

Cambridge Centre for Risk Studies

Researching Business Risk Past Ten Years, Next Ten Years

Dr Andrew Coburn
Chief Scientist,
Cambridge Centre for Risk Studies

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School





Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

First Risk Summit 2009

**Managing the Risk of Catastrophic Failure
in Complex Systems**



Centre for
Risk Studies

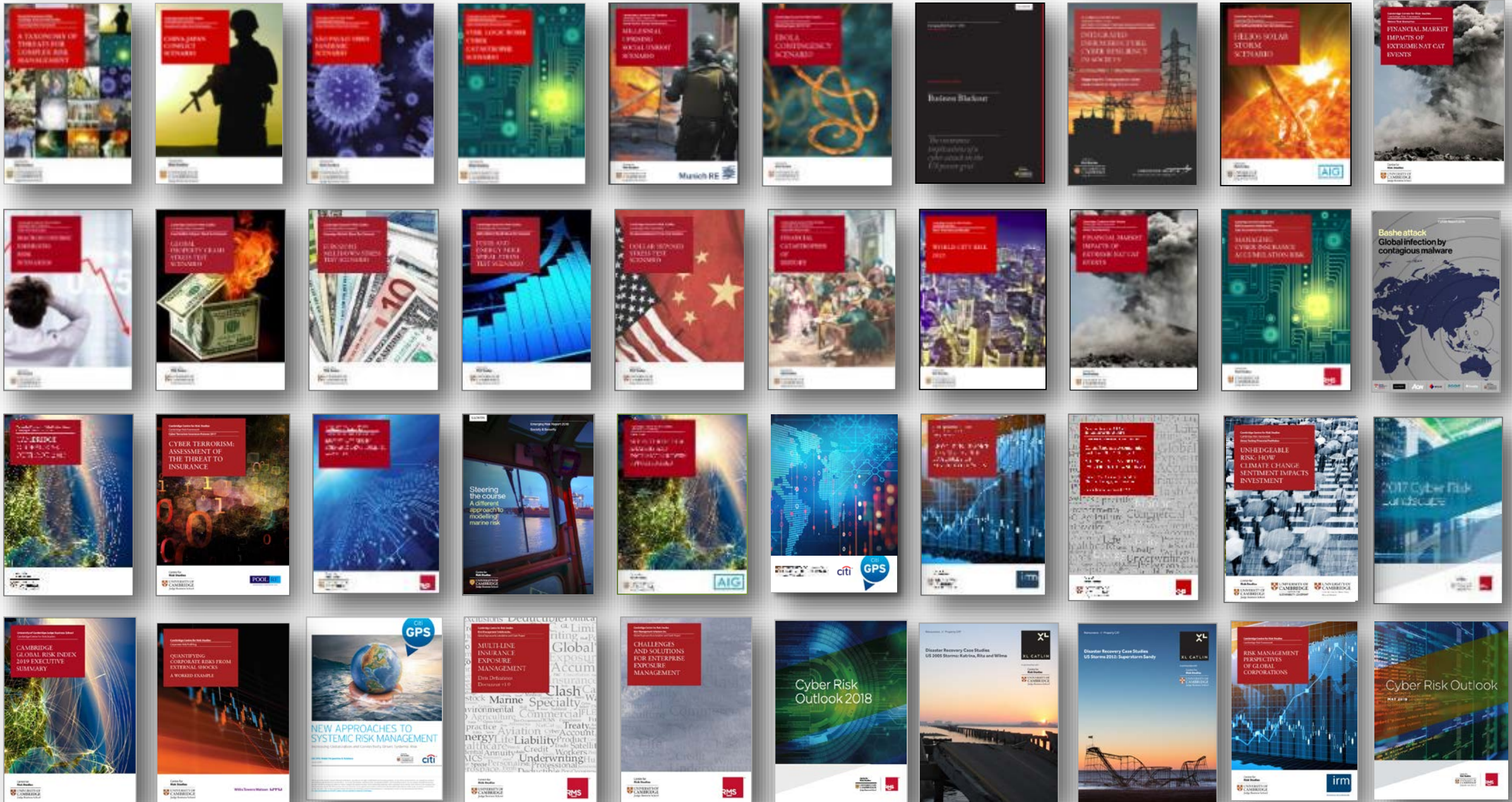


UNIVERSITY OF
CAMBRIDGE
Judge Business School

First Risk Summit 2009

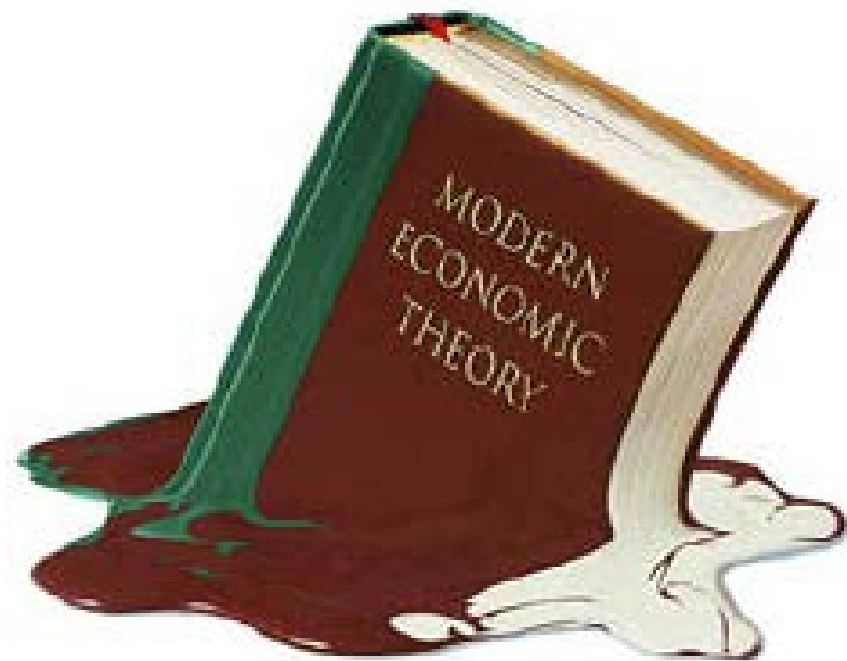
**Managing the Risk of Catastrophic Failure
in Complex Systems**

Science in Scenarios™



All Reports Available: <https://www.jbs.cam.ac.uk/faculty-research/centres/risk/publications/>

“FinCat”: The Great Financial Crisis of 2008

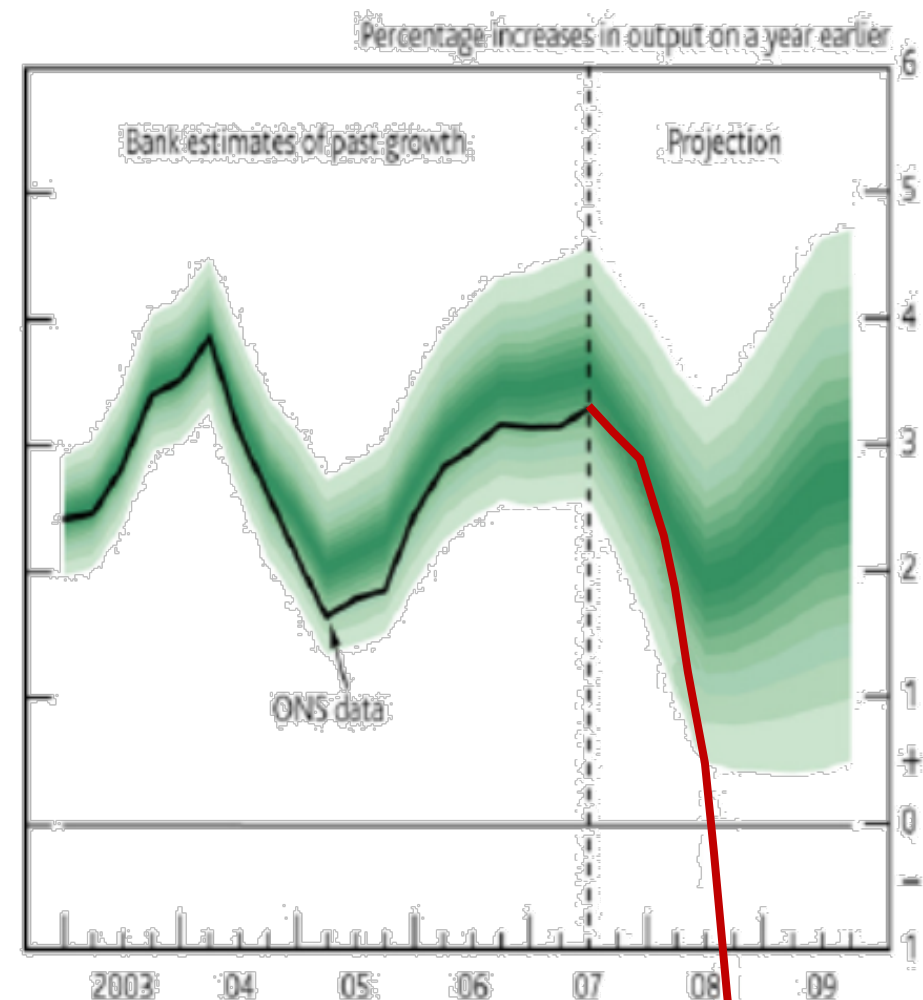


“We suffered adverse 25-standard deviation events, several days in a row according to our models...”

