# Compound Cascade Systems Modelling Framework

*A Reusable Methodology for Building Probabilistic Risk Models of Systemic Crises*

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Applications: *From Hormuz to Hunger* (food systems) and *The Fall of the United Kingdom?* (nation-state decline) — both Kelly, 2026.

Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6695618

# Contents

## Abstract

Institutional risk analysis systematically underestimates outcomes in complex systems because it assesses risk factors independently and combines them additively. This paper presents the **Compound Cascade Systems Modelling Framework**: a structured, reusable methodology for building probabilistic risk models that capture the interaction effects, feedback loops, and cascading failures that additive assessment misses.

The framework consists of nine steps — from system boundary definition through causal chain identification, interaction matrix construction, feedback loop formalisation, scenario building, sensitivity analysis, historical calibration, and impact conversion — supported by explicit guidance on probability estimation, presentation architecture, and validation.

The methodology has been applied to two domains: global food system vulnerability under the Strait of Hormuz crisis (*From Hormuz to Hunger*, Kelly 2026) and structural decline of the United Kingdom (*The Fall of the United Kingdom?*, Kelly 2026). In both cases, compound assessment produced risk estimates 3–5 times higher than additive institutional projections using the same underlying data sources. The consistency of this divergence across fundamentally different domains — a single-trigger global supply chain crisis and a multi-vector endogenous national decline — suggests that the methodology gap between additive and interactive risk assessment is a structural property of complex systems, not an artefact of either specific model.

The framework addresses common objections to non-institutional risk modelling, including the role of expert judgement in probability estimation, the distinction between prediction and structured downside-risk assessment, and the conditions under which compound cascade modelling should and should not be applied. A 37-item quality checklist and five-method validation framework are provided for practitioners.


**Keywords:** compound risk, systems modelling, cascading failure, feedback loops, interaction matrix, scenario analysis, systemic crisis, risk methodology, institutional silo problem.

*Distribution note. This paper is an independent methodological contribution intended to inform risk analysis practice. It presents a reusable framework derived from stated principles and validated through application; it is not a forecast.*

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## 0. When to Use This Methodology (and When Not To)

**Use compound cascade modelling when:**

- Multiple risk factors are active simultaneously and at least some of them interact through identifiable causal mechanisms
- Institutional analysis exists but is siloed — different agencies model different aspects of the same system independently
- Feedback loops are plausible — deterioration in one area could worsen another, which worsens the first
- Historical precedent shows that additive assessment underestimated outcomes in comparable situations
- The system has weak circuit-breakers — mechanisms that should contain cascading failure are themselves degraded or absent

**Do not use compound cascade modelling when:**

- Risks are genuinely independent — if risk factors do not interact through causal mechanisms, an additive model is appropriate and simpler
- The system has strong, tested circuit-breakers — well-capitalised insurance, automatic stabilisers, redundant systems tested under stress
- Data quality is insufficient to identify causal mechanisms — compound cascade modelling requires mechanistic clarity, not just correlation
- A single dominant variable overwhelms all others — a single-variable model with sensitivity analysis is more appropriate
- You are modelling a short-duration event — for events measured in hours, event-tree or fault-tree analysis is more appropriate

### The methodology gap: the central finding

The gap between compound and additive assessment is not just a methodological curiosity — it is itself a finding. In both applications to date, the compound model produced materially higher risk estimates than the sum of individual chain assessments:

| Application | Institutional estimate | Compound estimate | Divergence |
|---|---|---|---|
| Hormuz famine | 30–50M at risk (WFP/FAO) | 118–225M excess deaths | 3–5× |
| UK structural decline | 10–20% significant decline (additive) | 40–70% Accelerated Decline or worse | 2–3.5× |

The consistency of this divergence across two very different domains suggests it is a structural property of how interactive systems behave, not an artefact of either specific model.

## 1. The Core Principle

Institutional risk analysis is typically linear and additive: identify individual risk factors, quantify each one, add the results. This systematically underestimates outcomes in complex systems because it misses **interaction effects** — where one risk factor triggers, amplifies, or accelerates others.

Compound cascade modelling captures these interactions. The output is not a single number but a scenario-weighted probability distribution with explicit uncertainty ranges, sensitivity analysis, and historical calibration.

