Cambridge Centre for Risk Studies

Annual Prospectus and Research Agenda 2016

2016 RESEARCH AND ACTIVITIES PROSPECTUS

Centre for **Risk Studies**

UNIVERSITY OF CAMBRIDGE
Judge Business School

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Foreword

The Cambridge Centre for Risk Studies enters the seventh year of its research and activities programme with a strong set of achievements and a world-class team of researchers, associates, and supporters.

The past year has been a major period of dissemination of key findings and publication of the Centre's research achievements, with the release of a suite of report publications, combined with public presentations. As a result we have found ourselves receiving significant media attention to our research findings.

And as always we have continued to learn from our close interaction with the business community, about the problems they face and the value of research in helping them manage risk. Our engagement programme has continued to build, with another highly successful Risk Summit, our flagship conference, and a full and active programme of seminars and workshops that are a vital part of the two-way street that enables applied research to provide business value.

The Centre experienced some new and important milestones in recent months:

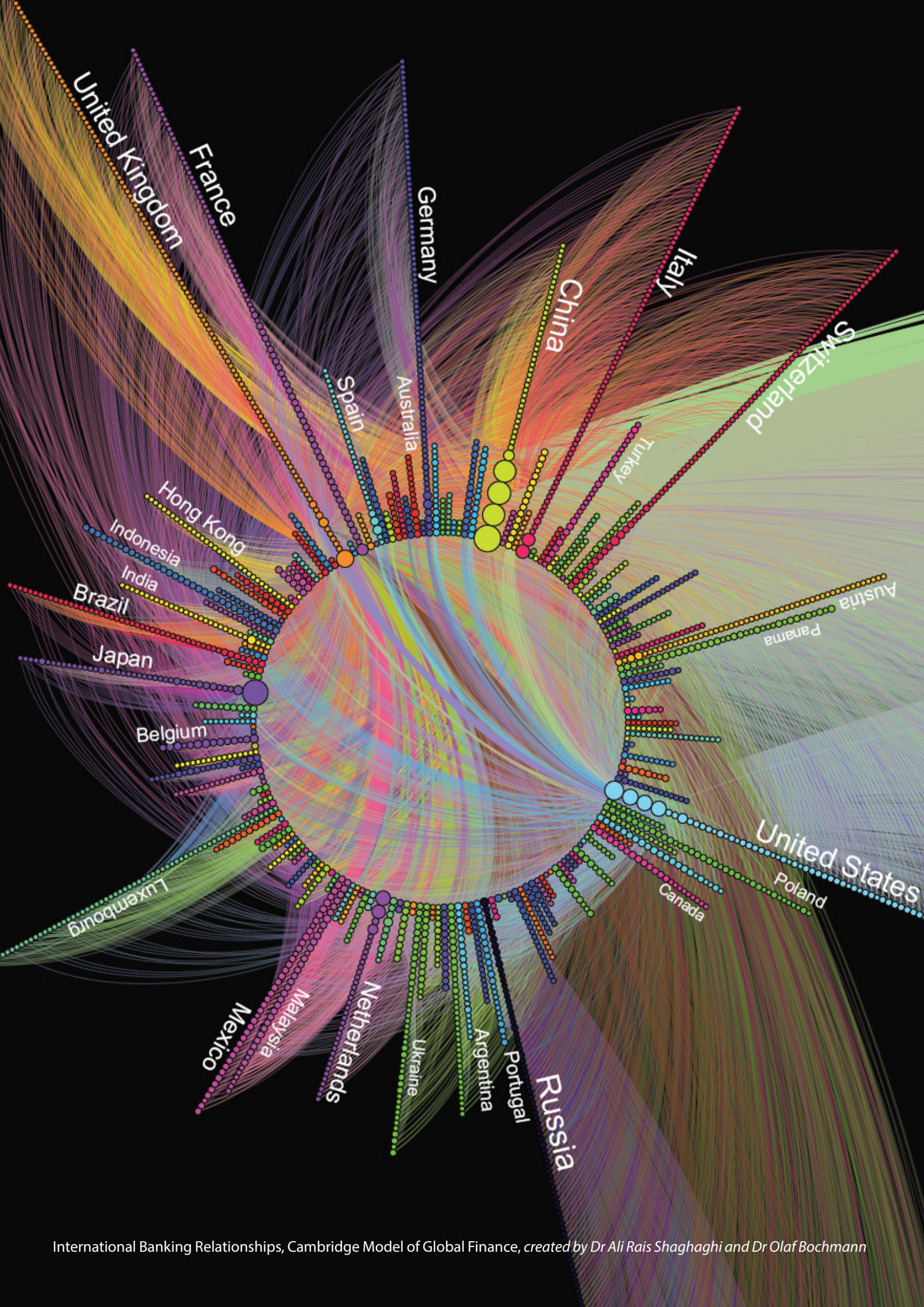
- The publication of a suite of financial catastrophe scenarios for use in stress tests that have been a major focus of our research for two years. These have greatly benefited from the review and inputs of many of our community of practitioners in the financial services industry and set the foundations for the next stage of our financial catastrophe research.
- The worldwide media launch of the Lloyd's City Risk Index marked the culmination of many years of our research into the full taxonomy of threats, and was an important proof of concept for quantifying a full range of economic catastrophes on 300 of the world's most economically important cities. The project has helped build out the Cambridge Risk Framework ready for use in our next stage of research.
- We continue to be at the forefront of research into cyber risk, a dynamic and rapidly emerging key threat to business and society. We published a ground-breaking assessment of a scenario of a cyber attack on US critical national infrastructure for Lloyd's, and another examining a potential UK blackout scenario with Lockheed Martin UK and RMS. We are continuing with work on other scenarios, data standardization and insurance accumulation management for practitioners and regulators. This research is set to play a major role in the risk management of this emerging threat in coming years.
- Our community of researchers and contributing associates has expanded to become a truly interdisciplinary team representing a wide range of complementary skills that makes our rich output possible. We held our first team-building offsite and are proud of the collaborative and problem-solving ethic of the pool of current and past members.
- We tackled the important subject of climate change with the publication of "Unhedgeable Risk: How Climate Change Sentiment Impacts Investment" a scenario on investor sentiment shock, created with the Cambridge Institute for Sustainability Leadership (CISL),
- Our strong interaction with the business community took on a practical dimension of knowledge transfer by designing and co-delivering the HSBC'"Aspiring Chief Risk Officer Programme" with the executive education arm of Cambridge Judge Business School. We have contributed to developing thought leadership toward systemic and financial risks in particular with the maintenance of the Risk Summit and Aspen Risk Forum along with participation in the Cambridge CRO Council.

This report describes the research programme of the Centre for Risk Studies and its objectives for the next several years. We continue our ambitious programme of research into systemic and complex risk in business and are attacking this on numerous fronts.

As a conclusion, let me thank our supporting organizations for their ongoing inputs and guidance. We are grateful to them for sharing our vision and engaging with us on the problems they face. Our triple mission of engagement, risk research and academic output could not be sustained without you.

We look forward to a challenging and exciting year of discovery together.

Professor Danny Ralph, Academic Director



International Banking Relationships, Cambridge Model of Global Finance, *created by Dr Ali Rais Shaghaghi and Dr Olaf Bochmann*

Strategy of the Centre for Risk Studies

The mission of the Cambridge Centre for Risk Studies is to be the world's leading academic centre for research into systemic risk in business, the economy, and society.

A Focus on Complex Risk

The Centre for Risk Studies originated from an overlap of specialised research interests into both complex systems and catastrophe risk analysis. Being located in Judge Business School has enabled the Centre to apply these interests to the business community and to structure an appropriate multi-disciplinary team.

The research of the Centre maintains a focus on 'complex risk' – i.e. processes where loss occurs through the disruption of business systems and cascades through interrelated networks in complex and non-intuitive ways. The management and governance of complex risk has attracted interest and support from several sectors of the business community and government policy-makers, including the financial services industry, the energy sector, and major corporations. It poses a wide range of analytical and methodological challenges for the academic community to tackle. These different stakeholders form the community served by the Centre for Risk Studies.

The Centre's strategy for developing thought leadership around complex risk has been:

- **Engagement** – an active programme of events in which academics, business leaders and other stakeholders discuss risk-management issues. Over the past several years the Centre has established a reputation for thought-provoking meetings that tackle leading edge issues, attracting senior executives and influential attendees. Engagement has been the principle method of identifying supporters and ensuring that research is aligned with the issues of most importance to the community served by the Centre.
- **Risk Research** – a number of inter-related tracks of investigation have been developed and are described in the following sections. Research involves the proposal of methodological advances, the structuring of conceptual frameworks, compilation of data, and the development of models to explore issues. Research that is aligned with real-world business problems is valued by the University in terms of its 'impact'.
- **Academic Output** – the quality of a research centre is ultimately judged by its academic output, in terms of peer-reviewed publications. The current research programme is intended to produce high quality management science publications as well as contribute to the MBA and MPhil teaching curriculum.

Demonstrating Impact

The Centre is proactive in disseminating its research outputs and demonstrating that such outputs have business value to a community of subscribers. The Centre's programme of dissemination and community-building, detailed in this report, gives the team confidence that the research is relevant and has real impact.

Full Research Programme

The Centre is pursuing a full research programme, expanding the active research team and working in a number of challenging areas. Achievements include methodology breakthroughs, conceptual innovation, and development of new tools and approaches that have attracted positive peer review and external attention.

Executive Education in Risk Management

The Centre is expanding its engagement activities with the business community by developing an offering for executive education through a partnership with the Cambridge Judge Business School Executive Education and Leadership, Ltd. The executive level programme in risk management is expected to broaden the corporate engagement profile at the Centre and promote research activities through its 'deep engagement' opportunities.

Academic Output

The Centre contributes to the educational priorities of CJBS and engagement with the students through its MBA elective in Risk Management and the award of the McKinsey Risk Prize. For our more theoretical and fundamental research, we expect the planned academic programme to require sustainable and longer-term funding from a funding body such as the Research Councils.

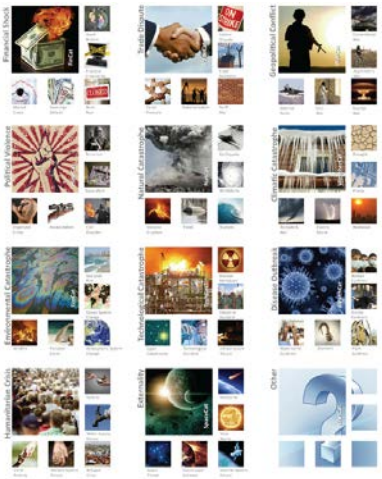
Recent Research Achievements

2016 marks the seventh year of operation of the Centre for Risk Studies. The Centre is making significant progress in developing methodologies for understanding and managing systemic risk. This includes scenario development, network analysis techniques, and macroeconomic modelling of shock events. The Cambridge Risk Framework provides an approach to analysing a wide range of emerging and less-well understood threats, with specific application to understanding emerging technology risks, and financial risk.

Developing the Cambridge Risk Framework 2010-2013

The research programme of the Centre for Risk Studies focusses on business applications of management science to reduce risk. A number of interlinked research themes are being explored. They share a common approach and risk analysis framework to complex risk – the 'Cambridge Risk Framework'.

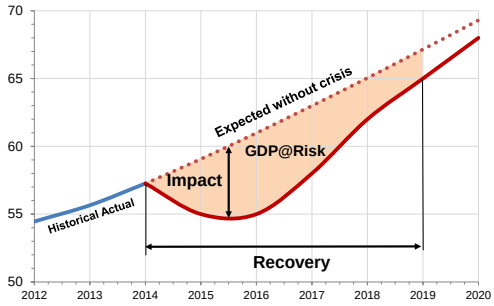
Over the past few years the research has progressed from identifying a 'Taxonomy of Threats', to compiling a 'state-of-knowledge' for several of the threat types, and the exploration of the consequences of a stress test scenario for a number of selected threats. A key contribution of the research was the standardisation of scenario selection (e.g. 1% annual probability of exceedance as a '1-in-100' event) for emerging risks. In 2013 an innovative methodology was developed to assess the different facets of scenario impact, ranging from direct loss, to macroeconomic consequences, to investment portfolio effects. This involved developing techniques of network analysis, including gathering and visualizing data on the interconnectivity of the global economy.



Cambridge Taxonomy of Threats

GDP@Risk: A new metric for comparing different types of shocks

In 2015 the research continued to explore the similarities and contrasts between shocks from different types of threats, initially using scenarios and their variants analysed in detail. This work developed a metric – 'GDP@Risk' loss of economic output –to measure the severity of shocks from widely different causes. This metric has been well received and has proven to be a useful and versatile benchmark for assessing the magnitude of catastrophes on the macroeconomy. It has enabled historical events to be recalibrated and compared with hypothetical events, and to allow comparison of widely different types of threat events. It provides a financial measure that can be used to assess the value of investment in risk management.



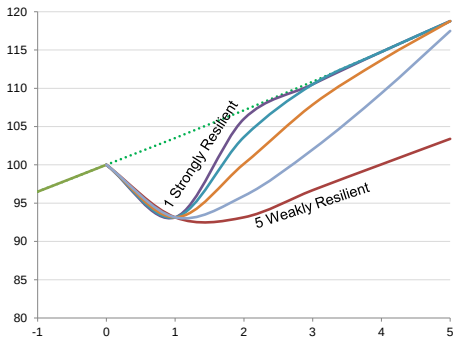
GDP@Risk – measuring economic output loss

Catastronomics: the economics of catastrophe

Assessing the macroeconomic impact of catastrophes led to a programme of research to explore how shocks cause output loss, how different types of threat influence specific macroeconomic variables, and how these flow through the economic system, which factors affect the severity of the initial shock and what processes determine how quickly the economy recovers.

An important exercise, our world city risk project, tested a much wider range of threats to show that GDP@Risk estimation techniques could be extended to more classes of catastrophe.

Modeling the economic impact of catastrophes is a key area of focus for the research.



