Centre for Risk Studies

5th Risk Summit: Special Topics Seminar

Centre for Risk Studies
Research Agenda 2015

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Centre for
Risk Studies

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Scenarios

2014

Geopolitical Conflict
China-Japan Conflict
Regional conflict in Southeast Asia embroiling multiple military powers

Cyber Catastrophe
Sybil Logic Bomb Cyber Attack
Systemic loss to commercial IT systems by cyber attack

Human Pandemic
São Paulo Virus Pandemic
Virulent influenza pandemic causes months of absenteeism and economic disruption

Social Unrest
Millennial Uprising
Austerity-driven riots and strikes across multiple cities in US & Europe

2013

Oil Price Shock
Regime Change in Saudi Arabia
Arab Spring event leads to western military intervention triggering major oil price spike

Banking Crisis
Bank run in Southern European
Run on banks in Greece and Cyprus causing contagion through European financial system

Climatic Freeze Event
8 week freeze in Northern Hemisphere
Severe and extended winter in Northern Europe and East Coast USA
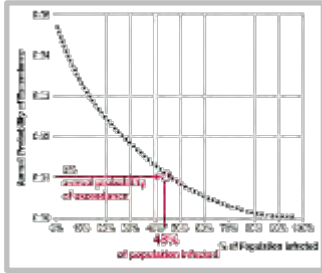

Piracy Crisis
Severe Piracy Activity in Horn of Africa
Intensity of piracy incidents increases to the point that shipping patterns are impacted

What Does a Stress Test Scenario Include?

Context
A justification and context for a 1% annual probability
of occurrence worldwide

Timeline & Footprint
Sequencing of events in time
and space in hypothetical scenario
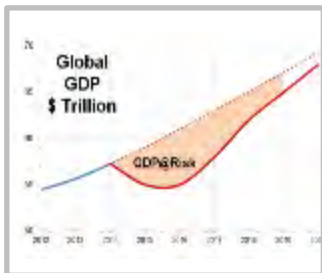

Narrative
Detailed description of events

Loss Assessment
Metrics of underwriting loss across many
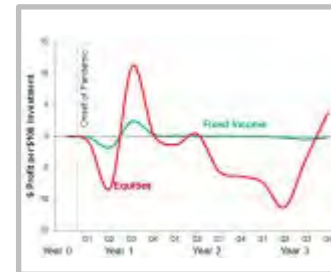different lines of insurance business

Macroeconomic Consequences
Quantification of effects on
many variables in the global economy

Investment Portfolio Impact
Returns and performance over time
of a range of investment assets

2015 Research Agenda

- The Centre for Risk Studies will extend its focus into **networks and catastrophe risk**

- We will extend our work on **using scenarios** as vehicles for exploring risk issues

    – **Deepen**: Improve the usefulness of scenarios to risk managers, improve scenario development methodology and increase our understanding of the networks at risk

    – **Extend**: Add new scenarios to the suite

    – **Broaden**: Take lessons from scenarios to build a holistic picture of risk across multiple threats

Deepen: Extend the Usefulness of Scenarios

- Work with companies to improve the way these scenarios help their risk management processes
  - Insurance supporters are interested in assessing losses to their underwriting portfolio from scenarios
  - Investment managers interested in applying the scenarios to their investment portfolios
- Standardize data formats and data interchanges with the systems and processes that companies use

BLACKROCK SOLUTIONS®   **FNA**   Integration of CRS scenarios with systems such as BlackRock and Financial Networks Analytics

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Emerging Risks Scenarios for Risk Management

- Scenarios for risk management of geopolitical conflict, cyber catastrophe and pandemic

- Macroeconomic outlooks and consequences

- 90 attendees

- High scoring on feedback form
  - Average response **4.46** on 5 point scale
  - 48% scored it a '5'

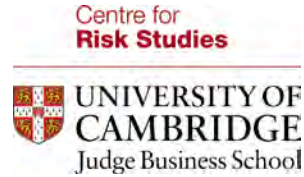- Strong focus on adoption and usability

Developing a
Global Insurance Industry Exposure Database

- ■ Insurers have asked for insurance industry loss estimates from the stress test scenarios

- ■ To estimate this, we propose to develop an insurance industry exposure database for multiple lines of business