### Why institutions fail to model interactions

The institutional silo problem is structural, not accidental. Institutions are mandated to model specific domains:

| Domain | Institution (UK example) | What they model | What they miss |
|---|---|---|---|
| Fiscal policy | OBR | Debt trajectory, tax revenue | Interaction with NHS, brain drain, housing |
| Healthcare | NHS England | Waiting lists, workforce | How health failure drives emigration, reduces productivity |
| Demographics | ONS | Population projections | Interaction with fiscal trap, political paralysis |
| Food security | FAO/WFP | Caloric availability, supply | How food price spikes interact with sovereign debt, political instability |

No institution is mandated to model the interactions *between* these domains. The gap between siloed assessment and compound interaction modelling is a structural feature of how institutional analysis is organised.

### The compound cascade hypothesis

**Hypothesis:** In systems where multiple structural risk factors operate simultaneously and interact through identifiable causal mechanisms, the probability-weighted outcome will be materially worse than the sum of individual risk assessments, because:

1. **Interactions amplify individual chains** — a chain that would be manageable in isolation becomes critical when reinforced by other chains
2. **Feedback loops create self-sustaining deterioration** — once activated, they worsen without external intervention
3. **Containment mechanisms are shared** — the same fiscal capacity, institutional bandwidth, and political attention is needed to address multiple chains simultaneously
4. **Temporal coupling creates simultaneity** — chains that might be individually manageable if sequential become unmanageable when they coincide

This hypothesis has been tested against historical cases and found to hold consistently: in every case of systemic crisis examined, the actual outcome was worse than contemporaneous additive assessment predicted.

## 2. Domain Adaptation: External Shock vs Endogenous Decline

The methodology has been applied to two fundamentally different types of system, and the adaptation required is instructive.

| Element | External Shock (Hormuz) | Endogenous Decline (UK) |
|---|---|---|
| Trigger | Specific event (Hormuz blockade) | No single trigger — cumulative structural deterioration |
| Causal direction | Trigger → cascading consequences | Multiple simultaneous deteriorations interact |
| Chain structure | Transmission pathways from event to outcome | Independent decline vectors that interact |
| Time horizon | Short: months to 5 years | Long: 5–10 years (roots extend decades) |
| Counterfactual | Clear: what if blockade had not happened? | Diffuse: what if interactions were modelled? |
| Key challenge | How quickly/far does the shock propagate? | Distinguishing correlation from interaction |
| Meta-chains | Not applicable (trigger is exogenous) | Critical — identify coordinating failures |

# 3. The Nine-Step Process

## Step 1: Define the System Boundary

Define the system under analysis, its geographic and temporal scope, and what outcome you are measuring.

| Element | Hormuz famine model | UK structural decline model |
|---|---|---|
| System | Global food production and distribution | UK political, economic, social, institutional, and territorial systems |
| Scope | 2026–2030, all countries above IPC Phase 3 | 2026–2035, all UK systems |
| Outcome metric | Excess starvation deaths (direct + indirect) | GDP per capita decline, institutional trust, living standards, territorial integrity, excess mortality |
| Trigger | Strait of Hormuz blockade (specific event) | No single trigger — cumulative structural deterioration |

Key decisions at this stage include: what counts as inside the model vs exogenous; whether to use single or multiple outcome metrics; and what time horizon determines which chains are relevant.

## Step 2: Identify Causal Chains

Map every mechanism through which the system produces the outcome. Each chain must be: **individually sourced** (backed by institutional data or peer-reviewed research), **mechanistically clear** (A causes B through an identifiable pathway), **quantifiable** (with stated uncertainty ranges), and **historically observable** (the mechanism has operated before in comparable conditions).

