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1 Introduction

This working paper, part of the OECD Horizontal Foresight Initiative on Anticipating and Managing Emerging Global Transformations, reviews the findings of a pilot online mapping exercise of emerging risks conducted by the OECD High-Level Risk Forum (HLRF). The exercise sought to identify emerging risks requiring countries' vigilance, and to assess the confidence and capacities of government risk experts to understand and manage them. This paper provides an overview of the approach, the key terms used, the identified risks, and the analytical findings. It draws on the main lessons learned to present principles for a rigorous, effective, and repeatable process that governments could consider using as part of the OECD Framework on the Management of Emerging Critical and Existential Risks.

The paper goes through the following stages of analysis:

1. An exploration of the risks identified in the online pilot exercise, the main themes raised, and how these risks might be characterised. Thirteen risks were identified, including primarily social and environmental issues but also potential economic disruptions and conflict. Results overall demonstrated extensive interaction among the respondents, highlighting the value of dialogue in filling gaps and obtaining diverse perspectives.
2. A comparison with other sources that sought to identify risks that might be considered emerging, critical, or global. This comparison revealed consensus on climate-driven disruptions, resource scarcity, and geopolitical instability. However, risks tied to technological threats such as cyberwar, digital rights, and hazards related to artificial intelligence (AI) are highlighted as absent from the OECD shortlist.
3. An overview of the role AI played in the process. A large-language model (LLM) was used to synthesise a list of 10 additional risks, which focussed on technological factors such as deepfakes and virtual reality worsening political polarisation.
4. A comparison of the results with a selection of other studies with similar objectives, which revealed consensus on the importance of the three main themes from the pilot exercise: environment and green transition; strengthening democracy; and digital transformation.
5. A discussion of the benefits and potential limitations of various methods. This discussion identified three main priorities for future action:
    - **Ongoing mapping** (not just a one-off exercise) to identify and monitor emerging risk.
    - **Anticipation** in addition to historical evidence.
    - **Diversified mapping** using alternative perspectives and multiple methods can broaden and sharpen the field of vision in which emerging risks are identified and monitored in a comprehensive manner.

2 Mapping moving terrain

Navigating the complexities of emerging critical risks requires approaches and tools that adapt to constant change. Prior OECD work, notably the report "Emerging Systemic Risks in the 21st Century" (OECD, 2003), the OECD Recommendation of the Council on the Governance of Critical Risks (OECD, 2014), and the OECD Framework on Anticipating and Managing Emerging Critical Risk (OECD, 2024) serve as a guiding force, providing an analytical basis for the uncertainties and challenges of risks that are expanding, evolving, or entirely novel.

This section builds on that guidance to identify key characteristics of emerging critical risk of importance to mapping them. The terms emerging, critical, systemic, and existential are dissected. Through exploring **outliers**, **emergence**, **perception**, **context**, and **values**, the course is set for an in-depth analysis of the mapping of emerging critical risk.

Emerging risk

Drawing on previous definitions:

> *The emerging dimension of systemic risks is shaped by the view to the future. A multitude of trends, developments, driving forces and obstacles are at work which will affect in important ways the nature of risks and the context in which they are managed. Thus, factors influencing the evolution of hazards and the vulnerability of systems over the next ten to fifteen years (and in some cases longer) are of great significance. But so too are factors that might modify the propagation of damage, or that affect the likely responses of institutions and the perceptions of the public (OECD, 2003)*

Emerging risks as defined in the OECD Framework on Management of Emerging Critical Risks are:

> *Either new risks or familiar risks that are evolving due to new or unfamiliar conditions*

These risks lack historical precedent and can be a specific threat or a condition ripe for exploitation. Emerging risks stand in contrast to "familiar risks" which are defined here as "risks with historical precedent and/or a deep knowledge base, for which authorities and capabilities already exist."

Critical risk

Under the OECD Recommendation of the Council on the Governance of Critical Risks (OECD/LEGAL/0405), critical risks are defined as

> *Threats and hazards that pose the most strategically significant risk, as a result of (i) their probability or likelihood and of (ii) the national significance of their disruptive consequences, including sudden onset events (e.g. earthquakes, industrial accidents, terrorist attacks), gradual onset events (e.g. pandemics), and steady-state risks (notably those related to illicit trade or organised crime)*

Emerging critical risk

From the draft OECD Framework on Anticipating and Managing Emerging Critical Risk, emerging risks have the following key characteristics:

- **Expanding**: These risks are familiar but growing in frequency or scale. Countries have existing capabilities and management practices; however, because of new or unfamiliar conditions or changes in the threat, exposure, or vulnerability environment these incidents are becoming more frequent and/or imposing greater consequences.
- **Evolving**: These risks are familiar but changing in a way that requires updated management strategies. Both expanding and evolving risks appear as risks that have been managed before; however, unlike expanding risks, where historical management strategies remain effective, evolving risks require new management tools.
- **Novel**: These risks are unfamiliar and require the development of novel management strategies. Novel risks have never been encountered—and in some cases, have never been seriously contemplated—before. These risks can typically be driven by drastic shifts in society, technology, climate, or geopolitics.

Central concepts to the definition of emerging critical risk include:

- **Unquantifiability**: Without historical precedent, data are insufficient to attribute probability to emerging critical risks based on past frequency. Only subjective probability estimates based on understanding of emerging risks may be possible.
- **Outlier status**: Emerging critical risks can be seen as outliers in the risk landscape due to their novel and unexpected nature, deviating from established risks. They are unpredictable and rare, requiring proactive identification and mitigation. Learning from these outliers can lead to improved risk management strategies to navigate uncertainty and potential disruptions. Related to the term is the concept of **weak signals**—small, uncertain, or under-documented changes with the potential to evolve into larger disruptions.
- **Perception**: Risks may not be widely recognised or fully understood by all stakeholders due to unfamiliarity.
- **Context**: Risks expand, evolve, or arise within specific contextual factors, such as technological advancements, geopolitical shifts, environmental changes, or socio-economic trends, which require a deep understanding of causal layers (Inayatullah, 2004) for accurate assessment and response.
- **Values**: Risk management reflects subjective judgments about the importance, ethics, and societal impact of risks, influencing how societies prioritise and respond to emerging risks, beyond purely quantitative risk assessment.

3 The identified emerging risks

This section synthesises candidates for emerging risks resulting from the pilot online exercise conducted for the OECD High-Level Risk Forum (HLRF) in October and November 2022. The risks receiving the most votes and the most discussed are highlighted and the findings are compared with emerging critical risks identified in other sources.

From the pilot online exercise

Reflecting the experimental nature of the pilot exercise, this section of the paper presents an overview of the findings sufficient to draw lessons and point to avenues for further development. For a detailed account of the methods and results, readers can refer to Annex B, “Findings of the Emerging Critical Risks Brainstorm”.

In the pilot exercise, 30 participants from 20 countries identified key emerging risks and assessed the government confidence and capabilities in addressing them. The study was structured in two stages:

1. Initial Identification and Voting: Participants were presented with an initial list of socio-environmental, socio-political, and socio-technological emerging critical risks. They were asked to vote on which risks should be on the governments’ radar.. Respondents were also invited to add their own proposals for emerging critical risks that did not figure in the list but were, in their understanding and expertise, important.
2. Shortlisting and Assessment: Based on the votes, 13 were selected, and respondents assessed these shortlisted risks in terms of their impact, scope, country capacity, likelihood to occur in the next five years, and level of confidence in their assessment.

Risks identified and overall findings

The risks identified (in no particular order) were:

- Extreme and sustained heatwaves
- Disinformation and social polarisation
- Limits on drinking water due to acute scarcity
- Vector-borne diseases affecting new areas
- Raw materials scarcity impact infrastructure restoration
- Climate change impacts drive mass population displacements
- Strategic and regional tension
- System-wide impact of forest fires
- Release of hazardous materials in armed conflict settings
- Large scale conflict-induced displacement
- Disruption of the global and regional food supply chain
- Energy vulnerability and financial destabilisation
- Political, social, and economic destabilisation arising from hybrid threats

Box: Terms used in risk mapping surveys

The pilot exercise used risk management terms which occur in other similar surveys:

Probability: Measures the chance of a risk event happening within a specified future timeframe, rated on a scale from "exceptionally unlikely" to "virtually certain." It aids in risk prioritisation and management.

Impact: Assesses the potential severity and duration of consequences from an emerging risk. This evaluation informs preparation and mitigation strategies to address the anticipated adverse effects.

Confidence: Denotes the level of certainty in evaluating an emerging risk's likelihood and effects, influenced by expert agreement and evidence quality. Higher confidence enhances the reliability of risk assessments for informed decision-making.

Capacity: Measures the readiness of entities to handle emerging risks, assessing preparedness, resources, and mechanisms available. It identifies system strengths and weaknesses, informing enhanced resilience and response planning.

The overall experience of conducting the exercise demonstrated extensive interaction among respondents, highlighting the value of dialogue in bridging knowledge gaps and incorporating diverse perspectives.

There is a growing perception of a convergence between human-induced threats and natural hazards. This implies that the traditional boundaries separating these categories are becoming less distinct due to various factors such as technological advancements, environmental changes, or societal dynamics. For example, climate change, driven by human activity, may lead to increased frequency and severity of extreme weather events, which in turn may lead to greater loss and damage because of larger coastal populations. This convergence underscores the complexity and interconnectedness of risks, requiring a more holistic and integrated approach to risk management and response.

Themes

Almost half of the risks shortlisted during the first stage (e.g., risks garnering 14 votes or more), were related to socio-environmental issues such as extreme temperatures and heatwaves, drinking water scarcity, vector-borne diseases affecting new areas, climate change induced mass displacements, and the impact of droughts on vital and critical services and systems. There was consensus among participating countries that risks arising from climate change are of significant concern. The difficulty in predicting some of these risks and their growing impact in all regions led to a strong consensus on their criticality. Participants highlighted impacts from climate change go beyond the environment with more far-reaching effects on the population and society. The second-most voted risk pertained to the threat of disinformation and social polarisation. The results of the first stage show the impact and threat of climate change as perceived by the experts, not only on the environment but with more far-reaching effects on the population and society.

A further discussion of the main themes identified follows in the section on categorisation and comparison.

Impact and probability

Risks assessed as high in both impact and probability were generally given lower confidence and capacity assessments. This highlights the need for countries to strengthen their capacities, resources, and strategies to effectively anticipate and manage high-impact risks such as disinformation and social polarisation, extreme and sustained heatwaves, energy vulnerability and financial destabilisation, and strategic and regional tensions. On the other hand, risks with fewer votes tended to be assessed as having

similarly high probabilities, but lower impact. These risks were assessed as being more restrained in scale and duration (local and short term). Examples of these risks included limits on drinking water, forest fires and the release of hazardous materials in armed conflicts.

Confidence

Some emerging critical risks are not entirely new but result from changing circumstances such as technological advances or evolving contexts, which amplify their potential impact and urgency or these risks. Respondents had low confidence in their assessments of these types of risks, underlining the dynamic nature of emerging risks and the need to adapt existing strategies and approaches to address their evolving manifestations effectively.

