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The potential created by an open data standard

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Assessing the potential impact of future climate change scenarios

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EXPOSURE

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THE NEXT 10 YEARS
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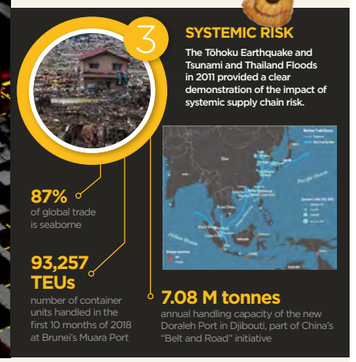

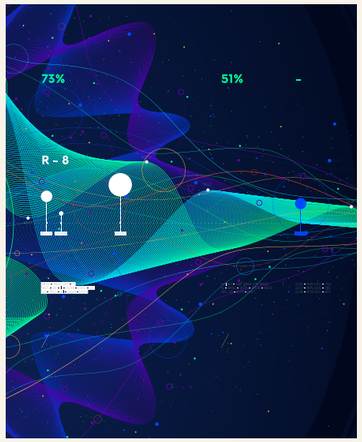

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FOREWORD

THE FUTURE'S BRIGHT

Welcome to the latest edition of EXPOSURE magazine. We launch this edition at the Rendez-Vous de Septembre in the sunshine of Monte Carlo, with business leaders from across the insurance and reinsurance industry gathering to discuss current market dynamics and looking ahead to a new decade as 2020 looms on the horizon. There are many causes for optimism, with big strides being made on the big challenges, not just in our market but for the world.

The industry is embracing change on many fronts: from the need to tackle growing "protection gaps" whether in developed or developing markets or for emerging risks, to quantifying the impact of climate change, or harnessing the potential of technology to reduce costs, complexity and serve customers better.

To tackle such a broad sweep of challenges simultaneously requires new approaches, but many of the issues that the industry faces are largely interconnected. The need for data and insight runs through them all. Without being able to measure the extent of a problem, it is hard to propose a solution.

As we show in this edition, whether measuring the impact of flood defenses in the U.K., examining resilient construction built after the 2011-12 earthquakes in Christchurch, New Zealand, or assessing what a U.S. hurricane season could look like by 2050 or 2100, all this requires actionable insight.

As an industry — armed with the right insight, using the right tools, approaches and processes, and getting technology and science innovation to accelerate at the required pace — we can work together and play our role in tackling these big issues and help build that brighter future.

KAREN WHITE
CEO, RMS

NEWS ANALYSIS

FLOOD RE

Flood barrier in Shropshire, England

THE VALUE OF DEFENSE

Current flood defenses in the U.K. reduce annual losses from river flooding by £1.1 billion, according to research by RMS

Flooding is one of the most significant natural hazards for the U.K. with over five million homes and businesses in England at risk of flooding and coastal erosion, according to the Environment Agency.

In 2015, the U.K. government announced a six-year, £2.3 billion investment in flood defenses. But the Environment Agency proposes a further annual investment of £1 billion through 2065 to keep pace with the flood-related impacts of climate change and shifts in exposure levels.

Critical to targeted flood mitigation investment is understanding the positive impacts of current defenses. In June, Flood Re* released its Investing in Flood Risk Management and Defenses study, conducted by RMS.

Addressing the financial benefits of existing flood defenses for the first time, data from the RMS® Europe Inland Flood HD Model demonstrated that current infrastructure reduced annual losses from riverine flooding by £1.1 billion. This was based on ground-up losses, using the RMS U.K. Economic Exposure Database covering buildings and contents for residential, commercial, industrial and agricultural, plus business interruption losses.

"Our flood model incorporates countrywide defense data sourced from the Environment Agency and the Scottish Flood Defence Asset Database," says Theresa Lederer, a consultant within the RMS capital and resilience solutions team, "including walls, levees and embankments, carefully reviewed and augmented by RMS experts. Our initial model run was with defenses in place, and then, using the in-built model functionality to enter user-defined defense values, we removed these [defenses in place]."

The differences in average annual loss results between the two analyses was £1.1 billion, with losses increasing from £0.7 billion under current defenses to £1.8 billion in the undefended case. The analysis also revealed a differentiated picture of flood risk and defenses at the regional and local levels.

"The savings relative to total inland flood risk are more pronounced in Northern Ireland and England (both over a 50 percent reduction in average annual losses) than Scotland and Wales," she explains. "But when you view the savings relative to surface-water flood risk only, these are similarly significant across the country, with loss reductions exceeding 75 percent in all regions. This reflects the fact that pluvial flooding, which is kept constant in the analysis, is a bigger loss driver in Scotland and Wales, compared to the rest of the U.K."

Other insights included that the more deprived half of the population — based on the U.K. Townsend Deprivation Index — benefited from 70 percent of the loss reduction.

The study also showed that while absolute savings were highest for catastrophic events, the proportion of the savings compared to the overall level of loss caused by such events was less significant. "In the case of 1-in-5-year events," Lederer says, "river flood defenses prevent approximately 70 percent of inland flood losses. For 1-in-500-year events this drops to 30 percent; however, the absolute value of those 30 percent is far higher than the absolute savings realized in a 1-in-5-year event.

"Should the focus of defenses therefore be on providing protection from major flood events, with potential catastrophic impacts even though return on investment might not be as attractive given their infrequency? Or on attritional losses from more frequent events, which might realize savings more frequently but fail to protect from the most severe events? Finding a balanced, data-driven approach to flood defense investment is crucial to ensure the affordability of sustainable flood resilience."

CRITICAL TO TARGETED FLOOD INVESTMENT IS UNDERSTANDING THE POSITIVE IMPACTS OF CURRENT DEFENSES

* The U.K.'s Flood Re is a joint government/insurance industry initiative. It plays a central role in the drive for greater flood resilience. Launched in 2016 with a 35-year mandate, it aims to enable insurers to offer competitive premiums and lower excesses to U.K. homes at high flood risk.

PROTECTION GAP

A NEED FOR MULTI-GAP ANALYSIS

The insurance protection gap is composed of emerging markets and high-risk and intangible exposures

There cannot be many industries that recognize that approximately 70 percent of market potential is untapped. Yet that is the scale of opportunity in the expanding "protection gap".

While efforts are ongoing to plug the colossal shortage, any meaningful industry foray into this barren range must acknowledge that the gap is actually multiple gaps, believes Robert Muir-Wood, chief research officer at RMS.

"It is composed of three distinct insurance gaps — high risk, emerging markets and intangibles — each with separate causes and distinct solutions. Treating it as one single challenge means we will never achieve the loss clarity to tackle the multiple underlying issues."

High-risk, high-value gaps exist in regions where potential loss magnitude outweighs the ability of the industry to refund post-catastrophe. High deductibles and exclusions reduce coverage appeal and stunt market growth.

"Take California earthquake. The California Earthquake Authority (CEA) was launched in 1996 to tackle the coverage dilemma exposed by the Northridge disaster. Yet increased deductibles and new exclusions led to a 30 percent gap expansion. And while recent changes have seen purchase uptick, penetration is around 12-14 percent for California homeowners."

On the emerging market front, micro- and meso-insurance and sovereign risk transfer efforts to bridge the gap have achieved limited success. "The shortfall in emerging economies remains static at between 80 to 100 percent," he states, "and it is not just a developing world issue, it's clearly evident in mature markets like Italy."

Power outage in lower Manhattan, New York, after Hurricane Sandy

"THE PROTECTION GAP IS COMPOSED OF THREE DISTINCT INSURANCE GAPS — HIGH RISK, EMERGING MARKETS AND INTANGIBLES — EACH WITH SEPARATE CAUSES AND DISTINCT SOLUTIONS"

— ROBERT MUIR-WOOD, RMS

A further fast-expanding gap is intangible assets. "In 1975, physical assets accounted for 83 percent of the value of S&P 500 companies," Muir-Wood points out. "By 2015, that figure was 16 percent, with 84 percent composed of intangible assets such as IP, client data, brand value and innovation potential."

While non-damage business interruption cover is evolving, expanding client demand for events such as power outage, cloud disruption and cyberbreach greatly outpace delivery.

To start closing these gaps, Muir-Wood believes protection gap analytics are essential. "We have to first establish a consistent measurement for the difference between insured and total loss and split out 'penetration' and 'coverage' gaps. That gives us our baseline from which to set appropriate targets and monitor progress.

"Probabilistic cat risk models will play a central role, particularly for the high-risk protection gap, where multiple region and peril-specific models already exist. However, for intangibles and emerging markets, where such models have yet to gain a strong foothold, focusing on scenario events might prove a more effective approach."

Variations in the gaps according to severity and geography of the catastrophe could be expressed in the form of an exceedance probability curve, showing how the percentage of uninsured risk varies by return period.

"There should be standardization in measuring and reporting the gap," he concludes. "This should include analyzing insured and economic loss based on probabilistic models, separating the effects of the penetration and coverage gaps, and identifying how gaps vary with annual probability and location."

INSURANCE-LINKED SECURITIES

ILS: A RESPONSIBLE INVESTMENT APPROACH

As environmental, social and governance principles become more prominent in guiding investment strategies, the ILS market must respond

In recent years, there has been a sharper focus by the investment community on responsible investment. One indicator of this has been the increased adoption of the Principles for Responsible Investment (PRI), as environmental, social and governance (ESG) concerns become a more prominent influencer of investment strategies.

Investment houses are also seeking closer alignment between their ESG practices and the United Nations' Sustainable Development Goals (SDGs). The 17 interconnected SDGs, set in 2015, are a call to action to end poverty, achieve peace and prosperity for all, and create a sustainable society by 2030.

As investors target more demonstrable outcomes from their investment practices, is there a possible opportunity for the insurance-linked securities (ILS) market to grow, given the potential societal capital that insurance can generate?

"Insurance certainly has all of the hallmarks of an ESG-compatible investment opportunity," believes Charlotte Acton, director of capital and resilience solutions at RMS. "It has the potential to promote resilience through enabling broader access and uptake of appropriate affordable financial protection and reducing the protection gap; supporting faster and more efficient responses to disasters; and incentivizing mitigation and resilient building practices pre- and post-event."

"INVESTORS WILL WANT A CLEAR UNDERSTANDING OF THE EXPOSURE OR ASSETS THAT ARE BEING PROTECTED AND WHETHER THEY ARE ESG-FRIENDLY"

— CHARLOTTE ACTON, RMS

RMS has been collaborating on numerous initiatives designed to further the role of insurance and insurance technologies in disaster and climate-change resilience. These include exploring ways to monetize the dividends of resilience to incentivize resilient building, using catastrophe models to quantify the benefits of resilience investments such as flood defenses, and earthquake retrofit programs for housing. The work has also involved designing innovative parametric structures to provide rapid post-disaster liquidity.

"ILS offers a clear route for investors to engage with insurance," explains Acton, "broadening the capital pool that supports insurance is critical as it facilitates the expansion of insurance to new regions and allows the industry to absorb increasingly large losses from growing threats such as climate change."

