

Rethinking Sectoral Risk Assessment: Bridging Risk Governance and Resilience Engineering

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ABSTRACT

Public sector governance increasingly faces systemic risks that evolve across organisational boundaries, yet sectoral risk assessments remain largely event-focused and often duplicate overarching or underlying analyses. Through a participatory action research case in the City of Oslo, this study examines why such duplication occurs and how the lack of sector-adapted methodologies limits the use of sectoral risk assessment as a governance tool. The findings reveal a structural misalignment between vertically organised sector governance and horizontally evolving systemic risks, resulting in analytical duplication, fragmentation, and limited managerial use.

To address this gap, the study develops sector values, governability criteria, and operational excerpts centred on sectors' functional and governance capacities. By reframing sectoral risk analysis around sectoral governance and functional capacity, the study demonstrates how risk assessment can operate as a governance interface rather than merely as a documentation exercise within a multi-level, cross-sectoral governance system. Theoretically, the study bridges systemic risk, resilience engineering, and risk governance by operationalising these perspectives within sector-based public administration.

Keywords

Sectoral risk assessment, systemic risk, multi-level governance, risk governance, resilience engineering

INTRODUCTION

A cross-sectoral knowledge base on risks and vulnerabilities provides cities, as local authorities, with a comprehensive, systematic, and cross-sectoral picture necessary to prevent and manage undesirable incidents. To develop knowledge of risks and threats, analyses are conducted at all levels: a national approach, a sectoral approach at the ministry level, a regional approach at the County Governor level, and a local approach at the municipal level.

One area that has gradually developed and appears important for linking different risk and threat scenarios is sectoral risk assessment (sectorRA). The risk assessment from each sector together forms the basis for a cross-sectoral risk picture, while they should also break down this overall cross-sectoral risk picture and clarify what it means for each sector. A cross-sectoral risk picture is a comprehensive risk assessment developed and maintained at the national, regional, or municipal level.

The main challenge this article addresses is the methodological conflict between holistic risk assessments and sectorRA. Based on an analysis of emergency preparedness practice in Norway and the role of sectoral risk analysis, the article documents that sectorRA at the highest administrative level has not been methodologically developed as a knowledge or management basis for comprehensive, cross-sectoral work.

The City of Oslo is used as a research case because the municipality is also a county municipality, and because it follows a parliamentary governance model similar to the national level. The City of Oslo is organised into eight city government departments (sectors), which together include more than 60 underlying entities, such as agencies, districts, municipal undertakings, and other municipally owned enterprises. The City of Oslo's emergency preparedness system and organisation largely reflect the national level, including sectorRA requirements within the municipal emergency preparedness system. At the top of this system is the municipal risk assessment (MRA), on which sectorRA must be based.

Using Oslo as a case for sectorRA, rather than the ministry level, offers several methodological and practical advantages. First, the municipality's risk and vulnerability analyses at all levels, especially at the city level, are required by law (DSB, 2022). This provides access to city risk analyses, methodological choices, and priorities through municipal publications. At the ministry level, sectorRA comprises internal documents, mostly security-classified and exempt from public disclosure. Limited access to detailed ministerial risk assessments makes it difficult to assess cross-sectoral quality, compare methods, or reproduce analyses, thereby weakening transparency and verifiability.

The sectorRA perspective within a comprehensive emergency preparedness system, viewed through sectoral governance and management, has largely been underexplored in the literature. Several studies address or relate to cross-sectoral risk analysis and societal resilience but tend to focus on critical infrastructures and functions (Hollnagel, 2014; Schauer et al., 2020; Woods, 2018), digital resilience (Liu et al., 2023), or systemic risk in a global context (Liu & Renn, 2025).

This research seeks to help bridge the gap among systemic risk, resilience engineering, and sectoral risk analysis. Contributions from different disciplines and frameworks are integrated, including risk governance, resilience engineering, systemic risk, and institutional theory (Renn, 2008; Hollnagel, 2014; Woods, 2018; Liu & Renn, 2025; DiMaggio & Powell, 1983).