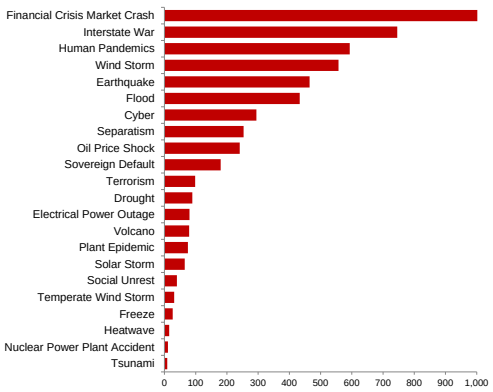
'Catastronomics': resilience of an economy determines recovery speed and affects total GDP@Risk

Project Pandora: Frequency, Severity and Geography of All Threats

An objective of the Cambridge Risk Framework is to develop a quantitative assessment of the likelihood of all of the systemic shock threats to the global economy.

A first order analysis of this has been achieved by applying GDP@Risk assessment techniques to derive economic output loss at city level for the most significant 300 cities of the world, responsible for over half of global GDP.

This required a very significant data compilation exercise on cities, threat maps, and historical precedents for 23 different threats. The resulting model provides the first holistic estimates of future catastrophe cost from each of the major threats in our taxonomy for the global economy. We believe this is a major advance in the field of catastrophe studies and provides a platform for 2016 research.

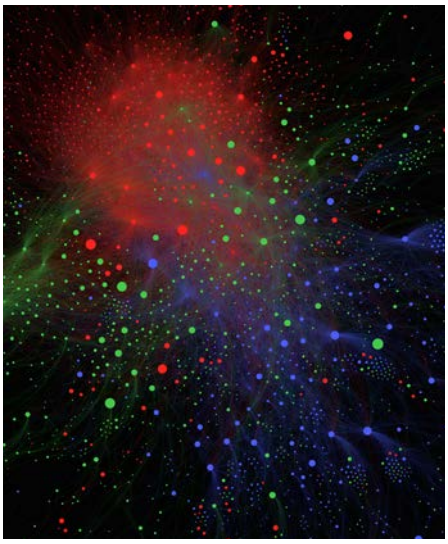


Expected loss by threat type to global economy GDP@Risk ($Bn) over next 10 years

Financial Catastrophe Risk

Financial crises represent a major class of threat in the taxonomy and the Centre maintains a research track on financial catastrophe risk. The Centre has developed a model of the global financial system to explore the propagation and consequences of crises. The model was developed through compilation of multiple databases and sources of information on financial institutions and currently incorporates over 18,000 banks across the world. It is the first known 'practitioner' model outside of regulatory central banks to attempt to model the world's entire banking system.

This model helps to extend the scenario analysis methodology already developed for 'exogenous' shocks – external events –to represent 'endogenous' internal failures in the financial system such as asset price bubbles and sovereign defaults. The FinCat research theme explored the development and propagation of several financial scenarios for use as structural stress tests. The Centre has developed techniques for representing how crises occur and propagate, and convenes an annual conference of researchers and practitioners in the nascent field of financial network analysis, and in honoured to be part of the editorial board of the new *Journal of Network Theory in Finance*.



Cambridge Model of Global Financial System

Technology Catastrophe Risk

The emerging threat of cyber disruption is a specific research theme at the Centre. The Centre's is at the forefront of research into cyber catastrophe risk – the potential for systemic loss across many organizations. Research has generated a model of the cyber economy and developed ways to quantify impacts to insurers and businesses as well as consequences for the public sector and critical national infrastructure. Our research has created new approaches to quantifying cyber risk, data standards, to measure it, and stress test scenarios for understanding how severe systemic cyber losses could be, which has been adopted by the insurance industry looking for accumulation techniques and exposure management for cyber insurance.

SITE linkages in the global cyber economy

Interconnected Corporate Risk

Research into the risk of business disruption to international corporations included hosting a workshop on Supply Chain Risk and its Insurability as well as applications of Revenue@Risk models for balance sheet risk recognition as promising avenues for research.

Agenda for Future Research

The research programme of the Centre for Risk Studies focusses on business applications of management science to reduce systemic risk. A number of interlinked research themes are being explored. They share a common approach and risk analysis structure – the 'Cambridge Risk Framework', which enables a range of threats, scenarios, and consequences to be analysed on networks of business and economic relationships. In 2016, we propose to continue development in several research areas.

Research Application Areas

Research application areas explored through the Cambridge Risk Framework are described in more detail in the next pages of this briefing. For 2016, we envision focussing on three primary research application areas:

A. **Cambridge Risk Framework:** Understanding and quantifying the risk to the economy and international business activities from catastrophe scenarios from all of the threat types in our taxonomy.

B. **Technology Catastrophe Risk:** Developing a more rigorous framework for the evaluation of systemic cyber risk, solar storms, and other emerging threats to critical infrastructure and social systems.

C. **Financial Catastrophe Risk:** Using the Cambridge Risk Framework to explore the consequences of financial shocks for practitioners managing tail risk in the financial services and investment industry.

Developing the research platform

In addition to pursuing specific research application area, we intend to continue developing the Cambridge research platform, allocating resources to enabling the framework, improving methodologies, compiling datasets, developing the programming environment for our research models, and exploring other application areas for the research.

Methodology Development: Catastronomics

The economic consequences of major catastrophic shocks of different types are not well understood. The Centre has strong relationships with economists and specialists in macroeconomic analysis. A track of research is to improving methodologies of catastronomics and expanding our understanding of how economic shocks translate into market impacts on asset values in an investment portfolio.

Additional Application Areas

In addition to our major application areas, we address research topics that are aligned with our objectives of populating the Cambridge Risk Framework in particular threat specializations, or other areas of business decision-making. Recent topics have included how climate change risk will affect investment portfolio strategies; improving risk assessments of geopolitical instability; macroeconomic consequences of extreme natural catastrophe events. We also encourage our research associates to pursue their own research topics for part of their time.

Research Platform Infrastructure

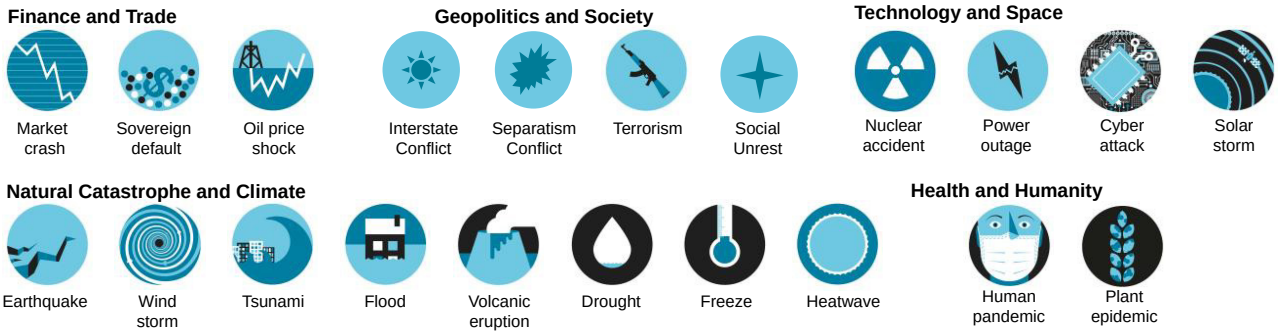
The Cambridge Risk Framework makes use of a cloud-based research platform for data compilation, model development, and research output: *http://www.CambridgeRiskFramework.com*. This platform is currently being enhanced to improve its usefulness in the research and presentation of outputs, including enabling research development partners to interact with data and analytics developed at the Centre.

Understanding Complex Business Exposure

We are continuing to populate the Cambridge Risk Framework with datasets about the international economy, business interconnectivity, elements at risk from shocks, and threat information. These datasets represent 'complex business exposure' – counterparty relationships, trading flows, supply chains, market dependencies, transportation and communication lines – that are vulnerable to the disruption of business processes. Developing a useful data architecture for this exposure and publishing data schemas for improved adoption of representations of complex business exposure is an important objective for our future research.

Research Application Area A: Cambridge Risk Framework

A key objective for our research is to develop a holistic analysis of the global threat universe. This has been a vision and objective of the Cambridge Centre for Risk Studies since its inception and the first publication of a Taxonomy of Threats in 2010. The existing World Cities at Risk framework will be further developed into a model for assessing threats and their impacts on the world economy. Specifically we propose to explore how this toolkit can be used in business risk management through specific use cases developed with our supporters, with the aim of providing global risk management tools that account for all of the perils in the Taxonomy, aimed at financial services, investment management, and corporate risk management.



Existing Threat Taxonomy of the Lloyd's World Cities at Risk Project

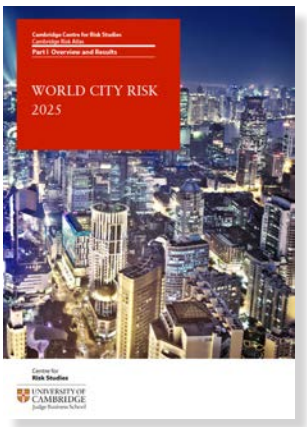
Project Pandora: Building on World Cities at Risk

Project Pandora references the classical story of Pandora's Box of All Ills, and is a culmination of the 'System Shock' research programme that the Centre for Risk Studies has been pursuing since 2010, generating a suite of catastrophe scenario publications, and our proof-of-concept World Cities at Risk package whose outputs are used by Lloyd's as their City Risk Index. The Centre has compiled a compendium of threat maps, analytics and data layers, as a toolkit for assessing international risk of business disruption.

This analysis set consists of a probabilistic event set of over 12,000 catastrophe scenarios representing 20 threats, with potential to cause disruption to economic activity in 300 of the world's most important cities, responsible for half of the world's GDP. The consequences of these events are quantified in terms of their 'GDP@Risk' – a constant metric that can be used to compare and standardize different types of threat. This is provided in a ten year projection outlook, to provide a planning tool for business risk assessment.

We propose to develop an interactive application for users to apply the research outputs to their business decisions around protecting balance sheets and operational strategies.

Threat Observatory



Methodology Documentation

The research uses the Cambridge Risk Framework, developed to analyse extreme systemic risks. The proposed project will develop a global probabilistic model of the risk of catastrophic disruption to economic activities from all of the major potential threats identified in the Cambridge Centre for Risk Studies Taxonomy of Threats and tracked in the Cambridge Risk Framework Threat Observatory.

Project Outline

In addition to pursuing specific research application area, we intend to continue developing the Cambridge Risk Framework, allocating resources to enabling the framework, improving methodologies, compiling datasets,

Research Application Area A: Cambridge Risk Framework

developing the research platform and toolkit, and exploring other application areas for the research.

The proposed research will:

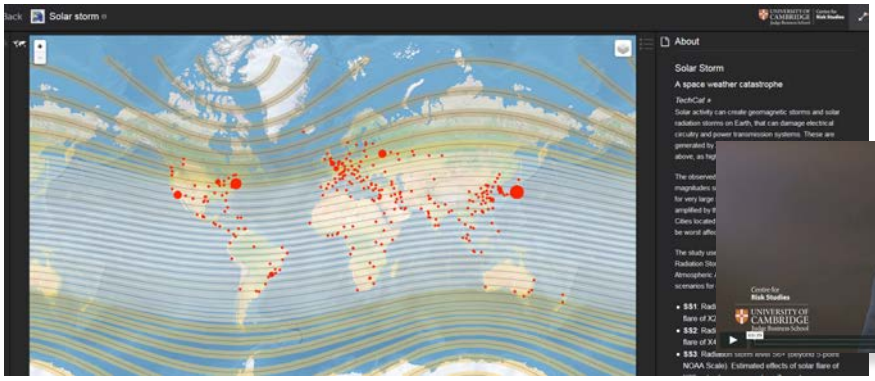
a) make the current model and framework more sophisticated by focusing on issues such as multi-city catastrophes, city interconnectivity and secondary "catastronomic" effects, cascading threats, and improvements to economic impact modeling

b) Indicate the importance of emerging risks, relative to better-understood risks

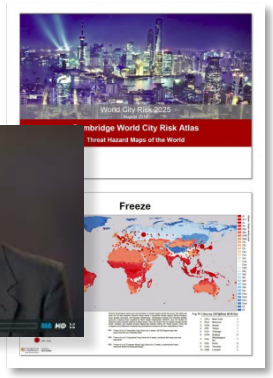
c) Establish a framework for quantitative and objective tracking of the changing importance of different threats

d) Provide insights into the effectiveness of risk mitigation decisions to protect against shocks to revenues, operational disruption and sudden liabilities.

The main project development will take place over two years with the first year concentrating on upgrading the World Cities at Risk methodology to take account of various application areas and use cases, and the second year on implementing tools specific to use cases.



Interactive Cambridge Risk Atlas and Database: http://wcr.cambridgeriskframework.com/



Presentations and printable risk atlas

Business use cases and project partners

The Centre for Risk Studies is inviting selected organizations to be part of a multi-year partnership to develop and exploit Project Pandora. The Centre will work with a steering committee of research partners representing different aspects of potential business users. This development consortium will shape the applications of the research to meet the needs of their specific use cases. The nature of the partnerships will facilitate the practical usage and benefits of the research outputs towards business applications.

Research Application Area B: Technology Catastrophe Risk

The modern knowledge economy is increasingly reliant on information technology, communication systems, and infrastructure service continuity. Exploring the emerging risk of disruption and catastrophic failure of these critical systems is a key theme of research at the Centre. Understanding cyber risk and the potential for massive failure of interconnected infrastructure systems requires a detailed technical appraisal of complex engineering interactions, a domain-specific assessment of the threat, and a risk analysis framework.

Simulated cyber attack on US Power Grid for Lloyd's Business Blackout project

An innovative risk assessment framework for cyber

The Centre for Risk Studies has developed an innovative framework for the assessment of cyber catastrophe risk, first published in 2013 and significantly expanded upon since. It includes an understanding of the cyber threat landscape resulting from different attack vectors, actors and motivations. The framework provides a method of assessing the economic and social impact of future cyber attacks. It also captures risk correlation structures and the potential for systemic cyber catastrophes to impact society, insurance companies, and national governments. This covers various mechanisms of cyber loss to the corporate 'cyber' economy.

In 2016 and beyond, we intend to develop this framework to explore the key issue of how public and private sectors can collaborate as joint stakeholders in reducing cyber risk to the functioning of society and the economy. We will examine the roles of individual companies in protecting themselves, the benefits provided by the IT security industry, the value of insurance in providing protection and incentives for risk reduction, law enforcement in deterring cyber criminals, and the function of regulators in enforcing standards for public protection. We believe that the Centre's cyber risk models provide one of the only frameworks that can quantify and inform the public debate around how the many stakeholders can reduce cyber risk to modern society.