Viewed as a force for social good, it can certainly be argued that insurance-linked securities supports a number of the U.N.'s SDGs, including reducing the human impact of disasters and creating more sustainable cities, increasing overall resilience levels and increasing access to financial services that enhance sustainable growth potential.

While there is opportunity for ILS to play a large part in ESG, the specific role of ILS within PRI is still being determined. According to LGT Capital Partners ESG Report 2019, managers in the ILS space have, in general, yet to start "actively integrating ESG into their investment strategies," adding that across the ILS asset class "there is still little agreement on how ESG considerations should be applied."

However, there is movement in this area. For example, the Bermuda Stock Exchange, a primary exchange for ILS issuers, recently launched an ESG initiative in line with the World Federation of Exchanges' Sustainability Principles, stating that ESG was a priority in 2019 "with the aim to empower sustainable and responsible growth for its member companies, listings and the wider community."

For ILS to become a key investment option for ESG-focused investors, it must be able to demonstrate its sustainability credentials clearly.

"Investors will want a clear understanding of the exposure or assets that are being protected," Acton explains, "and whether they are ESG-friendly. They will want to know whether the protection offered provides significant societal benefits. If the ILS market can factor ESG considerations into its approach more effectively, then there is no reason why it should not attract greater attention from responsible investors."

FUTURE OF INSURANCE

INSURANCE: THE NEXT 10 YEARS

Mohsen Rahnama, Cihan Biyikoglu and Moe Khosravy of RMS look to 2029, consider the changes the (re)insurance industry will have undergone and explain why all roads lead to a platform

Over the last 30 years, catastrophe models have become an integral part of the insurance industry for portfolio risk management. During this time, the RMS model suite has evolved and expanded from the initial IRAS model — which covered California earthquake — to a comprehensive and diverse set of models covering over 100 peril-country combinations all over the world.

RMS Risk Intelligence™, an open and flexible platform, was recently launched, and it was built to enable better risk management and support profitable risk selection. Since the earliest versions of catastrophe models, significant advances have been made in both technology and computing power. These advances allow for a more comprehensive application of new science in risk modeling and make it possible for modelers to address key sources of model and loss uncertainty in a more systematic way.

These and other significant changes over the last decade are shaping the future of insurance. By 2029, the industry will be fully digitized, presenting even more opportunity for disruption in an era of technological advances. In what is likely to remain a highly competitive environment, market participants will need to differentiate based on the power of computing speed and the ability to mine and extract value from data to inform quick, risk-based decisions.

Laying the foundations

So how did we get here? Over the past few decades we have witnessed several major natural catastrophes including Hurricanes Andrew, Katrina and Sandy; the Northridge, Kobe, Maule, Tōhoku and Christchurch Earthquakes; and costly hurricanes and California wildfires in 2017 and 2018. Further, human-made catastrophes have

TECHNOLOGY HAS ALSO EQUIPPED THE INDUSTRY WITH MORE SOPHISTICATED TOOLS TO HARNESS LARGER DATASETS

included the terrorist attacks of 9/11 and major cyberattacks, such as WannaCry and NotPetya.

Each of these events has changed the landscape of risk assessment, underwriting and portfolio management. Combining the lessons learned from past events, including billions of dollars of loss data, with new technology has enhanced the risk modeling methodology, resulting in more robust models and a more effective way to quantify risk across diverse regions and perils.

The sophistication of catastrophe models has increased as technology has enabled a better understanding of root causes and behavior of events, and it has improved analysis of their impact. Technology has also equipped the industry with more sophisticated tools to harness larger datasets and run more computationally intensive analytics. These new models are designed to translate finer-grained data into deeper and more detailed insights. Consequently, we are creating better models while also ensuring model users can make better use of model results through more sophisticated tools and applications.

A collaborative approach

In the last decade, the pace at which technology has advanced is compelling. Emerging technology has caused the insurance industry to question if it is responding quickly and effectively to take advantage of new opportunities. In today's digital world, many segments of the industry are leveraging the power and capacity enabled by Cloud-computing environments to conduct intensive data analysis using robust analytics.

Such an approach empowers the industry by allowing information to be accessed quickly, whenever it is needed, to make effective, fully informed decisions. The development of a standardized, open platform creates smooth workflows and allows for rapid advancement, information sharing and collaboration in growing common applications.

The future of communication between various parties across the insurance value chain — insurers, brokers, reinsurers, supervisors and capital markets — will be vastly different from what it is today. By 2029, we anticipate the transfer of data, use of analytics and other collaborations will be taking place across a common platform. The benefits will include increased efficiency, more accurate data collection and improvements in underwriting workflow. A collaborative platform will also enable more robust and informed risk assessments, portfolio rollout processes and risk transfers. Further, as data is exchanged it will be enriched and augmented using new machine learning and AI techniques.

An elastic platform

We continue to see technology evolve at a very rapid pace. Infrastructure continues to improve as the cost of storage declines and computational speed increases. Across the board, the incremental cost of computing technology has come down.

Software tools have evolved accordingly, with modern big data systems now capable of handling hundreds if not thousands of terabytes of data. Improved programming frameworks allow for more seamless parallel programming. User-interface components reveal data in ways that were not possible in the past. Furthermore, this collection of phenomenal advances is now available in the Cloud, with the added benefit that it is continuously self-improving to support growing commercial demands.

In addition to helping avoid built-in obsolescence, the Cloud offers "elasticity." Elasticity means accessing many machines when you need them and fewer when you don't. It means storage that can dynamically grow and shrink, and computing capacity that can follow the ebb and flow of demand.

In our world of insurance and data analytics, the macro cycles of renewal seasons and micromodeling demand bursts can both be accommodated through the elastic nature of the Cloud. In an elastic world, the actual cost of supercomputing goes down, and we can confidently guarantee fast response times.

Empowering underwriters

A decade from now, the industry will look very different, not least due to changes within the workforce and the risk landscape. First-movers and fast-followers will be in a position of competitive advantage come 2029 in an industry where large incumbents are already partnering with more agile "insurtech" startups.

The role of the intermediary will continue to evolve, and at every stage of risk transfer — from insured to primary insurer, reinsurer and into the capital markets — data sharing and standardization will become key success factors. Over the next 10 years, as data becomes more standardized and more widely shared, the concept of blockchain, or distributed ledger technology, will move closer to becoming a reality.

This standardization, collaboration and use of advanced analytics are essential to the future of the industry. Machine learning and AI, highly sophisticated models and enhanced computational power will enable underwriters to improve their risk selection and make quick, highly informed decisions.

And this ability will enhance the role of the insurance industry in society, in a changing and altogether riskier world. The tremendous protection gap can only be tackled when there is more detailed insight and differentiation around each individual risk. When there is greater insight into the underlying risk, there is less need for conservatism, risks become more accurately and competitively priced, and (re)insurers are able to innovate to provide products and solutions for new and emerging exposures.

Over the coming decade, models will require advanced computing technology to fully harness the power of big data. Underwater robots are now probing previously unmapped ocean waters to detect changes in temperatures, currents, sea level and coastal flooding. Drones are surveying our built-up environment in fine detail. Artificial intelligence and machine learning algorithms are searching for patterns of climate change in these new datasets, and climate models are reconstructing the past and predicting the future at a resolution never before possible. These emerging technologies and datasets will help meet our industry's insatiable demand for more robust risk assessment at the level of an individual asset.

This explosion of data will fundamentally change the way we think about model execution and development, as well as the end-to-end software infrastructure. Platforms will need to be dynamic and forward-looking verses static and historic in the way they acquire, train, and execute on data.

The industry has already transformed considerably over the past five years, despite traditionally being considered a laggard in terms of its technology adoption. The foundation is firmly in place for a further shift over the next decade where all roads are leading to a common, collaborative industry platform, where participants are willing to share data and insights and, as they do so, open up new markets and opportunities.

Mohsen Rahnama *is chief risk modeling officer and executive vice president, models and data,* ***Cihan Biyikoglu*** *is executive vice president, product and* ***Moe Khosravy*** *is executive vice president, software and platform at RMS*

RMS Risk Intelligence

The analytical and computational power of the Risk Intelligence (RI) platform enables the RMS model development team to bring the latest science and research to the RMS catastrophe peril model suite and build the next generation of high-definition models. The functionality and high performance of RI allows the RMS team to assess elements of model and loss uncertainty in a more robust way than before.

The framework of RI is flexible, modular and scalable, allowing the rapid integration of future knowledge with a swifter implementation and update cycle. The open modeling platform allows model users to extract more value from their claims experience to develop vulnerability functions that represent a view of risk specific to their data or to use custom-built alternatives. This enables users to perform a wide range of sensitivity tests and take ownership of their view of risk.

RESILIENCE

As Christchurch City Council continues to build back better, will its resilience investment pay dividends when it comes to citywide insurance cover?

THE POWER OF A CRISIS

The Canterbury Earthquake Sequence is the largest insured event in New Zealand's history. Between September 2010 and December 2011, four major earthquakes caused damage to approximately 168,000 residential buildings.

The earthquakes spawned more than 770,000 claims for the country's Earthquake Commission (EQC) alone, resulting in a payout of around NZ$10 billion (US$6.4 billion). The private sector absorbed almost twice that, with the Insurance Council of New Zealand putting the figure at NZ$21.4 billion (as of March 31, 2019).

Nine years on from the initial tremors, there remain over 1,200 open property claims in the private market, while the outstanding figure for the EQC stood at some 2,600 claims in February 2018.

"Dealing with the property claims was extremely challenging," explains Raf Manji, chair of the Christchurch City Council's Finance Committee, "not just in terms of contractual issues, but because the insurance was based on building-by-building cover. And when you're dealing with damage to so many buildings, it is going to take a very long time to agree what that damage is."

Building back better

The need to rebuild Christchurch presented the city with an opportunity.

"As American politician Rahm Emanuel once said, 'Never let a crisis go to waste,'" says Lianne Dalziel, mayor of Christchurch. "The earthquakes provided a major opportunity to build back better and ensure we embed resilience into every aspect, from below ground up."

That commitment means that new construction, whether of above-ground assets or horizontal infrastructure, is being carried out to a level much higher than building codes dictate.

"We're building to an exceptionally high standard," states Mike Gillooly, chief resilience officer for the city. This is a relatively new public position created following Christchurch's inclusion in the first wave of the Rockefeller Foundation's 100 Resilient Cities program. "The city's art gallery, for example, has been retrofitted to resist even the most severe earthquake activity," Gillooly continues.

But this dedication to resilience goes beyond the immediate rebuild. The council is also making resilience a core component of its long-term strategic planning. The city's 2021-2051 infrastructure strategy, which covers the council's investments in water supply, wastewater, stormwater, transport, parks, facilities, solid waste and communication technology for the next 30 years, will have resilience as its overarching theme.

"This is the first time we are proactively building risk and resilience into our long-term planning framework," states Dalziel. "We are developing a much deeper appreciation of risk and have spent considerable time understanding our infrastructure. We are also working toward a much more sophisticated engagement with risk at the community level."

