

---

## **COST VS. VALUE**

Albert Benchimol assesses the real meaning of efficiency

---

## **LAY OF THE LAND**

Cultivating agricultural insurance penetration in China

---

## **CRACKING THE CODE**

Unlocking the potential of the cyber insurance market

# EXPOSURE

ISSUE 03

A person's silhouette is seen from behind, standing on a wet street at night. The wet pavement reflects the blurred lights of city traffic in the background, creating a bokeh effect of yellow, red, and white lights. The person is wearing a dark jacket and has their hair tied back. The overall mood is contemplative and urban.

**HARVEY:  
THE RISE OF  
THE SUPER CAT**

## IN THIS ISSUE



# EFFICIENCY BREEDS VALUE

Insurers must harness data, technology and human capital to be more efficient and profitable, but as AXIS Capital's Albert Benchimol explains, offering better value to clients should be the motivation for insurers to improve efficiency over the long term

PAGE 9



## READYING THE INSURANCE INDUSTRY FOR A "MOONSHOT"

Are (re)insurance companies ready for the cultural and digital change needed to survive in an era of disruption?

PAGE 6



## THE PERIL OF IGNORING THE TAIL

How should reinsurers approach Version 17 of the RMS North America Earthquake Models?

PAGE 12

## IS HARVEY A SUPER CAT?

What is a super cat, and has Harvey already achieved this catastrophe status?

PAGE 4



## OTHER STORIES

### Quantifying the resilience dividend

Why city resilience officers are using cat models to inform their disaster mitigation investments

PAGE 19

### Cracking the cyber code

Using data and analytics to release the full potential of cyber insurance

PAGE 22

### A burgeoning opportunity

How new probabilistic casualty catastrophe models offer (re)insurance opportunities

PAGE 30

## FOREWORD

# CHANGE IS IN THE AIR

Welcome to the third edition of EXPOSURE, the RMS publication focusing on catastrophe and risk management practices. Change is in the air. All around, leaders are challenging assumptions. What is insurable and how can we break through to new opportunities? How can we crush the latencies in our process and move faster and closer to our clients? How do we innovate and what does it take to master new competencies? Where do we really add value, distilling the right secret sauce and partnering elsewhere? With whom?

And Hurricane Harvey only reinforces the need for agility. To adapt to new drivers of risk, to systematize data across the enterprise and scale insight in real time. Not only to respond to a catastrophe, but also to identify new opportunities in a fast-moving market.

In this edition of EXPOSURE, we explore a cross-section of issues at the intersection of modeling and data science, analytics technology, and risk and (re)insurance opportunities.

I hope this issue of EXPOSURE will inform and inspire you to ask bold questions, experiment and challenge the status quo, and most importantly, take agile action and be an agent of change.

HEMANT SHAH

CEO and co-founder, RMS Inc.



**EXPOSURE Editorial Board:** Hemant Shah, Eric Yau, Mike Pritula, Michael Steel, Mohsen Rahnama, Robert Muir-Wood, Ben Brookes.

**RMS Editorial and Design:** Simon Bennett, Bob Owen. **EXPOSURE is published by Zebra Media Limited. [www.zebracm.com](http://www.zebracm.com)**

Editors: Helen Yates, Nigel Allen. Designer: Maria Gonzalez. Publisher: Suzanne Hirst. Cover photo: Win McNamee/Getty Images

The material published in EXPOSURE is provided for informational purposes only and whilst the publisher and RMS make every attempt to ensure the accuracy and reliability of any content, it should not be relied upon. The publisher and RMS are not responsible for any loss, however arising, from the use of or reliance on any material published in EXPOSURE or from any inaccuracies, errors or omissions in this publication, or other documents that are referenced by or linked to this publication. Information published in EXPOSURE may only be used with the prior written permission of RMS.

