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INTRODUCTION

Disasters rarely happen in isolation.

Floods can trigger landslides, heatwaves can worsen wildfires, and storms can disrupt essential services far beyond their immediate impact.

Communities, authorities, and businesses increasingly face these multi-hazard events, where risks overlap and cascade into broader crises. Preparing for such complex situations requires not only science and technology, but also ethical safeguards, legal clarity, and active involvement from the people most affected.



Climate change, rapid urbanisation, and the growing interdependence of infrastructures mean that such cascading and compound risks are becoming more frequent and more severe. A disruption in one sector, such as energy or transport, can quickly spill over into health, safety, and economic impacts.

The MEDiate project aimed to confront these interconnected risks directly.

MEDiate was a European research project funded under the Horizon Europe programme. Running for three years until September 2026, it brought together 18 partners from seven countries, including research organisations, universities, local authorities, and industry. The shared goal was to strengthen Europe's ability to prepare for and respond to disasters in a changing climate.

To achieve this, MEDiate grounded its work in four diverse testbeds: Oslo (Norway), Nice (France), Essex (United Kingdom), and Múlabing (Iceland).



These sites reflected different governance systems, hazard profiles, and community dynamics — from metropolitan flood management to small-community avalanche risk.

This diversity allowed the project to test how ethical and participatory principles can be adapted across contexts.

At the heart of the project was a new Decision Support System (DSS). The platform combined physical, social,

exposure, impact, and resilience datasets to generate risk assessments. It allowed users to model cascading effects, explore "what if" scenarios, and compare different mitigation strategies — for example, how investment in flood defences or changes in evacuation planning might alter both immediate hazards and longer-

The DSS combines scientific data with local knowledge, making disaster risk management more resilient, inclusive, and transparent.

term vulnerabilities.

THIS BOOKLET EXPLORES THE TWO DIMENSIONS THAT MEDIATE PLACED AT THE HEART OF ITS WORK:

Principles: Ethics and Legal
 Foundations of Disaster Risk
 Management: Why protecting privacy,
 safeguarding data, and respecting
 rights are central to effective disaster
 preparedness — and how MEDiate
 applied these principles across four
 national contexts.

2. Practice: Participation and Co-Creation in Disaster Risk Management:

How MEDiate worked with local authorities, civil protection agencies, and communities through participatory methods — and what this means for building trust, collaboration, and resilience.

Together, these two dimensions show that resilience is not only about technical models or algorithms. It is also about trust, fairness, and collective responsibility. By combining science with social values, MEDiate has delivered practical tools that can help communities across Europe prepare for tomorrow's risks.