"It's not only about strengthening our physical infrastructure," she continues. "It's also about strengthening our social infrastructure."

"We are committed to promoting greater community well-being. We need to build up social capital by bringing people together to plan for an uncertain future. High levels of social capital accelerate recovery in the aftermath of a shock, while also creating greater inherent resilience to more slow-moving challenges, such as climate change and associated rising sea levels."

Dalziel is quick to stress the importance of insurance in all this. "There is a strong relationship between economic resilience and social resilience, and the role of insurance in facilitating both cannot be underestimated. The value of insurance does not simply equal the sum of claims paid — it's as much about the financial and social well-being that it supports."

Making resilience pay

Recently insurers across New Zealand have been shifting their appetite and premiums in high-hazard regions to be more reflective of the country's risk profile.

"WITH THE INFORMATION, WE WANT MORE INFORMED CONVERSATIONS WITH BOTH TRADITIONAL AND ALTERNATIVE MARKETS ABOUT HOW WE TRANSFER RISK MORE EFFECTIVELY" — RAF MANJI, CHRISTCHURCH CITY COUNCIL

Christchurch Art Gallery. The city's art gallery, for example, has been retrofitted to resist even the most severe earthquake activity.

There has been a shift too in the council's approach to insurance — a shift that is central to its resilience efforts, explains Manji.

"Following the earthquakes, Lianne asked me to run for council. I was a former financial markets trader and she wanted someone onboard with a financial background. But when I joined, I was taken aback by the lack of risk understanding that I saw at the local government level."

One of his first steps was to set up an independently chaired audit and risk committee and introduce a new risk management framework — a model that has since been adopted by Auckland.

"Through this new framework, we were able to establish a much more sophisticated view of risk," he explains, "and we also launched a five-year program to document every single asset in place — both above and below ground. Having this granular level of exposure insight means we can assess our approach to mitigating, retaining and transferring risk from a much more data-informed position."

At present, Christchurch is conservatively insured. This is a very deliberate choice, however, and Manji is convinced of the benefits of this approach.

"This excess capacity means we have headroom into which we can grow as we continue to construct new and reconstruct old assets. That's a much stronger position to be in than having to return to the market seeking more limit when capacity may be limited. It also demonstrates a long-term commitment to the insurance market upon which you can have much more constructive, ongoing dialogue."

Data-informed dialogue

Christchurch City Council has been making use of insurance capital for many years. It was the 2010-11 earthquakes, though, that spurred its focus on arming itself with increasingly higher-resolution data.

"We're now coming to the table each year with an ever more accurate picture of our exposure. Working with RMS, we've been able to significantly evolve our risk thinking based on a range of citywide loss scenarios, and to look at ways of creating a more effective balance between traditional and more innovative parametric-based solutions."

That desire for balance does not just apply to the source of Christchurch capital, but also what kinds of assets that capital covers. At present, while the council has secured coverage for 65 percent of the value of its above-ground structures, it has only managed to buy insurance to cover approximately 15 percent of its underground infrastructure.

"The insurance market is not comfortable with providing cover for underground infrastructure because it tends not to be well understood or documented," Manji continues.

"Unlike most cities, however, we know exactly what is underground and just how resilient it is. With that information, we want to have more informed conversations — with both the traditional market and alternative providers of risk capital — about how we transfer this risk more effectively. Parametric-based solutions, for example, give us the opportunity to look beyond typical building replacement covers and take a bigger-picture view of what we want to achieve from our investment in risk transfer.

"And whereas an indemnity-based policy is designed primarily to return you to where you were prior to the loss, parametric payouts can be deployed for whatever purpose you want. That flexibility — along with the speed and certainty of payout — is incredibly valuable."

For Gillooly, it is about becoming an increasingly sophisticated user of risk capital and engaging in ever more mature dialogue with the markets. "If we can demonstrate through the data and analytics that we understand the exposure, that we've quantified the risk and we're investing in effective risk reduction, then the market needs to acknowledge these efforts in the form of increased capacity, reduced premiums or both. Data, analytics and risk insights will continue to be the key focus of our annual discussions with the London market — and will allow us to explore parametric insurance-linked securities with confidence too."

Why the PRA's stress test has pushed climate change to the top of (re)insurance company agendas

TODAY'S STRESS TEST FOR TOMORROW'S CLIMATE

As part of its biennial insurance stress test, the U.K. insurance industry regulator has — for the first time — asked insurers and reinsurers to conduct an exploratory exercise in relation to climate change. Using predictions published by the United Nations' Intergovernmental Panel on Climate Change (IPCC) and in other academic literature, the Bank of England's Prudential Regulation Authority (PRA) has come up with a series of future climate change scenarios, which it has asked (re)insurers to use as a basis for stress-testing the impact on their assets and liabilities.

The PRA stress test comes at a time when pressure is building for commercial and financial services businesses around the world to assess the likely impact of climate change on their business, through initiatives such as the Task Force for Climate-Related Financial Disclosures (TCFD). Submission deadline for the stress-tested scenarios is October 31, 2019, following which the PRA will publish a summary of overall results.

From a property catastrophe (re)insurance industry perspective, the importance of assessing the potential impact, both in the near and long term, is clear. Companies must ensure their underwriting strategies and solvency levels are adequate so as to be able to account for additional losses from rising sea levels, more climate extremes, and potentially more frequent and/or intense natural catastrophes. Then there's the more strategic considerations in the long term — how much coverages change and what will consumers demand in a changing climate?

The PRA stress test, explains Callum Higgins, product manager of global climate at RMS, is the regulator's attempt to test the waters. The hypothetical narratives are designed to help companies think about how different plausible futures could impact their business models, according to the PRA. "The climate change scenarios are not designed to assess current financial resilience but rather to provide additional impetus in this area, with results comparable across firms to better understand the different approaches companies are using."

RMS is particularly well placed to support (re)insurers in responding to the "Assumptions to Assess the Impact on an Insurer's Liabilities" section of the climate change scenarios, with catastrophe models the perfect tools to evaluate such physical climate change risk to liabilities. This portion of the stress test examines how changes in both U.S. hurricane and U.K. weather risk under the different climate change scenarios may affect losses.

The assumptions around U.K. weather include shifts in U.K. inland and coastal flood hazard, looking at the potential loss changes from increased surface runoff and sea level rise. While in the U.S., the assumptions include a 10 percent and 20 percent increase in the frequency of major hurricanes by 2050 and 2100, respectively.

"While the assumptions and scenarios are hypothetical, it is important (re)insurers use this work to develop their capabilities to understand physical climate change risk," says Higgins. "At the moment, it is exploratory work, but results will be used to guide future exercises that may put (re)insurers under pressure to provide more sophisticated responses."

Given the short timescales involved, RMS has promptly modified the necessary models in time for clients to benefit for their submissions. "To help clients start thinking about how to respond to the PRA request, we have provided them with industrywide factors, which allow for the approximation of losses under the PRA assumptions but will likely not accurately reflect the impact on their portfolios. For this reason, we are also running (re)insurers' own exposures through the adjusted models, via RMS Analytical Services, better satisfying the PRA's requirements for those who choose this approach.

"To reasonably represent these assumptions and scenarios, we think it does need help from vendor companies like RMS to adjust the model data appropriately, which is possibly out of scope for many businesses," he adds.

Detailed results based on the outcome of the stress-test exercise can be applied to use cases beyond the regulatory submission for the PRA. These or other similar scenarios can be used to sensitivity test possible answers to questions such as how will technical pricing of U.K. flood be affected by climate change, how should U.S. underwriting strategy shift in response to sea level rise or how will capital adequacy requirements change as a result of climate change — and inform strategic decisions accordingly.

PRA climate change scenarios

SOURCE: PRUDENTIAL REGULATION AUTHORITY

SCENARIO A

A sudden transition scenario materializing over the medium-term business planning horizon that results in achieving a maximum temperature increase of 2˚C (relative to preindustrial levels) by 2100, but only following a **disorderly transition**. In this scenario, transition risk is maximized. Firms are invited to undertake scenario analysis assuming the Minsky moment has occurred by 2022.

SCENARIO B

A long-term **orderly transition** scenario that is broadly in line with the Paris Agreement. This involves a maximum temperature increase of 2˚C by 2100 (relative to preindustrial levels) with the economy transitioning to be greenhouse gas neutral in the next three decades by 2050.

SCENARIO C

A "hothouse" scenario reaching a maximum temperature increase of 5˚C (relative to preindustrial levels) by 2100, assuming no transition where physical climate change is maximized following an emissions pattern similar to an IPCC RCP 8.5. Firms have been asked to consider their physical risks as of 2100.

"THERE IS PRESSURE ON CLIENTS TO RESPOND TO THIS BECAUSE THOSE THAT DON'T PARTICIPATE WILL PROBABLY COME UNDER GREATER SCRUTINY"

— CALLUM HIGGINS, RMS

CLIMATE CHANGE

Insurance-linked securities (ILS) investors want to know more about how climate change impacts investment decisions, according to Paul Wilson, head of non-life analytics at Securis Investment Partners, an ILS asset manager

A CLIMATE MODEL CHALLENGE

"We make investments that are typically annual to two-to-three years in duration, so we need to understand the implications of climate change on those timescales," explains Paul Wilson, head of non-life analytics at Securis Investment Partners. "We reevaluate investments as part of any renewal process, and it's right to ask if any opportunity is still attractive given what we know about how our climate is changing.

"The fundamental question that we're trying to address is, 'Have I priced the risk of this investment correctly for the next year?'" he continues. "And therefore, we need to know if the catastrophe models we are using accurately account for the impact climate change may be having. Or are they overly reliant on historical data and, as such, are not actually representing the true current risk levels for today's climate?"

Expertise in climate change is a requirement for how Securis is thinking about risk. "We have investors who are asking questions about climate change, and we have a responsibility to be able to demonstrate to them that we are taking the implications into consideration in our investment decisions."

The rate at which a changing climate may influence natural catastrophes will present both a challenge and opportunity to the wider industry as well as to catastrophe modeling companies, thinks Wilson. The results coming out of climate change attribution studies are going to have to start informing the decisions around risk. For example, according to attribution studies, climate change tripled the chances of Hurricane Harvey's record rainfall.

"Climate change is a big challenge for the catastrophe modeling community," he says. "It's going to put a greater burden on catastrophe modelers to ensure that their models are up to date. The frequency and nature of model updates will have to change. Models we are using today may become out of date in just a few years' time. That's interesting when you think about the number of perils and regions where climate change could have a significant impact.

"All of those climate-related models could be impacted by climate change, so we have to question the impact that is having today," he adds. "If the model you are using to price the risk has been calibrated to the last 50 years, but you believe the last 10 or last 20 years are more representative because of the implication of climate change, then how do you adjust your model according to that? That's the question we should all be looking to address."