The research question addressed in this article is: *How can sectorRA be methodologically further developed to strengthen sectoral functional and governance capacities within a multi-level, cross-sectoral emergency management system characterised by systemic risks?*

The next section explains the concept of the sector as addressed in this article and how sectoral coordination, risk analysis, and decision-making are carried out at the sector level. A brief review of research on current perspectives and approaches to sectorRA follows this. We then present the methodological approach and the ongoing case study on which this research is based, before presenting preliminary results and discussion. The final section presents conclusions and implications.

SECTORAL APPROACHES

In the Norwegian governmental system, sector organisation is a pervasive principle at all administrative levels, particularly within parliamentary governance. At the national level, sectors are organised in ministries with governance lines to subordinate directorates and agencies. Municipalities with parliamentary governance follow a similar structure, with sector-based organisation and lines of governance to agencies and districts. A holistic cross-sectoral governance structure — linking political leadership and operational activities — is primarily found at the ministry and parliamentary municipal levels.

A sector can be defined as a delimited policy area under a political leader, such as a minister or city councillor, with support from senior administrative management. It represents the highest level in its management line and is responsible for policy formulation, administration, governance, and follow-up of subordinate entities (Oslo municipality, 2026).

In civil protection and emergency preparedness, sector responsibility is grounded in the principle of responsibility, a core organising principle in Norwegian preparedness. In normal situations, the organisation responsible retains responsibility during crises (DSB, 2022; Oslo municipality, 2025).

The sector thus functions as both risk owner and governance actor. While not all serious incidents are handled at the sector administrative level, the sector remains responsible for consequences, cross-sectoral coordination, and the maintenance of governance capacity under extraordinary circumstances. This defines the sector level's role in the Norwegian preparedness model.

SectorRA is central to sectoral risk and preparedness management. In a multi-level crisis management system comprising overall coordination, sector coordination, agency-level, and service-delivery levels, sectorRA becomes particularly important when sector coordination is activated (Oslo municipality, 2025). This occurs when incidents exceed the capacity of individual entities or affect multiple agencies simultaneously. The sector coordination level focuses on coordination, prioritisation, and support across agencies without assuming

operational command. SectorRA should therefore be understood primarily as a coordination and prioritisation tool, rather than a purely planning document.

CURRENT PERSPECTIVES AND APPROACHES FOR SECTORAL RISK ASSESSMENT

SectorRA is a pillar of Norwegian societal security work. At the national level, sector-specific assessments are conducted within ministries, while at the municipal level, risk and vulnerability analyses function as statutory management tools. Methodologically and normatively, many of these analyses are directly or indirectly inspired by the principles of ISO 31000 (ISO, 2018; Oslo municipality, 2025; Ministry of Justice and Public Security, 2017).

At the same time, sectorRA operates within a sector logic that assumes relatively stable system boundaries, identifiable events, and manageable cause-and-effect relationships. Recent research on systemic and compound risk increasingly challenges these assumptions. Studies of globally interconnected systems show how small disturbances can propagate through infrastructural and institutional networks and produce disproportionate consequences (Helbing, 2013; Pescaroli & Alexander, 2016). Risk governance in complex societal systems is characterised by uncertainty, non-linear dynamics, and interdependencies between actors (Renn, 2008). When sector coordination is activated, these challenges may intensify due to parallel decision-making processes and fragmented situational awareness, underscoring the importance of shared interpretation and institutional coordination in complex risk scenarios (Renn, 2008).

Furthermore, recent work highlights how simultaneous and mutually reinforcing crises, so-called polycrises, can undermine established governance structures and decision-making logics (Renn et al., 2025). Polycrisis requires analytical approaches capable of identifying interactions among crises and their systemic effects, and of linking systemic risk analysis more closely to governance and flexible decision-making structures. The concept extends the concept of systemic risk by emphasising governance challenges, societal consequences, and the need for methods that address dynamic systems and political decision-making under high uncertainty (Renn et al., 2025; Liu & Renn, 2025).

