Improving Impact

Building better links between insurance and academia

Collaborating for success - a summary of key research themes and challenges for the European re/insurance sector for 2020
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Improving Impact
Building better links between insurance and academia - 2020 vision

Often dubbed the ‘DNA of capitalism’, insurance is the business of understanding and mitigating the changing risks that face societies and economies, and helping build resilience in the face of misfortune.

A vital backstop providing financial compensation when the worst happens, the insurance sector must tackle the ever-evolving challenge of how to accurately assess and model for the risks that are underwritten, and develop the most appropriate insurance products in response.

“This report is intended to provide the research community with a gateway to collaborate with the insurance sector by highlighting current key research priorities.”

This report was compiled just before the COVID-19 pandemic crisis that has presented unprecedented global humanitarian and economic challenges, and as I write, the insurance industry is grappling to navigate the most appropriate responses. Doubtless, this crisis will impact our industry and many others in the months and years to come, and improving links with academia / insurance could help us all learn lessons and build resilience after the dust has settled.

The Coronavirus pandemic brings into sharp focus the constant need for the insurance industry to continuously develop and refine its understanding of risk and the drivers behind decision making and insurability. And the protection gap - the portion of economic losses not covered by the private sector or government-sponsored insurance programmes - is, in part, a consequence of these challenges.

But the challenges are broader and relevant to established activities as well. Insurance can and must increase its global impact and relevance and help build resilience and mitigate the impacts that risks such as natural disasters, systemic economic crashes, and emerging technology present to economies and societies.

How can we deliver products to people who do not buy insurance? How can we better communicate the value of insurance and is the perception of the value of insurance changing? At the same time, how can we make research more relevant to ultimate decision makers?
New conversations are required to handle the growing need for risk mitigation and resilience measures, and an honest assessment is required to validate how research can ultimately influence business, society and economies. Building better links with academia is central to this mission of improving the impact and benefit of insurance.

Enhancing knowledge transfer into business from academic experts is at the forefront of risk-related research and this report is intended to provide the research community with a gateway to collaborate with the insurance sector by highlighting current key research priorities.

As well as collating information from current reports across different potential research fields, this summary report also involved interviewing insurance experts in their respective fields to get to the heart of what they feel the next key research focuses should be.

It is by no means an exhaustive list of priorities and should be recognised as a first iteration which will be developed, edited and expanded over time.

In addition, this report does not consider life insurance priorities, and instead focuses on highlighting a snapshot of the current major challenges for the non-life property and casualty insurance sectors, ranging from climate change to cyber risk and managing global uncertainty - some of the biggest issues that global re/insurers are grappling with today and will continue to shape the face of the market in 2020 and beyond.

We have limited each section to a summary of key questions for researchers to consider. Certainly, there are many more but at its heart this report is intended to deliver a précis to facilitate and stimulate further discussion on crucial research areas. It also promotes innovation that could ultimately help the insurance industry, societies and economies become more resilient to extreme events.

I would like to thank those industry experts who contributed to this report either through the papers summarised and cited, or through directly supplying the key research questions for inclusion here. I hope this report results in better opportunities for researchers and academics to interact with the insurance industry, and vice versa.

Dickie Whitaker

Lighthill Risk Network Chief Executive
The Lighthill Risk Network

In today’s world where risk is everywhere – hurricanes, earthquakes, emerging diseases, terrorism, financial meltdown – new solutions must be found, and quickly. The Lighthill Risk Network performs a unique and dynamic role, tapping into a global network of people who are at the forefront of risk.

The Lighthill Risk Network is an all encompassing and inclusive organisation, aiming to facilitate and enhance knowledge transfer into the business from academic, government and commercial experts at the forefront of risk-related research.

A not-for-profit organisation funded by the industry and managed by a core team of professionals from the insurance market, the Lighthill Risk Network utilises expertise from each sector and is in a unique position of being able to link its extensive academic knowledge to the research needs of the industry.

The Lighthill Risk Network members include senior representatives from Guy Carpenter, Liberty Mutual, Aon, Hiscox, Lloyd’s, and MS Amlin.

By promoting personal contacts, this network provides the business community with a gateway into the latest knowledge and understanding of risk while also presenting the scientific community with opportunities to interact with industry. Targeting the latest developments in key areas of risk and promoting the translation of knowledge between stakeholder communities, the Lighthill Risk Network exists to focus and facilitate business’ response to risk management.

The Lighthill Risk Network allows academics to gain access to the insurance industry and delivers a forum for them to approach policymakers, regulators, professional bodies and scientific institutions. Benefits include:

- Access to a global bank of expertise in risk and risk management
- Networking opportunities within the entire Financial Services Sector
- Access to government agencies and data of interest and value
- Exchange ideas with other experts in own field and beyond
- Collaborate to publicise emerging themes, events and initiatives
- Apply own research to help answer real-time problems and identify opportunities to work with industry

https://lighthillrisknetwork.org
Research theme 1
Hydrological and Atmospheric Risk

EUR 453 billion
Economic cost of floods, droughts, heatwaves and other climate-related extremes in Europe between 1980 and 2017 ¹

2.4 million
Properties in England alone currently at risk of river or coastal flooding ²

EUR 798 million
Insurance industry loss estimate for European 2019 windstorms Dragi and Eberhard ³
Hydrological, Flood and Atmospheric Risk - Europe
The challenges for insurers


In the 1980s and 1990s Europe experienced a number of large damaging windstorms, including 87I (EUR 15 bn in economic losses), Daria (EUR 16 bn), and Lothar (EUR 18 bn), normalised to 2018 Euros and exposure. In addition, the 2003 European drought and heatwave remains the costliest in the world to date with normalised economic losses of EUR 18 bn. Floods have also had a notable contribution, including 2002 (EUR 24 bn) and 1997 (EUR 18 bn).

“Losses are rising, and the risks are evolving thanks to trends such as urbanisation, more buildings in exposed areas, failed land-use practices, and climate change.”

In the case of flood risk, socio-economic trends such as urbanisation are resulting in more buildings in exposed areas and land-use practices are increasing insurers’ potential exposure.

In the UK, for instance, the Environment Agency has estimated that 2.4 million properties in England alone are currently at risk of river or coastal flooding, and there are an additional three million properties at risk of surface water flooding; 600,000 of these are at risk of both.

Compounding the issue, on current trends up to 20,000 houses are likely to be built this year in flood risk areas, according to the British Insurance Brokers Association (BIBA).

Meanwhile, storms – or extratropical cyclones – result in some of the largest natural hazard impacts in Europe, both in terms of societal disruption and economic impacts 5. Eleanor and Friederike, two January 2018 windstorms, caused nearly USD 3.0 bn losses for European insures 6 alone.

But while losses from storms in the 1980s and 1990s were large, a recent Lighthill Risk Network report on European windstorms notes that some models include a “short-term” view of risk to reflect the fact that peak gusts over Europe have decreased in the past 20-25 years.
This raises the question as to whether recent changes in European storminess are due to natural variability, climate change, or some other process – which is an area of ongoing research and debate in both the academic and insurance sectors.

Other weather-related events present similar questions about wider trends and correlations. Across Europe, for instance, heatwaves and droughts have led to widespread disruption, with large parts of Europe are predicted to face an increasing risk going forwards.

