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ARTICLE

Coping with Persistent Disruptive Stressors and Polycrisis: Community-Based Policy Making and Local Empowerment

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Abstract
This article describes a conceptual approach for effective, inclusive, and integrative governance to cope with polycrisis and systemic risks. These challenges arise from the high complexity of causal relationships, particularly when multiple risks are interconnected, leading to cascading and cross-boundary impacts. Uncertainty in these relationships further complicates mitigation efforts. Our approach focuses on critical elements of systemic risk governance, particularly the "risk governance triangle," which connects persistent disruptive stressors, risk-absorbing systems, and contextual modifiers. These stressors can be physical (energy, substance, biota) or social (information, power) and interact with exposed targets influenced by their context. We decompose these circumstances into five layers, forming the Pagoda model: natural conditions, institutional arrangements, technical and social infrastructure, the built environment, and individual/social behavior. A central pillar of our proposal is prioritizing bottom-up policy making, creating common deliberative spaces that actively involve stakeholders and citizens.

Keywords Mediative policy style · Pagoda model · Persistent disruptive stressors · Polycrisis · SMART Governance · Systemic risk governance

You can't see the truth in words only by being passive—Hokiichi HANAWA

1 Introduction

Recent years have witnessed an increase in interconnected crises, collectively termed "polycrisis." These include global threats like climate change, biodiversity loss, geopolitical tensions, and complex disasters such as the Fukushima nuclear incident triggered by a tsunami. These crises are interconnected, producing amplifying and cascading effects (Lawrence et al. 2022; Lawrence et al. 2024; Renn 2024). Of particular significance are cascading disasters that are caused when impacts of one disaster trigger another disaster, often amplifying the detrimental effects from one disaster to the next (Lawrence et al. 2024; Liu and Renn 2025). Systemic risk, a related concept, refers to disruptions that threaten critical global services. These risks propagate through networks, exacerbating instability (IRGC 2018; Renn et al. 2019; Renn et al. 2022).

Polycrisis and systemic risks demand localized responses alongside global coordination (Schafft and Greenwood 2003; Koontz and Newig 2014). Although nations share global challenges, their specific impacts vary due to contextual differences (Okada 2004; Paton et al. 2013). Top-down solutions are often ineffective due to conflicts of interest, governance deficits, and collective action dilemmas (Gardner et al. 1990).

The empirical record for managing polycrisis is poor, in particular when cascading effects occur (Day 2024). We still lack relevant perspectives, working frameworks, and methodology that have been repeatedly tested, refined, or even restructured through empirical research works endorsed by strategically collected data and evidence. A review of the assessment, management, and communication literature on

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polycrisis and systemic risk is part of this special issue and should be consulted for more insights into both topics (Liu and Renn 2025).

Drawing on polycrisis literature (Liu and Renn 2025), complexity science, and systemic risk studies, we propose a bottom-up, community-centered approach integrating universal risk patterns with local sociocultural contexts and linking main features of representative democracy on the state or national level with participatory democracy on the community level (Bache et al. 2016; Renn and Schweizer 2020). This approach emphasizes:

- Focus on the community level*:* Local familiarity is crucial for effective intervention. Communities have a deep understanding of their unique challenges, historic legacies, available resources, and social dynamics (Fraser et al. 2006). This approach needs to be anchored on the community level, acknowledging the need to coordinate with higher vertical governance levels (national, continental, global) and to adopt a comprehensive holistic perspective. This does not imply that all communities are functional or attentive to its physical and social resources. Yet, the best intervention point for effective risk and disaster management is on the local level.
- Creation of communicative space: Establishing neutral and inspiring spaces for the mutual exchange of situational analysis (where are we now?), problem definitions, ideas, visions, and suggestions for policies and their implementation is essential. These spaces facilitate open dialogue, encourage creativity, and allow for the free flow of information, leading to more innovative and socially accepted solutions (Okada 2018).
- Inclusivity*:* Open invitations to all ensure no exclusivity, promoting diverse participation. This inclusiveness helps gather a wide range of perspectives, fostering a more comprehensive understanding of the issues and more robust solutions that consider various needs, experiences, and viewpoints (Schweizer 2021).
- Respect and attentiveness: Valuing others' perspectives without necessarily agreeing, and being attentive to weak signals, is vital. This approach encourages empathy, reduces conflicts, and allows for early detection of emerging issues that might otherwise be overlooked (Turnhout et al. 2020).
- Trusting relationships: Fostering trust among all participating individuals and groups builds a strong foundation for collaboration (Arkorful et al. 2021). Trust facilitates cooperation, reduces resistance to change, and enhances the commitment to collective actions. Trust cannot be produced but only earned through an honest, constructive, and open discourse. This takes time and concentrates efforts by those who facilitate the open space debates.
- Shared understanding: Starting from a common definition of the present situation and its challenges ensures that all stakeholders are on the same page. This shared understanding is crucial for coordinated efforts and the development of coherent strategies.
- Incremental progress: Adopting a policy of continuous small steps forward allows for gradual and manageable changes. This approach reduces the risk of overwhelming stakeholders, facilitates continuous learning and adaptation, and builds momentum over time.

This introduction sets the stage for exploring community-based policy making and local empowerment as vital strategies for coping with systemic risks and polycrisis. We are aware that meeting all these requirements poses many challenges and may be far from what we observe in communities around the world. However, our intention is to outline an approach that could address these points effectively and report on case studies in which these requirements were adequately met.

The article is structured as follows: Section 2 introduces key factors shaping polycrisis understanding and management. Section 3 outlines governance requirements using the Pagoda model. Section 4 examines different policy styles. Section 5 presents the SMART Governance model for local crisis management. Section 6 illustrates empirical applications from Japan and Germany. Section 7 summarizes findings and key insights.

2 Key Parameters for Analyzing Polycrisis: The Risk Governance Triangle

In addressing the multifaceted challenges of polycrisis and its associated risks, it is imperative to consider three major aspects: persistent disruptive internal and external stressors, risk-absorbing systems, and contextual modifiers. These aspects collectively form what can be termed the "risk governance triangle," providing a first approach for understanding and managing the complexities of polycrisis.

2.1 Persistent Disruptive Internal and External Stressors

Persistent disruptive stressors are central to polycrisis (Okada 2018). These recurring stressors demand sustained attention, often amplifying systemic risks. They fall into internal (for example, social unrest, economic collapse, political polarization) and external (for example, natural hazards, climate change, conflict) categories.