Research Application Area B: Technology Catastrophe Risk

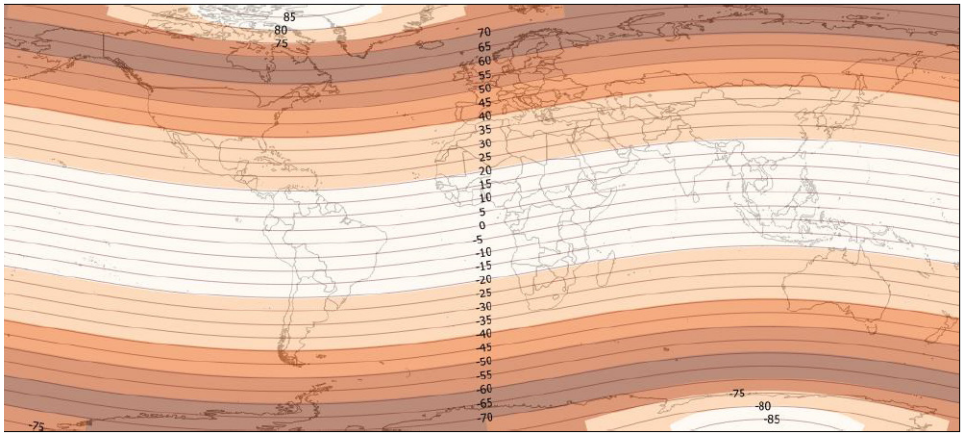
Insurance accumulation

The Centre has played a significant role in helping develop the growing market for cyber insurance through assisting with the development of data standards for recording cyber insurance exposure and in the development and dissemination of accumulation scenarios of systemic cyber insurance losses, including the Lloyd's Business Blackout publication and publications of affirmative cyber scenarios. Another example of ongoing work, with RMS Inc., is our project Managing Cyber Insurance Accumulation Risk.

Cyber Loss Category	Leakomania	Cloud Compromise	Financial Transaction Interference	Extortion Spree	Mass DDoS
Breach of privacy event	3	2	1	1	1
Data and software loss	3	2	2	2	2
Incident investigation and response costs	1	1	1	1	1
Liabilities	2	2	2	1	2
Financial Theft	2	1	3	1	
Business interruption	1	3	1	2	3
Cyber Extortion	1	1	1	3	2
Intellectual Property (IP) theft	1	1		1	
Impact on reputation	2	1	2	2	2

Cyber accumulation scenarios and their impact on affirmative stand alone cyber insurance coverage categories.

A significant challenge for insurers in 2016 and beyond is to identify systemic cyber threats to 'silent' exposure – claims that could occur to conventional insurance coverages from cyber attacks. The Centre will continue to work with insurance partners, industry associations, regulators, and government pools to push forward the frontiers of understanding cyber risk and the best ways to manage this new and emerging class of insurance.



Solar storm risk map of potential intensity of effects across the world.

Interdependencies in critical national infrastructure

A major areas of societal concern is the potential for failures of critical national infrastructure. In 2015 the Centre analysed a number of scenarios of failure of critical national infrastructure, including cyber attacks, solar storms, and interdependencies and cascading failures from one system to another.

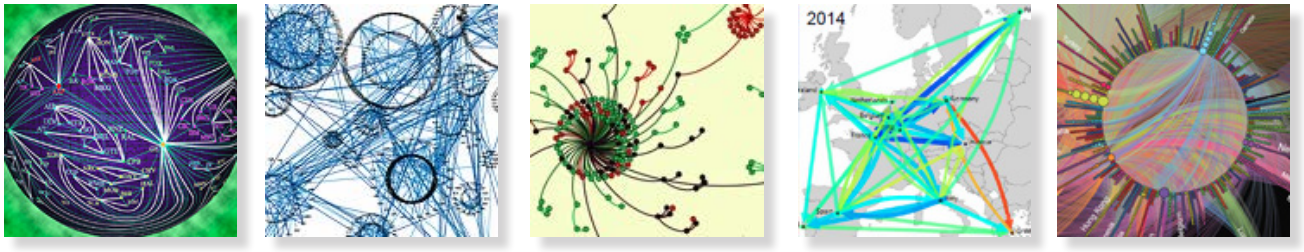
The interaction and vulnerability of different types of national infrastructure is a continuing and important theme for research, involving understanding how power, communications, energy networks, transport and other systems rely on each other and their critical failure points and vulnerabilities to disruptive threats. A current project in its final stages looks a cyber-induced blackout of the greater London and south-east England, in collaboration with Lockheed Martin. One of its most novel and important aspects is an assessment of cascading failure of critical infrastructure undertaken in collaboration with infrastructure researchers at Oxford University in its Climate Change Centre. Interdependencies between failure modes of infrastructure, whether digital or physical, is a continuing area of focus of the Centre for Risk Studies.

Multiple stakeholders in improving cyber safety

The research on cyber catastrophe risk proposes to explore how the risk to society can be managed better, and how the roles of different stakeholders could be optimized. Different stakeholders are involved and there are a variety of approaches to making society safer, including applying regulation, relying on enterprises investing and taking measures to protect themselves, improving the role of the security consultant industry, government security services and counter-cyber forces, insurance and financial incentives to change behaviour. The complexity of the interaction of different stakeholders increases with state-backed cyber forces, and the extension of cyber interventions as a foreign policy instrument and an instrument of proto-warfare. We propose to play an active role in the thought leadership around the societal cyber risk management.

Research Application Area C: Financial Catastrophe Risk

The objective of our research into financial crises is to fully understand the frequency and severity of extreme tail risk catastrophes, and how measures taken by regulators, financial services companies, and other practitioners can manage risk at an individual company level, and for society as a whole. The Centre's research provides coherent structural models of extreme financial crisis scenarios that reflect the systemic dynamics of the interconnected financial system, for practitioners managing tail risk in the financial services and investment industry.



Financial network representations presented by guest speakers at the Cambridge Financial Risk and Network Conference series

Understanding Systemic Financial Risk

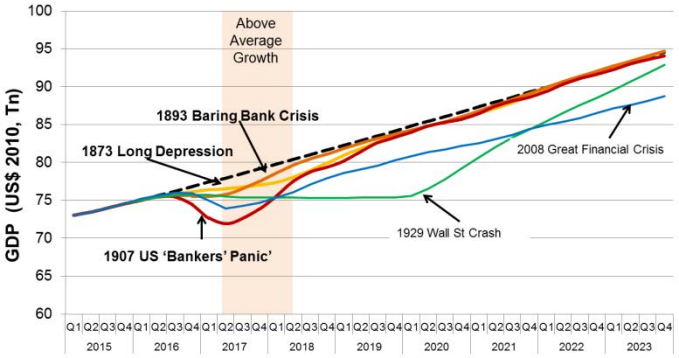
Many businesses, financial institutions, and investors are grappling with improving their understanding of market risk ever since the 2008 financial crash. The Centre for Risk Studies' FinCat research programme contributes to the understanding of financial catastrophe risk, generating a suite of publications on hypothetical financial stress test scenarios that are coherent, plausible, and challenging. The most significant methodological challenge is to determine the probability of future financial crises of different characteristics and severities.

A Probabilistic Model of Financial Crises

Our objective is to develop a probabilistic model that describes the full range of potential future financial crises, from the wide range of potential triggers, and incorporating the contagion propagation mechanisms that are likely to result. There are significant methodological challenges in quantifying the likelihood and the consequences of future crises, but major benefits if this can be achieved. Risk managers need to understand financial contagion and the correlations that increase during a financial crisis, to track and monitor systemic risks, to develop contingency plans for their occurrence, and to set aside adequate risk capital and meet regulator and governance requirements for the most extreme of these events.

Historical Catalogue of Financial Crises

Fully understanding the past is an essential element of understanding financial catastrophes. The Centre for Risk Studies partners with the Centre for Financial History at University of Cambridge in order to study past financial crises and help inform the risk management of future financial shocks.



Historical financial crises compared as if they occurred during the present day

Model of the Global Financial System

The Cambridge Model of the Global Financial System provides a framework to explore how the interconnectivity of banks and other institutions provides contagion mechanisms for financial shocks (Interbank lending; fire-sales of commonly-held assets; cross shareholding; rollover risk, etc.).

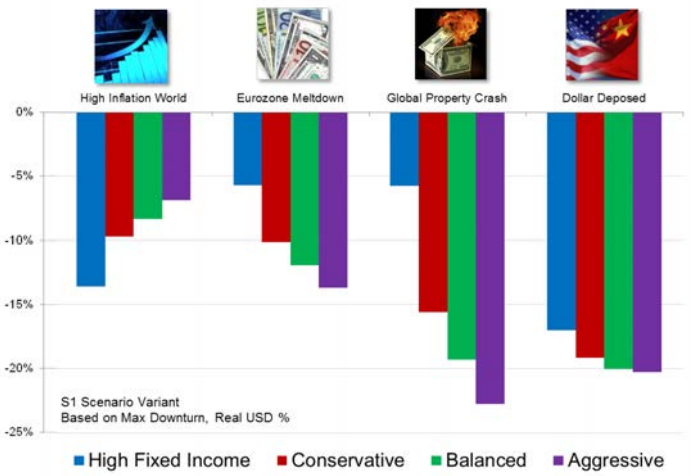
We propose to develop this for use by practitioners in understanding limits and constraints to the severity of crises, counterparty risk, how resilient the system is as a whole, and how systemic behaviour may change under new conditions, such as regulatory constraints, industry consolidation, or institution behaviour.

Research Application Area C: Financial Catastrophe Risk

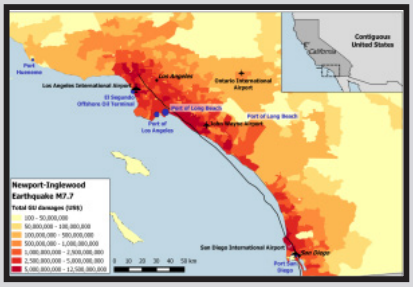
Scenario Studies and Investment Portfolio Impacts

In 2015 the release of four financial catastrophe stress test scenarios demonstrated a methodology for extrapolating extreme events beyond conventional forecasting limits. This suite provides coherent stress tests of the global financial system of relevance to the investment community, policy makers, and international business.

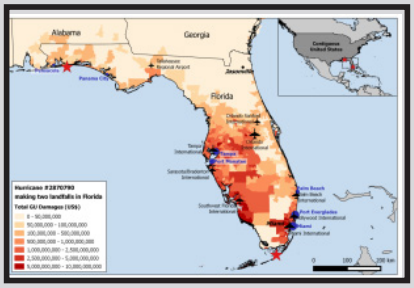
We propose to extend the suite of potential stress test scenarios to address key areas of economic and financial planning concerns, and to develop improved approaches for understanding how likely these are to occur. We propose to produce counterfactual catastrophes for forward-looking stress tests.



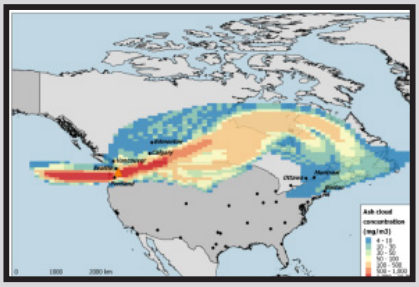
Impact on different types of investment portfolios from four stress test scenarios



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

Trillion Dollar Natural Catastrophe events capable of impacting financial markets

Indicators and Early Warning Systems

As part of our financial catastrophe scenario research, we have begun an exploration of historical and theoretical evidence for early warning indicators of financial crises. This work identifies and assesses potential leading indicators of systemic risk and explores the business value of early warning in rebalancing investment portfolios and other risk management measures.

2016 Planned Event Calendar for the Cambridge Centre for Risk Studies

13 January	**Centre for Risk Studies Advisory Board** The Cambridge Centre for Risk Studies will hold the 2016 meeting of its Advisory Board, with attendees representing the supporting organisations of the Centre, academic advisors, and invited guests. The executive team of the Centre for Risk Studies will present a progress report on the past year's activities, the current positioning and strategy of the Centre, and the various strands of research.
14 January	**Cambridge CRO Council "Leading Ideas in Risk" Roundtable, Carlton Club, London** *Anticipated regimes for senior managers and the measures and implications associated with incentive, administrative, and civil structures* This roundtable will be comprised of senior risk and human resources executives from a variety of sectors to allow for a broad-based discussion.
Deadline: 4 March	**The 2016 Cambridge-McKinsey Risk Prize** The Centre for Risk Studies, in conjunction with McKinsey & Company, is pleased to announce the 2016 annual risk prize. An award will be made for the best submission on risk management by a current student at the University of Cambridge Judge Business School.
April	**Executive Series in Risk Management: Topics for Financial Crime Compliance** Delivery of a thought leadership workshop on the complexities of financial crime compliance.
20-21 June	**Cambridge Centre for Risk Studies 7th Risk Summit, Cambridge Judge Business School** Cambridge Centre for Risk Studies will bring together leaders and decision makers from businesses, governments, intergovernmental organisations, academia and NGOs to explore salient topics in risk management. The summit will be held at the University of Cambridge Judge Business School, followed by a conference dinner at one of the University colleges. This year's summit theme will be 'Risk Culture: Challenging Individual Agency', and will explore the meaning of risk culture and its contribution and governance to culture in organisations.
July	**5th Annual Aspen Crisis and Risk Forum, Aspen, CO** Cambridge Centre for Risk Studies with its partners in business and academia will address governance issues faced by boards. This forum explores the growing demands on directors to make risk management among their top priorities.
September	**2016 Financial Risk and Network Theory Conference**
October	**Executive Series in Risk Management: Topics for Financial Crime Compliance** Delivery of a thought leadership workshop on the complexities of financial crime compliance.

Global Banking Network Nebula, Cambridge Banking Model, *created by Dr Andrew Skelton*

2015 Centre for Risk Studies Research Outputs

Publications

Financial Catastrophe Stress Test Reports

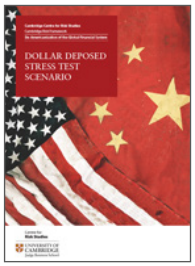
The University of Cambridge Centre for Risk Studies has developed a new suite of four coherent stress tests that represent extreme 'real-world' examples of future hypothetical global financial crises for use in investment portfolio management, business risk management, and policy-making.