**How to find chains:**

1. Start with the obvious first-order effects (the ones institutions already model)
2. Ask: "What does this first-order effect trigger?" — second-order chain
3. Ask: "What makes this worse?" — amplification chain
4. Ask: "What would normally contain this, and is that containment degraded?" — constraint chain
5. Ask: "What external variable could couple otherwise independent chains?" — convergence chain
6. Ask: "Is there a chain whose dysfunction propagates across all domains?" — meta-chain
7. Keep going until you stop finding new mechanisms with independent evidence bases

| Chain type | Hormuz example | UK example |
|---|---|---|
| First-order | C1: Direct yield collapse | C1: Productivity collapse (18-year stagnation) |
| Second-order | C4: Fertiliser export cascade | C8: Brain drain (conditions drive emigration) |
| Amplification | C3: Sovereign debt doom loop | C5: Fiscal trap (debt amplifies underfunding) |
| Constraint | C7: Humanitarian access denial | C10: Political failure (reform capacity blocked) |
| Convergence | C5: El Niño convergence | C13: Mass migration (external shock couples with all domestic chains) |
| Meta-chain | Not applicable | C10: Political system failure |

Aim for 7–20 chains. Fewer than 7 and you are probably missing interactions. More than 20 and you are likely double-counting. The Hormuz model uses 9; the UK model uses 18. The difference reflects the greater complexity of endogenous multi-domain decline compared to a single-trigger cascade.

**Chain independence test:** each chain should be defensible on its own evidence base. If removing Chain B would eliminate the evidence for Chain A, they are not independent chains — they are one chain with two manifestations.

## Step 3: Map Chain Interactions

This is the step that institutions skip. Build an N×N interaction matrix showing how each chain triggers, amplifies, or constrains others.

| Interaction strength | Score | Criterion |
|---|---|---|
| Strong | 3 | Direct causal mechanism with quantitative evidence; removal of one chain would measurably alter the other |
| Moderate | 2 | Plausible mechanism supported by evidence; interaction amplifies but does not fundamentally alter the target chain |
| Weak | 1 | Indirect interaction mediated through other chains |
| None | 0 | No significant interaction identified |

**Interaction types:** *triggers* (A causes B to activate), *amplifies* (A makes B worse once active), *constrains* (A limits responses to B), *couples* (A connects two otherwise independent chains), *feedback* (A worsens B which worsens A).

**Matrix diagnostics:** after completing the matrix, compute interaction density (significant interactions as percentage of possible), outgoing/incoming connections per chain (identifying drivers and vulnerable nodes), and strong interaction clusters (groups likely to produce the most significant compound effects).

## Step 4: Identify and Formalise Feedback Loops

A feedback loop is identified when a cycle of three or more chains creates a self-reinforcing dynamic: Chain A worsens Chain B, which worsens Chain C, which worsens Chain A. Once activated, the system cannot reach equilibrium without external intervention or structural change.

Feedback loops are where compound cascade models diverge most from additive assessment. An additive model treats each chain as a fixed input. A compound model recognises that feedback loops make chain severity *endogenous* — chains worsen each other in cycles that accelerate over time.

| Status | Definition | Implication |
|---|---|---|
| Latent | Conditions for activation exist but loop is not yet self-sustaining | Intervention can prevent activation |
| Active | Loop is operating and measurably worsening all member chains | Intervention must break the loop, not just address individual chains |
| Self-sustaining | Loop continues even if original trigger is removed | Only structural change can break it |

**Loop-breaking analysis:** for each active or self-sustaining loop, identify the weakest link, the cost and feasibility of breaking the loop at that point, what happens to the rest of the model if the loop is broken (sensitivity analysis), and historical precedent for loop-breaking in comparable cases.

## Step 5: Identify Meta-Chains and Temporal Dynamics

Meta-chains are chains whose dysfunction propagates across all other domains. Not every model will have one. A chain qualifies if it has the highest combined connectivity in the matrix, its dysfunction prevents effective response to other chains, and addressing it would create conditions for addressing multiple other chains simultaneously.

In the UK model, Chain 10 (Political Failure) is the meta-chain: FPTP produces governments unable to implement structural reform, propagating dysfunction across all 17 other chains. In the Hormuz model, there is no meta-chain — the trigger is exogenous.

