, emergency warning systems with both visual and audio alarms ought to be installed in all HEIs. This makes HEIs more autonomous and efficient in imposing risk management. The obligation is within the wider European framework on the organization of national disaster management systems (European Commission, 2024).

2.3 Emergency Management Peculiarities in HEIs

The implementation of EM measures in HEIs presents specific challenges. Owing to their unique characteristics:

- High population density and heterogeneity, resulting in complex evacuation processes. (Alexander, 2002; Kapucu et al., 2010; UNISDR, 2015).
- Existence of research laboratories with chemical and biological materials, thus requiring special SOPs. (Lekkas, 2000; ISO, 2018; WHO, 2020)
- Architectural diversity (heritage buildings on modern campuses) creates different risks of vulnerability toward seismic events (Lekkas, 2000; Spence, et al., 2011; Alexander, 2013; EPPO., n.d.-c).
- Knowledge gap among students and staff with minimum participation in drills (Skoulidas et al., 2024; Samson, et al., 2025).

- Underfunding of critical infrastructure-alarm systems, ICT-backup and institutional resilience (Aradau, 2010; Boin and Lodge, 2016; European Commission/JRC, 2019;).

Overall, EM in HEIs requires a combination of institutional structural approach and intensive involvement from the community within the HEI because resilience is not wholly infrastructural but also emanates from preparedness and adaptability as a collective (Paton and Johnston, 2001). Overall, for HEIs to achieve resilience and effective EM, a combination of both institutional structural approach and active participation of the academic community are required (Paton and Johnston 2001).

2.4 International Best Practices and Hazard & Risk Analysis in HEIs

Experience from HEIs on an international scale indicates that systematic Hazard and Risk Analysis (HRA) is necessary for the development of structured and interoperable EM systems, especially when operating in multi-hazard environments. To this aim natural, technological, and anthropogenic threats—such as earthquakes, fires, floods, chemical hazards, and active threats— are identified and taken into consideration in the design of emergency plans and preparedness measures (FEMA, 2013; ISO, 2018). Thus, leading HEIs around the world, built on HRA for designing their EM frameworks, to which prevention, preparedness, response, and recovery are integrated. Comprehensive and regularly updated Emergency Operations Plans (EOPs), such as those of UC Berkeley, UCL, UBC, and the University of Oxford constitute a core component. These plans incorporate multi-hazard scenarios, activation protocols, command systems, and hazard-specific annexes and are designed in accord with FEMA's guidelines (2013; 2021), ISO standards (2018), and established academic principles (Alexander, 2016). Another common feature lies in the development of strong multi-channel early warning systems to ensure quick messages of an alert through SMS, mobile app SafeZone and other similar apps/broadcast emails/Public Address (PA) system/digital platforms (UCL Safety Services, n.d.; UC Berkeley OEM, n.d.; UBC SRS, n.d.). This makes people aware of what has happened or is happening hence reducing delay in response. Structured training programs on first aid, use of AEDs and fire safety handling, in collaboration with public authorities and certified organizations enhance preparedness (UBC SRS, n.d.; University of Sydney – Protective Services, n.d.; Thayaparan et al., 2014). Regular drills and practices through both earthquake and fire simulations sustain the readiness, routinely followed by after-action reviews for continuous improvement (University of Canterbury, 2023; UCL Safety

Services, n.d.). There is constant real-time monitoring and incident response at international HEIs through 24/7 Security Operations Centers (SOCs) or campus police units. That is an operational feature found across the institution (UC Berkeley UCPD, n.d.; Oxford Security Services, n.d.). Equally important are structured protocols on accessibility for PwDs which follow international guidelines-and include Personal Emergency Evacuation Plans; designated refuge areas; and implementation of a "buddy system" (WHO et al. 2013 UNISDR 2015). Table 1 summarizes the specific mechanisms that can be adapted or integrated in compliance with Law 4662/2020 and ISO 22320/22301, mapping the transferable international EM pillars to the context of Greek HEIs.

Table 1. International EM Pillars and Transferability to the Greek HEIs Context (Sources: UC Berkeley – OEM; University of Oxford – Security Services; UCL – Safety Services; UBC – SRS; University of Sydney – Protective Services; University of Canterbury, 2023; WHO et al., 2013; UNISDR, 2015.)
Note: Adaptations align with the requirements of Law 4662/2020 and the standards ISO 22320/ISO 22301.

Pillar	Indicative Examples	Adaptation to Greek HEIs
Integrated EOPs	UC Berkeley OEM; University of Oxford Security Services	Standard EOP from Rectors' Conference; wiki-format & annexes per building
Multi-channel alerting	UCL SafeZone; UBC (SRS)	Interconnection with 112, Copernicus EMS & university servers – app, SMS, email, PA
Regular drills	University of Canterbury; UCL	Biannual mixed drills (earthquake-fire) per campus, public after-action report
24/7 Campus Safety	UC Berkeley UCPD; University of Sydney Protective Services	Integration of security with Signal Reception Center & CCTV analytics at each HEI
Collaboration with authorities	UBC SRS; University of Oxford Security Services	Mandatory MoUs HEI - Fire Service / Hellenic Police / Hellenic National Center of Emergency Care, joint scenarios & data exchange
Inclusion / PwDs	University of Oxford; WHO/UNISDR	PwD chapter in each plan, “buddy system”, accessible assembly points

3. Research Methodology

The study implements a mixed-methods convergent design (Creswell and Plano Clark, 2018), to integrate qualitative and quantitative data, for the examination of EM in Greek HEIs. While focusing on the NKUA as the main case study, the design enables broader insights for other HEIs in Greece and abroad, and comparisons with international best practices (Kapucu, 2012). NKUA was selected for its scale, its complex infrastructure, the density of its population and the existence of hazardous laboratories. In addition, as a public HEI it must comply with current legislation mandating the design of disaster response plans and the assignment of personnel responsible for their implementation. It thus represents a case of strategic importance and "analytical generalization" (Flyvbjerg, 2006; Yin, 2018), closely linked to organizational resilience (Kapucu, 2012; Boin and Van Eeten, 2013;).

3.1 Research Design

The research design comprised four stages, aiming at a general understanding of EM in HEIs and in-depth research of the NKUA case:

- **Literature Review:**

It comprised a systematic analysis of national and international literature involving published articles, official reports and documents on EM in HEIs, with particular emphasis on the Greek relevant legislation and the challenges of its implementation.

- **International Best Practices:**

Successful models in HEIs worldwide (USA, Canada, Europe, Australia, etc.) were identified and investigated to extract lessons based on experiences and evaluate their applicability within the Greek and broader international environment (Comfort, 2007), drawing also on international guidelines (ISO, 2018; FEMA, 2021).

- **Qualitative Research (Semi-structured Interviews):**

Qualitative research involved semi-structured interviews with NKUA stakeholders in order to acquire deeper understanding of the institutional framework and procedures of Greek HEIs, besides challenges confronted by them. Transcribing their responses were later coded thematically to identify dominant themes or narratives (Kvale and Brinkmann, 2009; Patton, 2015). Due to the nature of the discussion, they preferred that their identity should not be revealed.

- **Quantitative Research (Questionnaires):**

An anonymous, structured questionnaire was distributed to administrative staff, building supervisors, P.I.I. supervisors, and members of Emergency Management Units across 14 NKUA facilities and 12 Greek HEIs, with the aim of ensuring confidentiality

and enhancing response sincerity (Baruch and Holtom, 2008; Singer and Couper, 2017). The design followed the Tailored Design Method for mixed-mode surveys (Dillman, Smyth, and Christian et al., 2014).

- **Questionnaire Design:**

The questionnaire (in Supplementary material) included various types of questions: dichotomous (Yes/No), multiple choice, open-ended, frequency-based, fixed-response, and multiple predetermined-response formats. It was structured into three sections:

(I) general questions regarding the existence of an emergency plan;

(II) questions on fire risk preparedness and fire safety;

(III) questions on earthquake risk preparedness and seismic readiness.

3.2 Data Analysis

- Qualitative Analysis: Interview data were analyzed thematically for the identification of patterns, categories, and challenges for both NKUA and other HEIs (Hsieh and Shannon, 2005; Elo and Kyngäs, 2008).
- Quantitative Analysis: Questionnaire data were examined through descriptive statistics (Agresti, 2019).