"WE HAVE INVESTORS WHO ARE ASKING QUESTIONS ABOUT CLIMATE CHANGE, AND WE HAVE A RESPONSIBILITY TO DEMONSTRATE TO THEM THAT WE ARE TAKING THE IMPLICATIONS INTO CONSIDERATION IN OUR INVESTMENT DECISIONS"

— PAUL WILSON, SECURIS INVESTMENT PARTNERS

RISK DATA OBJECT

A DATA STEP CHANGE

With the introduction of the Risk Data Object open data standard, the potential now exists to change the way the (re)insurance industry interacts with risk modeling data

In May, RMS introduced the (re)insurance industry to a new open data standard. Set to redefine how the market structures data, the Risk Data Object (RDO) offers a flexible, fully transparent and highly efficient framework — spanning all risks, models and contracts and information sets — that can be be implemented using a wide range of data technology.

That this new standard has the potential to alter fundamentally how the market interacts with exposure data is not hyperbole. Consider the formats that it is replacing. The RMS Exposure and Results Data Modules (EDM and RDM) have been the data cornerstones of the property catastrophe market for over 20 years. Other vendors use similar data formats, and some catastrophe modeling firms have their own versions. These information workhorses have served the sector well, transforming the way property catastrophe risk is transacted, priced and managed.

Out with the old

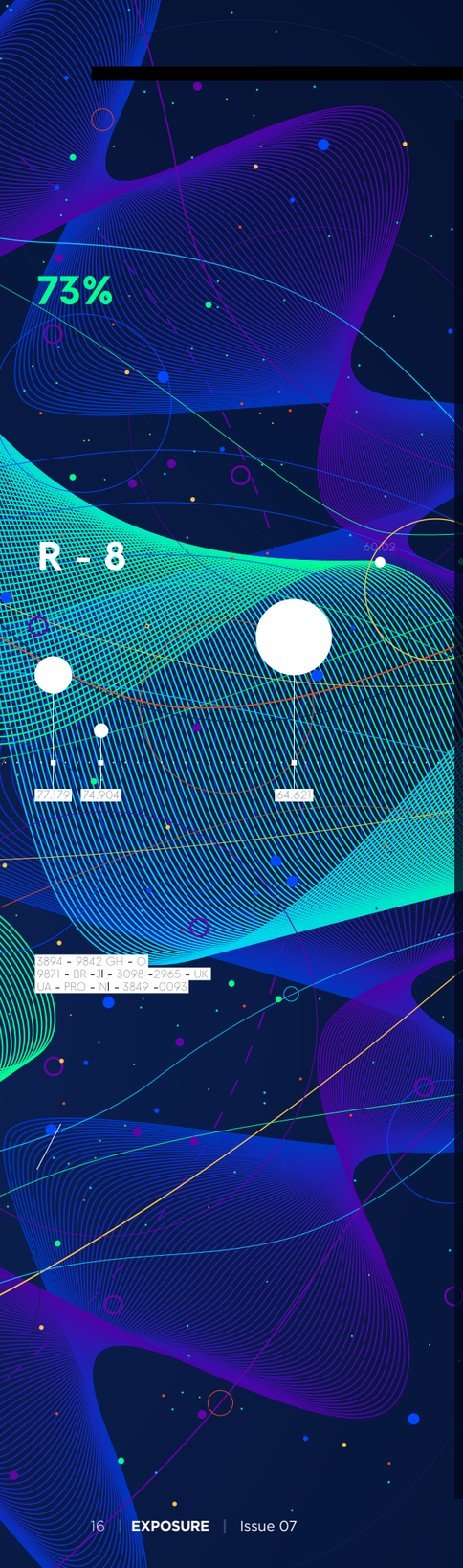
But after over two decades of dedicated service, it is past time these formats were put out to pasture. Built to handle a narrow range of modeling approaches, limited in their ability to handle multiple information formats, property-centric by design and powered by outdated technology, the EDM/RDM and other formats represent "old-gen" standards crumbling under current data demands.

"EDM and RDM have earned their status as the de facto standards for property catastrophe data exchange," explains Ryan Ogaard, senior vice president at RMS. "Clearly documented, easy to implement, SQL-based, they were groundbreaking and have been used extensively in systems and processes for over 20 years. But the industry has evolved well beyond the capabilities of all the existing formats, and a new data model must be introduced to facilitate innovation and efficiency across our industry."

The RDO is not the only attempt to solve the data formatting challenge. Multiple other initiatives have been attempted, or are underway, to improve data efficiency within the insurance industry. However, Ogaard believes all of these share one fatal flaw — they do not go far enough.

"I have been involved in various industry groups exploring ways to overcome data challenges," he explains, "and have examined the potential of different options. But in every instance, what is clear is that they would not advance the industry far enough to make them worth switching to."

The switching costs are a major issue with any new data standard. Transitioning to a new format from one so firmly embedded within your data hierarchy is a considerable move. To shift to a new standard that offers only marginal relief from the data pains of the current system would not be enough.



"The industry needs a data container that can be extended to new coverages, risk types or contracts," he states. "If we require a different format for every line of business or type of model, we end up with a multiplicative world of data inefficiency. Look at cyber risk. We've already created a separate new standard for that information. If our industry is truly going to move forward, the switch must solve our challenges in the short, medium and long term. That means a future-proof design to handle new models, risks and contracts — ideally all in one container."

Setting the standard

Several years in the making, the RDO is designed to address every deficiency in the current formatting framework, providing a data container that can be easily modified as needs change and can deliver information in a single, auditable format that supports a wide range of analytics.

"The RDO is designed to be extended across several dimensions," Ogaard continues. "It can handle the data and output to support any modeling algorithm — so RMS, or anyone else, can use it as a basis for new or existing models. It was originally built to support our high-definition (HD) modeling, which requires a domain-specific language to represent policy or treaty terms and structures — that was not possible with the old format. During that process, we realized that we should design a container that would not have to be replaced in the future when we inevitably build other types of models."

The RDO can also span all business lines. It is designed to accommodate the description of any risk item or subject at risk. The standard has inherent flexibility — new tables can be introduced to the framework without disrupting existing sets, while current tables can be extended to handle information for multiple model types or additional proprietary data.

"EDM and RDM were fundamental to creating a much more stable, resilient and dynamic marketplace," says Ogaard. "That level of modeling simply isn't available across other lines — but with the RDO it can be. Right off the bat, that has huge implications for issues such as clash risk. By taking the data that exists across your policy and treaty systems and converting it into a single data format, you can then apply an accumulation engine to evaluate all clash scenarios. So, essentially, you can tackle accumulation risk across all business lines."

It is also built to encompass the full "risk story." Current data formats essentially provide exposure and modeling results, but lack critical information on how the exposure was used to create the results. This means that anyone receiving these data sets must rely on an explanation of how an analysis was done — or figure it out themselves.

"The RDO has been constructed to hold the entire set of information that supports the analysis of any risk," he explains. "This includes exposures, (re)insurance coverage information, the business structure used to create the results, complete model settings and adjustments, the results, and the linkage between the information. Multiple analyses can also be included in a single container. That means more time can be spent on accurate risk decision-making."

The RDO is also independent of any specific technology and can be implemented in modern object relational technology, making it highly flexible. It can also be implemented in SQL Server if the limitations of a relational representation are adequate for the intended usage. The insurance industry, and cat analytics software, has been slow to adopt the power of tools such as Parquet, Spark, Athena and other new and powerful (and often open-source) data tools that can drive more data insights.

Opening the box

For the RDO to achieve its full potential, however, it cannot be constrained by ownership. By its very nature, it must be an open standard operated in a neutral environment if it is to be adopted by all and serve a larger market purpose.

RMS recognized this and donated the RDO to the industry (and beyond) as an open standard, harnessing open-source principles common in the software industry. Taking this route is perhaps not surprising given the executive leadership now in place at the company, with both CEO Karen White and Executive Vice President of Product Cihan Biyikoglu having strong open-source credentials.

"When they saw the RDO," Ogaard explains, "it clearly had all of the hallmarks of an open-source candidate. It was being built by a leading market player with an industrywide purpose that required a collaborative approach."

What RMS has created with the RDO represents a viable standard — but rather than a finished product, it is a series of building blocks designed to create a vast range of new applications from across the market. And to do that it must be a completely open standard that can evolve with the industry.

"Some companies claim to have open standards," he continues, "but by that they mean that you can look inside the box. Truly open standards are set up to be overseen and actually modified by the industry. With the RDO, companies can not only open the box, but take the standard out, use it and modify it to create something better. They can build additions and submit them for inclusion and use by the entire industry. The RDO standard will not be driven by RMS needs and priorities — it will exist as a separate entity. RMS cannot build every potential solution or model. We hope that by making this an open standard, new synergy is created that will benefit everyone — including us, of course."

Under scrutiny

To create a standard fit for all, RMS accepted that the RDO could not be built in isolation and pushed out into the market — it had to be tested, the underlying premise reviewed, the format scrutinized.

To ensure this, the company set up a steering committee from across the (re)insurance market. Charged with putting the RDO through its paces, the committee members are given a central role in virtually every development stage. The committee is currently fourteen companies strong and growing. It will be dynamic and membership will change over time as issues and company focuses evolve. The membership list can be seen at www.riskdataobject.com.

"THE RDO HAS BEEN CONSTRUCTED TO HOLD THE ENTIRE SET OF INFORMATION THAT SUPPORTS THE ANALYSIS OF ANY RISK"
— RYAN OGAARD, RMS

"You cannot sit in an ivory tower and decide what might work for the industry as a whole," Ogaard explains. "You need a robust vetting process and by creating this group of leading (re)insurance practitioners, each committed not simply to the success of the project but to the development of the best possible data solution, the RDO open standard will be guided by the industry, not just one company."

The role of the committee is twofold. Currently, it is to review the existing specification, documentation and tooling to determine if they are ready for market consumption. Once the RDO is published, the committee's role will be to advise on the priorities and scope of future developments based on market-led requests for change and improvement.

Set for its industry launch in January 2020, the data specification, documentation and tooling is currently undergoing an end-to-end review. While not yet released publicly, it is already used within the framework of the recently launched risk management platform RMS Risk Intelligence™.

"Almost every open standard in any industry is based on a real, working product — not a theoretical construct," he states. "Because the RDO was built for a practical purpose and is in real-world use, it is much more likely to hold up to wider use and scrutiny."

So, while the RDO may be an unknown entity to the wider market, it has already established its data credentials within the RMS model framework.

Of course, there remains the fundamental challenge of shifting from one data format to another — but measures are already in place to make this as painless as possible.

"The RDO is essentially a superset of the original EDM and RDM formats," he explains, "offering an environment in which the new and old standards are interchangeable. So, a company can translate an EDM into an RDO and vice versa. The open standard tooling will include translators to make this translation. The user will therefore be able to operate both formats simultaneously and, as they recognize the RDO data benefits, transition to that environment at their own pace. The RDO could be extended to include other modelers' data fields as well — so could solve model interoperability issues — if the industry decides to use it this way."

The standard will launch on the global development platform GitHub, which supports open-source standards, offering a series of downloadable assets including the RDO specification, documentation, tools and data so that companies can create their own implementation and translate to and from old data formats.

The potential that it creates is considerable and to a degree only limited by the willingness of users to push boundaries.