In parallel, resilience research has developed a functional perspective on security and risk management. In resilience engineering, safety is understood not as the absence of failure, but as a system's ability to adapt, absorb disturbances, and maintain function under pressure (Hollnagel, 2014). This perspective emphasises adaptive capacity, organisational learning, and the management of the unforeseen — dimensions only partly operationalised in traditional sectoral analyses. Recent research further highlights the need to integrate resilience into governance models, emphasising continuous learning, flexible structures, and systemic analysis rather than purely technical robustness (Provan et al., 2022; Woods, 2024; Renn et al., 2026).

The literature indicates three main developments: (1) systemic risk research increasingly focuses on complex, interdependent systems and cascading effects; (2) resilience research conceptualises safety as adaptive capacity and continuous adaptation; and (3) risk management research, including ISO 31000, emphasises institutional anchoring, management logic, and structured decision-making.

However, these three research tracks remain weakly integrated theoretically and methodologically. Systemic risk is often addressed at the macro level, resilience at the organisational or operational level, and ISO-based governance frameworks focus on process, accountability, and verifiability. Their integration into concrete public-sector contexts, such as sectorRA, remains underexplored in the literature.

Overall, the literature suggests a convergence in which systemic risk describes the phenomenon, polycrisis frames governance challenges, and resilience engineering offers operational strategies (Liu & Renn, 2025). Nevertheless, operationalisation within public risk management remains limited. Most studies remain conceptual or global, with limited application to sector-based risk assessment practices despite calls for new frameworks (Aven & Zio, 2021).

Taken together, this suggests that sectorRA is methodologically embedded in vertical administrative structures, while systemic risks emerge through horizontal interdependencies, creating a structural misalignment between governance logic and risk dynamics. This reflects a structural misalignment between vertically organised sector governance and horizontally evolving systemic risks, which forms the analytical starting point of this study.

The largest body of research concerns the analysis of critical infrastructure, particularly energy, transport, and digital systems. Network analysis, multi-hazard modelling, and criticality assessments are used as methodological parallels to sectorRA. Recent studies analyse infrastructural interdependencies and cascading failures, assessing resilience by the system's ability to maintain function (Saruniene et al., 2024; Gorthi, 2025).

Disaster research and systemic risk studies analyse how risk emerges through interconnected systems, policy failures, and complex societal interactions. Systemic disasters are characterised by high complexity, cross-border

effects and governance challenges, often linked to pandemics, climate change and economic shocks (Aitsi-Selmi et al., 2015). Much of the proto-polycrisis thinking is located here, but without sectorRA frameworks. SectorRA is grounded in administrative structures, whereas systemic risk analysis is grounded in functional interdependencies. The tension arises because governance is organised vertically, while risk manifests horizontally.

Renn argues for integrated, iterative, and adaptive governance processes for systemic risks such as pandemics and climate change (Renn et al., 2025; Renn et al., 2026). Although these models describe governance logics relevant to sectorRA, they have not been operationalised in national or municipal risk analysis methodologies. Governance literature emphasises cross-sectoral coordination, yet provides limited methodological tools for sectorRA, resulting in an implementation gap between theory and practice. The OECD (2022) offers governance frameworks, but few studies apply these to evaluate sectorRA models. A similar gap exists in the time dimension: resilience engineering assumes continuous analysis of adaptive capacity, whereas sectorRA is typically periodic.

Although interdependence is widely acknowledged, sector-based risk assessment systems remain largely event-based, sector-bound, and structurally static. Few empirical studies directly link systemic risk and resilience engineering to national or municipal risk and vulnerability frameworks. This suggests a methodological gap between theory and public practice. The gap does not reflect theoretical incompatibility, but rather institutional and methodological misalignment: the fields have developed in parallel rather than in an integrated manner. This may explain the absence of explicit links between systemic risk, governance, resilience engineering, and sectorRA in the literature.