3.3 Sample and Data Collection

The sample consisted of building supervisors/assistant supervisors at NKUA, members of fire safety teams, and directors with supervisory responsibilities that have an active operational role in EM. Responses were received from 13 HEIs, including: National and Kapodistrian University of Athens, University of Ioannina, University of Thessaly, Agricultural University of Athens, Ionian University, Panteion University, Athens School of Fine Arts, University of Macedonia, University of Crete, Technical University of Crete, University of Patras, Hellenic Mediterranean University, and School of Pedagogical and Technological Education (ASPETE). Online data collection was performed between May and June 2024, with a desired response rate of $\geq 60\%$, in accordance with the standards for organizational surveys (Baruch and Holtom, 2008; Singer and Couper, 2017). A total of 53 questionnaires were completed with most responses originating from NKUA building supervisors/assistant supervisors, thus reflecting the large number of NKUA facilities and its decentralized organizational structure. The study focused on collecting and assessing experiences and informed perspectives from personnel responsible for implementing EM with the results being mostly qualitative and diagnostic rather than statistical. The sample is therefore

purposive (non-probability sampling), in accordance with the principles of qualitative inquiry and analytical generalization (Flyvbjerg, 2006; Creswell and Plano Clark, 2018).

4. Comparative Analysis of Emergency Management Systems in HEIs Worldwide

A comparative analysis was conducted to determine how international best practices outlined in Section 2.4 are operationalized in seven HEIs and how their systems differ in structure and function from those of HEIs in Greece. A synthesis of their systems key components and identification of convergent patterns across institutions was selected over the description of each system anew. The selected institutions - UC Berkeley, UBC, the University of Oxford, the University of Tokyo, the University of Sydney, the University of Canterbury, and UCL - represent mature, multi-hazard EM systems situated in diverse risk environments. This enables evaluation of organizational readiness and identification of gaps relevant to Greek HEIs, including NKUA.

To determine both structural and functional differences, the six themes of hazard and risk analysis principles and international CP standards used for comparison are as follows:

- completeness of Emergency Operations Plans (EOPs),
- 24/7 security operations and readiness,
- security operations and readiness on a 24/7 basis,
- alerting and communication systems, preparedness training and drills, protocols for PwDs,
- collaboration mechanisms with emergency authorities.

Table 2 presents a consolidated overview of EM components across the selected HEIs. It merges and summarizes the material from Supplementary Table S2.

Table 2. Comparative overview of EM components across selected international HEIs

Institution	Completed EOP	24/7 Security / SOC	Multi-channel alerting	Drills / Training	Protocols for PwD	MoUs / Cooperation
UC Berkeley	✓	✓	✓	✓	✓	✓
UBC	✓	✓	✓	✓	✓	✓
University of Oxford	✓	✓	✓	✓	✓	✓

University of Tokyo	✓	✓	✓	✓	✓	✓
University of Sydney	✓	✓	✓	✓	✓	✓
University of Canterbury	✓	✓	✓	✓	✓	✓
UCL	✓	✓	✓	✓	✓	✓

Completeness of Emergency Operations Plans (EOPs)

All seven HEIs maintain fully developed, multi-hazard Emergency Operations Plans aligned with national and international standards (e.g., FEMA CPG-101; ISO 22320). These plans include activation and escalation protocols, incident command structures, hazard-specific annexes (earthquake, fire, chemical incidents, violent threats), and clearly defined responsibilities for staff and emergency teams. This developing realization among EOPs is based on a structured and organized risk assessment, mitigation measures, preparedness, response, and recovery. Therefore, an operational readiness posture can be maintained consistently within different hazard environments

24/7 Security and Operations Centers

Campus police departments or Security Operations Centers ensure perpetual monitoring to quickly detect any incident that may warrant their immediate response (UCPD 2023; UCL Safety Services n.d.).

Multi-channel Early Warning Systems

SMS, email, mobile apps (e.g., SafeZone), PA system and website ensure redundancy and quick delivery of warning messages (UC Berkeley OEM, n.d.; UCL SafeZone, n.d.).

Preparedness Drills and Targeted Training

Drills are institutionalized and include earthquake, fire, hazardous materials, medical emergencies and active threat scenarios; some HEIs conduct an annual campus-wide exercise with after action review (UBC SRS, n.d.; University of Canterbury EMP, 2023).

Accessibility Protocols for PwDs

In international HEIs, structured accessibility measures include PEEPs and refuge points with assisted evacuation procedures to ensure an inclusive emergency response (Oxford Security Services, n.d.; UCL Safety Services, n.d.).

Collaboration With Authorities

MoUs are institutionalized with the fire service, police and health agencies including municipal emergency structures for interoperability and a coordinated response (UC Berkeley OEM, n.d.; University of Canterbury EMP, 2023). Collectively, these international EM systems are indicative of a very high level of organizational maturity and provide an obvious benchmark against which the present situation in Greek HEIs, including NKUA, can be measured. Based on this comparison, the next section analyzes the current EM structures in Greek universities and highlights the main gaps that inhibit institutional preparedness.

5. The State of Emergency Management in Greek HEIs: Analysis and Gaps

EM in Greek HEIs is found to be significantly variant with persistent structural gaps, contrary to the mature systems described in the previous section. To understand how current EM structures function in practice and where systemic weaknesses remain, this section provides a necessary background building on the comparative foundation established Section 4. The analysis draws on official documents, a mapping of involved groups, and research data from interviews and questionnaires, to identify key gaps and challenges in the EM structures of NKUA and other Greek HEIs.

5.1 Mapping Existing Emergency Management Structures and Procedures in Greek HEIs

The development of EM in Greek HEIs, accelerated after the 1999 earthquake (Lekkas, 2000) and institutionalized by Laws 3013/2002, 4662/2020, 4957/2022 and 5224/2025, aims at ensuring the safety of the academic community and the smooth operation of the institutions (Hellenic Republic, 2002; Hellenic Republic, 2020, Hellenic Republic, 2022, Hellenic Republic, 2025).

The main structures involved include:

- Rectorate Authorities (overall administration and coordination).
- Risk and Crisis Management Committees [e.g., the Interdisciplinary Committee for Risk and Crisis Management (ICRCM) at NKUA, responsible for planning and evaluation].

- Local Emergency Managers (LEMs) per unit (plan implementation).
- Support Teams (trained staff for emergencies).

The hierarchical structure follows the national framework (Ministry of Climate Crisis & Civil Protection, General Secretariat for Civil Protection), with HEIs implementing plans such as the General Civil Protection Plan "Xenokratis" and specific plans like "Dardanos" (floods) and "Enceladus" (earthquakes) (GSCP, n.d.-a; GSCP, n.d.-b; GSCP, n.d.-c). The main procedures include development and revision of emergency plans (earthquakes, fires, floods), conducting preparedness drills, developing communication channels, and mapping/analyzing risks (see also FEMA, 2021; ISO, 2018; ISO, 2019 as international guides for best practice). The analysis was based on:

- Official documents and regulations: Institutional Statutes, Safety and Risk Management Regulations (e.g., supervisor regulations for NKUA), Civil Protection Manuals (Xenokratis, Enceladus, Dardanos), and GSCP circulars (GSCP, n.d.-a; GSCP, n.d.-b; GSCP, n.d.-c).
- Civil Protection Groups and Committees: Mapping of ICRCM, LCPMs, and Emergency Teams through interviews and observation.
- National and European Legislative Framework: Law 4662/2020, Law 4957/2022, Regulation (EU) 1313/2013, Sendai Framework (Hellenic Republic, 2020; Hellenic Republic, 2022; European Union, 2013; UNISDR, 2015).

5.2 Analysis of the Effectiveness of Existing Emergency Management Structures at NKUA and Other Greek HEIs

The sample includes 53 fully completed questionnaires from Emergency Management officers, covering 13 HEIs across Greece (including NKUA), clearly reflecting small, medium and large institutions from different geographical regions with various organizational complexities.

The analysis of the basic and functional gaps in operation at NKUA and other Greek HEIs' EM structures pointed out the existence of an institutional mechanism that coexists with operational gaps at many levels. The questionnaire data highlighted gaps or weaknesses in strategic planning, infrastructure, human resource preparedness, and the integration of EM into the institution. (Supplementary Tables S3-S7, Fig.9).

Strategic Planning (Fig. 1): Disaster response plans are rare: fewer than 10% at NKUA and about 20% at other HEIs reported their existence, while none at NKUA had

received administrative approval. In contrast, about one third of other HEIs had secured official endorsement.