### *Temporal dynamics*

Chains operate on different timescales. Classifying chains by their velocity and impact horizon prevents the model from treating a 20-year slow burn the same as a mechanism that can activate in weeks:

| Temporal class | Timescale | Examples | Modelling implication |
|---|---|---|---|
| Acute | Days to weeks | Financial shock (UK C18), supply disruption (Hormuz trigger) | Can shift scenarios rapidly; binary in character |
| Fast-moving | Months to 2 years | Brain drain, food prices, political crisis | Visible within projection period; responsive to intervention |
| Structural | 2–10 years | Productivity stagnation, fiscal deterioration | Defines the projection period; gradual but cumulative |
| Generational | 10–20+ years | Education decline, demographic shift, infrastructure decay | Deterministic for long-term outcomes but invisible in short-term |

## Step 6: Build Scenarios

Construct 4–6 scenarios spanning the outcome range. Each scenario is defined by explicit, falsifiable assumptions, a probability range (not a point estimate), an outcome range for each metric, and the number and status of feedback loops under that scenario.

| Scenario | Outcome range | Probability | Defining conditions |
|---|---|---|---|
| Best case | Low impact | 5–15% | Multiple positive variables resolve; key feedback loops broken |
| Positive variant | Low–mid | 10–25% | Most important positive variables resolve; most loops contained |
| Base case | Mid range | 25–40% | Most likely trajectory of key variables; some loops active |
| Negative variant | High | 15–30% | Key negative variables materialise; multiple loops active |
| Worst case | Very high | 5–15% | All negative variables + tail risk event; most loops self-sustaining |

**Rules:** probabilities must sum to approximately 100%. Every scenario must be defined by specific, falsifiable assumptions. Include at least one positive-pathway scenario. The probability-weighted central estimate (sum of midpoint × probability) must be explicitly labelled as an expected-value calculation, not a prediction.

**Scenario selectors:** identify the 2–4 variables whose binary resolution most strongly determines which scenario materialises. In the UK model: Hormuz resolution, financial shock occurrence, major climate event, and domestic energy scarcity. In the Hormuz model: blockade duration, India export ban decision, and El Niño severity.

## Step 7: Sensitivity Analysis

Test each major variable independently to determine how much it moves the central estimate. This serves two purposes: identifying which assumptions the model is most sensitive to, and demonstrating that the compound finding is robust to disagreement about individual inputs.

### *Assumption-set sensitivity (the critical test)*

Test the headline finding under progressively simplified assumptions. This answers: *“Does the compound cascade finding depend on extreme assumptions?”*

| Assumption set (UK model) | Accelerated Decline or worse |
|---|---|
| Full model (all 18 chains) | 40–70% |
| No Hormuz (Chain 13 at baseline) | 35–45% |
| No financial shock (Chain 18 at gradual erosion) | 35–50% |
| No external shocks | 25–35% |
| Domestic structural model only (Chains 1–12, 16) | 15–25% |

If the compound finding disappears when a single assumption is removed, the model is too dependent on that assumption. If it persists across all assumption sets (as it does in both models), the finding is structurally robust.

**Individual chain sensitivity:** test what happens when any single chain is adjusted by ±1 point. In the UK model, no single chain adjustment changes the headline probability by more than 3 percentage points.

**Feedback loop sensitivity:** test what happens when specific loops are broken. In the UK model, breaking Loops 3 and 8 simultaneously shifts approximately 15–20 percentage points from Accelerated Decline toward Managed Decline.

### Step 8: Historical Calibration

Identify 5–10 historical events with comparable initial conditions. For each, document: what happened, what the contemporary institutional projection was, what the actual outcome was, the ratio between projection and outcome (typically 2–10× for systemic crises), and what mechanisms were missed (typically: compound interactions).

This serves three purposes: (1) an independent plausibility check on model output, (2) pre-empting the "unprecedented" objection, and (3) identifying the systematic direction of institutional error — which in every case examined across both models was *underestimation*.

| Approach | External shock model (Hormuz) | Endogenous decline model (UK) |
|---|---|---|
| Comparable events | Historical famines with similar triggers (Bengal 1943, China 1959–61, Ethiopia 1983–85) | Historical state-decline episodes (Italy 1990s, UK 1970s, Argentina 2001, Greece 2010–15) |
| Calibration metric | Mortality as % of affected population | Decline trajectory on comparable metrics (GDP, trust, territory) |
| Key finding | Historical famines: 5–15% of vulnerable population; model at 8% = within range | Every case with 3+ critical chains: outcome at or worse than Accelerated Decline equivalent |

### Step 9: Impact Conversion Methodology

Make the conversion from structural risk assessment to human outcome metrics fully transparent. Show conversions by region or segment (not global aggregates), use established metrics, calibrate against historical rates, and state all conversions as ranges. The methodology gap table — showing the difference between additive and compound totals — is the central analytical contribution.

