



Cambridge Centre for Risk Studies
Advisory Board Research Showcase – 13 January 2016

Research Objectives for 2016

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

Dr Andrew Coburn
Director of Advisory Board
Centre for Risk Studies

Advisory Board Guidance

2014



2015



- Our annual research agenda priorities are set by our Advisory Board each year
- These are some of the themes we are proposing to them this year

Where Next?



Scenarios

- Taking scenario methodologies to a new level
- Variantsⁿ
- Help other people create them



Making our research more useful

- Turning it operational: Data standards & outputs
- Applying the analysis to decision-making and strategies
- Interpreting events:



Putting it all together

- Project Pandora
- Objectively prioritizing the importance of threat scenarios
- Tracking emerging systemic risks

Scenarios



Doing More Scenarios



- We have a few more scenarios in the 2016 pipeline:
 - European power grid cyber attack
 - Marine insurance stress test (RDS)
 - NatCat FinCats
 - ‘Silent’ Cyber insurance accumulation scenarios
- Financial Catastrophe Scenarios...

Future Financial Stress Test Scenarios?

Scenarios suggested for future study by Cambridge Centre for Risk Studies in 2016:

12 Extreme Deflation

Financial Taxonomy Causes not yet covered:

8 2. Bank Run (multiple banks)

13 3. Flash Crash / Cyber Predation

6 4. Internal fraud / Rogue trading

10 5. US sovereign default

18 Systemic pension fund collapse from under-funding (Longevity “Disaster”)

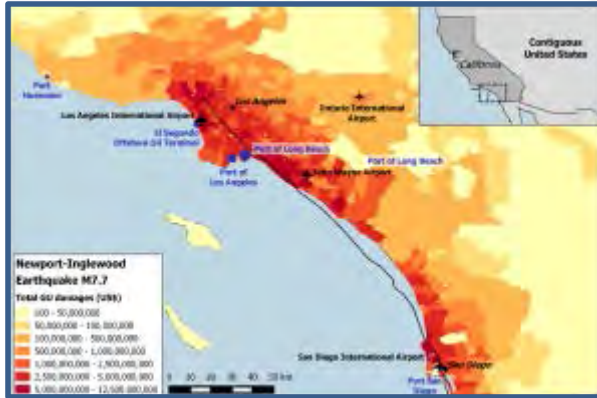
9 ‘Brexit’ – UK votes to leave EU

8 Currency collapse: Cryptocurrency (Bitcoin or similar)

20 Geopolitical: Long term climate of fear from persistent terrorist attacks in West, coupled with immigration destabilization

Straw poll of 60 attendees at CRS Seminar on Market Risk, 8 December 2015

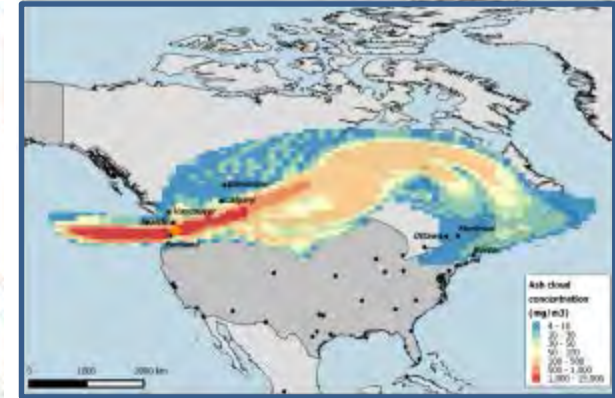
Clash: 'Trillion Dollar NatCat' Events



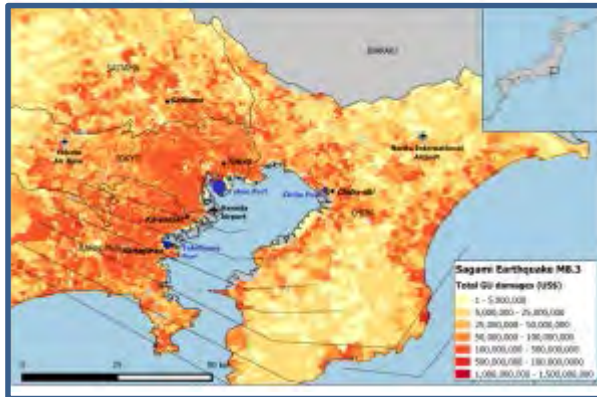
Earthquake M7.7 Los Angeles
GU Loss: \$863 Bn
Global GDP Loss: \$3.6 Trillion
RP: 1,100 yrs