# NEWS ANALYSIS

## FLOODS

## IS HARVEY A SUPER CAT?

RMS assesses the potential for Hurricane Harvey to elevate to “Super Cat” status as Houston and the other impacted regions face up to one of the most devastating floods in U.S. history

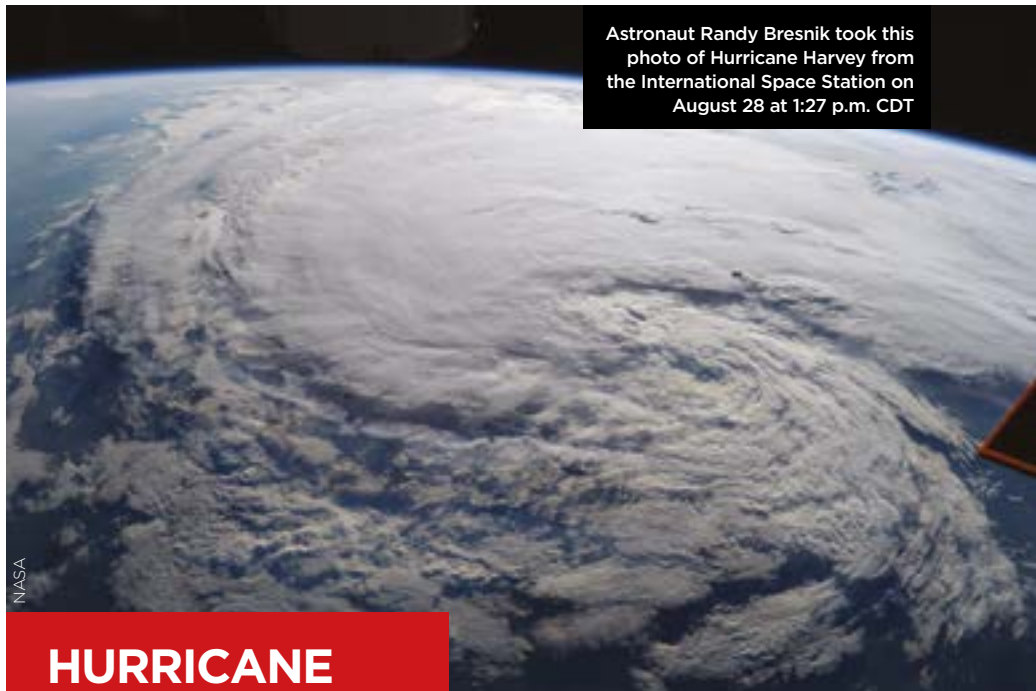
At time of writing, flood waters from Hurricane Harvey are continuing to inundate Houston. While initial loss estimates for wind and surge-related damage from the Category 4 storm are limited, the catastrophic flooding across southeastern Texas and southern Louisiana, including the greater Houston metropolitan area, has escalated the scale of the event to Katrina-like levels.

While still at a very early stage of assessment, expectations are that Harvey will prove to be the largest tropical cyclone flooding event in U.S. history. Harvey has already broken all U.S. records for tropical cyclone-driven extreme rainfall with observed cumulative amounts of 51 inches (129 centimeters) — far exceeding Allison in 2001, along with Claudette in 1979 and Amelia in 1978, not only in volume but also regional extent.

“The stalling of Harvey over the coast prior to landfall increased moisture absorption from the exceptionally warm waters of the Gulf of Mexico,” explains Robert Muir-Wood, chief research officer at RMS, “resulting in unprecedented rainfall causing flooding far beyond the capacity of Houston’s retention basins, drainage systems and defenses.”

Unlike Harvey’s wind footprint, which didn’t affect the most highly populated coastal areas, Harvey’s flood footprint sits squarely over Houston. The exposed value is indeed vast — there are over seven million properties with over US\$1.5 trillion in value in the Houston area. This is almost 10 times more exposed value, in today’s prices, than what was affected by Hurricane Katrina 12 years ago.

“From a wind damage and storm surge perspective, Harvey would have ranked as one of the smallest Cat 4 loss impacts on record,” says Paul Wilson, vice president of model development at RMS. “But the



Astronaut Randy Bresnik took this photo of Hurricane Harvey from the International Space Station on August 28 at 1:27 p.m. CDT

## HURRICANE HARVEY

Harvey rapidly developed from a tropical depression to a Category 4 major hurricane in 48 hours, and intensified right up to making landfall.

It made landfall between Port Aransas and Port O’Connor, Texas, at around 22:00 local time on Friday, August 25, with maximum sustained wind speeds of around 130 mph (215 km/hr).

Approximately 30,000 residents of Houston were reported to have been evacuated as the storm approached.

Harvey is the first major hurricane (Category 3 or greater) to make landfall in the U.S. since Hurricane Wilma in 2005, and the first Category 4 hurricane to make landfall in the U.S. since Hurricane Charley in 2004.

flooding has considerably amplified the scale of the loss. You are seeing levy breaches due to overtopping and reservoirs close to overflowing, with huge amounts of rainwater dropping into the river networks. This is a completely different driver of damage compared to wind, as it results in a much longer impact period due to the time it takes the flood waters to recede, which significantly extends the duration of the damage.”

