Emerging Risk Assessment

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Agenda

• What is Emerging Risk and Why Should We Care?

• Assessment Methods
WHAT IS EMERGING RISK AND WHY SHOULD WE CARE?
What is Emerging Risk? ... Some Definitions

- “an issue that is perceived to be potentially significant but which may not be fully understood or allowed for in insurance terms and conditions, pricing, reserving or capital setting” Lloyds

- “new or already known risks which are difficult to assess and which may have a major impact on an organisation” Swiss Re

- “developing or already known risks which are subject to uncertainty and ambiguity and are therefore difficult to quantify using traditional risk assessment techniques” IAA
What is Emerging Risk? ... Characteristics

- **Common themes**
  - Something you don’t fully understand
  - Uncertain impact and/or timing
  - Impact *may be* significant

- **Key points**
  - May not be sure that impact is significant at the point of study
  - An emerging risk does not need to be unknown
  - The risk may not be emerging (uncertain) for everyone
So What... Why Do We Care?

- LAGIC Pillar 2 requires stress and scenario analysis
  - Holistic risk and capital assessment
  - Operational risk assessment (internal models)

- Strategic planning and strategic risk assessment
  - Opportunity and risk

- An emerging risk framework lets us be proactive to create value from emerging risk dynamics, rather than be bogged down in hypothetical biased scenarios and reactive to actual events
Why are Emerging Risks Hard to Spot?

• You don’t know where to look
  – A universe of possibilities...
  – Study every science journal...
  – Scrutinise every news story...
  – Employ futurists...
• Too much data and not enough information
• Hard to engage people if scenarios unrealistic or fanciful

• You can’t make sense of what you see
  – Which trends will lead to risk for us...
  – What scale is the risk operating at...
  – Observed trends may be important but not yet combining sufficiently for sight of the risk to emerge...
  – Cognitive biases...
  – Insufficient resources...
  – Relevance to us...
The Right Perspective

Emerging risks by spotting “events”
Too late in development to react
Imagined events too hard to relate to

Emerging risks spotted early from understanding of system

Emerging risk is hard to spot if you look in the wrong place
Knowing Where To Look

Risks can emerge at multiple scales.

Reaching a tipping point at one scale will cascade to others.

Identify indicators signalling onset
Non-linear relationships
Connectivity established via:
- Cognitive approaches
- Data and analytics
- Combination

Most connected / systemic risks:
- Global governance failure
- Severe income disparity
Section 2

ASSESSMENT METHODS
An Evolutionary Approach to Risk

• Risk is an outcome of a complex adaptive system, rather than an aggregation of events

• Complex adaptive systems such as organisations evolve, and hence risk can be viewed as an evolutionary process

• Insights that evolution of risks can provide:
  – Rigorous risk classification system
  – Guide to emerging, dynamic and systemic risks
  – Unique organizational risk lineage and history
  – Identification of systemic risk characteristics
  – Powerful connectivity measure
### How Risk Fits Evolutionary Criteria

<table>
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<tr>
<th>Biological Evolution</th>
<th>Linguistic Evolution</th>
<th>Risk Evolution</th>
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<tr>
<td>Discrete characters</td>
<td>Vocabulary, combined sounds</td>
<td>Descriptions, causes, impacts, regulatory capital risk class categories</td>
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<td>Common ancestors</td>
<td>Words with common origin</td>
<td>Risks from common origin e.g. fraud, pricing</td>
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<td>Mutation</td>
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<td>Natural selection</td>
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<td>Horizontal gene transfer</td>
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<td>Fossils</td>
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<td>Historic case studies, losses</td>
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<td>Species splitting into others</td>
<td>Language lineage splits</td>
<td>Risk categories (strategic, operational, market etc.)</td>
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<td>Extinction</td>
<td>Language death</td>
<td>Risk mitigation and eradication</td>
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*After Pagel (2009) Nature, see also McCarthy*
Phylogenetics is the study of the evolutionary relationships between living and non-living things. Based upon analysis of the characteristics that define each thing, that seeks to draw 1-many relationships that represent the simplest solution.
Emerging risk events are new combinations of known risk characteristics.