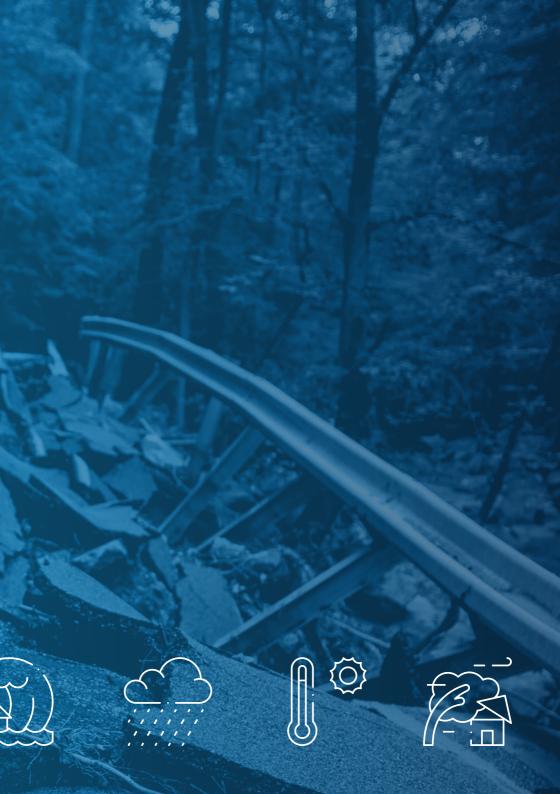
O1— PRINCIPLES: ETHICS AND LEGAL FOUNDATIONS OF DISASTER RISK MANAGEMENT









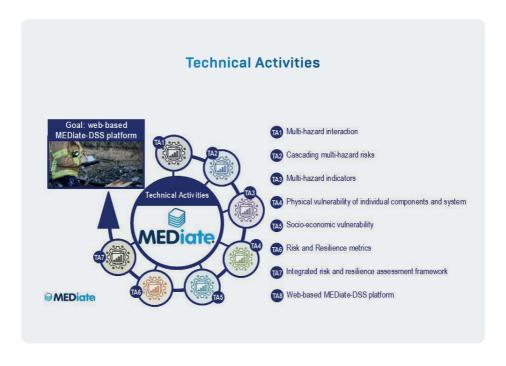


FOUNDATIONS: WHY ETHICS AND LAW ARE CENTRAL TO DISASTER PREPAREDNESS

Disaster risk management is not only a technical challenge; it is also a matter of values, rights, and obligations. Decisions taken before, during, and after disasters can profoundly affect people's lives — from who receives timely warnings, to which

neighbourhoods get priority support, to how data about individuals and communities is collected and shared.

Ethical principles provide a compass for these decisions. Respect for persons, fairness, proportionality, and the duty to avoid harm all shape how authorities and researchers should act. These principles echo long-standing ethical traditions



in medicine and research - autonomy. beneficence, non-maleficence, and justice - but gain new significance in disaster settings. They highlight not only the obligation to protect life, but also the need to balance competing rights (for example, privacy versus public safety), to act transparently under pressure, and to ensure accountability when mistakes are made. Ethical practice also requires recognising vulnerabilities: certain groups - such as the elderly, migrants, or people in remote areas — may need additional protections to ensure they are not left behind. Vulnerability is not fixed; it changes depending on the hazard, the social setting, and the resources available. A person who is resilient in everyday life may become highly vulnerable in a crisis if cut off from transport, health care, or social support. Ethical frameworks therefore stress the importance of context, emphasising that resilience planning must adapt to the realities of different communities.

Legal frameworks give these values

force. At European level, the General Data Protection Regulation (GDPR) establishes strict conditions for handling personal data, ensuring that it is collected only when necessary, used proportionately, and stored securely. Beyond data protection, European civil protection cooperation

highlights another challenge: disasters rarely stop at national borders, Information exchange between authorities in different countries is often hampered by legal uncertainty, incompatible systems, or lack of trust. MFDiate's review showed that while cross-border cooperation is encouraged through EU mechanisms. legal frameworks for sharing detailed risk and exposure data remain patchy and sometimes contradictory. National laws add further requirements. For example, the UK's Civil Contingencies Act creates a statutory duty to cooperate and share information: France's Code de la Sécurité Intérieure obliges municipalities to plan and communicate risks; Norway's Civil Protection Act embeds responsibility at the municipal level; and Iceland's Civil Protection Act integrates scientific expertise directly into the national command structure.

In practice, these ethical and legal frameworks remind us that disaster preparedness is not only about saving lives in the moment of crisis. It is about building systems of trust and accountability that make communities stronger and more resilient long before disaster strikes.

COMPARATIVE PERSPECTIVES: COMMONALITIES, DIVERGENCES, AND GAPS

By studying four testbed countries — Norway, France, the United Kingdom, and Iceland — MEDiate was able to compare how principles are applied in practice. The analysis revealed areas of shared ground, important differences, and ongoing gaps.

Commonalities. All four countries mandate some form of multi-hazard planning and inter-agency cooperation. Each has legal or regulatory instruments requiring risk assessments at the local level - whether through municipal ROS analyses in Norway ("Risiko- og sårbarhetsanalyse", Norway's mandatory local risk and vulnerability assessments), Plans de Prévention des Risques in France (legally binding local risk prevention plans that regulate land use and construction in hazard zones), Community Risk Registers in the UK, or regional contingency planning in Iceland. All are bound by GDPR or equivalent safeguards for personal data. Public communication and risk awareness are widely recognised as essential duties, and simulation exercises are used across countries to test readiness. Ethical safeguards also converge: all four countries emphasise proportionality in restricting rights

during emergencies, and transparency in explaining why certain measures are taken. MEDiate's review showed that fairness — ensuring that no community bears disproportionate risk — is recognised in principle across the board, though implementation varies.