The absence of consensus regarding the severity, likelihood or impacts of critical risks can also point to knowledge gaps. Consensus among respondents was lacking for risks such as out-of-control cyber-attacks, release of hazardous material during armed conflict, and rejection of government communication. These findings highlight the areas where further research, discussion and collaboration are needed.

Capacity

Countries assessed their capacities for dealing with chronic challenges to supply chains as stronger than their capacities to handle acute disruptions. This suggests that while countries have developed better practices, methods, and tools to mitigate long-term challenges in supply chains or resource availability, there is a need to strengthen capacities to effectively respond to sudden and short-term disruptions, and pivot production needs accordingly.

Countries were found to have relatively strong capacities to handle acute surges in displaced populations, indicating preparedness for immediate responses to humanitarian crises. However, the findings suggest that countries may face challenges in managing and responding to chronic increases in displaced populations. This highlights the need for long-term strategies, policies and resources to address sustained or ongoing displacement situations effectively.

Enhancements to the survey using AI

In addition to the human inputs, the survey tool used offered the possibility to suggest additional risks using generative AI language models.

Generative AI language models analyse and synthesise existing information to generate human-like text. They learn from a vast amount of reading material, which helps train them to mimic the way humans write and speak (OECD, 2023). These models can be used to help anticipate emerging critical risks by scanning through large volumes of data, discussions, and reports available online to inform generated outputs in response to prompts provided by humans.

When asked to simulate a risk mapping exercise with similar parameters to the online pilot described above, the AI tool generated the following suggestions:

- **AI-Generated Hyperrealistic Videos**: AI creates ultra-realistic videos, enabling high-impact disinformation.
- **Augmented Reality Misinformation**: AR is used to distort information in physical spaces, reinforcing biases.
- **Deepfake Political Figures**: Convincing deepfakes of leaders disrupt trust and democratic integrity.
- **Advanced Disinformation Bots**: AI chatbots spread tailored disinformation, widening social divides.

- **Virtual Reality Echo Chambers**: VR experiences trap users in belief-reinforcing environments.
- **Deepfake Epidemic**: Rampant deepfakes undermine societal trust and consensus on reality.
- **Rise of AI-Powered Disinformation Bots**: AI bots on social media drive persuasive false narratives.
- **Disinformation Wars between Nations**: State-led disinformation campaigns exploit and intensify societal fractures.
- **Disinformation as Political Control**: Targeted false narratives by regimes suppress dissent and widen gaps.
- **Counter-Disinformation Communities**: Movements fighting disinformation inadvertently fuel further divisions.

Further discussion of generative AI and its potential benefits and limitations in anticipating and managing emerging critical risk is presented in the next section of this paper.

From other sources

Another source is existing research, including desk research and other surveys. There are numerous studies into risk, but fewer deal with emerging risk. This paper considers four sources; this list is merely indicative for the purpose of complementing the analysis of the OECD pilot online brainstorm; it should not be considered exhaustive.

- **WEF** Global Risks (WEF, 2023): an analysis of present known risks, combined with horizon scanning and megatrends analysis to derive sources and examples of emerging risks
- **Economist Intelligence Unit** Top Global Risk Scenarios (Economist Intelligence, 2023): an overview of 10 emerging risks at the global scale across four major domains: political, military, economic, and environmental
- **European Parliamentary Research Service** Future Shocks 2030: an example of work by another international organisation identifying potential future risks, not just those present today
- **OECD** Risks that Matter Survey (OECD, 2021a): another perception survey, but of members of the public, asking what potential future risks concern them
- **United Nations Office for Disaster Risk Reduction**: an investigation of what could cause global and existential catastrophe, what set of events and processes would lead to such worst-case scenarios, and what the implications are for risk research and governance.

A full list of risks identified in these studies is presented in Annex A of this paper, roughly categorised into main themes identified by the United Nations Office for Disaster Risk Reduction (UNDRR, 2023).

Categorisation and comparison

Table 1 categorises the risks identified in the OECD pilot online exercise and other sources according to three main areas:

1. **Environment and green transition**
2. **Strengthening democracy**
3. **Digital transformation**

In bold are the risks that are potentially global in nature.

The OECD pilot online exercise captures a broad array of risks focused on environmental, geopolitical, and societal factors, with a particular emphasis on climate-driven disruptions, resource scarcity, and geopolitical instability. However, the exercise seems to lack consideration of certain emerging risks

identified by other sources, such as biodiversity loss, antimicrobial resistance, and the transformative potential of AI. Additionally, risks tied to technological threats like cyberwar, digital rights, and hazards related to the Internet of Things are absent from the OECD shortlist. This suggests the OECD exercise may have been more focused on immediate, tangible risks and less on longer-term or systemic changes, especially in technology, ecology, and societal shifts.

Table 1 Categorised risks from pilot online exercise

Risk category	Identified in the OECD pilot online exercise	Identified only in other sources
Environment and green transition	**Extreme and sustained heatwaves** Limits on drinking water due to acute scarcity **Climate change impacts drive mass population displacements** **System-wide impact of persisting forest fires** **Disruption of the global and regional food supply chain**	**Climate action hiatus (WEF)** **Natural ecosystems past the point of no return (WEF)** **Biodiversity loss or collapse (EPRS)** **Antimicrobial resistance (EPRS and UNDRR)** **Volcanic gases and aerosols (UNDRR)** **Harmful algal blooms (UNDRR)**
Strengthening democracy	Disinformation and social polarisation **Strategic and regional tension**	**Human security: new weapons, new conflicts (Including hybrid threats) (WEF)** **Strategic and systemic threats to the democratic information sphere (EPRS)** Decline in mental health and societal well-being in young people (potential impact on civic engagement and societal trust) (EPRS) Lack of confidence in government (RTM, UNDRR) Discontent with public services (RTM)
Digital transformation	Political, social, and economic destabilisation arising from hybrid threats	Digital rights: privacy in peril (WEF) **Cyberwar (EIU)** Instability stemming from the financial technology sector (EPRS) Hazards related to the Internet of Things (UNDRR) **AI as a transformative process (UNDRR)**
Other	Raw materials scarcity impact infrastructure restoration Vector-borne diseases affecting new areas Release of hazardous materials in armed conflict **Large scale conflict-induced displacement** Energy vulnerability and financial destabilisation	Cost-of-living crisis (WEF) **Economic stability: global debt distress (WEF)** **Deteriorating ties between major powers (EIU)** **Financial sector contagion triggers global recession (EIU)** **Economic warfare (WEF)** **New, highly aggressive infectious disease emerges (EIU, UNDRR)** **Nuclear agents and nuclear winter (UNDRR)**

4 Discussion

This section explores various aspects of the pilot mapping exercise described above. The section evaluates various approaches, and presents principles for an anticipatory, diversified mapping to ensure relevance, effectiveness, and legitimacy in identifying and managing emerging critical risk.

The approach of a pilot exercise like the one discussed has considerable advantages over a full-scale study that seeks definitive answers. The iterative and modifiable nature of a pilot exercise ensures constant review and refinement, which aligns with the constantly evolving and fluid nature of emerging risks. As fresh data and insights emerge, research can be swiftly adapted to proficiently address the changing landscape of risks. A continuous cycle of learning and adaptation ensures that the methodologies for managing emerging risks are always relevant, timely, and efficient. In essence, a pilot exercise reflects the dynamism of emerging risks. This adaptability is not just a characteristic but a necessity when dealing with emerging risks, marking pilot exercises as an indispensable asset in this field.

However, it is also important to set reasonable standards for evaluating a pilot exercise. Given its experimental nature, a pilot is inherently limited in scope and scale, meaning that the results and findings may not be entirely representative of what will occur during full-scale implementation. It is not a definitive analytical product but a learning process to gather insights and identify areas for improvement.

What follows then is not a retrospective critique of the pilot online exercise, but a set of insights gained from it, which lay the foundation for subsequent mapping exercises, should they be proposed.

Benefits and potential limitations of surveys

This section looks at benefits and potential limitations of survey-based methods of identifying and anticipating emerging risk.

Benefits of surveys

Conducting an international survey among government experts can offer several advantages in identifying emerging risks:

- **Broad coverage**: A survey with findings from multiple studies and scientific forecasting literature helps ensure comprehensive coverage of research on emerging risks from various sources and disciplines.
- **Diverse perspectives**: Government experts from different countries bring diverse knowledge and experiences, enabling a broader understanding of potential risks. They may be exposed to different geopolitical, economic, and environmental contexts, leading to a more comprehensive identification of emerging risks.
- **Clarified terms**: By exchanging on different concepts and their connection with the real world, discrepancies in definitions and delineations of different terms can be identified and addressed.
- **Transnational coverage**: An international survey can encompass a wide geographical area, allowing for the identification of risks that have cross-border implications or are transnational in nature.

- **Specialised knowledge**: Government experts often possess specialised knowledge about their respective domains. A risk that is familiar to one expert may be emerging to another.
- **Mutual learning and knowledge-sharing**: The process itself of conducting a survey fosters collaborative and critical thinking among experts, promoting the exchange of knowledge and best practices in risk assessment and management. This allows for reflection, redirection, and innovation for policy action.
- **Policy relevance**: By gathering knowledge from experts close to policymaking, the conception and identification of risk can be closely related to the needs and capabilities of government.

It is further noted that repeating the same survey over time would give the opportunity to **identify patterns** and **newly emerging** potential risks.

Potential limitations of surveys

- **Bias towards known risks**: A study based on finding common perceptions among respondents is by design paradoxical to discovering emerging risks because it suppresses outliers and weak signals. Emerging risks may not have significant historical precedent, making it difficult for respondents to recognise or articulate them.
- **False finish line bias**: If survey participants or even organisers believe they've thoroughly identified and understood all emerging risks, they may think they've reached a comprehensive understanding, an "endpoint" in risk identification. As a result, they might overlook or undervalue continuously or newly emerging risks beyond the publication of the survey. This misperception can create a sense of complacency, potentially leaving them unprepared for unforeseen challenges.
- **Reliance on probability**: Many methods for estimating probability rely on data. Emerging risks by definition lack historical data. Therefore it is not possible to estimate probability of emerging risks using past frequency. Nonetheless, it may still be possible to provide subjective probability estimates based on understanding of emerging risks. Use of probabilities may also encourage experts to focus consideration and treatment only on the risks estimated as most probable, potentially resulting in the neglect of less probable but potentially highly impactful risks.
- **Groupthink and social influence**: In any survey, there is a risk of groupthink, where respondents' opinions converge towards the dominant perspective, suppressing dissenting views or novel ideas. This can prevent the identification of unconventional and emerging risks that may be less widely understood or acknowledged.
- **Homogeneity of viewpoints**: An expert-based approach may not incorporate the perspectives of diverse stakeholders who possess niche knowledge about emerging risks. These stakeholders may be more adept at identifying nascent threats that have not yet been widely recognised.
- **Lack of agency**: By scanning for emerging risks as an independent variable that appear spontaneously, the risk manager’s agency in helping avoid and prevent them is unaccounted for. Objectivity cannot account for subjective notions of what risks matter and what policymakers are willing to do about them (OECD, 2003).
- **Unclear connection to decision-making**: The sole process of mapping out a set of risks does not inevitably produce a resource of direct relevance to decision-making. Simply making a longer list from more sources does not address this problem. From general information it is usually necessary to draw specific insights to inform decisions.

