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Interventions for Rapid Global Change

Introduction to Polycrisis Analysis

A Guide to the Cascade Institute's Approach

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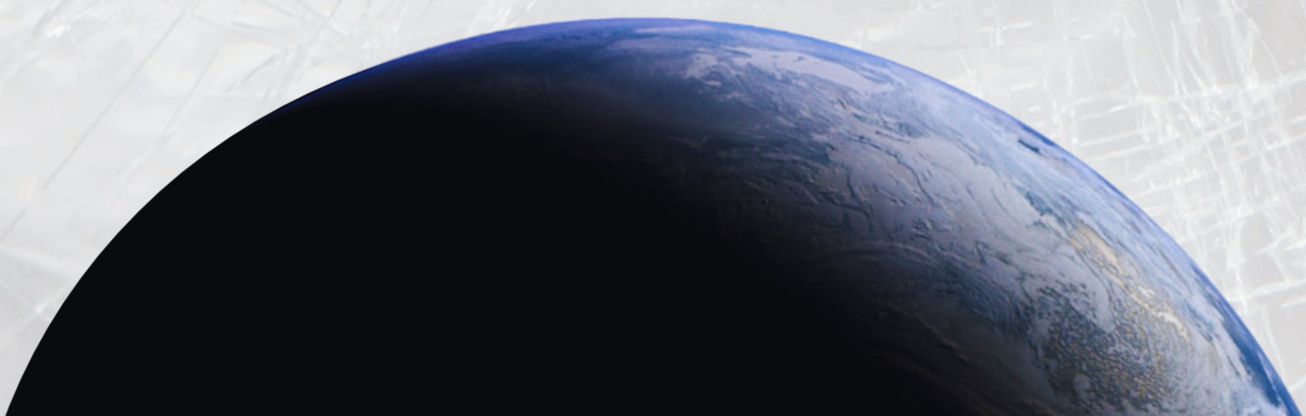


Summary

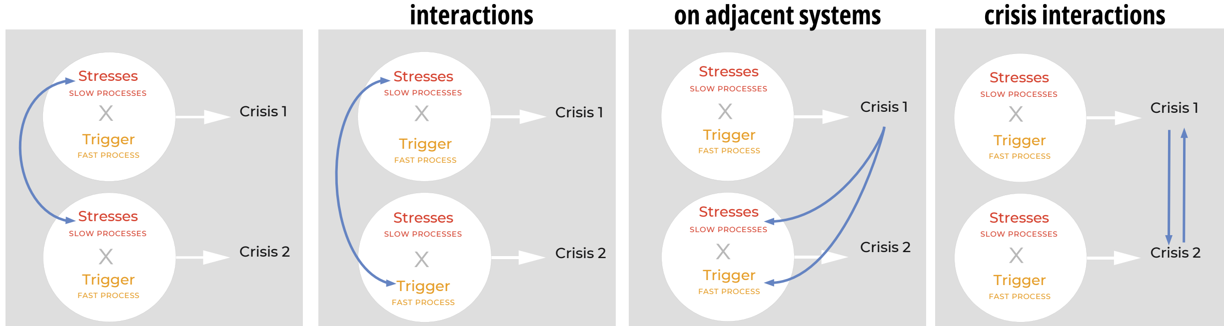
This briefing note presents the Cascade Institute's framework for polycrisis analysis. It introduces an integrated set of concepts that clarifies interactions between global systemic crises and the potential outcomes of those interactions. It is intended to help governments, firms, and communities see through the fog currently surrounding global risks more effectively, so they can better anticipate and respond to emerging threats.

In the following pages, we provide precise definitions for terms commonly used in global risk assessment, such as crisis, stress, trigger event, and flashpoint. And we introduce less commonly used concepts—such as systemic crisis, **dynamic equilibrium**, and global polycrisis—that will help analysts trace causal interactions among crises in multiple global systems.

At the core of our framework is the **stress-trigger-crisis (STC) model**, which depicts crises as the product of slow-moving stresses that interact with fast-moving **trigger events** to push a global system out of its established equilibrium and into a state of disequilibrium (**systemic crisis**) that causes major human harm.

We describe how the relationships between **stresses**, trigger events, and crises in two or more systems can combine to create four broad causal pathways. These pathways provide a "grammar" for mapping the distinct system interactions that can form a polycrisis.

Interacting stresses | **Inter-systemic stress-trigger interactions** | **Crisis impacts on adjacent systems** | **Inter-systemic crisis interactions**



Stresses in one system amplify stresses in a second system, or the two systems have common stresses.

Stresses in one system affect the trigger event of another system.

A crisis in one system may affect the stresses and/or trigger event of another system.

A crisis in one system may interact with a crisis in another system.

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Finally, we apply our framework to better understand real-world crisis interactions using two polycrisis mapping techniques: **domino diagrams** that chart the interactions of stresses, triggers, and crises among multiple systems along a causal timeline; and **inter-systemic feedback diagrams** that depict the cyclical relationships by which a polycrisis can become self-amplifying.

This guide summarizes concepts developed in much greater detail in the paper: Michael Lawrence, Thomas Homer-Dixon, Scott Janzwood, Johan Rockström, Ortwin Renn, and Jonathan F. Donges. 2024. 'Global Polycrisis: The Causal Mechanisms of Crisis Entanglement'. *Global Sustainability* 7. doi: 10.1017/sus.2024.1.

Key points

THE GLOBAL RISK ASSESSMENT LANDSCAPE

- Private and public sector organizations conduct three main types of global risk assessment: **risk lists**, **flashpoint reports**, and **stress analyses**.
- The Cascade Institute's approach focuses on the underlying stresses that render global systems vulnerable to crises.

WHAT IS A GLOBAL POLYCRISIS?

- A **global polycrisis** occurs when crises in multiple global systems become causally entangled in ways that significantly degrade humanity's prospects.
- When crises interact, they reshape and intensify one another to produce harms both greater than and different than the sum of the harms they would produce separately.

THE STC MODEL: THE ELEMENTS OF POLYCRISIS ANALYSIS

- **Stresses** are slow-moving processes—such as increasing socio-economic inequality, climate heating, and demographic change—that gradually, over the course of years or decades, erode a system's equilibrium, making it progressively less resilient. Stresses tend to be societal, regional, or global in scale, and their slow pace makes them somewhat predictable.
- **Trigger events** are fast-paced events—such as an assassination, major bankruptcy, or devastating storm—that interact with one or more stresses in timespans of seconds to weeks to push a system out of its equilibrium. Triggers tend to be local in scale and stochastic in nature, so they are generally unpredictable in the time and place of their occurrence.
- A global **systemic crisis** occurs when one (or more) fast-moving trigger event interacts with one (or more) slow-moving stress to push a global system from its established equilibrium into a state of disequilibrium that causes major human harm.

POLYCRISIS MAPPING: THE GRAMMAR OF CRISIS INTERACTIONS

- Stresses, trigger events, and crises in multiple systems can influence one another in four ideal type pathways (see figure above), which together provide a grammar that can be used to trace the causal relationships of a polycrisis.
- Two mapping techniques apply this grammar to chart the causal interrelationships between systems in crisis:
    - Domino diagrams trace the causal relationships between stresses, triggers, and crises in multiple systems as they unfold over time, presenting a causal timeline
    - Inter-systemic feedback diagrams capture the cyclical and synchronous relationships between stresses, triggers, and crises, depicting feedback loops by which effects influence their own causes.

1. The global risk assessment landscape

KEY POINTS

- Private and public sector organizations conduct three main types of global risk assessment: risk lists, flashpoint reports, and stress analyses.
- The Cascade Institute's approach focuses on the underlying stresses that render global systems vulnerable to crises.

Global risk assessments are a regular—often annual—activity for many companies, consultancies, governments, think tanks, and international organizations. Though all these organizations scan the same general risk landscape, their assessments paint different pictures of the world's potential harms. Many of these differences emerge from how their risk assessments answer three foundational questions:

1. What is the value (or object) to be protected from harms?

Global risk assessments focus on different harms depending on which referent "thing" they hope to protect, whether it is humanity as a whole, an organization's investment portfolio, the national interest, the ecosphere, international order, the global business environment, or some other object of value.