- ■ This would be an open source CRS resource for the insurance industry
  - Property
  - Casualty
  - Auto
  - Marine & Specie
  - Aerospace
  - Energy
  - Specialty
  - War & Political Risk
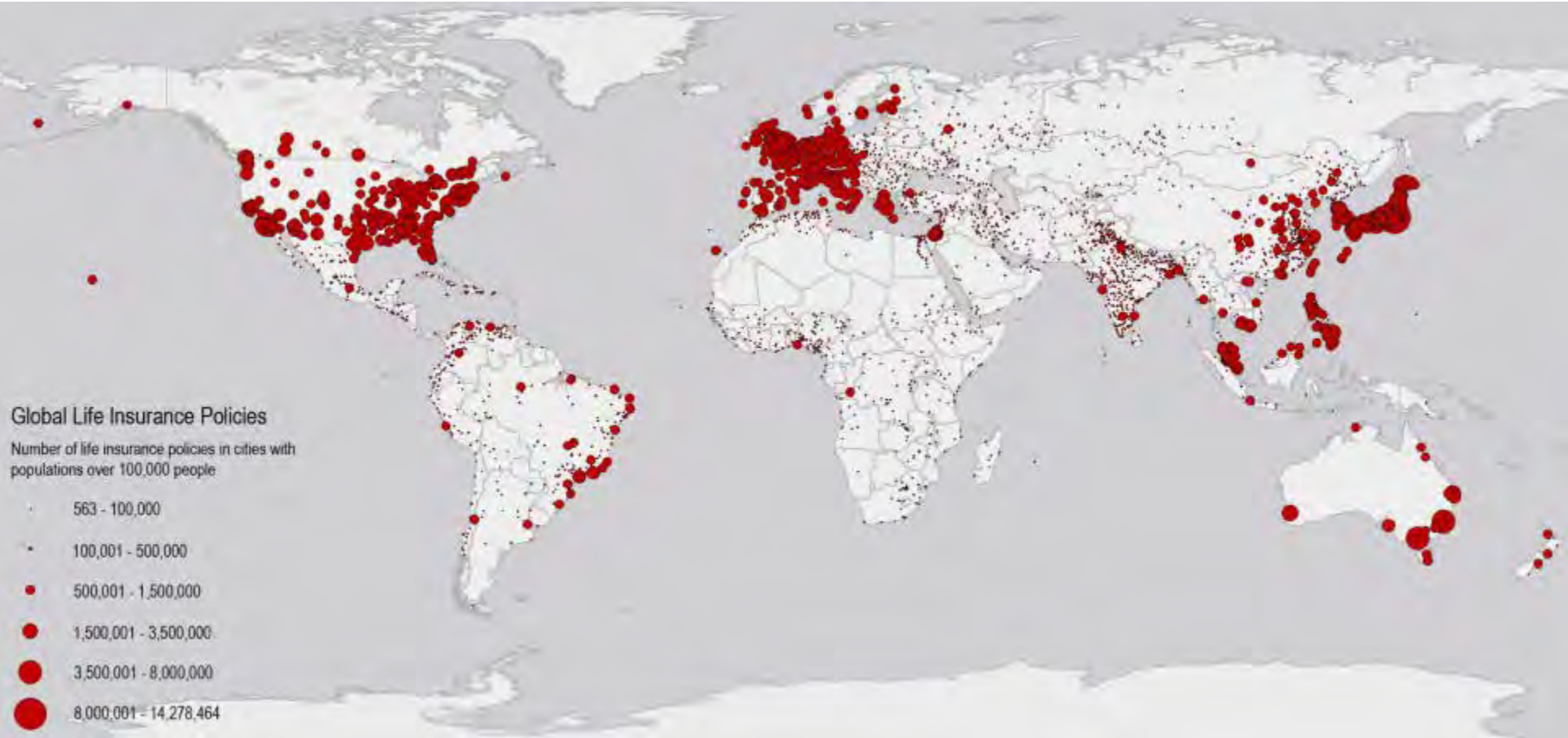 - Agriculture
  - Life & Health
  - Pensions and Annuities

Potential collaboration with AXCO
A Wilmington Company

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Global Life Insurance Industry Exposure Database

AXCO — A Wilmington Company

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A joint development project between Axco and the Centre for Risk Studies

Global Life Insurance Policies

Number of life insurance policies in cities with populations over 100,000 people

- 563 - 100,000
- 100,001 - 500,000
- 500,001 - 1,500,000
- 1,500,001 - 3,500,000
- 3,500,001 - 8,000,000
- 8,000,001 - 14,278,464

- $2.4 Trillion of Life Insurance Premium worldwide
- 1.2 Billion Life Insurance policies
- Total aggregate value of life cover: $78 Trillion

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Deepen: Improve our Methodology

- **The scenario development process is multi-stage**
- **It involves approximation and 'heroic assumptions'**
- **We are reviewing the methodology to identify areas of potential improvement**
- **Candidate areas include:**
  - Macroeconomic modelling process
  - Investment asset movements inferred from macroeconomic output
- **Intend to identify and incorporate uncertainty**

Scenario Definition

Process definition, timeline, footprint, sectoral impacts, contagion mechanisms

Loss Estimation

Impact on workforce; means of production; utilities; supply chains; finance; sentiment

Macroeconomic Modelling

Sectoral & regional productivity loss on key metrics such as GDP, Employment

Market Impact Assessment

Valuation of key asset classes, such as equities, fixed income, FX

Partnering with Oxford Economics on improving macroeconomic modelling for shocks

OXFORD ECONOMICS

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Deepen: Improve our Understanding of Networks