Renn and colleagues offered a coherent but highly abstract framework for classifying these stressors through the concept of risk agents, which include three physical

agents, that is, energy, substance, biota, and two social agents, that is, information, power (Schweizer et al. 2021; Renn 2024). These agents interact in complex ways, as illustrated by a hypothetical causal diagram: an earthquake (kinetic energy) might damage a chemical plant (toxic substances), leading to river pollution (biota), which then impacts human and animal health. Ineffective communication and management can exacerbate these effects, highlighting the interconnected nature of risk agents in a polycrisis situation (SAPEA 2022). The interactions between the agents are characterized by three genetic processes: amplification, infection, and cascading (Lawrence et al. 2024). Amplification refers to a process where a minor event triggers a set of ripple effects that grow in intensity with each new ripple that is formed. Infection refers to impacts of one event tightly coupled to another event and its impacts, and cascading describes a sequential process of events that trigger each other. For example, the COVID-19 pandemic spread out from one country to the rest of world via infection. The real estate crisis in the United States led to multiple amplification effects on the financial markets and caused political turmoil. The 2011 Eastern Japan Earthquake was a typical case of cascading consequences first triggered by an earthquake and a subsequent tsunami, which triggered the Fukushima Nuclear accident. Many consequences of polycrisis proved to be extensively complex and systemic, resulting in, for example, cascading damages of supply chains in production, from local, regional, to global. All of this indicates multiple scales of complexities and systemic risks that could cause distinct types of cascading consequences from polycrisis occurrences.

2.2 Risk Absorbing Systems

Risk-absorbing systems—comprising individuals, communities, ecosystems, and infrastructure—are exposed to stressors and must mitigate their impacts (IRGC 2019). Vulnerability reflects susceptibility to damage, while resilience denotes adaptive capacity (IRGC 2018). Resilience encompasses both preventive measures (improving the capacity to resist stress and thus maintaining functionality) and crisis management (quick recovery) (Reid and Botterill 2013). In a broader sense, resilience refers to a dynamic functionality that allows for a continuous adaptive process of transformation (structural change). The concept is, therefore, not only descriptive but also normative, guiding improvements toward greater resilience, such as the principle of "build back better" after disruption (Norris et al. 2008; Okada 2018). Resilience focuses on the system's ability to adapt, reconstruct, and evolve in response to stress.

2.3 Contextual Modifiers

The performance of risk-absorbing systems under persistent stressors is significantly influenced by contextual modifiers, which include natural, economic, social, political, and cultural factors (O'Brien et al. 2010). Of particular importance here is the distribution of power and the governance structure (see Sect. 4). Scientific research faces the challenge of distinguishing universal patterns from unique, context-specific patterns that shape perceptions and responses to stressors. Major variables in this context include the local natural conditions, social composition, cultural traditions, community size, and settlement characteristics (urban versus rural, dense versus sparse), among others.

These contextual conditions also affect a community's capacity for adaptive crisis management and social learning, potentially leading to improved resilience. Communities that are prepared and have developed coping capacities can leverage experiences with persistent stressors as catalysts for change and enhancement of resilience (Okada 2018). Figure 1 illustrates the triangle.

2.4 Key Variable: Open Communicative Space

At the center of the risk governance triangle is the open communicative space—a vital forum for stakeholder dialogue, collaboration, and participatory policy making (Okada et al. 2013; Okada 2022a). This space fosters transparent communication, trust-building, and adaptive risk governance,

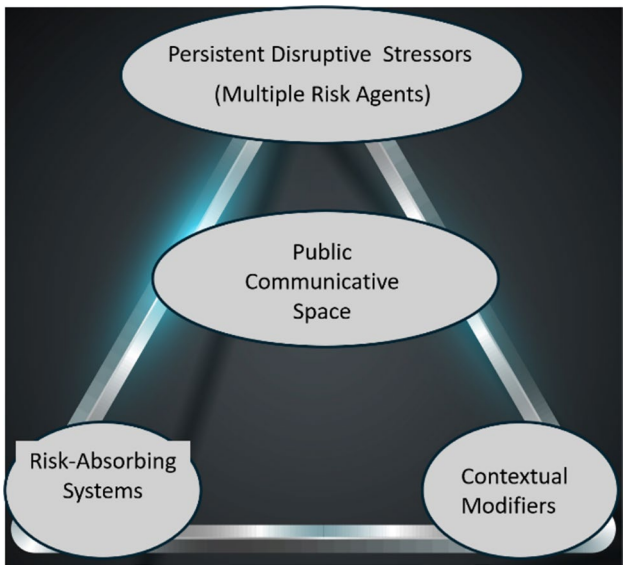

Fig. 1 Systemic risk governance triangle. The three major components of risk are based on the International Risk Governance Center (IRGC) risk governance framework with an additional emphasis on communicative space for dealing with each component.

ensuring diverse perspectives are considered in resilience strategies.

The risk governance triangle—comprising persistent disruptive stressors, risk-absorbing systems, and contextual modifiers—provides a foundational approach for analyzing and managing polycrisis. In this section we have outlined the key parameters, emphasizing the need for a holistic and integrated approach to risk governance. In subsequent sections, we will further explore these aspects, including a detailed examination of contextual modifiers through the Pagoda model developed by Okada (2004). This model elucidates the varying levels of contextual factors and their implications for risk management and resilience building.

3 The Pagoda Model: Structuring the Contextual Modifiers

The complexity of polycrisis necessitates a nuanced and differentiated understanding of the various factors that influence the vulnerability and resilience of risk-absorbing systems. The Pagoda model that was first introduced by Okada (2004) for governing the responses to natural hazards provides a structured approach to analyzing these contextual modifiers by delineating them into five distinct but interconnected layers. This section elaborates on each layer and discusses the systemic perspective required to manage polycrisis effectively.

3.1 The Five Layers of the Pagoda Model

The Pagoda model includes five different layers that need to be considered when designing policies for dealing with multiple risks. The five layers are explained in the following paragraphs and illustrated in Fig. 2.