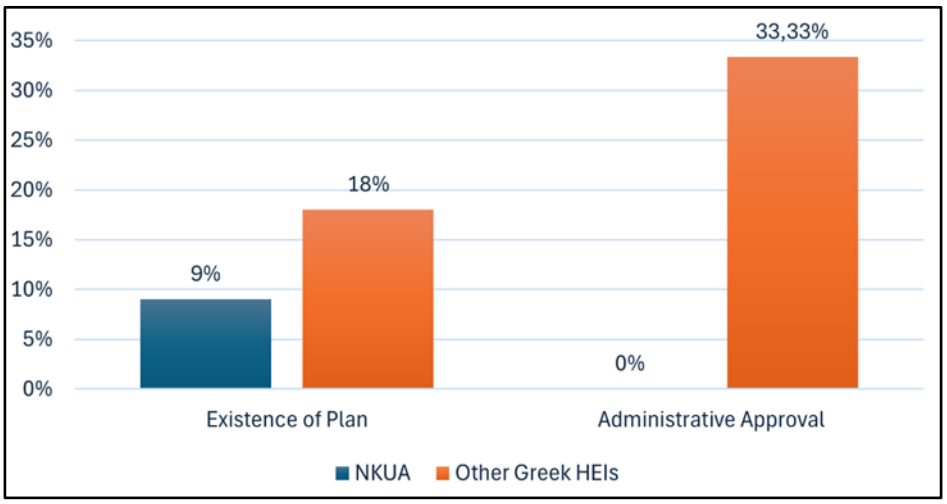

Figure 1: Strategic Planning

Accessibility for PwDs (Fig. 2): Provisions for PwDs are almost absent: only 5% at NKUA and 12.5% at other HEIs reported relevant measures.

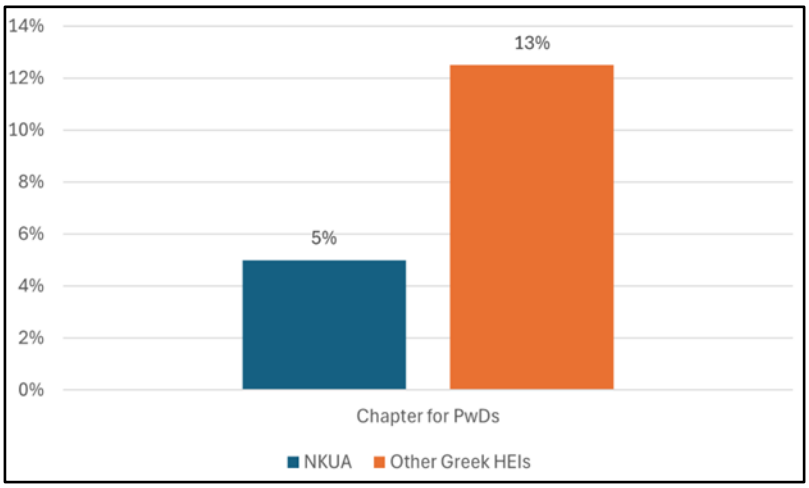

Figure 2. Accessibility for PwDs

Infrastructure and Signage (Fig. 3): Coverage of emergency exits is generally adequate, but at NKUA around one in five buildings has only one exit, limiting evacuation capacity. Greater variety is exhibited in other HEIs, with some buildings featuring up to five exits. The posting of floor plans with evacuation routes is insufficient: at NKUA, only half of the spaces have such signage, compared to nearly three quarters at other HEIs.

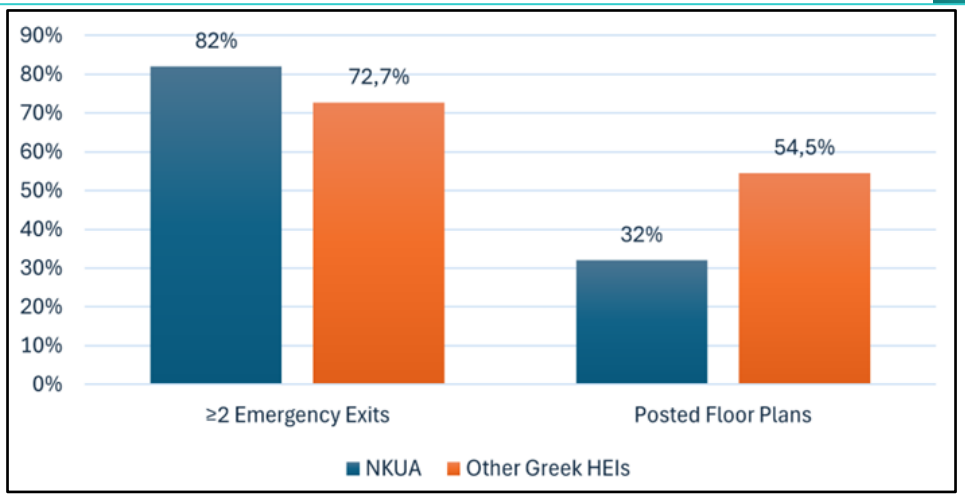

Figure 3. Infrastructure and Signage

Staff Preparedness (Fig. 4): The number of specialized teams is limited: only about one in four units reported first aid or CPR teams. The staff at NKUA were fully informed of defibrillator locations, where these existed; at other HEIs, only about one third knew. Earthquake response teams exist at NKUA but lack training, while about one third of other HEIs had undertaken relevant preparation. Security staff, although present in most facilities, have limited knowledge of plans or procedures.

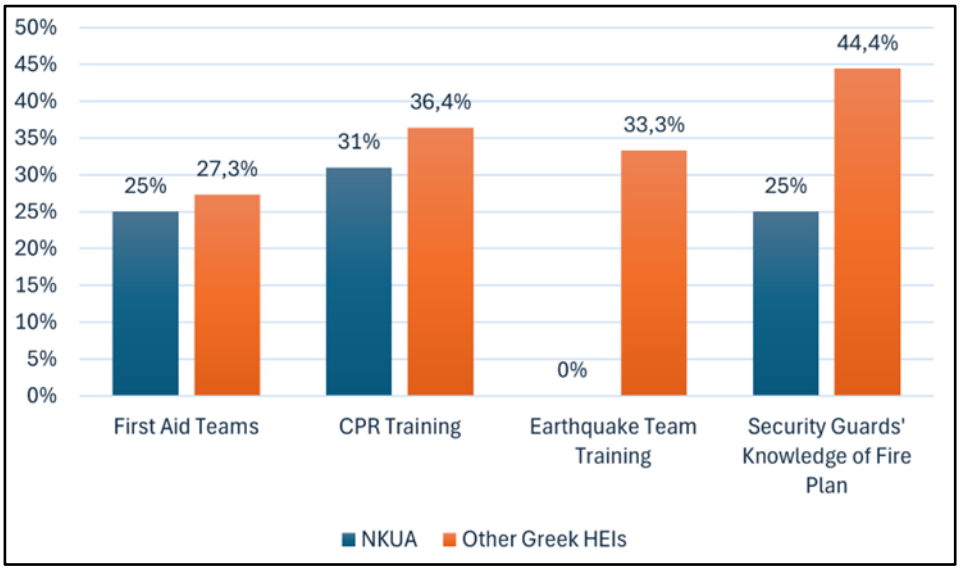

Figure 4. Staff Preparedness

Fire Protection (Fig. 5): NKUA shows relative strength in the existence of firefighting teams (about half of the facilities, compared to one quarter at other HEIs). However, these teams are composed mainly of administrative staff and training is not universal. Smoke detectors and alarm systems are less common at NKUA (about two thirds of buildings), whereas coverage is nearly universal at other HEIs. Fire extinguisher maintenance is inconsistent, with about one in ten facilities failing to carry out refilling.

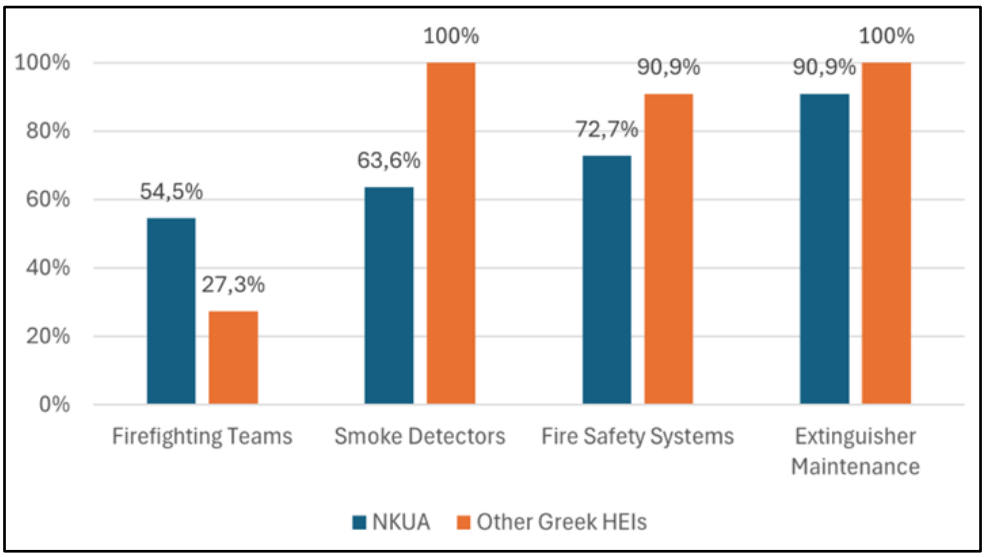

Figure 5. Fire Protection

Earthquake Preparedness (Fig. 6): Knowledge of the guidelines of the Earthquake Planning and Protection Organization (EPPO) is found to be low (about one in four). At NKUA, earthquake response teams exist yet they are reported to be untrained. A number of drills have been carried out in recent years, unlike at other HEIs, though these were accompanied by operational problems. Knowledge of designated assembly points is particularly limited.