We can analyse which risk characteristics exhibit evolutionary change and hence are more likely to evolve into new emerging risk events.
Cladistics Technique - a Simple Example

Cladistics is a method used in systematics to infer evolutionary relationships among species based on shared characteristics. In this example, we use a cladistic matrix to illustrate the relationships between four taxa: lamprey, shark, salmon, and lizard.

The matrix shows the presence (1) or absence (0) of certain derived characters for each taxon:

- **a** (paired fins)
- **b** (jaws)
- **c** (large dermal bones)
- **d** (fin rays)
- **e** (lungs)
- **f** (rasping tongue)

The cladogram on the right visualizes the evolutionary relationships based on these characters:

- **a** (paired fins) is shared by all taxa.
- **b** (jaws) is shared by lamprey, shark, and salmon.
- **c** (large dermal bones) is shared by shark and salmon.
- **d** (fin rays) is shared by salmon and lizard.
- **e** (lungs) is shared by shark and salmon.
- **f** (rasping tongue) is unique to the lizard.

By analyzing the shared and unique characters, we can infer the evolutionary history and relationships among these species.
Risk Cladistics and Phylogeny

• The risk methodology* identifies small groups of highly related risks which share a common ancestor.

• The evolutionary history of each of these groups can then be traced.

• Can apply to ex-post losses, or ex-ante risks.

• By understanding the phylogeny of the risks we can:
  – Determine where evolution is most prolific.
  – Detail path dependency and co-evolution of risk.
  – Identify the most active characteristics to manage.
  – Create focused scenarios for emerging risks modelling.

*For a detailed review of the methodology applied in the case study please refer to Allan, Cantle, Godfrey & Yin (2012) British Actuarial Journal.
Ex-post Case Study - Selection of Large Derivative Trading Losses

- Derivative losses seem to show no sign of abating in term of either frequency or severity
- How can we understand these events?
- Are they homogenous or heterogeneous?
- Are they relevant to my company?
- How can we understand the next emerging operational risk event?
**Data Preparation** - ‘1’ Represents Characteristic Present

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<th>Rogue trade loss characteristics/ Company name</th>
<th>Involving Fraud</th>
<th>Involving Fraudulent Trading</th>
<th>To Cover Up a problem</th>
<th>Normal trading activity gone wrong</th>
<th>Trading in Excess of limits</th>
<th>Primary Activity Financial or Investing</th>
<th>Failure to Segregate Functions</th>
<th>Lax Mgmt/control Problem</th>
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*Data extracted on Coleman (2011) Practical guide to risk management, CFA Institute*
Cladogram of Losses - Evolutionary Events

- Normal trading activity gone wrong & primary activity financial / investing

1. Involving Fraud
2. Involving Fraudulent Trading
3. To Cover Up a problem
4. Normal trading activity gone wrong
5. Trading in Excess of limits
6. Primary Activity Financial or Investing
7. Failure to Segregate Functions
8. Lax Mgmt/control Problem
9. Long-term accumulated losses >3 years
10. Single Person
11. Physicals
12. Futures
13. Options
14. Derivatives

Fraud clade

Derivatives clade
Cladogram of Losses - Evolutionary Characteristics

1. Involving Fraud
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Fraud clade

Derivatives clade
Interdependency - Highlighted on State of West Virginia Loss

State of = State of West Virginia 1987

Red line show how exactly State of Virginia loss is related to other risks and tells a connectivity story, e.g. direct link to NAB

Blue line now indicates branches impacted by Characteristic No 14 ‘Derivatives’
Interpreting Evolutionary Properties

- **Look at tree shape**
  - Areas of cascading bifurcation are likely areas for more evolution and therefore emerging risks
  - AIB & Daiwa Bank could share characters such as Derivatives (14) & Physicals (9) to create new losses