3.1.1 Nature

The foundational layer encompasses both the objective living conditions and the dominant cultural perceptions of nature. This includes topography, weather patterns, and natural hazard and disaster proneness. While these factors have traditionally remained stable over centuries, recent global climate change and cultural globalization are accelerating changes in both the physical environment and its social and cultural interpretations. Increasingly, natural conditions are seen as shaped by human actions, reflecting a dynamic flux of new perceptions and interpretations (Steffen et al. 2007).

3.1.2 Institutional Arrangements

This layer includes governance structures and public agencies responsible for risk and disaster management. Institutional systems generally evolve over decades, but contemporary multiple stressors and the drive towards sustainability are prompting more frequent changes. Effective governance structures are crucial for addressing the complexities of polycrisis and facilitating coordinated responses.

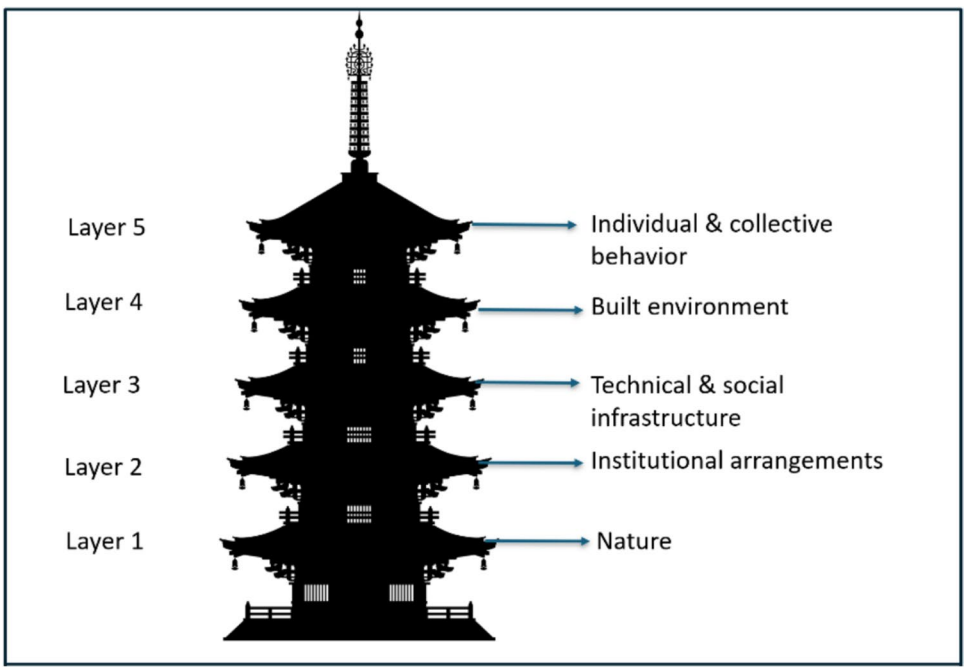

Fig. 2 The five-story Pagoda model of contextual factors. All five layers are interconnected by multiple feedbacks.

3.1.3 Technical and Social Infrastructure

This encompasses technological structures such as electricity grids, water supplies or levies against flooding, basic social services such as a functional banking system, emergency response system, and basic education services as well as social infrastructure such as hospitals, transportation networks, and communication systems. The infrastructure layer operates on a time frame of decades, but it can adapt more rapidly if environmental conditions and social demands necessitate swift changes. The resilience of these systems is critical for maintaining societal functions during crises.

3.1.4 Built Environment

This layer refers to the physical design of settlements, urban planning, and open space management. While changes in the built environment typically span several decades, accelerated building cycles and urgent environmental or social needs can lead to quicker modifications. Urban planning strategies must consider resilience to withstand and recover from disruptions.

3.1.5 Individual and Collective Behavior

The most dynamic layer, individual and collective behaviors, can change within less than a decade. However, entrenched routines and practices often exhibit considerable stability. Understanding behavioral patterns is essential for implementing effective risk management and resilience-building strategies.

All five layers of the Pagoda interact with each other and co-produce positive as well as negative impacts. There are multiple feedback loops between the layers and each layer can trigger impacts on another layer. Some layers may also co-produce disasters such as a close loop between human interventions and natural responses. It is crucial for risk governance organizations to understand the interactions between these layers and to explore the effects of governance measures on each layer.

3.2 The Pagoda System in Times of Polycrisis: A Systemic Perspective

In times of polycrisis and systemic risks, the dynamic effects of multiple risk agents demand comprehensive and timely policy responses. This challenge requires an understanding of the interconnectedness of the five layers of the Pagoda model, as each layer experiences different stressors based on the composition of the polycrisis (Okada 2022a). Effective management must acknowledge these interdependencies to prevent exacerbating vulnerabilities in other layers. Understanding interactions between these layers is critical to managing risks effectively and avoiding complex feedback loops.

A common issue in both academic literature and management practice is focusing on a single layer while neglecting the interconnected nature of the layers (Stone 2004; Comfort et al. 2010). This oversight can increase risks across other layers. An integrative approach ensures a comprehensive view, recognizing the broad spectrum of influences on risk-absorbing systems. While the complexity of causal connections makes integration difficult, it is possible to model these interdependencies with a degree of reliability (Djalante 2012). The goal is not to predict all impacts precisely but to design adaptive governance measures in response to available knowledge and complex challenges. Effective governance requires the best possible policy sets, even amidst uncertainty and ambiguity. Developing comprehensive models helps anticipate cascading effects across layers.

Complex issues are more manageable when approached on a small scale, considering all layers simultaneously (Norris et al. 2008). Policies should prioritize community-level analysis using the governance triangle, which includes interacting stressors, vulnerable systems, and contextual modifiers as defined by the Pagoda model. A community-based approach offers two key advantages: flexibility to adapt to local situations and fostering an open learning environment among community members (Tabara and Chabay 2013). Risk governance agencies must empower communities to take actions that enhance resilience across all Pagoda layers, including altering perceptions of nature. Engaging local stakeholders ensures that interventions are contextually relevant and culturally appropriate. The success of this approach relies on creating well-structured, public communicative spaces that allow community members to plan, share experiences, and design proactive resilience measures (Okada 2022a).