Benefits and potential limitations of data-driven risk identification

In addition to surveys, data-driven methods offer a powerful source in mapping emerging risks. This section looks and benefits and potential limitations of such approaches. Data-driven methods involve the use of

quantitative data and statistical tools to identify, analyse, and predict risks. They leverage data, analytics, and mathematical models to extract insights, detect patterns, and forecast future trends and risk scenarios.

Examples include:

- **Predictive analytics such as modelling and forecasting:** modelling and analysing historical and real-time data to make informed predictions about future risks
- **Big data and sentiment analysis:** using vast datasets, including social media and news, to identify patterns and public sentiments
- **Geospatial and network analysis:** exploring location data and connections between entities to identify geographical and systemic risk patterns

By surveying patterns and trajectories over extended periods, it is possible to draw insights into potential future developments. Such data-driven insights can be further enhanced through the use of modelling in the style of UNDRR reports (UNDRR, 2023). Modelling allows experts to simulate different scenarios based on current data, making it possible to anticipate and understand the potential consequences of various situations. Unlike trend data, which offers a retrospective look at patterns over time, modelling is inherently forward-looking. It uses existing data to project future outcomes based on a set of assumptions. This is especially valuable in situations where real-world experimentation is not feasible, for instance understanding the spread of a disease under various containment strategies. Modelling thus presents an additional way to 'top up' a list of emerging risks with additional points on the map, while also offering supporting data for those already identified.

Benefits of data-driven methods

- **Accuracy**: Using large datasets and sophisticated algorithms increases the accuracy in predicting and identifying risks. This enables more precise and informed decision-making.
- **Comprehensiveness**: Computers capable of large numbers of concurrent calculations can consider and combine far greater numbers of relevant factors, and simulate far more scenarios than a human would be able to cognitively process, thus allowing for a more comprehensive picture of emerging risks
- **Efficiency**: Automation and machine learning algorithms can quickly analyse vast amounts of data.
- **Validation**: Combining perception studies with scientific forecasting literature can help validate the identified risks. When perception-based concerns align with evidence-based forecasts, it strengthens the confidence in the potential impact of those risks.

Potential limitations of data-driven methods

- **Reliance on past experiences**: Modelling and forecasting rely on historical evidence to identify risks. However, emerging risks lack such data, making it difficult for forecasts to identify them.
- **Wicked problems**: These are complex, interdependent issues with no clear solutions, often characterised by significant uncertainty and ambiguity (Camillus, 2008). In the context of data-driven risk identification, these problems arise because data and algorithms are suited to problems with clear boundaries; and cannot fully capture the complexity and interdependencies of certain risks. This limitation means that data-driven methods may provide incomplete or oversimplified insights, leading to potentially inadequate or misdirected risk mitigation strategies.
- **Chaos**: This refers to inherent unpredictability in systems sensitive to initial conditions. Even if all the factors were defined and included, it is usually impossible to get the precision needed to make an accurate forecast for all the variables in a chaotic system like the international risk environment (Hilborn, 2004). This sensitivity makes it difficult to rely on data-driven methods for precise, long-term predictions of emerging risks.

- **Undecidability**: This characterises problems that cannot be conclusively resolved through computational means, reflecting limitations in algorithmic prediction and decision-making. Undecidability has been proven as an inherent limitation of all mathematical systems, and concerns all current and future computers, even with infinite power (Reyzin, 2019). This phenomenon underscores the limitation of relying solely on data-driven approaches for emerging risk identification, emphasising the need for integrating human judgment and qualitative insights.
- **False perception of objectivity**: This phenomenon occurs as data-driven methods are often seen as unbiased, overlooking the subjective elements embedded in data collection, processing, and analysis. The limitation here is that decision-makers might over-rely on data-driven insights, potentially leading to biased, or misinformed decisions in identifying emerging risks.

In addition, it is worth noting a particular limitation of combining surveys from multiple sources like those listed above:

- **Blurring of signal and noise**: An intuitive assumption is that combining knowledge from expert sources could reinforce the quality of the conclusions drawn. However, in the case of wicked, chaotic, and undecidable problems, this is not the case. Different sources define the problem differently, take different levels of precision in their measurements, and set different decision criteria. Therefore combining them is analogous to trying to tune into multiple radio stations simultaneously: it blurs rather than amplifies understanding.

Benefits and potential limitations of AI-driven risk identification

Increasingly, AI tools are being used with large and various sources of data in a sophisticated yet easy-to-understand way. AI language models, with their capacity to interpret and generate complex text, have the potential to become highly valuable tools in risk management. By continuously analysing global data and discourse, these models offer early detection of emerging risks, flagging shifts in public sentiment and unrecognised threats with speed and precision. Beyond mere surveillance, generative AI can extrapolate from and reveal links between known risks to uncover new ones, drawing on vast, diverse data sets to enrich the pool of identified risks.

Benefits of AI

AI can assist in synthesising a list of new suggested emerging critical risks based on an existing list identified by humans through several mechanisms:

- **Pattern Recognition**: AI algorithms can analyse the existing list for underlying patterns and themes. By identifying commonalities among the listed risks, it can generate hypotheses about other related areas that may be at risk.
- **Predictive Modelling**: Using historical and current data, AI can simulate the task of prediction, coming up with future trends and scenarios that humans might not have considered.
- **Text Mining and Natural Language Processing**: By scouring vast amounts of textual data from diverse sources such as news articles, academic papers, social media, and expert blogs, AI can identify topics that are gaining traction and might constitute emerging risks.
- **Scenario Simulation**: AI can simulate various complex scenarios based on different variables and parameters found in the initial risk list. By altering these parameters, it can suggest new risks that could arise under different conditions.
- **Cross-Domain Analysis**: By integrating multiple datasets, AI can identify gaps and overlaps that might suggest new areas of vulnerability. For example, merging health and climate data might suggest risks related to the spread of diseases in changing climate zones.

- **Crowdsourcing and Collaborative Filtering**: By analysing data from crowdsourced risk assessments, AI can identify which risks are most frequently mentioned or rated as high priority by a diverse pool of contributors.

Potential limitations of AI

Using AI to identify emerging critical risks has several potential limitations and disadvantages, including:

- **Complexity and Contextual Understanding**: The extent to which generative AI systems have coherent mental models of how the world works is debated. Some experts argue large language models merely reproduce patterns of language use, reflecting statistically significant combinations of ideas based on pre-existing cues. As such, these systems might lack the nuanced understanding of risks that come from complex social, political, or cultural contexts for which human experts are better equipped to interpret.
- **Adaptation to Novelty**: AI systems are trained on historical data. They may not adapt quickly to new types of risks that weren't present in that training data, potentially causing delays in the identification of truly novel threats.
- **Data Biases**: AI models can inherit biases present in their training data, potentially leading to skewed risk assessments that do not accurately represent reality. AI may also prioritise risks that are easier to quantify, potentially overlooking qualitative but significant risks that are harder to measure or predict.
- **Explainability and Transparency Issues**: AI decision-making processes can be opaque, making it difficult to understand how the AI arrived at a particular risk assessment, which can hinder trust and accountability.
- **Ethical and Privacy Concerns**: The use of AI in monitoring and risk assessment can raise ethical questions and concerns about privacy, especially if personal data is involved.

Principles for future mapping exercises

This section outlines insights drawn from the above analysis, and implications for future mapping of emerging critical risk, should they be proposed. It advocates moving from a retrospective to an **anticipatory** stance, and from a single frame to a **diversified** perspective.

retrospective + diversified	anticipatory + diversified
retrospective + single-frame	anticipatory + single-frame

Retrospective stance means relying exclusively on historical evidence to inform decisions; learning only from the past. An **anticipatory stance** attempts to proactively perceive and make sense of future changes through exploratory and experimental approaches such as modelling and strategic foresight (Tõnurist and Hanson, 2020). Strategic foresight is the ability of an organisation to constantly perceive, make sense of, and act on knowledge of the future as it emerges in the present (OECD, 2021b).

Single-frame analysis refers to using one set of assumptions to identify, model, prioritise, and analyse the characteristics of emerging risks. **Diversified** approaches seek to reframe those processes to make them robust against unexpected and evolving future conditions (Ramírez and Wilkinson, 2016). This includes the ability to use different versions of the future to reframe and reperceive the present and the strategies developed therein (Tibbs, 2021).

An anticipatory, diversified approach to mapping emerging risks is preferable.

Greater anticipation

Envisaging to repeat the exercise

Effectively mapping emerging risks relies not only on the accurate identification of the risks, but on the time at which the mapping took place. Emerging risks, by definition, are not analogous to static land waiting to be discovered; they are constantly evolving and interacting. Indeed, emerging risks are more analogous to moving targets; hence the field of vision and level of focus into which they emerge are of great importance in being able to spot them. Constantly developing risk implies constant monitoring. This paper emphasises the benefits of ongoing and recursive mapping of emerging risk.

Weak signals and non-trend data

Often the evidence of an emerging risk—if it exists at all—is too weak to capture in surveys or trend data. Waiting for evidence to reach a certain threshold may mean waiting until a risk has emerged beyond the point of being able to respond effectively; the so-called Collingridge dilemma (Collingridge, 1980). Thus to catch emerging risks at an earlier stage, this report thus argues for the use of weak signals and non-trend data. An example of such data could be patent filings for technologies with the potential to disrupt systems and become a source of critical risk.

Maps designed with navigation in mind

An effective mapping exercise can aspire to go beyond merely listing information and reach into providing decision-makers with a guide for navigating irreducible uncertainty (Kay and King, 2021; Lang and Ramirez, 2021). This suggests that it is not enough to attempt to list and categorise emerging risks; but also to prioritise and present them in such a way that policymakers can use them to make decisions. This concept of usefulness implies designing the mapping with users (policymakers) in mind; as well as the contexts in which they will use it. In this context, mapping the ‘outer space’ of emerging risks in the world is mutually dependent on understanding the ‘inner space’ of policymakers’ decision-making processes underlying their actions (Wack, 1985). This report therefore argues for a mapping methodology tailored to the needs of the policymakers for whom it is intended to support deciding and acting.

Greater diversification

Harnessing multidisciplinarity

To take advantage of the differing advantages and limitations in surveys, trend data, forecasts, and other methods such as those of strategic foresight, it is desirable to use a multidisciplinary approach to mapping emerging risk, such as that used in the report on Existential Risk and Rapid Technological Change commissioned by the UNDRR (Maxime Stauffer *et al.*, 2023).