CFO of Brevan Howard, one of the world’s largest hedge funds

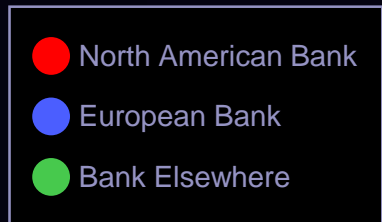
June 2008

Bank of England modelled estimates of UK GDP
November 2007



Graphic from the front cover of The Economist, July 18, 2009, encapsulating the crisis in economic theory

Cambridge Model of Global Financial System



Centre for
Risk Studies



**UNIVERSITY OF
CAMBRIDGE**
Judge Business School

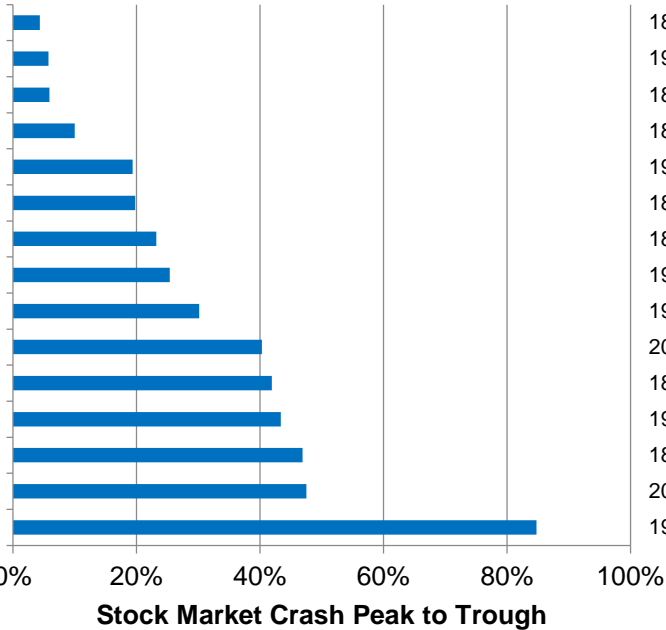
Cambridge Centre for Risk Studies
Network Model of
Global Financial System

Financial Risk and Network Theory

Financial Crisis Research



US Stock Market Crashes



- 1845 Railway Mania...
- 1866 Collapse of Overend...
- 1873 Long Depression
- 1877 Railroad Mania...
- 1883 Latin American Debt...
- 1893 Baring Bank Crisis
- 1907 Knickerbocker
- 1910 Black Monday
- 1929 Wall Street Crash
- 2001 Dotcom
- 2008 Great Financial Crisis

Observed, last 200 years

| Crashes Greater Than | Number of Crises | Average Interval (Yrs) |
|----------------------|------------------|------------------------|
| 10% | 12 | 16 |
| 20% | 9 | 21 |
| 40% | 6 | 32 |
| 50% | 1 | 190 |



Centre for Risk Studies

Financial Crisis Stress Test Scenarios



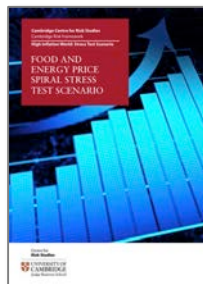
Global Property Crash

Sudden collapse of property prices in China followed by many other emerging and developed markets triggers a cascading crisis throughout the global financial system



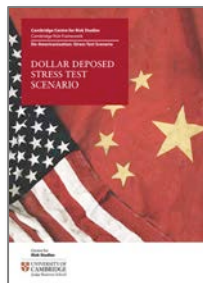
Eurozone Meltdown

Unexpected default of Italy is followed by a number of other European countries, leading to multiple cession from the Union and causing an extensive financial crisis for investors



High-Inflation World

A series of world events puts pressure on energy prices and food prices in a price increasing spiral, which becomes structural and takes many years to unwind



Dollar Deposed

US dollar loses its dominance as the default trading currency as it becomes supplanted by the Chinese Renminbi, with rapid unwinding of US Treasury positions and economic chaos

Financial Risk and Network Theory Conference Series



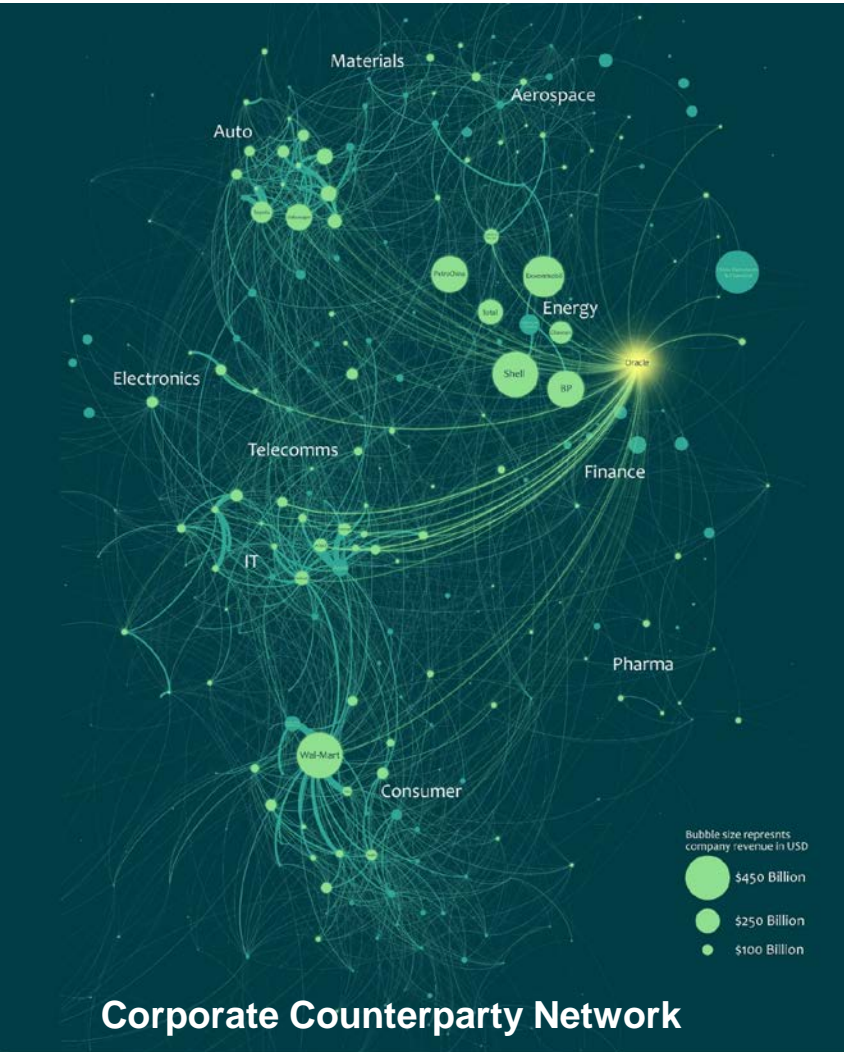
Journal of Network Theory in Finance



Financial Network Analytics Ltd.



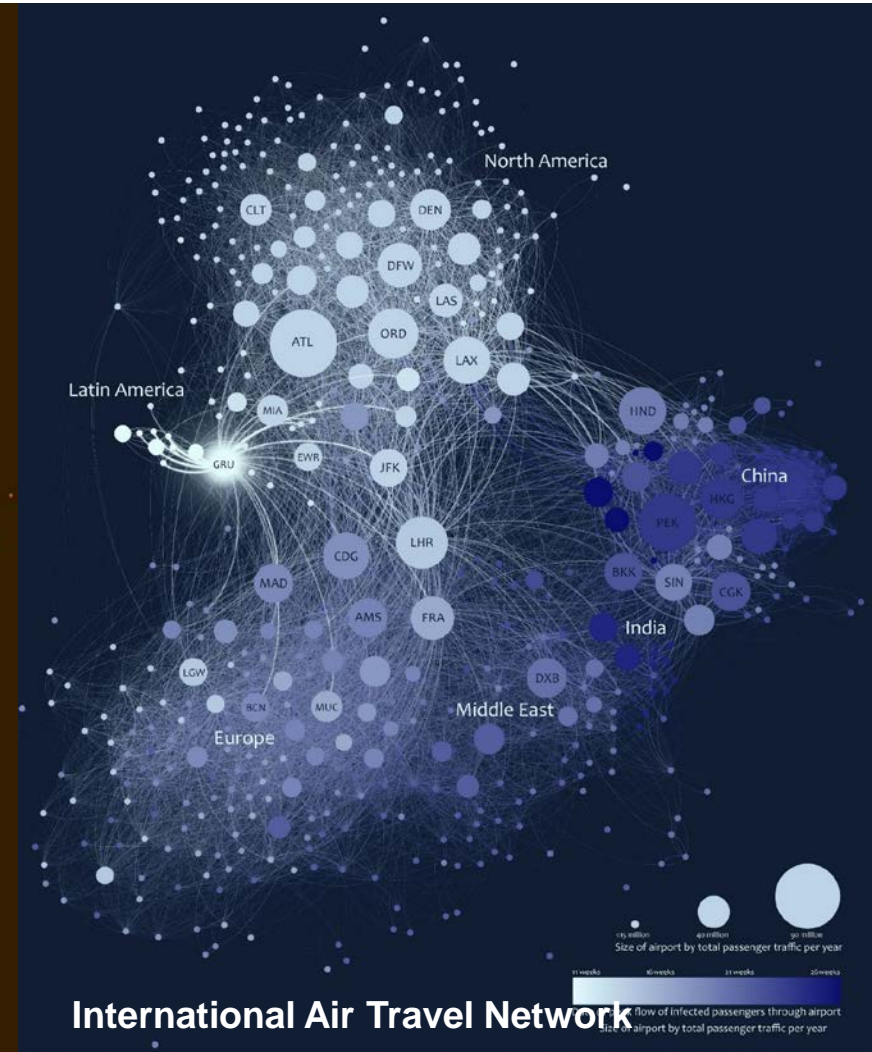
Analysis of Non-Linear Impacts on Economic and Social Networks