METHODOLOGICAL APPROACH

The study focuses on knowledge development through practical problem-solving in complex management systems (Lewin, 1946; Reason and Bradbury, 2008; Coghlan & Brannick, 2014). The aim is not only to describe sectorRA, but to develop it further as a function and a governance-oriented analytical approach within multi-level and cross-sectoral emergency management systems characterised by systemic risks. The research design is based on Participatory Action Research (PAR) (Lewin, 1946).

The analytical framework applied in this study is based on an integrative approach to the knowledge base, combining insights from systemic risk, resilience engineering, risk governance and institutional theory. Relevant literature in these fields was identified through backward and forward searching in journals and books in the respective research fields, as well as through the work of highly cited authors in these fields.

These research perspectives were used as analytical lenses throughout the research process to interpret empirical observations and to identify tensions between sector-based governance structures and cross-sectoral risk dynamics. The use of these lenses supported the identification of a structural misalignment between vertically organised governance and horizontally evolving systemic risks, which informed the development of the proposed methodological approach.

Case Setting

The study is connected to the Oslo Emergency Preparedness Agency's (EPA) assignment to strengthen sectoral competence and coordinate sectoral RA. Representatives from eight sectors participated throughout the process: Health and care, Social services, Childhood and education, Environment and transport, Urban development, Culture and business, Finance, and the Mayor's Office. Participants included emergency preparedness managers and technical managers responsible for sector planning and follow-up of subordinate entities. The municipality operates under politically adopted emergency-preparedness regulations, with delegated authority across governance levels and within a coordinating sector. This provides a structured framework aligned with Norwegian preparedness principles of responsibility, proximity, equality, and cooperation (DSB, 2022). A tiered response system spans cross-sectoral, sectoral, and operational levels, providing a foundation for coordination of critical functions (Hollnagel, 2014; Folke et al., 2010).

The first author held a dual role as facilitator and analyst, consistent with action research methodology (Coghlan & Brannick, 2014). The case study provides insight into how sectorRA operates in practice under parliamentary governance, while aiming for analytical generalisation by identifying mechanisms and principles relevant beyond the case.

Oslo, as a large municipality with parliamentary governance, mirrors national governance structures at a smaller scale, with a city council and sector-based city government. This provides a "laboratory" for analysing sectoral governance, cross-sectoral coordination, and political decision-making within a complex administrative setting. The complexity of sectoral risk assessment in Oslo is comparable to that of ministry-level structures, as both

involve semi-autonomous units that must coordinate through policy networks and governance arrangements (Klijn & Koppenjan, 2000). Network governance becomes particularly relevant when risks cross sectoral boundaries, such as during floods or pandemics (Comfort et al., 2010). While situated in a local context, the case thus provides insight into broader sectorRA challenges.

Working within a municipal setting also enables proximity to practice, which is essential for action research and for developing, testing, and refining a unified sectorRA methodology that may later be adapted to more closed ministerial contexts.

Implementation of PAR

The PAR process was conducted in five phases over 11 months (2024–2025) and involved representatives from eight municipal sectors. Participants included emergency preparedness managers and sector-level coordinators responsible for planning, coordination and follow-up of subordinate entities.

Data were generated through multiple sources, including document analysis of existing sector risk assessments, observations and documentation from workshops, meeting notes, draft templates and iterative revisions of sectorRA frameworks.

The research followed iterative cycles of planning, action, reflection and revision. Each phase contributed to both problem identification and methodological development, allowing continuous refinement of analytical concepts and tools in collaboration with participating sectors.

All phases were documented through presentations, meeting minutes, working notes, drafts, and revised sectorRA templates, ensuring traceability between problem identification, interventions, and analytical conclusions.



Figure 1. PAR Process

Phase 1: Mapping Practice, Requirements, and Needs

The first phase established the empirical basis through:

- Document analysis of existing sectorRA
- Analysis of the municipal risk picture
- Review of governing documents
- Cross-sectoral conversations (individual and group) on practice and expectations

The document analysis followed a practice-oriented approach (Asdal & Reinertsen, 2022), focusing on units of analysis (consequence types), value categories, and implicit management logics. The analysis revealed the systematic use of municipal societal values without adaptation at the sector level and the repetition of scenario assessments. This phase identified the core problem: lack of level-specific differentiation.