The insurance industry requires a better understanding of the drivers behind the variability in the frequency and/or severity of Europe's droughts and other major weather events, how they are potentially interlinked, and the resulting insurance claims.

All of the above hydrological and atmospheric risks are particularly challenging for insurers to model - losses are rising, and the risks are evolving thanks to trends such as urbanisation, more buildings in exposed areas, failed land-use practices, and climate change.

To tackle this, the insurance industry must work more closely together with the academic sector to improve physical process understanding and risk modelling.

How can researchers help?

Researchers can continue to support the insurance sector by further developing current flood, hydrological and atmospheric model methodologies, supporting end-user validation of models, and improving the accuracy of results through better input data.

The insurance industry also requires a clearer, consolidated understanding of the scientific processes, such as clustering and correlations, that drive extreme weather events. For instance, there is currently very little understanding (or indeed implementation in catastrophe models) of the correlation between wind and flood in Europe.

There is also an opportunity for insurers to partner with academics to analyse claims data and validate the vulnerability functions used in catastrophe models. Globally, the field of ‘attribution science’ has made significant progress in recent years in assessing whether climate change has affected the odds of a specific observed extreme weather event.

A recent review of reports in this field demonstrated that the large majority of the analysed heat waves, and a majority of droughts and heavy rain and flooding events were found to have become more likely and/or severe as a result of global climate change.

As such, there is also a pressing need to embed the impact of climate change within flood risk modelling (see Research theme 2, Climate Change).
Key Research Questions

- Can we improve local forecasting for floods, storms, droughts, and heatwaves?
- One of the main determinants of flood risk, and a key source of uncertainty in risk modelling, is the location of flood defences, their standard of protection, and their quality/tolerance. Can we improve this data set?
- Are tail event footprints (i.e. 1-in-200 year) realistic in terms of their spatial extent and severity/flood depths?
- Can we develop a better understanding of the natural variability mechanisms and their relation to European windstorms?
- Can we develop a better understanding of the correlation between windstorm and flood losses, both on an occurrence and aggregate basis, and for different return periods?
- Does the suggested future atmospheric/oceanic warming extend the crossover region between hurricanes and re-intensify systems further NE into the Atlantic?
- Can we develop windstorm hazard maps at different return periods to assist in the validation of catastrophe models?
- What datasets or models are available to assist (re)insurers in validating vulnerability functions used in catastrophe models?
- Can we better understand non-modelled factors that inflate losses such as loss adjustment expenses and underinsurance?

Case study  Flood Re

Flood Re is a joint government and insurance initiative. Its purpose is to promote the availability and affordability of flood insurance for eligible homes, while minimising the costs of doing so and managing the transition to risk reflective pricing for household flood insurance.

In a recent report developed in partnership with the Lighthill Risk Network, Flood Re establishes a prioritised list of challenges and questions that the insurance industry has on flood risk modelling to feed into academic priorities and upcoming funding calls.

The highest-ranked research priority is vulnerability curves - insurers and re-insurers feel current damage ratios oversimplify the reality of damage distributions. This is followed by the correlation of rainfall/flood and windstorm hazards - the industry would like to assess the contribution of flood losses to wind events and vice versa.

Further research into appropriate methods for assessing flood risk would clearly be beneficial before implementing the results into commercial catastrophe models.

Case Study  Weather and Climate Hazards Lab

Developed as a partnership between the UK National Centre for Atmospheric Science (NCAS), the Institute for Environmental Analytics (IEA) and the Lighthill Risk Network, the Weather and Climate Hazards Lab is a demonstration web application that presents data on tropical cyclones for the benefit of users in the insurance industry.

The Lab allows the user to interactively visualise tropical cyclones from a number of data sources and generate summary statistics to give indications of the risks posed by these cyclones to populations and assets.
USD 344 billion in global economic loss in 2017, making it the costliest year on record for natural catastrophe events, 97% of which were weather-related.¹²

USD 140 billion insured loss estimate from 2017 natural catastrophes.¹³

USD 200 billion of investment each year for the next 20 years will be needed globally to combat losses from climate impacts.¹⁴

Source: Aon “Weather, Climate & Catastrophe Insight – 2018 Insight Report.”
Climate Change
The challenge for insurers

The effects of climate change can now be observed across all continents and oceans, with scientific consensus that the phenomenon is changing the risk of extreme events including flooding, storms and heat waves across Europe, and indeed globally.

When it comes to insurance, the increasing frequency and severity of major weather events means a higher number of more costly claims and losses. Insurers have a unique role in the global effort to mitigate and adapt to climate change as a loss event, as both providers of risk protection and as a major group of investors managing around USD 30 trillion of assets.  

“Much of current insurance risk modelling is based on the assumption of a stable climate, using historical parameters that are increasingly outdated.”

Insurers can help maintain insurability and sustain the real global economy by planning ahead and insurance affordability are likely to become an increasing concern as the impacts of climate change increase.

At the same time, emanating from their own investment portfolios, insurers could provide long-term climate-related investment, including existing efforts to support greener technologies and transition activities. But how could they manage such a transition sustainably and profitably? (See figure 2.2.)

Modelling for climate change

Extreme weather events have of course been on the insurance agenda for some time; for the last 30 or so years the industry has been using catastrophe models to monitor the frequency and severity of major weather-related events such as hurricanes, wildfires, hail and floods.

As the effects of climate change become more severe, catastrophe risk modelling is more relevant than ever. But while scientists have gained much more confidence evaluating how climate change may affect an extreme weather event over the last 15 years, much of current insurance risk modelling is based on the assumption of a stable climate.
Factoring climate change calculations into risk models presents many challenges, not least because catastrophe models historically have been statistical, usually relying on up to 100 years of data to get a representative sample. Current risk modelling uses historical parameters that are increasingly outdated amid rising temperatures and increasing severity and frequency of extreme weather events.

The models look backwards and not forwards, and are based on average losses over many years. The models of the future need to be forward-looking, and joined up with data from climate models and event attribution science to predict likely impacts of climate change. What does the new 1 in 100 year hurricane risk look like?

In addition, insurers also require a better understanding of the interaction between climate change and exposure change over time. Increases in insured losses may result from both changes in hazard and changes in exposure. Many countries have seen a significant increase in exposure in recent decades, particularly in coastal regions such as Florida. Furthermore, insurers need to factor in adaptation measures, such as the building of new flood defences, which may reduce vulnerability.

Infrastructure exposure

Similarly, a significant portion of economic losses associated with natural catastrophes, particularly in the high- and middle-income countries, have been caused by damage to infrastructure as a result of extreme weather events.

As well as factoring in the impact of climate change to models, it is also important to understand how extreme events impact on critical infrastructure, and how infrastructure damage and failure could lead to secondary catastrophic consequences all of which provide opportunities for mitigating future risks by taking preventive measures.

The same thought process applies to the insurance industry’s understanding of the risk of a further knock-on or systemic impacts of climate change to other areas of society such as food security and political instability.

For instance, a long-lasting drought in one or more major growing region, especially if combined with a heatwave at a sensitive point in the crop’s life cycle, could affect crop yield and/or spikes in global agricultural commodity prices and lead to food shortages and price increases that could contribute to civil unrest (see Research theme 4: Resilient economies and complex systems).

There is an urgent need for comprehensive, global supply chain mapping across sectors, as well as a clearer understanding of contingent business interruption exposures in insurance.
How can researchers help?