Corporate Counterparty Network

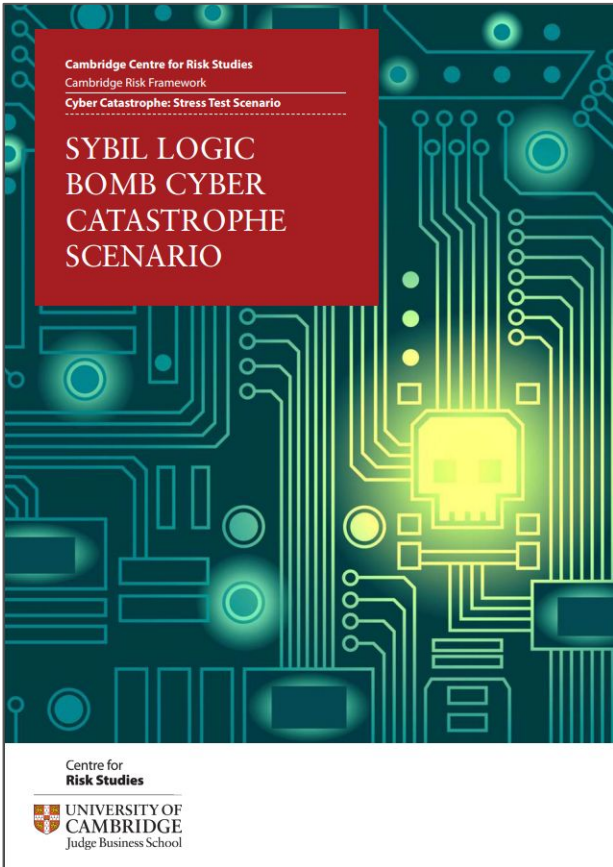


Country Trade Network

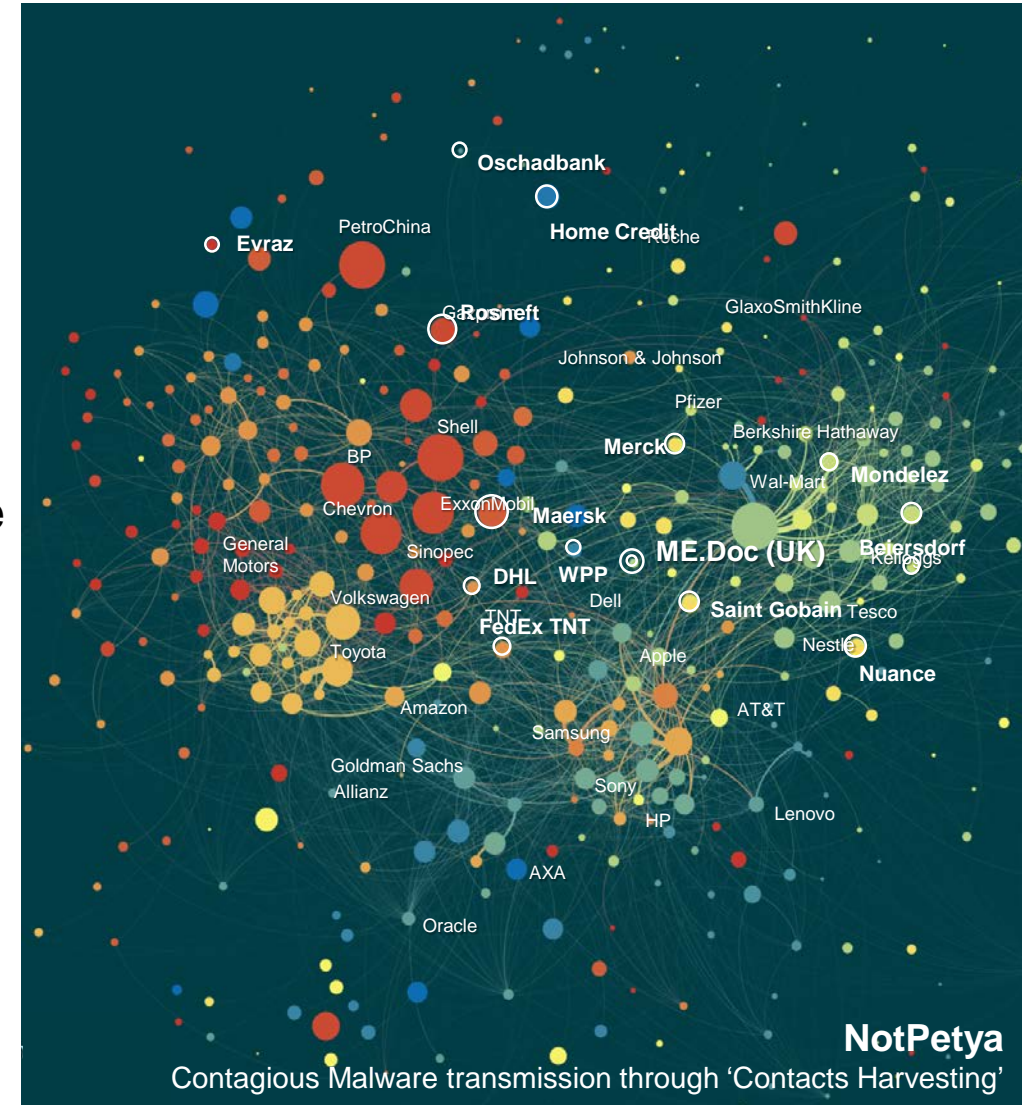


International Air Travel Network

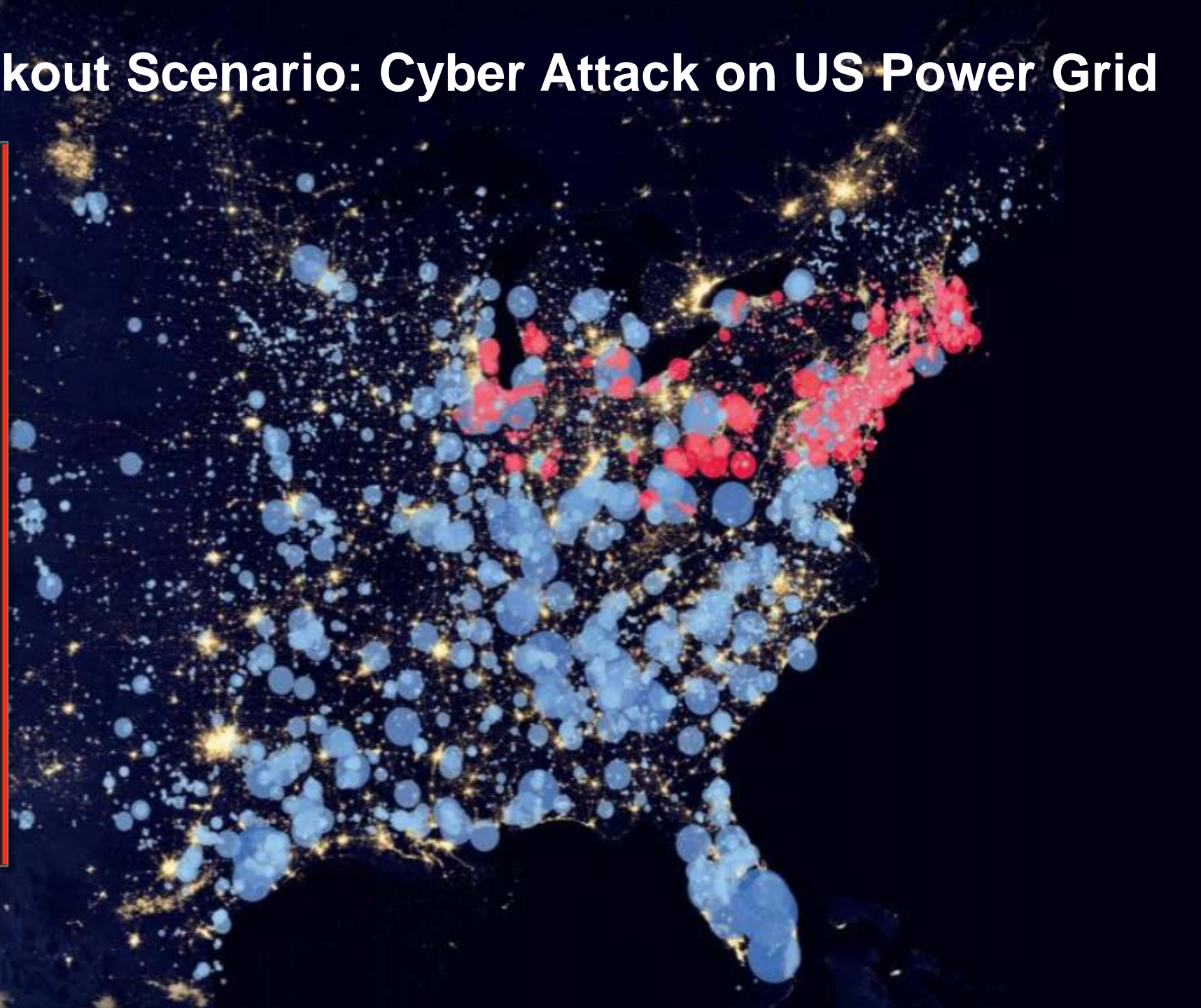
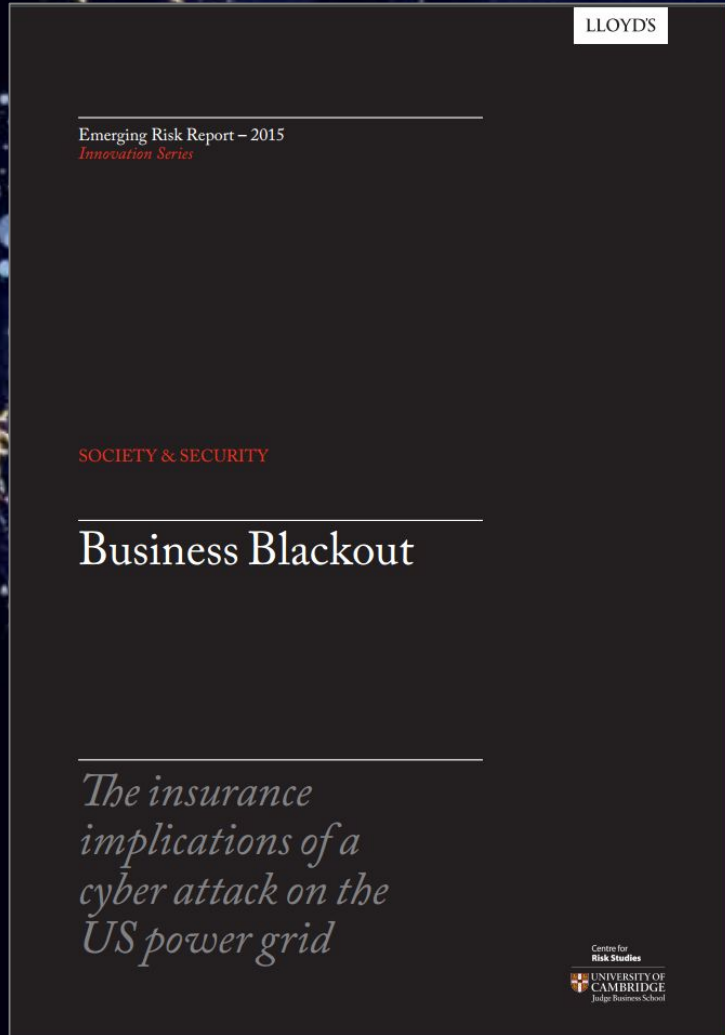
Systemic Cyber Risk