This extension looks set to elevate Harvey to “Super Cat” status, a phrase coined in the aftermath of Hurricane Katrina and the subsequent storm-surge flooding of New Orleans. In its most simple form, a Super Cat occurs when the loss experience begins to far exceed the losses from the physical drivers of the event. RMS estimates that the economic loss from this event could be as high as US\$70-90 billion

in total from wind, storm surge and inland flood, which includes damage to all residential, commercial, industrial and automotive risks in the area, as well as possible inflation from area-wide demand surge.

“In some of the most extreme catastrophes, the level and extent of disruption reaches levels where the disruption itself starts to drive the consequences,” Muir-Wood explains, “including the extent of the insurance losses. Disruption can include failures of water, sewage and electricity supply; mandatory evacuation; or where buildings are too damaged for people to return. Further, economic activity is severely disrupted as businesses are unable to function. As a result, businesses fold and people move away.”

“Super Cat events therefore have a huge potential impact on commercial and industrial business interruption losses,” Wilson adds. “Even those commercial properties in the Houston area which have not been directly impacted by the floods will suffer some form of loss of businesses from the event.”

Muir-Wood believes Harvey’s Super Cat potential is significant. “Tens of thousands of properties have been flooded, their occupants evacuated; while many businesses will be unable to operate. We can expect significant expansions in BI losses from industrial facilities such as oil refineries and local businesses as a result, which we would identify as Super Cat conditions in Houston.”

Such events by their very nature test modeling capabilities to their limits, adding much greater complexity to the loss dynamic compared to shorter-term events.

“Quantifying the impact of Super Cats is an order of magnitude harder than for other catastrophic events,” Wilson explains. “For example, trying to quantify the degree to which a major evacuation leads to an increase in BI losses is extremely challenging — particularly as there have only been a handful of events of this magnitude.”

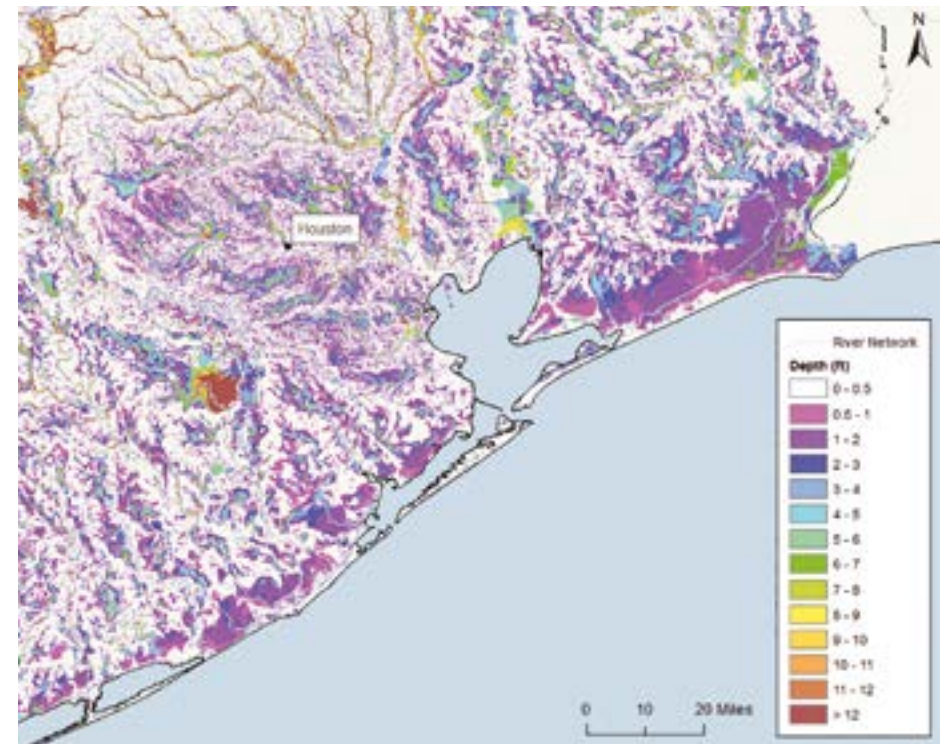
There are also a number of other post-event loss amplification challenges that will need to be modeled.