Once community-level needs are addressed, vertical governance levels (regional, national, global) should be approached incrementally (Fraser et al. 2006; Radtke and Renn 2024). A global framework should guide local actions to ensure alignment with broader objectives, such as upstream flood protection benefiting downstream communities or climate change mitigation staying within planetary boundaries (Lade et al. 2020). Multi-level governance fosters coherence and synergy across policy scales. In addition, in democratic political systems, state and federal governance levels are mainly structured according to the principles of representative democracy while at the community level a variety of participatory modes of direct public involvement are more common and also easier to implement.

Cross-sectoral and cross-governance cooperation is vital for promoting fairness and social justice (De Goër de Herve 2023). Different communities or regions experience varying degrees of vulnerability, making solidarity and

cross-community cooperation crucial. Mutual assistance and resource pooling enhance resilience-building initiatives and ensure that the most vulnerable are not left behind in risk management processes.

4 Policy Styles: Suitability for Systemic Risk Governance

There is no consensus in the literature on what democratic governance means concerning institutional structures, decision-making procedures, and the roles of elites versus citizens, particularly in managing systemic risks (Richardson 1982; Benz and Papadopoulos 2006; Biegebauer and Hansen 2023). Based on Radtke and Renn (2024), five prototypes are suitable for discussing policy styles in systemic risk management within democratic political regimes: autocratic, adversarial, collaborative, reflective, and inclusive. These prototypes, ideal types in the Weberian sense, do not represent empirical entities but conceptual tools to analyze social phenomena. Most democratic systems blend these prototypes, with one approach often dominant. Each of these governance styles is briefly characterized below.

4.1 Autocratic Governance Prototype

This style features a leading role for a political leader and a ruling party, affirmed by free and fair elections (Marsh 1991; Miller 2021). Autocratic leaders limit opposition voices and control media and judiciary influence. Examples include Hungary, Poland, Israel, and the United States under Trump (Erhardt et al. 2021). Autocratic systems could theoretically implement comprehensive risk governance policies, but such policies might conflict with leaders' ambitions for popularity and support. Participation is symbolic, with autocratic leaders claiming to know what is best for the population. Genuine stakeholder and public participation is rare, making inclusive risk governance ineffective (Radtke and Renn 2024). The main requirements for a comprehensive, effective risk reduction policy are unlikely to be met in autocratic governance systems.

4.2 Adversarial Governance Prototype

Characterized by competition between two dominant parties, adversarial systems depend on legal requirements and litigation to resolve conflicts (Busenberg 1999; Renn 2008). Ambitious risk reduction policies may be implemented if they align with a party's strategic interests but are often reversed when the opposing party gains power. Participation is orchestrated to garner support, avoiding cross-party formats. Public debates, protests, and media scrutiny may force reluctant participation. This style is not aligned with inclusive, community-based policy making essential for effective systemic risk governance.

4.3 Collaborative Governance Prototype

Collaborative governance seeks consensus among powerful players, including multiple parties, economic actors, and nongovernmental organizations (NGOs) (Papadopoulos 2012; Mosley and Wong 2021). While historically closed-door negotiations were the norm, transparency has increased with the rise of NGOs and social media. This style is inclusive of major stakeholders but excludes non-organized citizens, focusing on consultation rather than co-designing policies. Legal requirements for public hearings are often symbolic. This style slows implementation to maintain cooperation and rarely initiates radical actions. Countries in Scandinavia, the Netherlands, Austria, and Japan exemplify this style. Risk reduction policies reflect the lowest common denominator, minimizing opposition but reducing efficiency and persistence.

4.4 Reflective Governance Prototype

Reflective governance emphasizes deliberative democracy, providing open discourse opportunities for all parties (Bächtiger et al. 2014; Lafont 2019). It aims for rational solutions and broad acceptance. However, participant selection, power hierarchies, and conflicting values can hinder true consensus. Reflective governance often remains rhetorical, with verbal commitments not translating into action (Brand et al. 2019). Public input spaces are limited, making implementation difficult. Despite its constraints, this style fosters community-based action plans for risk reduction but often lacks the energy for implementation.

4.5 Inclusive Governance Prototype

Inclusive governance emphasizes direct participation through referenda and citizen assemblies (Fischer 2012; Setälä 2017). While allowing broad participation, it can lead to unpredictable outcomes and stop-and-go decision making. It ensures public resonance but may falter in ambitious risk reduction. Inclusive governance is popular but vulnerable to manipulation and oversimplifies complex issues. This model requires extensive information campaigns and citizen deliberations. The main challenge is a lack of long-term predictability (Radtke and Wurster 2023), which is crucial for addressing systemic risks.

4.6 Synopsis of Policy Styles

None of the five prototypes offers an optimal solution for systemic risk governance (Radtke and Renn 2024).

Autocratic governance excludes participation. Adversarial governance lacks stability. Collaborative governance slows implementation. Reflective governance struggles with action. Inclusive governance is unpredictable.

Systemic risk governance requires balancing top-down and bottom-up processes, shifting emphasis to the community level. A hybrid style, based on collaboration and enriched by reflective and inclusive elements, enhances community agency and efficacy. Steps include public deliberation spaces, flexible participation, benefit-sharing with communities, and linking local action to broader governance. This approach balances policy making, ensuring democratic principles and subsidiarity while fostering community empowerment.

This hybrid policy style, termed "mediative governance" by Radtke and Renn (2024, originally in Renn 2011), bridges citizens and communities with state and supranational entities. It combines collaborative, reflective, and inclusive elements to address systemic risks effectively and equitably. However, the term "mediative" may be misleading, as most policy styles involve mediation. A more precise term might be "deliberative" or "integrative." Lacking empirical validation, it remains an ideal mix of existing styles designed for "small and solid, modest and multiple perspectives, adaptive and anticipatory, responsive and risk-concerned, and timely and transformative" (SMART) governance. By linking local initiatives with broader governance, this approach promotes sustainable and just risk governance. Table 1 provides a synopsis of the discussed policy styles, including the mediative governance style.