Divergences. The greatest differences lie in governance structures. France has a centralised, hierarchical system where Prefects lead major incident response, while Norway delegates primary responsibility to municipalities. The UK relies on Local Resilience Forums as institutionalised partnerships, whereas Iceland uses a national command structure adapted to small-community contexts. These differences affect how quickly data flows, how decisions are made, and how citizens are engaged. Legal duties to share information also vary. In the UK, cooperation is a statutory obligation under the Civil Contingencies Act. In Norway and France, information-sharing is embedded in planning requirements and protocols, but less explicitly codified. In Iceland, legal structures emphasise dignity and fairness, but practical implementation often depends on close community ties. MEDiate also noted differences in how vulnerable groups are recognised. In France and the UK, specific legal provisions address support for people with disabilities during emergencies. In Norway and Iceland, vulnerability is framed more generally, leaving much to municipal discretion. These distinctions matter for how ethical principles are translated into operational planning.

Gaps. Despite shared commitments. important gaps remain. Laws often speak of "all-hazards" but rarely require systematic treatment of cascading or compound risks, the very focus of MEDiate. Open-data ambitions sometimes clash with privacy rules, especially when vulnerability lavers can allow indirect re-identification. Many municipalities lack the resources to fully meet their legal duties or to integrate advanced digital tools. Finally, across all systems, the role of algorithmic or Albased decision support remains unclear: are outputs advisory, binding, or subject to independent audit? Stakeholders across testbeds voiced concern about accountability: if an algorithmic tool influenced a decision that caused harm, who would be responsible — the software developer, the municipal authority, or the national government? The absence of explicit legal guidance creates uncertainty, especially as digital platforms like the DSS gain prominence. These unresolved questions matter for the legitimacy of DSS platforms.

Cross-border challenges. Another persistent gap lies in international cooperation. Disasters ignore borders, but laws usually do not. The Union Civil Protection Mechanism provides operational assistance, but legal conditions for real-time data exchange remain complex. GDPR allows data to move freely within the EEA, but extra safeguards are required for transfers to third countries - including the UK, whose adequacy decision is reviewable. Differences in emergency powers, thresholds for declaring crises, or sectoral regimes (like nuclear safety under EURATOM) create additional friction. MEDiate workshops highlighted that even when information can legally be shared, institutional habits and trust barriers often prevent timely exchange. For example, local authorities expressed hesitation in releasing detailed vulnerability data, fearing misuse or reputational risk. Technical solutions such as federated learning or privacy-preserving analytics were identified as promising but require stronger legal and political backing to be adopted widely. Stakeholders in MEDiate emphasised the need for pre-negotiated agreements, common drills, and technical solutions such as federated access or privacy-preserving data sharing to overcome these obstacles.

FROM PRINCIPLES TO PRACTICE: MAPPING MEDIATE'S FRAMEWORK

To test its ethical and legal framework, MEDiate compared its principles directly against the emergency procedures of the four testbeds. This exercise demonstrated where the project's safeguards — such as consent, anonymisation, and role-based access — aligned with existing practice, and where tensions or gaps remained. It also highlighted how ethical concepts such as proportionality, fairness, and the duty to avoid harm were interpreted differently in each country. In some contexts, legal duties provided strong anchoring; in others, reliance on custom or informal practice left greater room for interpretation.

- NORWAY (Oslo)

Municipal responsibility creates both opportunities and challenges.

MEDiate's reliance on aggregated data was compatible with requirements for proportionality and transparency, but also revealed barriers in cross-sector data sharing. Local authorities welcomed tools that could integrate multiple hazards while protecting privacy. However, MEDiate's consultations also showed that while

municipal actors valued transparency, cross-sector information sharing remained slow and uneven. Fire services, health authorities, and infrastructure operators often used different data formats and had differing views on what could be lawfully shared. This created tension between the ethical duty of preparedness and the legal constraints of sectoral silos.

- FRANCE (Nice)

The top-down system is strongly codified, but citizen participation has traditionally been limited, MEDiate's cocreation activities contrasted with this pattern, demonstrating how participatory approaches can complement legal obligations under municipal and prefectural planning. Informed consent in workshops was essential for legitimacy. The Nice testbed further showed that citizen-facing activities could reinforce official plans by bringing community knowledge into otherwise technical procedures. At the same time, participants noted that the highly codified French framework still lacks clear space for deliberation: the law obliges municipalities to inform, but not necessarily to consult. MEDiate's participatory approach therefore filled a cultural gap as much as a legal one.