“Super Cat consequences can happen in addition to other sources of post-event loss amplification that we include in the models,” Muir-Wood says. “These include demand surge resulting from an escalation in labor and materials due to shortages after a major

## Texas flood inundation

RMS modeled flood inundation in south Texas, based on rainfall forecast totals out to August 31

Source: RMS



**“THIS IS A COMPLETELY DIFFERENT DRIVER OF DAMAGE COMPARED TO WIND ... DUE TO THE TIME IT TAKES THE FLOOD WATERS TO RECEDE”**

— PAUL WILSON, RMS

catastrophe; claims inflation due to insurers relaxing how they monitor claims for exaggeration because they are so overwhelmed; and coverage expansion, where insurers end up paying claims that are beyond the contractual terms of the original coverage.”

Fortunately, model advances are enabling a much more granular assessment across the loss spectrum, Wilson believes. “We’re able to apply extremely high-resolution models to all aspects of the loss, especially with our new U.S. flood models, including very specific hydrological modeling capabilities. We’ve also introduced the ability to model flood defenses and the probability of failure, as a result of Sandy and Katrina, as well as more granular data on property elevation and the impact of basement flooding, which

was a major issue for commercial properties during Sandy.”

Such model advances will need to continue at pace, however, as Super Cat events have the clear potential to become an increasingly frequent occurrence.

“Such events are triggered by major metropolitan urban centers,” Wilson explains. “There are specific locations within our model which have to be hit by catastrophes which have a significant impact damage for us to even acknowledge the potential for a Super Cat. Increases in urban populations and the expansion of ‘downtown’ areas are raising the potential for events of this scale, and this will be exacerbated by climate change and rising sea levels, coupled with a lack of robust flood defenses.”

THE BIG STORY

# READYING THE INSURANCE INDUSTRY FOR A “MOONSHOT”

There is growing acceptance that trying to squeeze more efficiency out of existing systems and processes is folly in an industry that must make fundamental changes. But are insurance and reinsurance companies ready for the cultural and digital change this necessitates?

In an article in Wired magazine, Google X lab director Eric “Astro” Teller (whose business card describes him as “Captain of Moonshots”) suggested that it might actually be easier to make something 10 times better than 10 percent better. Squeezing out a further 10 percent in efficiency typically involves tinkering with existing flawed processes and systems. It’s not always necessary to take a “moonshot,” but making something 10 times better involves taking bold, innovative steps and tearing up the rule book where necessary.

The term “moonshot” came from IBM, describing how they foresaw the impact of Cloud in the future of healthcare, specifically its impact in the hunt for a cure for cancer. IBM argued a new architectural strategy — one based on open platforms and designed

to cope with rampant data growth and the need for flexibility — was required in order to take cancer research to the next level.

But is the 330-year-old insurance industry — with its legacy systems, an embedded culture and significant operational pressures — ready for such a radical approach? And should those companies that are not ready, prepare to be disrupted?

In the London and Lloyd’s market, where the cost of doing business remains extremely high, there are fears that business could migrate to more efficient, modern competitor hubs, such as Zurich, Bermuda and Singapore.

“The high cost of doing business is something that has been directly recognized by [Lloyd’s CEO] Inga Beale amongst others; and it’s something that has been explicitly highlighted by the rating agencies in their reports on the market,” observes Mike van Slooten, head of market analytics at Aon Benfield. “There is a consensus building that things really do have to change.”

The influx of alternative capacity, a rapidly evolving risk landscape — with business risks increasingly esoteric — a persistently low interest rate environment and high levels of competition have stretched balance sheets in recent years. In addition, the struggle to keep up with the explosion of data and the opportunities this presents, and the need to overhaul legacy systems, is challenging the industry as never before.

“You’ve got a situation where the market as a whole is struggling to meet its ROE

targets,” says van Slooten. “We’re getting to a stage where pretty much everyone has to accept the pricing that’s on offer. One company might be better at risk selection than another — but what really differentiates companies in this market is the expense ratio, and you see a huge disparity across the industry.”

“Some very large, successful organizations have proved they can run at a 25 percent expense ratio and for other smaller organizations it is north of 40 percent, and in this market, that’s a very big differential,” he continues. “Without cost being brought out of the system there’s a lot of pressure there, and that’s where these M&A deals are coming from. Insight is going to remain at a premium going forward, however, a lot of the form-filling and processing that goes on behind the scenes has got to be overhauled.”