Table 1 Policy styles, participation opportunities, and impacts on risk reduction policies. Source: Adopted and changed from Radtke and Renn (2024)

Autocratic governance	Adversarial governance	Collaborative governance	Reflective governance	Inclusive governance	Mediative governance
Strong political leadership Limited participation Lack of aspirations for effective risk reduction No participatory inclusion of communities Modus of legitimacy: Trust Outcome level of actions is limited through a lack of benefits for political leaders	Two dominating parties Strong public participation Little incentive for effective risk reduction Low level of inclusion of communities Modus of legitimacy: Persuasion Outcome level of actions is limited through opposition and fear of losing public support	Multi-stakeholder arrangements Strong stakeholder participation High incentive but low probability of implementation Medium level of inclusion of communities Modus of legitimacy: Responsiveness High outcome level of actions is possible, but mostly limited to lack of implementation	Joint decision-making process Strong public deliberation High incentive, but lack of implementation High level of inclusion, but lacking agency Modus of legitimacy: Consensus Low outcome level of actions, but high level of process quality	Direct participation process Strong direct public participation High aspirations but low predictability High level of inclusion but no coherence Modus of legitimacy: Representation High outcome level of actions is possible, but lack of coordination and comprehensive strategies common	Scaling up issues: Delegating local representatives to the next governance level Inclusive formats for effective risk reduction Strong bottom-up participation in communicative spaces Modus of legitimacy: Balance of top-down and bottom-up High outcome level, and community empowerment

5 Introducing SMART Governance 2.0: A New Risk Governance Framework

In our quest to develop robust, community-based solutions for risk governance, we introduced the SMART Governance 2.0 framework (Okada 2022a; Okada et al. 2023). This innovative approach addresses the multifaceted nature of systemic risks and their impact on communities by integrating flexibility, responsiveness, and adaptive management. This section outlines the essential requirements for an effective risk governance framework and elaborates on the components of the SMART Governance 2.0 model.

5.1 Essential Requirements for an Appropriate Risk Governance Framework

An effective risk governance framework must provide a flexible, timely, and adaptive response to the critical endpoints of risk management as we have outlined them in the risk governance triangle. The first endpoint involves characterizing risk agents and their interactions. Understanding

the nature of these agents and how they interact is crucial. This involves both academic research and local experiential knowledge to accurately assess potential threats. The second endpoint focuses on improving the resilience of risk-absorbing systems, ensuring that communities can withstand and recover from disruptive events by strengthening infrastructure, social networks, and local economies. The third endpoint requires sensitivity to contextual conditions, as each community has unique cultural, social, and environmental factors that necessitate tailored responses.

Addressing these endpoints is essential, but it is equally important to consider the multiple layers of contextual factors highlighted in the Pagoda model. This model underscores the necessity of considering individual and collective level behaviors, built environment characteristics, infrastructural demands, intuitional arrangements, and natural conditions. Such multi-level management systems rely on professional risk management authorities but also on a style of decision making that Radtke and Renn (2024) characterized as mediative integrating vertical as well as horizontal governance levels.

Respecting planetary boundaries and fostering solidarity with other communities, particularly those more vulnerable to potential disasters, are also critical components of an effective risk governance framework (Sultana 2023). Policies must align with national and supranational objectives, such as climate change regulations, to ensure that risk governance contributes to global sustainability and equity.

It may not be easy to meet all these objectives and to establish an effective, resilient, and fair governance structure. However, as explained in the following section, we can outline the main features of a governance framework that in principle is capable of meeting all these objectives.

5.2 The SMART Governance Model 2.0

The SMART framework represents an evolution in risk governance, emphasizing attributes that make the framework more responsive and effective. Each letter in SMART stands for two critical attributes: small and solid; modest and multiple perspectives; adaptive and anticipatory; responsive and risk-concerned; and timely and transformative (see Fig. 3). We explain each of these attributes in the following paragraphs (more details in Okada (2022a) and Okada et al. (2023)):

- Small and solid: While systemic risks are global, effective management occurs at the community level. By developing context-sensitive programs locally, communities can significantly contribute to addressing global challenges. This approach links local actions with higher governance levels, emphasizing the interaction of persistent stressors, the impact on communities, and the role of contextual variables (Pagoda model).
- Modest and multiple perspectives: SMART Governance advocates for modest, incremental steps that allow for continuous learning and adaptation. Ambitious policies can delay responses, so smaller, more manageable actions ensure sustainability. Complex challenges require diverse perspectives from various stakeholders, epistemic communities, and local residents. A deliberative discourse in open spaces fosters collaborative problem-solving and holistic approaches to systemic risks.
- Adaptive and anticipatory: Adaptive management is essential for navigating complex challenges. Responses must be evidence-based, flexible, and capable of improvement. An anticipatory approach ensures that communities develop resilience strategies ahead of crises, enhancing prepared-

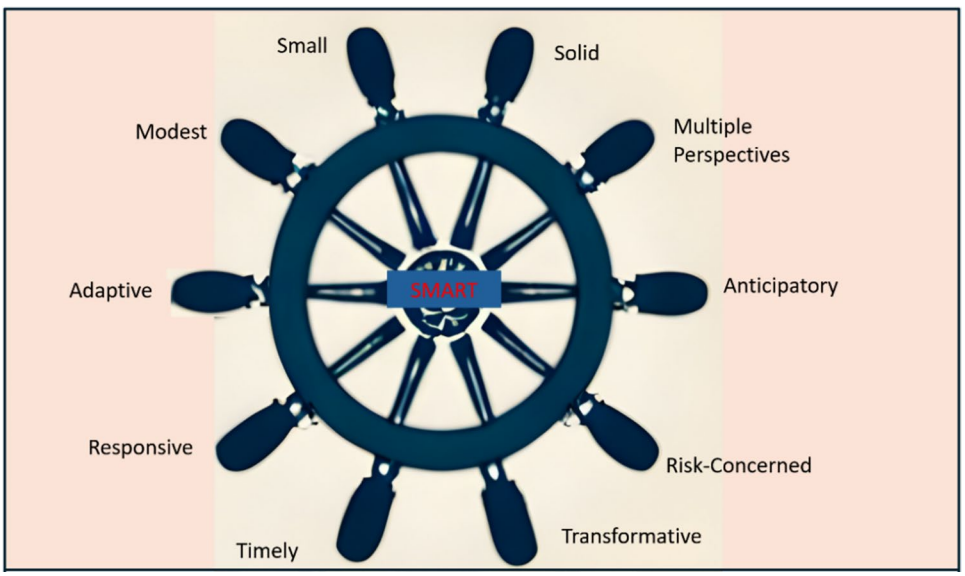

Fig. 3 The SMART 2.0 Governance model. The 10 criteria relating to each capital letter constitute a prescriptive characterization of how an ideal governance process should be designed to cope with systemic risks.

ness and reducing vulnerability. Institutional learning environments, where policymakers and residents collaborate, are key to building coping mechanisms and resilience.