- Identified the potential for cyber to pose a systemic risk
- ‘Systemically Important Technology Enterprises’ (SITEs)
 - Industry standard software platforms providing common failure pathways
- Key issue for managing accumulation risk in cyber insurance portfolios
- Cyber insurance market was nascent in 2013
- CCRS developed a cyber insurance data schema, which was rapidly adopted as a standard



Lloyd's Business Blackout Scenario: Cyber Attack on US Power Grid



Cyber Terrorism Feasibility in Scenarios



REINSURING TERRORISM RISK

Pool Re to extend cover to include physical damage from cyber terrorism from April 2018

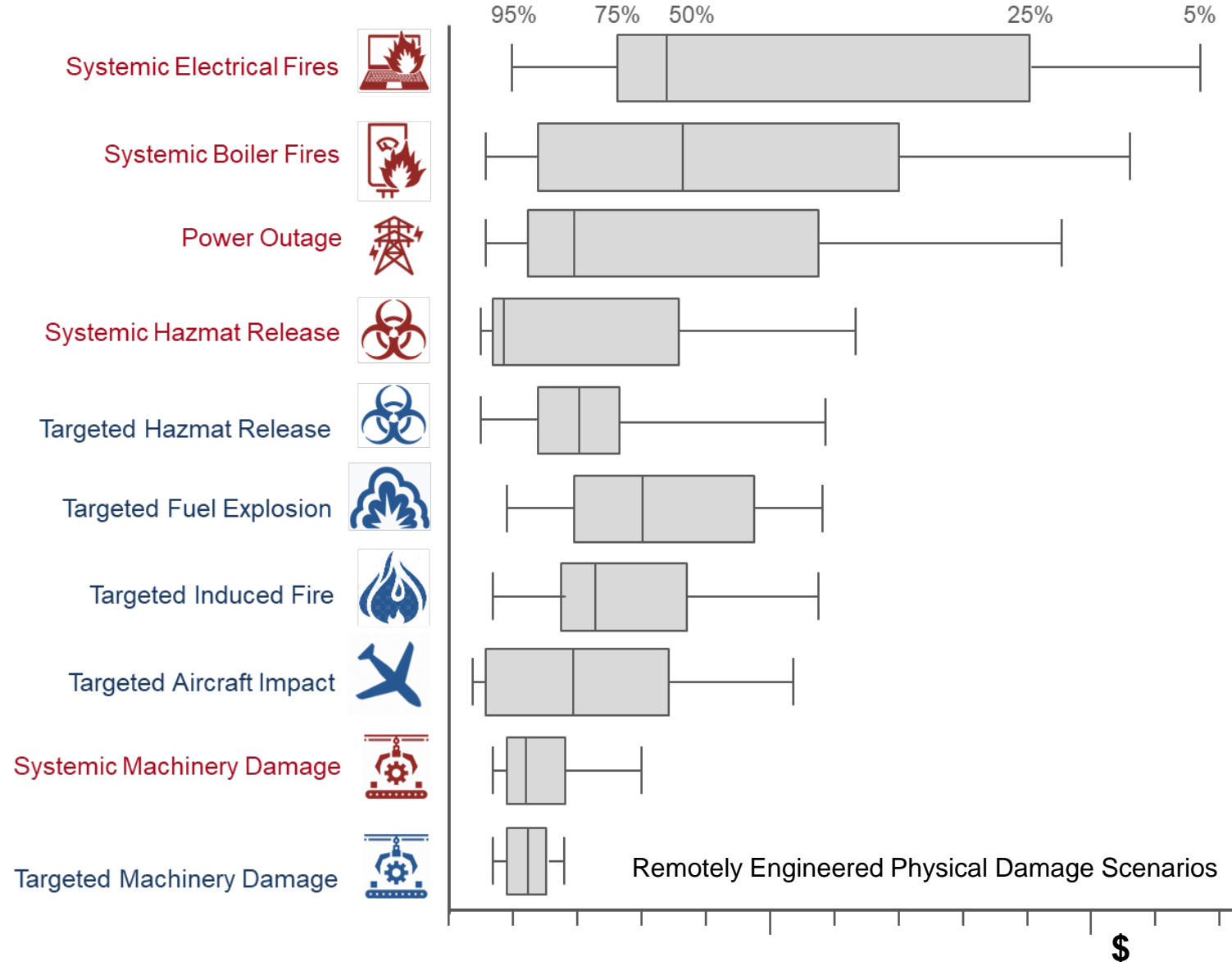


Pool Re to extend cover to include physical damage from cyber terrorism from April 2018



Australian Government

Australian Reinsurance Pool Corporation



Awards and Recognition for CCRS

Cambridge Centre for Risk Studies was honoured to be nominated for awards and invited to be involved in data standards activities, including:



Reactions

CCRS shortlisted for **Risk Modeller of the Year**, Reactions 2018



2018 Cyber Risk Awards **Pool Re** and **CCRS** shortlisted for **Cyber Risk Innovation of the Year** for work on developing the Pool Re Cyber Terrorism Extension 2018



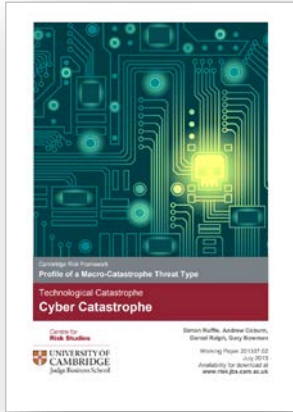
ACORD selected the **Cambridge Cyber Exposure Data Schema** (published 2016) to provide to all 4,000+ ACORD members.



ISO 31050 Emerging Risk Standards

CCRS invited to be a member of the British Standards Institution Working Group on scoping the proposed ISO 31050 standard for identifying and managing **Emerging Risks** in business

An Extensive Programme of Cyber Risk Research



2013
Cyber Catastrophe Threat
Monograph



2014
Sybil Logic Bomb
Stress Test Scenario



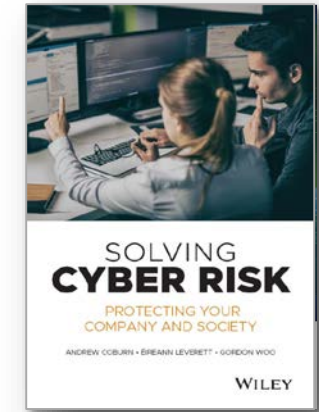
2015
Business Blackout
CNI Scenario



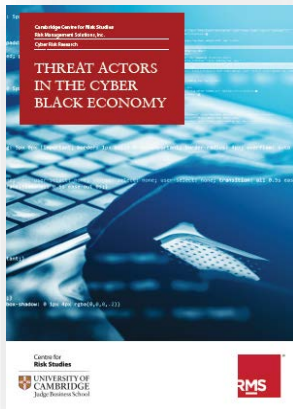
2016
Exposure Data Schema
and Accumulation Risk