Highlighting constructive disagreements

The characteristics of emerging risks, by their nature, are not universally agreed upon; if there were agreement then the risk would be considered familiar, not emerging. The discrepancies between impact and capacity for risks such as strategic and regional tensions versus droughts and forest fires can thus provide a foundation for further research or dialogue. Exploring why such discrepancies exist can help in understanding underlying beliefs, values, and knowledge gaps among respondents.

Highlighting discrepancies in data or perspectives can be beneficial, fostering a richer understanding of complex subjects. Discrepancies highlight the multi-faceted nature of emerging risk, prompting deeper

inquiry and preventing over-reliance on singular narratives. Instead of viewing discrepancies as aberrations to overcome, they should be explored for the knowledge they may reveal.

Unconventional and unorthodox sources

Consulting unconventional and unorthodox experts can enhance a survey by introducing diverse, holistic, and fresh perspectives. Such experts, ranging from indigenous leaders to science fiction authors, can highlight often overlooked risks, provide alternative measurement tools, and challenge inherent biases in mainstream methodologies. Their insights can offer a nuanced understanding of global risks at multiple levels. By blending traditional and unconventional methodologies, surveys can achieve a richer, more balanced assessment, and potentially unveiling innovative solutions.

Top-down and bottom-up

A combined top-down and bottom-up approach in risk identification can help capture a comprehensive view of emerging risks. Top-down sources, employed by senior management, offer macro insights and strategic relevance, but can sometimes miss real-time, granular data. Bottom-up sources tap into on-the-ground insights from frontline workers and local communities, capturing early-warning signals of potential risks. For example, junior doctors might notice unusual health patterns before they're recognised at a higher level as a potential epidemic. Integrating top-down and bottom-up approaches ensures that risk management is both strategically informed and responsive to emerging, real-time data.

Multiple maps

It is recognised that defining emerging risks is a complex task, with multiple considerations and a degree of subjectivity (OECD, 2003). The task of mapping emerging risks hence involves inevitable decisions and trade-offs (conscious or unconscious) about focus, omissions, level of detail, readability, and intended use. Every map reflects such decisions, known as cartographic generalisation, resulting in advantages and disadvantages, depending on the reader’s point of view.

The impossibility of making a complete, accurate map of emerging risks has parallels with the impossibility of making a complete, accurate map of the world. A map may be correct on its own terms; but will always misrepresent the world in some way relative to another map. Figure 1 illustrates two commonly used projections of the globe, each of which contains advantages and disadvantages in terms of distortion, shape, area, lines, and uses.

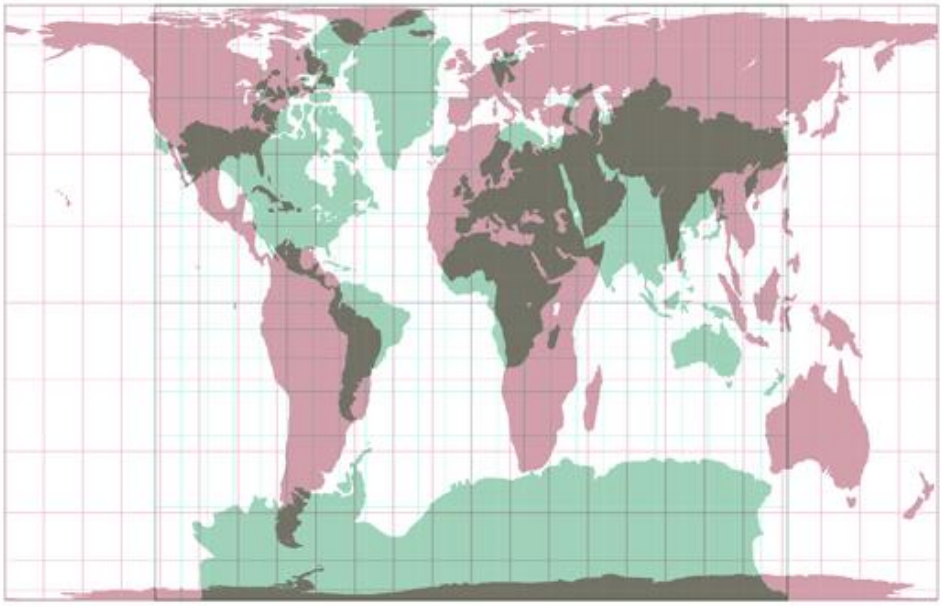


Figure 1 Two superimposed alternative projections of the globe, extending the metaphor of "mapping" to incorporate the benefits of multiple perspectives

Using multiple maps simultaneously allows the advantages of one to compensate for the disadvantages of another, leading to a greater understanding of the Earth's geography. Hence, this report considers the benefits of multiple concurrent maps for identifying risk. These alternative maps could take the form of future Risk-Worlds (Wilkinson and Eidinow, 2016), in which the framing, identification, and management of risks take place in intentionally different supposed future contexts (analogous to projections of the globe), resulting in a more comprehensive and dynamic view of emerging risks than could be achieved with one map alone.

Conclusions

This paper outlines an analysis of emerging risks identified through the pilot online mapping exercise. It defines essential terms related to emerging risks and distinguishes them from familiar risks.

The paper further provides an overview of identified emerging risks from various sources, including the pilot online exercise, categorising them into themes for better understanding. It points to desk research, other perception surveys, trend data, and forecasting as additional ways to enhance the list of emerging risks.

The discussion emphasises the value of surveys and forecasting, while also pointing to some potential limitations to avoid. It is argued that an **ongoing, anticipatory**, **diversified** approach is preferable in conducting a mapping of emerging risk. This can be achieved through envisaging future iterations of such exercises, by capturing weak-signal and non-trend data, by keeping a strong focus on the user of the mapping (policymakers), by harnessing multidisciplinarity, by highlighting constructive disagreement, by using unconventional and unorthodox sources, and by preparing multiple maps.

Annex A. Table of the emerging critical risks identified

The table below summarises the emerging critical risks identified in the other sources cited for comparison with the OECD pilot exercise. It is noted that the comparison is limited for various reasons, including the different criteria used to select risks in each survey, which may or may not have stipulated all the characteristics of emerging critical risk as understood in this report.

	OECD pilot online exercise	WEF Global Risks	EIU Top Global Risk Scenarios	EPRS Future Shocks	OECD Risks That Matter
People	Disinformation and social polarisation Vector-borne diseases affecting new areas Decline in mental health and societal well-being in young people Large scale conflict-induced displacement	Societal polarisation Human health: perma-pandemics and chronic capacity challenges Human security: new weapons, new conflicts Digital rights privacy in peril	War in Ukraine turns into global conflict Conflict arising in the South China Sea Cyberwar erupts New, highly aggressive infectious disease emerges High inflation fuels social unrest	Foreign destabilisation Conflict arising in the South China Sea Instrumentalisation of irregular migration at EU borders Strategic and systemic threats to the democratic information sphere The economic crisis as an accelerator for social instability in democracies Decline in mental health and societal well-being in young people	Financial insecurity, especially in old age Securing good-quality and affordable long-term care Concern about getting a fair share of benefits relative to taxes
Planet	Extreme and sustained heatwaves Limits on drinking water due to acute scarcity	Climate action hiatus Natural ecosystems past the point of no return	Extreme weather and war in Ukraine prompt famine	Extreme weather events: Droughts and water scarcity Biodiversity loss or collapse	Falling ill (as related to environmental conditions)

	Climate change impacts drive mass population displacements System-wide impact of persisting forest fires Release of hazardous materials in armed conflict settings				
Prosperity	Disruption of the global and regional food supply chain Energy vulnerability and financial destabilisation	Cost-of-living crisis Economic downturn Economic warfare Economic stability: global debt distress	Economic downturn due to factors like cyberwar, inflation, and geopolitical tensions	Collapse of the internet Security of energy supply Elevated sovereign debt Rising challenges to major powers' growth performance Critical raw materials supply shock Instability stemming from the financial technology sector	Concern about household finances (as related to economic conditions)

Annex B. Findings of the Emerging Critical Risks Brainstorm

Over the months of October and November of 2022, the OECD conducted a pilot exercise that invited risk analysis experts from 20 countries to collectively identify key emerging risks countries ought to have on their radars. 30 experts shared how much confidence they had in their assessment of the top risks, and estimated how developed national capabilities are for coping with them.

The brainstorm was structured along two stages. During the first stage, an initial list of socio-environmental, socio-political, and socio-technological emerging critical risks was presented to the respondents with which they could engage through votes and comments. Moreover, in this stage, respondents were invited to add their own propositions of emerging critical risks which do not figure in the list but are, in their understanding and expertise, key.

In the first stage, the median number of votes for shortlisting risks was approximately 13. The higher half of risks received more than 13 votes, while the lower half received less. The majority of the most-voted risks were related to socio-political issues. To determine the list for the second stage, a prioritisation of risks was required. Three options were considered: a list of the most voted risks overall, a list of the most voted risks within the socio-environmental domain, or the top-three most voted risks from each domain (socio-technological, socio-political, socio-environmental and other hybrid risks). The secretariat selected the option of using the list of most voted risks overall for the second stage of the brainstorm.

In preparation for the second stage, the team selected a list of some of the most voted risks, accounting to thirteen in total (incl. socio-political, socio-technical, socio-environmental). Respondents were then asked to assess these risks in terms of their impact (economic, human, environmental, political, and social, and impact on cultural heritage) and scope (local and short term, regional and short term, regional and long term or global and long term), the capacity of their countries vis-à-vis these risks, their estimated probability/likelihood to occur in the next five years, and their confidence level of their assessment and the evidence available.

Findings from the first round showed great interaction of the respondents, especially in adding new risks missing from the list and in engaging with each other through comments, precisions, and opinions. Almost half of the most voted risks during the first stage (e.g., risks garnering 14 votes or more), were related to socio-environmental issues: extreme temperatures and heatwaves, drinking water scarcity, vector-borne diseases affecting new areas, climate change induced mass displacements, and persisting droughts and their impact on vital and critical services and systems. The second-most voted risk pertained to the threat/danger of disinformation and social polarisation. The results of the first stage show the impact and threat of climate change as perceived by the experts, not only on the environment but with more far-reaching effects on the population and society.

Findings from the second stage, show in general, for the most scored risks, a high impact and probability assessment with a low/lower capacity and confidence level assessments. These risks include, among others, disinformation and social polarisation, extreme and sustained heatwaves, energy vulnerability and financial destabilisation, and strategic and regional tensions. For the lower scored risks, however, less variance can be observed. While all risks have a relatively high probability estimate, their impact is

assessed as relatively low ranking, thus restrained in its scale (local and short term). This concerns risks such as limits on drinking water, forest fires and the release of hazardous materials in armed conflicts.

Key findings

The findings indicate there is a widespread consensus among the countries that risks arising from climate change are of significant concern. The increasing difficulty in predicting these risks and their growing impact in all regions have led to a strong consensus on their criticality. This alignment highlights the recognition of climate change as a global challenge requiring urgent attention and concerted efforts for mitigation and adaption.

