Best Practices In Scenario Development And Usage: Present And Future

6 September 2017, Cambridge

Using Scenarios in Decision-Making

Applying Research for Business Impact

Centre for **Risk Studies**

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Agenda

1. History of Scenarios as Management Tools
   i. Strategic Risk Scenarios
   ii. Stress Test Scenarios
   iii. View from Cambridge Centre for Risk Studies
2. Case Studies of Use of CCRS Cat Stress Test Scenarios
3. Best Practice in Using Scenarios in Insurance Decision-Making

History of Scenarios as Management Tools
i. Strategic Risk Scenarios

- Scenario Planning: Scenarios for strategic business risk
  - Shell scenario planning since 1970s, describes future ways of the world working
  - "Scenario planning is a disciplined method for imagining possible futures…" to be "better positioned to take advantage of the unexpected opportunities"

    P Schoemaker, Sloan Management Review 1995

- Strategic risk scenarios are plausible but extreme narratives used in corporate planning
  - Bring challenge to BAU: "Is my organisation fit for the futures?"
  - Relies on Imagineering
  - Typically not probabilistic
  - Further methodology needed to quantify impacts, make decisions

Shell Global

NEW LENS ON THE FUTURE
2013

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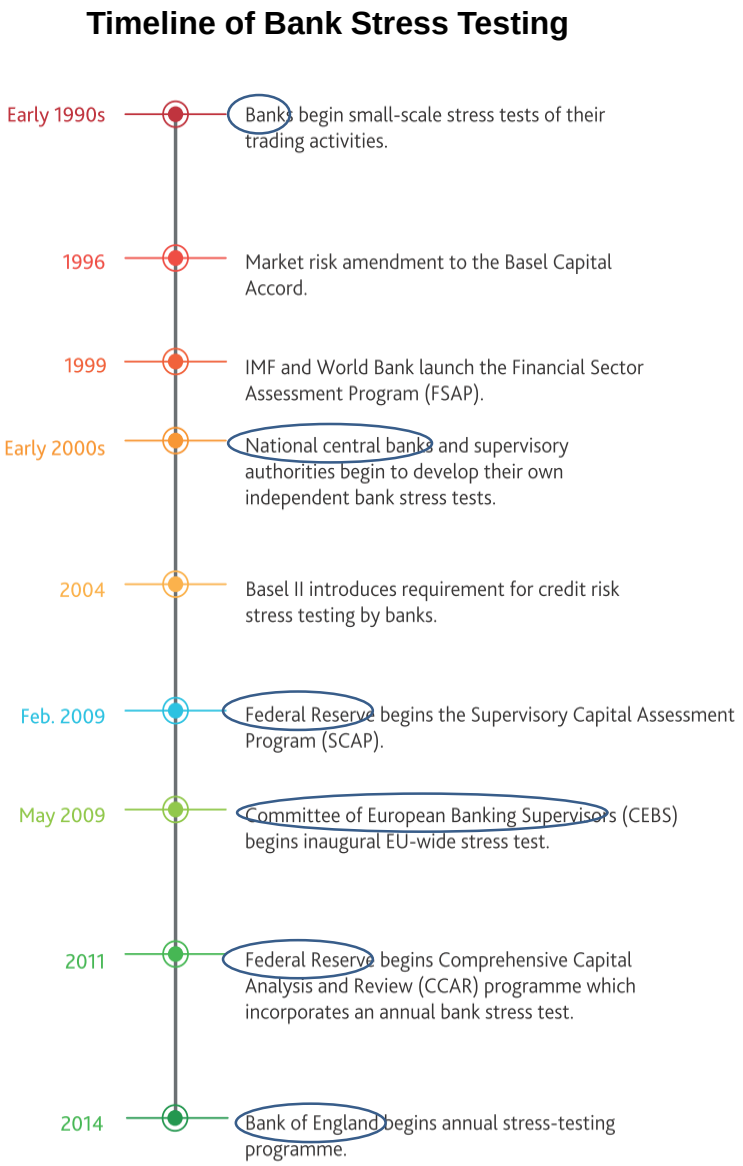
History of Scenarios as Management Tools
ii. Stress Test Scenarios