2. What is the nature of potential harms?

Harm can be conceptualized in different ways that then shape the characterization and analysis of global risks. Assessments can be roughly grouped into three (non-exclusive) categories distinguished by their conception of harm: risk lists, flashpoint reports, and stress analyses.

Risk lists: Many assessments present laundry lists of pressing issues that are perceived to constitute threats across multiple systems and geographies. The World Economic Forum's (WEF's) 2024 *Global Risks Report*,[1] for example, includes 34 global risks; Eurasia Group[2] and BlackRock[3] each publish a "top ten" risk list. Meanwhile, the UN Office for Disaster[4] Risk Reduction maintains a list of 302 "hazards."

Flashpoint reports: Other assessments tend to focus on violent conflict by highlighting existing problems in particular regions of the world that have the potential to escalate in highly consequential ways. Examples include the Armed Conflict Location and Event Data Project's *Conflict Watchlist 2024,*[5] the Council on Foreign Relations' *Conflicts to Watch in 2023,*[6] and the International Crisis Group's monthly *Crisiswatch* tracker of conflict escalation risks.[7]

Stress analyses: Some assessments focus on mid-to-long-term systemic stresses that generate the flashpoints and risks identified by the other two approaches. Stresses (sometimes called "drivers") include such global trends as demographic changes, technological advances, geopolitical shifts, politico-ideological movements, growing resource scarcities, economic cycling, and ecological degradation, among others. Stress analyses are common in foresight and scenario planning exercises, such as the US National Intelligence Council's (NIC's) *Global Trends* reports.[8]

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3. How does the assessment determine which potential harms are of greatest concern?

Once values and harms have been conceptualized in a certain way (whether as risk lists, flashpoint reports, or stress analyses), analysts can use several methods to identify, assess, and rank the specific sources of potential harm that are most pressing. They may use in-house expertise to create a rough-and-ready situational assessment (e.g., Eurasia Group's *Top Risks 2024*), engage in a broad expert elicitation using standardized surveys (e.g., the WEF's *Global Risks Reports*), or use some form of quantitative-algorithmic modelling to prioritize risks (e.g., BlackRock's *Geopolitical Risk Indicators*, which mines brokerage and financial reports using machine learning to rank risks according to market sentiment). In one way or another, each of these methods collates expert opinion into an inter-subjective assessment of the likelihood and severity of future events.

Table 1 compares prominent global risk assessments according to the three foundational questions discussed above.

Table 1 : Comparison of notable global risk assessments

	WEF's *Global Risk Reports*	Eurasia Group's *Top Risks*	Blackrock's *Geopolitical Risk Dashboard*	ICG's *Crisiswatch*	US NIC's *Global Trends* Reports
Referent at risk of harm	Global economy	Global economy	Global economy	Human lives	American geopolitical interests
Conceptualization of harm	Risk list	Risk list	Risk list	Flashpoint report	Stress analysis
Method of Assessment	Structured expert elicitation	In-house expertise	Report mining with quantitative- algorithmic analysis	In-house expertise	In-house expertise

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Of the above approaches, no one is inherently better or more reliable than the others, but each has strengths, limitations, and biases that can shape its findings in subtle ways.

Risk lists provide a straightforward way to prioritize risks based on the product of each risk's likelihood and potential harm. The higher the product, the greater the priority, echoing economists' notion of "expected disutility." But risk lists have four major shortcomings.

First, they often present mixed bags of abrupt trigger events, long-term stresses, and flashpoints. By blurring these categories, they impede efforts to trace the interrelationships between risks. Second, when risk lists are based on survey results, they are subject to availability bias—people's tendency to draw on information or examples that come most immediately to mind. Survey respondents may fixate disproportionately on issues that happen to be in the headlines at the time of their input. Risk lists are, consequently, often capricious and can vary widely from year to year. Table 2 below suggests that both of these issues affect the WEF's *Global Risks Reports*.

Third, risk lists assume that risks are independent from each other, when it is increasingly evident that today's risks are *interdependent*. They are entangled by complex and hidden causal linkages, so that the realization of one risk into a crisis alters the likelihood and impacts of other risks. Traditional methods of risk prioritization are therefore ill-suited to gauge risk in interconnected global systems.

And finally, when risk lists do map risk interconnections (e.g., the WEF's risk interconnection diagrams in its *Global Risks Reports*), they present only static correlations between risks that are perceived to influence one another. They do not analyze the nature of these relationships as they evolve—and perhaps amplify each other—over time, which would help explain the current and future behaviour of interconnected systems.

Flashpoint reports tend to focus more narrowly on violent conflicts that could emerge out of existing conflicts or geopolitical tensions (often in conjunction with other factors, such as extreme weather events). This approach has the advantage of geographical specificity, but it often does not fully capture the underlying global stresses that converge at a given flashpoint.

Stress analyses focus on the root causes of risks and approach risk assessment from a systems perspective. Stresses often reach a tipping point at which gradual change suddenly produces non-linear effects, like an economic crisis, the collapse of an ecosystem, or the eruption of violent conflict. But no stress analyses, to date, have offered precise predictions of when and where tipping events will occur, which has limited their utility for organizations hoping to inform short-term decision making. More fundamentally, none have rigorously assessed the *complex interactions among multiple stresses* that appear to be causing the crisis cascades observed today.

The Cascade Institute's polycrisis analysis focuses on the stresses underlying global crises. We analyze many of the issues that appear on risk lists and highlight trigger events that could ignite flashpoints. But because those triggers are highly unpredictable and widely abundant, our approach targets first and foremost the *interactions among stresses* in global systems that lend trigger events their causal power and compound their consequences.

In the next section, we outline a framework of polycrisis analysis that aids understanding of today's acceleration, amplification, and synchronization of global crises. Section 3 describes the basic STC model by explaining how stresses, trigger events, and crises interact within a single system. And Section 4 combines the STC model with causal mapping techniques to explore the interactions between *multiple systems* in crisis.

Table 2. The influence of availability bias? Only four of the top-ten risks in the WEF's 2023 *Global Risks Report* reappear in the report's 2024 top-ten list

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2. What is a (global) polycrisis?

KEY POINTS

- A global polycrisis occurs when crises in multiple global systems become causally entangled in ways that significantly degrade humanity's prospects.
- When crises interact, they reshape and intensify one another to produce harms both greater than and different than the sum of the harms they would produce separately.

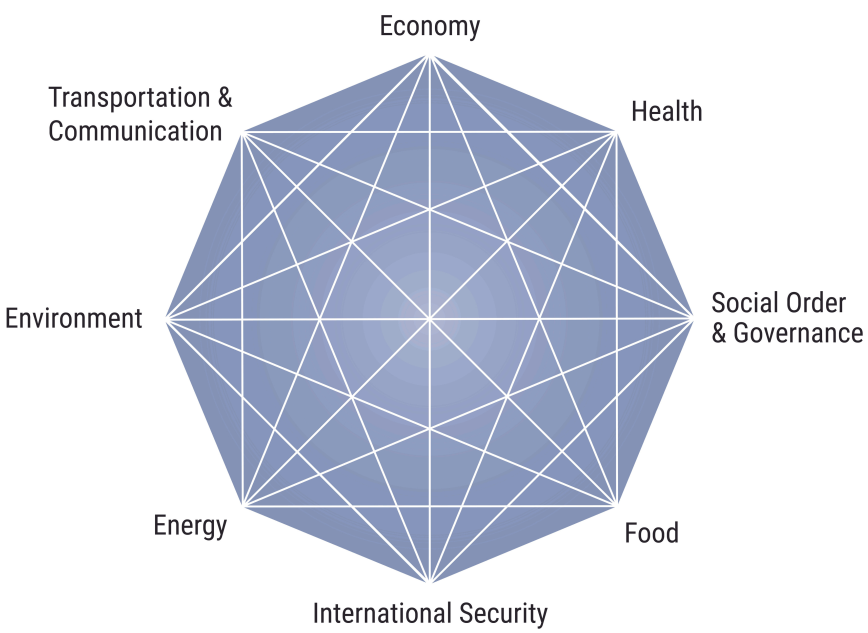
In the field of risk analysis, the term "risk" describes a shared perception (that may or may not be quantifiable) of the possibility of harm that may arise in the future from a particular event, such as a car accident, fire, or bankruptcy. As explained below, the Cascade Institute prefers the concept of "crisis" to capture not just potential events, but presently unfolding chains of cause and effect that result in realized harms, especially when they spread through interconnections among global systems.