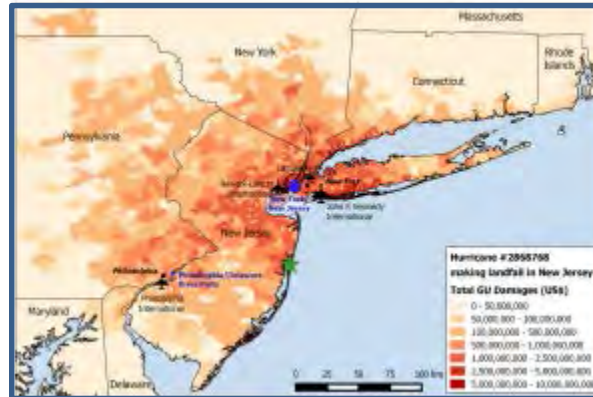
Hurricane CAT 4 Florida
GU Loss: \$1,350 Bn
Global GDP Loss: \$2.4 Trillion
RP: 1,200 yrs



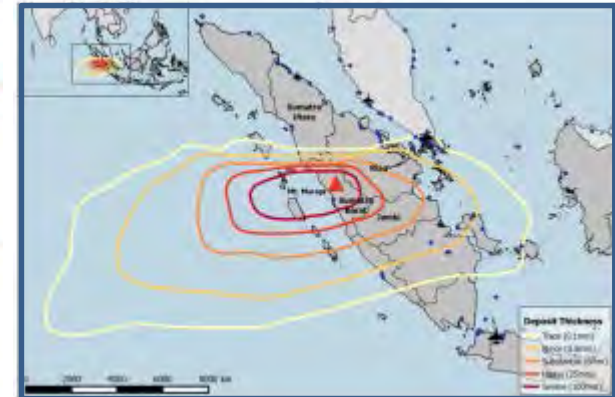
Volcano VEI VII Mt Rainier, Seattle
GU Loss: \$1,100 Bn
Global GDP Loss: \$6.3 Trillion
RP: 3,000 yrs



Earthquake M8.3 Tokyo, Japan
GU Loss: \$1,368 Bn
Global GDP Loss: \$1.6 Trillion
RP: 1,400 yrs



Hurricane CAT 4 New Jersey
GU Loss: \$1,150 Bn
Global GDP Loss: \$3.6 Trillion
RP: 1,150 yrs



Volcano VEI VII Mt Marapi, Indonesia
GU Loss: \$493 Bn
GDP Loss: \$2.5 Trillion
RP: 750 yrs

Methodological Advances

- Catastronomics – a much deeper understanding of the economics of catastrophe
 - Detailed analysis of the process of shock & recovery
 - Let's lose our equilibrium: improve macroeconomic modelling to remove the equilibrium assumption
- Variants – generating a lot more variants
 - Sensitivity analysis by generating stochastic variants of possibilities around the occurrence
 - Process of creating more scenarios
- Spreading the capability
 - Share our methodological knowledge to other groups
 - Create a 'best-practice' guide on how to develop scenarios

Making Our Research More Useful



Making Our Research More Useful

- Plugging scenarios into decision-support systems
- ‘Data Standards’ – consult widely to develop schemas for
- Maintain these data schemas – become a secretariat for data standardization
- Develop scenarios into Policy Tools

A Data Schema for Multi-Line Impact Assessment





- Create a standard output structure for scenarios to:
 - Generate portfolio-specific multi-line insurance losses
 - Develop a standard format for estimating impact on investment portfolio