- **Global Property Crash** estimates the impact of a series of property bubble collapses beginning with collapse of the Chinese property market and spreading to a number of other property markets worldwide, to estimate the consequences for banks and financial institutions as the crisis spreads through the global financial system.
- **Eurozone Meltdown** explores the impact of the breakup of the Euro trading bloc in a cascade of sovereign defaults.
- **High Inflation World** depicts the impact of a period of sustained high inflation brought about through price hike spirals.
- **Dollar Deposed** considers the effects of the de-Americanization of the financial system if the US dollar were replaced by the Chinese renminbi as the world's dominant reserve currency.

Financial Catastrophes: Asset Bubble Collapse Scenario - "Global Property Crash"

Kelly, S.; Coburn, A. W.; Copic, J.; Evan, T.; Neduv, E.; Ralph, D.; Ruffle, S. J.; Shaghaghi, A.; Skelton, A.; Yeo, Z. Y.; 2015. ***Stress Test Scenario: Global Property Crash***; Cambridge Risk Framework series; Centre for Risk Studies, University of Cambridge.

An illustration of the risks posed by an extreme but plausible Global Property Crash financial catastrophe. A sudden loss of confidence in the boom markets of South East Asia triggers a housing market collapse that impacts mortgage and non-mortgage assets worldwide.



Financial Catastrophes: De-Americanization of the Financial System Scenario - "Dollar Deposed"

Ralph, D.; Chaplin, A.; Coburn, A. W.; Copic, J.; Evan, T.; Kelly, S.; Neduv, E.; Ruffle, S. J.; Skelton, A.; Yeo, Z. Y.; 2015. ***Stress Test Scenario: Dollar Deposed***; Cambridge Risk Framework series; Centre for Risk Studies, University of Cambridge.

An illustration of the risks posed by an extreme but plausible Dollar Deposed financial catastrophe. The rapid development of the Chinese domestic economy ultimately destabilizes the value of the dollar. The Chinese renminbi supplants the greenback as the number one reserve currency.

Financial Catastrophes: Food and Oil Price Spiral Scenario - "High Inflation World"

Yeo, Z. Y.; Coburn, A. W.; Copic, J.; Evan, T.; Kelly, S.; Neduv, E.; Ralph, D.; Ruffle, S. J.; Skelton, A.; 2015. ***Stress Test Scenario: High Inflation World***; Cambridge Risk Framework series; Centre for Risk Studies, University of Cambridge.

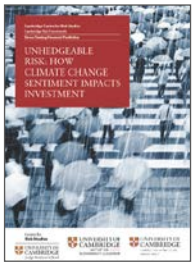
An illustration of the risks posed by an extreme but plausible High Inflation World financial catastrophe. Ecological and political pressures lead to a sudden shock to global food and oil supplies causing prices to spiral uncontrollably worldwide.

Financial Catastrophes: Sovereign Default Crisis Scenario - "Eurozone Meltdown"

Kelly, S.; Chaplin, A.; Coburn, A. W.; Copic, J.; Evan, T.; Neduv, E.; Ralph, D.; Ruffle, S. J.; Schwendner, P.; Skelton, A.; Yeo, Z. Y.; 2015. ***Stress Test Scenario: Eurozone Meltdown***; Cambridge Risk Framework series; Centre for Risk Studies, University of Cambridge.

An illustration of the risks posed by an extreme but plausible Eurozone Meltdown financial catastrophe. The sudden exit of Italy from the Eurozone triggers a cascade of sovereign debt defaults in vulnerable European states.

Other Published Reports



Unhedgeable Risk: How Climate Change Sentiment Impacts Investment

Kelly, S., Yeo, J.Z., Coburn, A., Copic, J., Crawford-Brown, D., Foley, A., Neduv, E., J., Ralph, D., Saidi, F., 2015, ***Unhedgeable Risk: How Climate Change Sentiment Impacts Investors***. University of Cambridge.

Commissioned by the Cambridge Institute of Sustainability Leadership (CISL) Investment Leaders Group (ILG), this groundbreaking report looks at the economic and financial impacts of climate risk modelled over the next five years.

Lloyd's Erebos "Business Blackout" : The insurance implications of a cyber attack on the US power grid

Ruffle, S.; Coburn, A., Evan, T.; Kelly, S.; Leverett, E.; Copic, J.; 2015. ***Erebos Cyber Blackout Scenario***; Cambridge Risk Framework series; Centre for Risk Studies, University of Cambridge.

Research undertaken in collaboration with Lloyd's that estimates the economic and insurance impacts of a severe, yet plausible, cyber attack against the US power grid.

Lloyd's City Risk Index 2015-2025

Coburn, A.W.; Evan, T.; Foulser-Piggott, R.; Kelly, S.; Ralph, D.; Ruffle, S.J.; 2014, ***World City Risk 2025***; Cambridge Risk Framework series; Centre for Risk Studies, University of Cambridge.

A project undertaken in partnership with Lloyd's comprises a risk assessment of over 20 catastrophe threats to the world's most important 301 cities, using the Cambridge Risk Framework to assess the likely GDP@Risk for a ten year projection of economic output.

Further content at: *http://cambridgeriskframework.com/wcr*

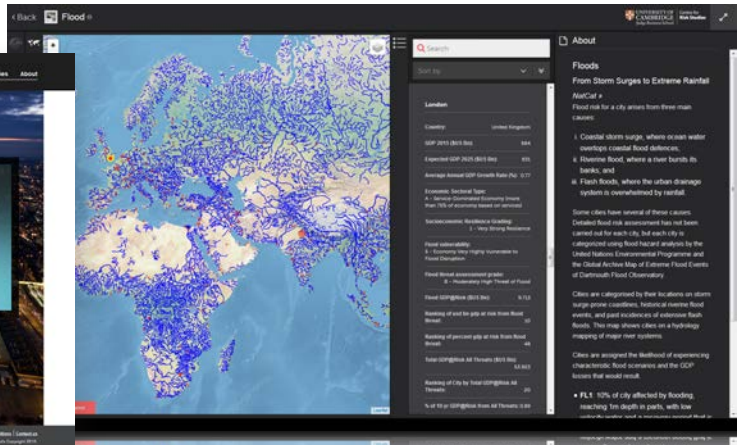
- Tuveson, M and Ralph, D., Jan. 2016, ***Is Regulation of Risk Culture the Missing Piece? Civil Actions Reconsidered***. *Banking and Financial Services Policy Report*, Wolters Kluwer Law & Business, Vol. 35, No. 1, 1 January 2016.

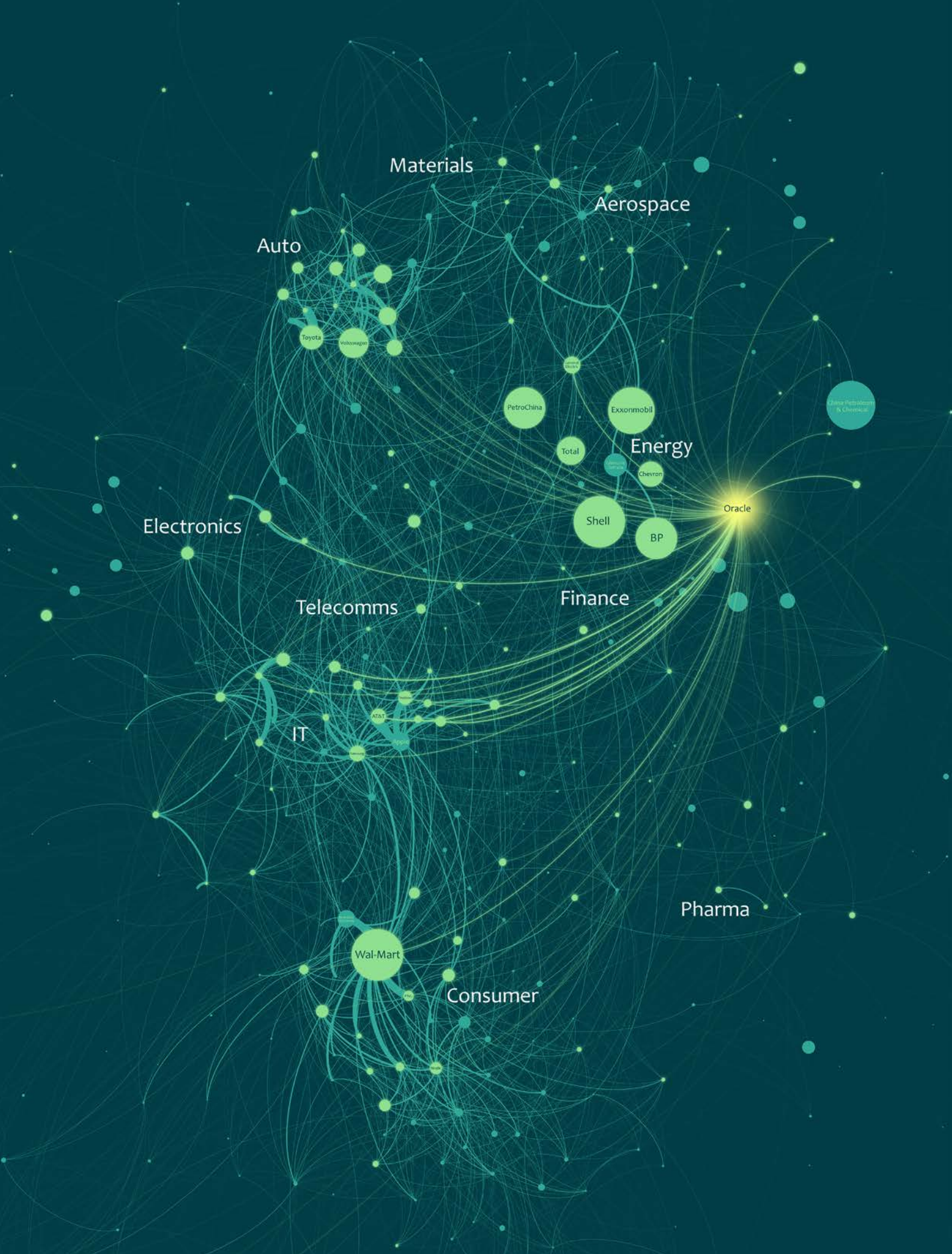
Cambridge World City Risk Atlas: Interactive Maps and Reports

Lloyd's produced an website dedicated to presentation of the City Risk Index research. The Centre has set up its own Risk Atlas site comprised of online maps pertaining to the World City Risk 2025 project, containing interactive city data, threat hazard mapping, and results for the world's most important 301 cities.

Lloyd's City Risk Index homepage:
http://www.lloyds.com/cityriskindex/

Centre for Risk Studies Risk Atlas site: http://wcr.cambridgeriskframework.com





"Systemic Cyber Threats", the world's largest commercial companies and their trading relationships, showing the systemic linkages through major software providers, using Oracle as an example; *created by Dr Andrew Skelton*

Engagement Activities 2015

In 2015, the Centre built on the dissemination activities established during the previous year, continuing the expansion of its stakeholder community and engagement with the wider research community in order to develop real and significant thought leadership in the business industry.

The Centre's dissemination strategy involves the packaging the research outputs into self-published reports and creating a multi-channel process for publicizing and distributing them. The self-published aspect of this strategy has allowed the Centre to tailor these reports to specific audiences and areas of expertise in 2015. This has made them more effective as tools for business strategy and broadened their appeal to various industry sectors. In addition, the Centre's previous stress test reports were adopted by the Society of Actuaries to form part of their catalogue of learning materials.

In 2015, members of the Centre for Risk Studies were invited to speak on various risk seminars and business strategy conferences around the world, including the biannual FERMA meeting (Danny Ralph, speaker), Advisen's "Predictive Modelling Insights Conference" (Andrew Coburn, keynote); Skytop Strategies Sustainability and Risk Management symposium (Michelle Tuveson, delegate, March 2016) and the George C. Marshall European Center for Security Studies "International Cyber Summit" of NATO states (Simon Ruffle, speaker).

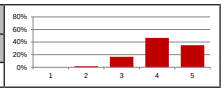
Centre members also served on boards and as senior executives for external publications and academic series, including the World Economic Forum Global Risk Report 2015, Cambridge CRO Council and the Executive Education Curriculum Design, and contributed to media discussions on hot topic issues such as climate change, the Greece Debt Crisis, the November 2015 Paris attacks, and the growing threat of cyber terrorism and critical system compromise. The Viewpoints blog also provided an easily accessible platform for commentary and insight on these pertinent topics at the rate of roughly one column per month.

Attendee Feedback Summary
Financial Risk & Networks Seminar, September 2015

Improving Understanding

The material presented was useful in improving my understanding of issues that affect my business or professional activities.

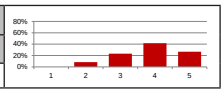
Number of responses	Average Score	Percentage of Respondents scoring as 1 Strongly disagree	2	3	4	5 Strongly agree
60	**4.15**	0%	2%	17%	47%	35%



Dissemination to Others

The material presented is likely to be of interest to colleagues and I will pass on presentations from the seminar to others in my organization or elsewhere.

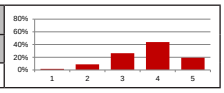
Number of responses	Average Score	Percentage of Respondents scoring as 1 Strongly disagree	2	3	4	5 Strongly agree
60	**3.87**	0%	8%	23%	42%	27%



Personal Decisional-Making

I am likely to incorporate material from the research presented here into my future business decisions.

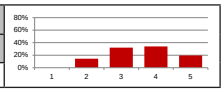
Number of responses	Average Score	Percentage of Respondents scoring as 1 Strongly disagree	2	3	4	5 Strongly agree
57	**3.70**	2%	9%	26%	44%	19%



Organization Value

The scenarios, framework and taxonomy of threats may be directly useful in helping my organisation structure risk management actions in future.