"Success could come in several forms," Ogaard concludes. "The RDO becomes the single universal container for data exchange, creating huge efficiencies. Or it creates a robust ecosystem of developers opening up new opportunities and promoting greater industry choice. Or it supports new products that could not be foreseen today and creates synergies that drive more value — perhaps even outside the traditional market. Ideally, all of these things."

CASUALTY

Are (re)insurers sufficiently capitalized to withstand a major earthquake in a metropolitan area during peak hours?

SHAKING UP WORKERS' COMPENSATION

The U.S. workers' compensation insurance market continues to generate underwriting profit. According to Fitch Ratings, 2019 is on track to mark the fifth consecutive year of profits and deliver a statutory combined ratio of 86 percent in 2018. Since 2015, it has achieved an annual average combined ratio of 93 percent.

The market's size has increased considerably since the 2008 financial crisis sparked a flurry of activity in the workers' compensation arena. Over the last 10 years, written premiums have risen 50 percent from approximately US$40 billion to almost US$60 billion, aided by low unemployment and growth in rate and wages.

Yet market conditions are changing. The pricing environment is deteriorating, prior-year reserve releases are slowing and severity is ticking upwards. And while loss reserves currently top US$150 billion, questions remain over whether these are sufficient to bear the brunt of a major earthquake in a highly populated area.

The big one

California represents over 20 percent of the U.S. workers' compensation market. The Workers' Compensation Insurance Rating Bureau of California (WCIRB) forecasts a written premium pot of US$15.7 billion for 2019, a slight decline on 2018's US$17 billion figure.

"So, the workers' compensation sector's largest premium is concentrated in the area of the U.S. most exposed to earthquake risk," explains Nilesh Shome, vice president at RMS. "This problem is unique to the U.S., since in most other countries occupational injury is covered by government insurance schemes instead of the private market. Further, workers' compensation policies have no limits, so they can be severely impacted by a large earthquake."

Workers' compensation insurers enjoy relatively healthy balance sheets, with adequate profitability and conservative premium-to-surplus ratios. But, when you assess the industry's exposure to large earthquakes in more detail, the surplus base starts to look a little smaller.

"We are also talking about a marketplace untested in modern times," he continues. "The 1994 Northridge Earthquake in Los Angeles, for example, while causing major loss, occurred at 4:30 a.m. when most people were still in bed, so had limited impact from a workers' compensation perspective."

Analyzing the numbers

Working with the WCIRB, RMS modeled earthquake scenarios using Version 17 of the RMS® North America Earthquake Casualty Model, which incorporates the latest science in earthquake hazard and vulnerability research. The portfolio provided by the WCIRB contained exposure information for 11 million full-time-equivalent employees, including occupation details for each.

The analysis showed that the average annual estimated insured loss is US$29 million, which corresponds to 0.5 cents per $100 payroll and $2.50 per employee.

The 1-in-100-year insurance loss is expected to exceed US$300 million, around 5,000 casualties including 300 fatalities; while at peak work-time hours, the loss could rise to US$1.5 billion. For a 1-in-250-year loss, the figure could top US$1.4 billion and more than 1,000 fatalities, rising to US$5 billion at peak work-time hours. But looking at the magnitude 7.8 San Francisco Earthquake in 1906 at 5:12 a.m., the figure would be 7,300 injuries, 1,900 fatalities and around US$1 billion in loss. At peak work hours, this would rise to 22,000 casualties, 5,800 fatalities and a US$3 billion loss.

To help reduce the impact of major earthquakes, RMS is working with the Berkeley Research Lab and the United States Geological Survey (USGS) to research the benefits of an earthquake early warning system (EEWS) and safety measures such as drop-cover-hold and evacuating buildings after an EEWS alarm. Initial studies indicate that an EEWS alert for the large, faraway earthquakes such as the 1857 magnitude 7.9 Fort Tejon Earthquake near Los Angeles can reduce injuries by 20 percent-50 percent.

Shome concludes: "It is well known in the industry that workers' compensation loss distribution has a long tail, and at conferences RMS has demonstrated how our modeling best captures this tail. The model considers many low probability, high consequence events by accurately modeling the latest USGS findings."

RISK TROPISM

Why is it that, in many different situations and perils, people appear to want to relocate toward the risk? What is the role of the private insurance and reinsurance industry in curbing their clients' risk tropism?

LIKE MOTHS TO THE FLAME

If the Great Miami Hurricane of 1926 were to occur again today it would result in insurance losses approaching US$200 billion. Even adjusted for inflation, that is hundreds of times more than the US$100 million damage toll in 1926. Over the past 100 years, the Florida coast has developed exponentially, with wealthy individuals drawn to buying lavish coastal properties — and the accompanying wind and storm-surge risks. Since 2000, the number of people living in coastal areas of Florida increased by 4.2 million, or 27 percent, to 19.8 million in 2015, according to the U.S. Census Bureau.

This is an example of unintended "risk tropism," explains Robert Muir-Wood, chief research officer at RMS. Just as the sunflower is a 'heliotrope,' turning toward the sun, research has shown how humans have an innate drive to live near water, on a river or at the beach, often at increased risk of flood hazards.

"There is a very strong human desire to find the perfect primal location for your house. It is something that is built deeply into the human psyche," Muir-Wood explains. "People want to live with the sound of the sea, or in the forest 'close to nature,' and they are drawn to these locations thinking about all the positives and amenity values, but not really understanding or evaluating the accompanying risk factors.

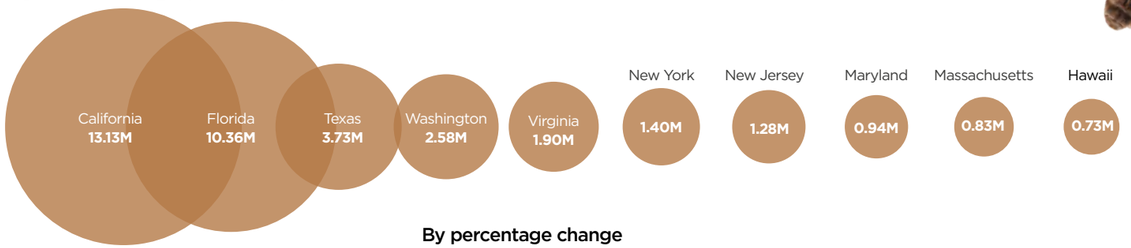
"People will pay a lot to live right next to the ocean," he adds. "It's an incredibly powerful force and they will invest in doing that, so the price of land goes up by a factor of two or three times when you get close to the beach."

Risk tropism

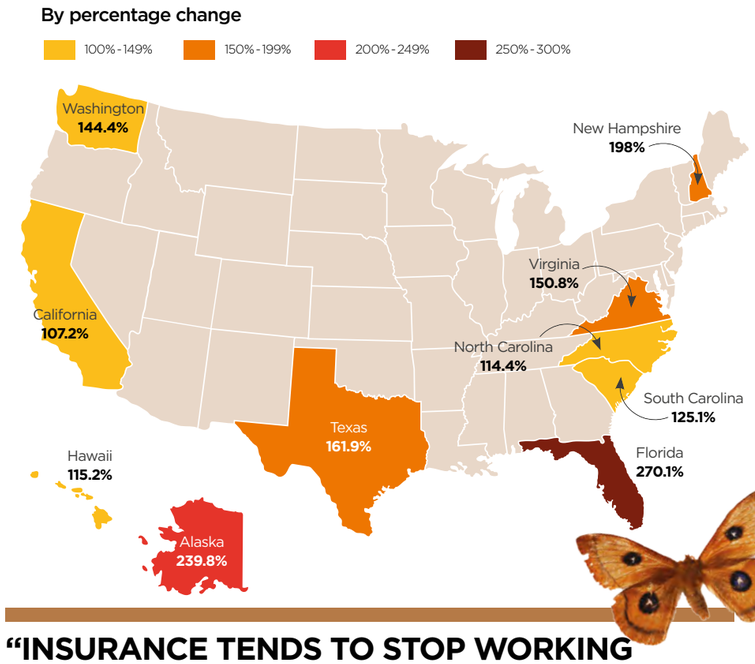
Top 10 states by population change in U.S. coastal counties, 1960-2010

SOURCE: U.S. DEPARTMENT OF COMMERCE, CENSUS BUREAU

By number change (in millions)



By percentage change



Even when beachfront properties are wiped out in hurricane catastrophes, far from driving individuals away from a high-risk zone, research shows they simply "build back bigger," says Muir-Wood. "The disaster can provide the opportunity to start again, and wealthier people move in and take the opportunity to rebuild grander houses. At least the new houses are more likely to be built to code, so maybe the reduction in vulnerability partly offsets the increased exposure at risk."

Risk tropism can also be found with the encroachment of high-value properties into the wildlands of California, leading to a big increase in wildfire insurance losses. Living close to trees can be good for mental health until those same trees bring a conflagration. Insurance losses due to wildfire exceeded US$10 billion in 2017 and have already breached US$12 billion for last year's Camp, Hill and Woolsey Fires, according to the California Department of Insurance. It is not the number of fires that have increased, but the number of houses consumed by the fires.

Muir-Wood notes that the footprint of the 2017 Tubbs Fire, with claims reaching to nearly US$10 billion, was very similar to the area burned during the Hanley Fire of 1964. The principal difference in outcome is driven by how much housing has been developed in the path of the fire. "If a fire like that arrives twice in one hundred years to destroy your house, then the amount you are going to have to pay in insurance premium is going to be more than 2 percent of the value per year," he says.

"INSURANCE TENDS TO STOP WORKING WHEN YOU HAVE LEVELS OF RISK ABOVE ONE PERCENT [...] PEOPLE ARE UNPREPARED TO PAY FOR IT"

— ROBERT MUIR-WOOD, RMS

"People will think that's unjustified and will resist it, but actually insurance tends to stop working when you have levels of risk cost above 1 percent of the property value, meaning, quite simply, that people are unprepared to pay for it."

Risk tropism can also be found in the business sector, in the way that technology companies have clustered in Silicon Valley: a tectonic rift within a fast-moving tectonic plate boundary. The tectonics have created the San Francisco Bay and modulate the climate to bring natural air-conditioning.

"Why is it that, around the world, the technology sector has picked locations — including Silicon Valley, Seattle, Japan and Taiwan — that are on plate boundaries and are earthquake prone?" asks Muir-Wood. "There seems to be some ideal mix of mountains and water. The Bay Area is a very attractive environment, which has brought the best students to the universities and has helped companies attract some of the smartest people to come and live and work in Silicon Valley," he continues. "But one day there will be a magnitude 7+ earthquake in the Bay Area that will bring incredible disruption, that will affect the technology firms themselves."

Insurance and reinsurance companies have an important role to play in informing and dissuading organizations and high net worth individuals from being drawn toward highly exposed locations; they can help by pricing the risk correctly and maintaining underwriting discipline. The difficulty comes when politics and insurance collide.