- Systemic instabilities challenge our intuition
  - Crowd behavior, traffic congestion, financial crash, power grid failures…
- Strongly coupled, complex systems have unexpected behavior:
  - Feedback loops
  - Non-linear amplifications, control interactions
  - Cascade effects, avalanche phenomena
  - Threshold effects and regime shifts
  - Emergent behaviour and self-organization
  - Temporary stabilities, equilibrium states, plateaus, stationarity
- Developing models of interconnectivity and network behaviour
- Understanding Systems of Systems

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Deepen: Develop a Network Model of Financial System

- We are currently developing a model of the financial system
  - A pseudo-realistic model of banking network and its links to commerce
- We intend to use this to model the propagation of shocks through the financial system
  - Using techniques already in use by regulators and central banks
- We are exploring the usefulness of catastrophe modelling techniques for managing risk in investment
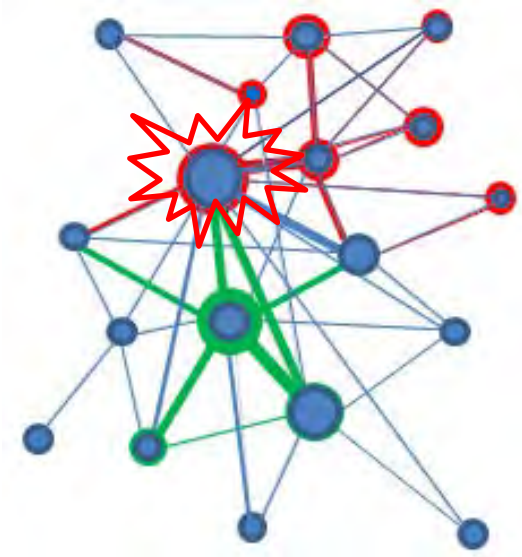
Deepen: Supply Chain Risk Research
9 April 2014: Workshop on Insurability of Supply Chain Risk

- Survey and workshop attendees:
  - Insurers
  - Corporate risk officers
  - Consultant/brokers
  - Academics

- Output: an agenda for supply chain research at Centre for Risk Studies
  - Develop an appropriate framework for assessing supply chain risk
    - Fully understand perils and threats
    - Be able to quantify network consequences all along supply chain
    - Develop metrics of resilience
  - Understand exposure, threats and patterns of loss
  - Support practitioner decision-making with tools and information

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Extend: Add to the CCRS Scenario Suite

- **New scenarios looking at Financial Shocks**
  - 'Endogenous processes of financial shock'
- **Extend to trends as well as shocks**
  - Different views of long-term trajectories and possible alternative futures
- **Additional scenarios of climate change stress tests**
  - Investment and business decision risk management
- **Additional scenarios for cyber catastrophe**
  - Cyber attack on critical infrastructure

Extend: Add Scenarios of Financial Catastrophe

Asset Bubble Shock
China Property Bubble Collapse
Sudden collapse of property prices in China mainland triggers a cascading crisis through financial system

Sovereign Default Shock
Country defaults
Sudden default of a number of countries on their debt causes a financial crisis in investors

High-Inflation World
High levels of inflation run for many years
Rampant inflation running in many countries

De-Americanization of Economy
Dollar loses its dominance as a trading currency
US dollar replaced by another or multiple currencies

Scenario Definition
Process definition, timeline, footprint, sectoral impacts, contagion mechanisms

Loss Estimation
Impact on workforce; means of production; utilities; supply chains; finance; sentiment
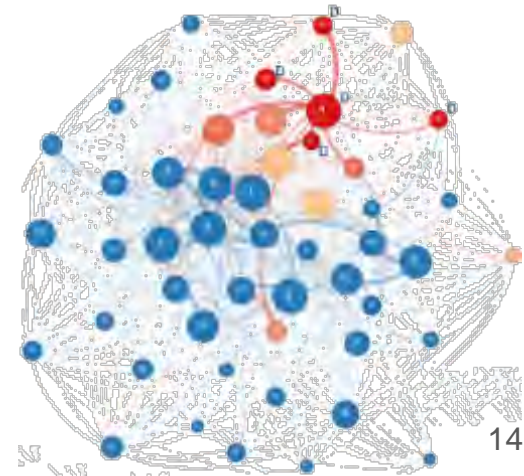
Macroeconomic Modelling
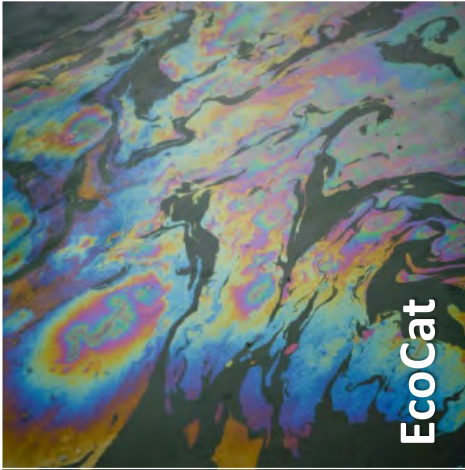Sectoral & regional productivity loss on key metrics such as GDP, Employment