Number of responses	Average Score	Percentage of Respondents scoring as 1 Strongly disagree	2	3	4	5 Strongly agree
56	**3.59**	0%	14%	32%	34%	20%



Viewpoints blog visitor map for December 2015

6th Annual Risk Summit - "Stressing the Boundaries"

Our feature engagement activity is our major Risk Summit conference, attended by 150 senior executives and decision-makers. This year the Summit featured more content from our own research, in a pre-conference Special Topics Seminar. Video interviews were conducted with experts and speakers who participated in the conference and were made public online.

Seminars

Specific topic seminars included *Financial Risk and Network Theory* in September and *Market Risk: Understanding & Managing Tail Risk Events* in December. All seminars were fully subscribed and well recieved (see feedback data above). In the latter part of 2015, the Centre embarked on an effort to film and record seminar presentations and make them available online in order to contribute to a climate of accessible academic research and discussion.

London Risk Briefings

Dissemination involved the continuation of the lunchtime London Risk Briefings series including several subject matter experts among the speakers -- with an additional New York Risk Briefing held in April 2015 -- and increased media outreach. Relationships with members of the print and online media community established in 2014 flourished further as a result of a continued decision to make our research available to industry professionals in this way.

Calendar of Events 2015

13 January	**Centre for Risk Studies Advisory Board** Research strategy review by the members of the Centre for Risk Studies Advisory Board.
15 January	**Cambridge CRO Council Round-Table Discussions, London** *Through the Financial Crime Lens: Impacts & Risks to the Global Economy*
22 January	**London Risk Briefing: Social Unrest Risk** Defining a Risk Test Scenario for managing the business risks posed by youth uprisings and political instability
19 February	**London Risk Briefing: Geopolitical Conflict Risk** Defining a Risk Test Scenario for managing the business risks posed by war disruption
3 March	**The 2015 Cambridge - McKinsey Risk Prize** The Centre for Risk Studies, in conjunction with McKinsey & Company, is pleased to announce the 2015 annual risk prize. An award will be made for the best submission on risk management by a current student at the University of Cambridge Judge Business School.
30 April	**New York Risk Briefing: Financial Risk Scenarios -- Could Your Portfolio Hold Up?** Presented by the University of Cambridge Centre for Risk Studies, in partnership with Cambridge in America
20 May	**London Risk Briefing: Financial Catastrophe Stress Tests for Investment Portfolios** The recent round of stress tests to check the health of banks and economic institutions has highlighted issues in the design and implementation of stress tests
22-23 June	**Cambridge Centre for Risk Studies 6th Annual Meeting** **The Risk Summit - "Risk Testing: Stressing the Boundaries"**
June	**Chief Risk Officer Round-table Discussions, London** *Aligning Risk Culture with Organisational Culture: Implications to Innovation, Adaptation, and Institutional Values*
July 8	**Lloyd's Cyber and Business Blackout Launch Event** Emerging Risk Research Report: Cyber Attack Against the US Power Grid
29 July	**4th Annual Aspen Critical Issues & Risk Forum** *Rebuilding Trust: Effective Board Governance in Times of Public Scrutiny*
12 August	**London Risk Briefing: Learning from Historical Financial Crises** The history of modern financial crises, using example crises of the past to illustrate important lessons for the future, for investment managers and financial risk officers everywhere
3 September	**Lloyd's City Risk Index 2015-2025 Launch Event** Launching the Lloyd's City Risk Index 2015-2025, which will provide groundbreaking analytics of the potential impact on the economic output (GDP@Risk) of 301 of the world's major cities from 18 manmade and natural threats

Calendar of Events 2015 *continued*

8-9 September	**2015 Financial Risk & Network Theory Conference** Cambridge Centre for Risk Studies Seminar, in collaboration with *Journal of Network Theory in Finance*
6 October	**London Risk Briefing: Lloyd's City Risk Index - Methodology and Usage of City Economy Risk Analysis** In this London Risk Briefing, hosted at Lloyd's, we will discuss the methodology and research strategy behind the City Risk Index and look towards its application in the future
11 November	**Unpatchable: Living with a Vulnerable Medical Device** Cambridge Centre for Risk Studies Seminar, in collaboration with the University of Cambridge Computer Laboratory
8 December	**Market Risk: Understanding & Managing Tail Events** This seminar will present research work from the Cambridge Centre for Risk Studies, together with contributions from leading practitioners in understanding market tail risks, developing coherent stress tests, and instigating effective risk management strategies

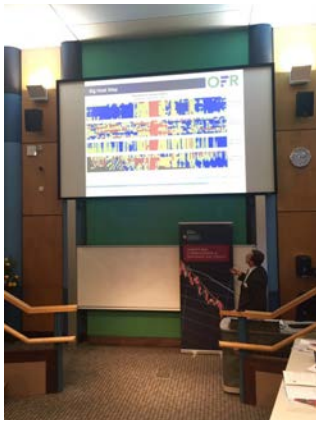
Centre's 7th Risk Summit - Insights on Stress Testing

Continuing Risk Centre social media presence

Scenario Reports published, December 2015

London Risk Briefings - lunchtime seminars in the City

New York Risk Briefing with Cambridge in America



Market Risk: Understanding & Managing Tail Events Conference

Financial Risk & Network Theory Conference

Cambridge-XL Catlin Annual Workshop

Official launch events for Business Blackout and City Risk Index with Lloyd's

Cambridge Centre for Risk Studies 7th Risk Summit, 20 & 21 June 2016

Risk Culture: Challenging Individual Agency

University of Cambridge Judge Business School

In June 2016, Cambridge Centre for Risk Studies will bring together leaders and decision makers from businesses, governments, intergovernmental organisations, academia and NGOs to explore salient topics in risk management. The summit will be held at the University of Cambridge Judge Business School, followed by a conference dinner at one of the University colleges.

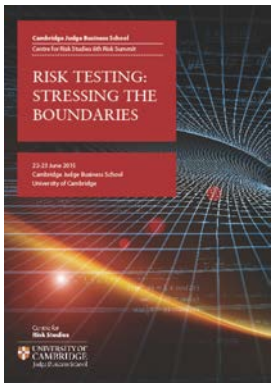
This year's summit theme will be 'Risk Culture: Challenging Individual Agency', and will explore the meaning of risk culture and its contribution and governance to culture in organisations.

Agenda

The agenda for the 2016 Risk Summit is currently in development. Proposals for eminent speakers are welcomed. Please refer to Dr Michelle Tuveson, Executive Director. Registration opens March 2016.

Last Year's Risk Summit

22 & 23 June 2015 - "Risk Testing: Stressing the Boundaries"



2015 Summit Proceedings

Last year's summit, 'Risk Testing: Stressing the Boundaries', took the topical theme of applying stress tests to financial institutions, business management, and other operations. The past few years of requiring banks in all the major jurisdictions of the world to perform different sets of stress tests has proved controversial and has prompted questions about the objectives and techniques of stress testing.

The conference addressed current thinking about how to develop better stress tests that make our financial services – and our overall society – safer, including learning from how stress tests are used in other disciplines and setting 'risk tests' that reflect likelihood and realistic narratives as well as severity benchmarks.

Keynote speakers addressed a number of different viewpoints around stress testing, the issues of understanding systemic risk, and improving the resilience of our society and our economic system. Panels of specialists, including regulators, practitioners, and analysts debated the business benefits of stress testing as a practice.

Proceedings, speaker biographies, video interviews and photos of the event: **http://www.risk.jbs.cam.ac.uk/news/events/risksummits/risksummit2015.html**

Selected Press Features

Business Insurance: "Catastrophe modelers developing cyber risk technologies to assess exposures," Bill Keanealy, 1 January 2015

Reactions: "Insurers prepare for cybergeddon: insurers are waking up in 2015 to the massive accumulation of losses that could accompany a cyber attack," Garry Booth, February 2015

The Conversation: "Planning for war: a guide for businesses," 17 February 2015

The Actuary: "Social unrest: a systemic risk," Scott Kelly, 5 March 2015

Intelligent Insurer: "Lloyd's considers forming 'incubator' syndicate to write experimental risks", 15 September 2015

ValueWalk: "Climate Change Could Erase 4% Of Your Portfolio By 2020", VW Staff, 13 November 2015

Post Magazine: "Paris attacks to cost French economy up to $12 billion", 16 November 2015

BBC News: "Could hackers break my heart via my pacemaker?" Chris Vallance, 3 December 2015

Lloyd's Business Blackout Selected Media Coverage

Wall Street Journal: "Attack on U.S. Electrical Grid Could Cost $1 Trillion", 8 July 2015

Bloomberg: "Attack on U.S. Power Grid Could Cost $1 Trillion, Lloyd's Says", Sonali Basak, 8 July 2015

CNBC: "Cost of a Potential Blackout From Cybercrime: $1 Trillion", 8 July 2015

Reuters: "Cyber attack on U.S. power grid could cost economy $1 trillion: report", Carolyn Cohn, 8 July 2015

Post Magazine: "Lloyd's highlights data sharing as imperative to mitigating cyber risk", 8 July

Business Insurance: "Lloyd's cyber study reveals insurers' aggregation risks", Sarah Veysey, 8 July 2015

Forbes: "Report: The Trillion-Dollar Risk Of A Cyber Attack On U.S. Power Grid", Ucilia Wang, 8 July 2015

Association of Lloyd's Brokers: "Business Blackout - the insurance implications of a cyber attack on the US power grid"

Tripwire: "Cyber Attack on the U.S. Power Grid Could Cost Economy More Than $1 Trillion, Report Says", Maritza Santillan, 10 July 2015

Intelligent Insurer, "Who turned the lights out?", 14 September 2015

Lloyd's City Risk Selected Media Coverage

BBC Radio 4: "The 'Today' programme", 3 September 2015

BBC Business: "Insurers flag risks of cyber-attacks and markets", 3 September 2015

Sky News: "Intangible risks are big concern for insurers", 3 September 2015

CNBC: "The 18 biggest risks for global cities", 3 September 2015

The Washington Post: "Insurer says 'catastrophic threats' could cost D.C. region $26.6 billion", 3 September 2015

Bloomberg: "Lloyd's City Risk Index shows $4.6 trillion GDP is at risk across 301 cities", 3 September 2015

CISL Climate Change Report

BBC News: "Climate risk could undermine investments, report warns", Mark Kinver, 12 November 2015

Business Weekly: "Storm warning for climate change investors", Tony Quested, 12 November 2015

Pensions & Investments: "Climate change risk could erode nearly half of portfolio value, report warns", Sophie Baker, 13 November 2015

ValueWalk: "Investors Can't Entirely Hide From Climate Change, Says Study", Mark Melin, 21 November 2015

The Cambridge-McKinsey Risk Prize 2015

The Cambridge Centre for Risk Studies, in conjunction with McKinsey & Company, is pleased to award the "Cambridge - McKinsey Risk Prize". This award recognises the best submission on risk management by a current student at the University of Cambridge Judge Business School.

Judges include members of McKinsey's Global Risk Practice, the Editor-in-Chief of the McKinsey Working Papers, and members of the Cambridge Centre for Risk Studies at the Cambridge Judge Business School.

First Place Finalist

Siobhan C. Sweeney, Cambridge Judge Business School MBA Candidate

The Creation of the Contrarian Director and Their Role in Achieving Workable Board Independence & Better Risk Oversight

In the current economic climate marked by volatility and uncertainty, risk oversight by boards is increasingly important. The function of boards to ensure a healthy balance between risk-taking and risk avoidance is critical to the success of the company and the stability of the economy. This paper notes the significant failings of boards in this regard. The changes suggested by this paper go directly to improving this position.

The paper examines the economic, social and psychological forces propelling directors on boards towards collegial consensus and deterring real independence from each other. The paper offers a highly innovative yet simple solution. It develops the concept of a 'Contrarian Director', inspired by the Advocatus Diaboli ('Devil's Advocate') of 1587 but modeled more closely to the Advocate General of the European Court of Justice. The paper provides a structure and process to appoint and support this director. The result of these proposed changes would be a change to culture on boards and a radical improvement in the risk oversight function by boards.

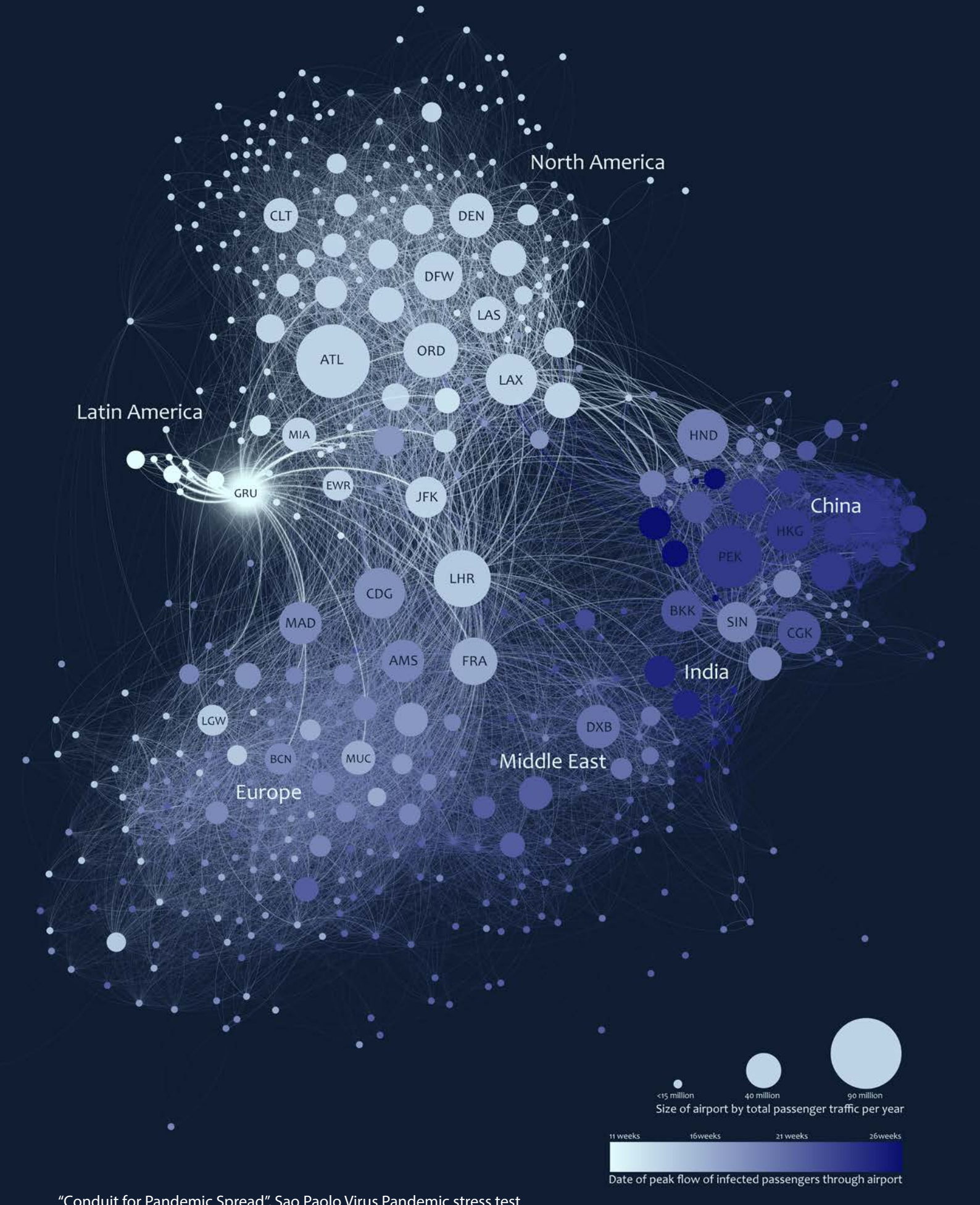
Selected Media Mentions

Financial Times: "Give the devil a voice in the boardroom", Stefan Stern, 8 July 2015