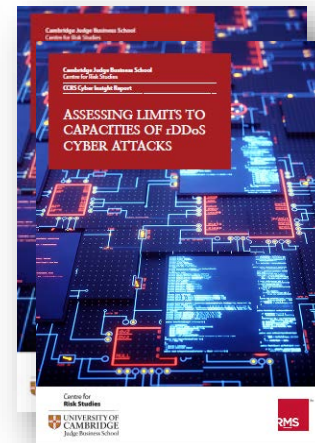
2017
Cyber Risk
Landscape Monitoring



2019
Solving Cyber Risk
Publication



2018
Threat Actors in the Cyber
Black Economy



2018
Assessing Limits to Capabilities of
rDDoS Cyber Attacks



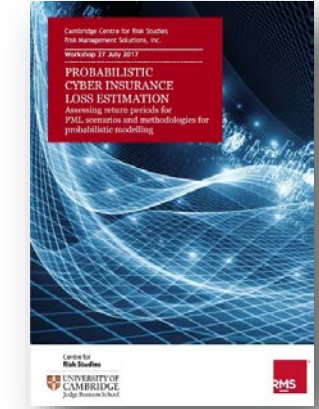
2018
Insights from the MISP
Database



2018
Assessing the Impact of Global ISP
Outages



2018
Cloud Outage: The Potential for
Catastrophic Loss

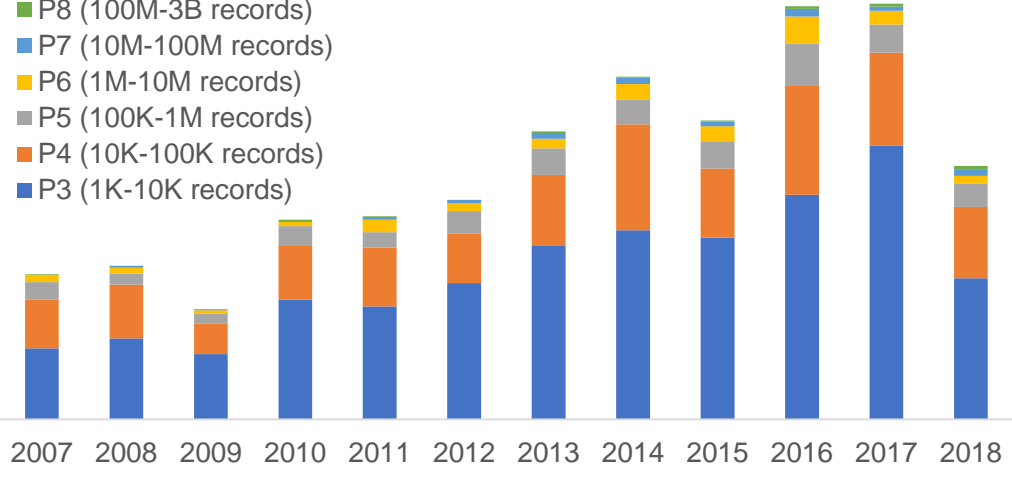


2018
Probabilistic
Cyber Assessment

Annual Updates of Our Cyber Risk Outlooks

Occurrence of Data Exfiltration Events by Size

- P8 (100M-3B records)
- P7 (10M-100M records)
- P6 (1M-10M records)
- P5 (100K-1M records)
- P4 (10K-100K records)
- P3 (1K-10K records)



2016
Cyber Risk
Outlook



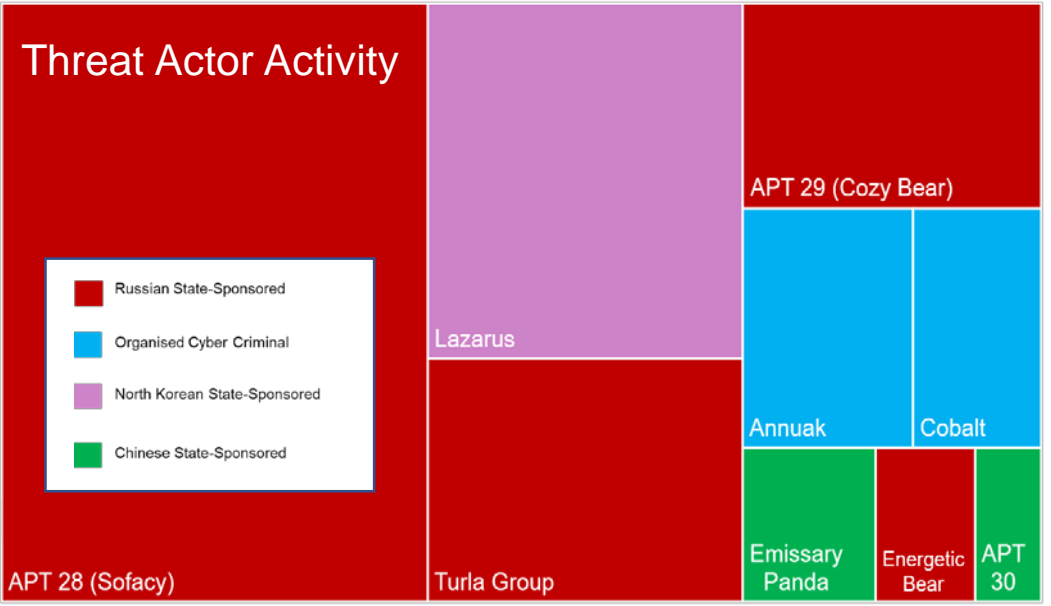
2017
Cyber Risk
Outlook



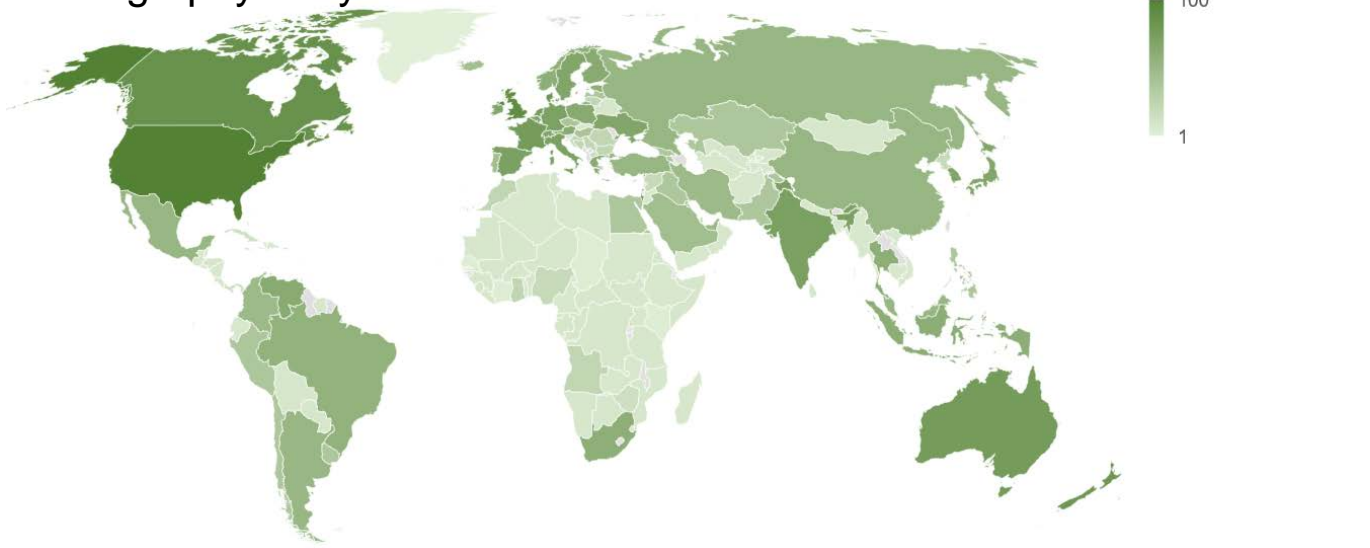
2018
Cyber Risk
Outlook



2019
Cyber Risk
Outlook

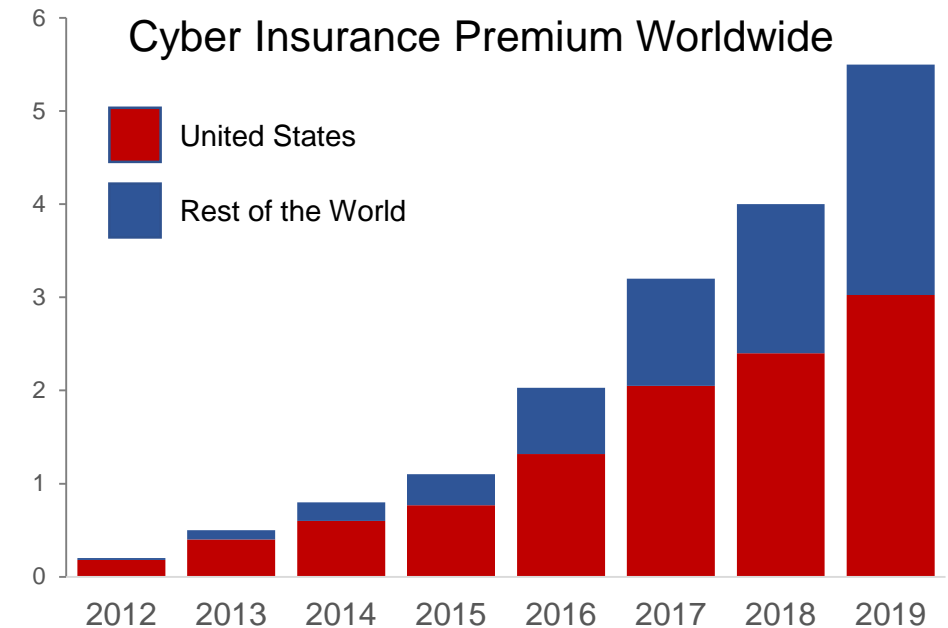


Geography of cyber loss incidence



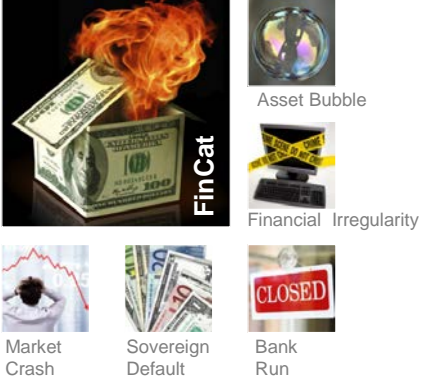
CCRS Role in Growth of Cyber Insurance Market

- Cyber risk research at Cambridge Centre for Risk Studies has played an important role in the growth of the cyber insurance market
- CCRS created a cyber exposure data schema
 - Endorsed by Lloyd's
 - Adopted by RMS
 - Selected by ACORD
- CCRS research provided the structure for RMS Cyber Accumulation Management System (CAMS)
 - The leading commercial cyber risk model
- CCRS scenarios adopted by Lloyd's for regulatory accumulation reporting
- CCRS scenarios now being created for SE Asia market to boost cyber insurance market there