While certain emerging critical risks may not be entirely new, their criticality stems from changing circumstances or factors associated with them. Technological advances or evolving contexts have amplified the potential impact and urgency or these risks. It highlights the importance of considering the dynamic nature of risks and the need to adapt strategies and approaches to address their evolving manifestations effectively. Moreover, as shown through the findings of the brainstorm, this type of risks garnered less high levels of confidence by respondents.

The pilot study has provided valuable insights into areas where consensus among respondents is lacking. Examples such as the out of control cyber-attack vector, release of hazardous material during armed conflict, and rejection of government communication demonstrate the divergence of opinions among respondents regarding the severity, likelihood or impacts of these risks. These findings highlight the areas where further research, discussion and collaboration are needed to reach shared understanding and consensus among stakeholders.

The risks perceived as most impactful require substantial efforts to develop and enhance capacities for their management and mitigation. It emphasises the need for countries to focus on building capacities, resources and strategies to effectively address these high-impact risks.

The findings suggest countries generally have stronger capacities for dealing with chronic challenges to supplies compared to handling acute disruptions. This suggests that countries have developed better practices, methods and tools to mitigate long-term challenges in supply chains or resource availability. However, there is a need to strengthen capacities to effectively respond to sudden and short-term disruptions.

Countries have relatively stronger capacities to handle acute surges in displaced populations, indicating preparedness for immediate responses to humanitarian crises. However, the findings also suggest that countries may face challenges in managing and responding to chronic increases in displaced populations. This highlights the need for long-term strategies, policies and resources to address sustained or ongoing displacement situations effectively.

There is a growing convergence between human-induced threats, risks associated with industrial accidents and natural hazards. This implies that the traditional boundaries separating these categories are becoming less distinct due to various factors such as technological advancements, environmental changes or societal dynamics. This blurring of boundaries underscores the complexity and interconnectedness of risks, necessitating a more holistic and integrated approach to risk management and response.

Next steps

It is of increasing importance to improve the exchange of knowledge among different stakeholders to inform research agendas effectively. There may be gaps in knowledge in certain areas that hinder the development of comprehensive research agendas. Enhancing knowledge sharing, collaboration and

communication among researchers, policy makers and experts can help make it possible to address these gaps and ensure that research efforts are better informed and targeted.

There is a need for co-operation among different actors to identify signals or early warning signs that can trigger specific preparedness activities. By working together, countries, organisations and communities can identify indicators or trends that reveal the emergence or escalation of a risk. This collaborative approach enables timely and targeted preparedness measures, allowing for more effective risk management and response.

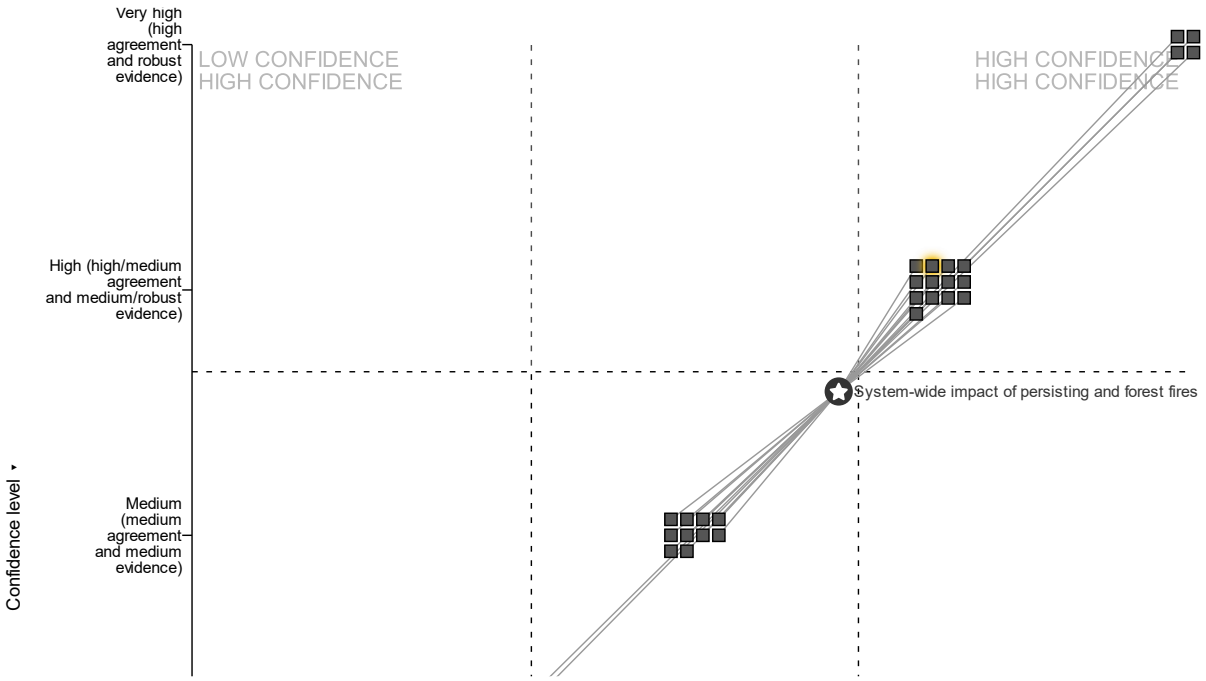
It is important to reinforce international co-operation in building capacities where they are most needed. Some countries or regions may require support, resources or expertise to enhance their preparedness and response capacities and by fostering cooperation and collaboration at the international level, countries can share lessons, best practices and resources to strengthen capacities and ensure a more coordinated and effective global response to emerging critical risks.

There is an urgent need for co-operation and collaboration, specifically on emerging critical risks that may have cascading effects beyond national or regional boundaries. Risks such as climate change demonstrate the interconnected nature of global challenges. High emissions in one part of the world can rapidly lead to water scarcity in another region of the world. By developing cooperation frameworks, countries can work together to address these risks, share knowledge and implement coordinated strategies that take into account transboundary impacts and potential ripple effect.

Discussion on the findings of the brainstorm

Confidence levels

Respondents were asked to assess the confidence level for each risk ranging from: 1) very low: low agreement and limited evidence supporting the assessment, 2) low: low to medium agreement among and evidence supporting the assessment is limited or of medium quality, 3) medium: medium level of agreement and moderate amount of evidence supporting the assessment, 4) high: high or medium agreement and evidence supporting the assessment is considered medium to robust, and 5) very high: high agreement and robust evidence supporting the assessment. Additionally, respondents were also asked to provide a broad estimation of the current system's capacity to deal with each risk. This estimation allows them to assess and express their beliefs regarding the adequacy of existing systems in addressing the identified risks.



Based on the findings during the second stage of the brainstorm some conclusions can be drawn about the knowledge gathered on the confidence of respondents, and thus countries, on the specific risks. The findings (as shown in the figure above) indicate that the mean confidence levels within the medium to high range. The highest confidence levels are observed for risks associated with system-wide impact of persisting forest fires and extreme and sustained heatwaves. This could be attributed to the well-documented and observable nature of these risks, along with the extensive research and data available to support risk assessments. Moreover, these risks have garnered significant attention and resources for monitoring and mitigation, leading to a more robust analysis and higher confidence levels.

Following closely behind are risks that have attracted political attention such as disinformation and social polarisation and political, social and economic destabilisation arising from hybrid threats. These risks have received significant media coverage and are subject to active discussions and interventions by governments and international bodies. The increases focus on these risks leads to a more comprehensive analysis and higher confidence levels.

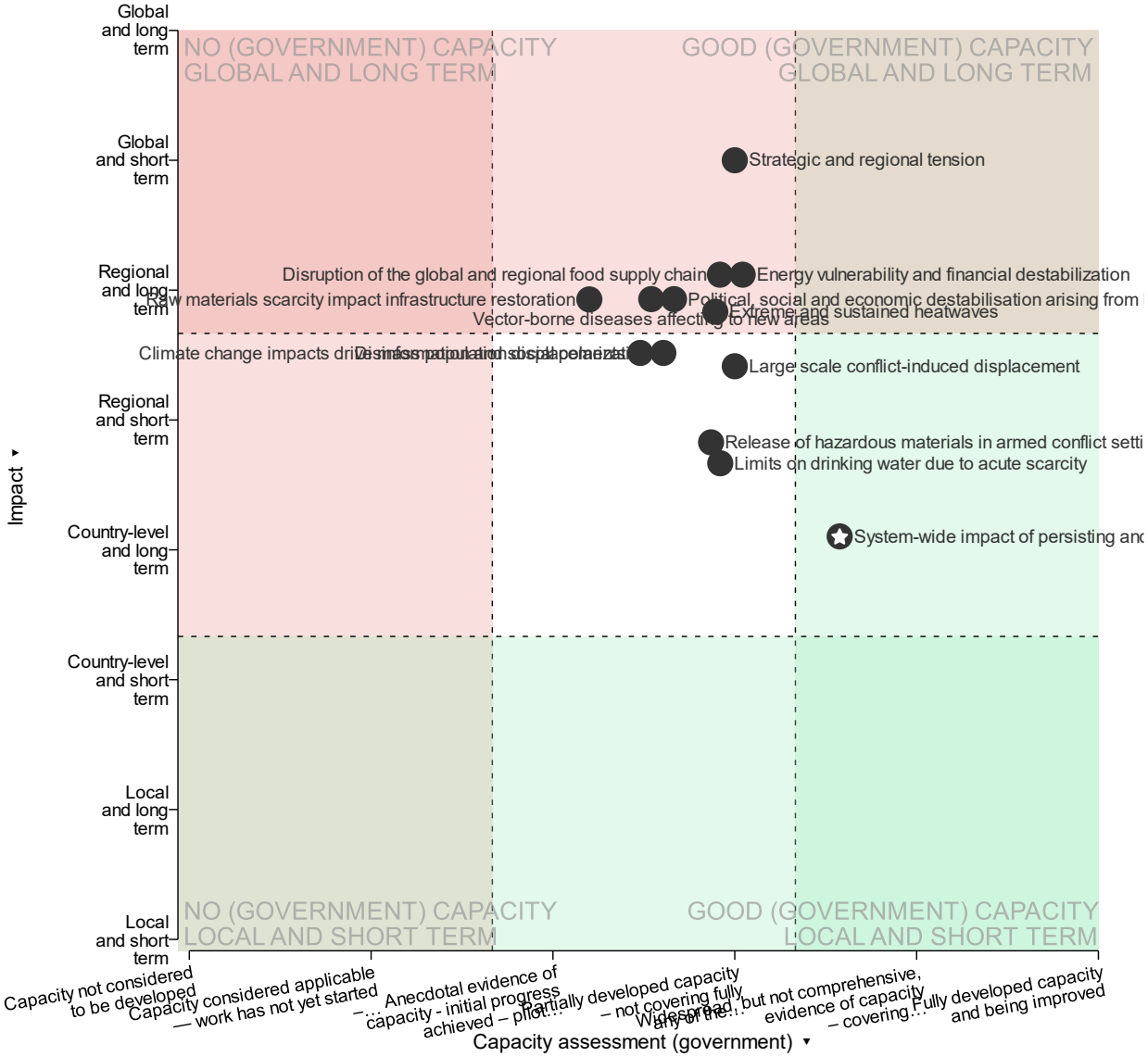
Risks related to raw materials scarcity and its impact on infrastructure restoration or the release of hazardous materials in armed conflict settings receive the lowest confidence ratings. This could be due to several factors. First, these risks are more complex and challenging to assess accurately due to various interdependencies and uncertainties involved. Second, limited data availability or lack of comprehensive research in these areas contributes to lower confidence levels. Third, the potential political sensitivity or limited attention to these risks compared to others could also impact the level of confidence in their assessments.