In everyday use, "crisis" refers to an abrupt rupture of normalcy that significantly harms (or threatens to significantly harm) the wellbeing of a large number of people in a relatively short period of time, and thus requires an urgent response. [9]

All sorts of different things (or "referents") are routinely declared to be in crisis: a nation in crisis, the economy in crisis, a person in crisis, the climate in crisis, and so on.

A **systemic crisis** occurs at the level of a whole system, like an ecosystem or country. The Cascade Institute's polycrisis approach seeks to understand *global* systemic crises, where the referents are global systems, such as those shown around the octagon in Figure 1. We investigate how the departure of global systems from normal functioning—into **disequilibrium**—can be a source of significant harm.

Figure 1. Eight Global Systems



Global polycrisis defined

A global polycrisis occurs when crises in multiple global systems become causally entangled in ways that cause major human harm.

The interactions between constituent crises are significant enough to produce emergent harms that are different from, and usually greater than, the sum of the harms those crises would produce separately.

A polycrisis causes direct, immediate harms, and also restricts humanity's opportunities to flourish in the future.

What may appear to be separate crises in different systems in fact exacerbate and reshape one another to form a conjoined polycrisis that must be understood and addressed as a whole.

Differences between polycrisis and systemic risk

As noted, conventional risk analysis focuses on the *possibility of harm* arising from a particular event. **Systemic risk** analysis focuses on "the risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components." [10] Our polycrisis concept differs from these risk concepts in three important ways.

First, whereas risk analysis focuses on the *potential* harms that might arise, the polycrisis concept focuses on the *realized chains of cause and effect* that generate those harms.

Second, systemic risk analysis generally focuses on just one or two systems, whereas a polycrisis (by definition) arises from interactions among multiple systems.

And finally, the systemic risk literature highlights the complexity of risks, while our polycrisis approach instead emphasizes the complexity of the systems that generate those risks.

3. The STC model: Elements for polycrisis analysis

KEY POINTS

- Stresses are slow-moving processes—such as increasing socio-economic inequality, climate heating, and demographic change—that gradually, over the course of years or decades, erode a system's equilibrium, making it progressively less resilient. Stresses tend to be societal, regional, or global in scale, and their slow pace makes them somewhat predictable.
- Trigger events are fast-paced events—such as an assassination, major bankruptcy, or devastating storm—that interact with one or more stresses in timespans of seconds to weeks to push a system out of its equilibrium. Triggers tend to be local in scale and stochastic in nature, so they are generally unpredictable in the time and place of their occurrence.
- A global systemic crisis occurs when one (or more) fast-moving trigger event interacts with one (or more) slow-moving stress to push a global system from its established equilibrium into a state of disequilibrium that causes major human harm.
- The interaction between stresses and trigger events to produce a systemic crisis is the central causal mechanism of our **stress-trigger-crisis (STC) model**.

The Cascade Institute's polycrisis approach advances the study of contemporary global crises in two ways. First, our **stress-trigger-crisis (STC) model** provides a distinctly systemic understanding of crisis (see explanation in Figure 2). Second, we develop a causal "grammar"—a set of ideal-type causal pathways—that can be used to trace the interactions among crises in multiple global systems. In this section, we present the STC model to explain crisis in a single system, while in Section 4 we apply our causal grammar to explore interactions between multiple systems in crisis.

The Cascade Institute defines a systemic crisis as an incomplete critical transition in which one (or more) fast-moving trigger event interacts with one (or more) slow-moving stress to push a global system from its established dynamic equilibrium and into a state of disequilibrium that is both unstable and causes major human harm. This definition has several key components.

A complex system is never still, it is always in motion; but fluctuations in its day-to-day (and even year-to-year) behaviour tend to stay within a certain range of values—that is, within a **dynamic equilibrium**. Key feedbacks between a system's components keep its behaviour within this accustomed range and thereby maintain the "normal" functioning of the system amidst shocks and changes in its environment.

A **critical transition** (also known as a "regime shift") occurs when a system rapidly shifts from one dynamic equilibrium to another dynamic equilibrium—from one range of "normal" functions and behaviours to a different range of "normal" functions and behaviours. Critical transitions typically occur when gradual change in a key driving variable (what we refer to as a "stress") weakens or overloads the stabilizing feedbacks that maintain the established equilibrium, and the system reaches a threshold (or "tipping point") at which it "flips" to another dynamic equilibrium in a non-linear change that is very hard to reverse. Gradual reductions in moisture levels, for example, can cause a rainforest ecosystem to flip to a savannah ecosystem.[11]

But when a system is forced out of its established equilibrium, it may not immediately settle into another equilibrium.

It may enter a period of volatility, unpredictable behaviour, and disruption of basic system functions. The system is then in a state of **disequilibrium**. And when that disequilibrium generates harm to large numbers of people (which is almost always the case given its volatility), it constitutes a systemic crisis.

The COVID-19 pandemic, for example, stretched healthcare systems well beyond the bounds of their normal functioning—sometimes to the verge of collapse—and radically disrupted their ability to provide standard services. This disequilibrium created harms far greater than those arising from the spread of the SARS-CoV-2 virus alone.

If a systemic crisis is a period of incomplete critical transition, **crisis resolution** happens when the system either returns to its previous equilibrium or finds a new, stable equilibrium. In a new equilibrium, the system could behave in ways that generate better outcomes than within the previous equilibrium, or it could generate tremendous harms in the course of its normal functioning. A critical transition in an ecosystem, for example, may render one species maladapted to new conditions, so that its population declines, while a once marginal species may find a new niche and thrive. The key point is that such harms and benefits stem from the feedbacks and behaviours of the new equilibrium, rather than the tumult of disequilibrium.

Stresses

The STC model proposes that the interaction of slow-moving systemic stresses and fast-moving trigger events causes a systemic crisis. The slow-moving stresses reduce the **resilience** of an existing dynamic equilibrium (e.g., by disrupting the feedbacks that maintain it), so that one or more trigger events knocks the system out of that equilibrium.

Stresses create systemic risk—that is, the potential for a problem in one part of a system to spread through the entire system and disrupt its functioning. Stresses tend to be societal, regional, or global in scale, and their slow pace makes them somewhat predictable. We distinguish three types:

Pressures are forces that accumulate over long periods of time until they are suddenly released, like the tectonic stresses that produce earthquakes, or the long-standing grievances that drive a community to erupt in revolt. The flipside of growing pressure—depletion—is also a form of stress (e.g., the gradual desertification of arable land), but involves the exhaustion of a beneficial factor rather than the build-up of a harmful one.

Contradictions are conflicting forces or self- undermining processes within a system, like the tendency of unregulated markets to produce external costs—like pollution and extreme inequality—that, if unaddressed, threaten the social and environmental stability on which markets depend.

Vulnerabilities are the potential pathways to systemic failure that a system develops as it grows more complex. For example, the dense connections between global financial actors and the homogeneity of their financial instruments undermined the resilience of the global financial system and thereby contributed to the cascading failures of the 2007-9 global financial crisis.[12]

Trigger Events

Trigger events are the fast-moving (on a rough timescale of seconds to weeks) processes that interact with stresses to push a system out of its established equilibrium and into crisis, like the random lightning strike that ignites a forest fire after months of drought. Where stresses (such as drought) create the conditions for crisis, trigger events are the proximate causes of crisis (fire).

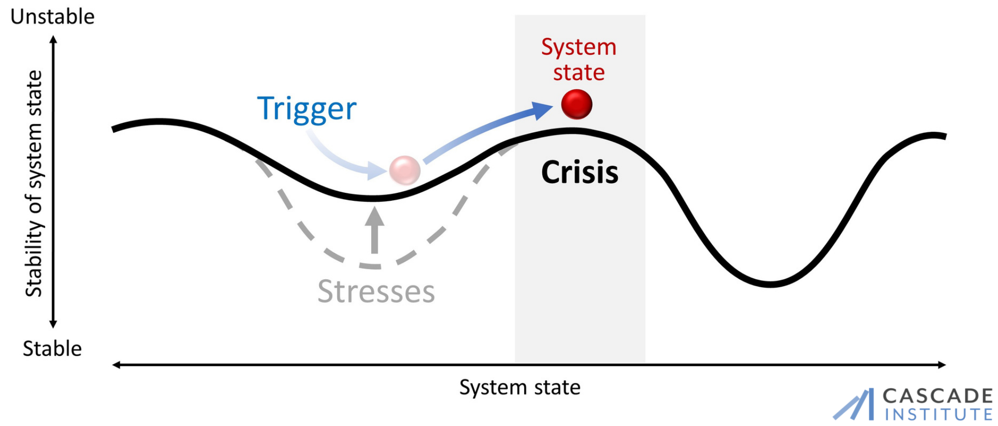
Trigger events tend to be short-lived and local or regional in scale. Their exact timing and location are largely unpredictable. We distinguish two types of trigger events:

Exogenous trigger events: Events generated by one system can act as the trigger event for another system. A spike in oil prices in the energy system, for example, could prevent farmers from planting or harvesting, thus producing food shortages in the food system.