Market Impact Assessment
Valuation of key asset classes, such as equities, fixed income, FX

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Extend: Add Scenarios for Climate Change Stress Tests
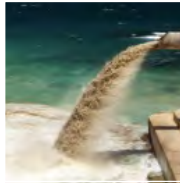
Environmental Catastrophe

EcoCat

Sea Level Rise


Ocean System Change

Wildfire

Pollution Event

Atmospheric System Change

- Our Taxonomy of Threats includes climate change threats
- We propose to develop stress test scenarios of climate change
- Aimed at businesses and investors
- As with other scenarios we will position them at the 99th percentile of likelihood
  - "1-in-100" probability of exceedance
- Scenarios are likely to include:
  - Sea Level Rise from rapid ice shield collapse and thermal ocean expansion
  - Increased frequency of extreme weather events such as
    - Heatwaves
    - Freeze events
    - Tropical storms
    - Precipitation
- In partnership with
  - Cambridge Centre for Climate Change Mitigation Research (4CMR)
  - Cambridge Institute for Sustainability Leadership

Extend: Cyber Risk Research

Power Grid Vulnerability

United States transmission grid
Source: FEMA

- The Centre's Cyber Scenario has attracted major interest

- We propose to extend our cyber risk analysis framework

- Applications in public policy and the vulnerability of public sector

- Interest from insurance sector on opportunities and threats
  - Might a well-structured risk framework enable more insurance capacity?

- Focus on Critical Infrastructure

- We propose to add scenarios of systemic attacks on national power grids to quantify macroeconomic impacts
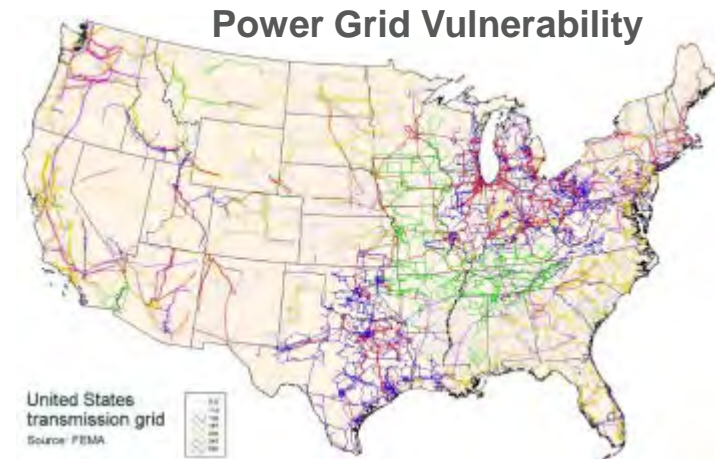
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27 February 2014 Last updated at 00:26   Share f ⚥ ✉ 🖨