- Responsive and risk-concerned: Governance structures must be responsive to community needs. Building narratives that resonate with residents and providing communicative spaces ensures inclusivity and effective governance. A focus on risk reduction and sharing ensures that governance remains directed at addressing key threats, preventing the dilution of efforts.
- Timely and transformative: Early detection and intervention can mitigate crisis impacts, making timely responses crucial. Proactive actions reduce harm and help manage risks before they escalate. Ultimately, all policy actions should aim for transformative outcomes that promote sustainability in ecological, economic, and social domains, ensuring long-term resilience.

In conclusion, SMART Governance 2.0 offers a comprehensive, adaptive, and community-focused framework for risk governance. The primary goal is to "build back better" before disasters strike by enhancing community coping capacities. This proactive approach minimizes disaster impacts, strengthens community identity, and fosters broader benefits in economic development and social cohesion. The integration of flexibility, responsiveness, and adaptive management ensures that SMART Governance 2.0 is not only effective in addressing immediate risks but also contributes to long-term sustainability and resilience.

However, it should be kept in mind that the SMART Governance approach provides a normative frame of how to best prepare communities for coping with risks and disasters. We do not claim that such a management approach has been typical for communities worldwide. On the contrary, as we have witnessed for example in the recent floods in Germany (2023) and Spain (2024) most of what the SMART Governance approach prescribed had not been implemented or even considered. There are many reasons for an inadequate or even counterproductive disaster response, which has been analyzed in many publications (for example, Wachinger et al. 2013). Our intention with this publication is to provide normative guidance for communities for an improved and adequate response to risk and disaster management. However, there are good case studies that show the feasibility of our approach and document its success. We have selected two cases—one from Japan and one from Germany—to illustrate our approach.

6 Illustrations of Inclusive and Mediative Governance Processes

This section provides two international examples of how an inclusive and mediative governance process can be organized and implemented at the community level. These two examples demonstrate, on the one hand, the importance of taking the local context into account and, on the other hand, that despite different cultures, local conditions, and mentalities, the general framework that we laid out in the previous sections can be applied to both cases.

6.1 Illustration 1: Community Revitalization through SMART Governance in Chizu, Japan

Chizu Town, a mountainous municipality in western Japan, is located 500 km west of Tokyo in Tottori Prefecture. As of October 2018, the town had a population of 6689. Tottori Prefecture, which borders the Sea of Japan, has the lowest population among Japan's 47 prefectures, with around 570,000 residents as of 2018. Chizu Town, established in the ninth century, has faced severe rural decline, especially since the 1950s. Its primary industries—forestry, particularly high-quality cedar timber, and rice—have been affected by population loss, especially those under 65. The town now has an increasing elderly population, a demographic trend referred to as the *Kaso* (hollowing-out) syndrome. Despite government efforts, Chizu, like many rural areas, struggled to reverse this trend and became less able to manage its challenges independently by the early 1980s.

Chizu is particularly vulnerable to both internal and external persistent stressors. External stressors, or polycrisis, include demographic shifts such as outmigration to cities and an increasing elderly population. These trends were compounded by the national government's enforced amalgamation of municipalities. Additionally, Chizu faced natural hazard-related disasters, including heavy rainfall, floods, landslides, and earthquakes. Global economic competition impacted the local timber industry, while climate change worsened forestry challenges and caused more severe weather-related disasters. Most recently, the COVID-19 pandemic has further complicated the situation, affecting the community's health and economy.

Internally, Chizu has experienced a loss of coping capacity, which has led to diminished local pride. This erosion of self-reliance contributed to growing social conflicts within the community, particularly between different generations and between long-time residents and newcomers. These internal tensions compounded the difficulties of managing external stressors, complicating efforts for revitalization.

With support from Tottori University, Chizu initiated the Zero-to-One Community Revitalization Project, inspired by Okada's SMART Governance concept. The process of community transformation unfolded in four key phases.

Decade I (1987–1997), Learning and Initial Changes: Local leaders formed the Chizu Creative Project Team (CCPT), including policymakers and young collaborators, who sought external support and academic guidance from Prof. Okada. This decade focused on creating a "communicative space" to share and test ideas. The village of Yakodani, deeply affected by persistent stressors, was selected as the test site. The CCPT initiated a log cabin-building project involving community members and experts from Japan and Canada, demonstrating that small community-driven initiatives could spark meaningful changes and lay the groundwork for SMART governance.

Decade II (1997–2007), Expansion of the Zero-to-One Project: The CCPT expanded the project by developing the Zero-to-One Project, which was adopted by the Chizu municipal government. The 10-year project aimed to empower village communities through self-governance, community resource management, and regional exchange. Sixteen of the town's 89 villages were selected to create community associations, prepare transformation plans, and participate in annual peer review meetings.

Decade III (2007–2017), Upscaling to Valley-Wide Communities: The Chizu government extended the project to entire valley districts. Village leaders and residents worked together to form district-wide community associations, further expanding "communicative spaces" from the previous decade. The Yamasato Valley District, for example, used the Pagoda model and the Yonmenkaigi system method (Na et al. 2009) to bridge cultural and traditional gaps between neighboring villages. This valley-wide approach proved successful, as demonstrated during the Western Japan Heavy Rainfall Disaster, when Chizu Town experienced over 500 mm of rainfall in three days. Villages involved in the Zero-to-One Project reported no casualties due to prompt evacuations to local shelters rather than distant public evacuation centers.

Decade IV (2018 Onwards), Post-Zero-to-One Project: By 2024, the Zero-to-One Project formally ended. Its legacy includes strengthened community coping capacities and new social enterprises. The project fostered more visible and active "communicative spaces," promoting collaboration between the municipal government and residents. A notable initiative is the *Hyakunin Iinkai* (100 residents' Committee), where 100 selected residents are empowered to propose and implement mini-scale self-assigned projects.