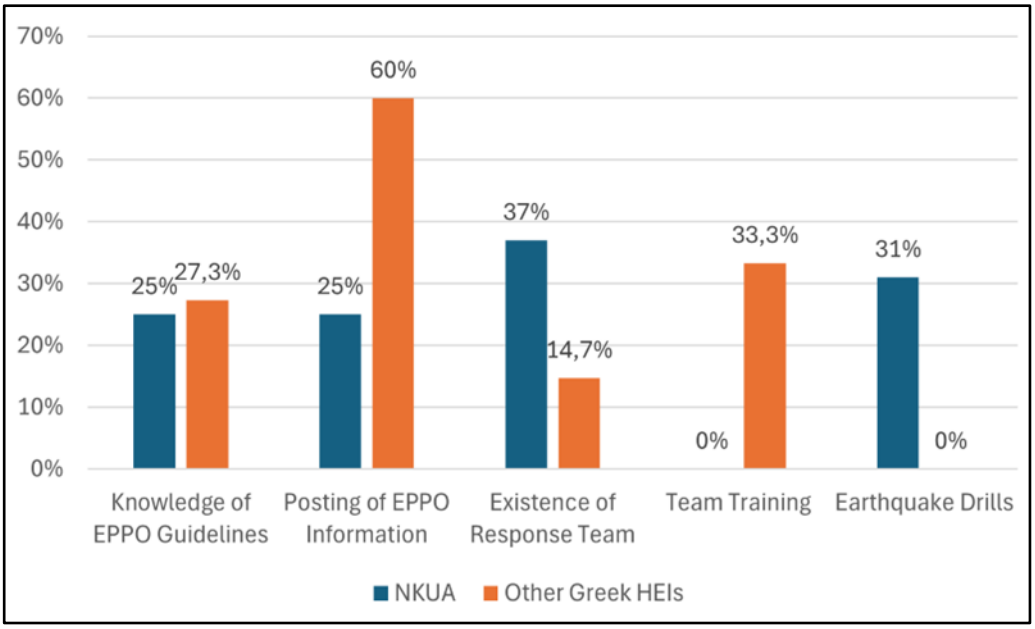

Figure 6. Earthquake Preparedness

Communication and Notification (Fig. 7): Alerting mechanisms are inadequate: less than half of NKUA buildings have an evacuation alarm system, while coverage at other HEIs is more than 90%. In practice, announcements rely primarily on improvised voice calls, with limited use of megaphones or alternative channels.

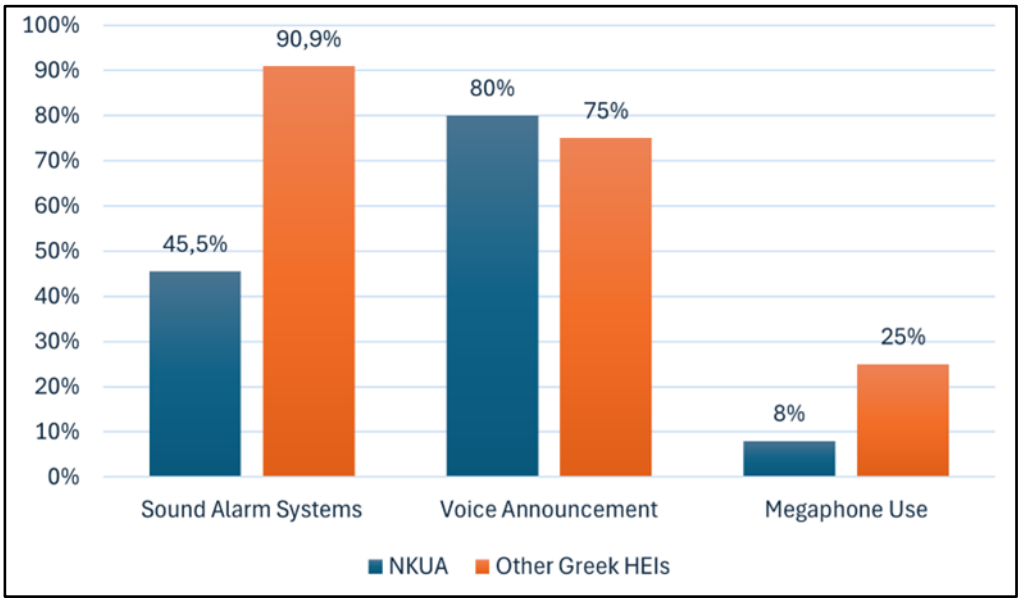

Figure 7. Communication and Notification

Perception of Responsibility (Fig. 8): Responsibility is often assigned to technical services or central administration, with limited personal accountability. Nevertheless, an agreement on the need for a central EM Unit is almost unanimous with about 87% at NKUA and 100% at other HEIs supporting this idea.

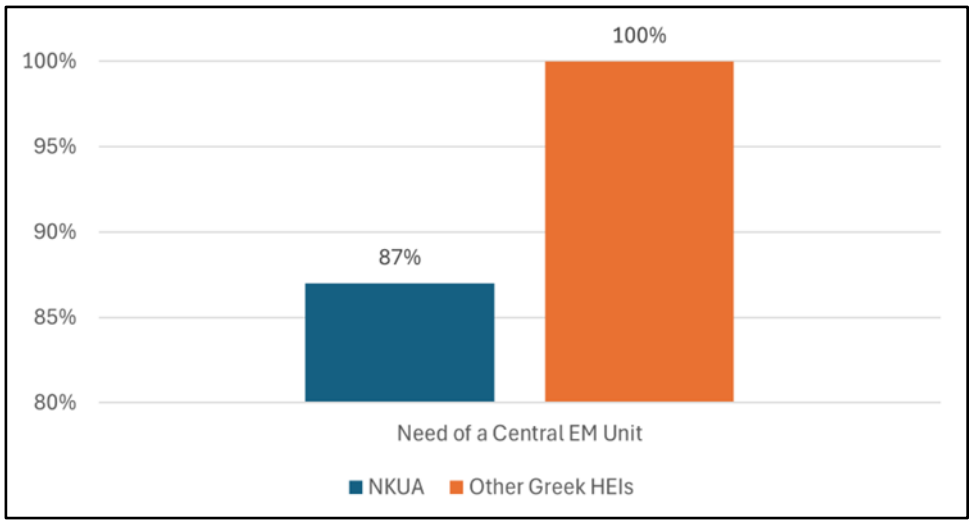

Figure 8. Perception of Responsibility

Overall Assessment

The results reveal fragmented planning, limited training, uneven infrastructure, and the absence of systematic evaluation demonstrating that EM has not yet been consolidated as a strategic priority within Greek HEIs. While NKUA shows certain strengths (e.g., firefighting teams, periodic drills), critical weaknesses remain, including the lack of approved plans, inadequate staff training, and insufficient notification systems. These findings highlight the urgent need for a coherent and standardized EM framework across the tertiary education sector.

5.3 Gaps, Opportunities, Practices, Tools, and Improvement Proposals

The analysis revealed notable gaps but also opportunities for improvement to strengthen HEIs resilience. Proposed actions involve:

- Institutional Approval & Dissemination: Immediate completion and institutional approval of the Unified Emergency Management Plan at the Senate level for all HEIs; a model EOP with electronic availability (FEMA, 2021; FEMA, 2025 ISO, 2018; ISO, 2019).
- Specific PwD Chapter: Mandatory integration of assisted evacuation protocols, designation of refuge points and accessible routes (WHO et al., 2013).
- Improved Signage: Systematic posting of updated floor plans with clearly identified emergency exits; use of QR codes for access to instructions (see EPPO., n.d.-a; EPPO., n.d.-b).
- Training & Drills: Establishment of a biannual/annual drill program and expansion of CPR certification (FEMA, 2021).
- Standardized Maintenance: Establishment of a minimum biannual preventative maintenance for critical electrical/mechanical systems and fire protection equipment.
- Strengthening Notification Systems: Upgrading sound systems and other immediate notification tools.
- Upgrading the Security Role: Systematic and certified training for security personnel in emergency management.
- Creation of a Central EM Service: Institutionalizing an inter-departmental service in each HEI, with 24/7 operation and clear responsibilities (Hellenic Republic, 2020).

Furthermore, EM planning ought to ensure that educational functions continue even under crisis conditions. This is in line with the framework of education in emergencies and crisis-sensitive planning (Geneva Global Hub for Education in Emergencies, 2022).

