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Preparing for frontier risks in the new economy



Leaders in the public and private sectors manage a multitude of risks. Among these are high-likelihood, high-impact threats that don't come out of the blue but instead follow a series of indications and evidence that such an event was on the horizon, such as the 2008 financial crisis (these have been called "grey rhinos" because of their scale and probability).¹⁰⁵

At the other end of the predictability spectrum are so-called "black swan" risks,¹⁰⁶ which are characterized by their extreme rarity, severe impact

and improbability, such as the use of civilian aircraft in the 9/11 terrorist attacks.

Recognizing that attention and resources are focused on managing immediate crises, this chapter spotlights a unique kind of risk alongside the predicted and the almost-impossible-to-predict: "frontier risks" – risks that emerge at a frontier as technologies surface or human and societal forces shift. These risks are characterized by their unknown likelihood, unknown impacts or both.¹⁰⁷

TABLE 1 **Frontier risks**

	Low impact	High impact	Unknown impact
Low likelihood	<ul style="list-style-type: none"> – Minor manufacturing error 	<ul style="list-style-type: none"> – 9/11 use of civilian aircraft – Supervolcanic eruptions 	<p>Frontier</p> <ul style="list-style-type: none"> – Democratic backslide – Militarization of space
High likelihood	<ul style="list-style-type: none"> – Global warming by .01C – Minor road/transport accidents 	<ul style="list-style-type: none"> – 2008 financial crisis – Global warming by 3C – Growing inequality 	<p>Frontier</p> <ul style="list-style-type: none"> – Genetic engineering enhancement – AI weaponry – Extreme citizen unrest
Unknown likelihood	<p>Frontier</p> <ul style="list-style-type: none"> – Isolated data theft 	<p>Frontier</p> <ul style="list-style-type: none"> – Bioweapons – Human-engineered pandemic 	<p>Frontier</p> <ul style="list-style-type: none"> – Permafrost methane release – AI superintelligence

There are at least four critical realms in which humans are advancing and for which there is more limited understanding of whether, when and how specific risks could emerge:

- Advancing into new territorial and geographic frontiers, e.g. through space exploration.
- Breaching ecological and environmental boundaries, e.g. through geoengineering.
- Expanding frontiers in human communication, e.g. through social networks and AI.
- Reaching a new human-technology frontier, e.g. through genetic enhancement.

Additionally, in many cases, potential risks will lie at the intersection of frontiers (e.g. risks emerging from brain-computer interface technologies). Frontier risks could manifest as an extreme version of a known risk, or as a completely new phenomenon, and its emergence could be rapid, gradual or non-linear.¹⁰⁸

Examples of frontier risks could include fallout from militarization of outer space or unforeseen damage from AI weaponry, risks that would carry harms if manifested but for which the likelihood is unknown

today (see Table 1). Breaching ecological frontiers could also bring about risks: for example, a rapid, massive methane release if permafrost melts quickly – an "unknown unknown". New frontiers in human communication channels could engender risks with unknown characteristics as well; for example, if democracy breaks down within a country or political identity crises intensify because of social networks. New technological frontiers such as nanotechnology may exacerbate existing or carry novel risks, too.

While decision-makers must confront the risks of all categories, frontier risks require exploration for three reasons: 1) the early-warning signs are often subtle and difficult to detect; 2) these risks are less likely to be understood beyond a niche group of experts; and 3) their uncertainty means they could manifest at any point, and with any magnitude. Before exploring pathways to better preparedness, however, it is important to consider why decision-makers so often fail to prepare for these risks. Armed with this understanding, the chapter then postulates pathways towards better resilience. It represents the latest thinking based on consultation with leaders from government, business and civil society in the Global Future Council on Frontier Risks.

Frontier risk pathologies

Failure to understand and effectively build resilience against frontier risks is the result of certain “pathologies” – from human neurobiology and psychology to societal norms to institutional architecture – that can lead to paralysis or errors in judgement in the face of uncertainty. Each of the pathologies listed below could represent an entire field of study and such a treatment is not attempted here. Rather, the purpose is to touch upon the various ways in which phenomena such as frontier risks are underappreciated by individuals, governments, organizations and societies alike.