The insurance industry must adapt to the increasing volatility of the global climate. It has been reported that data infrastructure is as important as our physical infrastructure in averting the climate crisis, but it is being dangerously neglected with a lack of data-flow leading to a misallocation of resources, missed opportunities and the creation of catastrophic risks on global balance sheets. 17

A collective endeavour across insurers, the scientific community and model vendors are necessary, not only to benefit further from the current modelling framework but also to extend the models’ capabilities.

There is a lot of data out there, and there is a pressing need to join the dots and share relevant data between industries. To do this we need to make data open source but current restrictions on e.g. climate reanalysis data mean it is often not available for commercial purposes.

Insurance industry-owned not-for-profit collaboration called Oasis Loss Modelling Framework, which provides open source software, is bringing three climate conditioned catastrophe models to market produced by the UK Met Office, the Potsdam Institute for Climate Impact Research (PIK) and Columbia University.

The usefulness of catastrophe risk models to the insurance industry and wider society could be even further enhanced by integrating the latest climate science and a variety of technologies into the modelling framework, according to the Geneva Association, which added that it was imperative to bring together different fields of science to ensure that catastrophe models widen their scope and address the unprecedented complexity of natural and man-made disasters, and the interconnections between them.18

For instance, there is an opportunity for academia to work with re/insurers to harness the huge volume of climate model data available and develop techniques for incorporating such data into catastrophe modelling frameworks.

There is also an increasing need for innovative approaches to risk communication and greater investment in education and training for different users of risk information19 and their real-world applications.
Key Research Questions

- What impact could insurance have in incentivising better community planning and supporting physical mitigation infrastructure such as flood barriers?

- How can insurers best quantify the impacts of climate change using current catastrophe models? How can we best separate out climate change impacts from other factors such as exposure growth?

- How can insurers best communicate the uncertainties involved with climate change projections and their impacts to key stakeholders?

- How can insurers develop new products to help close the protection gap? What new models and/or datasets are required?

- National government agencies, academic and other research centres collect and manage various databases, using a wide range of observing platforms (land, air, ocean, space) and networks - data which is critical for modelling risks and enhancing resilience. Can we make this data accessible for commercial use?

- How does climate model resolution impact risk estimation?

- What have been the outcomes of public–private partnerships between governments and the financial markets, including the reinsurance industry and institutional investors, seeking to address climate change mitigation and adaptation?

- What impacts could the insurance industry as an investor in its own right have on transitioning to low carbon investments?

- What are the rates of return observed in capital markets from activities related to climate finance?

- How can we connect catastrophe models to other systems-based models for economics analysis, food, energy and water management, the provision of critical infrastructure and health services to engender a better understanding and assessment of the impacts of feedback loops and cascading effects that can further aggravate disaster impacts?
Stress Testing Insurers’ Response to Climate Change

In 2019, for the first time, the UK Prudential Regulatory Authority (PRA) asked re/insurers to submit climate change scenarios as part of the General Insurance Stress Test (GIST) 20. It said that while firms were starting to consider impacts to their strategic resilience, resulting from climate change, few were systematically using scenario analysis.

Insurers are requested to consider the impact of three hypothetical greenhouse emission scenarios on selected metrics of their liabilities and asset valuations and translate these scenarios into their possible business model impacts.

In addition, firms were requested to assess and report separately on the impacts from transition and physical risks on their investments and liabilities (see figure 2.2).

“The PRA is increasingly focused on cognitive dissonance in some insurers whose careful management of climate risks on the liability side of their balance sheets is not always matched by similar considerations on the asset side,” the then Bank of England Governor Mark Carney said. 21

The general findings of both the insurers’ and banks’ climate stress tests are expected to be made public, although not addressing how individual firms’ balance sheets are affected.

This year the scenarios were non-compulsory and intended as an exploratory exercise. However, in the future compulsory scenarios and stricter guidelines could be set, potentially impacting the amount of capital insurers have to hold.

![FIGURE 2.2] The impact of climate change on investments

Source: PRA 22
Case study  Climate-KIC / Lighthill Risk Network Project Report

The co-funded Lighthill Risk Network / Climate-KIC project is researching high resolution climate modelling of European windstorms.

The key research aims include acquiring and reformatting a large range of risk model data related to windstorms and building an insurance exposure database that exists on the model data grid using available online risk data.

The ongoing project involves building active links between researchers, insurers and re-insurers to create data sets of all storm footprints and perform analysis on loss data to better understand variability, the impact of resolution on models, how this impacts losses and frequency of events and event clustering across the dataset and over time, as well as identifying some potential tail events that may not be evident in the historical record, but may be worth considering in risk analysis.

The data is most useful for risk studies because of the number of years modelled, meaning the industry can start to look at changes in tail risk, potentially.

Visit the Lighthill Risk Network to view this report: https://lighthillrisknetwork.org/reports

Case Study  The ClimateWise Physical Risk Framework

ClimateWise is a global network of leading insurers, re-insurers, brokers and industry service providers who share a commitment to reduce the impact of climate change on the insurance industry and society. It is a voluntary initiative, driven directly by its members and facilitated by the University of Cambridge Institute for Sustainability Leadership (CISL).

The latest ClimateWise Physical Risk Framework report demonstrates how the expertise and tools of the insurance industry can support other parts of the financial system to understand their physical risk exposure.

This report shows how investors and lenders can make use of well-established insurance models, tools and metrics to improve their management of some of the physical risks of climate change, in particular how outputs from climate models can be used in combination with natural catastrophe models to assess some of the physical risks of climate change in different scenarios.

Crucially, there is also a powerful opportunity for investors, lenders and policymakers, working with insurers, to target the uptake of adaptation measures in the most beneficial areas. At the same time, the collective understanding of the risks posed by climate change will be enhanced as more investors and lenders undertake similar analysis.
Research theme 3
Emerging Technology and Cyber Risk

USD 7.5 billion
forecast annual cyber gross written premium by end of 2020

USD 150 billion
insurance industry’s estimated global cyber risk exposure

USD 400 billion
estimated annual losses from cyber attacks

100 billion+
connected IoT devices forecast by 2025

USD 14.3 billion
in modelled insurance payouts in the event of a significant cloud service provider outage
Emerging Technology and Cyber Risk
The challenge for insurers

We are amidst the 4th Industrial Revolution, with technology evolving and proliferating at an exponential rate. From artificial intelligence (AI), machine learning (ML) and smart contracts taking decision-making and processes out of human hands, to the interconnected world of the Internet of Things (IoT), our dependency on technology is systemic.

As new technology emerges all around us, so too do the risks this represents. A key peril associated with these types of emerging technology is cyber risk - the threat of malicious hacking and the resulting theft of data, harm to individuals, and/or disruption to a business or facility.

“Cybercrime is a triple threat combining severity, frequency and systemic risk for insurers.”

And with the increasing scope of connected IoT devices, including connected homes, driverless cars and automated factories, the risk of physical damage and disruption due to cyber incidents is increasingly relevant for insurers.

Increased networking of machines, and equipment in particular, give rise to very complex risks such as data theft, disruptions in the interaction between networked machines, and even the failure of entire production lines and supply chains.

Cyber insurance is a potentially huge, but still largely untapped opportunity for insurers and reinsurers. RBC Capital Markets estimates that the global market for cyber insurance will grow from about USD 6 bn of premiums a year to USD 15 bn by 2022, driven by data hacks and large fines against businesses that have suffered breaches.