“Efficiency needs to be partnered with business agility,” says Jon Godfray, chief operating officer at Barbican Insurance Group. Making a process 10 times faster will not achieve the “moonshot” an organization needs if it is not married to the ability to act quickly on insight and make informed decisions. “If we weren’t nimble and fast, we would struggle to survive. A nimble business is absolutely key in this space. Things that took five years to develop five years ago are now taking two. Everything is moving at a faster pace.”

As a medium-sized Lloyd’s insurance group, Barbican recognizes the need to remain nimble and to adapt its business model as the industry evolves. However, large incumbents are also upping their game. “I spent some years at a very large insurer and it was like a massive oil tanker ... you decided in January where you wanted to be in December, because it took you four months to turn the wheel,” says Godfray.

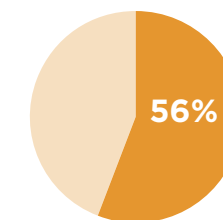
“Large organizations have got a lot better at being adaptable,” he continues. “Communication lines are shorter and technology plays a big part. This means the nimble advantage we have had is reducing, and we must therefore work even faster and perform better. Organizations need to remain flexible and nimble, and need to be able to embrace the increasingly stringent regulatory climate we’re in.”

## Creating a culture of innovation

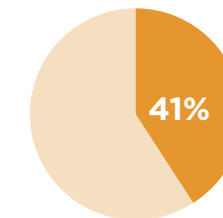
Automation and the efficiencies to be gained by speeding up previously clunky and expensive processes will enable organizations to

## BIG NUMBERS

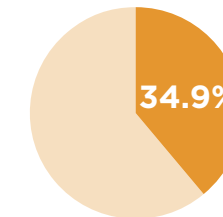
Sources: Gartner, Forrester, Harvey Nash/KPMG



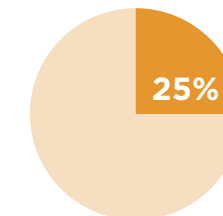
Proportion of CIOs who say that “increasing operational efficiencies” is the key business issue that management is looking for IT to address



Proportion of insurance companies looking to invest in software-as-a-service (compared to average of 49% across other industries)



Annual growth of Cloud computing in 2016



Average percentage of insurance IT budgets allocated to Cloud computing

compete more effectively. But not all organizations need to be pioneers in order to leverage new technology to their advantage,” adds Godfray. “We see ourselves as a second-level early adopter. We’d love to be at the forefront of everything, but there are others with deeper pockets who can do that.”

“However, we can be an early adopter of technology that can make a difference and be brave enough to close an avenue if it isn’t working,” he continues. “Moving on from investments that don’t appear to be working is something a lot of big organizations struggle with. We have a great arrangement with our investor where if we start something and we don’t like it, we stop it and we move on.”

The drive for efficiency is not all about technology. There is a growing recognition that culture and process is critical to the →

## ACHIEVING 10X: A PLATFORM-CENTRIC APPROACH

Together with increasing speed and agility and initiatives to drive down the transactional cost of the business, technology and how it enables better risk selection, pricing and capital allocation is seen as a savior. Analytics, and fusing the back office where the data lives, through to the front office — where the decision-makers are — is imperative.

According to 93 percent of insurance CEOs surveyed by PwC in 2015, data mining and analysis is the most strategically important digital technology for their business. Many (re)insurance company CIOs have taken the plunge and moved parts of their business into the Cloud, particularly those technologies that are optimized to leverage its elasticity and scalability, in order to enhance their analytical capabilities.

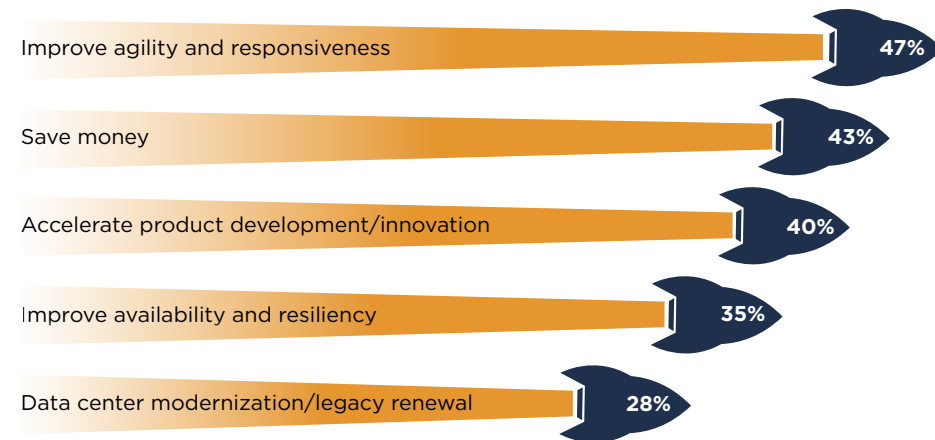
When it comes to analytics, simply moving exposure data, contract data, and existing actuarial and probabilistic models into Cloud architecture will not enable companies to redesign their entire workflow, explains Shaheen Razzaq, director, software products at RMS.