## 4. Meta-Chains: When Dysfunction Propagates

Not every model will contain a meta-chain. They are most relevant in endogenous decline models where a coordinating mechanism has itself become a source of systemic failure. A chain qualifies as a meta-chain if it meets all three criteria:

1. **Highest combined connectivity:** highest combined outgoing + incoming interaction count in the matrix
2. **Propagation function:** its dysfunction does not just add one more problem — it prevents effective response to all other problems
3. **Reform leverage:** addressing it would create conditions for addressing multiple other chains, even if it does not directly fix any

**The UK model example:** Chain 10 (Political System Failure) has 14 outgoing interactions and 11 incoming. FPTP produces governments with large majorities from minority vote shares, enabling populist responses while preventing structural reform. Electoral reform would not fix productivity, healthcare, or housing directly — but it would break Loop 3 (political paralysis) and create the conditions under which effective policy becomes possible.

**The paradox:** the meta-chain is simultaneously the most important chain to address and the hardest to address, because the system that needs reforming is the system that would have to authorise its own reform.

When a meta-chain is present, scenario construction should hinge partly on whether its dysfunction is broken (the Renewal mechanism); policy recommendations should be tiered (Tier 1 addresses the meta-chain); and sensitivity analysis should specifically test what happens if it is resolved.

## 5. How Judgement Becomes Probability

The most common objection to compound cascade models is: “*These are just your opinions with numbers attached.*” This section addresses that objection by making the scoring methodology fully transparent.

### The honesty principle

Compound cascade modelling uses structured expert judgement to assess chain severity, interaction strength, and scenario probability. This is a limitation, and it should be stated explicitly. However, two things are also true: (1) all risk assessment involves judgement — institutional models embed these choices in equations rather than stating them explicitly; and (2) the structural finding is robust to individual judgement variation.

### Chain scoring methodology

| Dimension | Scale | Definition |
|---|---|---|
| Severity | 0–5 | Magnitude of impact on system outcomes if chain operates at assessed level |
| Velocity | 0–5 | Speed at which deterioration is occurring or could accelerate |
| Evidence confidence | 0–5 | Quality and quantity of source data supporting the chain assessment |
| Interaction density | Count | Number of significant interactions with other chains (from the matrix) |
| Resilience offset | 0 to −3 | Degree to which identified resilience factors mitigate chain severity |

Net assessment is derived from a transparent formula simple enough that any reviewer can check every chain assessment and disagree with specific scores. In the UK model: if (Severity + Velocity) / 2 + Resilience offset ≥ 4: Critical; ≥ 3: High; ≥ 2: Medium; < 2: Low.

### From chain scores to scenario probabilities

1. **Baseline severity profile.** What does the distribution of chain scores tell you about overall system stress? Compare to historical cases with known outcomes.
2. **Interaction amplification.** Apply the historical calibration factor: in comparable cases, the ratio between additive and compound outcomes was typically 1.5–3×.
3. **Scenario mapping.** Define each scenario by conditions: chains at critical threshold, feedback loops self-sustaining, presence of external shock triggers.
4. **Sensitivity adjustment.** Express probabilities as ranges reflecting uncertainty in external shock severity, loop activation speed, and positive shocks not modelled.
5. **Historical cross-check.** Compare estimates to outcomes in historical cases with comparable initial conditions.

**Limitations:** state these explicitly in every model — scores represent structured judgement, not mathematical outputs; different analysts might produce different scores; the model's contribution is structural (forcing consideration of interactions), not mathematical precision; even if every score were adjusted by ±1, the structural finding (compound > additive) would remain.