However, a lack of data about cyber risk and loss events has led underwriters to approach cyber cautiously so far, with small policy limits and extensive reinsurance to protect themselves.

This is in many respects an untested market and this has not gone unnoticed by regulators (see figure 3.2). Part of the challenge is that cyber risk isn’t like any other risk insurers and reinsurers have ever had to underwrite, with each attack and loss different from the last as hackers adapt and proliferate their tactics.

PWC points out that while underwriters can estimate the likely cost of systems remediation with reasonable certainty, there simply isn’t enough historical data to gauge further losses resulting from brand impairment or compensation to customers, suppliers and other stakeholders from cyber-attacks.
And while the scale of the potential losses is on a par with natural catastrophes, if not wider as there are no geographical boundaries to a cyber-attack, incidents are much more frequent than hurricanes or earthquakes. As a result, there are growing concerns about both the concentrations of cyber risk and the ability of less experienced insurers to withstand what could become a fast sequence of interlinked, high loss events.

Looking down the lens of IoT and its implications, cyber-attacks in the future could cause widespread pollution, vehicle collisions, and even the pandemic spread of viruses thanks to the development of advanced biological printers. All these factors make cyber risk a triple threat combining severity, frequency and systemic risk for insurers that is challenging to model for.

Attempts have been made to create cyber risk models - CyberCube, a cyber modelling specialist worked with reinsurance broker Guy Carpenter to model scenarios that could cause big losses for the industry, resulting in some dramatic loss estimations.

An extended outage at a large cloud services provider could lead to USD 14.3 bn in payouts, for example, while a widespread theft from an email service provider could result in losses of USD 19.1 bn. And these figures are based on the US only, and the loss across the global insurance ecosystem could be significantly greater.

How can researchers help?

When it comes to natural catastrophe risks, the risk modelling may not be perfect but at least there is strong market alignment on what the risk is and what it means in terms of scale as an insurable event, i.e. we know with a degree of certainty the levels of loss a category four hurricane making landfall in Miami would result in.

However, there is no such alignment when it comes to what we mean by a cyber event, and the impact such scenarios could have. Even the definitions and reported scope of the same events - such as NotPetya or Wannacry - differ from report to report, including the information released by the major online security software providers.

Underwriting cyber has become a major challenge for many insurers trying to make informed decisions about a risk that can be hard to evaluate. The ability to describe the problem in consistent terminology is essential, to allow comparisons between scenarios and threats. As such, insurers would benefit enormously from research into a standardised terminology framework for cyber incidents, as well as consolidated data set of major historic cyber loss events.

The latter point is also problematic, not only cyber is a relatively new and constantly evolving risk, but also because there has been reluctance for entities to ‘go public’ with news of cyber breaches, and data sharing on the causes and impacts of individual breaches is poor as a result.

Insurers face a cat and mouse game of keeping pace with the evolving nature of cyber risk and the ever-expanding frontier of the technology that it involves. Further research is required into how insurers could be more proactive about cyber risk in an impactful way; for example, developing scenarios that describe what the risk could be, stress testing them, and then creating risk mitigation strategies based on the results.
Finally, there is the issue of transparency within the insurance industry. A ground-breaking 2019 content analysis of cyber insurance policies exploring how carriers price cyber risk noted that there is almost no public information about how carriers actually assess – and differentiate – cyber risk across firms and industries, and particularly, how they compute prices for cyber insurance premiums.  

The report noted that this lack of transparency in policies and practices is cited as one of the leading obstacles hindering adoption of cyber insurance and presents significant challenges for senior executives seeking to manage risks across their organisations.

Key Research Questions

- Can we solve the data deficit - how could better industry-wide data sharing on cyber breaches be effectively encouraged and standardised, and develop responsible data access or sharing methods?

- Can we create a single, objective, peer-reviewed framework to describe past cyber events with consistent terminology and data? Can we use such a framework to analyse the evolution of cyber risk and apply this analysis and framework to describing future events?

- Can we fill the transparency gap in the design, understanding, and purchase of cyber insurance by providing fundamental analysis of actual cyber insurance policies, building on the first-ever systematic qualitative analysis of the underwriting process for cyber insurance?

- How will liability risks develop with the emergence of new technology such as biological printers?

- Algorithms play a key role in the interface between human and machine decision-making, but what are the potential systemic risks of flaws / biases in algorithm design and how could they impact insurance? What ethical framework should insurers adopt to mitigate the risks?

- Have cyber management behaviours changed in the wake of recent high-profile cyber-attacks such as Wannacry (including on a business level and on policymaker level)?

- How can insurers adapt to be able to process large and complex data streams that could be generated by “active” insurance products tied to an individual’s behaviour and activities?

- Smart contracts, possibly based around blockchain technology, could lead to a move away from “all risks” policies. What is the future of smart contracts and how can we ensure that smart contracts are legally sound?

- Have recent cyber events invalidated any risk models?

- What are the regulatory and practical issues around data quality, privacy and infrastructure compatibility that are impacting insurers’ adoption of AI to improve their own processes and analytics?
Stress Testing for Cyber Risk

An exploratory cyber underwriting loss scenario was proposed in the UK Prudential Regulatory Authority General Insurance Stress Test 2019. Insurers are asked to consider a specific scenario based on a gang of hackers exploiting a systemic weak point in operating systems or chip architecture to carry out a ransomware attack leading to a mass outage of a few days across multiple sectors of the economy.

The aim is to provide additional understanding of the industry's sophistication and the different approaches taken in estimating the potential sources of loss from a cyber event. Firms are asked to estimate the impact of such a cyber event that creates losses across geographies and multiple industries.

PRA has asked for gross loss estimates to break down the loss between the stand-alone cyber classes and other lines of business. For stand-alone cyber policies, firms should provide a breakdown of losses split between privacy breaches, remediation costs, business interruption and contingent business interruption and other.

For other classes of business, firms should split the gross loss between D&O, E&O, Crime including Kidnap & Ransom and Other Classes.

This information will be used to improve and develop future stress tests in this area.

Case Study  Improving Cyber Underwriting

Data analytics provider Verisk has launched an insurtech tool dubbed the Cyber Underwriting Report aimed at helping insurers underwrite a variety of risks in the cyber market where historical data is limited.

The Verisk report seeks to address these challenges from both an insurance and cybersecurity perspective by leveraging nearly 100,000 historical cyber events, combined with machine learning and stochastic modelling, to provide estimates of the frequency and financial impacts of potential cyber incidents.

The tool gives underwriters a cyber risk score for a company they are underwriting, a peer score to provide context and a profile describing critical business and technology characteristics. Streamlining the process can help insurers underwrite greater volumes of cyber coverage in a market that Verisk estimated will reach USD 6.2 bn in premiums by 2020.
Cyber Terrorism Research

The Geneva Association is launching a joint task force on cyber terrorism and cyber warfare with the International Forum of Terrorism Risk Reinsurance and Insurance Pools (IFTRIP). The special-purpose task force aims to conduct research on cyber terrorism risks across the insurance industry.

The aim is to foster an enhanced understanding of cyber terrorism risks that will enable the insurance industry to promote sustainable cyber underwriting and assess the potential exposure it faces.