“Legacy systems were not designed to scale to the level needed,” he adds. “We are now in a world dealing with huge amounts of data and even more sophisticated models and analytics. We need scalable and performing technologies. And to truly leverage these technologies, we need to redesign our systems from the ground up.” He argues that what is needed is a platform-centric approach, designed to be supported by the Cloud, to deliver the scale, performance and insurance-specific needs the industry needs to achieve its moonshot moment. Clearly RMS(one)®, a big data and analytics platform purpose-built for the insurance industry, is one solution available.

## What are your top reasons for using Cloud technology?

Nearly half of CIOs from over 160 insurers are investing in a platform-centric approach to improve their organization’s agility and responsiveness

Source: KPMG



change underway in the industry. Attracting the right talent, enabling bold decisions and investments to be made, and responding appropriately to rapidly changing customer needs and expectations all rest on the ability for large organizations to think and act more nimbly.

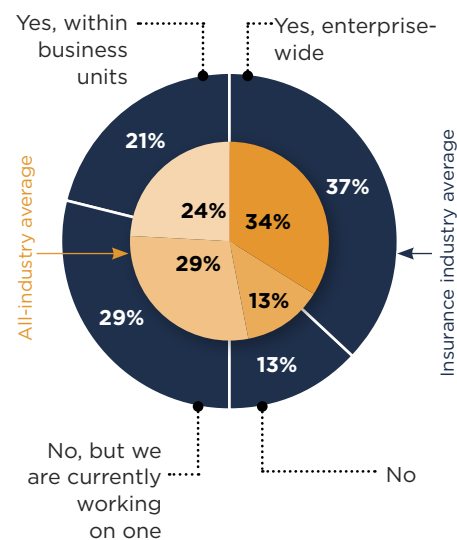
And at the end of the day, survival is all about making tactical decisions that enhance an organization’s bottom line, Godfray believes. “The winners of the future will have decent P&Ls. If you’re not making money, you’re not going to be a winner. Organizations that are consistently struggling will find it harder and harder as the operating environment becomes less and less forgiving, and they will gradually be consolidated into other companies.”

Much of the disruptive change that has already occurred within the industry has occurred within general insurance, where the Internet of Things (IoT), artificial intelligence and product innovation are just some of the developments underway. As we move into an era of the connected home, wearable devices and autonomous vehicles, insurers are in a better position to both analyze individuals and to feed back information to them in order to empower and reduce risk.

But even within personal lines there has not been a remarkable product revolution yet, thinks Anthony Beilin, head of innovation and startup engagement at Aviva. “The same can be said for disruption of the entire value chain. People have attacked various

## Does your business have a clear digital vision/strategy?

Source: KPMG



parts and a lot of the focus so far has been on distribution and the front-end customer portal. Maybe over the next 10 years, traditional intermediaries will be replaced with new apps and platforms, but that’s just a move from one partner to another.”

Innovation is not just about digitization, says Beilin. While it is important for any (re)-insurance company to consistently improve its digital offering, true success and efficiencies will be found in redesigning the value

chain, including the products on offer. “It isn’t just taking what was a paper experience onto the Internet, then taking what was on the Internet onto the mobile and taking a mobile experience into a chatbot ... that isn’t innovation.

“What we really need to think about is: what does protecting people’s future look like in 50 years’ time? Do people own cars? Do people even drive cars? What are the experiences that people will really worry about?” he explains. “How can we rethink what is essentially a hedged insurance contract to provide a more holistic experience, whether it’s using AI to manage your finances or using technology to protect your health, that’s where the radical transformation will come.”

Beilin acknowledges that collaboration will be necessary. With a background in launching startups he understands the necessary and complementary characteristics of niche players versus large incumbents.