Stochastic trigger events: Sometimes a system's equilibrium is so stressed that a seemingly random event is enough to tip the system into crisis. For example, the self-immolation of a fruit vendor in Sidi Bouzid, Tunisia sparked the revolutions of the Arab Spring, which ultimately transformed the politics of the Middle East.

Stability landscape diagrams help us visualize a systemic crisis by showing how the interaction of stresses and trigger events can force a system out of its dynamic equilibrium and into a state of disequilibrium. Figure 2 presents the STC-model as a stability landscape diagram:

Figure 2. The STC model of systemic crisis as a stability landscape



Stresses gradually shallow a basin of attraction so that a trigger event can push the system out of equilibrium and into systemic crisis.

The landscape's horizontal axis represents the full range of possible configurations of the system's variables and behaviours. The vertical axis represents the system's stability, where lower positions indicate greater stability than higher ones. The red ball represents the system's "state" at a moment in time.

The ball is always moving because a complex system is never still; internal processes and external influences from its environment create fluctuations in its state and behaviours. Those shifting states and behaviours, however, tend to stay within a normal range, defined as a dynamic equilibrium.

A stability landscape represents this dynamic equilibrium as a dip in the landscape—a **basin of attraction**—where stabilizing feedbacks keep the system within a segment of the full range of its possible states.

A basin of attraction is like a valley, with gravity pulling the system state (the ball) towards its bottom—towards greater stability—while other forces push it back up the sides. The ball never truly settles at the bottom of its basin. But as long as it stays within the basin, it remains in the same dynamic equilibrium—that is, within a familiar range of states and behaviours. The shape of the basin can change over time, but only slowly, because it represents deeply entrenched structures of the system and broader environmental conditions.

Stability landscapes generally have multiple basins of attraction—that is, multiple dynamic equilibria into which the system can settle, each encompassing a different set of behaviours. A critical transition occurs when a perturbation (what we call a "trigger event") pushes the system from its established equilibrium into another equilibrium, one that features a different range of system states and characteristic behaviours.

Once a system is forced out of equilibrium, it may take one of three paths: (1) it may move into a different basin, completing a critical transition; (2) it may return to its original equilibrium (if earlier conditions are restored); or (3) it may move around the landscape without settling into a basin, remaining in a state of disequilibrium—what we call a systemic crisis.

Any complex system faces constant **shocks** (or "perturbations") that affect its state and behaviours. If the system has a resilient equilibrium (a "deep basin," in the language of stability landscapes), these shocks will generally not be powerful enough to push it into disequilibrium; in other words, they will not be trigger events that create a crisis. But as the system becomes more and more stressed, it becomes increasingly likely that one or other shock (including some that earlier would have had little consequence) will ultimately push the system from its equilibrium.

By carefully discerning stresses, trigger events, and crises, the STC model helps us think more precisely about the causal processes of systemic crisis. Figure 3 shows two possible interactions between stresses, triggers, and crisis within a single system.

Figure 3. Crisis interactions within a single system

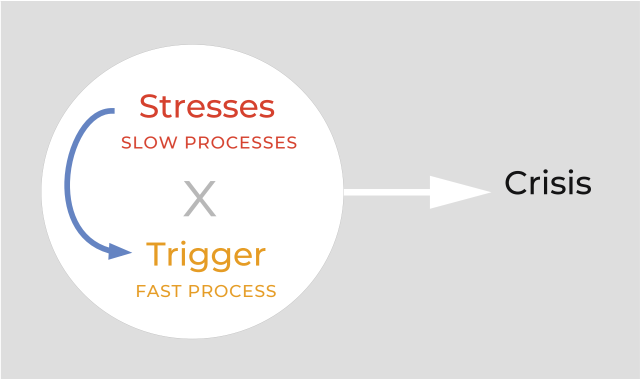


Figure 3A: Stresses may may generate trigger events within the same system. The stress of accumulating greenhouse gases, for example, may produce the extreme weather event that tips an ecosystem into a critical transition.

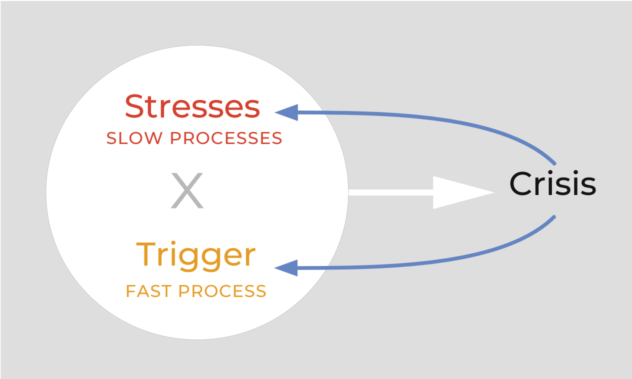


Figure 3B: A crisis may feed back upon (worsen) the stresses and/or trigger event that produced it. A financial crisis, for example, may worsen the contributory stress of high debt levels and cause a string of bankruptcies in addition to the one that triggered the crisis.

The STC model has important implications for efforts to either strengthen or transform global systems.

If a system's existing equilibrium is desirable, then crisis response should aim to rejuvenate and bolster the feedbacks that maintain it, thus deepening and widening the basin so that crises are less likely to occur. If the existing equilibrium is undesirable, then changemakers should try to weaken the feedbacks that maintain it while simultaneously strengthening the core structures of an alternative, more desirable basin.

Although the system must pass through a state of disequilibrium as it moves from an undesirable equilibrium to a desirable alternative, changemakers can help steer the course to minimize harms and avoid a prolonged systemic crisis. But they must also recognize the risk that a system displaced from one equilibrium may end up in an even less desirable equilibrium, despite their best efforts.

Finally, it is worth reiterating that while triggers and stresses are both essential contributors to systemic crises, the Cascade Institute deliberately emphasizes stresses in its polycrisis analysis.

Figure 4. Strategies for preventing and navigating systemic crises

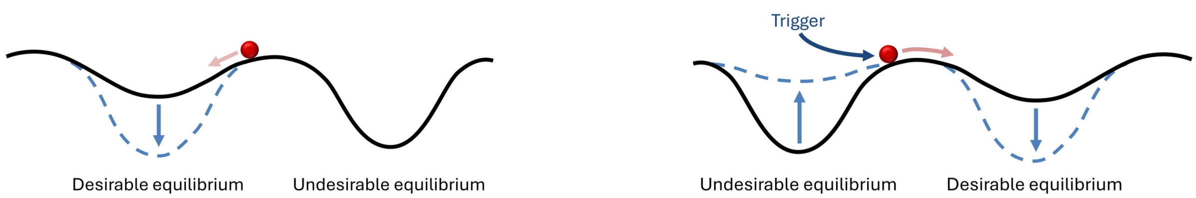


Figure 4A: Increasing the resilience (deepening the basin of attraction) of a desirable equilibrium (left) so the system won't move to an undesirable equilibrium (right). Additional actions might shallow the undesirable equilibrium so that the system won't get stuck there.

Figure 4B: Decreasing the resilience (shallowing the basin) of an undesirable equilibrium (left) while increasing the resilience (deepening the basin) of an alternative, desirable equilibrium (right), so that a trigger event can push the system into the desirable equilibrium with as little turmoil as possible.

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It is quite natural to fixate on the most immediate and visible causes of a crisis, but focusing on triggers often distracts our attention from the deeper causes that ensure the crisis recurs. Even worse, "trigger fixation" often allows leaders to shirk their responsibility to address the root causes of crises.