Overall, the findings suggest that confidence levels vary across the different risks (socio-political, socio-environmental, socio-technological). However, it can be observed that the risks having garnered higher confidence levels are often familiar risks occurring in novel or unfamiliar circumstances. These risks have been extensively studied, albeit in different settings or circumstances, have a substantial body of research and /or have attracted a significant amount of attention from policymakers and experts. Risks with lower confidence levels are unfamiliar in nature and have not been encountered before in any form. To increase confidence, further research, data collection and expertise is required to improve our understanding and assessment of their potential impacts.

Findings also showed that, whilst there are variations in the scores assigned by respondents, most risks attract similar scores from the majority of respondents. This indicates a general alignment among respondents regarding the assessment of risks. Consensus on the confidence levels of risks shows a shared understanding of the severity of these risks and an agreement on the significant consequences and ripple effects associated with these risks, which are likely to be driven by scientific evidence, previous experiences and observable impacts of these events.

Impact levels

Respondents were asked to assess the different impact levels along these scales: 1) local and short term, 2) local and long term, 3) country-level and short term, 4) country-level and long term, 5) regional and short term, 6) regional and long term, 7) global and short term, and 8) global and long term. These scales allow for an estimation of the expected geographical coverage (local, country-level, regional, global) and the anticipated duration (short term or long term) of the impacts of a risk envisaged.



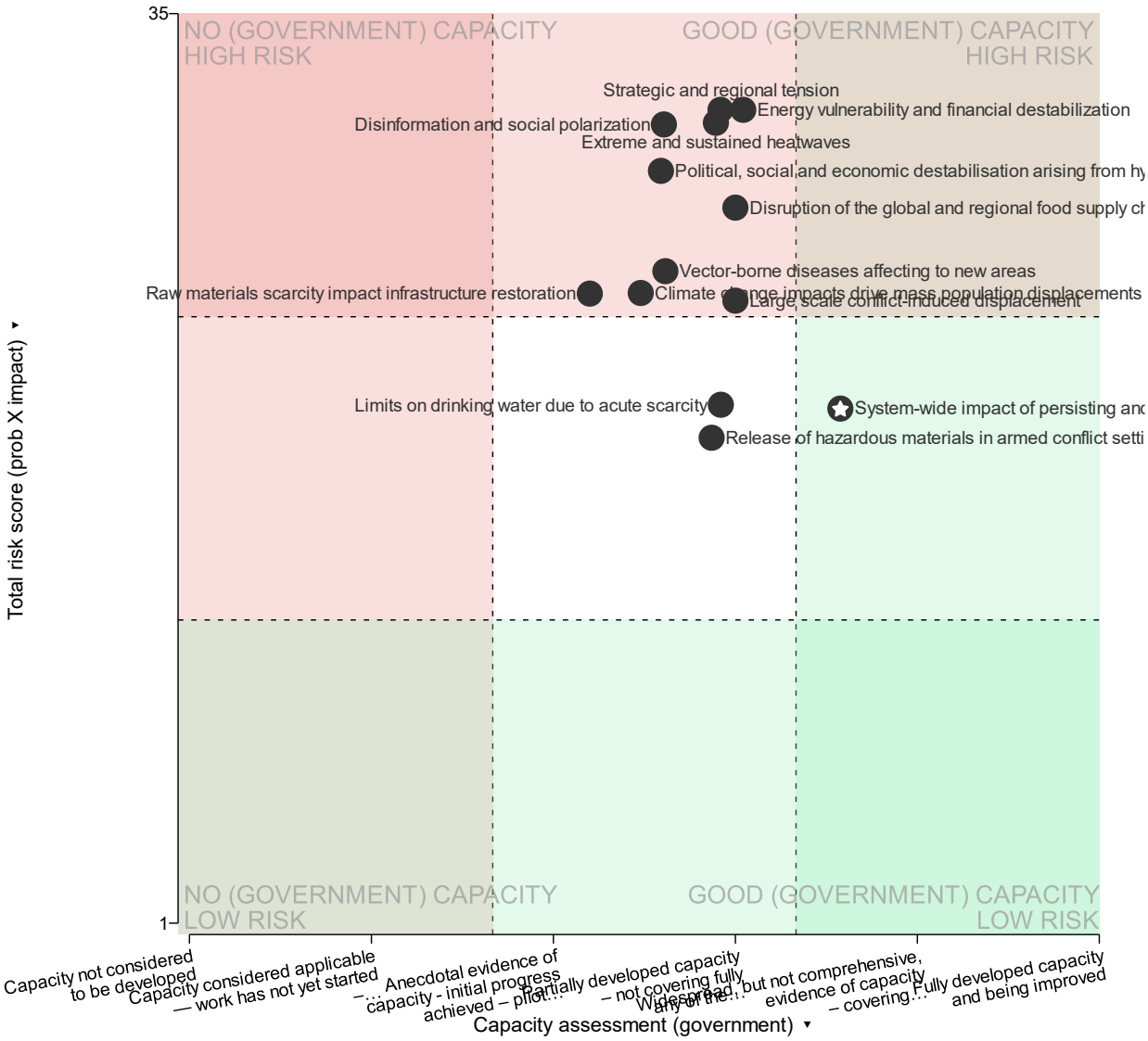
In the figure above, we can see that most of the risks assessed are deemed to have regional impact (somewhere between short and long term in nature). The findings show that the majority of the assessed risk are expected to affect specific regions rather than being global or localised to a single country. The

timeframe of these impacts falls with the range of short-term to long-term, indicating that the consequences may unfold over varying periods. This suggests that the risks are not isolated events but have the potential to influence multiple countries or areas over a significant duration.

The risk of strategic and regional tensions leading to armed conflict figures as the most impactful, while the risk of systemic impact of persistent droughts and forest fires is deemed to have mostly country-level implications. This suggests that such conflicts have the potential to create widespread and severe consequences, affecting multiple regions and potentially having global ramifications. Persistent droughts and fires are understood as having direct effects, such as a damage to ecosystems, agricultural productivity and local communities and are expected to be concentrated within individual countries. These insights provide valuable information for understanding the spatial and temporal dimensions of these assessed risks and can aid in developing appropriate mitigation and response strategies at different scales.

Capacities

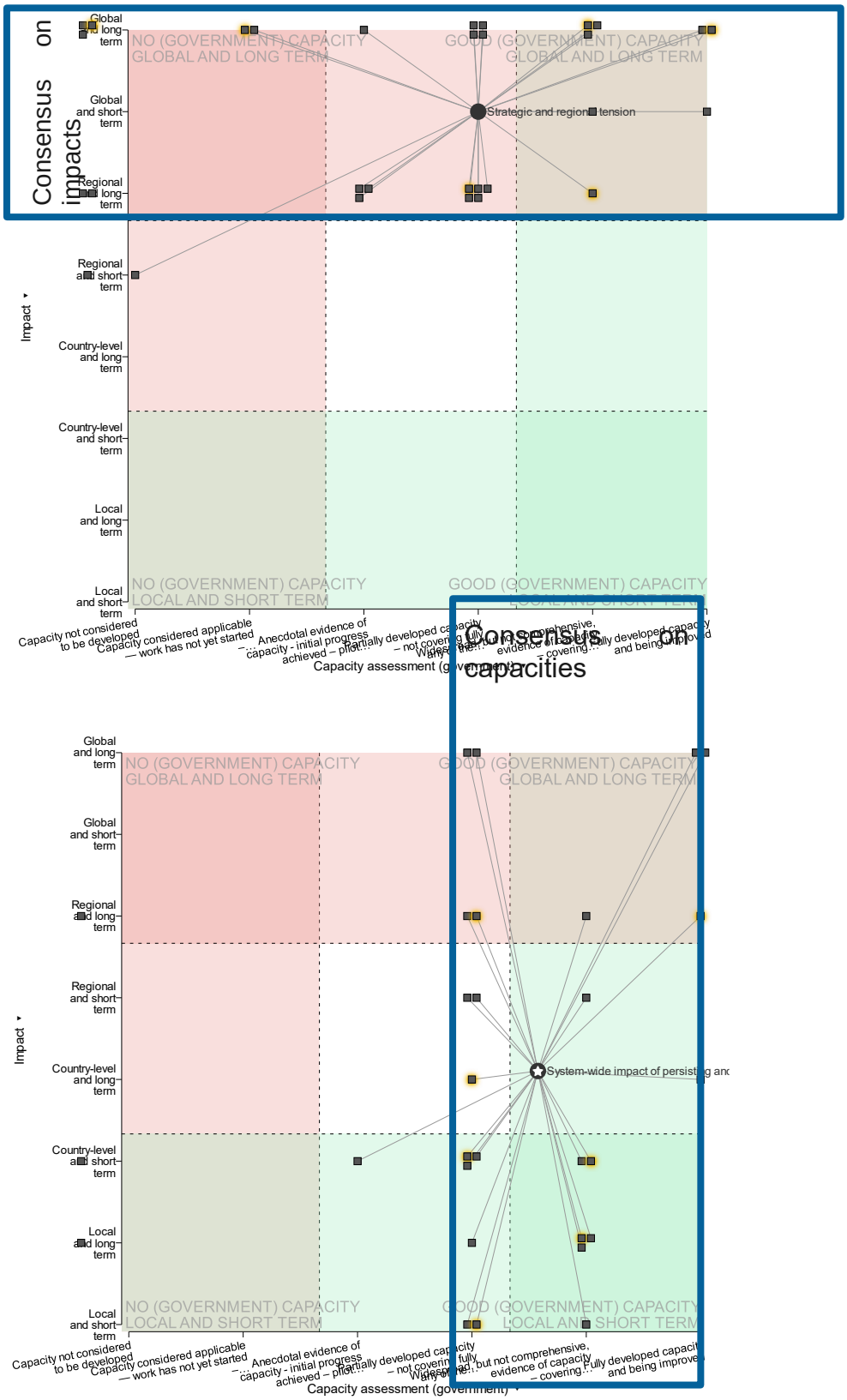
When asked to estimate the capacity levels of their countries in case of an emerging critical risk situation, respondents used the following scale: 1) capacity considered applicable: indicates that work has not yet started, but there it a strategy or policy in place to address capacity requirements, 2) anecdotal evidence of capacity: at this level there is initial process made towards capacity developments (includes implementation of pilot projects), 3) partially developed capacity: some capacity development efforts have been undertaken, but do not yet fully cover all dimensions required, 4) widespread, but not comprehensive, evidence of capacity: there is evidence of capacity development that covers fully at least one of the dimensions, and while capacity might not be all-encompassing, there are widespread indications of progress in building the required capacities, 5) fully developed capacities and being improved: indicates the highest degree of capacity development, capacity has been fully developed and is currently being refined further, and 6) capacity not considered applicable to be developed.