— UNITED KINGDOM (Essex)

Cooperation duties under the Civil Contingencies Act aligned closely with MEDiate's framework. Stakeholders valued the ability to visualise risk and vulnerability at community scale. At the same time, consultations highlighted the need for inclusivity: digital participation tools must reach beyond already-engaged actors to ensure fairness. Stakeholders also questioned how DSS outputs would be treated in practice; would visualisations be regarded as advisory, or as quasi-official evidence within Local Resilience Forum. planning? MEDiate's mapping suggested that while the DSS fits neatly within the Act's duty to cooperate, the absence of quidance on digital decision support leaves authorities uncertain about accountability.

— ICELAND (Múlaþing)

Small populations make anonymisation more difficult, but also heighten the importance of trust. MEDiate applied enhanced safeguards such as restricted data access and careful phrasing in reports. The DSS outputs were mapped to national alert phases and decision—making structures, showing compatibility with Iceland's scientific—legal framework. Even so, the challenge of small numbers

remained. In a municipality like Múlaþing, aggregating data did not always guarantee anonymity, since individual households could still be inferred from vulnerability maps. MEDiate therefore stressed careful balancing between transparency and privacy — a balance particularly delicate in close-knit communities where trust is central.

LESSONS LEARNED

The mapping exercise showed that ethical and legal safeguards are not barriers to innovation — they are enablers. Where MEDiate aligned with national duties, adoption was easier. Where gaps emerged — especially in handling cascading risks, clarifying the legal weight of DSS outputs, and enabling cross-border data sharing - the project provided evidence for where national and European frameworks need to evolve. These lessons underline that innovation cannot succeed without legal and ethical alignment, but equally, that law and ethics must adapt to the realities of digital, datadriven resilience tools.

KEY TAKEAWAYS

The review of ethical and legal principles across four national contexts highlighted several lessons that go beyond compliance and point to what truly builds resilient systems.

Compliance is necessary but not sufficient

GDPR and national rules provide the floor, not the ceiling. Building trust requires transparency about how data is used, inclusivity in whose voices are heard, and privacy-by-design in how tools are built.

• Context shapes implementation

Safeguards must fit their environment. A centralised state needs to create space for participation, while a decentralised system must support uneven municipal capacity. In small communities, protecting anonymity requires especially careful balance.

Cross-border readiness is unfinished business

Disasters spill across borders, but laws

rarely do. Legal frameworks for realtime data exchange still lag behind operational needs. Progress will depend on pre-negotiated agreements, shared drills, and technical solutions that allow cooperation without compromising privacy.

• Trust is the foundation of resiliences

People and institutions engage more openly when their rights are respected, their data is secure, and they can see how ethical safeguards are applied in practice. Without trust, even the most advanced digital tools risk rejection.

These lessons show that law and ethics are not obstacles to innovation, but the very conditions that make new tools credible, trusted, and sustainable.



O2-PRACTICE: PARTICIPATION AND CO-CREATION IN DISASTER RISK MANAGEMENT











FOUNDATIONS: WHY PARTICIPATION MATTERS

Disaster resilience cannot be built by experts and authorities alone. It
depends on the knowledge, cooperation,
and trust of the communities most at
risk. Participation gives citizens and

stakeholders a voice in shaping strategies, ensures that diverse knowledge informs decisions, and strengthens legitimacy. Yet participation is not automatic. MEDiate observed that groups differ in their ability to engage — due to technical knowledge, time constraints, or trust in institutions. This means participation strategies must be tailored: what works in a city with strong



^ Oslo Police

municipal structures may not fit a rural or resource-limited context.

Ethically, participation reflects the right to be informed and the right to contribute to decisions affecting safety and wellbeing. It also embodies fairness, by making sure that no group is excluded from planning. These duties often arise in different forms: France's Code de l'environnement mandates information for citizens living in at-risk zones; the UK Civil Contingencies Act creates obligations for cooperation across responders; Norway requires municipalities to conduct inclusive Risk and Vulnerability (ROS) analyses; and Iceland embeds public risk communication in its Civil Protection Act. While varied, all recognise participation as a component of resilience.

Legally, it is supported in multiple national systems: France requires municipalities to inform residents in risk zones, the UK imposes statutory duties of cooperation, Norway tasks municipalities with inclusive ROS analyses, and Iceland requires public risk communication in civil protection plans.