In 2023, for example, amidst Canada's worst wildfire season on record, several leaders simply blamed the fires on lightning strikes and unattended campfires and refused to consider the stresses that made the fires so unprecedentedly devastating.[13] As the United Nations Environmental Programme explains, "Lightning strikes and human carelessness have always—and will always—spark uncontrolled blazes, anthropogenic climate change, land-use change, and poor land and forest management mean wildfires are more often encountering the fuel and weather conditions conducive to becoming destructive."[14] Wildfires are, consequently, burning longer, hotter, and in unexpected places.

Where trigger events tend to be local, stochastic, and nearly impossible to precisely predict in their time and location, stresses are much easier to study and anticipate. And so long as stresses continue to worsen, one trigger event or other will almost inevitably come along to create a crisis. We therefore pay particular attention to the slow-moving, gradual, and often hidden processes that erode an established equilibrium's resilience and render humanity's critical systems vulnerable to trigger events.

4. Polycrisis Mapping: The grammar of crisis interactions

KEY POINTS

- Stresses, trigger events, and crises can combine in four broad causal pathways (and combinations of those pathways) to produce a polycrisis. These ideal-type pathways provide a grammar with which to trace the causal relationships of polycrisis. Two mapping techniques use combinations of the four causal pathways to chart the causal interrelationships between systems in crisis:
  - Domino diagrams trace the causal relationships between stresses, triggers, and crises in multiple systems as they unfold over time, presenting a causal timeline.
  - Inter-systemic feedback diagrams capture the cyclical and synchronous relationships between stresses, triggers, and crises, wherein effects influence their own causes and thereby create feedback loops.

The previous section described the basic STC model, which explains how stresses, trigger events, and crises operate within a *single system*.

This section shows how the model can help explain interactions between *multiple systems* in crisis. The relationships between stresses, trigger events, and crises can combine in four broad causal pathways to create a polycrisis, as depicted in Figure 5 below. Figure 6 (further below) provides a real-world example of such interactions.

Figure 5. Causal pathways of inter-systemic stress, trigger, and crisis interactions

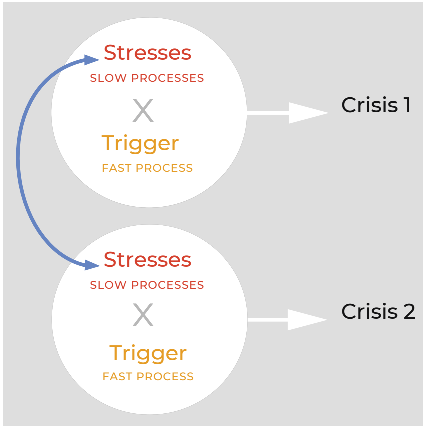

Figure 5A: Interacting Stresses A stress in one system may causally interact with a stress in a second system, which could then affect the stress in the first system (as indicated by the blue arrow denoting a causal relationship). Insecurity in the food system, for example, forces the poor to devote a major portion of their income to their alimentary needs rather than education, investment, and enterprise. The result is greater poverty and inequality in the economic system, which may then lower incomes and worsen food insecurity for the most vulnerable segments of society.

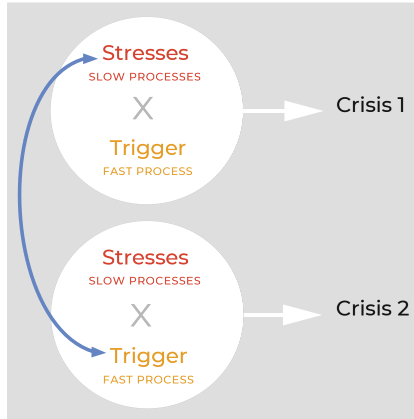

Figure 5B: Inter-systemic stress-trigger interactions A stress in one system may generate a trigger event in another system. By disrupting habitats, for example, climate heating in the environmental system increases the zone of contact between humans and unfamiliar animal species, which increases the likelihood of a zoonotic (animal to human) viral transfer that triggers a pandemic in the health system.

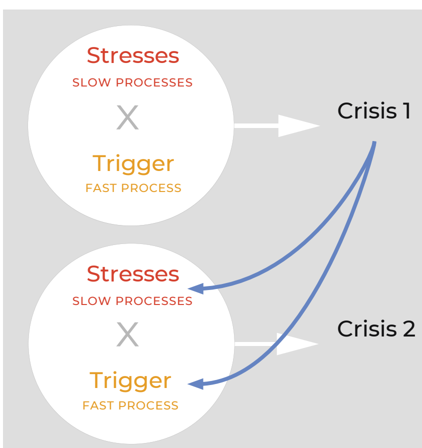

Figure 5C: Crisis impacts on adjacent systems A crisis in one system may affect the stresses and/or trigger event of another system. The COVID-19 pandemic, for example, deepened the stress of socio-economic inequality in the economic system, while aggressive fiscal responses by governments triggered inflation.

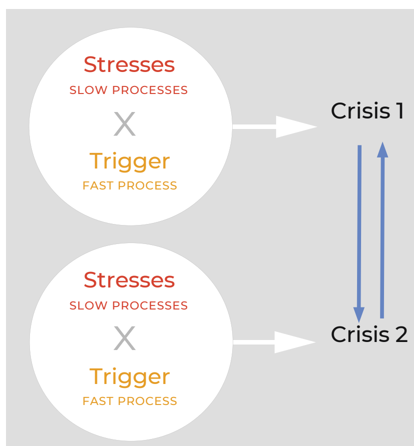

Figure 5D: Inter-systemic crisis interactions A crisis in one system may causally interact with a crisis in another system, altering the dynamics of each. A security crisis in the international system, for example, can worsen the climate crisis by diverting urgently needed attention and resources from climate action, while the climate crisis can intensify an international security crisis by escalating conflict over resources and propelling mass migration.

Feedback loops: System behaviours can sometimes influence their own causes, creating feedback loops. Negative (i.e., dampening) feedbacks tend to stabilize systems by counteracting change, such as when markets correct for overvalued assets. Positive (i.e., self-amplifying) feedbacks involve two or more variables that intensify one another in spirals of run-away growth or decay, such as arms races or stock market crashes. We argue that feedbacks arise from combinations of the four interactions shown in Figure 5 and that these feedbacks, in turn, produce the crisis synchronization manifested in a polycrisis.

Although one crisis may on occasion dampen another, the real danger arises when interactions among two crises' causes and effects create a positive feedback, where each crisis keeps worsening the other. Positive feedbacks can quickly overwhelm institutional safeguards and controls. And they can create an acute policymaking dilemma in which one crisis cannot be resolved without remediating a second one—but the second cannot be resolved without remediating the first. The inter-systemic feedback diagrams presented further below depict only positive feedback loops, but more advanced diagrams integrate negative feedback loops as well.

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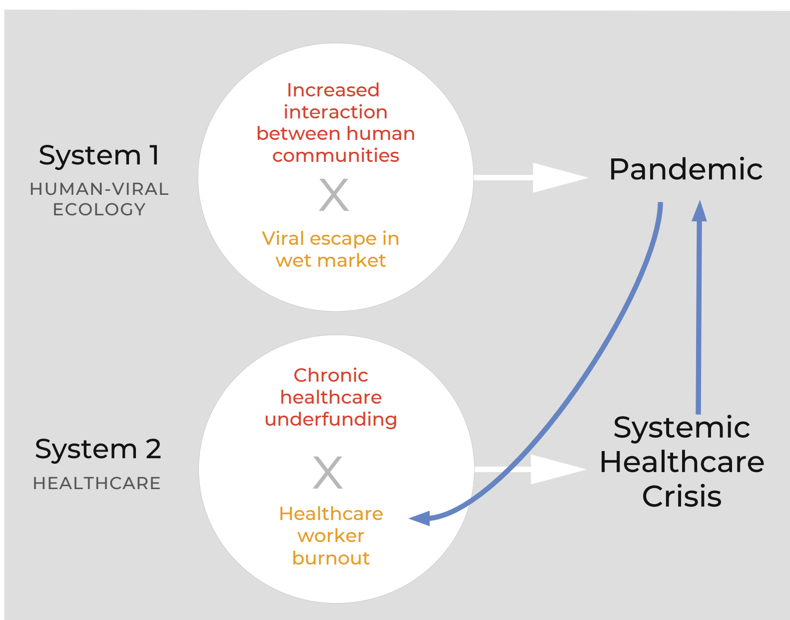
Figure 6. An example of crisis interactions between multiple systems



A pandemic crisis arising from the human-viral ecological system triggers a crisis in the healthcare system, which then further amplifies the pandemic crisis. This example uses elements of the ideal types shown in Figures 5c and 5d.