Phase 2: Competence-enhancing Measures

This phase aimed to establish a shared knowledge base through a half-day seminar covering:

- Risk assessment methodology
- Links to the municipal risk picture
- Systemic risk
- Resilience engineering
- Critical societal functions
- Multi-level governance

Resilience and systems perspectives were used as analytical tools for reflection (Engeström, 2008; Folke et al., 2010) to identify tensions between societal and sectoral levels. This strengthened collective understanding and reflexive capacity.

Phase 3: Development of Methodological Framework

Phase 3 developed a sector-specific analytical method through iterative workshops addressing:

- Differentiation between societal and sectoral values
- Sector values as analytical core
- Scales and criteria for impact assessment
- Criteria clarifying sector roles across the crisis management chain (prevention, contingency planning, management, normalisation)

The sector's responsibility, influence, and performance assessment tools were clarified to avoid analyses becoming either too broad (at the societal level) or too operational (at the enterprise level). The work followed the action research cycle (plan–action–reflection–revision), with drafts continuously tested and revised.

The key step was shifting the impact assessment from a general societal perspective to a focused sectoral functional and governance capacity, clarifying sector roles across incident types.

This phase constitutes the study's methodological innovation: adapting societal values to the sectoral level, with an emphasis on sector governance and functional capacity to support underlying entities, an area not previously operationalised in the literature.

Phase 4: Piloting and Application

The revised methodology was piloted in selected sectors:

- The health sector implemented the new sectorRA method in 2024
- Template adjustments based on pilot experience
- Environment and transport sector in 2025
- Systematic comparison with previous analyses
- Ongoing implementation in remaining sectors

An analytical contrast was used to compare the old and new analyses, focusing on changes in units of analysis and in management relevance. Joint reviews of pilot experiences assessing strengths, weaknesses, and implementation challenges were conducted with all sectors.

Phase 5: Analytical Synthesis and Theoretical Interpretation (ongoing)

The final phase lifts findings from practice to theory through:

- Cross-cutting thematic analysis
- Coding of patterns related to level, unit of analysis, and management logic
- Theoretical interpretation drawing on risk governance, institutional theory, resilience, and multi-level governance

Preliminary analysis includes the systematisation of documentation, the identification of recurring structures, and theoretical triangulation.

Transferability is assessed analytically. While context-dependent, the identified mechanisms — particularly level shift and analytical duplication — are relevant for other multi-level governance systems. Resilience and systems perspectives provide theoretical anchoring (Engeström, 2008; Folke et al., 2010).

The overall analytical approach consisted of interpreting empirical material across the different phases of the PAR process. Patterns were identified through comparison of existing sector analyses, workshop discussions, and pilot implementations. Attention was given to how analysis, value categories and management logics were applied at different governance levels. The development of sector values emerged from this iterative analysis, in which recurring challenges related to level misalignment, analytical duplication, and limited management relevance were identified and translated into a governance- and function-oriented analytical framework.

FINDINGS AND DISCUSSION

This research examines how sectorRA can be further developed as a function- and governance-oriented approach within a multi-level and cross-sectoral emergency management system characterised by systemic risks. The Oslo case, with its parliamentary governance model, provides a strong empirical setting in which delegated authority, political anchoring, and a tiered preparedness system create favourable structural conditions for implementing sectorRA.

Overall, the findings show that the size and scope of municipal sectors influence how sectorRA is understood and

practiced. While approaches differ, there was broad agreement across sectors on the need for a shared methodological framework to strengthen cross-sectoral collaboration.

Fragmentation and Lack of Methodological Consistency

The sectors demonstrate considerable variation in experience and understanding of sectorRA, including its relationship to MRA and subordinate entities. Although MRA serves as a formal reference point, methodological approaches vary widely. In practice, sectors often duplicate event analyses from underlying enterprises or overarching assessments rather than developing sector-specific analytical perspectives.