Initial findings will be published in mid-2020. 32

Artificial Intelligence and Insurance

Businesses, homes and vehicles are already deploying artificial intelligence technologies in various forms and stages of advancement. The proliferation of interconnected devices through the IoT, the increased presence of physical autonomous machines such as drones and cars, and advances in deep machine learning technologies offer significant scope for AI to become ubiquitous in our everyday lives.

Carriers will need to understand how the increasing presence of AI for individuals and across industries will shift risk pools, change customer expectations, and enable new products and channels. At the same time, insurers must recognise how AI can improve their own operations.

AI has the potential to affect the insurance industry in multiple ways, including improving claims processing, underwriting, fraud detection and customer service. Indeed, AI and harnessing the unprecedented data generated by the IoT has been one of the most popular themes in insurtech start-ups in recent years.

But while AI provides opportunities for traditional insurers to modernise themselves, a number of obstacles to its adoption in the insurance industry remain, including the challenge of integrating AI into their existing technology due to issues such as data quality, privacy and infrastructure compatibility. 33

Technology driven change and next generation insurance value chains:

In the UK, Loughborough University is working with businesses to explore how AI can transform insurance services. The project involves working closely with some of the major UK insurance firms to examine how these technologies are changing business processes and business models in underwriting and risk analytics, claims processing and in customer engagement, examining the barriers to adoption and the enablers of change 34.
Research theme 4
Resilient Economies and Complex Systems

**EUR 200 billion**
estimated global market for resilience services 36

**USD 90 trillion**
global investment in infrastructure expected over the next 15 years 37

**USD 100 billion**
at least per year to be mobilised from public and private sources to help developing countries mitigate and adapt to climate change by 2020 38

**7%**
improvement in stock price for companies that included resilience as part of their supply chain management strategy 39
Underestimation and interconnection of risks
The challenge for insurers

In a world of increasing political, economic and climate volatility and complexity resilience an ability to recover and adapt after disasters, particularly systemic disasters, is of critical importance. Local events, such as the failure of a major metal manufacturer, can quickly have severe impacts on supply chains and economies around the world.

“For example, the global food supply system is profoundly interconnected. A long-lasting drought in one or more major growing region could affect crop yield and lead to food shortages, spikes in global agricultural commodity prices and even civil unrest far further afield.

Agricultural planning is an area of particular concern highlighted by the Geneva Association, which points to the events stemming from the Russian drought in 2010, which led to Russia banning exports of wheat, barley and other grains. The resulting food shortages and price increases are also believed to have contributed to the civil unrest throughout the Middle East in 2010–2011.

Interlinked events such as this are leading governments to increasingly recognise the importance of systems thinking for managing defence policies and operational plans for addressing the national security implications of global food system vulnerabilities.”
Understanding complex systems to create resilient economies

As mentioned, the complex systems that govern the modern world make it highly challenging to effectively model supply chain risk and other systemic risks such as climate change, man-made perils and pandemics - a challenge that can result in a severe underestimation of risk, unintentional risk aggregations and inaccurate pricing of products.

For example, our global supply chains are changing rapidly, while companies are underprotected and insurers overexposed. Yet companies that include resilience as part of their supply chain management strategy have seen both market share gains and a premium on their stock price of 7%.

The concept of resilience is becoming a key criteria in business and investment decisions. Significant opportunity exists in developing world countries as governments take action to meet global targets related to the Sustainable Development Goals, COP21, and the G7 InsuResilience initiative (see case study).

Indeed, the Industrial Strategy Challenge Fund (ISCF) notes that there is growing global demand for resilience services - which it defines as products and services developed to anticipate and manage risks from extreme systemic events, environmental shocks and climate change - a market currently worth an estimated GBP 200 bn.

The insurance and risk modelling sectors have a key part to play in boosting global resilience to extreme events. However, the key challenge is that cross-sectional collaboration is required to ensure resilience of a system, not just its components.

Micro-insurance and resilience

Another area of innovation in building resilience is micro-insurance, offering lower premium coverage usually to low income families and businesses in markets where established insurance options are unavailable or unaffordable.

The Climate Finance Roadmap highlights enhancing access to climate risk insurance as a key driver of resilience – initiatives designed to offer insurance to those who are vulnerable to natural disasters, such as tropical cyclones and droughts caused by climate change.

Examples of initiatives include large-scale regional facilities such as the African Risk Capacity initiative, Pacific Catastrophe Risk Assessment and Financing Initiative, and Caribbean Catastrophe Risk Insurance Facility (see Box 1).
How can researchers help?

Many established and emerging businesses are tapping into new sources of data and modelling, developing new methods of data interpretation in order to more accurately predict future risks and the impact of interconnected existing risks emerging from complex systems such as climate change and supply chains.

However, access to data is challenging, particularly for SMEs, and inefficiencies have been introduced due to the resources required to transform it into industry-useable form.

The UK’s academic capability in environmental science, systems modelling, big data, engineering, economics, and data analytics, holds significant untapped potential for this market, however, efforts would benefit from greater interdisciplinarity and focus on business requirements.

There is a clear gap for researchers to work with insurers to support the development of innovative tools to assess risk and resilience and provide a clearer framework for embedding resilience into decision making for businesses and governments.

The research community can also enable access to data, models, and expertise which can be further developed by business into protectable IP on which to base risk assessments and resilience services.

Meanwhile, a publicly funded initiative would also enable greater collaborative working between academics, insurance, consultancy and the public sector to share data and develop innovative risk assessment and novel approaches to resilience which draw on the best from academics and industry.

Key Research Questions

- How can we improve access for all businesses - particularly SMEs - to usable data and models and new methods of data interpretation and prediction in order to more accurately predict future systemic risks?
- How can we approve modelling for supply chain risk to include analysis of the wider degree of correlation, interconnected risks and macro-economic trends?
- How can we develop a clearing house for industry data to be collated and anonymised? The lack of such an instrument is a significant barrier to academic – industrial collaboration.
- How can we de-risk innovation by demonstrating emerging technologies and solutions, effectively trialing on behalf of the industry?
- Complex modelling approaches into resilience are beginning to be developed by academia, but how can we make these more inter-disciplinary and focus on the needs of business?
- How resilient is insurance? Have product and industry correlation in insurance policies led to overexposure to product groups and multiple industries where a widely used sub(product) could affect more than one industry?
- Can we implement a data standard for underwriting supply chain risks to help insurers become more consistent?
• What is the potential for parametric insurance products and smart contracts to offer lower priced, more comprehensive cover to insureds - particularly SMEs - to help improve supply chain resilience?

• Will the new IFRS 17 methods affect insurance market cycles, and will insurance company valuations be affected?

• How can big data analytics initiatives like AgriTask be further adapted and developed to have a wider impact?

**Disaster Scenario Planning Resources**

Early 2020 saw the launch of two reports Developing Scenarios for the Insurance Industry; and Developing Scenarios for Disaster Risk Reduction, produced in partnership between the Lighthill Risk Network and the Cambridge Centre for Risk Studies, and co-funded by the Lloyd's Tercentenary Research Foundation.

The result of linking leading academics with senior insurance professionals, the reports provide a practice scenario planning tools for the insurance industry and governments, particularly of developing countries, when considering the outcomes of catastrophic shock risk scenarios.