Mapping polycrises with domino and inter-systemic feedback diagrams

The Cascade Institute's polycrisis analysis uses two types of diagrams to combine the ideal-type causal pathways presented above to map crisis interactions between multiple global systems:

- **Domino diagrams** depict the causal relationships between stresses, triggers, and crises in multiple systems as they unfold over time. The left-to-right temporal logic of these diagrams presents a causal timeline, but relationships can, consequently, only go in one direction.

- **Inter-systemic feedback diagrams** capture the cyclical and synchronous relationships between stresses, triggers, and crises, depicting feedback loops by which effects influence their own causes.

Both types of diagram are composed of elements (shapes representing stresses, triggers, and crises) and connections (arrows representing causal relationships) between those elements. We have developed graphical conventions common to both domino diagrams and inter-systemic feedback diagrams to depict complex causal relationships as clearly, consistently, and informatively as possible. Our diagrams draw upon other causal mapping techniques but are tailored specifically to our framework of polycrisis analysis and its STC model.

Elements

The elements (i.e., the labeled shapes) of polycrisis diagrams represent "occurrences" within a global system. The shape identifies an occurrence as a stress, trigger, or crisis.

The coloured outline of an element indicates the system in which the stress, trigger, or crisis occurs. The Cascade Institute pragmatically distinguishes eight global systems using the colour scheme below, but other categorizations may be used.

- Economy (red)
- Health (blue)
- Social order & governance (purple)
- Food (yellow)
- International security (turquoise)
- Energy (grey)
- Environment (green)
- Transportation & communication (orange)

Connections

The connections (arrows) between elements represent the causal relationships by which one stress, trigger, or crisis generates, contributes to, influences, or intensifies another (see the Cascade Institute's publication: *Causal Loop Diagrams: A Short Handbook*).[15]

Systems diagrams versus network maps

Systems diagrams consist of elements and connections, which in network theory are referred to as nodes and links (or edges), respectively. But systems diagrams differ from network maps in two key respects. First, the connections in systems maps specifically indicate causal relationships between elements. The links between nodes in a network map may depict a wider variety of relationships, or exchanges of information, money, or goods, for instance, between specific actors involved in such relationships. Second, the causal nature of the connections in systems diagrams requires that the lines have arrowheads indicating the direction of causation, even if causation sometimes flows both ways. Network diagrams usually do not use arrows to indicate the direction of a relationship or exchange.

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Steps and tips for drawing polycrisis diagrams

Domino and inter-systemic feedback diagrams can be drawn by hand or with basic software such as PowerPoint. The process involves three broad steps that often overlap in practice.

1) Identify the elements (stresses, triggers, and crises) involved most significantly in the polycrisis, or part of polycrisis, under investigation.

Polycrisis maps cannot include everything—far from it. The elements included depend on what part of the polycrisis story the analyst wants to tell. Elements should be labeled clearly and concisely. And each element (stress, trigger, or crisis) should be distinct (separate, non-redundant, and logically independent) from the others (i.e., not just a slightly different version of another element).

Tip: Diagrams with more than 12 elements tend to overwhelm viewers and can lead to more confusion than understanding. When many elements are relevant, it is best to present the diagram in stages, each introducing a new batch of elements along with a narrative explanation of their relationships (see the domino diagram example below).

2) Lay out the elements and draw the causal relationships between them.

For domino diagrams, this step involves first arranging the elements from left to right by their occurrence in time. Stresses are, by nature, long-term and ongoing processes. But rather than extending them over the entire length of the domino diagram, they should be placed in the timeline at the moment they become particularly severe—that is, when they have eroded a system's equilibrium. Next, draw arrows to indicate the causal relations between elements. Arrows cannot point from right to left because causation cannot work backwards in time. Arrows may, however, be vertical to indicate occurrences that are more-or-less simultaneous, when the effect follows rapidly from the cause.

For inter-systemic feedback loop diagrams, this step involves arranging the elements and connections in roughly circular chains connecting cause and effect in a cycle. The feedback loop indicates a causal sequence rather than a timeline, so arrows can point up, down, left, and right. And not all the elements in the diagram have to be part of the feedback loop; some may affect, or be affected by, elements in a feedback loop but lie outside (or beside) the circuit.

Tip: To make diagrams clear and viewer-friendly, connections and elements should be arranged to have as few criss-crossing arrows as possible (though some intersections may be unavoidable). This often takes several rounds of laying out the elements, drawing connections, then rearranging the elements in a more organized configuration. The first draft is almost always a mess!

3) Analyze and interpret the diagram.

Analysis of both domino and inter-systemic feedback diagrams should be formulated into a narrative story that explains the relationships in a logical order, following the causal chains step by step.

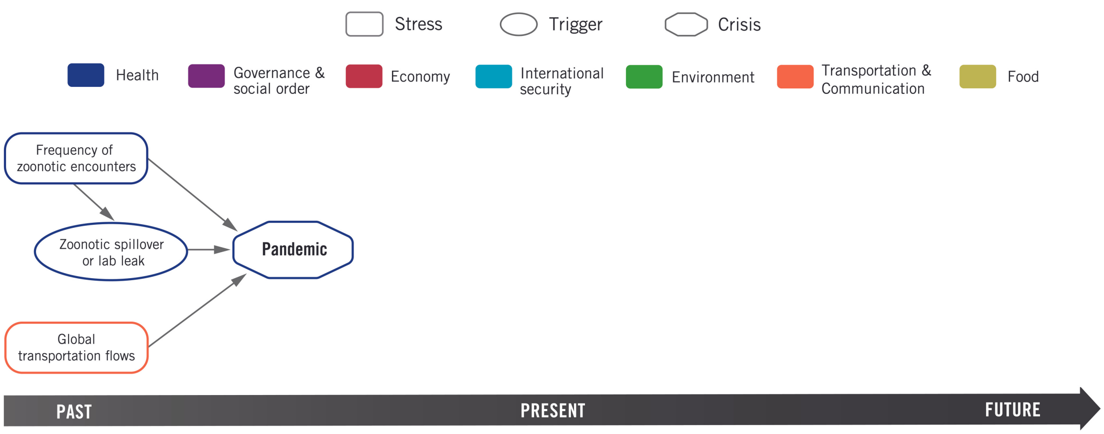
A helpful starting point with either type of diagram is to identify the elements that are most vulnerable and the elements that are most influential. Vulnerable elements are those that are most highly affected by other elements—that have the most arrows pointing to them. Vulnerability may indicate that an element is "over-determined," meaning that several other causes are each sufficient to produce it. If one or more of those causes is eliminated, the remaining ones continue to generate the vulnerable element. But vulnerability may also indicate "interactive causation" in which each cause is necessary but insufficient on its own to produce the vulnerable element. All of these causes must be present and interact together to generate the effect, so the elimination of any one cause will also eliminate the vulnerable element. It may require additional research to determine whether a vulnerable element is over-determined or the product of interactive causation, and the difference will affect which elements should be targeted in any attempt to change system behaviours.

Influential elements are those that most affect other elements—that have the most arrows pointing from them. These elements may represent the most significant drivers of a polycrisis and important sites for intervention.

With inter-systemic feedback diagrams, the analysis should explain the feedback loops—the circuits by which elements reinforce or inhibit one another in ongoing cycles. Though the inter-systemic feedback diagrams presented below depict only positive (reinforcing) feedback loops, other diagrams may include negative (balancing) feedback loops as well.

These steps may draw upon information from many sources, including surveys, expert elicitation, literature scans, intuitions, participatory discussions with stakeholders, datasets, and quantitative or qualitative studies. The process is an *iterative* one in which the analyst moves back and forth between the information they have about a system, the elements and connections they depict, and the arrangement of these elements and connections in the diagram.

Domino diagram example



The domino diagram above depicts a causal timeline of interactions between climate change, the COVID-19 pandemic, and the Russia-Ukraine war, along with their knock-on effects. We present it in three stages due to the high number of elements involved.