## 6. The Three-Layer Build-Up Architecture

Present findings in three layers with explicit confidence ratings:

| Layer | What it covers | Confidence | UK example |
|---|---|---|---|
| **Layer 1: Established facts** | Documented and irreversible | HIGH | 18-year productivity stagnation; 7M+ NHS waiting list; 4–4.5M housing deficit |
| **Layer 2: Structural amplification** | Mechanistically likely compound interactions | MEDIUM | Fiscal–NHS–brain drain spiral; demographic fiscal time bomb; political paralysis loop |
| **Layer 3: Conditional cascades** | Depend on binary variables not yet determined | CONDITIONAL | Hormuz mass migration; financial shock activation; major climate event |

This works because reviewers can engage with each layer independently. Layer 1 is hard to dispute (documented fact). Layer 2 is where the analytical contribution lives. Layer 3 is explicitly conditional. A critic who rejects Layer 3 entirely must still engage with Layers 1 and 2, which alone produce materially higher risk than additive assessment.

# 7. Presentation Architecture

Reports produced with this methodology will face scepticism from human reviewers who react to headline numbers before engaging with methodology. The report structure must defeat this pattern.

- **Opening section: "How to Evaluate This Analysis."** State that the gap between this analysis and institutional projections is the central finding, not an error. Provide three evaluation criteria. Frame the question correctly: not *"is this higher than consensus?"* but *"do compound effects occur in this domain?"*
- **Lead with methodology gap, not headline number.** Executive summary opens with WHY the estimates differ (model structure), not WHAT the estimates are.
- **"What This Report Is Not" section.** State explicitly: not a prediction, not ideological, not a claim that all resilience fails. Define what it is: a structured downside-risk assessment.
- **Executive Dashboard.** One-page summary table capturing the complete model architecture at a glance.
- **Anticipated Objections section.** State each objection in its strongest form and respond with sourced rebuttals.
- **Explicit limitations section.** Acknowledge both overestimation and underestimation risks, list data gaps, state falsifiability conditions.
- **Distribution note.** Front page: independent technical analysis, scenario-based risk estimates, not a forecast.

# 8. Validation Framework

## How to know if your model is working

1. **Internal consistency:** do scenario probabilities sum to ~100%? Does sensitivity analysis confirm structural robustness? Does removing chains shift probability in the predicted direction?
2. **Historical calibration match:** is the output range within the calibrated range of historical cases? Does the divergence ratio match the historical 1.5–3×?
3. **Out-of-sample retrodiction:** can the methodology, applied to a historical case using only data available at that time, retrodict the actual outcome better than contemporaneous institutional assessment?
4. **Cross-domain validation:** does the methodology produce consistent structural findings across different domains? The Hormuz and UK models provide this: methodology gap is consistent across two very different systems.
5. **Falsifiability conditions:** every model must state explicit, time-bound, measurable conditions under which its central assessment would be falsified.

## What the model cannot do

- **It cannot predict timing.** The model assesses probability ranges over a projection period; it does not predict when specific events will occur.
- **It cannot predict sequence.** It identifies which chains and loops are most dangerous; not the order they will activate.
- **It cannot capture unknown unknowns.** Only interactions between identified chains are modelled.

- **It cannot replace institutional analysis.** It depends on institutional data for chain-level inputs. If that data is wrong, the compound model will also be wrong — compoundly so.

## 9. Source Requirements

Minimum 15 primary sources, including at least 3 institutional datasets (FAO, World Bank, OECD, ONS, OBR, BoE — depending on domain), at least 3 academic or peer-reviewed sources, at least 5 historical case studies for calibration, and at least 2 independent sources per causal chain.

| Priority | Source type | Purpose |
|---|---|---|
| 1 | Institutional data (FAO, OECD, ONS, OBR, BoE) | Quantitative inputs — same sources as institutional models |
| 2 | Academic research (peer-reviewed, working papers) | Mechanisms and causal relationships |
| 3 | Think tank analysis (Chatham House, IFS, CSIS) | Policy context and assessment |
| 4 | Historical case studies (books, retrospectives) | Calibration |
| 5 | Journalism (Reuters, FT, specialist outlets) | Real-time data points and contemporary assessment baselines |

**The source discipline:** the model's credibility depends on using the same source base as institutional analysis. The contribution is the methodology (modelling interactions), not different data.