5.4 Comparison of Emergency Management: NKUA, Other Greek HEIs, and HEIs worldwide

The comparison between NKUA and other HEIs in Greece and abroad revealed significant differences in infrastructure, planning, and preparedness (Fig. 9). Namely: Emergency Management Plans: Only a very small percentage of NKUA units reported having an EM plan, which shows a major gap in strategic crisis management. The situation is only slightly better in other Greek HEIs, while, in all the examined international cases (UC Berkeley, UBC, Oxford, Tokyo, Sydney, Canterbury, UCL), comprehensive emergency and emergency management plans are in place, regularly updated, and covering all phases of risk management (Supplementary Table S3).

Safety Infrastructure and Equipment: Emergency exits at NKUA infrastructures appear to be generally adequate. The fact, however, that many buildings are reported to have only one such exit, is limiting safe evacuation options. Furthermore, only about half of the facilities have evacuation floor plans posted, compared with a much higher percentage in other Greek HEIs and full coverage abroad. Maintenance is another concern, as some NKUA facilities lack regular upkeep, while HEIs abroad have systematic, scheduled maintenance integrated into their safety programs.

Staff Training and Preparedness: Only about one in three staff members at NKUA report first aid training, with the situation being similar or slightly worse in other Greek HEIs. On the other hand, fire safety training appears more developed at NKUA, where roughly three out of four staff members have received such training, compared to a smaller percentage in other Greek HEIs. In HEIs abroad, however, training apart from systematic is also mandatory and involves first aid, firefighting, evacuation, and crisis response, with regular refresher courses both for staff and students.

Communication and Warning Systems: Audible alarm systems for evacuation are installed in less than half of NKUA's buildings while other Greek HEIs perform somewhat better. Only HEIs abroad demonstrate full coverage. In addition, by employing multi-channel warning systems (SMS, email, mobile apps, sirens, and social media), they ensure rapid communication and minimize delays during emergencies.

Security and Drills: Most facilities of NKUA have 24/7 security, a situation better than several other Greek HEIs. However, there is low participation in fire or earthquake drills, as only about 20% reported recent involvement in fire drills. Higher levels of participation, though still insufficient, are recorded in other Greek HEIs. HEIs abroad,

often in collaboration with local authorities, conduct regular, large-scale evacuation and disaster drills engaging the entire academic community.

Overall Assessment: The overall picture is that NKUA and Greek HEIs show partial compliance in areas such as fire safety training and 24/7 security but demonstrate deficiencies in fundamental aspects, such as comprehensive EM plans, provisions for PwDs, systematic staff training, and modern alerting systems. HEIs abroad, by comparison, have fully integrated EM into their institutional framework, combining strategic planning, constant preparedness, and strong collaboration with public authorities.

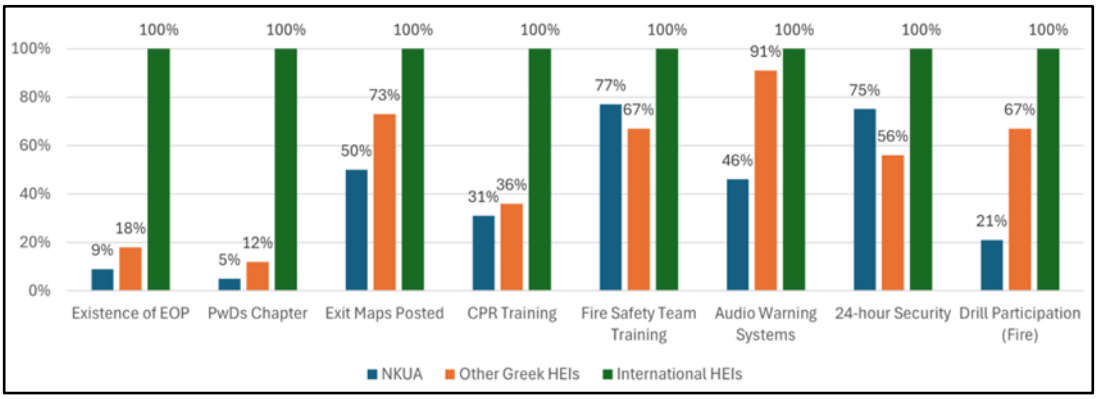

Figure 9. Comparison of organizational preparedness in Emergency Management at NKUA, other Greek HEIs, and HEIs worldwide.

5.5 Overall Readiness Assessment

The HEIs abroad included in this study maintain a clear priority and highly organized EM systems, with integrated plans, training programs, drills, and collaborations with local agencies (UC Berkeley — Office of Emergency Management, n.d.; The University of British Columbia — Safety & Risk Services, n.d.; Federal Emergency Management Agency, 2021). In contrast, NKUA and other HEIs in Greece show gaps in all areas, with a significant lack of strategic planning, limited training and drills, and low interoperability with external agencies, despite the existence of a legal framework (Hellenic Republic, 2002; Hellenic Republic, 2020; Hellenic Republic, 2022; Hellenic Republic, 2025; EPPO. n.d.-a). This comparison highlights the need for immediate reinforcement of the EM system in Greek HEIs, drawing lessons from the best practices of international institutions (Kapucu and Garayev, 2011; Boin and Lodge, 2016; ISO, 2019). These disparities and their implications for governance, institutional resilience, and policy design are further analyzed in the Discussion (Section 6), where the findings are interpreted within broader theoretical and organizational frameworks.

6. Discussion

The deficiencies spotted in the empirical evaluation of NKUA and other Greek HEIs light up and justify this ensuing discussion which interprets these patterns through established EM frameworks and comparative international evidence. The present study emphasized the vital role that EM plays in HEIs, with NKUA used as a case study and other Greek HEIs involved in the analysis. A literature review accompanied by an assessment-comparison both of best international practices and qualitatively-quantitatively at NKUA provided a suggested model approach to enhance institutional resilience (ISO, 2018; ISO, 2019; FEMA, 2021).

6.1 Discussion of Findings and Comparative Analysis

The results show a better-developed organizational maturity of EM systems outside Greece, compared with their Greek counterparts. The HEIs in the UK, USA, Australia and New Zealand that were included in this study have integrated comprehensive EOPs with multi-modal systematic training programs accompanied by 24/7 security operations based on an institutionalized set of emergency management principles to include notification systems (Perry and Lindell, 2003; Kapucu and Van Wart, 2006; Comfort, 2007; Kapucu et al., 2010; Kapucu and Garayev, 2011; Boin and Lodge, 2016; ISO, 2018; ISO, 2019; FEMA, 2021).

However, the emerging picture in Greek HEIs is one of fragmented structures with very limited mechanisms for coordination and extreme disparities in the implementation of preparedness activities. This can be put down to a much wider theoretical perspective on the dilemma within public organizations between resilience-and adaptiveness-seeking crisis management systems (Kapucu and Van Wart, 2006; Comfort, 2007). The structural gap emphasized both through interviews and questionnaires is, in fact, the nonexistence or lack thereof an Emergency Management Directorate at Greek HEIs that would centrally coordinate planning proactively initiates operational readiness internally integrates external agencies into its operation interface (Kapucu et al., 2010; Kapucu and Garayev, 2011).

HEIs abroad place the EM into a continuous and regular cycle of drills and post-action reviews, improvements added to their routines. Drills in Greece are either absent or at best sporadic, thereby reflecting the much-noted gap between formal planning and practical implementation (Perry and Lindell 2003; UNISDR 2015). Meanwhile, institutions abroad appear to have internalized contemporary risk governance conceptualizations deeper-institutional learning-and adaptation capacities-preparedness through cross-organizational collaboration emphasized as a top priority (Boin and Lodge 2016; ISO 2018; ISO 2019). Another major aspect that needs to be addressed is inclusivity and accessibility. Both the literature and international practice emphasize the need to institutionalize specific structured provisions for PwDs- Personal Emergency Evacuation Plans (PEEPs), points of refuge, and support teams (WHO et al., 2013; UNISDR, 2015). The limited institutionalization of such measures in Greek HEIs constitutes a significant preparedness gap, with direct implications for safety and alignment with international standards.

In general, the comparative analysis highlights Greek HEIs (including NKUA) need a shift from a compliance-based and fragmented approach to an integrated, proactive and risk-informed EM model. A structured framework of preparedness (as shown by the international cases in this study through institutional coordination and inclusive risk management) substantially improves resilience systematically at organizations such as HEIs.

6.2 Limitations of the Study

There are several methodological limitations to this study. None of them, however, render their findings invalid or unreliable. First, international HEIs were selected based on specific criteria-at least transparent, publicly available emergency plans in a country

exposed to natural and technological hazards. Therefore, most sampled institutions have well-developed EM systems that are also clearly documented enabling strong comparative patterns to be drawn but do not represent the entire spectrum of global HEIs (Alexander 2002; Perry and Lindell 2003; Alexander 2016).