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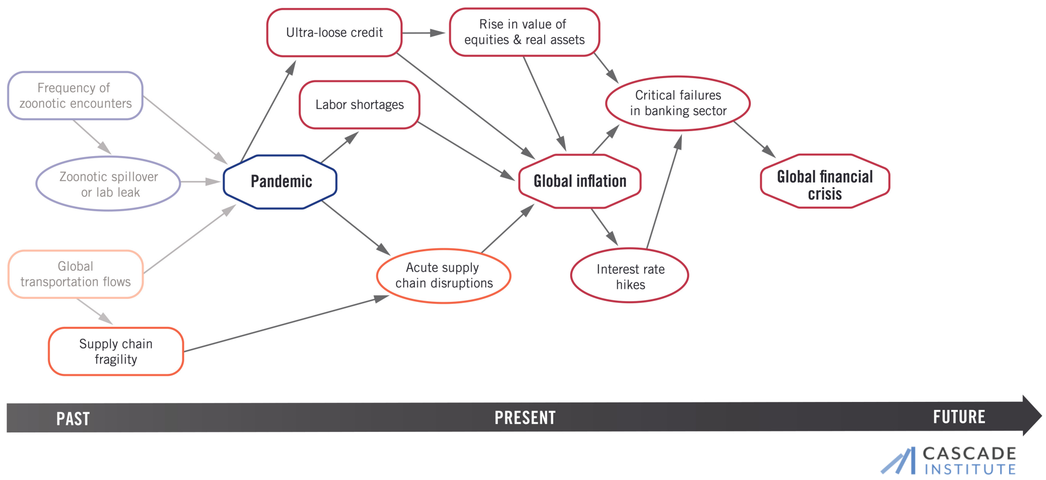
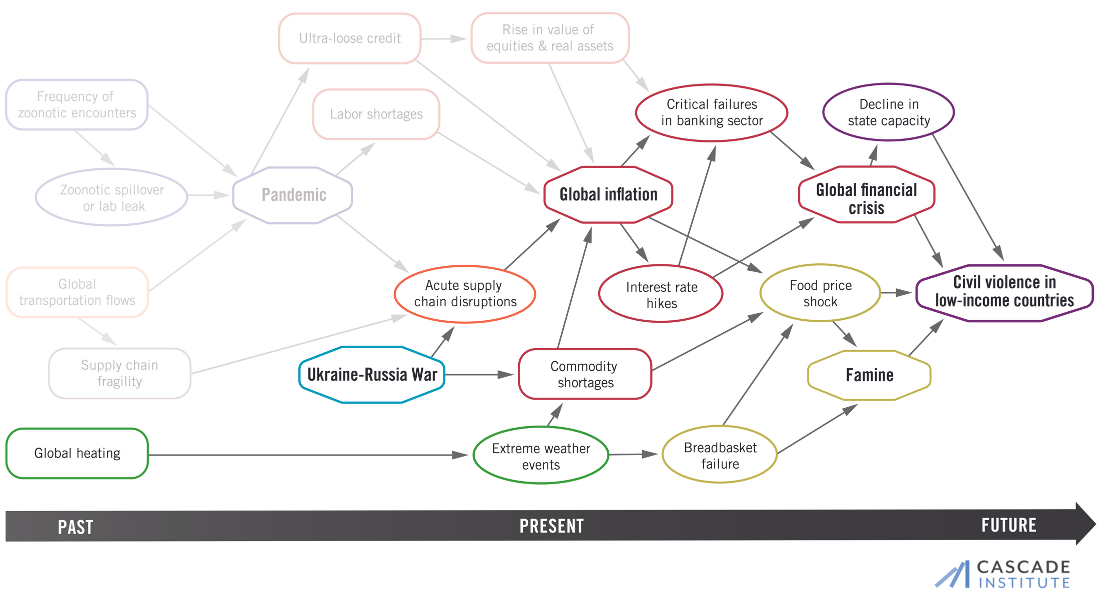
This first stage indicates that more frequent contacts between humans and animals (a stress) generated a viral transfer (trigger event) that interacted with rapid global transportation flows (another stress) to cause the COVID-19 pandemic.



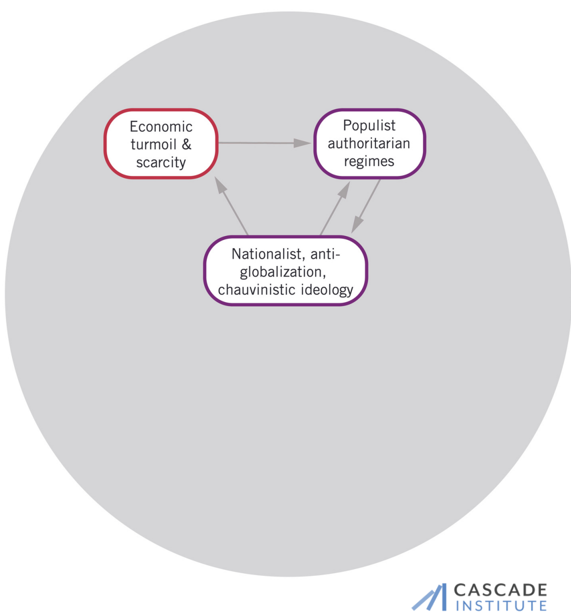
This second stage indicates that the COVID-19 pandemic interacted with several economic stresses and generated acute supply chain disruptions (trigger events) to cause global inflation (an economic crisis) that could, in the future, generate critical banking failures (trigger events) and, in turn, a global financial crisis.



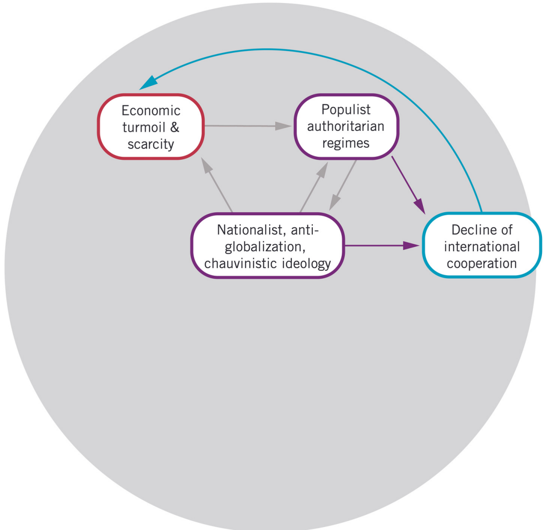
This third stage shows how the Ukraine-Russia war (a crisis) interacted with the acute supply chain disruptions (trigger events) and commodity shortages (a stress) to contribute to the crisis of global inflation, and how climate heating (a stress) is generating extreme weather events (trigger events) that further worsen the stress of commodity shortages. Climate heating and extreme weather may, in the near future, generate breadbasket failures and a food price shock that trigger famine, which, in combination with a global financial crisis, could then rapidly reduce the capacity of weak and poor states and trigger civil violence.

Inter-systemic diagram example

The inter-systemic feedback diagram below, also presented in stages, depicts the positive feedbacks by which economic turmoil and nationalist authoritarianism can reduce international cooperation and worsen climate change in ways that generate violent conflicts that exacerbate the initial economic and political stresses. These feedbacks are certainly not inevitable; but if they were to take hold, they would escalate all the problems depicted and create a vicious, self-amplifying spiral.



This first stage depicts a positive feedback loop in which economic turmoil (arising perhaps from inflation, financial crisis, debt, or scarcities of key resources) creates mass grievances and institutional opportunities for populist leaders to capture political power and weaken the rule of law. These leaders draw on and amplify nationalist, chauvinistic, and anti-globalization ideologies, often by scapegoating foreigners, cosmopolitans, and internal minorities. Their efforts to decouple their national economies from the world economy generally worsen economic turmoil in ways that, paradoxically, increase opportunities for such authoritarian leaders to consolidate their power.