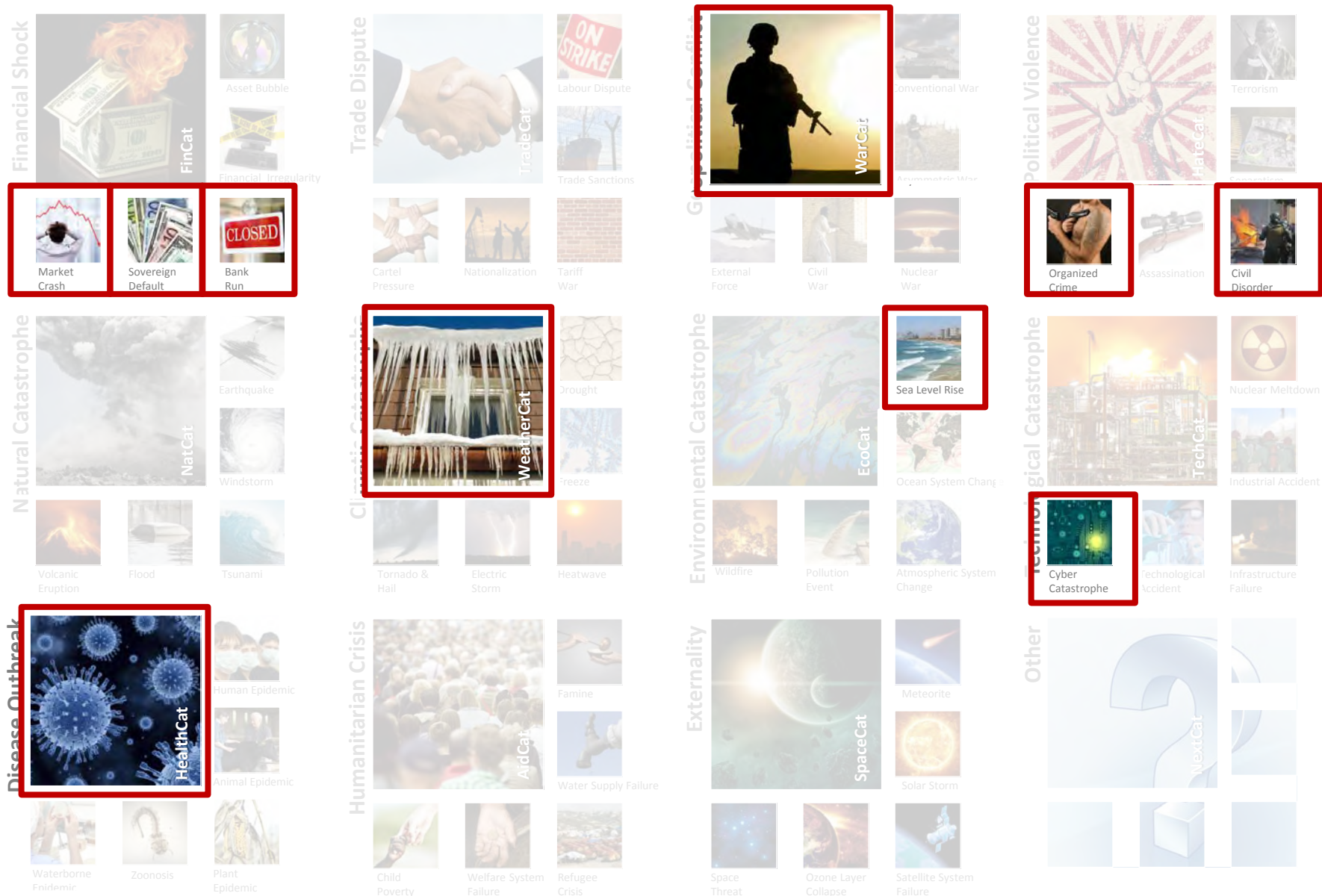## Energy firm cyber-defence is 'too weak', insurers say

By Mark Ward
Technology correspondent, BBC News

Energy bosses are getting increasingly worried about the risks posed by cyber attack

Power companies are being refused insurance cover for cyber-attacks because their defences are perceived as weak, the BBC has learned.   Related Stories

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Broaden: Consider More Threats

Financial Shock — FinCat: Asset Bubble, Financial Irregularity, **Market Crash**, **Sovereign Default**, **Bank Run**

Trade Dispute — TradeCat: Labour Dispute, Trade Sanctions, Cartel Pressure, Nationalization, Tariff War

Geopolitical Conflict — WarCat: Conventional War, Asymmetric War, External Force, Civil War, Nuclear War

Political Violence — Terrorism, **Organized Crime**, Assassination, **Civil Disorder**

Natural Catastrophe — NatCat: Earthquake, Windstorm, Volcanic Eruption, Flood, Tsunami

Climatic Catastrophe — WeatherCat: Drought, Freeze, Tornado & Hail, Electric Storm, Heatwave

Environmental Catastrophe — EcoCat: **Sea Level Rise**, Ocean System Change, Wildfire, Pollution Event, Atmospheric System Change

Technological Catastrophe — TechCat: Nuclear Meltdown, Industrial Accident, **Cyber Catastrophe**, Technological Accident, Infrastructure Failure

Disease Outbreak — HealthCat: Human Epidemic, Animal Epidemic, Waterborne Epidemic, Zoonosis, Plant Epidemic

Humanitarian Crisis — AidCat: Famine, Water Supply Failure, Child Poverty, Welfare System Failure, Refugee Crisis

Externality — SpaceCat: Meteorite, Solar Storm, Space Threat, Ozone Layer Collapse, Satellite System Failure

Other — NextCat

Cambridge Risk Framework **Threat Taxonomy**

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Broaden: A Global Model of the Risk Landscape

- Feedback from our community is encouraging us to look at relativities between threats, to get a holistic assessment of the macroeconomic 'Risk Landscape'
- We propose to develop a first-order frequency-severity distribution for all the major threats in the taxonomy
- This will use evidence-based approaches to magnitude recurrence of each threat type, with macroeconomic consequence analysis
  - Threat consequences will be expressed in GDP@Risk metrics
- 2014/15 exercise is top-down: considering the world as a system
  - Exploring more granular versions in future, for major cities of the world
- The primary intension is to compare and rank the threats to the global economy
- It will be the first global, all-threat model

Restructuring the Taxonomy

5 Primary Classes
11 Families
55 Types

A — Finance & Trade

Financial Shock (FinCat)

Asset Bubble	Financial Irregularity	Bank Run	Sovereign Default	Market Crash

Trade Dispute (TradeCat)

Labour Dispute	Trade Sanctions	Cartel Pressure	Commodity Price Shock	Tariff War

B — Geopolitics & Society

Geopolitical Conflict (WarCat)