Business Review Europe: "Challenging concensus: a devil's advocate on your board", John O'Hanlon, 10 July 2015

Financial Director: "Corporate culture proves an abstract concept for FDs", Richard Crump, 14 August 2015

Financial Times: "Women in Business - Siobhan Sweeney", Charlotte Clarke, 28 August 2015



"Conduit for Pandemic Spread", Sao Paolo Virus Pandemic stress test spread through the global air traffic network; *created by Dr Andrew Skelton*

Current Team and Resources at the Centre for Risk Studies

Executive Team

Professor Daniel Ralph, Academic Director

Dr Michelle Tuveson, Executive Director

Dr Andrew Coburn, Director of Advisory Board

Simon Ruffle, Director of Technology Research and Innovation

Research Team

Dr Scott Kelly, Senior Risk Associate

Scott leads the macroeconomic modeling and catastronomics studies at the Centre, and oversees the financial catastrophe research. Scott also holds a research post in the Centre for Climate Change Mitigation Research (4CMR).

Dr Olaf Bochmann, Risk Associate

Olaf works on the financial catastrophe modelling research at the Centre, where he is responsible for the development of the model of the global financial system. Olaf has experience in agent-based modeling of contagion.

Dr Andrew Skelton, Risk Associate

Andrew is helping to develop a dataset of the world's largest enterprises that drive the global economy and their relationships with each other. He also holds a research post in the Centre for Climate Change Mitigation Research (4CMR).

Éireann Leverett, Senior Risk Researcher

Éireann is managing cyber risk research projects at the Centre. He conducts research that focuses upon technological disasters and the economic impacts of computer security failures or accidents.

Dr Edward Oughton, Senior Risk Researcher

Edward has expertise in modelling the economic effects associated with interdependent infrastructure networks and has completed a PhD at the University of Cambridge on developing long-term national infrastructure strategies for the UK.

Dr Louise Pryor, Senior Risk Researcher

Louise is Risk Researcher at the Centre for Risk Studies and also an independent consultant on risk and software development. Louise is researching financial and networking risk models at the Centre.

Grace Campbell, Risk Researcher

Grace provides assistance with geographic spatial modelling and data gathering and analyisis. She completed PhD studies on tectonics and paleoseismology in the Tien Shan region with the University of Cambridge Department of Earth Sciences.

Dr Andrew Chaplin, Risk Researcher

Andrew is a Risk Researcher at the Centre for Risk Studies. His research interests currently focus on central bank response to international crises.

Dr Jay Chan Do Jung, Risk Researcher

Jay is interested in examining various aspects of risk elements in the network of financial services institutions and developing tools that can monitor and analyse behaviour of financial networks.

Dr Duncan Needham, Risk Researcher

Duncan works on financial history for the Centre. Duncan is also Director of the Centre for Financial History at the University of Cambridge and a Research Fellow at Darwin College, Cambridge.

Dr Eugene Nedev, Research Affiliate

Eugene Neduv is an expert in quantitative methods in finance and a risk management professional. His interest include network analytics, volatility trading and portfolio optimisation.

Jennifer Copic, Research Assistant

Jennifer's research is on financial and organisational networks. She holds a BS in Chemical Engineering from the University of Louisville and a MS in Industrial and Operations Engineering from the University of Michigan.

Tamara Evan, Research Assistant and Editorial Associate

Tamara is the Editorial Associate for the Centre for Risk Studies and oversees the completion and final production of the Centre's research publications. She also assists in social sciences research, holding an MA from UCL in Historical Studies.

Viktorija Kesaite, Research Assistant

Viktorija works on modelling and macroeconomic analysis for the Centre, having recently completed an MSc in Economics from the University of Nottingham which was fully funded by the European Union.

Dr Ali Shaghaghi, Research Assistant

Ali focuses on analysing systemic risk and contagion in financial systems using computational network models. At the Centre, he is researching a model of contagion effects in the international banking network.

Jaclyn Zhiyi Yeo, Research Assistant

Jaclyn works on macroeconomic modelling and systemic shocks, and recently graduated with an MPhil from the University of Cambridge in Sustainable Development.

Advisors and Fellows

Lee Coppack, Senior Advisor, Insurance & Risk Media

Andrew Freeman, Risk Fellow

Ganchi Zhang, Research Affiliate

Administration

Crystal Mbanefo, Events & Operations Manager

Ruth Newman, Web Editor

Cambridge Judge Business School, Finance, Legal and Administration Offices

Alumni

Many members of our research team continue on to successful careers in academia and business.
Some of our recent alumni include:

- **Dr. Gary Bowman, CCRS Research Assistant 2010 – 2013**
  Now Assistant Professor of Global Strategy, Faculty of Business, Bond University; Australia
- **Dr. Roxane Foulser-Piggott, CCRS Research Assistant 2010 – 2013**
  Now Model Application Specialist, Suncorp Group; Brisbane, Australia
- **Dr Fabio Caccioli, CCRS Research Associate 2012-2014**
  Now Lecturer, Financial Computing and Analytics, Faculty of Engineering Science, University College London
- **Dr Scott Kelly, Senior Research Associate 2012-15**
  Now Head of Research with University of Technology Sydney
- **Ganchi Zhang, CCRS Risk Affiliate 2014-15**
  Now at Goldman Sachs
- **Benjamin Leslie, CCRS Risk Researcher 2014**
  Now R&D Engineer, Oxford Technical Solutions
- **Dr. Grace Campbell, CCRS Risk Researcher 2015**
  Now a Geologist at Arup Group.
- **George Cooper, CCRS Risk Researcher 2015**
  Now Risk Analyst, Model Development & Evaluation, SCOR Global P&C

Executive Committee of the Cambridge Centre for Risk Studies

Professor Danny Ralph

Academic Director, Cambridge Centre for Risk Studies

Professor Danny Ralph is a Founder and Director of the Centre for Risk Studies, Professor of Operations Research at Cambridge Judge Business School, and a Fellow of Churchill College.

Danny received his PhD in 1990 from the University of Wisconsin Madison. He was a faculty member of the Mathematics & Statistics Department at the University of Melbourne before coming to Cambridge University for a joint appointment in the Engineering Department and Cambridge Judge Business School.

Danny's research interests include: risk in business decision making; risk aversion in electricity markets; methods and models for optimisation problems and equilibrium systems. Specific projects undertaken in collaboration with the banking and insurance industry (Catlin, HSBC, ICBC, Lloyd's, Munich Re, Risk Management Solutions, Swiss Re) cover emerging risk scenarios, financial stress testing and a global ranking of cities by risk exposure. Engagements with other sectors include electricity consultancies (Artelys, LCP), oil and gas (Shell Exploration, Statoil) and retail (BT Retail, Gap) on decision making under high uncertainty. Public service contributions to the UK Cabinet Office, UK Industry and Parliamentary Trust, UK Office of the Government Chief Scientific Advisor, and United Nations World Humanitarian Summit.

Professor Ralph is a member of the Australian Mathematical Society, INFORMS, the Mathematical Optimization Society and SIAM. He was Editor-in-Chief of Mathematical Programming (Series B) from 2007-2013 and has served on the editorial boards of Mathematics of Operations Research and the SIAM Journal on Optimization, as well as the SIAM-MPS book series on optimisation.

Dr Michelle Tuveson

Executive Director, Cambridge Centre for Risk Studies

Dr Michelle Tuveson is a Founder and Executive Director at the Cambridge Centre for Risk Studies hosted at the University of Cambridge Judge Business School. Her responsibilities include the overall executive leadership at the Centre. This includes developing partnership relationships with corporations, governments, and other academic centres. Dr Tuveson leads the Cambridge CRO Council and she chairs the organising committee for the Cambridge Risk Centre's Annual Risk Summits. She is one of the lead organisers of the Aspen Crisis and Risk Forum. She is an advisor to the World Economic Forum's 2015 & 2016 Global Risk Report and a contributor to the Financial Times Special Report on Risk Management. She is also an advisor to a number of corporations and boards as well as a frequent conference speaker.

Dr Tuveson has worked in corporations within the technology sector with her most recent position in the Emerging Markets Group at Lockheed Martin. Prior to that, she held positions with management strategy firm Booz Allen & Hamilton, and U.S. R&D organisation MITRE Corporation. Dr Tuveson's academic research focusses on the application of simulation models to study risk governance structures associated with the role of the Chief Risk Officer. She was awarded by the Career Communications Group, Inc. as a Technology Star for Women in Science, Technology, Engineering and Maths (STEM). She earned her B.S. in Engineering from the Massachusetts Institute of Technology, M.S. in Applied Math from Johns Hopkins University, and PhD in Engineering from Christ College, University of Cambridge.

Executive Committee of the Cambridge Centre for Risk Studies

Dr Andrew Coburn

Director of the Advisory Board, Cambridge Centre for Risk Studies

Dr Andrew Coburn is the Director of the Advisory Board at the Cambridge Centre for Risk Studies. Andrew is Senior Vice President at Risk Management Solutions (RMS), the leading provider of catastrophe risk models to the insurance industry. Andrew is the principal coordinator of the research programme on the risk of catastrophic collapse of complex systems at the Centre and leads the financial catastrophe research.

Andrew is one of the leading contributors to the creation of the class of catastrophe models that over the past 20 years has come to be an accepted part both of business management in financial services and of public policy making for societal risk. He has extensive experience in developing risk models and using them for business decision support. Andrew has also provided research inputs into government policy, such as membership of the UK government Blackett Review Panel on strategic shock convened by Sir John Beddington, and U.S. House of Congress legislation on terrorism risk management policy. Andrew is an Editorial Board Member of *Journal of Network Theory in Finance* (publishers Risk.net). He is a Bye-Fellow at Christ's College, Cambridge.

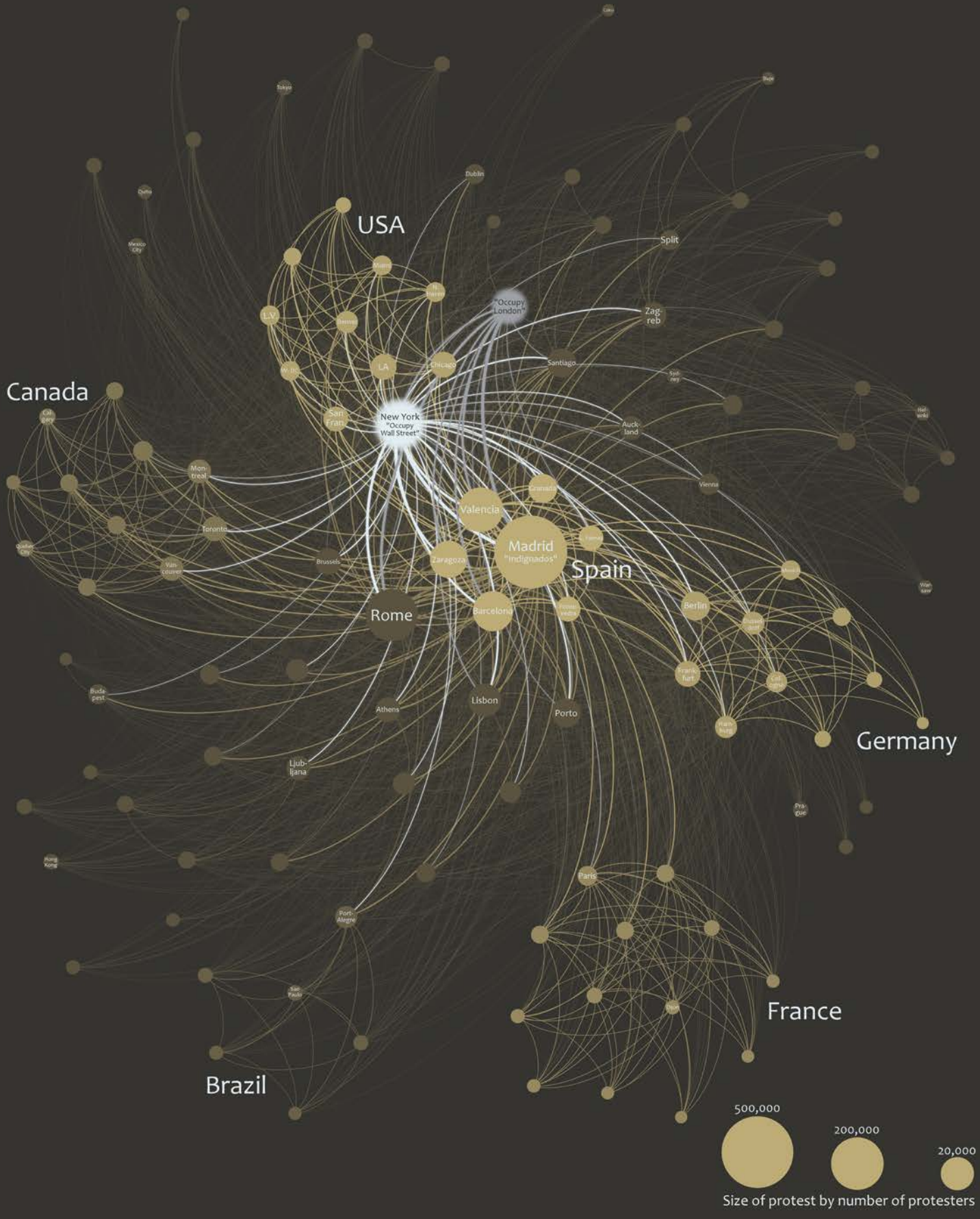
Simon Ruffle

Director of Research & Innovation, Cambridge Centre for Risk Studies

Simon Ruffle is researching a common framework for analysing complex global systemic risk. He coordinates research in the Centre though a unified modelling software platform, a common database architecture and information interchange standards. He is developing methods for storing and applying the Centre's Stress Test Scenarios and other Risk Assessment Tools to macro-economic analysis and investment portfolio impact. He is researching how network theory can be applied to understanding the impact of catastrophes in a globalized world, including supply chains, insurance and banking.