- The human brain is powerful, but it is subject to many forms of systematic error in judgement – **or cognitive biases** – when processing information.¹⁰⁹ Some errors that are particularly problematic when confronting uncertainty include: information overload, failure to notice subtle changes in the environment, future devaluing (“the present is more important than the future”), bystander effect (“someone else will deal with this”) and ambiguity biases.¹¹⁰
- **Misinformation or disinformation**, spread through social networks, can fill in information gaps, ultimately swaying individuals and groups into believing or acting upon false information.¹¹¹
- **Vague warnings** within dense and noisy information sets make deciding upon action challenging, particularly when there are divergent understandings about predictions, probabilities or time frames.¹¹²
- **Diffuse accountability** in government, organizations or societies may leave risk(y) management decisions unaddressed.¹¹³
- **Fragmentation** between risk experts, the scientific community and decision-makers can lead to isolated policy choices.
- **Political cycles** often reward funding immediate priorities, which can impede resourcing for longer-term, less-certain risk preparedness.
- The **cost of action** (which may not be fully representative in any case) is often weighed against the **risk of doing nothing**.
- For some, there may exist fear of addressing future crises because of **obligations** – financial, legal or otherwise – that arise once risks are acknowledged.
- **Information gaps** may exist where there is a lack of intelligence on certain types of risk scenarios.
- Certain **societies or belief systems** may reinforce a disregard for frontier risks or fail to build resilient systems to face them, whereas others embrace a “fail forward” culture.
- **Lack of public trust** in public and private institutions that warn of frontier risks can exacerbate head-in-the-sand approaches to potential future challenges.



Confronting frontier risks

This section offers decision-makers pathways that can help them confront frontier risks better. In some cases, there are opportunities to hedge against frontier risks; in others, it may only be possible

to mitigate exposure. Some pathways flow from lessons learned in responding to more traditional risks, such as the COVID-19 pandemic, and others offer novel opportunities to explore the goal of more resilient societies.

6.1 Identifying and prioritizing frontier risks

While identifying and prioritizing is a challenge for all risks, it is particularly difficult for frontier risks because the early-warning signs are often subtle and ambiguous. This makes interpretive, or sense-making processes, more complex than in situations

that are more representative of the status quo. Compounding the problem is the simultaneous momentum to push towards or beyond a frontier that could blind (consciously or unconsciously) decision-makers from perceiving a risk.

6.1.1 Use horizon-scanning tools and institutions to expand the risk universe

Most individuals do not regularly observe the world around them, which makes it hard to notice subtle signs that signal shifts. Similarly, the more obscure a risk or the more distant someone is from a situation, the harder it is to pay attention to it. These barriers can be even higher in groups, such as in government institutions or businesses, where individual biases may be magnified. More regular frontier risk assessment that uses horizon scanning could help make identification more robust. Strategies to employ might be:

- **Leverage existing lists of risks as starting points**, e.g. public national risk registers or lists developed by business or civil society organizations (business, civil society).

- **Use methodologies such as Delphi groups** (which convene expert panels to consult on a particular issue or offer future scenario possibilities) and crowdsourcing and radar plots, which provide useful tools in threat conception where there may exist uncertainty (government, business, civil society).
- **Explore organizations that focus on risks with uncertain characteristics**, such as the Centre for the Study of Existential Risk, the Future of Humanity and the Centre for the Future of Intelligence; experts or outputs from these groups could help illuminate the contours of these risks for all sectors (government, business, civil society).