CCRS Taxonomy of Business Risks

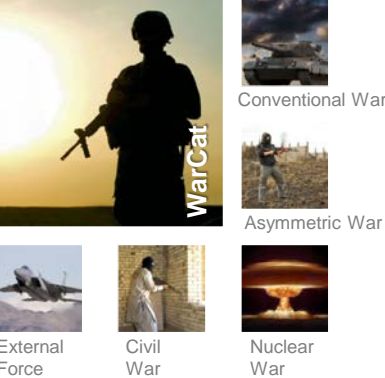
Financial Shock



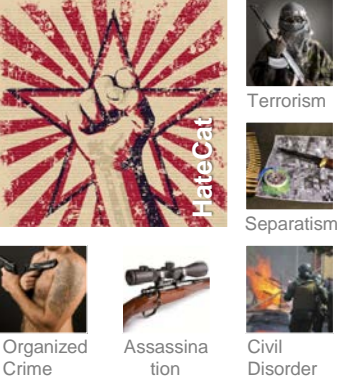
Trade Dispute



Geopolitical Conflict



Political Violence



Natural Catastrophe



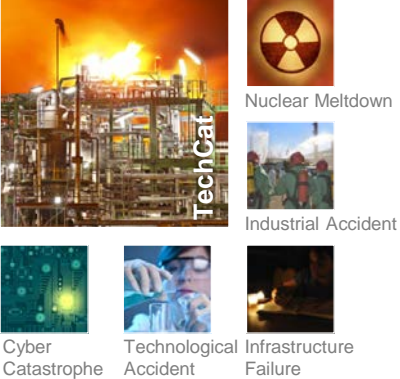
Climatic Catastrophe



Environmental Catastrophe



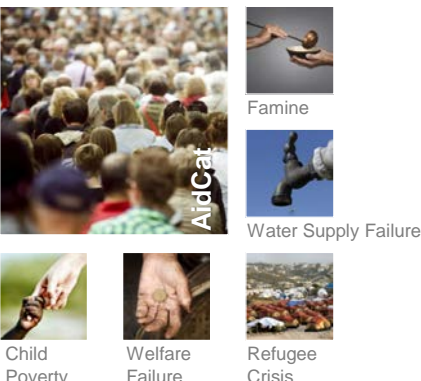
Technological Catastrophe



Disease Outbreak



Humanitarian Crisis



Externality



Other



The Evolution of our Global Risk Taxonomy

Threats to the Global Economy 2011

Financial Shock
 Market Crash, Sovereign Default, Bank Run, Asset Bubble, Financial Irregularity, Financial Crisis

Trade Dispute
 Trade Sanctions, Tariff War, External Pressure, Negotiation, Trade Dispute

Geopolitical Conflict
 External Force, Civil War, Nuclear War, War, Asymmetric War

Political Violence
 Organized Crime, Assassination, Civil Disorder, Terrorism, Separatism

Environmental Catastrophe
 Volcanic Eruption, Flood, Tsunami, Sea Level Rise, Ocean System Change, Air Pollution, Air Quality System Change

Technological Catastrophe
 Cyber Catastrophe, Technology Accident, Industrial Accident, Nuclear Meltdown, Industrial Accident, Failure

Natural Catastrophe
 Volcanic Eruption, Flood, Tsunami, Tornadoes, Earthquake, Electric Storm, Heatwave

Climatic Catastrophe
 Tornadoes, Earthquake, Electric Storm, Heatwave, Freeze

Disease Outbreak
 Waterborne Epidemic, Zoonosis, Plant Epidemic, Avian Influenza, Ebola

Humanitarian Crisis
 Poverty, Welfare System Failure, Refugee Crisis, Famine, Water Supply Failure

Externality
 Space Threat, Outer Layer Collapse, Satellite System Failure, Space Debris

Global Risk Index 2014

Finance, Economics and Trade
 Market Crash, Sovereign Crisis, Commodity Prices

Geopolitics and Security
 Interstate Conflict, Terrorism, Separatism Conflict, Social Unrest

Technology and Space
 Nuclear Accident, Power Outage, Cyber Attack, Solar Storm

Health and Humanity
 Human Pandemic, Plant Epidemic

Natural Catastrophe and Climate
 Earthquake, Tropical Windstorm, Temperate Windstorm, Tsunami, Flood, Volcanic Eruption, Drought, Freeze, Heatwave

Taxonomy of Corporate Risks 2019

Finance & Economics
 Market Crash in each of the major stock markets of the world; 10%, 50% and 85% peak to trough
 Sovereign Crisis in each of 180 countries, leading to default and currency devaluation
 Commodity Crisis of price hikes of varying magnitude causing related price shocks to other commodities
 Tariff Trade Wars between each of the major trading blocs of the world
 Macroeconomic Regimes: Recession plus 5 other states of the economy

Geopolitics & Security
 Interstate conflict between each of 60 national pairings, with three different severities of conflict
 Social Unrest in each of the countries most at risk, scenarios of varying severity
 Separatism Conflict in each of 180 countries, leading to default and currency devaluation
 Terrorist Attack at key facilities and in major national markets, terrorist attacks of different severities

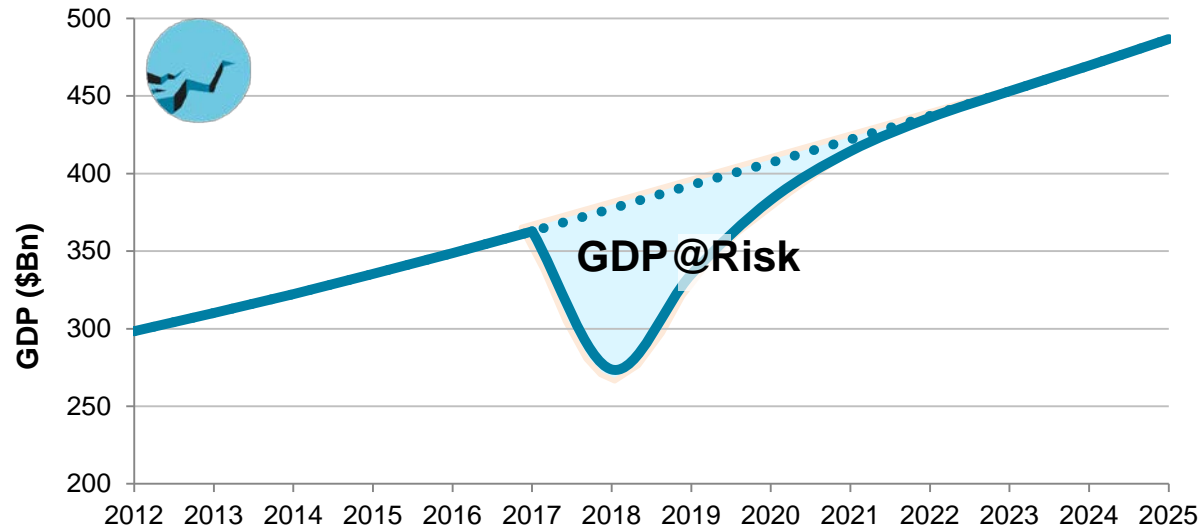
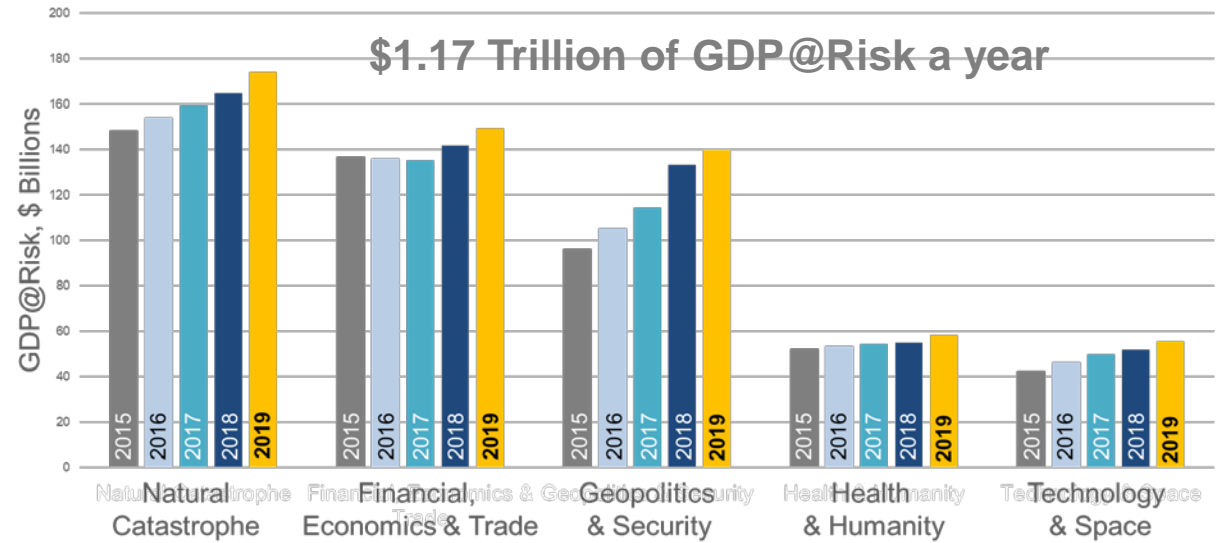
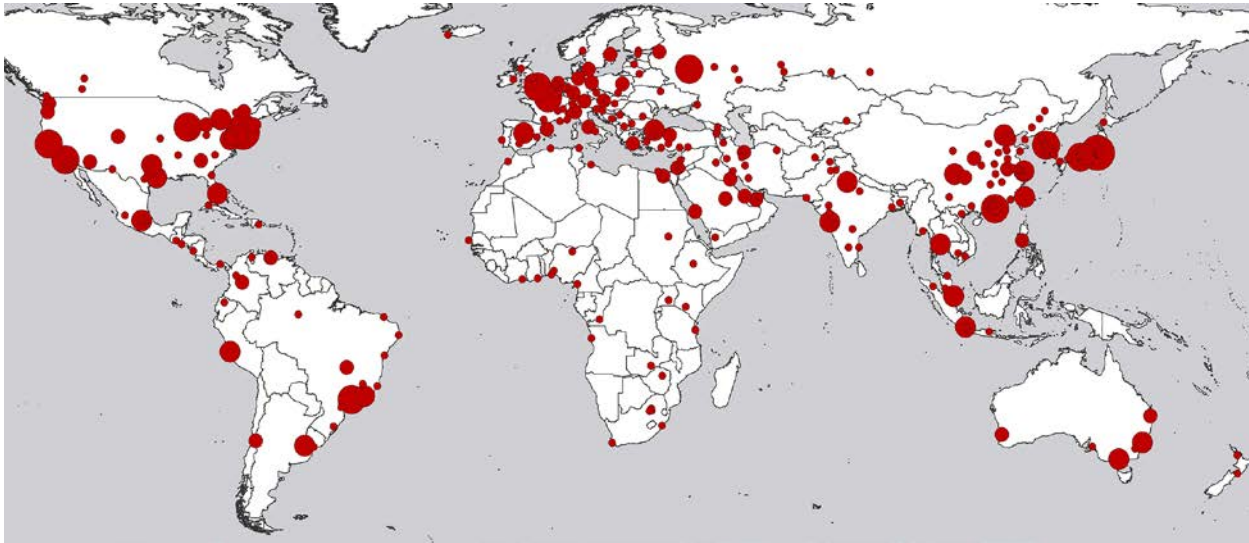
Technological
 Cyber Attack six different loss processes, multiple scenarios for systemic attacks
 Power Outage in each Wide Area of 180 countries, leading to default and currency devaluation
 Solar Storm Economy impact from coronal mass ejection causing power outage and satellite damage
 Nuclear accident core meltdowns simulated from each of 160 nuclear power plants in the world