All four stages constitute an epoch-making SMART Governance practice, which is institutionally backed up by the municipal government, and also implemented by each person, who makes his or her own proposal for community revitalization. Notably, Chizu's four decade-long SMART Governance achievements have reached a high level of mutual collaboration between the local government (top-down) and mini-scale human centered initiatives (bottom-up.) With this approach, community's resilience has made remarkable progress: from learning and initial changes by a small number of motivated people in Decade I (1987–1997) to an institutionalized top-down support system and self-motivated bottom-up movement in Decade IV. Over four decades, the community's resilience progressed from small-scale efforts by motivated individuals to an institutionalized system supporting self-motivated actions. These efforts continue to nurture inclusive governance and enhance the community's resilience to social and natural stressors.

6.2 Illustration 2: Community Climate Protection Plan in Erlangen

The Mandate: In November 2020, the city of Erlangen[1] committed to "creating all necessary institutions, infrastructures, and measures for reaching the 1.5-degree target and to make effective climate protection the guiding principle for city policy" (City of Erlangen 2020, p. 59). Following the declaration of a climate emergency in May 2019 (City of Erlangen 2019, p. 12), the city council resolution initiated a so-called "Climate Awakening" roadmap, with the objective to achieve climate neutrality by 2030. The roadmap is a comprehensive process that "includes the creation of CO_2 balance sheets, the development of a CO_2 reduction tool, a citywide monitoring program and an outreach, education and participation component" (Bergk et al. 2022, p. 6). Transition management (Loorbach 2007) inspired the process, focusing on integrating knowledge and including both stakeholders and citizens. The aim was to assess the current greenhouse gas emissions and develop strategies to address the climate crisis, establishing a foundation for an effective climate protection plan involving the city government, local businesses, civil society, and private households. The contract was one of the first in Germany that integrated physical, economic, social, and educational measures into a consistent and interdependent political agenda.

The Architecture of the Participatory Process (Oppold and Renn 2022; 2023): The city engaged external support

[1] Separate from the small medieval town of Alt-Erlang, Landlord Christian Ernst gave order to construct the new town called Christian Erlang (later called Erlangen) for hosting the French Huguenots in the seventeenth century. Over time, it has grown to become one of Germany's best-preserved planned cities from the Baroque era and a monument of European importance with a vibrant city center. The city spreads over 77 km^2 and has approximately 112,000 inhabitants (https://www.germany.travel/en/cities-culture/erlangen.html).

from the Institute for Energy and Environmental Research (ifeu) in Heidelberg, offering scientific expertise and assessments, and Green City Experience (GCX) from Munich, experts in participatory processes. Ifeu's role included creating CO_2 balance sheets, developing CO_2 scenarios, and proposing climate protection measures. They were pivotal in participation events, answering questions and advising participants, while also drafting the catalog of policy measures. GCX assisted in structuring and conducting the participatory process.

Overall management was entrusted to the Climate Protection and Sustainability Department of the Erlangen City Administration. The participation process comprised a Round Table with stakeholders and a Citizen Assembly, the latter consisting of residents randomly selected to represent Erlangen's diverse population. A political steering committee, including climate policy spokespersons from the city parliament and respected local citizens, oversaw the process, meeting every three months to serve as an information bridge to the political establishment.

The Citizen Assembly and Stakeholder Round Table: The Citizen Assembly included 25 residents, randomly selected from 750 candidates, who were directly contacted by the Lord Mayor. The selection aimed to represent Erlangen's demographic makeup, ensuring diversity across age, gender, nationality, and place of residence. The stakeholder Round Table, involving 36 participants from organized local groups and associations, was based on a stakeholder mapping exercise by the city administration. The areas covered included educational institutions, city administration, businesses, civil society, and NGOs. All selected stakeholders accepted the invitation.

The working phase of the Climate Awakening process, spanning March to July 2022, involved four meetings of the Citizen Assembly and three meetings of the stakeholder Round Table, plus several working group meetings.

Tasks of the Participatory Committees: Both citizens and stakeholders were tasked with two main objectives. First, they analyzed the risks of global climate change and its implications for Erlangen. They also examined the city's context, including natural conditions, infrastructure, economic data, energy consumption, and energy sources. Though the planners did not specifically use the Pagoda model, its five layers were intuitively applied in their efforts to educate participants. In addition, they reviewed a list of proposed climate protection measures from ifeu, assessing their feasibility and effectiveness, and suggested their own measures for consideration.

Participants were encouraged to suggest voluntary commitments for their climate protection actions. Stakeholders were asked to implement these measures within their organizations, while citizens were encouraged to take action individually or inspire others. Both groups' commitments were incorporated into the final Climate City Contract, which summarized their pledges and included the measures ultimately adopted by the City Council. The contract was signed by the City Council, the Citizen Assembly, and the stakeholder Round Table in October 2022.

Procedures of the Participatory Process: The process began with a public kick-off event on 22 March 2022. Following this, three separate meetings for the Citizen Assembly and the Round Table took place, during which both groups worked through several interconnected phases.

The first meetings allowed participants to familiarize themselves with the process and each other, agreeing on the rules and objectives for the deliberations. Both groups were provided with comprehensive information on the city's context and previous policy measures. In the second round of meetings, the Round Table and the Citizen Assembly discussed a draft of policy options developed by ifeu. Both groups prioritized actions and proposed adjustments to the measures. These were then evaluated by the Round Table and the Citizen Assembly. The third meeting brought both stakeholders and citizens together to address controversial issues and jointly propose solutions. Prior to this meeting, stakeholders consulted their organizations and provided feedback, which was reviewed by ifeu experts and incorporated into the third meeting's agenda. In this session, the voluntary commitments of all stakeholders, previously negotiated, were finalized and documented in a formal contract. A major challenge during this meeting was resolving conflicting assessments or evaluations from stakeholders, experts, and citizens. Using resistance measurements based on the systemic consensus method (Berger 2019), the various policy packages were either included in the catalog of measures, adjusted through joint decision making, or discarded. The building of consensus was facilitated by the steady influx of scientific feedback on the effectiveness of each proposed policy measure in terms of climate protection and other key variables. In addition, the character of an open space discourse and the style of deliberation helped to create an atmosphere of mutual respect for each other but also for a constructive learning environment.

The fourth and final meeting of the Citizen Assembly aimed to reach formal agreement on all measures using resistance measurement, culminating in a set of recommendations for the City Council and administration. The catalog, consisting of 41 recommended measures, was passed to the City Council with a recommendation for formal democratic approval. The City Council approved the catalog in October 2022, agreeing to implement 14 priority measures immediately and allocate resources for the remaining recommendations.