The growth of Fair Access to Insurance Requirements (FAIR) plans and beach plans, offering more affordable insurance in parts of the U.S. that are highly exposed to wind and quake perils, is one example of how this function is undermined. At its peak, the size of the residual market in hurricane-exposed states was US$885 billion, according to the Insurance Information Institute (III). It has steadily been reduced, partly as a result of the influx of non-traditional capacity from the ILS market and competitive pricing in the general reinsurance market.

However, in many cases the markets-of-last-resort remain some of the largest property insurers in coastal states. Between 2005 and 2009 (following Hurricanes Charley, Frances, Ivan and Jeanne in 2004), the plans in Mississippi, Texas and Florida showed rapid percentage growth in terms of exposure and number of policyholders. A factor fueling this growth, according to the III, was the rise in coastal properties.

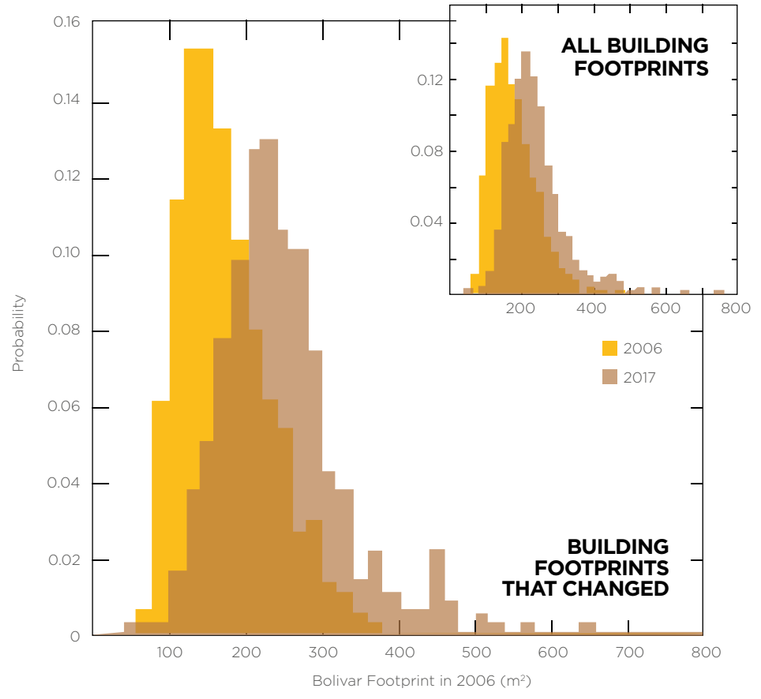
As long as state-backed insurers are willing to subsidize the cost of cover for those choosing to locate in the riskiest locations, private (re)insurance will fail as an effective check on risk tropism, thinks Muir-Wood. "In California there are quite a few properties that have not been able to get standard fire insurance," he observes. "But there are state or government-backed schemes available, and they are being used by people whose wildfire risk is considered to be too high."

Florida showed rapid percentage growth in terms of exposure and number of policyholders

Building back bigger in hurricane strike zones

Comparisons of building footprint size in pre-storm versus 2017 — the images show that categorical changes in residential development occurred. Pre-storm and 2017 imagery for the Bolivar Peninsula was obtained from Google Earth. Building footprints were digitized manually and their areas were calculated using GIS software.

SOURCE: BUILDING BACK BIGGER IN HURRICANE STRIKE ZONES: LAZARUS ET AL. NATURE SUSTAINABILITY VOL 1 DECEMBER 2018: 759-762



At this year's RMS Exceedance conference in Miami, Robert Muir-Wood and Michael Steel imagined 10 future risks

RISK IN 2030

1 HUMAN SOFTWARE INTERFACE

"Whilst automated systems reduce error and improve safety, the human controller needs to be ready to take control when automation fails."

— MICHAEL STEEL, GLOBAL HEAD OF SOLUTIONS AT RMS

2 MANUFACTURING 'NATURAL' CATASTROPHES

"Whether in giant industrial estates, vast port complexes or proliferating cities — especially those on the tectonic or cyclone front line — we have huge concentrations of risk."

— ROBERT MUIR-WOOD, CHIEF RESEARCH OFFICER AT RMS

41
tremors in Oklahoma in 2010

>900
earthquakes in Oklahoma in 2015

US$10.5 B
estimated liabilities incurred by PG&E related to the 2018 Camp Fire

M6.4
magnitude of the 1933 Long Beach Earthquake, which occurred during the Los Angeles oil boom

3 SYSTEMIC RISK

The Tōhoku Earthquake and Tsunami and Thailand Floods in 2011 provided a clear demonstration of the impact of systemic supply chain risk.

87%
of global trade is seaborne

93,257 TEUs
number of container units handled in the first 10 months of 2018 at Brunei's Muara Port

7.08 M tonnes
annual handling capacity of the new Doraleh Port in Djibouti, part of China's "Belt and Road" initiative

4 MODIFIED CLIMATE

California is moving toward a "whiplash climate," characterized by wetter, shorter winters and longer, drier summers. These are conditions that will substantially increase wildfire risk.

>US$10 B
insurance losses due to wildfire in 2017 and 2018

<US$100 M
average wildfire claims between 1964 and 1990

US$3.7 B
average wildfire claims between 2011 and 2018

"In the 53 years between 1964 and 2017, it was not the fires expanding into the exposure, but the exposure that was expanding into the path of the fires."

— ROBERT MUIR-WOOD, RMS

5 NEW TECHNOLOGY RISKS

"For years, manufacturers have been releasing products without giving much thought to security, so there are a lot of 'smart' devices out there vulnerable to relatively simple attacks."

— TOM GAFFNEY, OPERATOR CONSULTANT AT F-SECURE

6 RISK TROPISMS

"Humans have an inadvertent risk tropism ... a tendency to move toward risk."

— ROBERT MUIR-WOOD, RMS

Find out more on page 19.

7 AUTOMOTIVE DISRUPTION

As risk and ownership patterns change, motor insurance premiums will shrink dramatically. Currently, motor insurance represents over 40 percent of U.S. P&C insurance premiums.

57%
proportion of total auto losses covered by product liability insurance in 2050

70%
how much motor insurance premiums are expected to shrink by 2050

US$137 B
amount of P&C motor premiums that could leave the market by 2050

"With this diversifying risk no longer available, residual P&C portfolios will become riskier and require more detailed evaluation and more robust data and analytics."

— MICHAEL STEEL, RMS

8 SOCIAL MEDIA INTERFACE

On September 14, 2014, Hurricane Odile made a direct hit on the resort city of Cabo San Lucas in Mexico, located at the southern tip of Baja California. The only landfall pressure observation (at 943.1 mb) was made by hurricane hunter Josh Morgerman.

"If near-landfall pressures are measured by hurricane hunters, does this alter the pressure-in-a-box risk analysis? What if the hurricane hunter were themselves an investor in the bond?"

— ROBERT MUIR-WOOD, RMS

9 CYBER WARFARE

US$4 B - US$8 B
estimated cost of the NotPetya attack

US$100 M
size of the rejected claim issued by Mondelez for the NotPetya attack

US$250 M - US$300 M
Maersk's estimated revenue loss due to the NotPetya attack

"The challenge for our industry is whether in the situations like state-backed ransomware attacks we revert to war exclusions, or, as we've seen with other types of new technology, we try to embrace the risk and provide appropriate insurance coverage and risk advice."

— MICHAEL STEEL, RMS

10 OLD RISKS REEMERGE

High-rise fires have returned as a result of flammable cladding, and old diseases are reemerging like influenza.

"We have the perennial question around what the new asbestos is. What is going to cause long-running liabilities and insurance payouts across multiple industry sectors? The answer is quite likely to be asbestos."

— MICHAEL STEEL, RMS

CONVECTIVE STORMS

Severe convective storms (SCS) have driven U.S. insured catastrophe losses in recent years with both attritional and major single-event claims now rivaling an average hurricane season. EXPOSURE looks at why SCS losses are rising and asks how (re)insurers should be responding

SEVERE CONVECTIVE STORMS: A NEW PEAK PERIL?

2019 is already shaping up to be another active season for U.S. severe convective storms (SCS), with at least eight tornadoes daily over a period of 12 consecutive days in May. It was the most May tornadoes since 2015, with no fewer than seven outbreaks of SCS across central and eastern parts of the U.S. According to data from the National Oceanic and Atmospheric Administration (NOAA), there were 555 preliminary tornado reports, more than double the average of 276 for the month in the period of 1991-2010.

According to the current numbers, May 2019 produced the second-highest number of reported tornadoes for any month on record after April 2011, which broke multiple records in relation to SCS and tornado touchdowns. It continues a trend set over the past two decades, which has seen SCS losses increasing significantly and steadily. In 2018, losses amounted to US$18.8 billion, of which US$14.1 billion was insured. This compares to insurance losses of US$15.6 billion for hurricane losses in the same period. While losses from SCS are often the buildup of losses from multiple events, there are examples of single events costing insurers and reinsurers over US$3 billion in claims. This includes the costliest SCS to date, which hit Tuscaloosa, Alabama, in April 2011, involving several tornado touchdowns and causing US$7.9 billion in insured damage. The second-most-costly SCS occurred in May of the same year, striking Joplin, Missouri, and other locations, resulting in insured losses of nearly US$7.6 billion.

According to RMS models, average losses from SCS now exceed US$15 billion annually and are in the same range as hurricane average annual loss (AAL), which is also backed up by independently published scientific research. "The losses in 2011 and 2012 were real eye-openers," says Rajkiran Vojjala, vice president of model development at RMS. "SCS is no longer a peril with events that cost a few hundred million dollars. You could have cat losses of US$10 billion in today's money if there were events similar to those in April 2011."

Nearly a third of all average annual reported tornadoes occur in the states of Texas, Oklahoma, Kansas and Nebraska, all states that are within the "Tornado Alley." This is where cold, dry polar air meets warm, moist air moving up from the Gulf of Mexico, causing strong convective activity. "A typical SCS swath affects many states. So the extent is large, unlike, say, wildfire, which is truly localized to a small particular region," says Vojjala.

"THE TREND IN THE SCIENTIFIC DISCUSSION IS THAT THERE MIGHT BE FEWER BUT MORE-SEVERE EVENTS" — JUERGEN GRIESER, RMS

Research suggests the annual number of Enhanced Fujita (EF) scale EF2 and stronger tornadoes hitting the U.S. has trended upward over the past 20 years; however, there is some doubt over whether this is a real meteorological trend. One explanation could be that increased observational practices simply mean that such weather phenomena are more likely to be recorded, particularly in less populated regions.