In one sector, different subordinate entities conducted their own risk assessments using varying assumptions and categories, resulting in inconsistent risk pictures within the same sector. During cross-sector workshops, participants highlighted difficulties in comparing and prioritising risks across these analyses, citing a lack of a shared analytical structure. This fragmentation can be understood to reflect characteristics of systemic risk in interconnected systems, where interdependencies between actors and functions create coordination challenges and increase vulnerability to cascading effects (Renn, 2008; Helbing, 2013).

This fragmentation can also be interpreted through Engeström's (1987, 2008) activity theory, in which unclear goals and overlapping activity systems generate inefficiencies and "system knots." Similar dynamics are highlighted in systemic risk and polycrisis literature (Aitsi-Selmi et al., 2023; Liu & Renn, 2025), reflecting differences in management logic, professional norms, time horizons, and risk perceptions across administrative and operational levels (Acemoglu & Tahbaz-Salehi, 2015; Helbing, 2013).

The PAR Phase 1 mapping indicates that sectorRA often functions as a fragmented, document-oriented exercise with a limited role as a governance, learning, or development tool. This suggests a gap between formal risk analysis and adaptive operational practice (Woods, 2020; Renn et al., 2026).

Systemic risk research shows how a lack of coordination in interconnected systems can amplify vulnerabilities through cascading effects (Acemoglu & Tahbaz-Salehi, 2015; Helbing, 2019). Fragmented sectorRA practices may reduce the capacity to identify and manage cascading risks and polycrisis dynamics (Liu & Renn, 2025; Renn et al., 2025). These findings underscore the need for a methodology that more directly links risk analysis to sectoral functional and governance capacities, clarifying responsibilities, dependencies, and priorities across levels (Ostrom, 2010; Aven & Zio, 2021).

Duplication of Event Analysis

The study documents duplication between the MRA and sectorRA. Empirical data show that sectors either (1) used societal values from the MRA as a direct frame of reference, (2) built on analyses from subordinate entities using the same values, or (3) adopted the MRA framework in its entirety. Across these approaches, level adaptation was largely absent. Consequently, sectorRA often reproduced a societal risk perspective, such as MRA, rather than developing a sector-specific risk picture.

For example, in several sectors, scenario-based assessments from the MRA were reproduced with limited modification. In workshop discussions, participants noted that existing templates encouraged alignment with the municipal framework but offered little guidance on translating this into sector-specific responsibilities or management actions.

This finding and pattern can be interpreted through the lens of institutional isomorphism, multi-level governance, and sectorisation in public administration. DiMaggio and Powell (1983) explain how organisations tend towards structural and methodological similarity to maintain legitimacy. As the MRA is politically anchored and aligned with established risk governance frameworks (DSB, 2022), sectors may adopt its societal values and scenario structures to appear methodologically consistent and administratively correct. Duplication may therefore reflect normative isomorphism, adherence to perceived professional standards, or mimetic isomorphism (DiMaggio & Powell, 1973) arising from uncertainty and reliance on established practice, as sectors find it easier to adopt established analytical structures to maintain legitimacy, resulting in analytical similarity rather than level-specific differentiation. Analyses become vertically harmonised but lack functional translation into sector-specific responsibilities and management objectives, resulting in analytical similarity rather than differentiation.

This dynamic aligns with Power's (2007) concept of the ritualisation of risk management, in which analysis fulfils documentation requirements but offers limited new managerial insight. Multi-level governance theory emphasises that analytical tools must align with the mandate and decision context of each governance level (Panke & Stapel, 2024). While the MRA assesses broad societal consequences such as life, health, and social stability (DSB, 2022), sectorRA has a different purpose: analysing risks to sectoral objectives, regulatory responsibilities, and organisational capacity at the sector level.

Following Asdal and Reinertsen (2022), documents not only describe reality but shape problem understanding through their categories and frameworks. When sectors adopt municipal societal values, they also reproduce the municipality's problem framing, replacing analytical autonomy with documentary continuity.