“It is an agreed principle that the bigger the company, the harder it is to make change,” says Beilin. “When you start talking about innovating it runs contrary to the mantra of what big businesses do, which is to set up processes and systems to ensure a minimum level of delivery. Innovation, on the other hand, is about taking the seed of an idea and developing it into something new, and it’s not a natural fit with the day-to-day operations of any business.”

This is not just a problem for the insurance industry. Beilin points to the disruption brought about in the traditional media space by Netflix, Facebook and other social media platforms. “Quite frankly startups are more nimble, they have more hunger, dynamism and more to lose,” he says. “If they go bankrupt, they don’t get paid. The challenge for them is in scaling it to multiple customers.”

This is where investments like Aviva’s Digital Garage come in. “We’re trying to be a partner for them,” says Beilin. “Collaboration is the key in anything. If you look at the success we’re going to achieve, it’s not going to be in isolation. We need different capabilities to succeed in a future state. We’ve got some extremely creative and talented people on staff, but of course we’ll never have everyone. We need different capabilities and skills so we need to make sure we’re interoperable and open to working with partners wherever possible.”



THE BIG INTERVIEW

# EFFICIENCY BREEDS VALUE

Insurers must harness data, technology and human capital if they are to operate more efficiently and profitably in the current environment, but as AXIS Capital’s Albert Benchimol tells EXPOSURE, offering better value to clients may be a better long-term motive for becoming more efficient

**“I ADMIRE COMPANIES THAT CONSTANTLY CHALLENGE THEMSELVES AND THAT ARE DRIVEN BY DATA TO MAKE INFORMED DECISIONS — COMPANIES THAT DON’T REST ON THEIR LAURELS AND DON’T ACCEPT THE STATUS QUO”**

Efficiency is a top priority for insurers the world over as they bid to increase margins, reduce costs and protect profitability in the competitive heat of the enduring soft market. But according to AXIS Capital president and CEO Albert Benchimol, there is a broader, more important and longer-term challenge that must also be addressed through the ongoing efficiency drive: value for money.

“When I think of value, I think of helping our clients and partners succeed in their own endeavors. This means providing quick and responsive service, creative policy structures that address our customers’ coverage needs, best-in-class claims handling and trusting our people to pursue their own entrepreneurial goals,” says Benchimol.

“While any one insurance policy may in itself offer good value, when aggregated, insurance is not necessarily seen as good value by clients. Our industry as a whole needs to deliver a better value proposition — and that means that all participants in the value chain will need to become much more efficient.”

According to Benchimol — who prior to being appointed CEO of AXIS in 2012 served as the Bermuda-based insurance group’s CFO and also held senior executive positions at Partner Re, Reliance Group and Bank of Montreal — the days of paying out US\$0.55-\$0.60 in claims for every dollar of premium paid are over.

“We need to start framing our challenge as delivering a 70 percent-plus loss ratio within a low 90s combined ratio,” he asserts. “Every player in the value chain needs to adopt efficiency-enhancing technology to lower our costs and pass those savings on to the customer.”

With a surfeit of capital making it unlikely the insurance industry will return

to its traditional cyclical nature any time soon, Benchimol says these changes have to be adopted for the long term.

“Insurers have to evaluate their portfolios and product offerings to match customer needs with marketplace realities. We will need to develop new products to meet emerging demand; offer better value in the eyes of insureds; apply data, analytics and technology to all facets of our business; and become much more efficient,” he explains.

**Embracing technology**

The continued adoption and smarter use of data will be central to achieving this goal. “We’ve only begun to scratch the surface of what data we can access and insights we can leverage to make better, faster decisions throughout the risk transfer value chain,” Benchimol says.

“If we use technology to better align our operations and costs with our customers’ needs and expectations, we will create and open-up new markets because potential insureds will see more value in the insurance product.”

Technology, data and analytics have already brought improved efficiencies to the insurance market. This has allowed insurers to focus their efforts on targeted markets and develop applications to deliver improved, customized purchasing experiences and increase client satisfaction and engagement, Benchimol notes.

The introduction of data modeling, he adds, has also played a key role in improving economic protection, making it easier for (re)insurance providers to evaluate risks and enter new markets, thereby increasing the amount of capacity available to protect insureds.

“While this can sometimes raise pricing pressures, it has a positive benefit of bringing more affordable capacity to potential customers. This has been most pronounced in the development of catastrophe models in underinsured emerging markets, where capital hasn’t always been available in the past,” he says.