## 10. Output Documents

1. **Master Model (.md)** — the living analytical document, updated as new data arrives. Contains all chains, interactions, sensitivity analysis, calibration. Internal working document and authoritative version.
2. **Policy Brief (.docx, 15–25 pages)** — compressed case for policymakers, journalists, and general audience. Leads with methodology gap, includes executive dashboard, scenario table, key sensitivity findings, policy recommendations.
3. **Technical Report (.docx, 60–120 pages)** — full methodology for academics, researchers, and institutional analysts. Complete chain detail, interaction matrix, sensitivity tables, historical calibration, impact conversion, model construction appendix.
4. **Framework Document (.md / .pdf)** — domain-agnostic methodology reference for applying compound cascade analysis to new systems.

## 11. Quality Checklist

### Chain quality

- Every causal chain individually sourced (minimum 2 independent sources per chain)

- Chain independence test passed (each chain defensible on its own evidence base)
- Chain scoring dimensions applied consistently with stated criteria

## Interaction quality

- Interaction matrix complete — every chain-pair assessed
- Interaction scoring criteria applied consistently (Strong/Moderate/Weak/None)
- Matrix diagnostics computed (interaction density, connectivity, clusters)
- Feedback loops explicitly identified with activation status
- Loop-breaking analysis completed for each active loop

## Scenario quality

- Scenario probabilities sum to approximately 100%
- Every scenario defined by specific, falsifiable assumptions
- Scenario selectors identified (2–3 binary variables)
- Positive scenario included with mechanism
- Probability-weighted central estimate labelled as expected value

## Sensitivity quality

- Variable-level sensitivity covers all major assumptions
- Assumption-set sensitivity demonstrates structural robustness
- Individual chain sensitivity confirms no single chain dominates
- Feedback loop sensitivity identifies which loops matter most
- Non-linear thresholds identified with specific conditions

## Calibration quality

- Historical calibration against 5+ comparable events
- Model output within calibrated range of historical outcomes
- Systematic direction of institutional underestimation documented
- Falsifiability conditions stated (specific, time-bound, measurable)

## Impact conversion quality

- Conversion shown by region/segment, not global aggregate
- Established metrics used and cited
- Direct impact separated from compound effects
- Methodology gap table included

## Presentation quality

- “How to Evaluate This Analysis” opening section

- "What This Report Is Not" framing
- Executive dashboard (for complex models)
- Three-layer build-up with explicit confidence ratings
- Anticipated Objections section
- Explicit limitations and data gaps
- Distribution note on front page

# 12. Applications and Future Development

## Completed applications

| Application | Domain | Chains | Interactions | Loops | Headline finding |
|---|---|---|---|---|---|
| *From Hormuz to Hunger* (v3.0, 2026) | Global food systems | 9 | ~45% density | 3+ | 118–225M excess deaths vs 30–50M institutional estimate |
| *The Fall of the United Kingdom?* (v8.0, 2026) | Nation-state decline | 18 | 100/306 (33%) | 9 | 40–70% Accel. Decline vs 10–20% additive |

## Potential future applications

- **Climate-economic interaction models** — how climate impacts interact with fiscal, political, and social systems rather than being modelled as an independent variable
- **Healthcare system failure** — how workforce, fiscal, demographic, infrastructure, and governance chains interact in a health system under stress
- **Financial contagion** — how sovereign debt, banking, currency, trade, and political chains interact in a financial crisis
- **Democratic decline** — how media degradation, institutional erosion, polarisation, economic stress, and external interference interact to produce democratic failure
- **Supply chain vulnerability** — how logistics, energy, political, financial, and climate chains interact to produce supply chain collapse

## Methodology evolution

Each new application should refine the framework. Specific areas for development include: formal interaction scoring validation using quantitative methods (e.g., Granger causality testing); probabilistic modelling supplementing structured judgement with Monte Carlo simulation; real-time dynamic updating as new data arrives; and multi-model comparison testing whether the structural finding converges when independent analysts apply the framework to the same system.

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*Version 2.0 — May 2026. Developed by Jonathan Kelly. Contact: jon@ukoilwatch.com*

*Related publications: UK compound cascade model* — The Fall of the United Kingdom?* (Technical Report and Policy Brief). Hormuz famine model — *From Hormuz to Hunger* (Technical Report v3.0). All available via UK Oil Watch and SSRN.*

SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6695618