The sector principle in Norwegian public administration reinforces clearly defined responsibilities but can also create professional silos and coordination challenges in complex risk contexts (Christensen et al., 2016). In the absence of clear methodological guidance for sectorRA, sectors revert to established frameworks. This suggests limited vertical translation between governance levels and an unclear definition of sectorRA as a distinct analytical layer. Variation between sectors further complicates cross-sectoral coordination and co-governance.

Where analyses from subordinate entities formed the basis, sectorRA tended to become operational rather than strategic. This reflects the distinction between strategic and operational risk (Renn, 2008; Power, 2007). The concept of "system knots" highlights how overlapping activity systems generate tensions that hinder coordination (Engeström, 2008). In this context, duplication reduces adaptive capacity and limits responses to systemic risks (Folke et al., 2010; Woods, 2018).

Overall, duplication appears less as a methodological weakness than a lack of analytical translation between governance levels. What is missing is an explicit articulation of the sector's own risk logic.

Lack of Active Use of SectorRA as a Management and Knowledge Base

A central finding is that sectorRA was rarely used as an active management tool, whether in steering subordinate entities, internal planning, or crisis management. Participants also reported that sectorRA was rarely used during exercises or real incidents. In one discussion, several sector representatives described how existing analyses were perceived as too general and not directly applicable for coordination or decision-making during time-critical situations.

This aligns with Coghlan and Brannick (2014), who emphasise that co-creation requires active engagement for knowledge to become operational. The PAR process demonstrated that competence-building — particularly regarding systemic risk, multi-level governance, and resilience engineering — was necessary to establish a shared conceptual framework and clarify sector roles. The limited use of sectorRA as a management tool reflects a gap between formal risk governance structures and adaptive capacity, as highlighted in resilience engineering, where effective management depends on integrating analysis into operational decision-making (Hollnagel, 2014; Woods, 2018).

Need for Governance- and Function-oriented SectorRA

Sector representatives expressed a clear need for a methodology that strengthens sectoral governance and functional capacity while remaining operationally relevant during crises. This need was articulated in three areas:

1. **Governance and functional capacity:** A framework clarifying responsibilities, priorities, and resource control, strengthening adaptive capacity under systemic risk.
2. **Sector coordination during crises:** Linking risk analysis to coordination mechanisms, identifying cross-sectoral dependencies, and providing actionable decision support.
3. **Co-management and holistic risk understanding:** Identifying contradictions and "system knots", reducing brittleness and enabling graceful extensibility in complex systems (Woods, 2018).

These needs reflect the absence of methodological approaches that integrate administrative and operational perspectives in managing systemic risks and polycrisis within multi-level governance systems (Liu & Renn, 2025).

Development and Significance of Sector Values

A core contribution of the study is the development of sector values as an analytical and normative foundation for sectorRA. The development of sector values was driven by the identified misalignment between vertically organised sector governance and horizontally evolving systemic risks. The empirical findings showed that existing sectorRA tended to reproduce either overarching societal perspectives or operational-level analyses, without translating these into sector-specific governance and functional capacities. To address this gap, there was a need for an analytical framework that could capture the sector's role as both a governance actor and a risk owner within a multi-level system. Sector values were therefore developed to operationalise this level-specific perspective, focusing on the sector's ability to manage, coordinate and sustain functions under conditions of systemic risk.

Sector values operationalise a function- and governance-oriented perspective through five interrelated dimensions: governability, co-governance, sector stability, collaboration, and capacity for continuity and

communication.

1. **Governability:** Criteria for assessing the sector's ability to prioritise and control resources under systemic risk, aligned with resilience engineering principles (Hollnagel, 2014; Woods, 2018).
2. **Co-governance:** Clarification of cross-sectoral dependencies and priorities, reflecting polycentric governance approaches (Ostrom, 2010) and systemic risk perspectives (Aitsi-Selmi et al., 2023).
3. **Sector stability:** Assessment of the ability to maintain critical functions under stress, consistent with operational resilience concepts (Gorthi, 2025).
4. **Internal and external collaboration:** Strengthening coordination across organisational boundaries to reduce cascading effects and polycrisis vulnerabilities (Pescaroli and Alexander, 2016, 2018; Helbing, 2013).
5. **Continuity and communication capacity:** Emphasising communication as a prerequisite for governance and functional performance during complex incidents (Woods, 2024; Renn et al., 2026).