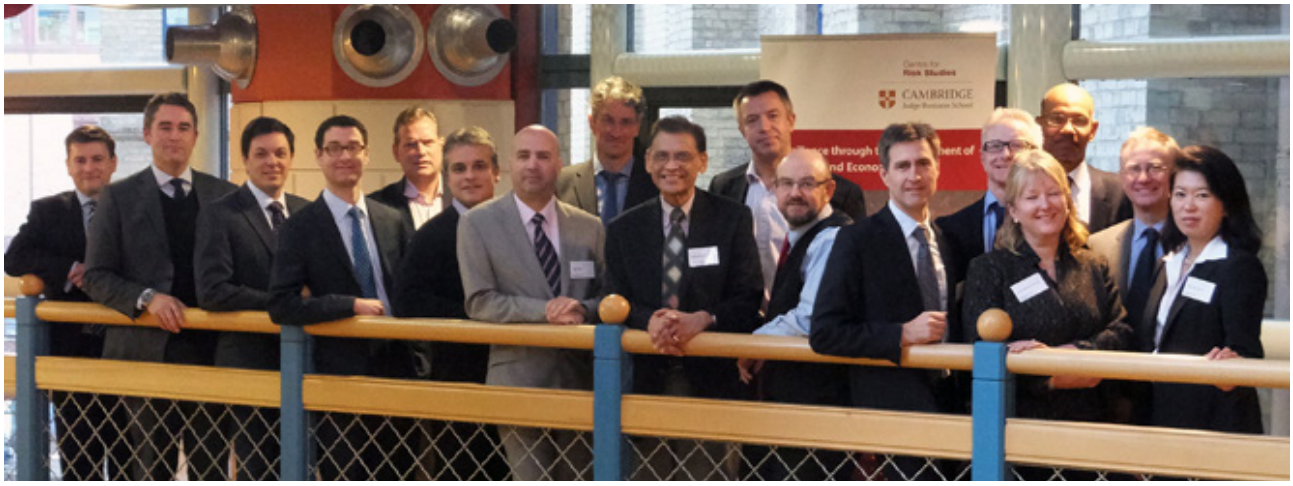
He is involved in specific threat topics, and currently is leading the Centre's cyber threat research track. He is a member of the Centre's Executive Team and manages several external sponsor relationships

Originally studying architecture at Cambridge, Simon has spent most of his career in industry, developing software for natural hazards risk. He has worked on risk pricing for primary insurers, catastrophe modelling for reinsurers, and has been involved in placing catastrophe bonds in the capital markets. He has many years of experience in software development, relational databases and geospatial analysis and has worked in a variety of organisations from start-ups to multinationals.



"Systemic Social Unrest", Geographical spread of the "Occupy" movement's hashtags between September-October 2011 coodinating simultaneous protests in 950 cities across the world; *created by Dr Andrew Skelton*

Centre for Risk Studies Advisory Board



The Cambridge Centre for Risk Studies at the University of Cambridge Judge Business School continues to be widely recognised as one of the UK's leading academic centres providing impactful research and thought leadership in risk management.

The Cambridge Centre for Risk Studies is very grateful to have the participation and support from the members of the Centre's Advisory Board. We view the Advisory Board as being critical to guiding the management strategy and research agenda objectives of the Centre. Advisors are invited from the Centre's partnership organisations, external academics, and subject matter specialists. The Centre's recent research and associated reports have gained visibility and positive media attention through the advocacy of our advisory board members and their respective organisations.

Cambridge Centre for Risk Studies Advisory Board Members

Russell Bean, Head of Financial Institutions Underwriting, Talbot Underwriting

Nick Beecroft, Head of Emerging Risks & Research, Lloyd's

Dr Siddhartha Dalal, Chief Data Scientist and Sr. VP of Advanced Research and Technology, Science, AIG

Matthew Grant, General Manager, RMS Model & Data

Anna-Marie Greenaway, Director of University Relations, BP

Dr Sven Heiligtag, Principal, McKinsey & Company

Professor Frank Kelly, Professor of the Mathematics of Systems, Statistical Laboratory, University of Cambridge, and Master of Christ's College, Cambridge

Dr Mike Maran, Chief Science Officer, XL Catlin

Professor John Rees, Risk Research Coordinator, UK Research Councils (RCUK)

Dr Rainer Sachs, Head of Group Accumulation and Emerging Risks, Munich Re

Professor David Spiegelhalter, Winton Professor for the Public Understanding of Risk, University of Cambridge

Alan Smith, Global Head of Risk Strategy and Chief of Staff, HSBC Holdings PLC

Matthew Swibel, Director, Corporate Sustainability, Lockheed Martin

Executive Team at the Centre for Risk Studies

Professor Danny Ralph, Academic Director

Dr Michelle Tuveson, Executive Director

Dr Andrew Coburn, Director of the Advisory Board

Simon Ruffle, Director of Technology Research & Innovation

Advisory Board Member Biographies

Russell Bean

Head of Financial Institutions Underwriting, Talbot Underwriting

Russell started his career at the Sun Alliance and between 1994 and 2002 he underwrote Professional and Financial Lines before becoming the worldwide FI product leader. He is currently the Head of Financial Institutions at the Talbot Syndicate where he oversees all aspects of the division. He is ACII qualified and sits on a number of market committees, including chairing the LMA FI panel.

Nick Beecroft

Head of Emerging Risks & Research, Lloyd's

Nick Beecroft is Manager, Emerging Risks and Research at Lloyd's. His team is responsible for providing foresight and actionable analysis on emerging risks, working with partners in the research community to provide forward-looking insight and to reduce uncertainty concerning new and rapidly changing risks. Key outputs are thought leadership reports, scenarios for stress-testing and insight to inform innovation strategy. Before joining Lloyd's, Nick spent the majority of his career as an Intelligence Officer in the Royal Air Force. Appointments included attachments to central government in a counter-terrorism role and to the British Army, where he was responsible for operational planning and mentoring of local forces on deployed operations.

Dr Siddhartha Dalal

Chief Data Scientist and Sr. VP of Advanced Research and Technology, Science, AIG Property Casual

Sid Dalal joined the Science Team in September of 2013. He comes to AIG from RAND Corporation where he served as CTO, and where he pioneered several new systems for conducting research. Sid also served as VP of Research at Xerox overseeing their worldwide imaging and software services research, and Bell Laboratories and Bellcore/SAIC/Telcordia Technologies, where he served as Chief Scientist and Executive Director. Sid received an MBA and a Ph.D. from the University of Rochester and has published more than 100 peer reviewed publications, patents and monographs covering the areas of risk analysis, medical informatics Bayesian statistics and economics, image processing and sensor networks. He was also responsible for the creation of technology and spinning off of Praedicat, Inc., an insurance analytics company in casualty space, from RAND Corporation. Sid is also a member of US Army Science Board, an advisory board of 20 scientists appointed by Secretary of Defense to advise US Army on technology. Sid has received several awards including from IEEE, ASA and ASQ.

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Advisory Board Member Biographies

Brad Fischtrom

Managing Director, Head of Scenario Development and Stress Testing, AIG Property Casualty

Brad Fischtrom is Managing Director, Head of Scenario Development and Stress Testing for AIG Property Casualty. He is accountable for designing, quantifying and reporting realistic disaster scenarios and regulatory-driven stress tests as part of AIG's Enterprise Risk Management (ERM) framework. Brad's team is also responsible for innovation in the areas of emerging risk management and development of data and risk measurement tools for insurance risk aggregation. Prior to joining AIG in 2010, he has held positions at Towers Watson and Aon Risk Services.

Brad holds a Bachelor of Science Degree in Finance from the University of Richmond Robins School of Business, and he is an Associate in Risk Management (ARM) and Chartered Property Casualty Underwriter (CPCU).

Matthew Grant

General Manager, RMS Model & Data

Matthew is today responsible for all of RMS' Model & Data business. RMS is the largest provider to the global insurance industry of pricing and portfolio management tools for natural and man-made catastrophes.

Having successfully introduced catastrophe modelling into the London market in 1992, Matthew founded the RMS European office in 1996, with a team of four people all of whom remain at RMS today.

In recent years, Matthew's responsibilities have included leading the sales, marketing, service and the RMS capital markets teams. In Matthew's time at RMS, revenue has grown from $24m to close to $300m.

Anna-Marie Greenaway

Director of University Relations, BP

Anna-Marie Greenaway was appointed BP Director of University Relationships in 2015, which is a global role encompassing technical and policy research to support BP's strategic objectives, recruitment, executive education and international research partnerships. Prior to this she was BP's VP Science and Technology at the University of Cambridge and still retains accountability for this strategic partnership. She is a member of the Board of the BP Institute and sits on the Advisory Board of the Scott Polar Institute and the Clean Energy Centre at Tsinghua University, Beijing. Previously, Anna-Marie spent four years in BP's Group Strategy team where she led the 2030 Energy Pathways research programme covering the US, EU, China, India and Brazil. This involved bringing together local, international and multi-disciplinary teams from across BP and incorporating external perspectives from wider industry sectors, government bodies and leading academics.

Earlier roles at BP have spanned special assignments to support Group Technology and Safety & Operations, Head of Downstream Change Leadership Capability and leading the Technical & Commercial Partnership between BMW & Castrol across Western Europe. Prior to BP, Anna-Marie spent 10 years in retail operations, advertising and corporate communications with Exxon after joining their graduate programme in 1989 as a capital investment analyst. She holds a BRc from the Dept of Earth Science RHBNC University of London and a Masters degree in Sustainability Leadership from the Department of Engineering, University of Cambridge.

Advisory Board Member Biographies

Dr Sven Heiligtag

Principal, McKinsey & Company

Sven is a Partner in McKinsey & Company´s Hamburg office. Sven is a leader in McKinsey´s Risk Management Practice as well as in the Electric Power & Natural Gas Practice. He is responsible for all Corporate Risk topics and is leading our energy trading and risk management survey in Europe.

He has deep experience in advising clients in the energy and natural resources industries on challenges in risk management, corporate finance, strategy and organization.

Sven has a master's degree and a PhD in Chemistry from the University of Hamburg.

Matthias Heuser

Expert Principal, McKinsey & Company

Since 1999, Matthias Heuser has been working with McKinsey & Co., Inc. in Hamburg, Germany.

He is a Principal focusing on Risk Management and Wholesale Banking. He has consulted Financial Institutions on Management of Credit and Market risk, implementation of Treasury/ALM Tools, and business strategy.

Matthias Heuser studied in the USA and in Germany business administration with a focus on finance and accounting. He holds graduate degrees from University of Frankfurt (Diplomkaufmann) and University of Iowa (MBA). In addition he has received the Master of Financial Engineering (MFE) from the University of California, Berkeley (USA).

Professor Frank Kelly

Professor of the Mathematics of Systems, Statistical Laboratory, University of Cambridge, and Master of Christ's College, University of Cambridge

Professor Frank Kelly is Master of Christ's College and Professor of the Mathematics of Systems in the University of Cambridge. His main research interests are in random processes, networks and optimisation. He is especially interested in applications to the design and control of networks and to the understanding of self-regulation in large-scale systems. From 2003 to 2006 he served as Chief Scientific Adviser to the United Kingdom's Department for Transport. He was chair of the Council for the Mathematical Sciences from 2010 to 2013, and a member of the RAND Europe Council of Advisors from 2008 to 2015. He is a Fellow of the Royal Society and a Member of the National Academy of Engineering.

(continued on following page)

Advisory Board Member Biographies

Dr Mike Maran

Chief Science Officer, XL Catlin

Michael Maran graduated from St. Catharine's College, Cambridge in 1983 with a bachelor's degree in Natural Sciences (having studied the biological and geological sciences) and subsequently a master's degree and PhD in Astrophysics from Queen Mary College, University of London. He is an ACII qualified Chartered Insurer with over 30 years of experience in the insurance industry, and a Fellow of the Royal Astronomical Society.

Mike joined the Catlin Group in 2002 and spent 10 years as Underwriter for the Space account. In 2012, he was appointed as the Catlin Group's Chief Science Officer, a position which he now holds in the newly formed XL Catlin Insurance.

Formerly the chairman of the Catlin's Emerging Risks Committee, Mike is now an active member of the XL Catlin Emerging Risks Task Force.

As Chief Science Officer, Mike works with XL Catlin underwriters, risk modellers, actuaries and other employees to improve risk assessment capabilities by reviewing the scientific aspects of risks. He also helps to identify new underwriting opportunities for XL Catlin created by scientific progress, and serves as an advisor for various XL Catlin activities that are related to science, such as the current XL Catlin Seaview Survey.