Conventional War	Asymmetric War	External Force	Civil War	Nuclear War

Political Violence (HateCat)

Terrorism	Separatism	Civil Disorder	Assassination	Organized Crime

C — Natural Catastrophe & Climate

Natural Catastrophe (NatCat)

Earthquake	Windstorm	Tsunami	Flood	Volcanic Eruption

Climatic Catastrophe (WeatherCat)

Drought	Freeze	Heatwave	Electric Storm	Tornado & Hail

Environmental Catastrophe (EcoCat)

Sea Level Rise	Ocean System Change	Atmospheric System Change	Pollution Event	Wildfire

D — Technology & Space

Technological Catastrophe (TechCat)

Nuclear Meltdown	Industrial Accident	Infrastructure Failure	Tech Accident	Cyber Catastrophe

Externality (SpaceCat)

Meteorite	Solar Storm	Satellite System Failure	Ozone Layer Collapse	Space Threat

E — Health & Humanity

Disease Outbreak (HealthCat)

Human Epidemic	Animal Epidemic	Plant Epidemic	Zoonosis	Waterborne Epidemic

Humanitarian Crisis (AidCat)

| Famine	Water Supply Failure	Refugee Crisis	Welfare System Failure	Child Poverty

Scenario Studies - Macroeconomic Impact from Threats

Geopolitical Conflict

S1
S2
X1

Pandemic

S1
S2
S3
X1

Cyber

S1
S2
T1
X1

2007-12 Great Financial Crisis

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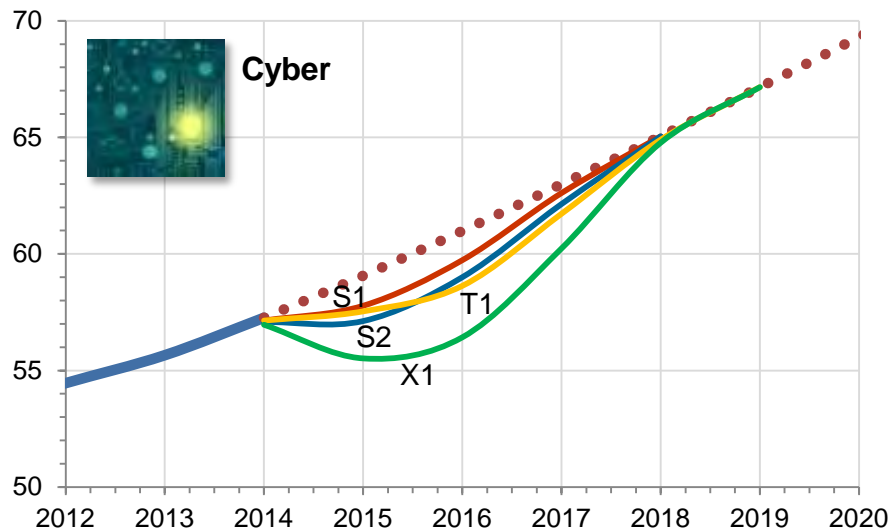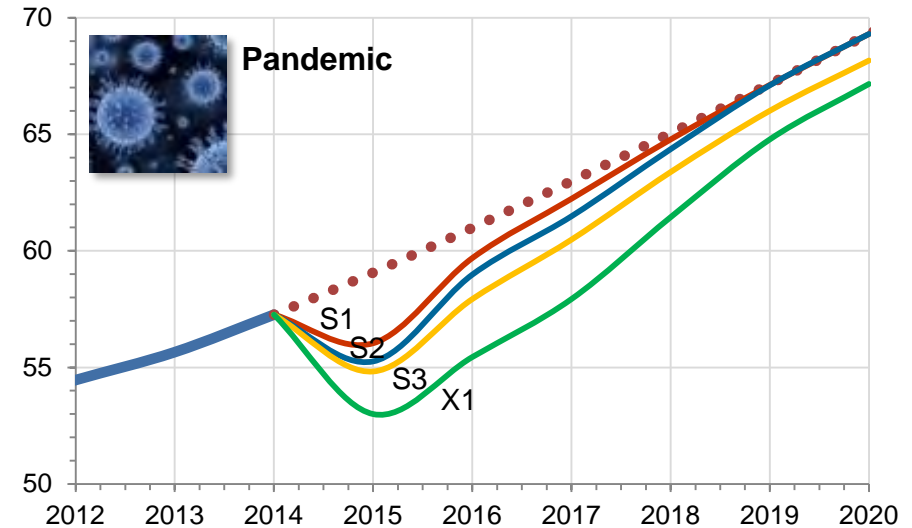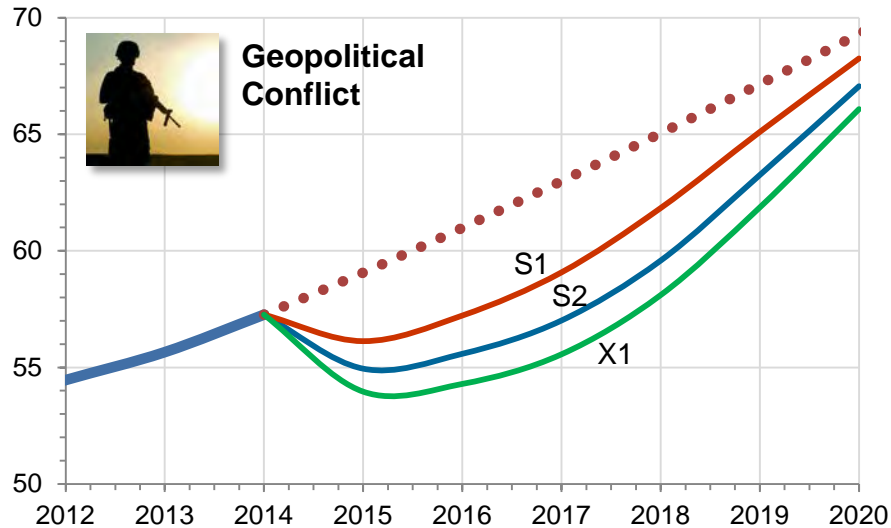
Broaden: Add Likelihoods of Different Severities