Scenarios are increasingly being used by underwriters, analysts, risk managers, actuaries, and other stakeholders in the re/insurance community to better understand and stress test the characteristics and consequences of unknown, uncertain, or unexpected future events.

Developing Scenarios for the Insurance Industry addresses scenario best practices in the insurance industry, with the case study example of a Cyber Blackout event, exploring the interlinked nature of such events and its global financial ramifications.

Developing Scenarios for Disaster Risk Reduction addresses the ever more complex and interconnected disaster risk landscape, with the potential for disasters – including natural catastrophes – to cascade through global systems increasing, with disproportionately negative impacts on developing countries.

Both reports benefited from the input of leading insurance experts from the Lighthill Risk Network, whose members include senior representatives from Guy Carpenter, Liberty Mutual, Aon, Hiscox, Lloyd's, and MS Amlin.

Professor Danny Ralph, Academic Director of the Cambridge Centre for Risk Studies, said:

“The Cambridge Centre for Risk Studies is proud to have collaborated with the insurance and disaster risk communities to provide novel insights and guidance on scenario development.

Scenarios are a critical tool to address and understand an increasingly complex landscape of systemic and emerging risks. We use scenarios to engage effectively with organisations, capturing creative thinking about plausible futures. Scenarios should be understood not as predictions but as stress tests to assess an organisation’s capacity to be resilient.

In the context of disaster risk, scenario analysis is widely advocated and applied but remains a challenge to many stakeholders without experience in scenario development. We hope to support a wider application of scenarios to understand potential disaster impacts and the efficacy of decisions to address them.”
Parametric Insurance and Resilience

Parametric insurance products are programmes that are triggered and paid using an index rather than words. A fixed amount is paid upon the occurrence of a triggering event and the amount payable is often based on a modelled forecast of the loss that the policyholder will incur. As soon as a predetermined threshold has been met, the policy is triggered and payment is made.

In 2007, the Caribbean Catastrophe Risk Insurance Facility (CCRIF) was formed as the first multi-country risk pool in the world and was the first insurance instrument to successfully develop parametric policies backed by both traditional and capital markets.

CCRIF helps to mitigate the short-term cash flow problems small developing economies suffer after major natural disasters. CCRIF’s parametric insurance mechanism allows it to provide rapid payouts to help members finance their initial disaster response and maintain basic government functions after a catastrophic event.

Clyde & Co notes that a fundamental benefit of parametric insurance for building resilience is that a policy can be triggered not by the calamity itself (such as crop failure or the resulting human impacts), but by its cause (such as inadequate rainfall), which through funding early intervention can minimise wider human and financial impacts and costs.

For example, one parametric crop policy is triggered on satellite images of grazing land – where a lack of greenery or yellow land indicates the crop is failing. If funds can be made available promptly to a vulnerable region, resources can flow to feed both people and livestock before famine strikes and migration follows[46].

Complexity and Regulation - IFRS 17

Insurers are also inextricably linked to complex systems, not least regulatory systems - where changes can have far-reaching consequences for financial stability. For instance, the International Financial Reporting Standards Foundation is introducing new regulation in the form of IFRS 17, effective for annual reporting periods beginning on or after 1 January 2021.

The new accounting standards will transform financial reporting requiring reserves to be disclosed in a more transparent way - for example, a poorly performing business must be singled out and reported to demonstrate that reserves need to be adequate, and not cross-subsidised by better performing classes.

As such, the new regulations may have a bigger effect on insurance reporting than Solvency II - yet these have been implemented without carrying out Quantitative Impact Studies.
**Case Study  G7 InsuResilience Initiative**

The InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions was launched at the 2017 UN Climate Conference in Bonn. At COP21 in Paris, G7 partners announced the provision of USD 420 mn in funding for InsuResilience allowing up to another 180 million people to benefit from climate risk insurance cover.

Since its launch, more than 65 public and private members have joined the Partnership, which aims to strengthen the resilience of developing countries and protect the lives and livelihoods of poor and vulnerable people against the impacts of disasters.

The central objective of the Partnership is to enable more timely and reliable post-disaster response and to better prepare for climate and disaster risk through the use of climate and disaster risk finance and insurance solutions, reducing humanitarian impacts, helping poor and vulnerable people recover more quickly, increasing local adaptive capacity and strengthening local resilience. This complements ongoing efforts in countries to avert, minimise and address climate and disaster risks.

In November 2019, Israeli agricultural insurtech AgriTask secured USD 8.5 mn in funding led by the public-private InsuResilience Investment Fund.

The AgriTask platform combines agricultural data, AI and other technologies into a "Farmers Intelligence Ecosystem" to give deeper insights and decision support for participants in the agricultural economy covering more than 50 crop types. Its clients include farmers, food and beverage companies, agricultural insurers, input providers and governments or developmental organisations.

The platform can integrate with over 40 hardware and software sources to create an architecture that can adapt to each client’s needs.

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**Case Study  GRAF**

The Global Risk Assessment Framework (GRAF) aims to improve the understanding and management of current and future risks, at all scales, to better manage uncertainties and mobilise people, innovation and finance by:

- Fostering interdisciplinary systems thinking, with shared metrics and shared understanding.
- Enabling the identification of anomalies and precursor signals, as well as the correlations and dependencies of risks and actors to enable decision makers to act.

GRAF is calling for an approach to risk from a systems perspective to build multi-dimensional maps of changing risk. Through multiple working groups it aims to understand Theory of Change and build a trusted approach to managing uncertainty by better understanding the interdependencies and the correlations of risk across global, national and local scales.

One such initiative is the Collaboratory - a collaborative laboratory proposed as a sandbox and/ or real-time experimentation space to form a practical demonstration to prototype the implementation of the GRAF vision, objectives and principles in practice.

GRAF is a key example of the kind of collaborative learning initiatives that can build better links between insurance and research communities, help better understand behaviour, change and systemic complexity, and ultimately improve the impact of insurance.
Research theme 5
Decision Making Under Uncertainty

DECISION MAKING
Humans in loop
Fully autonomous

JOB DISPLACEMENT
Gradual & incremental
Dramatic & fast

WEALTH CONCENTRATION
Less
More

DIGITAL TECHNOLOGY STANDARDS
Consolidating & open
Diverging & proprietary

LARGE DATA SETS
Assets
Burden, liability

AMBIENT TRUST
Lower
Higher

GROUP IDENTITIES & SOCIAL NETWORKS
Official, institutional, characterized by few “thick” ties
Tribes, self-identified, characterized by many “thin” ties

INDIVIDUAL AUTONOMY
Shrinking
Expanding

ATTACK VECTORS
Physical, with violent conflict dispersed
Digital, with violent conflict amplifying

The breadth of issues around cyber
SOURCE CYBERCUBE 49
Decision Making Under Uncertainty
The challenge for insurers

Decisions are made in the absence of perfect information on a daily basis in all forms of commercial activity. In the insurance industry, key decisions are made in a number of different areas but include underwriting decisions, risk governance decisions, and management decisions.

“As well as gaining a better understanding of the risks they insure, insurers could also benefit from more research into decision making under uncertainty when it comes to behaviours around buying insurance.”

It is generally accepted that our understanding of risk has many uncertainties. We know that our models are not perfect representations of the world, and there is no standard method of presenting, communicating or analysing uncertainty.