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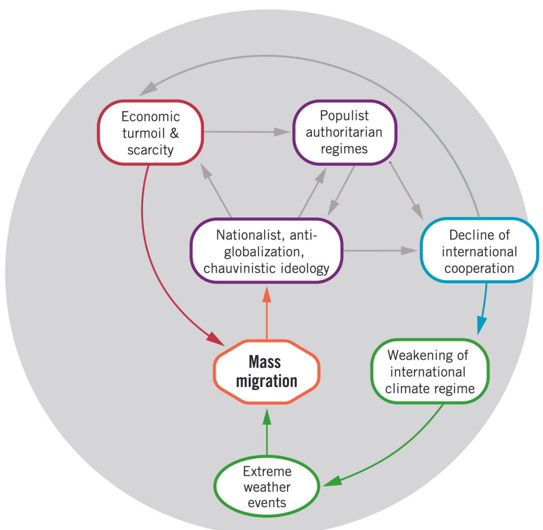
This second stage of the diagram indicates that populist authoritarian regimes espousing nationalist and anti-globalization ideologies generally decrease their participation in international institutions, reduce their international cooperation, and focus their attention and resources inward. They thus diminish opportunities for mutually beneficial economic exchange and forego the benefits of globalization, which can worsen both internal and global economic turmoil and thereby exacerbate the positive feedback depicted in the first stage of the diagram.



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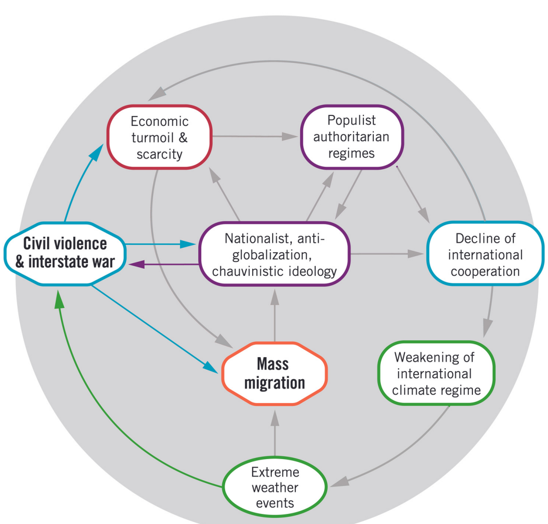
The third stage of the diagram proposes that, in the decades ahead, a decline of international cooperation will perhaps fatally weaken international action to slow climate change. More frequent and severe extreme weather events will then trigger flows of migrants towards richer countries, and the influx will likely increase support for chauvinistic and isolationist ideologies in receiving societies.



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The final stage of the diagram shows that the chauvinistic reaction to mass migration is likely to precipitate violence against those seeking refuge and those deemed too sympathetic towards outsiders. Meanwhile, extreme weather events could worsen intercommunal tensions, trigger state collapse and civil war, and increase the probability of international conflicts over scarce resources, including water and food. Civil violence and interstate war tend to deepen nationalism while generating new waves of refugees and exacerbating economic turmoil.

Moving forward with polycrisis analysis

In these pages, we have provided a detailed framework for polycrisis analysis. It includes an integrated set of concepts, the stress-trigger-crisis model, a grammar of causal interactions between global systems, and a suite of mapping techniques. The Cascade Institute hopes these contributions will strengthen a diverse and inclusive community of polycrisis knowledge and practice[16] and help establish polycrisis analysis as a productive field of inquiry. But much remains to be done.

Several research priorities emerge from our work. Analysts need to develop workable empirical indicators of equilibrium and disequilibrium in global systems, as well as precise methods for identifying feedbacks that maintain or destabilize systemic equilibria. We also need to learn how to trace with greater detail the complex causal connections between stresses, triggers, and crises as they travel through the architecture of multiple global systems. And we must be more sensitive to the variegated and unequal impacts of polycrisis on diverse communities and ecologies around the planet.

Effective polycrisis response demands new principles of systemic risk governance to support inclusive and responsive adaptation. Institutional reforms will help overcome the siloing of knowledge and practice into isolated domains. Local, national, and international actors must focus more on interconnections across systems, sectors, scales, and issues, as part of a renewed emphasis on forecasting and long-term thinking.[17]

Pursued vigorously, this agenda could help humanity steer through today's polycrisis—and the profound hardships it entails—towards a more just and sustainable future. Otherwise, as UN Secretary-General António Gutteres rightly warns, "business as usual could result in breakdown of the global order, into a world of perpetual crisis and winner-takes-all."[18]

Glossary

Basin of attraction: The visual depiction of a system's *dynamic equilibrium* as a valley in a *stability landscape diagram* of a system, encompassing a range of normal values and behaviours.

Common stress: *A stress (or stresses)* that affects two or more systems by weakening the resilience of their equilibria.

Contradiction: A type of system stress that involves conflicting or self-undermining forces within a system.

Crisis resolution: A system's entry into a (stable) *dynamic equilibrium* (or *basin of attraction*), thereby ending the period of *disequilibrium* that constitutes *systemic crisis*.

Critical transition: A system's rapid shift from one *dynamic equilibrium* to a different *dynamic equilibrium*, and thus from one set of normal behaviors and stabilizing feedbacks to another.

Domino diagram: A diagram that illustrates a temporal sequence in which stresses, triggers, and/or crisis in one system affect the stresses, triggers, and/or crisis in another system, often in chains of cause and effect.

Exogenous trigger event: A type of trigger in which events generated by one system act as the *trigger event* in another system.

Disequilibrium: A period of volatility, unpredictable behavior, and disruptions to basic system functions that occurs when a system has left one *dynamic equilibrium* (or *basin of attraction*) but not yet entered another.

Dynamic equilibrium: A system's normal range of fluctuating states and behaviours that is maintained by stabilizing feedbacks against shocks and changes in the environment.

Flashpoint report: A form of risk assessment that highlights existing problems (generally conflicts) in particular regions of the world that have the potential to escalate in highly consequential ways.

Global polycrisis: The causal entanglement of crises in multiple global systems in ways that cause major human harm.

Inter-systemic feedback diagram : A diagram that illustrates circular chains of cause and effect by which stresses, triggers, and/or crises in multiple systems reinforce (positive feedback) or dampen (negative feedback) one another.

Pressure: A type of stress in which harmful forces accumulate over long periods of time and may be rapidly released by a *trigger event*.

Resilience: The ability of a system's *dynamic equilibrium* to persist amidst shocks and change, depicted in *stability landscape diagrams* as the depth of a *basin of attraction*.

Risk list: A form of risk assessment that presents a "laundry list" of pressing issues and hazards.

Shock: A perturbation to a system whose interaction with underlying stresses is insufficient to force the system out of its *dynamic equilibrium* and into *crisis*.

Stability landscape diagram: A graphical tool that illustrates stability and change in complex systems using *basins of attraction* to represent different possible *dynamic equilibria*.

Stochastic trigger event: A random event that initiates a *systemic crisis*, especially when a system's *dynamic equilibrium* is under such stress that a seemingly trivial or unrelated event tips it into *crisis*.

STC model: A systemic understanding of *systemic crises* as the product of one or more slow-moving system *stresses* interacting with one (or more) fast-moving *trigger event* to push a global system out of its established equilibrium and into a state of *disequilibrium*.

Stress Analysis: A form of risk assessment that analyzes long-term stresses, trends, and drivers of change, often as part of forecasting and scenario planning exercises

Stress: A slow-moving process that gradually erodes a system's resilience.

Systemic crisis: The *disequilibrium* that arises when one (or more) fast-moving *trigger events* interacts with one (or more) slow-moving stress to push a global system from its established *dynamic equilibrium* and thereby generates major human harms.

Systemic risk: The risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components.

Trigger event: A fast-moving event that interacts with *stresses* to push a system out of its established *equilibrium* and into *crisis*.

Vulnerability: A type of *stress* in which a system develops potential pathways to systemic failure as it grows more complex.

Endnotes

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[15] Lawrence, Michael, 2024. In the terminology of causal loop diagrams, these connections are positive causal relationships in which an increase in the amount or value of the first element causes an increase in the amount or value of the second. Basic domino and inter-systemic feedback diagrams use arrows to depict only positive causal relationships whereby one element promotes another. More detailed diagrams may also include negative (or opposing) relationships wherein one element inhibits, resists, or reduces another. When diagramming both positive and negative relationships, arrows should be labelled with a + or – sign to distinguish between them. When the arrows are not labelled, they should be assumed to indicate a positive relationship." *Causal Loop Diagrams: A Short Handbook*. The Cascade Institute. Available at: https://cascadeinstitute.org/technical-paper/causal-loop-diagrams/

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