- ■ Estimating the frequency of small, medium, and large events in each threat class
  - – Using evidence-based assessments, including historical frequency and modified future frequency estimation
- ■ Use template of GDP@Risk outcomes for a sample of scenarios
  - – Generalise this to other threat classes
- ■ Incorporate compounded effects and likelihoods of one threat type triggering another

Pandemic EP Curve
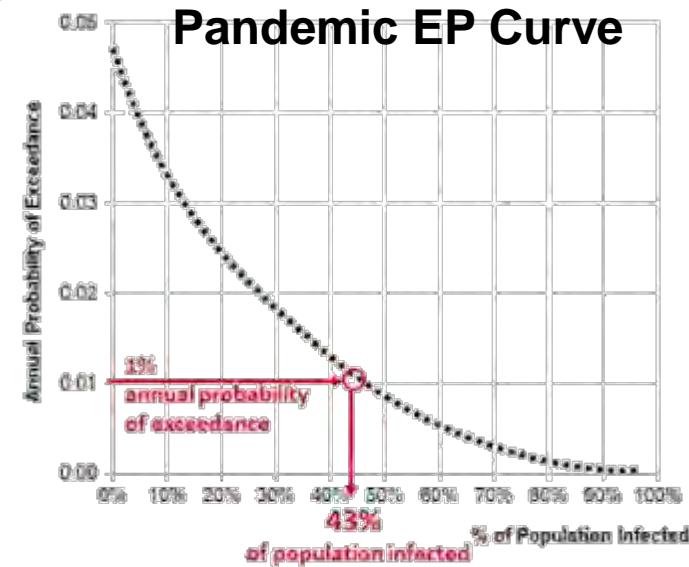
Historical Financial Crises

Outputs of Global Macroeconomic Risk Model

- An overall assessment of the frequency and severity of global macroeconomic shocks
- Simplified scenarios for use in risk management
- Use as inputs to
  - calibration of risk capital models
  - business planning for global corporations
  - policy-making for global resilience improvement
- Ability to benchmark different threats and track dynamic changes