And yet the business of insurance is the business of making decisions that manage and mitigate risk. From calculating exposure to catastrophic events and pricing premiums and structuring reserves accordingly, to calculating regulatory capital requirements - all these decisions take place amid a moving target of rating and modelling uncertainty.

Making strategic decisions

Scenario-building has been identified as an important tool in helping organisations to develop their own strategic direction and priorities: starting from uncertainties in the contextual environment and working inwards via the industry or transactional environment toward the organisation’s own strategic decisions. The use of scenarios to explore uncertainty requires “disciplined imagination”, however, rather than straying into the realm of science fiction.

Taking the broadest perspective, a model can range from a complex statistical tool with a number of dependency assumptions to a simple rule of thumb or heuristic. On the one hand, quantitative facts are required, on the other, we are dealing with things that may be unquantifiable.
As well as gaining a better understanding of the risks they insure, insurers could also benefit from more research into decision making under uncertainty when it comes to behaviours around buying insurance and closing the protection gap. What motivates people to buy insurance, and how could these motivations change and stimulate demand for insurance?

The use of models is pervasive and found in underwriting decisions, setting reserves to cover liabilities from past events, and in establishing solvency and economic capital requirements. Some models are also required as part of regulated activity and rating agencies also expect them to be used.

Models are sometimes criticised for their flaws in the presence of this uncertainty and their efficacy is often in debate. But, ultimately, insurers want to understand how key decisions that inform product development, underwriting, pricing and reserving, can be guided by improved use of tools, models, techniques and heuristics.

How can researchers help?

A fair volume of research has already taken place in the field of decision making under uncertainty, but elements are missing or are not directly useful to insurance. Across academia, different disciplines consider uncertainty separately, with no joined-up standardised framework or common language to communicate/correlate results.

Only a handful of studies have examined the relationship between investment in risk reduction and insurance purchase decisions for natural disasters, for instance, and fewer still have identified the behavioural mechanisms behind the relations between insurance and risk reduction activities.

In order to improve the impact of future research, it would be hugely helpful to de-construct the challenge and gain an oversight of what is missing, and what areas of new work should be pursued next.

There also needs to be a clearer understanding of the kind of decision makers such research should target to influence, and who the audience is in terms of decision makers in insurance - i.e. research should be undertaken with the end impact firmly in mind. Only stronger links between academia and the insurance sector can achieve this impact.

Key Questions for Researchers

- What existing work needs to be consolidated and developed further to be more directly useful to insurance?
- How can we use the data produced by models for better decision-making?
- How can we recognise how people select good heuristics in particular areas of insurance - for instance, how do different classes of business in insurance relate to one another?
- How can we combine analytical tools with an understanding of behavioural factors and biases?
• Can regulatory systems be developed with risk theory at their heart that react to extreme risks? What is the role of risk transfer in such a system?

• How can we incorporate an appreciation of uncertainty into the underwriting process?

• What are the behavioural mechanisms behind the relations between insurance and risk reduction activities?

• How do we explore the protection gap - de-construct the problem, and improve the motivation to buy?

Case study  Six Principles for Improved Decision Making

The Institute and Faculty of Actuaries highlights how high levels of uncertainty and unknowability are part of day to day life for insurers, and introduces six high level Uncertainty Principles for use in supporting, making, and critiquing decisions as well as a framework for further research.

The six principles, developed primarily with experiences of decision making within the insurance industry in mind but felt to have the broadest societal application, are:

1. **Face up to uncertainty**: In practice there is a tendency for people to downplay or ignore uncertainty when deciding on a course of action. The aim of this principle is to encourage us all to ‘tune in’ to uncertainty, with all its messiness and unpredictability, and in spite of our deeper instincts to turn away.

2. **Deconstruct the problem**: Simply breaking a problem into parts can be very helpful (so long as this is not at the expense of also considering the whole). Three particular deconstruction perspectives are worth considering - the decision making process, the decision stakeholders, and the assumptions (explicit and implicit). A structured framework is suggested to support this analysis.

3. **Don’t be fooled (un/intentional biases)**: This principle covers two different but important elements: the challenge of managing uncertainty where there are deliberate efforts made to mislead; and the wide-ranging ways unconscious bias can corrupt well-intentioned decision makers and their advisors.

4. **Models can be helpful, but also dangerous**: Where true uncertainty exists, complex models can be dangerous. Instead, the use of simple models or rules of thumb in the hands of an experienced practitioner can be a better approach. Understanding the context of the problem and the influence a model may have on a decision is key.

5. **Think about adaptability and resilience**: In the face of uncertainty it is important to adopt resilient thinking and forward-looking planning. This builds preparedness and adaptability to deal with the consequences of decisions that may not turn out as hoped. This is not just about risk mitigation or avoidance, but also the ability to take advantage of new circumstances.

6. **Bring people with you**: It is vital that all stakeholders recognise the implications of uncertainty (and unknowability) when the decision is made. The report looks at recognising resistance and managing it; building trust and engagement; and effective communication.
Research theme 6
The Risks of Risk Modelling

USD 1 billion+
current annual insurance sector spending on risk model license fees

Key factors driving catastrophe model development

Source: The Geneva Association
The Risks of Risk Modelling

The challenge for insurers

Catastrophe models have become an invaluable tool in managing large and unpredictable losses across the insurance industry - and since their introduction in the late 1980s to the point that today’s catastrophe model output has become a currency for understanding and quantifying risk in insurance and reinsurance transactions.

Risk modelling is a substantial cost for the insurance sector, which spends over USD 1 bn annually in licence fees for risk models and the expertise to operate and interpret them for clients. Paradoxically, however, one of the biggest systemic risks of catastrophe modelling is an over reliance on a small group of catastrophe model vendors.

“For example, past new model releases have resulted in instances of loss estimate changes for hurricane risk of as much as 200%, highlighting not only how much uncertainty there is in models but also impacting overall confidence in models 53.

Indeed, finding the most effective way of communicating the weaknesses of catastrophe modelling, without losing the headline messages in the detail and complexity of the modelling steps, and without senior management dismissing the models as too flawed to be of any use, has been cited as sometimes as important for the business as the original modelling process 54.

The Institute and Faculty of Actuaries spells it out when it states models can be helpful, but also dangerous when it comes to decision-making in insurance.

“Understanding the context of the problem and the influence a model may have on a decision is key. Models can still be useful in situations where there is significant uncertainty, or even unknowability. For example, value may still be obtained from comparing options or through a better understanding of a process or system. Simplified models or rules of thumb will have inevitable limitations. The uncertainty can be mitigated through thinking about adaptability and resilience.”55

The final result from the model is only as good as the inputs feeding into it 56. But a critical constraint here is the fact that, historically, each commercial catastrophe modelling firm has developed its own software platform, models and applications as an integrated package. The resulting lack of model standards and interoperability have been identified as a significant burden to the model users 57. Many of these models are closed boxes that do not demonstrate interoperability with other models or data sources - a wealth of data that cannot currently be joined together.
Indeed, the Geneva Association identifies the debate between open framework / open source and interoperable models, and the contrasting ‘closed box’ restricted models as a key barrier to future development in the field (see figure 6.2).

Pressure from the re/insurance industry to create more efficiency through greater interoperability is increasing, and major model providers are responding positively to assisting with this goal (see box story).

How can researchers help?