The Centre for the Study of Existential Risk submitted recommendations to the UK House of Lords on foresight and horizon-scanning methods for managing unknown, long-term and emerging risks.¹¹⁴

The CRO Forum, a consortium of chief risk officers from large multinational insurance companies, provides another effective methodology: it runs an Emerging Risk Initiative that gathers and develops insights into new or developing risks in addition to existing risks. Risks identified in the most recent Emerging Risk Radar include “new frontiers for resource extraction”, “plastics and microplastics” and “synthetic biology”.¹¹⁵

6.1.2 Call out and test assumptions

Part of the challenge in managing frontier risks is that “group-think” or siloed thinking can create blind spots in longer-term or less perceptible threats. One way to help overcome these biases is to bring in a diversity of perspectives to call out risks and test assumptions. Outside experts, for example, from a variety of disciplines, will be able to view an issue or situation from a distinct perspective, bringing fresh thinking to risks. Similarly, within organizations or institutions, diverse voices, including on-the-ground workers, can spot subtle issues that may not be visible to more senior decision-makers. Strategies to implement this pathway are:

- **Develop task forces** composed of diverse, cross-sectoral experts convened with a mandate to probe a specific frontier, such as deep-sea exploration (government, civil society)

- **Invite senior experts to peer review crisis or management decisions** in a scenario-based exercise (“red-teaming”) to test decision-making and foresight in relation to frontier risks (government, business, civil society).
- **Maintain a direct line between risk managers and on-the-ground workers**, who can more readily detect weak cues that may be early-warning signs of a frontier risk (government, business, civil society).

Swissgrid, the electrical network operator in Switzerland, operates a RiskTalk app and associated triage team that provides all employees with a channel to report, anonymously if they wish, any issue that could impact strategy, operations or safety.¹¹⁶ The company also convenes regular, interactive workshops for each subteam in which participants review previously identified and new risks.¹¹⁷

6.1.3 Prioritize and identify responsible actors where possible

Beyond identification, it is also useful for decision-makers to set priorities related to frontier risks, which will help organizations or individuals take decisions about resource allocation and timelines for intervention. Given the nature of frontier risks, it is difficult to prescribe a particular priority as each government, organization or individual might think about cost/benefit, risk, and reward differently; however, one approach might be to structure priorities around potential impacts (see Table 2). Additionally, frontier risks are unlikely to be confined to a single agency, particularly in the government context, so if it’s possible to assign “ownership” of a frontier risk, doing so could also help mitigate bias towards inertia. To implement this, decision-makers could:

- **Approach priorities based on factors other than likelihood** where such analysis is not possible, e.g. gestation period, overall size of impact or stakeholder priorities (government, business, civil society).
- **Track scientific and legal developments**, which may signal which risks are closer on the horizon and how impactful they may be (government, business, civil society).
- Once identified, **target specific agencies** to monitor and develop preparedness tactics for specific frontier risks (government).

TABLE 2 Sample prioritization

Tier 1	Tier 2	Tier 3
High impact/unknown likelihood	Unknown impact/high likelihood Unknown impact/unknown likelihood Unknown impact/low likelihood	Low impact/unknown likelihood



6.2 Developing and communicating scenarios

Without data to build probability models, well-formed scenarios developed in a collaborative process can help draw out potential impacts.¹¹⁸ Articulating the sources, drivers, amplifiers and tipping points of a particular risk will help flesh

out its shape and provide potential avenues for preparedness. Harnessing the methodologies described above can also ensure scenarios are robust enough to be useful to policy-makers.

6.2.1 Use narrative

Developing narratives around scenarios will awaken policy-makers and the public to more uncertain threats.¹¹⁹ Stories can much better communicate a threat as they will often elicit emotions that factual information alone may not. The best long-term scenarios are based on drivers and trends, which are then played out in multiple future dimensions. Importantly, effective narratives around uncertain risks should focus not only on protective actions, but also on clear explanations of the nature and known/unknown character of the risk in language that is accessible to the community. Strategies for better narrative development could be:

- **Appeal to collective experiences**, which often helps narratives find greater uptake (government, business, civil society).
- **Use other sensory tools**, such as art, gaming or virtual reality, to help fill gaps and make threats real (government, business, civil society).
- **Accompany the emphasis on threat with messages of hope**, such as offering examples of feasible pre-emptive actions that might help mitigate or avert the risk (government, business, civil society).