Insurance Underwriting Classes Impact

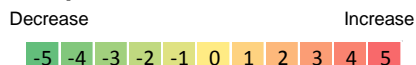
Class	Line of Business	
Property		
	Personal Lines/Homeowner	-1
	Personal Contents	0
	Commercial Combined	1
	Construction & Engineering	2
	Commercial Facultative	1
	Binding Authorities	0
Casualty		
	Workers Compensation	4
	Directors & Officers	3
	Financial Lines	4
	General Liability	3
	Healthcare Liability	5
	Professional Lines	1
	Professional Liability	2
Auto		
	Personal Lines	-1
	Commercial & Fleet	-2

Class	Line of Business	
Marine & Specie		
	Cargo	0
	Marine Hull	0
	Marine Liability	1
	Specie	2
Aerospace		
	Airline	3
	Airport	4
	Aviation Products	3
	General Aviation	2
	Space	0
Energy		
	Downstream	1
	Energy Liability	2
	Onshore Energy & Power	2
	Upstream	0
Specialty		
	Accident & Health	4
	Aquaculture insurance	1
	Contingency - film & event	5
	Equine insurance	1
	Excess & Surplus	3
	Life Insurance	3
	Livestock	1

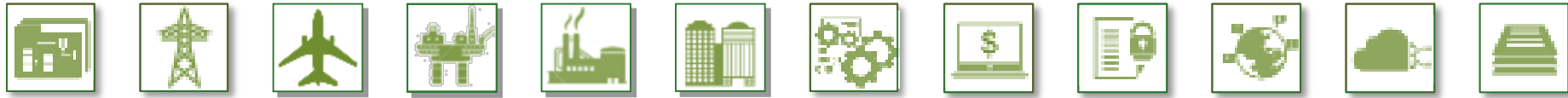
Investment Portfolio Asset Impact

Asset Class	Product	US 	UK 	Europe 	Japan 
Fixed Income	Govt. 2 yr	%	%	%	%
	Govt. 10 yr	%	%	%	%
	Corp 2 yr	%	%	%	%
	Corp 10 yr	%	%	%	%
Alternatives	RMBS 2 yr	%	%	%	%
	RMBS 10 yr	%	%	%	%
Equity	Share price index	%	%	%	%
Cash	Cash	%	%	%	%

Impact on Insurance Claims



Translate Scenarios into Policy Tools



- Cyber scenario development has entailed developing a detailed model of the cyber economy
- We are in a unique position to be able to quantify how much risk could be reduced by different types of cyber loss mitigation approaches
 - Improving IT security of companies (“fortress corp” world)
 - Regulating vulnerabilities
 - Resourcing and redesigning law enforcement
 - Costs and benefits to different stakeholders
 - Critical National Infrastructure cost-benefit analysis

Interpreting Events: Response and Operations

- Could we make our toolkit provide more useful insights into news events and trends?
- Can we project likely consequences from the initial stages of an event?
 - Can we predict economic consequences and how this might impact different sectors of the economy and investment assets?
- Could we help corporates with better emergency response and contingency planning?

Putting It All Together

Project Pandora

21 Threat Models in Project Pandora

Identifying which scenarios occurring where in the world could trigger more than a Trillion dollars of lost economic output