For most risks, respondents indicated that countries seem to have only medium levels of capacity (from partially developed to only anecdotal evidence of capacity). This suggests that, according to respondents, countries generally have a moderate level of capacity to address the identified risks. The assessed capacity levels range from partially developed to having only anecdotal evidence, indicating that there is room for improvement in terms of preparedness, resources and strategies. It implies that countries have made some progress in building capacity to manage risks, but there is more work to be done to enhance capacities further.

Among the assessed risks, the capacity ratings are highest for dealing with system-wide impacts resulting from persistent droughts and forest fires. This shows the progress and development of capacities to address and mitigate the impacts of this particular risk. However, the findings show that respondents deem there to be more room for improvement. This could also be taking up in areas of international cooperation. Furthermore, these findings highlight the ongoing efforts needed to enhance capacity and cooperation to effectively manage and mitigate risks at both national and international levels.

Impact and Capacities



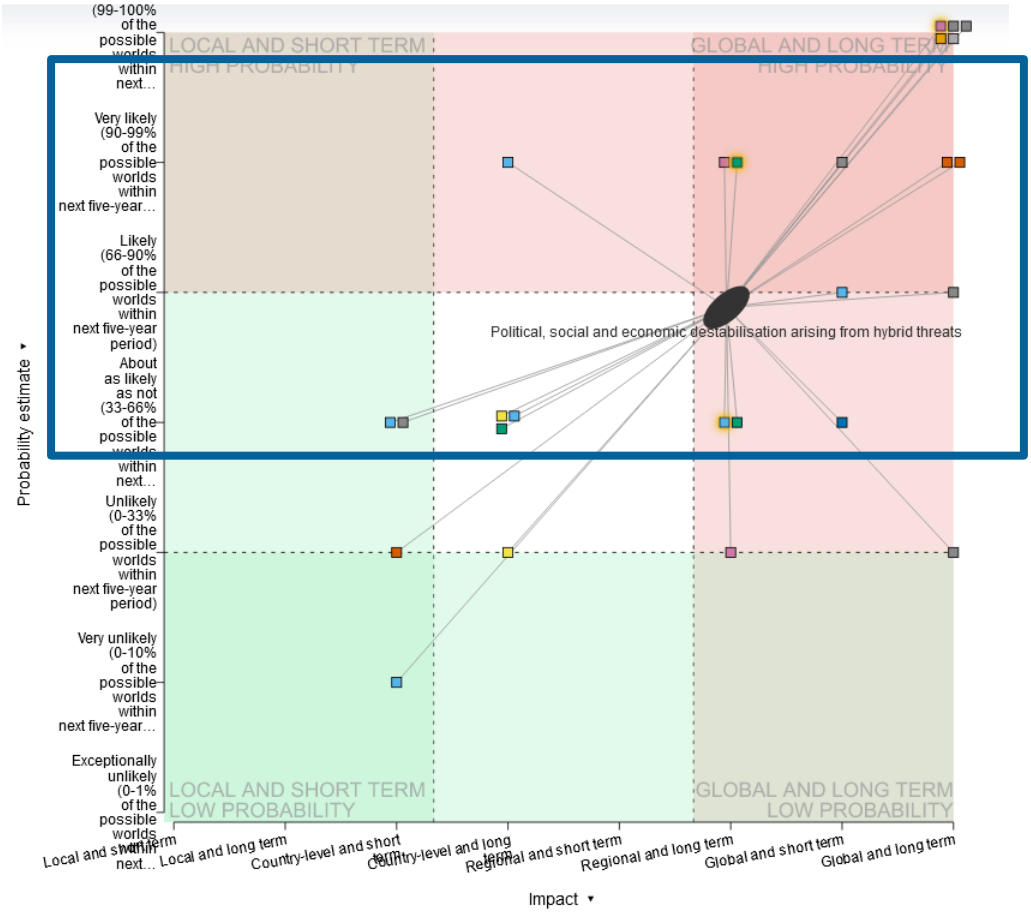
While there seems to be consensus on the level of impact of the risk of strategic and regional tensions leading to armed conflict, there is no real consensus on the level of capacity present for dealing with such

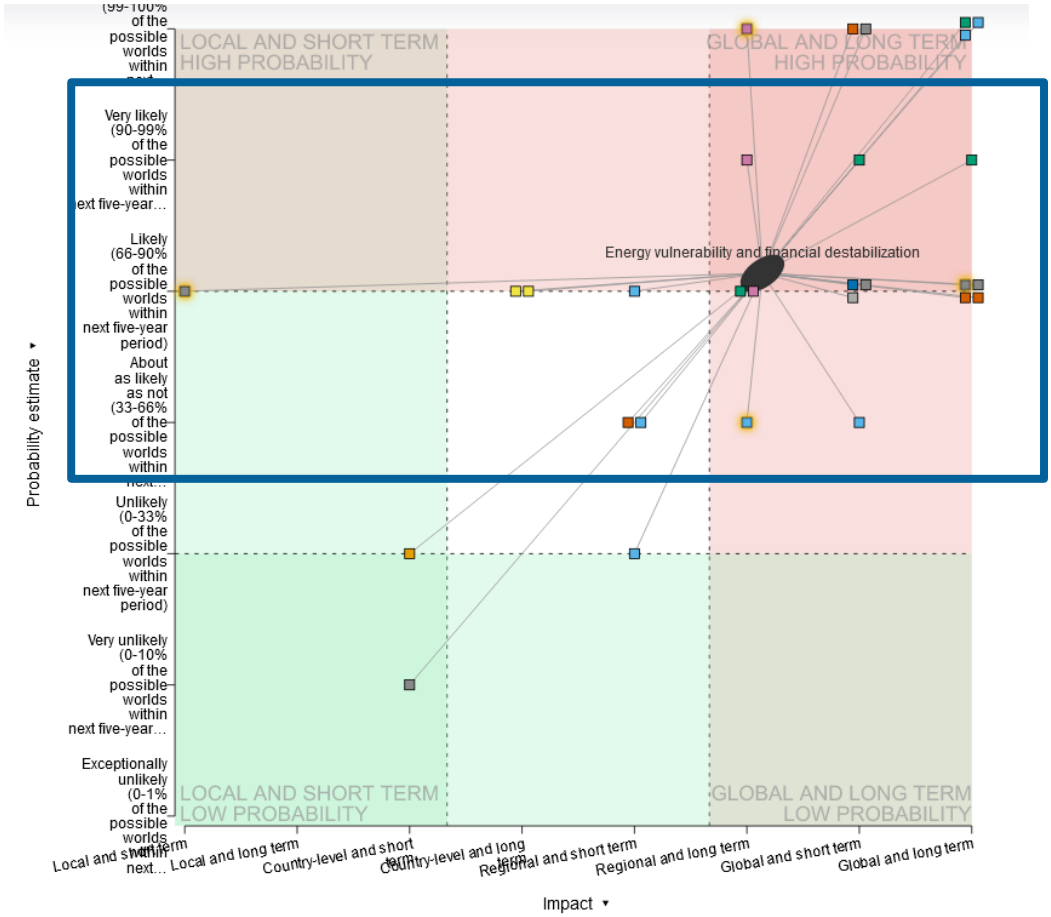
a risk (see figures above). This suggests that among respondents, there is a general agreement regarding the significant impact that the risk of strategic and regional tensions leading to armed conflict can have. The potential consequences and severity of this risk are widely acknowledged. However, there is no clear alignment regarding the level of capacity or preparedness in place to effectively mitigate this risk. This lack of consensus on capacity implies that opinions and perspectives differ on the readiness of organisations, governments and societies to handle and manage such a risk successfully.

The opposite is true for the risk of systemic impacts of persistent droughts and forest fires, where consensus lies on the capacity level, not on the impact estimations. There appears to be consensus on the level of capacity to deal with this risk. Respondents generally agree on the available resources, measures and strategies to mitigate the impact of this risk. However, there is less consensus on the assessment of the actual impact this risk can have. Thus, while there is a shared perception of the capacity level, there are divergent opinions on the severity and potential consequences of systemic impacts related to droughts and forest fires. These insights highlight the complexities and differing perspectives when it comes to assessing risks, capacity and impact and underlines the need for further discussion and collaboration to improve overall preparedness and knowledge of these risks.

Probability

The respondents were asked to assess the probability of an event occurring within the next five-year period using the following scales: 1) exceptionally unlikely: the event has probability of 0-1% of happening, 2) very unlikely: the event has a probability of 0-10% of happening, 3) unlikely: the event has a probability of 0-33% of happening, 4) about as likely as not: the event has a probability of 33-66% of happening, 5) likely: the event has a 66-90% of happening, 6) very likely: the event has a probability of 90-99% of happening, and 7) virtually certain: the event has a probability of 99-100% of happening.


LOCAL AND SHORT TERM HIGH PROBABILITY
GLOBAL AND LONG TERM HIGH PROBABILITY
LOCAL AND SHORT TERM LOW PROBABILITY
GLOBAL AND LONG TERM LOW PROBABILITY
Political, social and economic destabilisation arising from hybrid threats
Probability estimate
(99-100% of the possible worlds within next...
Very likely (90-99% of the possible worlds within next five-year...
Likely (66-90% of the possible worlds within next five-year period)
About as likely as not (33-66% of the possible worlds within next...
Unlikely (0-33% of the possible worlds within next five-year period)
Very unlikely (0-10% of the possible worlds within next five-year...
Exceptionally unlikely (0-1% of the possible worlds within next...
Local and short term
Local and long term
Country-level and short term
Country-level and long term
Regional and short term
Regional and long term
Global and short term
Global and long term
Impact



Most respondents when answering fell within three brands of potential likelihood. For instance, if most respondents assessed the probability as 4, other respondents would fall either within 5 or 6. Thus, there can still be a significant difference in the assessments provided (as can be seen above in the figure). The implication is that even with these broad categories (ranging from 1 – extremely unlikely to 7 – virtually certain), the range of assessments can be quite substantial, with a potential difference of up to sixty percent.

Methodology for the online brainstorm

Respondents

Respondents were invited from OECD Member countries, accession countries and from the private sector. This made the online brainstorm different from other risk surveys, in that it built on the point of view of government risk assessment experts. Nominated experts were seen by High Level Risk Forum delegates as peers with a good level of exposure and understanding of the sort of risk assessments conducted by their government. Respondents did not have to come from within their own national-level government – but had to be well plugged into the assessments of **critical risks** conducted by their country at the national level. Respondents participated on an informal and personal basis and thus were freer in their assessments and were able to propose linkages between risks.

The invited respondents are government risk assessment experts and have participated in this exercise from this point of view (not from their country affiliation but rather from their experiences as risk assessment experts). Respondents could furthermore also nominate other experts from their countries for participation

when they consider them as peers with the appropriate level of exposure and understanding for this exercise.