Lessons learned for Governance: The consultation and decision-making process in Erlangen closely aligns with our mediative model of policy making. It was effective

and evidence-based, involving Germany's leading energy research institute (ifeu); inclusive, by giving stakeholders and citizens a voice; comprehensive, by addressing all layers of the Pagoda model; and integrative, using open space methods for consensus building and conflict resolution. Moreover, the process did not merely design policy measures but also produced clear commitments for implementation.

7 Conclusion

This article set out to develop a conceptual approach for an effective, inclusive, and integrative governance framework that is capable of adequately addressing polycrisis and systemic risks. Through our exploration, we have identified and analyzed the inherent challenges in managing these risks and proposed a comprehensive approach designed to find appropriate governance solutions for addressing complexity, uncertainty, and ambiguity.

7.1 Lessons Learned for Effective Systemic Risk Governance

Systemic risk governance presents several formidable challenges (Renn et al. 2022; Liu and Renn 2025). The high complexity of causal relationships, particularly when multiple risks are interconnected, complicates risk management. Moreover, these interconnected risks often have cross-sectoral and cross-boundary impacts, magnifying their potential effects and often leading to cascades of disastrous consequences. There is also a significant degree of uncertainty and indeterminacy in causal relationships, making prediction and mitigation efforts difficult. The impacts of systemic risks are heavily influenced by contextual conditions, which vary greatly across different regions, rendering global solutions impractical.

Our approach addresses these challenges by focusing on critical elements of systemic risk governance. Central to our approach is the risk governance triangle, which connects three primary components: persistent disruptive stressors, risk-absorbing systems, and contextual modifiers. These stressors, which can be physical (energy, substance, biota) or social (information, power), interact with risk-absorbing systems—exposed targets influenced by the surrounding context. We further decompose the contextual circumstances into five layers, forming the Pagoda model. These layers are natural conditions, institutional arrangements, technical and social infrastructure, the built environment, and individual and social behavior. Understanding the interactions within and between these layers is crucial for effective risk governance.

A significant emphasis of our approach is the adoption of a mediative policy style, characterized by the subsidiarity principle, stakeholder inclusion, deliberative policy making formats, and a strong connection between policy making and implementation. By focusing on the community level and creating public communicative spaces, this style promotes a more engaged and responsive governance structure. The cornerstone of our approach is to give priority to the bottom-up approach to policy making and planning, which involves developing concrete projects that directly involve the community, guided by professionals and experts. The ideal is to foster self-governance (autonomy) by improving the community's coping capacity and agency. Such efforts require substantial time and dedication to initiate, structure, facilitate, and sustain the necessary communicative spaces for effective collaboration and decision making.

How realistic is it to expect that our approach can be implanted in political environment laden with ideology, geopolitical tensions, power abuse, and corruption? As much as we acknowledge that our two case illustrations might represent flagships for constructive and effective community involvement, we still feel that a community-based reform of hazard management is neither illusionary nor utopian. Okada, the main author of this article, has collected experiences and evidence from 30 communities in Japan over the last three decades (Okada 2018). He concluded that if people are motivated and empowered to eventually work out a SMART Governance approach and persistently work together, the impacts experienced by natural hazard-related and technological disasters were much less severe than in other communities without such programs.

7.2 Future Challenges and Research Needs

Looking ahead, future research on coping with polycrisis needs to be attentive to the paradigmatic distinction between universal patterns and unique, idiosyncratic patterns (Soler-Anguiano 2023). While systemic risks are often global, their manifestations and impacts are highly localized, influenced by social, political, and cultural contexts (Renn et al. 2022). An important element of these contextual conditions is the religious and spiritual traditions that shape community thinking and local sense-making, even in seemingly secularized modern societies.

Our approach operates under the assumption that evidence-based and systemic research can identify globally applicable categories and impact dimensions. However, the concrete experiences of impacts are shaped by local conditions, social and cultural traditions, and economic circumstances. Future research should aim to refine our approach by exploring these local nuances and their implications for systemic risk governance. We are aware that our recommendations refer to an ideal situation, but they are based on socially reconstructed experiences and ex post evidence-informed assessment. The framework of SMART Governance under

persistent disruptive stressors has been developed as a result of three-decade-long research efforts undertaken by Okada. Yet, there is more to be learned from empirical analysis and further case studies to investigate the conditions and barriers for our approach to be implemented.

One important methodological approach to managing diversity in systemic risk governance is to conduct multiple case studies or more accurately phrased, persistent case models. Persistent case models are investigations of enduring and typical patterns in different localities that allow cross-cultural comparisons. These studies could identify and analyze universal and unique patterns, investigating changes and contextual conditions across all five layers of the Pagoda model (Shi et al. 2011; Okada 2022b). This comprehensive approach includes examining natural conditions, which serve as both an objective backdrop and a social construct influenced by human perception and interaction.

Utilizing persistent case models as a basis for scientific inquiry necessitates inter- and transdisciplinary research concepts (Renn 2021). These concepts should be integrative, inclusive, and participatory, ensuring that diverse perspectives and expertise are incorporated into the research process. This holistic approach will provide a deeper understanding of systemic risks and more effective strategies for governance.

More research is needed on the process of social agenda setting in systemic risk governance. Key questions include: who sets the agenda? How can the agenda be self-propelled by the community rather than driven by external experts or political authorities? What degree of formalization is appropriate for this process? There have been some efforts to address these fundamental questions by developing new research perspectives for social implementation (for disaster reduction (for example, Okada et al. (2023)), but these are still limited to new ideas and preliminary considerations. Addressing these questions more deeply involves balancing top-down control and management with bottom-up self-governance, promoting co-determination and shared responsibility.

We hope that our approach for community-based risk governance will guide future research and help societies better prepare for and cope with polycrisis. Our goal is to design a process for preparedness and disaster response reforms that combine open discourse, mutual learning, and practical applicability. By fostering resilient communities, enhancing local coping capacities, and promoting inclusive and adaptive governance structures, we can mitigate the impacts of systemic risks and build a more sustainable and peaceful future. We are deeply convinced that, through collaborative efforts and innovative research, we can transform the challenges of systemic risks into opportunities for growth, resilience, and positive change. Through dedicated effort and shared vision, it is possible to achieve a more resilient and well-prepared society capable of navigating the complexities, uncertainties, and ambiguities of the modern world.

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