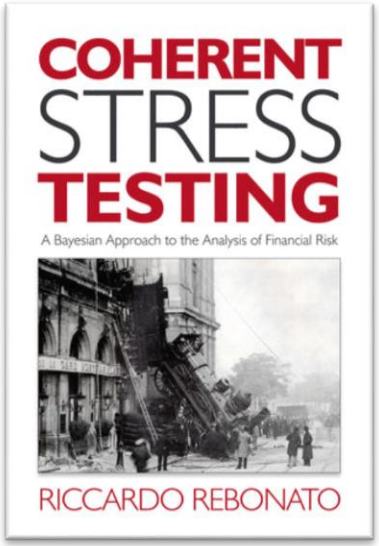
- Stress Tests are plausible but extreme narratives (scenarios)
  - What damage will a shock do to my business?
    - Imagineering
  - Challenge to quantify impact
    - Typically not probabilistic
    - Qualitative tail risk analysis
- Regulatory stress tests in banks
  - Standard in Compliance
  - Study weakness but not test fatality
    - In individual banks
    - In aggregate (system)
    - Weather a worse-than-expected outcome vs.a CCAR Adverse Scenario



History of Scenarios as Management Tools

ii. Stress Test Scenarios- Subtypes

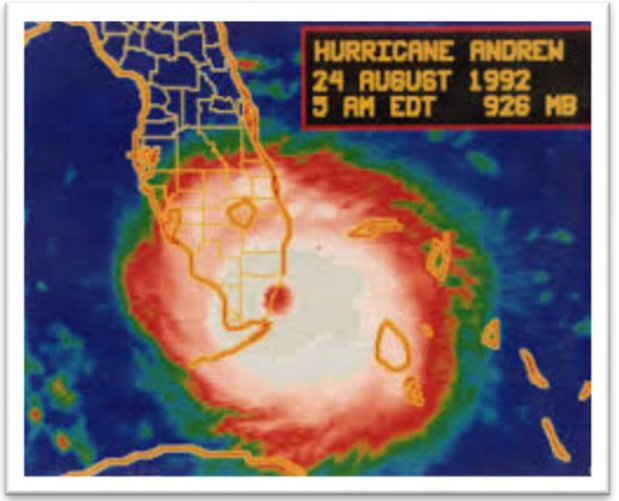
- **Reverse** stress tests for corporates and financial services: When would my organisation fail?
  - In what kind of situation, beyond what level of severity?
    - Imagineering required
    - Quantifying impact is the main challenge
    - Typically not probabilistic
- **Coherent** stress tests
  - Narrative describes/quantifies all parts of system moving at the same time (correlated change)
  - e.g. *counterfactual* scenarios drawing on historical events