Finance and Trade



Market crash



Sovereign default



Oil price shock

Geopolitics and Society



Interstate Conflict



Separatism Conflict



Terrorism



Social Unrest

Natural Catastrophe and Climate



Earthquake



Wind storm



Tsunami



Flood



Volcanic eruption



Drought



Freeze



Heatwave

Technology and Space



Nuclear accident



Power outage



Cyber attack



Solar storm

Health and Humanity



Human pandemic



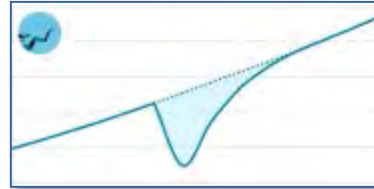
Plant epidemic

Project Pandora

Threat Maps



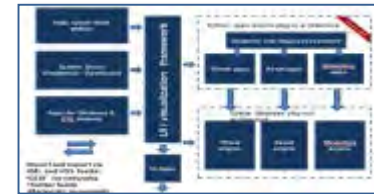
Risk Models & Output Data



Scenarios



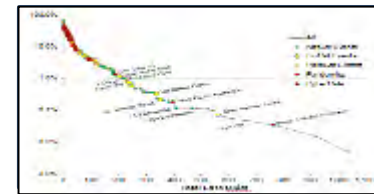
Software Platform (Cambridge Risk Framework)



Exposure Data



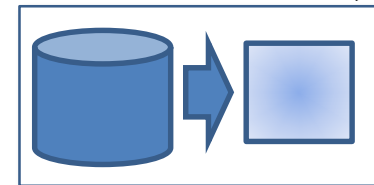
Use Cases – Business Applications



Network Models



Private Portals, APIs and modeling interfaces



Update Threat Models for 2016

	Threat	Events Since Analysis (2015)	2016 Update Actions
1	Market crash	2015 Aug 24 Shanghai Stock Exchange crash; VW scandal auto sector share price slump;	Recalibrate Market Crash implemented, including new risk capital holdings; banking network changes; market correlations; Reset model to latest stock market levels
2	Sovereign default	Grexit avoided; China economic 'decline' consequences on its trading partners; Argentina default 2014	Recalibrate Sovereign Default model using latest S&P ratings, updated sovereign default database
3	Oil price shock	Oil price crash Autumn 2014; cascading consequences on commodity prices and other economic metrics	Rebuild model for new oil price level; remove 'gain' modeling; Consider other commodity decline
4	Terrorism	Paris attack; escalation of ISIS crisis and radicalization of Western citizens; Russia involvement in Syria; Maghreb and central Africa increase in terrorism with Boko Horam attacks; export of terrorism to West;	Recalibrate with latest terrorism index, and trend projections from ISIS and other epicenters of exporting terrorism
5	Earthquake	Nepal earthquake(s) April 25 Ms7.8 9000 killed; May 12 Ms7.3; Chile Sept 16 Ms8.3; Malaysia June 4 (Ms 6.0);	Reassess TAG assessment of each city, esp Mexico etc.; Reassess vulnerability and resilience for highest risk cities/controversial assignments
6	Wind storm	Lessons from 2014 and 2015 Atlantic Hurricane (quiet) and Pacific Typhoon (hyperactive) season; Super Typhoons Vongfong Oct 2014 & Nuri Nov 2014; Hurricane Joaquin US Oct 2015; Typhoon Dujuan Sept 2015;	Reassess TAG assessment of each high risk city, esp Mexico etc.; Reassess vulnerability and resilience for highest risk cities/controversial assignments
7	Tsunami	Sept 2015 tsunami in Chile; additional studies published of localized tsunami risk	Extend tsunami analysis - coastal city verification
8	Flood	July 2015 Myanmar floods; June 2015 Gujarat flood; French Riviera flooding Cannes Oct 2015; 2015 floods in Malawi cause food crisis; Balkan floods May 2014	Revisit all high risk cities and recalibrate threat assessments;
9	Volcano	Mount Ontake eruption Japan Honshu; Frutillar Chile April 2015; Mt Sinabung Indonesia June 2015; air traffic disruption	Reassess local threat assessments for all higher risk volcanos
10	Drought	El Nino growing; Record drought in California (2012-2015 and ongoing); Brazil Cantareira worst drought for 80 years; Drought index trends	Reassess with updated drought index information; add El Nino implications
11	Freeze	El Nino forecast to result in severe cold winters in many regions of world; Met office forecast of severe winter across Europe that would follow eruption of Icelandic Bardarbunga volcano	Recalibrate model incorporating El Nino increase in frequency for next 2-3 years
12	Heatwave	India May 2015 heatwave killed 2500 and Pakistan heatwave June 2015; Karachi death toll 1200; El Nino forecast to bring increased heatwaves to other parts of world	Recalibrate model incorporating El Nino increase in frequency for next 2-3 years
13	Nuclear accident	Indian Point NPP in New York transformer fire May 2015; Ukraine nuclear reactor Zaporizhzhya shutdown after accident in Nov 2014;	Recalibrate & update model (incorporate nuclear subs?)
14	Power outage	March 2015 Turkey loses power to 90% of country (70m people) after technical problems; Jan 2015 Pakistan loses power to 80% of population (140m) from power surge after terrorist attack on Baluchistan power station; Feb 2015 Kuwait loses power to most of the country after technical problem in power grid; Major power outages in 2014 in Egypt (including paralyzing Suez Canal); Bangladesh; South Africa; Auckland New Zealand; Malta; Philippines (Typhoon Rammasun);	Recalibrate power outage model using latest data on power interruption; Possibly extend to consequential impacts of other threats on power outage (e.g. terrorism, nat cats; cyber attacks);
15	Cyber attack	Major increase in cyber attacks worldwide; rapidly changing landscape of cyber risk, including technologies; vulnerabilities; security initiatives; targets and threat groups; Ukraine power grid attack	Rebuild model - reassess frequency and severity of cyber incidents drawing from cyber research carried out at CRS during 2015; 'city' mitigation and geographical dimensions; potential for cyber attacks by state-sponsored cyber teams on infrastructure;
16	Solar storm	X2.7 Solar Flare May 5 2015, March 2015 solar storm triggered more powerful than normal aurora activity; June 2015 G4 event	Rebuild Solar Storm threat model (probability, severity and geography) using recent research and insights from stress test scenario CRS in 2015
17	Human pandemic	Middle East Respiratory Syndrome spread, including new outbreaks in Korea; continuing slow spread of Avian Flu (H5N1) additional cases in China July 2015 including 3 deaths; tail end of Ebola outbreak Dec 2014; new influenza virus (H7N9) identified winter 2014	Recalibrate and update with latest healthcare data and healthcare system stats for recent years
18	Plant epidemic	Cassava Mosaic virus disease Eastern and Southern Africa 2014; Wheat rust outbreaks North Africa & Middle East 2015	Recalibrate and update food epidemic shock threat, including programmes to eradicate and control recent outbreaks; Possibly extend model to include plant pests (e.g. locusts) and align with reports on food supply shocks