- **Identify branches that have the most characters/adaptation**
  - They are more likely to adapt again
  - Again Daiwa Bank plus Derivatives (14) or Futures (12) looks highly possible

- **Find characters that evolve most frequently**
  - Is there a character or pattern that is responsible?
  - In this tree this is characteristic no 6, ‘Primary activity financial or investing’

- **Are there any characters gained in sequence/co-evolution?**
  - Understand this pattern as a possible clue to new risks
  - In this tree Characteristics No 6 &10 appear to evolve together but is not a strong pairing here
Interpreting Emerging Properties

• The most influential losses, based on evolutionary relatedness, to whole system of losses are Hypo Group and State of Virginia, shown by the size of the node
  – Involving Fraud (1), To Cover up a Problem (3), Normal Trading Activity Gone Wrong (4), Primary Area Financial or Investing (6), Derivatives (14)
  – This is the core emerging risk narrative

• State of Virginia in turn is related as a loss to a broader set of losses including Orange County and Aracruz
  – Any character shared between these losses can be thought combine to create a new emerging loss, or at least be a plausible scenario; e.g. Single Person (10)
  – Characters driving evolution are strong candidates to join the core narrative
### Ex-ante Case Study: Insurance Company Risk Dataset

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Evolutionary Risk Tree

Areas of likely emerging risks

Blue highlights all risks with characteristic 36, Adverse Legal / Regulatory Change, being the most systemic characteristic.
Blue circle size represents most connected risk, Product, and most influential in cascade type failure. Note also Tax is highly influential.
Assessing Emerging Risk

Sensitivities

Triggers

Emerging Risks

Assessment processes to bound estimates of timing and impact

Risk Management Framework / System

Feed into regular risk management

What matters
Linking Inputs to Outputs

Knowing How It Works

• Leveraging your business experts
  – They have experience and knowledge about how inputs contribute to outputs
  – Combining their insights gives a “system” model
    • Identify the best “things” to set limits on
    • Identify how factors interact
    • Identify areas where people don’t know how outputs are impacted

Cognitive analysis techniques can help to leverage your experts’ knowledge

Source: Milliman
**Scenario Construction**

The more systems and networks are interconnected, the more vulnerable they are to failures.

Emerging risks, extreme events can be the result of inherent system dynamics and interdependencies, rather than “exogenous” events.

Scenarios derived from understanding of “real” system
- Extreme dynamics
- Causal flows
- Build up of factors

Scenarios must move through these areas

Scenarios must start in these areas
Making Scenarios Real

Scenarios designed to hit “painful” parts of strategy. Dynamics identified and explored. Responses pre-, during and post-crisis identified and implemented by Risk Committee.
Creating Meaningful Quantitative Scenarios

Aggregate outcome depends upon complex array of possible world states

Final outcome comprises a variety of individual outcomes all of which depend upon a complex array of possible world states

The world states are contingent upon the interactions and states of a variety of key characteristics – all possible scenario combinations are included.

Source: Milliman, using AgenaRisk™
Managing Emerging Risks

- Preventable, high degree of knowledge of risks → traditional risk mitigation
  - E.g. new type of operational process failure

- Strategic risks → traditional risk mitigation / strategic positioning
  - E.g. new type of customer behaviour

- Non-controllable, highly uncertain risks → cultivate organizational resilience
  - E.g. social, economic and political dynamics

- Resilience is the capability to adapt to a changing environment, withstand sudden shocks, and recover to a desirable state
Conclusions

• It is possible to spot emerging risks, and to do so formally and rigorously.
• The past is helpful but not exclusively predictive.
• Expert judgement is useful but not unbiased.
• Combining tools and methods is highly productive.
• Build scenarios considering “Tipping Points” between multiple system scales, and think about how to manage / mitigate / leverage them.
• Focus on resilience, rather than optimisation, to deal with the unavoidable ones.
• Emergence can lead to innovation and opportunity.
Questions?

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