Second, the generalizability of quantitative results in terms of number and proportion between Greek and international respondents to questionnaires and interviews may be limited. The study was qualitative rather than statistical but non-probability purposive sampling constrains its representativeness (Baruch and Holtom, 2008; Creswell and Plano Clark, 2018). However, different types and forms from 13 Greek HEIs have created a sufficiently firm basis on which common trends can be traced.

Third, publicly available institutional documents analyzed as part of the comparison vary in scope, detail, and completeness. While part of this is a function of transparency in HEIs-institutions, it also reflects varying degrees of organizational maturity expressed by emergency planning processes that are crystallized into final plans and policies. This must therefore be taken into consideration when interpreting findings (Kapucu and Van Wart, 2006; Comfort, 2007; Kapucu et al., 2010).

The study also fails to cover HEIs in low-and middle-income regions largely because of the unavailability or lack of access to reliable standardized information. This, therefore, makes a limitation on the generalization of conclusions globally. Since risk environments and institutional capacities vary so much between context than between countries, future studies must explicitly involve HEIs from such regions to develop a truly multidimensional picture of international EM readiness (UNISDR 2015; International Organization for Standardization 2019; UNDRR 2023).

Overall, these do not reduce the added value of the study but create needs and propose areas that could be better capitalized on a more coherent, systemic yet flexible EM framework in Greek HEIs.

6.3 Contribution of the Study

Even with all the limitations, a major headway is made both in literature and practical application of EM at HEIs by this paper through a systematic mapping of the existing situation at NKUA; identification and documentation of key gaps and challenges; development of context-sensitive recommendations involving international best practices adjusted to the Greek higher education sector (Kapucu and Garayev, 2011;

Boin and Lodge, 2016; FEMA, 2021). This framework shall hence be used as an institutional reform reference point for NKUA or transferable model framework for other Greek HEIs.

6.4 Proposed Organisational Model and Policy Implications for Greek HEIs

Based on the results of the comparative analysis, this is a six-pillar organization model for EM in Greek HEIs with NKUA used as a reference case: (a) Institutionalization of an EM Directorate, (b) Integration 24/7 physical and digital security, (c) Regular drills and training programs on preparedness, (d) Development comprehensive yet interoperable EOPs, (e) Multi-channel digital systems to be used for alerting, (f) Formal collaborations public authorities MOUs. Six pillars have been proposed under which the whole structure can be organized.

Figure 10 presents a possible structure and mode of functioning for an EM Directorate at NKUA or other Greek HEIs. The figure shows major units, reporting lines, and main responsibilities. This is a practical application at the institutional level of international best practices found in Sections 2.4 and 4, which can be placed within the current governance framework of Greek HEIs.

Table 3 links specific international examples (e.g., UC Berkeley OEM, UCL Safety, Security & Resilience, University of Oxford Security Services) to actionable reforms. These include the creation of a fully staffed CP Directorate, the upgrading of security operations into a Security Operations Center (SOC), the institutionalization of regular drills, the development of a unified EOP with building annexes, the implementation of multi-channel emergency alerting and the formalization of MoUs with local and regional authorities. Table 3 also summarizes the main EM lessons from international HEIs, specifies what each lesson implies for NKUA and for other Greek HEIs, and provides added details on how these could be implemented in practice.

Figure 10 and Table 3 constitute the practical application of the proposed model. They provide a pragmatic course of action that involves aligning Greek HEIs with international EM and resilience standards in ways compatible with the national legal and institutional framework.

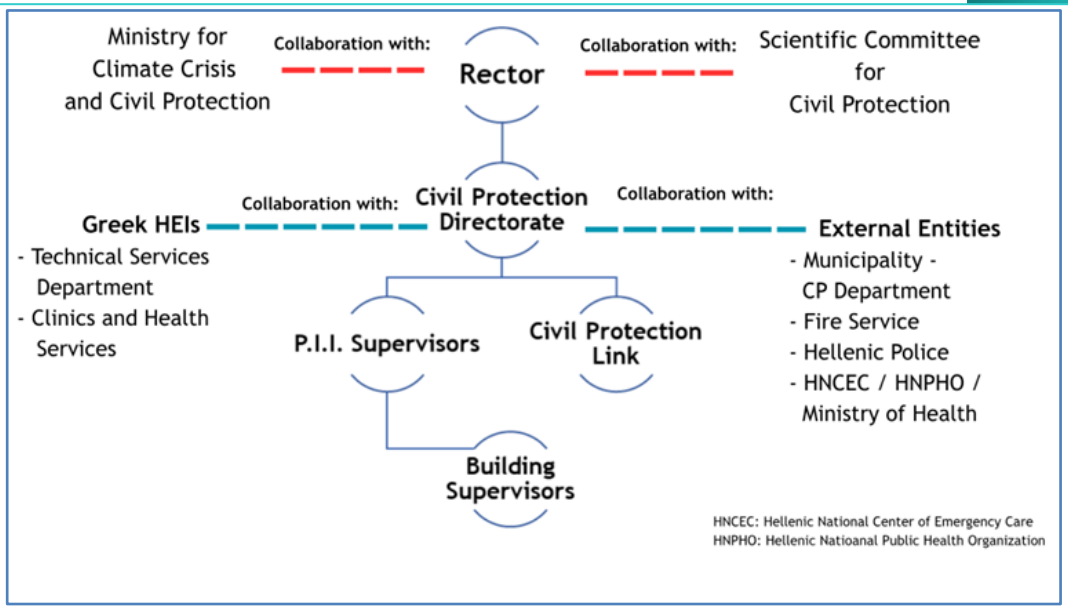

Figure 10. Proposed composition and operation of Emergency Management in Greek HEIs

Table 3: International Emergency Management Lessons for Greek HEIs		
International Lesson (indicative institutions)	**What It Means for NKUA**	**What It Means for Other Greek HEIs**
1. Autonomous Emergency Management Directorate (UC Berkeley OEM; UCL – Safety, Security & Resilience)	- Establishment of a fully staffed "CP Directorate" under the Vice-Rector for Finance & Infrastructure, with a clear organizational chart, a dedicated budget, and measurable KPIs.	In HEIs without a permanent CP structure, at least a "CP Office" should be established, with the prospect of upgrading to a Directorate. Additionally, the creation of a unified "CP Coordinating Committee for Greek HEIs" under the Ministry of Education (MoE) and the General Secretariat for Civil Protection (GSCP) is recommended.
2. 24/7 Physical & Digital Security (University of Oxford – Security Services; University of Sydney – Protective Services; University of Canterbury – Security)	- Upgrading NKUA's Signal Receiving Center into a 24-hour SOC with CCTV analytics, smoke detectors, and seismic triggers.	- HEIs should consolidate physical and IT security teams for a unified risk picture. - Adoption of the Civil Protection "Siren" system for common notifications.
3. Regular Preparedness Drills (UBC – SRS; UC Berkeley – OEM; University of Tokyo – EHS; University of Canterbury – Security)	- Institutionalization of two major drills per year ("earthquake" & "fire") across selected campuses, plus	- HEIs with geographically dispersed campuses should adopt "rolling-drills" by city, with joint scenarios in collaboration with

	smaller-scale drills per Faculty/laboratory.	municipalities and the Fire Service.
4. Integrated, Interoperable EOPs (UC Berkeley – EOP; UBC – EMP/CMP; UCL – emergency planning; University of Oxford – Security Plans)	- Development of a unified NKUA EOP with digital building annexes (wiki format).- Inclusion of protocols for PwDs and heritage buildings.	- Rectors' Synod to prepare a model EOP with standardized procedures (earthquake, flood, cyberattack).- Adaptation of annexes for university hospitals.
5. Multi-channel Emergency Alerting (UCL – SafeZone; University of Oxford – Security; UC Berkeley – OEM; University of Sydney – Protective Services)	- Implementation of "EKPA Alert" (SMS, email, push, PA) interconnected with 112 and Copernicus EMS.	- HEIs with student residences should integrate residence systems into the same alerting platform to ensure off-hours coverage.
6. Inter-departmental Synergies & MoUs with Authorities (UC Berkeley – OEM collaborations; UBC – local/regional cooperation; University of Canterbury – Civil Defence/4Rs; University of Tokyo – EHS/JMA)	- Signing of an MoU between NKUA, the Municipality of Athens, and public authorities (Police, Fire Service, NFCEC) - Participation in joint drills with the Region of Attica.	- All HEIs should have MoUs with regional and municipal authorities, especially in high-risk areas. - Establishment of a "Pan-Hellenic Network of University Public-Rescue Teams (PRT)."