Environmental
 Earthquake large magnitude events in major seismic areas close to centres of production
 Tropical Windstorm hurricane and food events in coastal regions prone to tropical cyclones
 Flood events from coastal storm surge, riverine flood, and flash floods in flood-risk areas
 Freeze events and extreme winter weather causing transport difficulties and activity outages
 Drought: Water stress scenarios, causing reduced availability for manufacturing and agriculture
 Volcanic Eruption for each of 700 active volcanoes causing ash plume disruption of air traffic and business

Social & Humanitarian
 Human Pandemic scenarios of influenza and emerging infectious diseases, with virulence and infectiousness
 Plant epidemic scenarios of agriculture and food stress from disease outbreaks in staple crops
 Anti Microbial Resistance in pathogens, with implications for epidemic exacerbation
 Human Resource and Talent between each of the major trading blocs of the world
 Ageing Economy: Demographic trends in each country with changing consumer patterns and trends

Governance & Liability
 Regulation Change scenarios of major regulatory changes in business activity in high risk jurisdictions
 Disruptive competitor scenarios of aggressive price competition and disruptive business models in market
 Reputation risk scenarios for consequences of brand devaluation, customer churn, and other effects
 Contingent liabilities scenarios of class action law suits and external litigation
 Mergers and Acquisitions Failures not adding the expected value and synergy in
 Insider threat scenarios of rogue employees and senior company officers

Cambridge Global Risk Index



Finance, Economics and Trade

- Market Crash
- Sovereign Default
- Commodity Price Shock

Geopolitics and Security

- Interstate Conflict
- Terrorism
- Civil Conflict
- Social Unrest

Natural Catastrophe and Climate

- Earthquake
- Tropical Windstorm
- Temperate Windstorm
- Tsunami
- Flood
- Volcano
- Drought
- Freeze
- Heatwave

Technology and Space

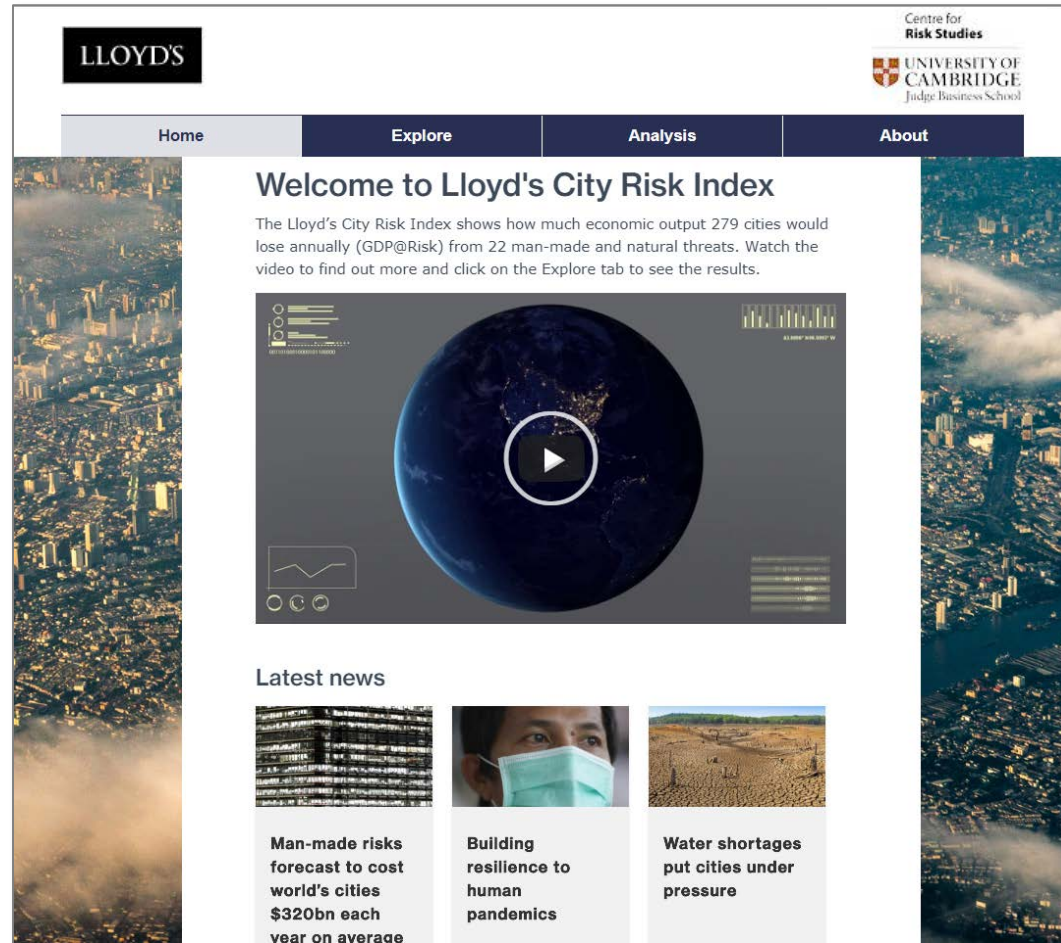
- Nuclear Accident
- Power Outage
- Cyber Attack
- Solar Storm

Health and Humanity

- Human Pandemic
- Plant Epidemic

Adopted for Lloyd's City Risk Index

- CCRS Global Risk Index adopted by Lloyd's for their City Risk Index
- 2018 version launched in Lloyd's
- Focus on risks to the economies of cities, as engines of growth
- Rolled out to 50 markets to raise awareness and improve focus on resilience
- Regional promotion by Lloyd's for the risk market
- API access provided to Lloyd's Managing Agents



Inga Beale, CEO of Lloyd's, launches City Risk Index 2018
6 June 2018



Available: <https://cityriskindex.lloyds.com/>

CCRS Taxonomy of Business Risks

Finance & Economic

Geopolitics & Security

Technology

Environmental

Social & Sustainability

Governance & Regulation

Macroeconomic

- Market Crash
 - Asset Bubble
 - Financial Irregularities
- Economic Recession
- Economic Restriction
- Trade Sanctions
- Tariff War
- Commodity Price Fluctuation
- Sovereign Crisis Default
- Investor Sentiment
 - Negative Market Outlook
- Low Carbon Transition

Competition

- Disruptive Competitor
- Aggressive Competitor
 - Price War
- Counterfeit Products

Counterparty

- Creditor Failure
- Customer/Client Failure
- Government Failure
- Supplier Failure
 - Supply chain disruptions
 - Bargaining power against suppliers

Political & Democratic

- Ideological Shift
 - Nationalism
 - Populism
 - Protectionism
- Political Shock
 - Sudden Leadership Change
 - Regime Change
- Political Corruption
- Nationalisation

Political Violence

- Assassination
- Terrorism
- Coup d'État
- Social Unrest
- Civil Conflict/Separatism

International Conflict

- Interstate Conflict
 - Conventional War
 - Asymmetric War
 - Nuclear War

Criminal

- Cartel Pressure
- Organised Crime

Disruptive Technology

- E-Commerce
 - Clicks & Mortar
- Gig Economy
- Robotics & Automation
- Artificial Intelligence
- 5G Technology
- Augmented/Virtual Reality
- Blockchain

Cyber Attack

- Data Exfiltration
 - Intellectual Property Loss
- Contagious Malware
- Cloud Service Provider Failure
- Distributed Denial of Service Attack
- Financial Transaction Theft
- Industrial Control System Compromise
- Internet Service Provider Failure

Infrastructure/System Failure

- Network Disruption
- Power Outage
- Satellite System Failure
- Internet Outage

Industrial Accident

- Explosion
- Fire
- Nuclear
- Pollution

Climate Change

- Climate Change
- Increase in Extreme Weather
- Ocean System Change
- Sea Level Rise

Hydrometeorological

- Drought
- Flood
- Freeze
- Heatwave
- Temperate Windstorm
- Tornado
- Tropical Cyclone
- Wildfire

Geophysical

- Earthquake
- Tsunami
- Volcanic Eruption

Resource Depletion

- Natural Resource Deficiency
 - Water
 - Fossil Fuels
 - Raw Materials
 - Biogeochemicals
- Food Insecurity
- Land/ Ocean System Change
 - Biodiversity Loss
 - Ecosystem Collapse
- Waste and Pollution

Space

- Solar Storm (CME)
- Astronomical Impact Event

Social Trends

- Sustainable Preferences
- Transparency of Information
 - Supply Chain Provenance
- Consumer Activism
 - Commodity Boycott
 - Brand Name Boycott
 - Single Firm Boycott
- Brand Management
 - Negative Customer Experience
 - Key Influencer Disruption
 - Negative Media Coverage