History of Scenarios as Management Tools

ii. Stress Test Scenarios- Subtypes

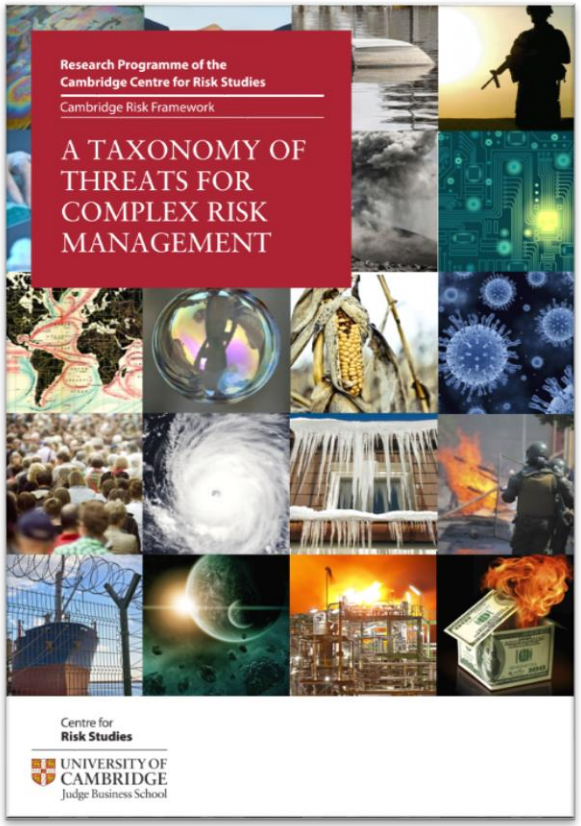
- Catastrophe stress tests for insurance tail risk assessment
  - Pre 1992, qualitatively severe stress tests used by insurance firms to check ability to survive a shock
    - C.f., CCAR Severely Adverse scenario
  - Hurricane Andrew led to many bankruptcies and consolidation in US insurance industry
  - This ushered in *probabilistic* analysis of tail events: What is chance of exceeding any given level of loss?
    - Exceedance, e.g., expected loss from 1-in-100 year event
    - C.f., 1% Value-at-Risk
  - Few insurance bankruptcies since 1992 even though pay-outs for large events ↑



Cambridge CRS view
Steps for Qualitative Scenario Stress Tests

Qualitative goal of risk assessment: How big/bad could a plausible disaster be?

1. Selection of stress test
   i. Taxonomy of stress test types
   ii. Knowledge: history, science, theory of each
2. Severity of stress test
   i. Severity metrics and units
   ii. Constraints or physics of shock
3. Severity of impact on system at risk
   i. Map of Loss Process including constraints
   ii. Expert elicitation on level of Conditional Impacts
4. Building the scenario
   i. Narrative including Footprint, Timeline, Quantified Direct Impacts and Variants
   ii. Model (quantify) indirect impacts and variants
5. Probabilistic analysis of Threats



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Agenda

1. Scenarios as Management Tools: Selective Survey
2. Case Studies of Use of CCRS Cat Stress Test Scenarios
   - #1: Multiline Global Insurer Testing Risk Appetite
   - #2: Global Reinsurer Explores Non-Standard Threat
   - #3: Regulatory Request to Global Insurer
   - #4: London Insurer Assesses Emerging Threat
   - #5: UK Reinsurer Explores Expanding Its Cover
   - #6: Risk Modeller brings Cyber Cat Models to Market
3. Best Practice in Using Scenarios in Insurance Decision-Making

Case Study #1: Multiline Global Insurer Testing its Risk Appetite

Objective

- Explore impact on claims pay-outs and investment portfolios from emerging risks: cyber, war, and pandemic

CRS Research Application

- Produce stress test scenarios for emergent risks
  - Plausible but extreme events – qualitative tail risk
  - Assess insurance claims
  - Assess investment portfolio
- Explore risk consequences of diverse threat types
  - Geopolitical Conflict: risk O (⇨ Inflation↑)
  - Human Diseases: risk ↑
  - Cyber Technology Catastrophe: risk ↑

Impact

- Risk appetite adjustments, e.g., for total exposure in Healthcare and Mortality
- Regular stress tests include emergent risk scenarios

China-Japan Conflict
Geopolitical Conflict Scenario

São Paulo Pandemic
Human Disease Scenario

Sybil Logic Bomb
Tech Catastrophe Scenario

Case Study #2: Global Reinsurer Exploring Impact of Non-Standard Threat on Pay-Outs in Different Lines

Objective

- Provide general analysis of triggers and consequences of social unrest events from a reinsurance perspective

CRS Research Application

- Produce stress test scenario for social unrest
  - Plausible but extreme event
  - Asses policy liabilities by insurance line