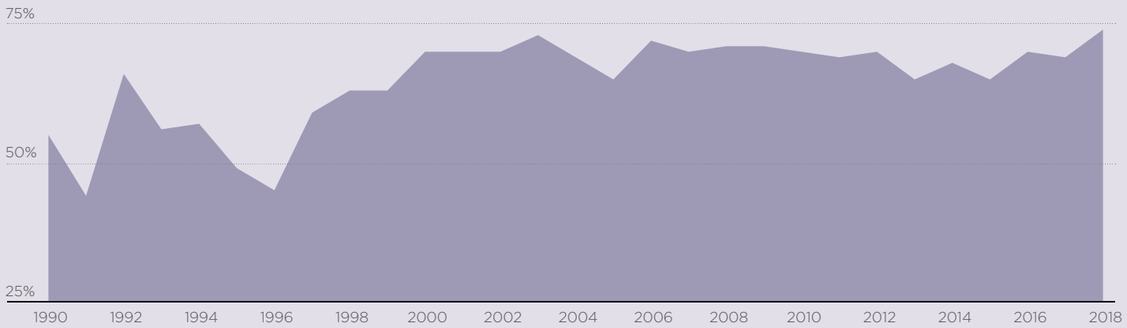
According to Juergen Grieser, senior director of modeling at RMS, there is a debate whether part of the increase in claims relating to SCS could be attributed to climate change. "A warmer climate means a weaker jet stream, which should lead to less organized convection while the energy of convection might increase," he says. "The trend in the scientific discussion is that there might be fewer but more-severe events."

Claims severity rather than claims frequency is a more significant driver of losses relating to hail events, he adds. "We have an increase in hail losses of about 11 percent per year over the last 15 years, which is quite a lot. But 7.5 percent of that is from an increase in the cost of individual claims," explains Grieser. "So, while the claims frequency has also increased in this period, the individual claim is more expensive now than it was ever before."

The mounting claims cost of U.S. severe convective storms

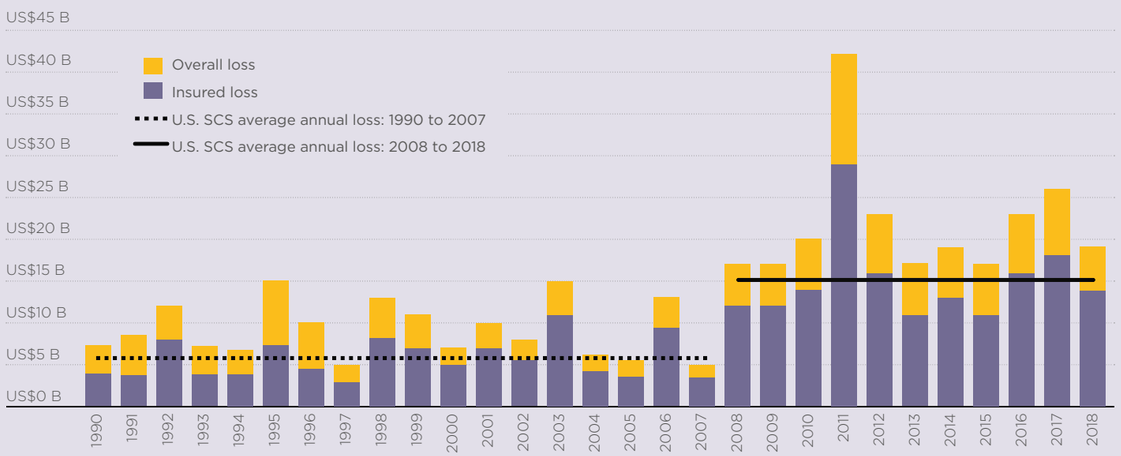
Percentage of insured U.S. severe convective storm loss

SOURCE: MUNICH RE NATCAT SERVICE



Annual U.S. severe convective storm losses (US$ billion)

SOURCE: MUNICH RE NATCAT SERVICE



Claims go 'through the roof'

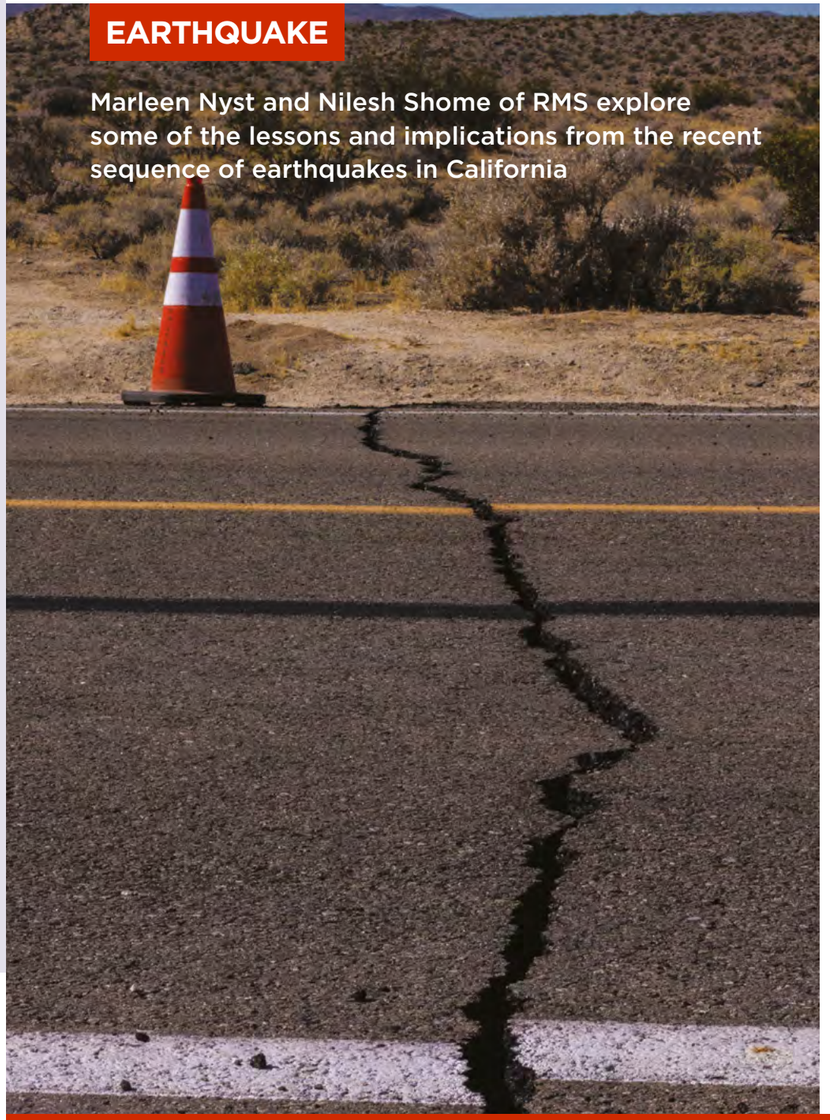
Another big driver of loss is likely to be aging roofs and the increasing exposure at risk of SCS. The contribution of roof age was explored in a blog last year by Stephen Cusack, director of model development at RMS. He noted that one of the biggest changes in residential exposure to SCS over the past two decades has been the rise in the median age of housing from 30 years in 2001 to 37 years in 2013.

A changing insurance industry climate is also a driver for increased losses, thinks Vojjala. "There has been a change in public perception on claiming whereby even cosmetic damage to roofs is now being claimed and contractors are chasing hailstorms to see what damage might have been caused," he says. "So, there is more awareness and that has led to higher losses.

"The insurance products for hail and tornado have grown and so those perils are being insured more, and there are different types of coverage," he notes. "Most insurers now offer not replacement cost but only the actual value of the roofs to alleviate some of the rising cost of claims. On the flip side, if they do continue offering full replacement coverage and a hurricane hits in some of those areas, you now have better roofs."

How insurance companies approach the peril is changing as a result of rising claims. "Historically, insurance and reinsurance clients have viewed SCS as an attritional loss, but in the last five to 10 years the changing trends have altered that perception," says Vojjala. "That's where there is this need for high-resolution modeling, which increasingly our clients have been asking for to improve their exposure management practices.

"With SCS also having catastrophic losses, it has stoked interest from the ILS community as well, who are also experimenting with parametric triggers for SCS," he adds. "We usually see this on the earthquake or hurricane side, but increasingly we are seeing it with SCS as well."



EARTHQUAKE

Marleen Nyst and Nilesh Shome of RMS explore some of the lessons and implications from the recent sequence of earthquakes in California

RIDGECREST: A WAKE-UP CALL

On the morning of July 4, the small town of Ridgecrest in California's Mojave Desert unexpectedly found itself at the center of a major news story after a magnitude 6.4 earthquake occurred close by. This earthquake later transpired to be a foreshock for a magnitude 7.1 earthquake the following day, the strongest earthquake to hit the state for 20 years.

These events, part of a series of earthquakes and aftershocks that were felt by millions of people across the state, briefly reignited awareness of the threat posed by earthquakes in California. Fortunately, damage from the Ridgecrest earthquake sequence was relatively limited. With the event not causing a widespread social or economic impact, its passage through the news agenda was relatively swift.

But there are several reasons why an event such as the Ridgecrest earthquake sequence should be a focus of attention both for the insurance industry and the residents and local authorities in California.

"We don't want to minimize the experiences of those whose homes or property were damaged or who were injured when these two powerful earthquakes struck, because for them these earthquakes will have a lasting impact, and they face some difficult days ahead," explains Glenn Pomeroy, chief executive of the California Earthquake Authority.

"However, if this series of earthquakes had happened in a more densely populated area or an area with thousands of very old, vulnerable homes, such as Los Angeles or the San Francisco Bay Area, this state would be facing a far different economic future than it is today —

potentially a massive financial crisis," Pomeroy says.

Although one of the most populous U.S. states, California's population is mostly concentrated in metropolitan areas. A major earthquake in one of these areas could have repercussions for both the domestic and international economy.

Low probability, high impact

Earthquake is a low probability, high impact peril. In California, earthquake risk awareness is low, both within the general public and many (re)insurers. The peril has not caused a major insured loss for 25 years, the last being the magnitude 6.7 Northridge earthquake in 1994.

California earthquake has the potential to cause large-scale insured and economic damage. A repeat of the Northridge event would likely cost the insurance industry today around US$30 billion, according to the latest version of the RMS® North America Earthquake Models, and Northridge is far from a worst-case scenario.

From an insurance perspective, one of the most significant earthquake events on record would be the magnitude 9.0 Tōhoku Earthquake and Tsunami in 2011. For California, the 1906 magnitude 7.8 San Francisco earthquake, when Lloyd's underwriter Cuthbert Heath famously instructed his San Franciscan agent to "pay all of our policyholders in full, irrespective of the terms of their policies", remains historically significant.

Heath's actions led to a Lloyd's payout of around US$50 million at the time and helped cement Lloyd's reputation in the U.S. market. RMS models suggest a repeat of this event today could cost the insurance industry around US$50 billion.

But the economic cost of such an event could be around six times the insurance bill — as much as US$300 billion — even before considering damage to infrastructure and government buildings, due to the surprisingly low penetration of earthquake insurance in the state.

Events such as the 1906 earthquake and even Northridge are too far in the past to remain in public consciousness. And the lack of awareness of the peril's damage potential is demonstrated by the low take-up of earthquake insurance in the state.

"Because large, damaging earthquakes don't happen very frequently, and we never know when they will happen, for many people it's out of sight, out of mind. They simply think it won't happen to them," Pomeroy says.