Although climate change is not a frontier risk, Indian Prime Minister Narendra Modi was successful in building a narrative on its mitigation measures around India's ancient texts, which helped transform a divisive North-South debate into a homegrown issue that the Indian populace could own.¹²⁰

Superflux, a strategic foresight company, took another approach: it imagined what a future UAE would smell like if no pollution measures were taken and created a scent for it.¹²¹

6.2.2 Ensure transparent risk communication

Once frontier risks are identified and mitigation scenarios are developed, they should be directly and transparently communicated to populations. COVID-19 has provided clear examples of the value of regular and consistent public reporting and the governments that have most successfully sustained popular confidence throughout the crisis have been able to do this well.¹²² Importantly, boosting epistemic security – or ensuring access to reliable information – can also facilitate resilience against threats with uncertain characteristics.¹²³

Additionally, more regulation of social networks, including penalties for those who may be knowingly perpetuating false information, could help take the onus off individuals to filter out misinformation

or disinformation, and place it on the government or businesses overseeing such networks. To implement this pathway, it is important to:

- Use as **precise language** as possible (government, business, civil society).
- Be intentional about **timing and format** of communications (e.g. weekday versus weekend communications) (government, business, civil society).
- Regulate media outlets to ensure **baseline standards for information** (government).

Twitter introduced warning labels to provide additional context and information on tweets containing disputed or misleading information related to COVID-19.¹²⁴ UK Research and Innovation also recently issued a call to establish a centre of excellence focused on epistemic security.¹²⁵

6.3 Refining organizational structures

While many organizations, public or private, employ strong enterprise risk management (ERM), these systems can fall short against frontier risks, which may not fall neatly within its frameworks. Governments, particularly, would benefit from centralized foresight bodies that have capacities

including but not limited to ERM frameworks. Both public- and private-sector organizations should also encourage cultures that accept uncertainty and value openness to alternative viewpoints – characteristics associated with both better risk detection and quicker recovery from shocks.

6.3.1 Invest in a coordinating government body to oversee risk management and resilience.

In the public sector, especially, frontier risk resilience often requires an all-of-government approach.¹²⁶ Thus, a coordinating body, ideally centralized with direct lines to both the head of government and on-the-ground units, could help avoid narrow viewpoints and non-systemic solutions.¹²⁷ The Government of New Zealand, for example, has instituted a national coordinating mechanism used across functions to manage risks.¹²⁸

At the same time, such a risk unit, to the extent that it is granted the authority needed to execute a broad-based mission, should also be checked against abuse and human biases. Independent, multidisciplinary ethical commissions could act as

such a check. Reorienting risk identification and response functions in these ways is not only vital to a government's ability to see through a crisis but also contributes to its broader competitiveness. Strategies to coordinate frontier risk management include:

- **Incorporate a frontier risks arm** into ERM functions (business).
- **Empower a coordinating body**, led by a champion for foresight, to oversee risk management across agencies and functions (government).

6.3.2 Build conducive cultures

Certain characteristics allow organizations to be more receptive to perceiving and preparing for frontier risks. Organizations that accept change and uncertainty, track and learn from small failures and rely upon front-line local knowledge can build a dynamic situational awareness that enables them to anticipate and contain surprises.¹²⁹ Monitoring systems that regularly reach senior-level management will ensure buy-in on the suite of possible scenarios that could arise from emerging risks.¹³⁰ Finally, trust and openness is critical: an environment that is psychologically safe, diverse and inclusive will encourage and reward perspectives that illuminate frontier risks and opportunities more than one that is not¹³¹ (see Chapter 4). These principles held up in the most recent crisis: organizations that scored higher on ESG metrics were better able to weather COVID-19 storms.¹³² To build such cultures, organizations can:

- **Assess organizational culture** through interviewing and surveying the workforce to determine where gaps might exist in characteristics conducive to better risk management; recruit and develop leaders to help close those gaps (government, business, civil society).
- **Train workforce in risk management**, exposing workers to frontier risks and how they might manifest (government, business, civil society).
- **Empower the entire workforce to understand the new frontiers** that the business or organization may be reaching (government, business, civil society).