- Work with supporters to identify their most significant scenarios from the global suite of potential events
 - Which of these scenarios are most impactful to you?
 - Identify all the Trillion-Dollar scenarios and rank them
 - Track how emerging threats are changing in importance over time
- Profile corporate risk: individual companies and sectors that overlay the risk models
 - How do these threats impact their customers, business models, revenues?

Towards a Resilience & Policy Institution

- We propose to join forces with government, law institutions, insurers, major capital providers, to put resilience centre stage for risk management
- Pandora will become a core framework for the analytics needed for this
- Major event for Pandora in late Feb/early March

Hosts	Policy / Regulation / Legal	Business / Finance
Cambridge CRS	Bank of England	Selected insurers
Lloyd's Register Foundation	Government Actuaries	Lloyd's of London
Government Office for Science	Department	Boston Consulting Group
Royal Society	Cabinet Office	BlackRock
Future Earth (UK Committee)	Foreign Office	British Standards Institution
Prime Minister's Council for Science & Technology (CST)	DEFRA	S&P
	Environment Agency	Global Business Development
	Risk Management	Director, Institute of Actuaries
	DECC	Major Banks
	Treasury	

2016

- 2016 will be an active year for the Centre for Risk Studies
- We have an ambitious agenda but one that is achievable with the interdisciplinary skill set and experience we have developed to date
- The subject of emerging and systemic risk in the economy is one of the most important facing society today
- We look forward to developing a detailed agenda to tackle it

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