Impact

- More comprehensive management information to risk function

Millennial Uprising
Social Unrest Scenario

Class	Line of Business	
Property		
	Personal Lines/Homeowner	1
	Personal Contents	1
	Commercial Combined	5
	Construction & Engineering	3
	Commercial Facultative	4
	Binding Authorities	2
Casualty		
	Workers Compensation	4
	Directors & Officers	4
	Financial Lines	5
	General Liability	3
	Healthcare Liability	3
	Professional Lines	2
	Professional Liability	3
Auto		
	Personal Lines	5
	Commercial & Fleet	5
Marine & Specie		
	Cargo	0
	Marine Hull	0
	Marine Liability	0
	Specie	0
Aerospace		
	Airline	1
	Airport	0
	Aviation Products	0
	General Aviation	0
	Space	0
Energy		
	Downstream	1
	Energy Liability	0
	Onshore Energy & Power	0
	Upstream	1
Specialty		
	Accident & Health	2
	Aquaculture Insurance	0
	Contingency – Film & Event	3
	Equine Insurance	0
	Excess & Surplus	0
	Life Insurance	4
	Livestock	0

Class	Line of Business	
Life & Health		
	Life Insurance	4
	Health Insurance	4
	Income Protection	3
	Death & Disability	5
	Hospital Cover	5
Pension and Annuities		
	Standard Annuities	-2
	Variable Annuities	-1
	Enhanced Annuities	-2
	Life Settlements	-1
War & Political Risk		
	Kidnap & Ransom	0
	Political Risk	5
	Political Violence & Terrorism	3
	Product Recall	0
	Trade Credit	4
Agriculture		
	Multi-peril Crop	1
	Crop Hail	0
	Livestock	0
	Forestry	0
	Agriculture	0

Key to change in insurance claims	
Major decrease in claims	-5
	-4
	-3
	-2
	-1
No change in claims	0
	1
	2
	3
	4
Major increase in claims	5

Table 5: Estimated impact of a social unrest scenario on claims patterns from different lines of insurance.

Case Study #3: Regulatory Request to Global Insurer

Objective

- Insurer asked by regulator to report its exposure to a non-standard natural catastrophe

CRS Research Application

- Produce stress test scenario for solar storm
  - Plausible but extreme event
  - Assess policy liabilities by insurance line

Impact

- Reporting to regulator and internal management

Solar Storm Externality Scenario

Case Study #4: London Insurer Assesses Emerging Threat

Objective

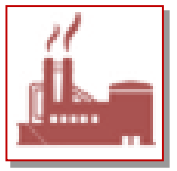
- Underwriter seeks assessment of "silent" exposure to cyber disaster
  - New loss process: cyber induced physical damage
  - Not excluded in existing Marine and Aviation policies

CRS Research Application

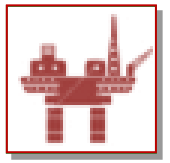
- Produce stress test scenario for cyber threats
  - Plausible but extreme events
  - Assess policy liabilities

Impact

- Review policy wording for clarity around cyber coverage



Cyber Attack on **Industrial Plant**



Cyber Attack on **Oil Rigs**

Case Study #5: UK Reinsurer Explores Feasibility of Expanding Its Cover

Objective

- Reinsurer investigating of expanding terrorism cover for emerging risk
  - New area combines cyber catastrophe with terrorism

CRS Research Application

- Produce stress test scenarios for cyber terror threats
  - Plausible but extreme attack
  - Assess property damage

Impact

- Seeking to include cyber terrorism, causing physical damage, in coverage scheme

Cyber arson attack on
Commercial Buildings

Cyber Attack on
Industrial Chemical Plant

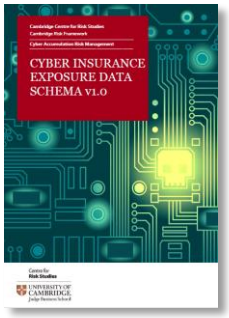
Case Study #6: Risk Modeller brings Cyber Cat Models to Market