The concept of sector values is theoretically informed by resilience engineering, which emphasises adaptive capacity and functional performance (Hollnagel, 2014; Woods, 2018), and by risk governance perspectives that highlight the importance of coordination and decision-making across organisational boundaries (Renn, 2008). In addition, insights from multi-level governance and institutional theory informed the need to distinguish analytical levels and avoid duplication across governance structures. The sector values were developed iteratively through the PAR process. Initial versions emerged from workshop discussions and the mapping of existing practices, during which recurring challenges related to duplication, unclear responsibilities, and limited management relevance were identified. These were progressively refined through testing in pilot sectors, feedback from participants and adjustments of analytical templates. During the research period, sector values were also tested as operational excerpts to be used in a central crisis management exercise to present sectoral status.

Integrating these values shifts sectorRA from an event-based approach towards a function- and governance-oriented practice, strengthening both management relevance and alignment with resilience and systems perspectives (Folke et al., 2010; Ganin et al., 2016; Hollnagel et al., 2011). In this sense, sector values represent a shift from event-based risk descriptions towards an assessment of governance and functional capacity at the sector level.

Taken together, these findings and discussions illustrate how sectorRA practices are shaped by governance structures, institutional norms and analytical conventions. The theoretical frameworks applied in this study served distinct but complementary roles. Systemic risk provides a lens for understanding the interconnected and cross-sectoral nature of contemporary risk landscapes, including cascading effects and interdependencies. Resilience engineering offers a functional perspective, focusing on sectors' capacity to adapt, coordinate, and maintain critical functions under pressure. Risk governance, in turn, frames the organisational and decision-making context, highlighting how responsibilities, coordination mechanisms, and institutional structures shape how risk is analysed and managed. Together, these perspectives enable an integrated understanding of sectorRA, not only as a technical risk assessment method but also as a governance tool situated within complex, multi-level systems.

LIMITATIONS

The work to establish sectorRA as a distinct analytical level with its own methodology remains ongoing. This study has been conducted within a comprehensive emergency preparedness system where an overarching municipal risk assessment (MRA) provides the structural foundation for sectorRA. Such conditions may differ across national levels or in other municipalities, where governance structures and coordination mechanisms vary.

The study aims for analytical generalisation by identifying mechanisms such as level misalignment and analytical duplication, which are relevant for other multi-level governance systems. While the Oslo case provides a structurally comparable setting, the applicability of the approach depends on contextual factors and requires further testing in other cases.

CONCLUSION

The study shows that sectorRA can be transformed from an event-based risk analysis into a function- and governance-oriented management tool. Using sector values as operational excerpts from sectorRA in a crisis management exercise confirmed added value to co-governance, adaptive learning, and robust decision-making.

The Oslo case demonstrates how political anchoring and a tiered governance structure can support implementation while offering insights transferable to similar governance contexts. The findings point to a structural misalignment

between governance structures and systemic risk dynamics and indicate that sectorRA has the potential to evolve into a living management tool that strengthens functional and governance capacity and contributes to systemic resilience in public risk management. Further evaluation is required to assess the strengths and weaknesses of the developed framework and to refine methodological design, templates, and supporting guidance.

This study contributes both theoretically and practically. Theoretically, it identifies a structural misalignment between vertically organised sector governance and horizontally evolving systemic risks. It shows how this misalignment manifests in analytical duplication, fragmentation, and limited use of sectorRA by management. By introducing sector values as an analytical core, the study operationalises system and resilience perspectives within a governance-oriented risk assessment framework. In practice, the study provides a methodology that shifts sectorRA from event-based documentation to a function- and governance-oriented tool that supports coordination, prioritisation, and adaptive learning in multi-level emergency management systems. The findings illustrate how sectorRA can serve as an interface between systemic risk analysis and sector-based governance practices.

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