55 nominees from 20 countries were given access to the platform being used for the online brainstorm. The first stage counted 33 active respondents[1] from the private sector and 15 countries: Austria, Ireland, Japan, Korea, Latvia, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom and the United States. The second stage counted 35 active respondents from 17 countries: Australia, Canada, Estonia, Japan, Korea, Latvia, Luxembourg, the Netherlands, New Zealand, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United States.

Timescales

The platform was available for the initial stage of the brainstorm from the 5th until the 28th October 2022. It was then open again for the second round of input on the 31st October, with the opportunity for respondents to login until the 29th November 2022.

Platform

Respondents provided input directly through an **online platform which** the provider, Inclus, had tailored for this exercise with input from the Secretariat.

For the exercise the platform Inclus was employed. Inclus is an Inclusive Risk Management Software which helps to build a common understanding. The platform is based on system analysis and multicriteria decision making, thus ideal for an online brainstorm. Inclus provides a comprehensive, shared overview of the results of the brainstorm with dynamic data visualisation.

Prioritisation exercise for the second stage

At the end of the first stage the median of the risks was around 13 votes. The higher half had gathered more than 13 votes and the lower half less. However, in the list of the most voted risks there was a clear majority of socio-political risks. To generate the list for the second stage, a careful prioritisation of risks was needed. Three options were considered: a list of the most voted risks, a list of the most voted risks of

[1] 55 in total were invited in both stages (minus OECD team)

the most voted domain (socio-environmental issues), or the top three most voted risks of each domain (socio-technological, socio-political, socio-environmental, and other (hybrid)). The secretariat chose the list of most voted risks (option 1) for the second stage of the online brainstorm.

Assessing the risks

Respondents were invited to conduct a high-level assessment of the top-voted risks – starting with probability estimates.

Probability estimate scales

1. Exceptionally unlikely (0-1% of the possible worlds within next five-year period)
2. Very unlikely (0-10% of the possible worlds within next five-year period)
3. Unlikely (0-33% of the possible worlds within next five-year period)
4. About as likely as not (33-66% of the possible worlds within next five-year period)
5. Likely (66-90% of the possible worlds within next five-year period)
6. Very likely (90-99% of the possible worlds within next five-year period)
7. Virtually certain (99-100% of the possible worlds within next five-year period)

Then an indication of the rough duration and scale of the impacts envisaged.

Scales for assessing impact

1. Local and short term
2. Local and long term
3. Country-level and short term
4. Country-level and long term
5. Regional and short term
6. Regional and long term
7. Global and short term
8. Global and long term

Followed by an estimation of the level of confidence in the assessment.

Confidence in the assessment

1. Very low (low agreement and limited evidence)
2. Low (low/medium agreement, and limited/medium evidence
3. Medium (medium agreement and medium evidence)
4. High (high/medium agreement and medium/robust evidence)
5. Very high (high agreement and robust evidence)

For each risk, respondents were also asked to provide a broad estimation of what they believed to be the capacity of current systems to deal with the risk.

Estimating capacity levels

1. Capacity considered applicable — work has not yet started – strategy/policy in place
2. Anecdotal evidence of capacity - initial progress achieved – pilot projects to be detected

3. Partially developed capacity – not covering fully any of the dimensions but mechanism is developed and it is functional
4. Widespread, but not comprehensive, evidence of capacity – covering fully at least one dimension mentioned above
5. Fully developed capacity and being improved
6. –: Capacity not considered applicable to be developed

Outcomes of the first stage of the online brainstorm

The most voted risks were (14 votes and above) in order from highest to lowest

Title of Risk	Number of votes
Extreme and sustained heatwaves	24
Disinformation and social polarisation	23
Acute water scarcity leading to limits on drinking water consumption	21
Vector-borne diseases affecting to new areas	18
Raw materials scarcity impact infrastructure restoration	18
Climate change impacts drive mass population displacements	17
Strategic and regional tension	16
Persisting droughts (and forest fires) affecting vital systems (food supply chains), critical systems (energy, transport, water) and ecosystems and leading to massive public disorders	15
Release of hazardous materials in armed conflict settings	15
Tropical storms affect new and less prepared areas	14
Hybrid threats	14
Development to resistance to antibiotics	14
Energy vulnerability and financial destabilisation	14

Most commented risks

Title of Risk	Number of Comments
Out of control cyber-attack vector	6
Release of hazardous materials in armed conflict	4
Space as a domain for CI	4
Internet of Things Devices	4
Higher morbidity and mortality during crises during lack of trust in public institutions	4
Rejection of government risk communication	4

The first four are socio-technical issues and the last two socio-political issues. The most commented risks have garnered between six and fifteen votes. The comments include specification or more detailed scenarios of the proposed risks, agreement or disagreement with it being classified as emerging critical risks, possible cascading effects or consequences of the risks, questions, or its relation to broader issues. The risks which have garnered the most comments are thus risks where there has been a divergence between the respondents and their assessment/opinion.

For instance, the socio-environmental risks (the most voted upon domain) has the least comments on the risks (a maximum of two on one risk, which are questions for clarification).

Risks that were added by respondents

Socio- technical

Title of Risk	Number of Votes	Number of Comments
Misuse or out of control of Artificial Intelligence	12	3
Space as Domain for Critical infrastructure	7	4
Underwater cables and pipes as domain for Critical infrastructure	7	3
Internet of Things Devices	6	4
Quantum Computing	5	2
Big Tech powers harboring monopoling, their influence on politics (policymaking) and individuals due to gathered information	3	1
Increased vulnerability to electromagnetic threats		
Biosecurity risks arising from expanded use of cloud labs	2	
In-space collision with key servers due to space congestion	2	
Threats of Interdependence	2	1
Abuse of (international) standard bodies to allow for monopolisation of developing technology	1	1
Digital divide / societal split along technological lines	1	
Cryptocurrencies and criminal financial flows due to lack of transparency and regulation	1	

Socio-environmental

Title of Risk	Number of Votes	Number of Comments
Persisting droughts (and forest fires) affecting vital systems (food supply chains), critical systems (energy, transport, water) and ecosystems and leading to massive public disorders	15	1
Increased frequency of serious natural disasters	12	
Lack of sufficient storage options for storage of renewably generated electricity (limiting decarbonisation)	6	
Soil degradation	6	
Manmade toxic and hormonally active agents in the environment	5	1
New animal-borne diseases	4	1
Space weather and Near Earth Objects	4	
Destabilisation of the surface as a result of an increased and intensive subsurface use	2	2
Armed conflicts' emissions derailing climate change targets	2	1
Phosphorus dependency	1	

Socio-political

Title of Risk	Number of Votes	Number of Comments
Disinformation and social polarisation	23	2
Strategic and regional tension	16	1
Hybrid threats	14	2
Development of resistance to antibiotics	14	1
Nuclear conflict affecting critical systems and climate and ecosystems	9	1
Deteriorating security policy situation (weakened adherence/respect for international norms/agreements and increased nationalism challenging social contract)	5	
Financial, economic, social, structural weakening of a country as a result of an accumulation of threats that have occurred	4	1
Bio-terrorism	4	
Ideological radicalism leading to violence and terrorism (e.g. extreme climate and animal rights activists)	4	1
Damaged economic relations between the East and the West	3	1
Increase in far left / far right violence	2	
Foreign direct investment in political parties/foreign funding of own diaspora groups, researchers and academics	1	
Assassinations of political opponents who are their own nationals but reside abroad	1	
Weaponisation of migration	1	
Exploitation of critical commodity and component supply chain fragility by foreign states	1	
State failure in a neighbour, key partner of geographically pivotal country	1	
Empowerment of extreme political parties 'supporters in democracies through their participation in foreign conflicts		

Attacks on transborder/transnational critical systems and infrastructure		

Other/ Hybrid

Title of Risk	Number of Votes	Number of Comments
Energy vulnerability and financial destabilisation	14	1
Disruption of global and regional food supply chain	13	1
Increasing lack of concern for truth, unbiasedness and reality	4	2
Attacks on space assets	3	
Plummeting birth rates	1	
Agro-terrorism used against a population's food source	1	1

From the 67 risks in total, 47 were added by the respondents.

Risks assessed during the second stage of the online brainstorm

The prioritised risks were:

Extreme and sustained heatwaves
Disinformation and social polarisation
Limits on drinking water due to acute water scarcity
Vector-borne diseases affecting to new areas
Raw materials scarcity impact infrastructure restoration
Climate change impacts drive mass population displacements
Strategic and regional tensions leading to armed conflict
System-wide impact of persisting forest fires
Release of hazardous materials in armed conflict settings
Large scale conflict induced displacement
Disruption of the global and regional food supply chain
Energy vulnerability and financial destabilisation
Political, social and economic destabilisation arising from hybrid threats

Instructions to the Respondents

OECD Online Brainstorm on Emerging Risks Stage 1: Risk identification

Dear respondent,

This constitutes the initial brainstorming session on emerging risks. The objective is to identify risks you think your countries should have on their radar.

By emerging risks we mean both new risks that have not been experienced in living memory are meant as are recognised hazards that take place in an unfamiliar context, under new conditions, and therefore whose likelihood and consequences are less well understood.

Based on your expertise and the assessments you are familiar with, **please identify any emerging risks you believe countries should be considering.**

As part of this stage of the brainstorm, you will be able to **comment (by clicking on the speech bubble icon)** and **vote (by clicking on the arrow icon)** on the suggestions of others, if you agree they should be considered by countries in their assessment, or if consider them particularly interesting and important to be analyzed further. You can also use the comments to indicate those risks you think are not worth pursuing or those which are not defined well enough (and you can suggest how they could be better defined).

You can also add new risks to the list.

Furthermore, you can easily identify the risks you have already voted for or commented on, as your own input will be visible in the colour of the comment bubbles and arrows. You are also always able to add further comments to any risks (even those you have already commented on).

Your answers will be saved automatically, so you can just close the page and come back later to continue.

This step of the online brainstorming will be **open until 20th October.**

You are invited to visit the risk list several times before then, to see what others have proposed to the list, to vote risks that should be in your countries radar and should be assessed more carefully or to comment on the risks on the list.

OECD Online Brainstorm on Emerging Risks Stage 2: Risk assessment

Dear respondent,

This stage follows the initial phase of this brainstorm, where we asked respondents to add to a list of emerging risks which they thought should be in countries' radars. Respondents were then able to add their own comments to each risk and vote for the risks they considered should be a priority for assessment.

You are now being asked to consider those risks that were ranked the highest from the previous state and provide a very top level assessment for each one of them.

Based on your knowledge of existing assessments, please indicate what you perceive to be the expected likelihood, scale of impacts, broad capacity levels and any additional capacities which might be required.

We are also asking you to please identify the confidence level attached to your assessment.

For this stage of the brainstorm, you will only be able to see your own assessment. At the end of this phase of the brainstorm, the secretariat will analyse the information collected and create visualisations that can serve to frame conversations about next steps.

Please note that, just like in the previous stage, all your answers are saved automatically, so you can just close the page and come back later to continue.

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