Information Technology
Business Loss Processes

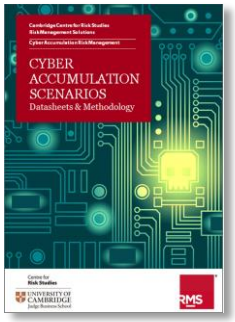
- **Data Exfiltration** ('Leakomania')
- **Denial of Service Attack** ('Mass DDoS')
- **Cloud Service Provider Failure** ('Cloud Compromise')
- **Financial Theft** ('Cyber Heist')
- **Contagious Malware** ('Extortion Spree')
- **Software Vulnerability** ('Sybil Logic Bomb'')

Operations Technology
Cyber-Physical Loss Scenarios

- Cyber Attack on **US Power Generation** ('Business Blackout')
- Cyber Attack on **UK Power Distribution** ('Integrated Infrastructure')
- Cyber attack on **Commercial Office Buildings** ('Laptop batteries fire induction')
- Cyber attack on **Marine Cargo Port** ('Port Management System')
- Cyber Attack on **Industrial Chemical Plant** ('ICS Attack')
- Cyber Attack on **Oil Rigs** ('Phishing-Triggered Explosions')



Exposure Data Schema



Accumulation Scenarios

2017 Cyber Risk Landscape

Objective

- Help insurance clients manage accumulation risk to their cyber products

CRS Research Application

- Exposure Data Schema
- Accumulation Scenarios: Initially 5 models for affirmative cyber cover
  - Assess accumulation to plausible but extreme cyber attacks

Impact

- Release of first cyber accumulation model in market

Agenda

1. Scenarios as Management Tools: Selective Survey
2. Case Studies of Use of CCRS Cat Stress Test Scenarios
3. Best Practice in Using Scenarios in Insurance Decision-Making
   I. Risk Management for an Insurer
   II. Insurance as a Service

Best Practice in Using Scenarios in Insurance Decision-Making

I. Risk Management for an Insurer

- Overriding principle is *comparability or ranking of all threats*.

II. Insurance as a Service

- Propose goal of *quantifying loss or damage for each of comprehensive set of threats to insurance clients*.

Best Practice in Using Scenarios in Insurance Decision-Making

I. Risk Management for an Insurer

Overriding principle is *comparability or ranking of all threats*. To achieve this with scenarios we recommend developing:

- **Comprehensive or universal taxonomy of risk types**
  - e.g, Cambridge Taxonomy of Threats
  - Taxonomy visibly frames what is relevant, excludes the rest
- Definition of **System at Risk**
  - The system is the unit of analysis
  - Metrics of impact are defined
- Qualitative **Tail Risk Analysis**
  - **Plausible but extreme threat scenarios using a clear and repeatable methodology**
  - Use operations of System at Risk and understanding of wider environment to bound outcomes
  - Translate threat characteristics to impacts on System
- Probabilistic Tail Risk Analysis is a significant next step

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Best Practice in Using Scenarios in Insurance Decision-Making

II. Insurance as a Service

Propose goal of *quantifying loss or damage for each of comprehensive set of threats to insurance clients*.

To achieve this with scenarios we recommend developing impact analytics:

- **Modelled Scenarios**:
  - Industrialise scenario building in models and software
    - Generate a library of many modelled scenarios
  - Estimate probability or frequency of each threat scenario
- **Modelled** Systems at Risk, aka **Insurance Clients**
  - Identify taxonomy of Systems at Risk, e.g., corporations in sectors
  - Model a loss process, on type of System, for each threat
  - The above are informed by learning and outputs from Stage 1
- **Probabilistic Risk Assessment,** including
  - Estimate **average impact of each threat** per unit time
  - Estimate **tail risk** for a given return period
  - **Gap analysis**: Where does insurance promise the best value?

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Holy Grail

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