Extend: Develop Models of City Risk

Which cities' economic growth will be most at risk over the next decade?
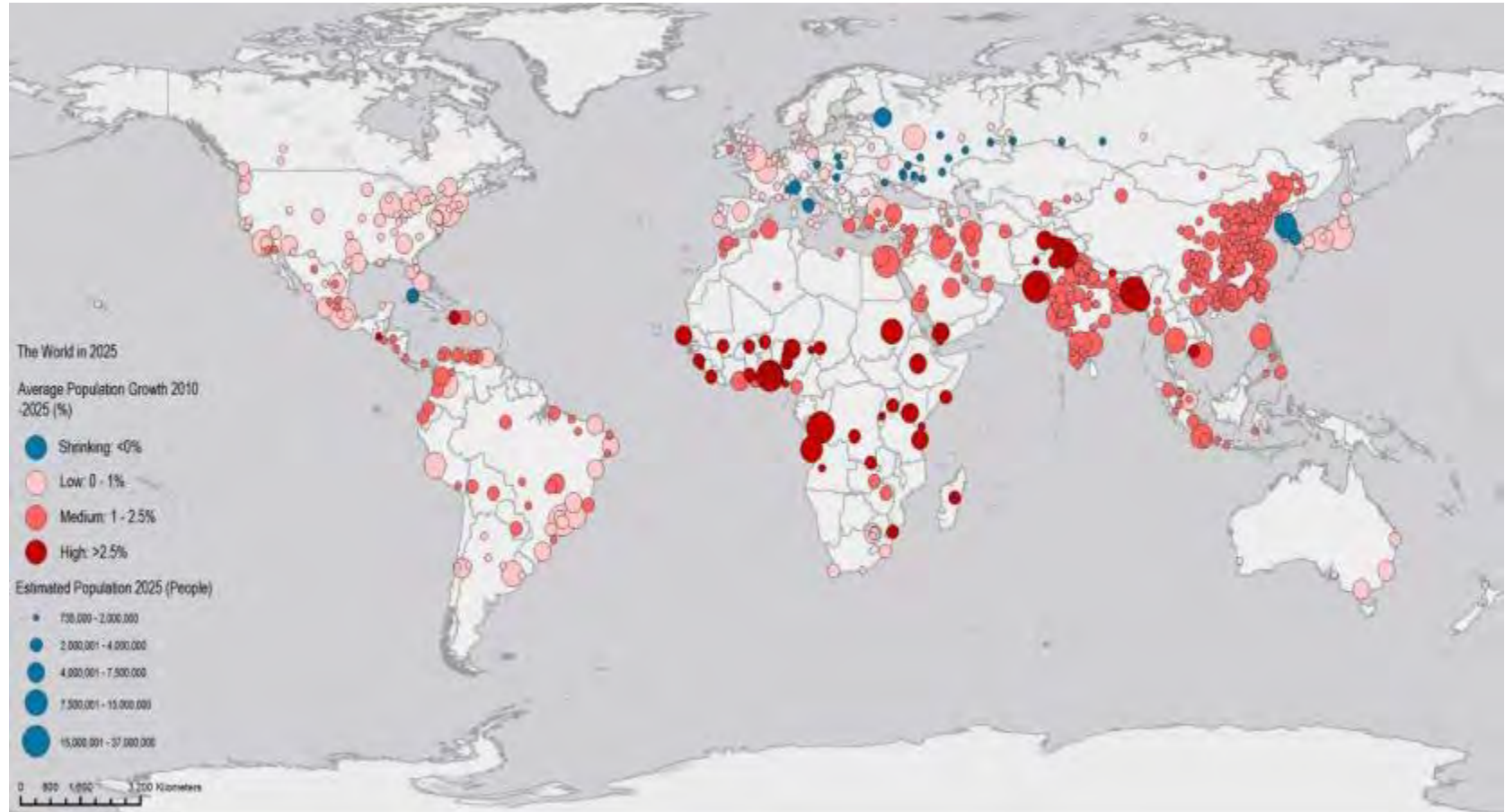

The World in 2025

The Road Ahead

- We are continuing to explore the implications of connectivity and shocks in the globalized economy

- This is a new way of looking at business risk and is providing interesting new insights

- We think it will change the way people manage risk

- We have an ambitious agenda, but are making good progress

- We welcome research partners and supporters

New Centre for Risk Studies Publications
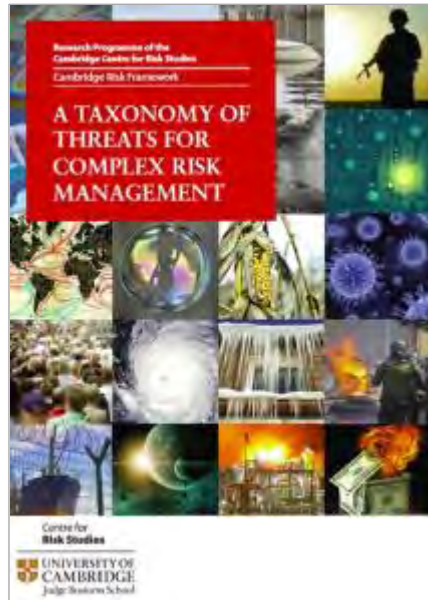
Taxonomy of Threats
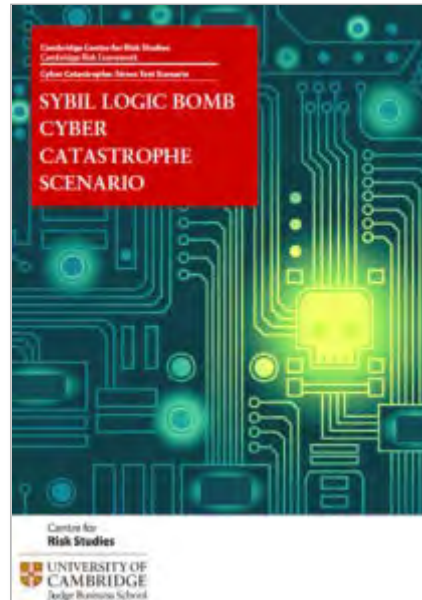
Cyber Catastrophe
Stress Test Scenario

Pandemic
Stress Test Scenario

Geopolitical Conflict
Stress Test Scenario

Available for Download from Our Website:
CambridgeRiskFramework.com

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