7. Conclusions and Recommendations

The study has shown how a comprehensive EM framework is critically important for HEIs. An integration of international best practices with an empirical assessment at NKUA and other Greek HEIs revealed structural and operational gaps that, while obvious in the context of Greece, are related to challenges tracked within the wider literature on EM. As noted in the Discussion section, EM should be conceived as a core institutional function instead of being relegated to the status of some peripheral administrative activity. The comparative findings and the proposed model are articulated around six major pillars which offer a coherent reference framework for resilience in higher education: (a) Institutionalized Emergency Management Directorate, (b) Integrated physical and cyber/digital security working 24/7, (c) Regular preparedness drill practices, (d) Comprehensive interoperable EOPs, (e) Multi-channel digital alert systems; and (f) Formal interdepartmental collaboration and MoUs with public authorities. These pillars are operationalized for NKUA and other Greek HEIs in the organizational scheme illustrated in Figure 10 and the targeted recommendations summarized in Table 3.

Specifically for Greek HEIs, horizontal recommendations include institutional strengthening per Law 4662/2020, development of a common EM data platform, targeted funding support to "university resilience," and preparedness culture as an immediate and practical step in the current gap of readiness toward international benchmarks. The same six-pillar framework can be adopted both practically and conceptually as an adaptive model at scale for HEIs worldwide-in fragmented governance settings or resource constraint contexts.

Future research can: (a) run a large-scale quantitative assessment survey on students and staff readiness, (b) pilot some selected components of the proposed model either in NKUA or other HEIs and evaluate their effectiveness, and (c) further explore the potential advanced technologies such as GIS and related digital tools for integrated risk and crisis management (Goodchild, 2007; European Commission/JRC, 2019; ISO, 2019).

The transformation of the preparedness culture from reactive to proactive is framed as a necessary condition for safe, resilient, and sustainable HEIs. This fact enhances the arguments of Section 6 while providing practical pathways for NKUA and other Greek HEIs as well as the academic community at large interested in similar matters. The pathway lies within the frame of transformation regarding responses developed by HEIs so that they become not only crisis-driven but also systematically anticipated and articulated.

Conflicts of Interest

The authors declare no conflicts of interest.

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Data Availability Statement

The data may be made available by the authors.

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Supplementary Material: Questionnaire Results

Comparative Analysis of Emergency Management Systems in Higher Education Institutions Worldwide: Lessons for the National and Kapodistrian University of Athens and Higher Education Institutions in Greece and Abroad

Table S1 presents the acronyms and abbreviations used throughout the article.

Table S1. Acronyms and Abbreviations (English only, alphabetically updated)

Acronym / Abbreviation	Explanation
112	European Emergency Number
AED	Automated External Defibrillator
CCTV	Closed-Circuit Television
CMP	Continuity Management Plan
Copernicus EMS	Copernicus Emergency Management Service (European Union)
CP	Civil Protection
CPR	Cardiopulmonary Resuscitation
EM	Emergency Management
EMP	Emergency Management Plan
EOP	Emergency Operations Plan
ΕΡΡΟ (ΟΑΣΠ)	Earthquake Planning and Protection Organization (Greece)
FEMA	Federal Emergency Management Agency (USA)
GSCP	General Secretariat for Civil Protection (Greece)
HEI	Higher Education Institution
HFS	Hellenic Fire Service
HNCEC (ΕΚΑΒ)	Hellenic National Center of Emergency Care
HNP	Hellenic Police
HRA	Hazard and Risk Analysis
ICRCM	Interdisciplinary Committee for Risk and Crisis Management
ICT	Information and Communication Technology
ISO	International Organization for Standardization
JMA	Japan Meteorological Agency
KPI	Key Performance Indicator
LEM	Local Emergency Manager
MoU	Memorandum of Understanding
NKUA	National and Kapodistrian University of Athens
OEM	Office of Emergency Management (UC Berkeley)
OECD	Organization for Economic Co-operation and Development
PA	Public Address (emergency announcement system)
PII	Public Indepe
PRT	Public-Rescue Teams
PwD	Persons with Disabilities
SOC	Security Operations Center
SOP	Standard Operating Procedure
Stanford CTL	Stanford Center for Teaching and Learning
UBC (SRS)	University of British Columbia – Safety & Risk Services
UC Berkeley OEM	University of California, Berkeley – Office of Emergency Management
UCL	University College London
UCPD	University of California Police Department
UCT	University of Canterbury (New Zealand)
UNDRR (formerly UNISDR)	UN Office for Disaster Risk Reduction (United Nations International Strategy for Disaster Reduction)
UTokyo (EHS)	University of Tokyo – Environment, Health and Safety Division
WHO	World Health Organization

Table S2: Sources per Institution						
Institution	**CompletedEOP**	**24/7 Security / SOC**	**Multi-channel alerting**	**Drills / Training**	**Protocols for PwD**	**MoUs / Cooperation with authorities**
UC Berkeley	✓ (UC Berkeley OEM n.d.; FEMA 2021)	✓ (UCPD 2023)	✓ (UC Berkeley OEM n.d.)	✓ (UC Berkeley OEM n.d.)	✓ (UC Berkeley OEM n.d., Annexes)	✓ (UC Berkeley OEM n.d.)
UBC	✓ (UBC SRS n.d.)	✓ (UBC SRS n.d., Campus Security)	✓ (UBC SRS n.d.)	✓ (UBC SRS n.d., Training)	✓ (UBC SRS n.d., Procedures)	✓ (UBC SRS n.d.)
University of Oxford	✓ (Oxford Security Services n.d.)	✓ (Oxford Security Services n.d.)	✓ (Oxford Safety & Security n.d.)	✓ (Oxford Security Services n.d.)	✓ (Oxford Security Services n.d., refuge points)	✓ (Oxford Security Services n.d.)
University of Tokyo	✓ (UTokyo Emergency Procedures n.d.)	✓ (UTokyo Emergency Procedures n.d.)	✓ (UTokyo Emergency Procedures n.d.)	✓ (UTokyo Emergency Procedures n.d.)	✓ (UTokyo Emergency Procedures n.d.)	✓ (UTokyo Emergency Procedures n.d.)
University of Sydney	✓ (University of Sydney Emergencies n.d.)	✓ (University of Sydney Emergencies n.d.)	✓ (University of Sydney Emergencies n.d.)	✓ (University of Sydney Emergencies n.d.)	✓ (University of Sydney Emergencies n.d.)	✓ (University of Sydney Emergencies n.d.)
University of Canterbury	✓ (UC Canterbury EMP 2019)	✓ (UC Canterbury EMP 2019)	✓ (UC Canterbury EMP 2019)	✓ (UC Canterbury EMP 2019)	✓ (UC Canterbury EMP 2019)	✓ (UC Canterbury EMP 2019)
UCL	✓ (UCL Emergency Management n.d.)	✓ (UCL Safety Services n.d., Security/Campus Safety Team)	✓ (UCL SafeZone n.d.)	✓ (UCL Emergency Management n.d.)	✓ (UCL Safety Services n.d., PEEPs/evacuation)	✓ (UCL Emergency Management n.d.)

B) Table S3-S7 Questionnaire Results

Section I: General questions regarding the existence of a disaster response plan

The following tables summarize the percentages of positive answers per question, distinguishing between NKUA and other HEIs; an interpretive comment for each thematic unit is then provided.

Table S3: General questions / Existing Civil Protection Plans and Infrastructures

#	Question (summary)	NKUA (%)	Other HEIs (%)	Critical observation
1	Is there a Disaster Response Plan?	9%	18%	Significant lack of strategic planning at NKUA.
2	Chapter for PWDs (Persons with Disabilities)?	5%	12.5%	The integration of vulnerable groups remains limited.
3	Plan author? (Building supervisors)	33%	—	Drafting is often assigned to non-specialists; absence of specialized study in other HEIs.
4	Approved by Administration?	0%	33.3%	NKUA has not yet officially approved a plan.
5	Available copy of plan (even draft)?	31%	27.3%	Limited circulation of existing plans.
6	Emergency exits?	87%	100%	Good coverage, but not universal.
7	≥ 2 emergency exits (Table 1)	52%	—	Almost half of the buildings have only one exit.
8	Exits in continuous use?	82%	72.7%	Satisfactory functionality; regular checks needed.
9	Floor plans with emergency exits?	50%	72.7%	Incomplete mapping & posting at NKUA.
10	Floor plans posted in all areas?	32%	54.5%	Large gap in visual signage.
11	Safety technician?	81%	63.6%	Significant presence at NKUA; needs utilization.
12	First aid team?	25%	27.3%	Low establishment of specialized teams.
13	CPR training?	31%	36.4%	Limited vital training.
14	First aid kit?	78%	90.9%	Good level, but not universal.
15	Defibrillator available?	41%	27.3%	Relative superiority of NKUA; coverage < 50%.
16	Staff know defibrillator location?	100%	33.3%	Excellent awareness where a defibrillator exists.
17	E/M installations in good condition?	87%	100%	There is room for improvement in preventive maintenance.
18	Regular maintenance (annual or more frequent)?	25%	—	The majority states "other" (mainly corrective-on-case-by-case basis).