For MEDiate, participation was not a side activity but a central method. It created opportunities for mutual learning, where experts, practitioners, and citizens shaped tools together. It also helped ensure that

the DSS was not an external imposition but a product of shared insight. Testbed workshops confirmed this value. In Nice, participatory serious games revealed new perspectives on cascading risks. In Essex, digital consultations highlighted both the appetite for visualisation tools and the challenge of reaching less-engaged groups. In Iceland, co-creation required extra safeguards to protect anonymity in small communities, while in Oslo, discussions showed the potential of integrating citizen perspectives into municipal ROS processes.

COMPARATIVE PERSPECTIVES: PARTICIPATION ACROSS FOUR TESTBEDS

- NORWAY (Oslo)

The Norwegian model decentralises responsibility to municipalities. This fosters local ownership, but also means that capacities vary. MEDiate's workshops showed enthusiasm for linking DSS outputs to existing ROS analyses. Stakeholders valued transparency but also flagged challenges in maintaining engagement across multiple agencies and levels of government. Workshops also showed that sharing information across sectors was not always straightforward. Different agencies kept their own systems, which made it harder to link data about related risks.

- FRANCE (Nice)

Participation had to adapt to a centralised system where risk management is highly codified and led by the Prefecture. MEDiate introduced serious games that allowed stakeholders to experience cascading risks interactively. This approach was novel in the French setting, making technical concepts more tangible. However, integrating such participatory methods into formal planning

remains challenging given the emphasis on hierarchy and command structures. Participants found the games useful for sparking discussion and raising awareness, but they noted that these methods still sit outside the formal rules and plans set by the Prefecture

— UNITED KINGDOM (Essex)

The UK's Civil Contingencies Act requires cooperation, and Local Resilience Forums provide a standing structure for engagement, MEDiate broadened participation beyond emergency responders, including health, social care, and infrastructure actors. Stakeholders stressed inclusivity - highlighting that vulnerable populations, such as the elderly in heatwaves, are often left out of planning. They also valued the DSS for supporting recovery as well as response. People also warned that digital tools can leave some groups behind, especially smaller organisations or those without the same resources as larger agencies.

— ICELAND (Múlaþing)

In small communities, participation is deeply personal. MEDiate workshops had to balance openness with sensitivity, as relocation or evacuation scenarios can touch directly on participants' lives. Trust and transparency were essential. Community memory of past disasters proved to be an invaluable resource, enriching hazard models with lived experience. At the same time, privacy

safeguards had to be especially careful, since full anonymity is rarely possible in small populations. To manage this, access to sensitive information was limited and reports were written carefully to avoid pointing to specific individuals.

CROSS-CUTTING LESSONS

Across the four countries, a clear pattern emerged: participation consistently added legitimacy and improved the quality of knowledge. Authorities and communities alike recognised that disaster resilience is stronger when people are involved in shaping it.

The way participation was embedded, however, differed widely. Centralised systems such as France faced cultural hurdles in making co-creation part of formal processes, while decentralised systems like Norway struggled with uneven capacity across municipalities. These structural differences shaped both the pace and depth of engagement.

Important gaps also persisted. Vulnerable groups — including migrants, the elderly, and people without digital access — were under-represented everywhere. Methods to include them were uneven and often ad hoc. In many contexts, consultation was equated with participation, but genuine co-creation requires deeper involvement and shared responsibility.

Above all, trust made the biggest difference. People engaged more openly when they felt their voices were genuinely heard and when they knew their personal information was being handled with care. Where trust was present, participation moved beyond formality to become a true foundation for resilience.

FROM PARTICIPATION TO PRACTICE: METHODS, CHALLENGES, AND LESSONS



Participation in MEDiate relied on a layered set of methods.

- Stakeholder mapping was the first step, clarifying which groups needed to be involved and when.
- 2. Workshops and action research then created spaces where people could shape problems, test the DSS, and reflect on results together with experts.
- 3. Structured input from specialists was gathered through expert panels using the Delphi method. These panels brought in perspectives from governance, policy, and insurance to highlight common challenges and opportunities.
- 4. To make technical ideas more tangible, serious games gave participants a way to "play through" cascading disaster scenarios and see how choices influenced outcomes.
- **5.** Finally, consultations and surveys reached wider groups, allowing the project to capture how different people perceived risks and responses beyond those directly involved in workshops.