Professor John Rees

Risk Research Coordinator, UK Research Councils (RCUK)

Professor John Rees is the UK Research Councils (RCUK) Risk Research Coordinator and leads the RCUK Risk Research Network. He is the current chair of the UK Collaborative for Development Sciences Disaster Research Group, and is a visiting Professor of Petrophysics at Leicester University. Previously he was the Natural Environment Research Council (NERC) Natural Hazard Theme leader, and Head of Corporate Policy and Science Coordination at the British Geological Survey (BGS), where he has been based for most of his career. He has worked extensively on coastal and marine hazards, urban risks - largely in Africa, Latin America and Asia, and bridging the science-policy gap. He has authored over 100 papers, books and major reports and was one of the co-recipients of the 2012 Lloyds Science of Risk prize. He has been called-upon to provide advice or evidence to many UK and international scientific panels, Government Policy Reviews and Select Committees. Prior to joining BGS he was educated in Sussex, at Sheffield University and at Trinity College Dublin before working for a period in industry

Dr Rainer Sachs

Head of Group Accumulation and Emerging Risks, Munich Re

Professor Frank Kelly is Master of Christ's College and Professor of the Mathematics of Systems in the University of Cambridge. His main research interests are in random processes, networks and optimisation. He is especially interested in applications to the design and control of networks and to the understanding of self-regulation in large-scale systems. From 2003 to 2006 he served as Chief Scientific Adviser to the United Kingdom's Department for Transport. He was chair of the Council for the Mathematical Sciences from 2010 to 2013, and a member of the RAND Europe Council of Advisors from 2008 to 2015. He is a Fellow of the Royal Society and a Member of the National Academy of Engineering.

Advisory Board Member Biographies

Professor David Spiegelhalter

Winton Professor for the Public Understanding of Risk, University of Cambridge

David Spiegelhalter is Winton Professor for the Public Understanding of Risk, and Professor of Biostatistics, at the University of Cambridge. His background is in medical statistics, particularly the use of Bayesian methods in clinical trials, health technology assessment and drug safety.

In his post he leads a small team (UnderstandingUncertainty.org) that attempts to improve the way in which the quantitative aspects of risk and uncertainty are discussed in society. He works closely with the Millennium Mathematics Project in Cambridge in trying to develop an exciting treatment of probability and risk for mathematics education. He gives many presentations to schools and others, advises organisations and government agencies on risk communication, and is a regular commentator on current risk issues. He presented "Tails you Win: the Science of Chance" and co-presented "Climate Change by Numbers", both BBC4 documentaries, and in 2011 came 7th in an episode of Winter Wipeout on BBC1.

He has over 190 refereed publications and is co-author of six textbooks, as well as The Norm Chronicles (with Michael Blastland). He is a Fellow of Churchill College Cambridge, an Honorary Fellow of the Institute for Risk Management, an Honorary Fellow of the Royal College of Physicians, and was elected Fellow of the Royal Society in 2005. He was awarded an OBE in 2006 and knighted in 2014, both for services to medical statistics.

Alan Smith

Global Head of Risk Strategy and Chief of Staff, HSBC Holdings PLC

Alan Smith is Global Head of Risk Strategy and Senior Executive Officer of Group Risk within the Global Risk function of HSBC Holdings, one of the world's largest financial services organisations. He is a member of HSBC's Global Risk Management Board, which oversees the 25,000 member Global Risk Function and of the Group Asset and Liability Management Committee. He co-chairs its Stress Testing, Model Risk and Pensions Risk Oversight Committees.

Alan has worked with HSBC for 21 years in a variety of senior finance, risk and capital management roles in the Group Head Office, in its Global Banking and Markets Business, in London and in Saudi Arabia. Prior to HSBC, Alan worked with KPMG London from 1987 to 1994. Alan is a Fellow of the Institute of Chartered Accountants of England and Wales and has an MBA in Finance from Cass Business School, City University in London which he attended as a UK Commonwealth Scholarship winner after completing his undergraduate degree at the University of the West Indies in Jamaica.

Outside of work, Alan has a keen interest in cricket, theatre and travel, amongst others. He sits on the Audit Committee of the Commonwealth Secretariat, on the Finance Committee of an international faith based organisation working with university students, and on the Advisory Board of the Centre for Risk Studies at Cambridge University's Judge Business School. He is a Fellow of the Royal Society of Arts, Manufactures and Commerce.

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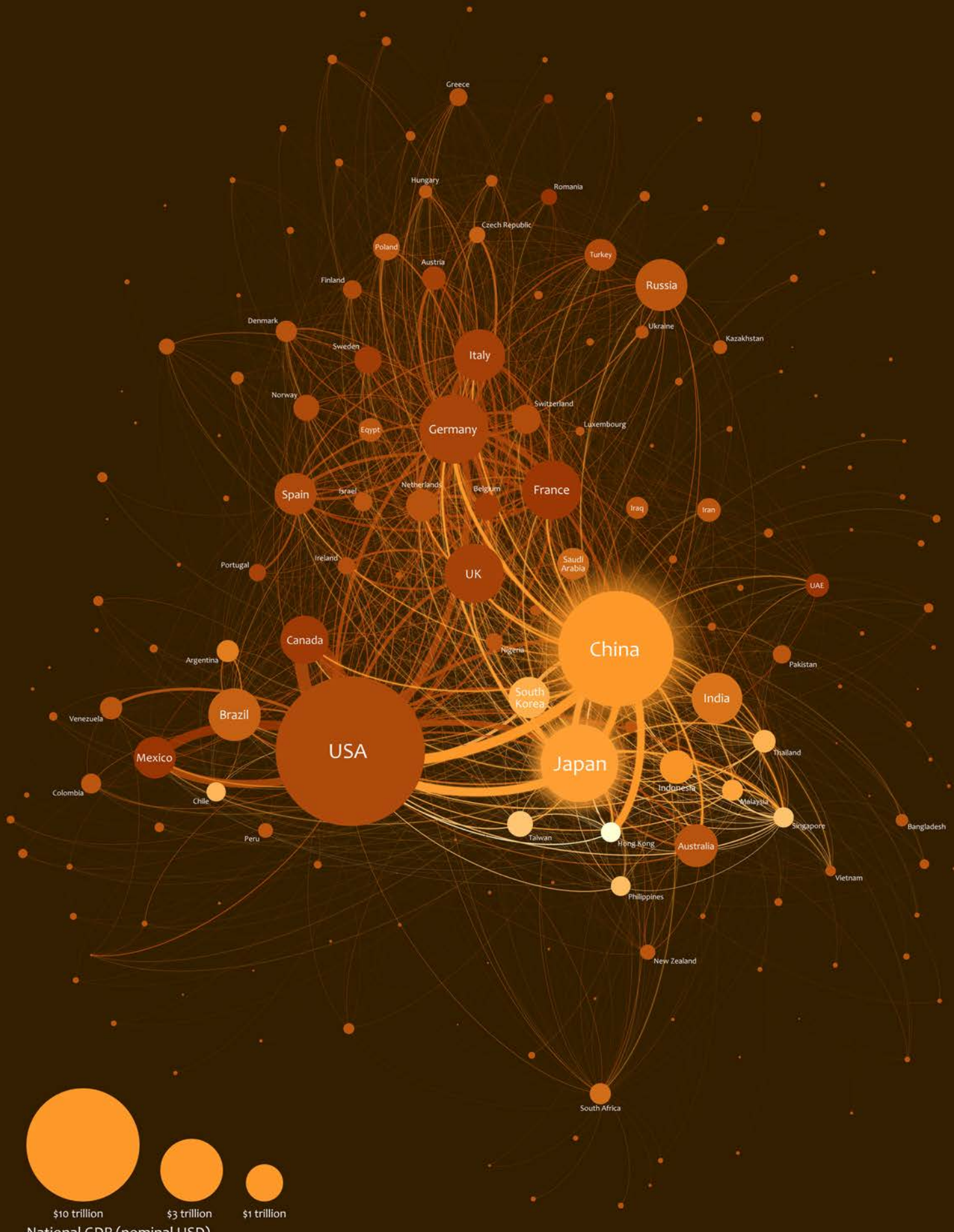
Advisory Board Member Biographies

Matthew Swibel

Director, Corporate Sustainability, Lockheed Martin

Matt directs sustainability strategy, reporting and stakeholder engagement at Lockheed Martin Corporation, which under his tenure was added to the Dow Jones Sustainability Index and became the top-ranked Aerospace & Defense prime contractor named to CR Magazine's 100 Best Corporate Citizens list. He led Lockheed Martin's inaugural report in 2012, and its first core issues assessment, formal stakeholder summits and GRI-based report in 2013. He reports to the corporate vice president - Ethics & Sustainability, and sits on the Corporate Sustainability Council, which oversees ethics & business conduct, diversity & inclusion, and sustainability policy & performance.

From 2008 to 2012, Matt was Director of Enterprise Communications, where he led a team supporting the CFO, Executive Office of the Chairman and other corporate officers. In this role, he developed and planned multiple aspects of integrated communications including employee and supplier engagement, advertising and outreach to investors and financial/environmental media. Matt spent almost a decade as a journalist, most recently as Associate Editor of Forbes, where he co-edited the World Billionaires issue and was recognised by the Overseas Press Club for his business reporting from abroad. Prior to Forbes, he was a staff reporter at Washington Business Journal, where his coverage of marketing and web-based political fundraising each earned Maryland-DC-Delaware and Virginia Press Association awards. He taught as an adjunct professional lecturer at American University's School of Communication from 2005 to 2008. Matt graduated cum laude from American University (DC) with degrees in Communications and Sociology and earned an MBA from the University of Maryland. He is an independent director of Cornerstone Capital.



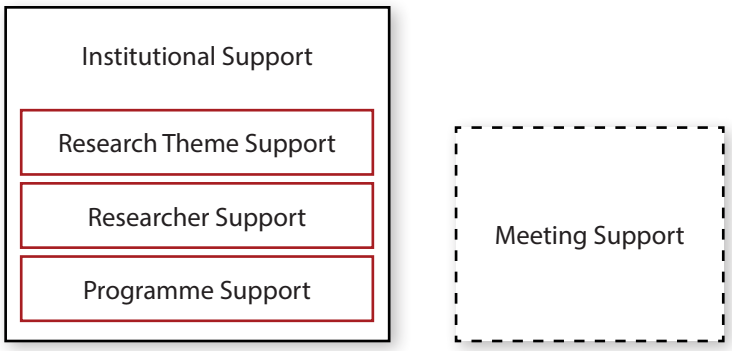
"Systematic Impact of War"; impact of Sino-Japanese War stress test on global imports and exports networks; *created by Dr Andrew Skelton*

Funding Opportunities and Support Contribution Structure

Confidential

The Cambridge Centre for Risk Studies is grateful for the financial support from its contributing funders as well as the University of Cambridge Judge Business School. The Centre is privileged to be part of the Cambridge Judge Business School infrastructure. The Centre is also grateful to the many individuals and institutions who provide in-kind support.

The Centre for Risk Studies works with external supporters of our research through funding donations that guide components of an overall programme of work towards understanding the risks faced by international businesses. External supporters can participate at different levels according to their interests and degree of involvement they are willing to engage in, and level of support that they are willing to provide. This document is an indicative guide



Institutional Support

The Centre is actively seeking institutional funding – a single company or individual interested in having a named centre or professorial chair and prepared to make an endowment to support the longer term sustainability of the research work at the Centre for Risk Studies. We would welcome the opportunity to discuss this if this might be of interest.

Research Theme Support

Within the overall research directions of the Centre for Risk Studies, there are several themes of focus, Research themes involve a multi-member research team exploring an issue within the Cambridge Risk Framework. Where a funder has interest in driving a particular research agenda or exploring a specific theme within our risk framework, the Centre for Risk Studies can accommodate this by dedicating a research team to that topic. A research team typically consists of a Project Investigator (a tenured academic project lead) supported by a Senior Research Associate, a Research Associate, and others where appropriate. Other senior academics are likely to participate on a part time basis in contributing subject matter expertise. The Centre for Risk Studies can facilitate and coordinate research themes involving a range of University departments, such as the Faculty of Economics, Centre of Applied Mathematics, Computer Laboratory, etc. If appropriate, the research theme can be based in a specific department, and managed by CRS.

As a Research Theme Supporter:

- Funder is invited to nominate two members of the Centre for Risk Studies Advisory Board
- Funder oversees progress review meetings specifically held for that research theme, and guide the prioritization of the current and future research agenda.
- Funder is invited to participate in the progress review meetings of the overall research activities of the Centre, and to assist with the prioritization of the current and future research agenda of the Centre for Risk Studies.
- Funder benefits from having the research team participate with company staff, disseminate current research understanding, and involve the broader company membership in emerging risk issues.

- The Project Investigator and the research team discuss the Funder's priorities with the funder's senior managers and ensure that these objectives are fully reflected in the research.

Researcher Support

Our typical level of engagement from supporting companies on our advisory board is a donation to fund an individual researcher who is added to the research team in order to progress the overall objectives of the System Shock, and who focuses on the areas of most benefit for that funder. Our ability to attract good post-doctoral research associate candidates is greatly increased by being able to offer three year contracts, so our strong preference is to secure multi-year commitments by funders where possible.

- Funder is invited to nominate a member of the Centre for Risk Studies Advisory Board, to attend the progress review meetings and to assist with the prioritization of the current and future research agenda.
- Funder benefits from having the researcher visit the company, disseminate current research understanding, and involve the broader company membership in risk issues.
- The researcher will discuss the Funder's priorities with the funder's senior managers and ensure that this is reflected in the research activities of the researcher and the broader team.

Programme support

Our ongoing research programme entails maintaining a team of technical specialists, editorial contributors and subject matter experts, and administrative support staff. Programme support provides resources for core research projects.

As a Programme Supporter:

- Funder is invited to nominate a member of the Centre for Risk Studies Advisory Board, to attend the progress review meetings and to assist with the prioritization of the current and future research agenda.
- Funder has access to the various subject matter specialists involved in the system shock project and access to information on technologies deployed, such as RSS data feeds and specifications that might be of interest.

Meeting support

The Centre for Risk Studies seeks supporters for its annual Risk Summit conference. We attract over 200 attendees from corporate risk management professionals, academia, and government policy-makers. We offer packages of support including Meeting Partner status, Principle Knowledge Partner or Sustaining Meeting Partner status.

As a Meeting Supporter:

- Funder is recognized as a corporate sponsor, with co-branding on the annual conference collateral with other meeting supporters
- Funder will be part of the organizing committee of the annual conference, and asked to propose speakers and content.
- We can offer space for display materials and incorporation of corporate materials in the attendee handout packs
- Other meetings can also be arranged with co-branding, for a private seminar on a relevant theme for funder and its guest invitees, on terms to be arranged.

Contact information for all support enquiries

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Join our LinkedIn group at Cambridge Centre for Risk Studies

Follow us @Risk_Cambridge