Table S4: Number of Emergency Exits per Building			
Number of Emergency Exits	**NKUA (%)**	**Other HEIs (%)**	**Critical Observation**
1	18%	-	Limited evacuation capability; inadequate safety coverage in case of danger.
2	52%	18.2%	The majority of NKUA buildings have two exits, which is positive but marginally sufficient for large buildings.
3	7%	27.2%	Other HEIs have more exits than NKUA at this level; possible need for upgrade.
4	4%	9.1%	Limited presence of a sufficient number of emergency exits; improvement required.
5	-	18.2%	Absence of corresponding buildings in NKUA; indications that other HEIs are more prepared.

Table S5: Maintenance Frequency of Networks			
Category	**NKUA (%)**	**Other HEIs (%)**	**Critical Observation**
Maintenance YES	88%	100%	A significant percentage of NKUA reports maintenance, but it falls short of the full coverage reported by other HEIs.
Maintenance NO	12%	-	12% of NKUA does not perform maintenance, possibly indicating safety and functionality gaps.

Table S5.4 - Maintenance Frequency of Installations			
Maintenance Frequency	**NKUA (%)**	**Other HEIs (%)**	**Critical Observation**
Semi-annually	5%	10%	Very low percentages of semi-annual maintenance at NKUA; a frequency considered critical for certain high-risk networks.
Annually	32%	60%	NKUA clearly lags in the implementation of annual maintenance programs, indicating a need for institutional intervention.
Biennially	4%	10%	Low application of biennial maintenance, however, this frequency is considered borderline for critical installations.
Other (e.g., as needed)	9%	10%	There is an unclear definition or non-standardized maintenance practice, which hinders evaluation.
I don't know	50%	10%	Particularly concerning that half of the participants at NKUA do not know the maintenance frequency, indicating a lack of transparency or information.

Section II: Questions about preparation and response to fire risk

The following table summarizes the percentages of positive answers per question, distinguishing between NKUA and other HEIs; an interpretive comment for each thematic unit is then provided.

Table S6: Fire Protection

#	Question (summary)	NKUA	Other HEIs	Critical observation
1	Is there a firefighting team?	54.5% Yes	27.3% Yes	NKUA has firefighting teams in only about half of its facilities; in other HEIs, their existence is even lower.
2	Composition of firefighting team	83% Administrative staff	100% Administrative	Teams rely almost exclusively on administrative personnel; scientific/technical staff are absent.
3	Have members been trained?	76.9% Yes	66.7% Yes	High but not universal level of training; 1/4 of NKUA teams remain untrained.
4	Training provider	83.3% Fire Service	50% Fire Service	The Fire Service primarily covers NKUA; in other HEIs, internal technical services are involved.
5	Do members possess the plan?	71.4% Yes	66.7% Yes	A significant percentage does not have direct access to the plan—a readiness gap.
6	Training for PWDs?	16.7% Yes	0% Yes	Critical inadequacy regarding vulnerable groups.
7	Readiness drills?	21.4% Yes	66.7% Yes	Very low practical drills at NKUA—increased operational risk.
8	Frequency of drills	7.1% Semi-annually | 92.9% Other*	33.3% Annually | 66.7% Other*	The majority state "other" (vague/irregular); absence of a standardized program.
9	Smoke detectors	63.6% Yes	100% Yes	Inadequate smoke detection coverage at NKUA.
10	Fire safety system	72.7% Yes	90.9% Yes	Fire safety systems need expansion at NKUA.

11	Type of system	Mainly water, less CO_2/foam	Mainly foam+water, less CO_2	NKUA relies on water systems—which may be unsuitable for certain uses.
12	System maintenance	31.3% Annually | 25% Other | 12.5% Don't Know | 25% No	10% Semi-annually | 60% Annually | 10% Biennially | 10% Don't Know	Lack of regular maintenance: 1/4 of NKUA facilities do not perform any checks.
13	Fire extinguishers & hydrants	22.7% Ext. only | 77.3% Ext. & Hyd.	18.2% Ext. only | 81.8% Ext. & Hyd.	Almost universal presence of hydrants; few cases of extinguishers only.
14	Hydrant equipment	76.5% Complete	88.9% Complete | 11.1% Incomplete	Notable percentage of hydrants at NKUA with complete equipment; however, 1/4 remains incomplete/unknown.
15	Maintenance & refilling of extinguishers	86.4% Main.+Refill. | 9.1% No	100% Main.+Refill.	NKUA shows a 9% gap in basic maintenance—critical for extinguisher effectiveness.
16	Adherence to maintenance/refilling intervals for extinguishers	78.9% Yes / 15.8% No / 0% Don't Know	90.9% Yes / 0% No / 9.1% Don't Know	There are deviations in NKUA's full compliance with regulations.
17	Temporary replacement of extinguishers during refilling	45% Yes	27.3% Yes	Low percentages of temporary coverage – potential safety gaps.
18	Types of extinguishers	All types, mainly powder, CO_2, foam	All types, mainly powder	Sufficient coverage of types, but powder predominates, with questions for special needs.
19	Number of extinguishers according to area	90% Yes	100% Yes	NKUA shows a slight lag.
20	Sound alarm system for evacuation	45.5% Yes	90.9% Yes	Serious deficiency at NKUA in a critical notification system.
21	Storage areas for flammable/hazardous materials	18.2% Yes	27.3% Yes	Very low percentages in both – need for infrastructure reinforcement.
22	Connection to remote monitoring for fire	45.5% Yes	18.2% Yes	NKUA is superior, but overall inadequate connection.
23	Availability of guarding	90.9% Yes	72.7% Yes	Relative adequacy of guarding at NKUA.

24	Form of guarding (24-hour/partial)	75% 24-hour / 25% partial	55.6% 24-hour / 44.4% partial	NKUA has a more stable guarding scheme.
25	Guard knowledge of fire plan	25% Yes	44.4% Yes	Significantly low level of knowledge at NKUA.
26	Guard knowledge of safety measures	42.1% Yes	37.5% Yes	Moderate awareness of safety measures in both.
27	Guard training in emergency situations	47.4% Yes / 36.8% Partially / 15.8% No	44.4% Yes / 33.3% Partially / 22.2% No	Inadequate training in critical situations – reinforcement required.
28	Alternatives in case of absence of guarding/fire extinguishing system	Technical Service or awaiting administration decisions	Similar answers	Lack of organized plan or training in the absence of basic systems.

Section III: Earthquake preparation and response questions

The following table summarizes the percentages of positive answers per question, distinguishing between NKUA and other HEIs; an interpretive comment for each thematic unit is then provided.

Table S7: Summary of Positive Responses

#	Question	NKUA (%)	Other HEIs (%)	Critical observation
1	Knowledge of EPPO. guidelines	25%	27.3%	Low level of awareness overall in both areas.
2	Posting of EPPO. information	25%	60%	Other HEIs show significantly better visual signage.
3	Knowledge of actions as DAI supervisor	87%	66.7%	NKUA demonstrates high awareness among supervisors.
4	Existence of response team	37%	14.3%	Better institutional provision in NKUA.
5	Team composition	70% admin., 30% faculty	100% administrative	More mixed participation model in NKUA.
6	Training of team members	0%	33.3%	Alarming complete lack of training in NKUA.
7	Training for PWDs	–	33.3%	NKUA shows a lack of inclusive policy.
8	Training provision – Provider	0%	50% Tech. Service, 50% none	Absence of any training procedure in NKUA.
9	Posting of plan instructions	0%	20%	Complete absence of crisis management guides in NKUA.
10	Employee knowledge of instructions	3%	10%	Generally inadequate knowledge, with NKUA at a critically low level.
11	Last earthquake drill	47% never, 31% (2019), 3% (2022)	92% never	NKUA has conducted at least periodic drills, as opposed to a complete absence in other HEIs.
12	Frequency of drills	3% semi-annually | 56% don't know	10% annually | 60% "other"	Inadequate drill frequency and widespread ignorance in NKUA.
13	Problems during drill	100% yes	0%	NKUA faces serious operational problems in drills.
14	Emergency supplies	Flashlight 48% | First aid kit 54%	Flashlight 45% | First aid kit 100%	Other HEIs have more complete resources.

15	Definition of assembly point	16%	10%	Very low percentage in both.
16	Selection criteria	100% open space	0%	Clear differentiation in approach.
17	Who decides on evacuation	Various answers	Hypothetical answers	Lack of clear protocol in both.
18	Announcement method	80% voice | 8% megaphone	75% voice | 25% megaphone	Improvisation predominates, absence of systems.
19	If central service is needed	87% yes	100% yes	Almost universal acceptance of the need.