These methods created several opportunities for improving both the technical quality of the DSS and the trust placed in it.

- 1. Local insights directly improved the technical models. In Oslo, community discussions helped refine socioeconomic vulnerability data, while in Nice, workshops shed light on interdependencies between different kinds of infrastructure. These local contributions made the models more realistic and better suited to planning.
- 2. Engagement also gave the DSS greater legitimacy. Because it was shaped together with participants rather than delivered as an external tool, stakeholders were more willing to see it as something they could use and trust.
- 3. Finally, participation promoted mutual understanding. Technical experts gained insight into everyday community concerns, while local actors better understood the assumptions and limitations behind the models. This exchange of perspectives made collaboration more effective.

Alongside the opportunities, MEDiate's PAR approach also revealed important challenges.

- Informed consent and transparency proved vital. Participants consistently wanted clarity on who would use the DSS and how the information would be applied.
- Avoiding tokenism was another concern. People expected that their contributions would genuinely shape the design of the tool, not just be acknowledged without influence.
- **3.** Inclusivity remained uneven. Migrants, older citizens, and those without digital access were often absent unless specific outreach was made to involve them.
- Capacity limits also constrained participation. Municipalities in particular struggled to devote staff and time to repeated workshops.
- 5. Finally, the balance between openness and security was not fully resolved. Sharing risk data widely helped raise awareness, but it also risked exposing vulnerabilities if that information was misused.

KEY TAKEAWAYS

The participatory work carried out in the testbeds demonstrated that involving people directly in risk management produces both practical benefits and lasting trust.

· Participation is essential, not optional

It grounds decisions in lived experience, makes technical tools more realistic, and strengthens legitimacy by showing that resilience is a shared responsibility.

Structures matter

Governance traditions shape how participation is received: centralised systems must work harder to embed co-creation, while decentralised systems need sustained resources to avoid uneven engagement.

· Inclusivity is the biggest gap

Migrants, elderly citizens, and digitally excluded groups are too often missing from participation.

Targeted outreach, tailored methods, and extra support are needed to ensure their voices are heard.

• Trust underpins success

People participate more fully when they understand the purpose of engagement, how their data will be handled, and what outcomes they can expect.

Clarity and follow-through are nonnegotiable.

Co-creation improves adoption

Tools developed with stakeholders are more likely to be trusted, integrated into real workflows, and used during crises. Participation therefore strengthens not only legitimacy but also the practical uptake of innovation.

Taken together, these insights underline that resilience is not delivered to communities but built with them, through dialogue, fairness, and shared responsibility.



CONCLUSION

ETHICS AND PARTICIPATION FOR A RESILIENT FUTURE

The MEDiate project demonstrated that resilience in the face of disasters depends as much on principles as on practice. Ethics and law provide the foundations: they protect rights, guide responsible use of data, and set standards for fairness and accountability. Participation and co-creation bring these principles to life, ensuring that communities, agencies, and experts share ownership of preparedness.

WHAT WE LEARNED

From the ethical and legal perspective:

- Compliance with data protection and emergency laws is the baseline, but building trust requires going further with privacy-by-design and transparency.
- National systems differ centralised, decentralised, or small-community

 but all face gaps in addressing cascading risks and clarifying the role of digital decision support.
- Cross-border cooperation remains a weak point: legal, technical, and operational tools must be aligned before crises occur.

From the participation and co-creation perspective:

- Engagement must be genuine and continuous, not tokenistic.
- Vulnerable groups remain underrepresented unless specifically reached.
- Stakeholders value co-created tools, as they are more likely to be adopted and sustained.
- Trust, clarity of purpose, and fairness are essential for participation to succeed.

LOOKING AHEAD

Ethics and participation are not separate from disaster risk management — they are integral to its success. By combining legal safeguards, ethical principles, participatory methods, and technical innovation, MEDiate showed how disaster preparedness can be both effective and legitimate. Resilience is not built only in control rooms or policy offices. It is built in the relationships of trust between authorities and citizens. the commitment to fairness in protecting all groups, and the willingness to share responsibility across borders and sectors. The lessons of MEDiate point to a simple truth: disaster resilience is strongest when it is grounded in both principles and practice, uniting ethics, law, and participation for a safer, more resilient future.

















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Coordinator



Participants

