Across California, an average of just 12 percent to 14 percent of homeowners have earthquake insurance. Take-up varies across the state, with some high-risk regions, such as the San Francisco Bay Area, experiencing take-up below the state average. Take-up tends to be slightly higher in Southern California and is around 20 percent in Los Angeles and Orange counties.

Take-up will typically increase in the aftermath of an event as public awareness rises but will rapidly fall as the risk fades from memory. As with any low probability, high impact event, there is a danger the public will not be well prepared when a major event strikes.

The insurance industry can take steps to address this challenge, particularly through working to increase awareness of earthquake risk and actively promoting the importance of having insurance cover-age for faster recovery. RMS and its insurance partners have also been working to improve society's resilience against risks such as earthquake, through initiatives such as the 100 Resilient Cities program.

Understanding the risk

While the tools to model and understand earthquake risk are improving all the time, there remain several unknowns which underwriters should be aware of. One of the reasons the Ridgecrest Earthquake came as such a surprise was that the fault on which it occurred was not one that seismologists knew existed.

Several other recent earthquakes — such as the 2014 Napa event, the Landers and Big Bear Earthquakes in 1992, and the Loma Prieta Earthquake in 1989 — took place on previously unknown or thought to be inactive faults or fault strands. As well as not having a full picture of where the faults may lie, scientific understanding of how multifaults can link together to form a larger event is also changing.

"IF RIDGECREST HAD HAPPENED IN A MORE DENSELY POPULATED AREA, THIS STATE WOULD BE FACING A FAR DIFFERENT ECONOMIC FUTURE THAN IT IS TODAY"

— GLENN POMEROY, CALIFORNIA EARTHQUAKE AUTHORITY

Events such as the Kaikoura Earthquake in New Zealand in 2016 and the Baja California Earthquake in Mexico in 2010 have helped inform new scientific thinking that faults can link together causing more damaging, larger magnitude earthquakes. The RMS North America Earthquake Models have also evolved to factor in this thinking and have captured multifault ruptures in the model based on the latest research results. In addition, studying the interaction between the faults that ruptured in the Ridgecrest events will allow RMS to improve the fault connectivity in the models.

A further learning from New Zealand came via the 2011 Christchurch Earthquake, which demonstrated how liquefaction of soil can be a significant loss driver due to soil condition in certain areas. The San Francisco Bay Area, an important national and international economic hub, could suffer a similar impact in the event of a major earthquake. Across the area, there has been significant residential and commercial development on artificial landfill areas over the last 100 years, which are prone to have significant liquefaction damage, similar to what was observed in Christchurch.

Location, location, location

Clearly, the location of the earthquake is critical to the scale of damage and insured and economic impact from an event. Ridgecrest is situated roughly 200 kilometers north of Los Angeles. Had the recent earthquake sequence occurred beneath Los Angeles instead, then it is plausible that the insured cost could have been in excess of US$100 billion.

The Puente Hills Fault, which sits underneath downtown LA, wasn't discovered until around the turn of the century. A magnitude 6.8 Puente Hills event could cause an insured loss of US$78.6 billion, and a Newport-Inglewood magnitude 7.3 would cost an estimated US$77.1 billion according to RMS modeling. These are just a couple of the examples within its stochastic event set with a similar magnitude to the Ridgecrest events and which could have a significant social, economic and insured loss impact if they took place elsewhere in the state.

The RMS model estimates that magnitude 7 earthquakes in California could cause insurance industry losses ranging from US$20,000 to a US$20 billion, but the maximum loss could be over US$100 billion if occurring in high population centers such as Los Angeles. The losses from the Ridgecrest event were on the low side of the range of loss as the event occurred in a less populated area. For the California Earthquake Authority's portfolio in Los Angeles County, a large loss event of US$10 billion or greater can be expected approximately every 30 years.

As with any major catastrophe, several factors can drive up the insured loss bill, including post-event loss amplification and contingent business interruption, given the potential scale of disruption. In Sacramento, there is also a risk of failure of the levee system.

Fire following earthquake was a significant cause of damage following the 1906 San Francisco Earthquake and was estimated to account for around 40 percent of the overall loss from that event. It is, however, expected that fire would make a much smaller contribution to future events, given modern construction materials and methods and fire suppressant systems.

Political pressure to settle claims could also drive up the loss total from the event. Lawmakers could put pressure on the CEA and other insurers to settle claims quickly, as has been the case in the aftermath of other catastrophes, such as Hurricane Sandy.

The California Earthquake Authority has recommended homes built prior to 1980 be seismically retrofitted to make them less vulnerable to earthquake damage. "We all need to learn the lesson of Ridgecrest: California needs to be better prepared for the next big earthquake because it's sure to come," Pomeroy says.

"We recommend people consider earthquake insurance to protect themselves financially," he continues. "The government's not going to come in and rebuild everybody's home, and a regular residential insurance policy does not cover earthquake damage. The only way to be covered for earthquake damage is to have an additional earthquake insurance policy in place.

"Close to 90 percent of the state does not have an earthquake insurance policy in place. Let this be the wake-up call that we all need to get prepared."

DIVERSITY AND INCLUSION

WHAT A DIFFERENCE

As the insurance industry's Dive In Festival continues to gather momentum, EXPOSURE examines the factors influencing the speed at which the diversity and inclusion dial is moving

September 2019 marks the fifth Dive In Festival, a global movement in the insurance sector to support the development of inclusive workplace cultures. An industry phenomenon, it has ballooned in size from a London-only initiative in 2015 attracting 1,700 people to an international spectacle spanning 27 countries and reaching over 9,000 people in 2018.

That the event should gather such momentum clearly demonstrates a market that is moving forward. There is now an industrywide acknowledgement of the need to better reflect the diversity of the customer base within the industry's professional ranks.

The starting point

As Pauline Miller, head of talent development and inclusion (D&I) at Lloyd's, explains, the insurance industry is a market that has, in the past, been slow to change its practitioner profile. "If you look at Lloyd's, for example, for nearly three hundred years it was a men-only environment, with women only admitted as members in December 1969.

"You also have to recognize that the insurance industry is not as far along the diversity and inclusion journey compared to other sectors," she continues. "I previously worked in the banking industry, and diversity and inclusion had been an agenda issue in the organization for a number of years. So, we must acknowledge that this is a journey that will require multiple more steps before we really begin breaking down barriers."

However, she is confident the insurance industry can quickly make up ground.

"By its very nature, the insurance market lends itself to the spread of the D&I initiative," Miller believes. "We are a relationship-based business that thrives on direct contact, and our day-to-day activities are based upon collaboration. We must leverage this to help speed up the creation of a more diverse and inclusive environment."

The positive effects of collaboration are already evident in how this is evolving. Initiatives like Dive In, a weeklong focus on diversity and inclusion, within other financial sectors have tended to be confined to individual organizations, with few generating the level of industrywide engagement witnessed within the insurance sector.

However, as Danny Fisher, global HR business partner and EMEA HR manager at RMS, points out, for the drive to gain real traction there must be marketwide consensus on the direction it is moving in.

"There is always a risk," he says, "that any complex initiative that begins with such positive intent can become derailed if there is not an understanding of a common vision from the start, and the benefits it will deliver.

"There also needs to be better understanding and acknowledgement of the multitude of factors that may have contributed to the uniformity we see across the insurance sector. We have to establish why this has happened and address the flaws in our industry contributing to it."

It can be argued that the insurance industry is still composed of a relatively homogeneous group of people. In terms of gender disparity, ethnic diversity, and people of different sexual orientations, from different cultural or social backgrounds, or with physical or mental impairments, the industry recognizes a need to improve.

Diversity is the range of human differences, including but not limited to race, ethnicity, gender, gender identity, sexual orientation, age, social class, physical ability or attributes, religious or ethical values system, national origin, and political beliefs.

"As a market," Miller agrees, "there is a tendency to hire people similar to the person who is recruiting. Whether that's someone of the same gender, ethnicity, sexual orientation or from the same university or social background."

"You can end up with a very uniform workforce," adds Fisher, "where people look the same and have a similar view of the world, which can foster 'groupthink' and is prone to bias and questionable conclusions. People approach problems and solutions in the same way, with no one looking at an alternative — an alternative that is often greatly needed. So, a key part of the diversity push is the need to generate greater diversity of thought."

The challenge is also introducing that talent in an inclusive way that promotes the effective development of new solutions to existing and future problems. That broad palette of talent can only be created by attracting and retaining the best and brightest from across the social spectrum within a framework in which that blend of skills, perspectives and opinions can thrive.

"Diversity is not simply about the number of women, ethnicities, people with disabilities or people from disadvantaged backgrounds that you hire," believes Miller. "It's about bringing together the most creative group of people that represent different ways of thinking that have evolved out of the multiple factors that make them different."

Moving the dial

There is clearly a desire to make this happen and strong evidence that the industry is moving together. Top-level support for D&I initiatives coupled with the rapid growth of industrywide networks representing different demographics are helping firm up the foundations of a more diverse and inclusive marketplace.

But what other developments are needed to move the dial further?

"We have to recognize that there is no 'one-size-fits-all' to this challenge," says Miller. "Policies and strategies must be designed to create an environment in which diversity and inclusion can thrive, but fundamentally they must reflect the unique dynamics of your own organization.

"We also must ensure we are promoting the benefits of a career in insurance in a more powerful and enticing way and to a broader audience," she adds. "We operate in a fantastic industry, but we don't sell it enough. And when we do get that diversity of talent through the door, we have to offer a workplace that sticks, so they don't simply walk straight back out again.

"For example, someone from a disadvantaged community coming through an intern program may never have worked in an office environment before, and when they look around are they going to see people like themselves that they can relate to? What role models can they connect with? Are we prepared for that?"

For Fisher, steps can also be taken to change processes and modernize thinking and habits. "We have to be training managers in interview and evaluation techniques and discipline to keep unconscious bias in check. There has to be consistency with meaningful tests to ensure data-driven hiring decisions.

"At RMS, we are fortunate to attract talent from around the world and are able to facilitate bringing them on board to add further variety in solving for complex problems. A successful approach for us, for example, has been accessing talent early, often prior to their professional career."

There is, of course, the risk that the push for greater diversity leads to a quota-based approach.

"Nobody wants this to become a tick-box exercise," believes Miller, "and equally nobody wants to be hired simply because they represent a particular demographic. But if we are expecting change, we do need measurements in place to show how we are moving the dial forward. That may mean introducing realistic targets within realistic timeframes that are monitored carefully to ensure we are on track.

"Ultimately," she concludes, "what we are all working to do is to create the best environment for the broadest spectrum of people to come into what is a truly amazing marketplace. And when they do, offering a workplace that enables them to thrive and enjoy very successful careers that contribute to the advancement of our industry. That's what we all have to be working toward."

"IT'S ABOUT BRINGING TOGETHER THE MOST CREATIVE GROUP OF PEOPLE THAT REPRESENT DIFFERENT WAYS OF THINKING THAT HAVE EVOLVED OUT OF THE MULTIPLE FACTORS THAT MAKE THEM DIFFERENT"

— PAULINE MILLER, LLOYD'S

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