All the research themes in this document so far have touched on the risk modelling challenges in one way or another, and it is clear that the industry should strive to continually strengthen the predictive power of its catastrophe modelling capabilities.

The approach to risk modelling must evolve to leverage the wider body of work and expertise, and bring forward innovative solutions, working practices, and coordination and participation mechanisms.

Data in the industry is currently collected but neither consistently consolidated nor shared. Better data, and improved interpolation and extrapolation methodologies, will help increase the accuracy of risk modelling. Researchers can support insurers by helping them to harness the data they hold to develop global databases of standardised information, such as a worldwide buildings database using unique building identification, for example, as well as with efforts to compare different models.

The benefits of consistently sharing data could not only improve model accuracy but also lead to a considerable reduction in transaction costs, improved comparability and facilitation of electronic placement.

Key Questions for Researchers

- How can we better understand and quantify the systemic risk associated with using a small number of model vendors?
- How can we objectively determine whether a model contains decision relevant information? Can methodologies from other disciplines be adapted or used directly?
- How can models be used to produce ‘robust’ decisions which do not alter materially in the face of parameter, data or model uncertainty, rather produce a ‘good practice’ outcome?
- Can we determine a framework to carry out a retrospective study on model performance; including past versions of models to see how they have evolved?
- How can we boost interoperability of models across modelling platforms and extending these models to public sector use and for expansion of risk?
• Can we develop a qualitative tool for model risk governance - ‘models of models’ and embrace a systems-based thinking for the development of the next generations of catastrophe models?

• Could a focus on ensuring geospatial accuracy of exposures limit the degree to which the model portrays false positives and will reflect a more accurate picture of risk geospatially?

• What is the business case for industry databases, and what are the obstacles to creating them when other sectors like aviation have gained so much?

• Can we design practical tools for the use of models at both the qualitative strategy level - to structure decision making at board level - and the quantitative decision level, to support business decisions by senior management?

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**Case Study  The Insurance Development Forum (IDF)**

The IDF is a public/private partnership led by the insurance industry and supported by international organisations. Its aim is to optimise and extend the use of insurance and its related risk management capabilities to build greater resilience and protection for people, communities, businesses, and public institutions that are vulnerable to disasters and their associated economic shocks.

The IDF Risk Modelling Steering Group (RMSG) is dedicated to improving global understanding and quantification of natural hazards disaster risk, through use, development and sharing of the re/insurance sector’s catastrophe risk modelling capability.

The RMSG includes representative members from 35 organisations across industry, the public sector and civil society.

The RMSG aims to drive improvements in modelling infrastructure, and model and data content, as well as build efficiency and reduce cost and duplication in the risk modelling and data ecosystem through continuous development of open platforms, an industry-wide interoperability programme and advocacy of open standards.

A key proposal of the RMSG is the launch of the ‘IDF Global Risk Modelling Alliance’ (GRMA) to drive a collaborative, networked programme of open risk models and data content available on the Oasis Loss Modelling Framework platform, and indeed other open platforms in the future.

The vision is for the GRMA to form the centre of an international cross-sector network of organisations similarly committed to the goals of open risk modelling in support of the UN SDGs.
Case study  Open Source Models

Common data standards and model protocols are essential to engage academia, centres of excellence and government scientists.

More specifically, data standards relating to exposure data input and model result outputs are key for accessing the efficiency gains from greater digitalisation in the placing of insurance and reinsurance contracts.

In June 2018, not-for-profit open source risk modelling initiative Oasis Loss Modelling Framework (Oasis) was awarded funding by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) for an international collaboration to improve climate and catastrophe risk resilience in the Philippines and Bangladesh.

Through this project, an international collaboration will co-develop new catastrophe models for floods in the Philippines and cyclones in Bangladesh on the open-source Oasis catastrophe modelling platform – two countries that are highly vulnerable to the impacts of climate change.

The models will be made available for the public sector as well as re/insurance use and will provide views of risk based on current as well as future conditions under climate change. The two-year project will improve knowledge and long-term access to catastrophe risk modelling across multiple stakeholders from national to local government for risk monitoring, risk reduction, adaptation and disaster risk financing.

The project will facilitate the connection of international reinsurance capacity with in-country demand for financial risk protection against the most extreme of events to aid with rapid post disaster recovery, as well as inform development planning and infrastructure management for long-term risk reduction and adaptation.

This first of its kind project will bring together expertise in catastrophe risk model development and risk data and expertise from the countries in a truly collaborative and open development process.

Partners include the National Reinsurance Corporation of the Philippines (Nat Re); the Disaster Risk and Exposure Assessment for Mitigation program of the Philippines (UP DREAM); the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA); experts from the Bangladesh University of Engineering and Technology (BUET); the technology, management, education and governance consultancy Kitetrackers of Bangladesh; U.K. Met Office; the Potsdam Institute for Climate Impact Research (PIK); catastrophe modelling company KatRisk, and international reinsurance brokers Willis Towers Watson and Tysers.
Section 7
Conclusion / Call to Action
The collaboration challenge

Compared to other sectors, re/insurance has not been prominent on academic research spending. One of the roles of the Lighthill Risk Network in this initiative is to improve the linkages between academia and the re/insurance industry – aggregating large companies to help fund research and bridge this gap.

We want to draw knowledge and innovation from academia into insurance and help improve catastrophe risk model methodologies and development, as well as help improve accuracy of results through improved input data.

Call for consolidation

Across the different research themes in this report, the need to consolidate and standardise information, open access and channels of communication have been consistently flagged.

Researchers can help the insurance industry to join the dots, providing access to high quality data and helping improve models with increased understanding and projections of climate change and other complex, systemic risks across scales.

Collaboration and consolidation of existing research is critical to improving its impact and value - ensuring the availability of observations, monitoring, and infrastructure for critical data collection and analysis for the ultimate business side decision makers.

Researchers can also help the insurance industry develop and implement a systems-based approach to climate change risk, and indeed other complex and interconnected systemic risks - understanding and modelling for the wider impacts on food security and agricultural planning, infrastructure and society of extreme weather events, for instance.

Make an impact

A shared vision is required to bring together key influencers of disaster risk financing and management from the government, researchers, and the insurance sector to build on the knowledge we have and solve the key challenges the industry faces.

Collaborative research is a way of democratising knowledge production, re-connecting high-level scientific problems to the very real needs of communities.

By fostering stronger, active links between research communities and insurance, and through an iterative process of defining, refining, generating and implementing evidence with a range of different stakeholders, we could really broaden our understanding of issues, helping generate new insights and mitigate some of the most challenging risks currently facing societies and economies.
How can academics get involved?

Active knowledge exchange between academia and industry is critical. From strengthening existing partnerships to developing new relationships, the focus must be on the real-world impacts and benefits for decision makers.

Useful contact information

Dickie Whitaker
Director

Email: dickie.whitaker@icloud.com
Appendix


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With special thanks to interviewees who directly contributed to this report:

**Matt Harrison**
Head of Casualty Exposure Management
Hiscox

**Cameron Rye**
Research Manager
MS Amlin

**Paul Kaye**
Analytics
Reinsurance Solutions
Aon

**Jessica Turner**
Vice President, Catastrophe Advisory
Guy Carpenter

**Alexander Alabaster**
Head of Model Evaluation UK & EMEA
Aon

**Anna Bordon**
Product Development and Thought Leadership Manager, Innovation
Lloyd’s of London