Human Resources

- Labour Disputes & Strikes
- Loss of Key Personnel
- Failure to Attract Talent
- Employment Practices
- Gender & Diversity
- Communication Failure
- Ageing Population
- Labour Shortages

Humanitarian

- Poverty
- Hunger or Famine
- Inequality
 - Welfare System Failure
- Mass Migration
 - Refugee Crisis

Infectious Disease

- Plant Epidemic
- Animal Epidemic
- Human Epidemic/Pandemic

Regulation & Liability

- Tightening Fiscal Policy
 - Taxation
- Non-Compliance
 - Violations of Existing Regulation
 - Internal Corruption & Fraud
 - Negligence
 - Emerging Regulation
 - Occupational Health & Safety
- Revised Accounting Standards
- Licence Revocation

Contingent Liabilities

- Private Lawsuit
- Mass Tort
- Class Action

Strategic

- Strategy Failure
 - Divestitures
 - Joint Ventures
 - Mergers & Acquisitions
 - Restructuring
- Asymmetric Board
 - Rogue CEO
- Hostile Takeover
- Model Failure
 - Failure to Forecast Business Future

Products & Services

- Product Defect/Failure
- Innovation (R&D) Failure

Helping with Corporate Risk Registers

Organizations have to publish their risk registers

- 10-K Section 1A Risk Factors - United States SEC
- UK Financial Reporting Council Corporate Governance Code – from Jan 2019

“a **robust assessment** of the company’s **emerging and principal risks**, and to confirm in its annual report the procedures in place to **identify emerging risks**, and an explanation of how these are being managed and mitigated ... and **probability** of related events”

“..companies should consider the potential **impact** and **probability** of the related events”



The Sessions for Today's Risk Summit

Finance & Economic Risks



Financial and Economic Risks
Ken Deng, CCRS



Financial Crises of the Future: The Lessons of History
Dr Duncan Needham
Cambridge Centre for Financial History



Managing Financial Risk
Alessandra Mongiardino,
Nordea Bank Abp

Geopolitical & Security Risks



Geopolitical and Security Risks
Tamara Evan, CCRS



Conflicts of the Future
Jim Maltby
Defence, Science & Technology Laboratory



Managing Future Risk in International Supply Chains
Nick Wildgoose
Supplien Consulting

Technology Risks



Technology Risks
Kelly Quantrill, CCRS



Managing the Risks of Digital Identity in Business
Olivia White
McKinsey and Company



The Future of Cyber Risk
Dr. Christos Mitas
Risk Management Solutions

Environmental & Natural Hazards Risk



Managing Risk in a Changing Environment
Dr Emily Shuckburgh
British Antarctic Survey



What Does a Business Need to Know about the Likely Impacts of Climate Change?
Dr Robert Muir-Wood, Risk Management Solutions, Inc.



Climate-Related Financial Disclosures in Businesses
Manjula Chummun, Tesco, member of the Task Force on Climate-Related Financial Disclosure

Social & Sustainability Risks



Societal and Sustainability Risks
Kayla Strong, CCRS



Key Sustainability Issues in the Next Decade
Professor Aled Jones,
Director of the Global Sustainability Institute,



Risk to Business and the Economy from Future Pandemics
Professor John Edmunds
London School of Hygiene and Tropical Medicine

Governance & Regulatory Risks



Governance and Regulatory Risks
Jennifer Copic, CCRS



Managing Reputational Risks: The Future Landscape
Clare Williams
Barclays



Working Towards a More Resilient Economy and Society
Rainer Sachs
International Risk Governance Council

The Next Decade of Risk



What kind of emerging risks, beyond those in the Cambridge Taxonomy of Business Risks, will the corporate strategic risk manager of the future have to deal with?

Social Change

- Rapid changes in social attitudes and behaviour are likely to be major drivers of new risks to businesses in the next decade
- We are already seeing this in attitudes to sustainability, climate change, ethical behaviour or companies, fairness in pay, liabilities, and others
- The speed of social change is accelerated by social media and rapid circulation of information
- There is also the danger of false news and manipulation of opinion by third parties and external agencies
- Organisations will need to adapt and respond rapidly, or suffer rejection and disapproval from customers and society in general
- CCRS has created a new research track, led by Dr Jen Daffron, a Behavioural Psychologist, to develop models of social change and attitudes to companies



Rapid Business Model Evolution

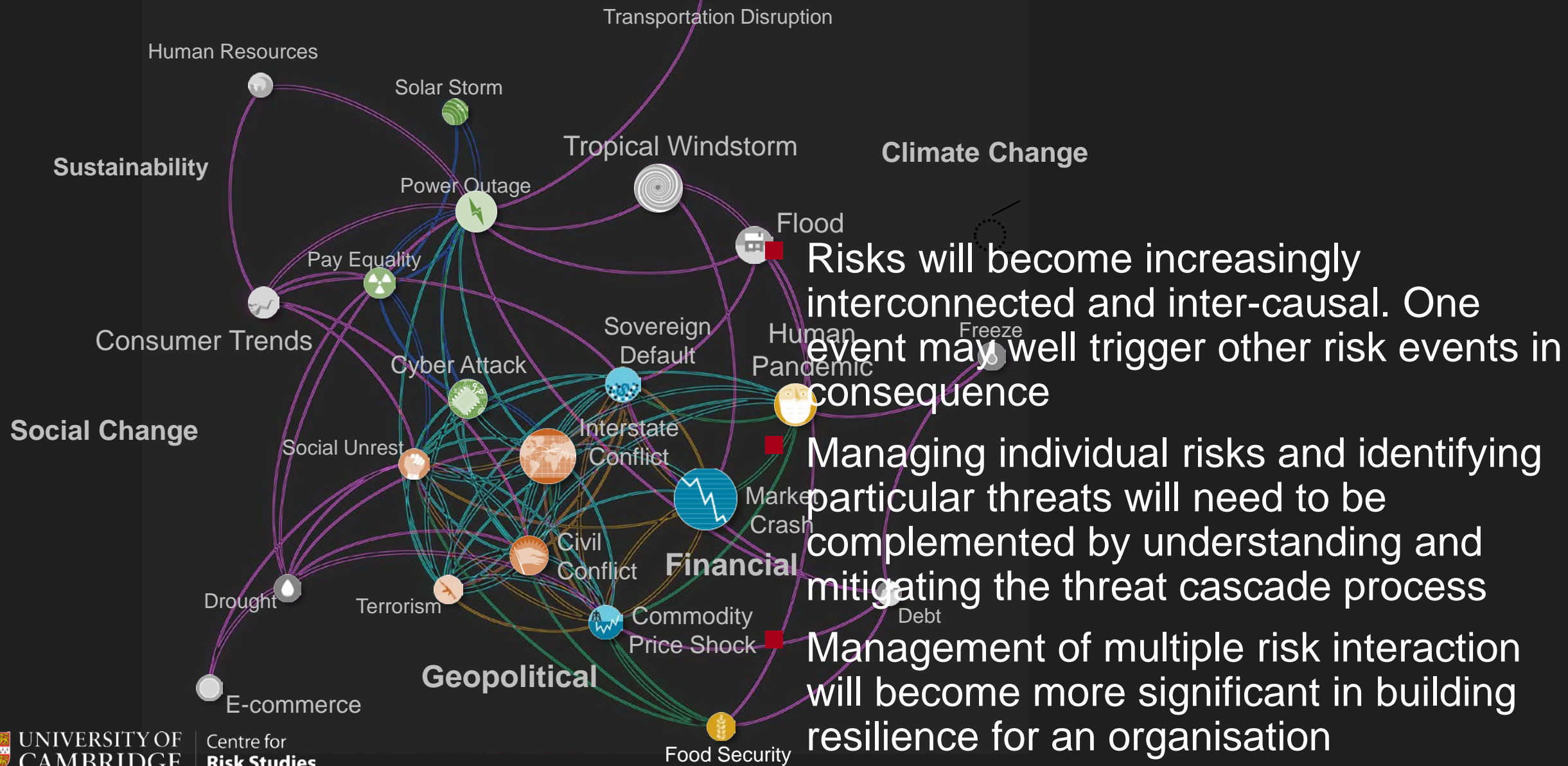
- Disruptive new businesses are already being born at a rapid rate
- Many of these are 'Unicorn' start-ups backed by venture capital pursuing winner-takes-all business models
- Typically these use digital assets to change the business model of traditional sectors of the economy
- The FAANGs – Facebook, Apple, Amazon, Netflix, Google – are utilizing their data resources, combined with big investment war-chests, to enter and transform other business sectors
- The lifetime of public companies is shortening – in 1900s the life expectancy of a traded business was around 67 years. Now it is 15. This will become even shorter
- Businesses will need to react to major changes in competitors and disruption to their business model if they do not anticipate and plan for it

Reputation Perception



- Reputation management and sustaining brand quality will become more critical with changing social attitudes and increasing competitive pressures
- Activist shareholders and regulators are likely to demand more rigorous risk identification, quantification, and monitoring
- Threats to the organisation will need to be mitigated explicitly. We will see a new raft of financial risk transfer and risk transformation instruments being created and offered to corporates to offset their risks

Risk Convergence



Risks will become increasingly interconnected and inter-causal. One event may well trigger other risk events in consequence

Managing individual risks and identifying particular threats will need to be complemented by understanding and mitigating the threat cascade process

Management of multiple risk interaction will become more significant in building resilience for an organisation

The Next Decade of Risk

- Cambridge Centre for Risk Studies is proud of the work that we have done over the past decade
- We have tackled the changing facets of business risk
- Risks are constantly evolving and emerging
- The risks that we will face over the next decade will include some that we don't expect today
- Cambridge Centre for Risk Studies looks forward to playing a significant part in the research and original thinking for the next decade of risk

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