6.4 Enhancing regulatory regimes and resilience financing

Along with significant uncertainties, reaching new frontiers can bring great opportunities. Governments, regional bodies and international organizations have

a role to play in hedging against potential risk by ensuring unintended consequences of a frontier risk manifested do not beset advancements.

6.4.1 Consider resilience financing

Public financing for frontier risk resilience must be (re)considered. For example, rather than assessing loss (and therefore future risk) from the direct impacts of risks such as national disasters or cyberattacks, governments should account for frontier risks: longer-term impacts, new factors and interconnections that could exacerbate down-the-line costs. While debt is already at an all-time high, some countries have managed to retain national emergency funds and crisis reserves, while others promote or provide unique insurance arrangements to shore up protections. One lesson from the COVID-19 crisis is that cushions such as automatic stabilizers and agile emergency spending triggers are key to ensuring economies can bounce back from unanticipated shocks (see Chapter 1).

Sovereign wealth funds (SWF), particularly when used transparently, could also be a useful tool to allocate resources to offset the impact of disasters, including those related to frontier risks.¹³³ For example, some countries with SWFs, such as Botswana, Chile, Peru, Kazakhstan, Namibia, Tanzania, Timor-Leste and Trinidad and Tobago, have been able to borrow against these funds, taking advantage of low interest rates on sovereign debt.¹³⁴

Infrastructure investment and redundancy expenditure is vital as well, with a focus on critical assets. Such initiatives are part and parcel of a country's ability to absorb unanticipated shocks and, therefore, its competitiveness. The Room for the River project in the Netherlands is a good example, investing 1.2% of gross national product each year in flood prevention.¹³⁵

Lastly, engineering choice architecture around public and private financing of frontier risks can also help overcome psychological biases that may prevent individuals or institutions from making the forward-thinking resilience investments needed today.

In financing resilience, strategies include:

- **Provide innovative insurance solutions** that can bridge gaps between frontier risks and opportunities (government, business).
- **Determine critical infrastructure assets** and develop a plan for investment in them (government).
- **Build strategies for overcoming risk pathology into business models**, e.g. ensuring long-term, frontier costs are incorporated into current plans (business).

The Dutch Bank ING addressed risk pathologies head-on by adding a behavioural risks management team to its global risks strategy in 2018. The team identifies high-risk behaviours and their drivers and analyses them in a “nudge lab”, which allows employees to explore their behavioural biases and develop simple but effective solutions to overcome them.

Flood insurance schemes provide another example of how choice architecture can force forward-thinking decision-making in relation to risk. For example, in some countries such as France and Spain, government-backed schemes include a compulsory, flat-rate surcharge for flood and other hazard coverage, whereas in the UK, flood coverage is included in standard household insurance (and required by mortgage lenders).¹³⁶

6.4.2 Responsibly regulate new frontiers

Governments and international bodies should prioritize closing obvious gaps in legal frameworks governing new frontiers, such as in the realm of space or AI. For instance, the last major treaty governing outer space entered into force more than half a century ago,¹³⁷ while space activity has expanded dramatically in the intervening years.¹³⁸ Similarly, new technologies should be regulated against malicious or unintentionally harmful use. This requires governing institutions to bring in, develop or collaborate with the private sector to harness the expertise needed to understand and responsibly regulate such technologies. A new or reoriented transnational body could also play a role: e.g. gathering various ethical standards and frameworks relating to frontier risk topics, such as a new technology, and providing standardized, industry-specific guidelines (see Chapter 5).¹³⁹ The

Global Partnership on AI provides an example of a transnational, multistakeholder approach to ethical techniques for one set of new technologies.¹⁴⁰ Strategies to ensure better regulation include:

- **Educate the public** on new frontiers and the possible risks they might carry (government, civil society).
- **Exercise precautionary principles** in the development of new technologies (government, business).
- **Leverage current international or transnational organizations** that may be well placed to coordinate frameworks or standards for new realms (government, civil society).

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