The introduction of models made these markets more attractive to capital providers which, in turn, makes developing custom insurance products more cost-effective and affordable for both insurers and their clients, Benchimol explains.

However, there is no doubt the insurance



industry has more to do if it is not only to improve its own profitability and offerings to customers, but also to stave off competition from external threats, such as disruptive innovators in the FinTech and InsurTech spheres.

**Strategic evolution**

“The industry’s inefficiencies and generally low level of customer satisfaction make it relatively easy prey for disruption,” Benchimol admits. However, he believes that the regulated and highly capital-intensive nature of insurance is such that established domain leaders will continue to thrive if they are prepared to beat innovators at their own game. “We need to move relatively quickly, as laggards may have a difficult time catching up,” he warns.

“In order to thrive in the disruptive market economy, market leaders must take intelligent risks. This isn’t easy, but is absolutely necessary,” Benchimol says. “I admire companies that constantly challenge themselves and that are driven by data to make informed decisions — companies that don’t rest on their laurels and don’t accept the status quo.”

Against the backdrop of a rapidly evolving market and transformed business environment, AXIS took stock of its business at the start of 2016, evaluating its key strengths and reflecting on the opportunities and challenges in its path. What followed was an important strategic evolution.

**“WE NEED TO START FRAMING OUR CHALLENGE AS DELIVERING A 70-PERCENT PLUS LOSS RATIO WITHIN A LOW 90S COMBINED RATIO”**

to customers’ needs, yet large enough to take advantage of its global capabilities and resources in order to help clients manage their risks. But like many of his competitors, Benchimol knows future success will be heavily reliant on how well AXIS melds human expertise with the use of data and technology.

“We need to combine our ingenuity, innovation and values with the strength, speed and intelligence offered by technology, data and analytics. The ability to combine these two great forces — the art and science of insurance — is what will define the insurer of the future,” Benchimol states.

The key, he believes, is to empower staff to make informed, data-driven decisions. “The human elements that are critical to success in the insurance industry are, among others: knowledge, creativity, service and commitment to our clients and partners. We need to operate within a framework that utilizes technology to provide a more efficient customer experience and is underpinned by enhanced data and analytics capabilities that allow us to make informed, intelligent decisions on behalf of our clients.”

However, Benchimol insists insurers must embrace change while holding on to the traditional principles that underpinned insurance in the analog age, as these same principles must continue to do so into the future.

“We must harness technology for good causes, while remaining true to the core values and universal strengths of our industry — a passion for helping people when they are down, a creativity in structuring products, and the commitment to keeping the promise we make to our clients to help them mitigate risks and ensure the security of their assets,” he says. “We must not forget these critical elements that comprise the heart of the insurance industry.”



# NORTH AMERICA EARTHQUAKE

# THE PERIL OF IGNORING THE TAIL

Drawing on several new data sources and gaining a number of new insights from recent earthquakes on how different fault segments might interact in future earthquakes, Version 17 of the RMS North America Earthquake Models sees the frequency of larger events increasing, making for a fatter tail. EXPOSURE asks what this means for (re)insurers from a pricing and exposure management perspective

**R**ecent major earthquakes, including the M9.0 Tohoku Earthquake in Japan in 2011 and the Canterbury Earthquake Sequence in New Zealand (2010-2011), have offered new insight into the complexities and interdependencies of losses that occur following major events. This insight, as well as other data sources, was incorporated into the latest seismic hazard maps released by the U.S. Geological Survey (USGS).

In addition to engaging with USGS on its 2014 update, RMS went on to invest more than 100 person-years of work in implementing the main findings of this update as well as comprehensively enhancing and updating all components in its North America Earthquake Models (NAEQ). The update reflects the deep complexities inherent in the USGS model and confirms the adage that “earthquake is the quintessential tail risk.” Among the changes to the RMS NAEQ models was the recognition that some faults can interconnect, creating correlations of risk that were not previously appreciated.

## Lessons from Kaikoura

While there is still a lot of uncertainty surrounding tail risk, the new data sets provided by USGS and others have improved the understanding of events with a longer return period. “Global earthquakes are happening all of the time, not all large, not all in areas with high exposures,” explains Renee Lee, director, product management at RMS. “Instrumentation has become more advanced and coverage has expanded such that scientists now know more about earthquakes than they did eight years ago when NAEQ was last released in Version 9.0.”

This includes understanding about how faults creep and release energy, how faults can interconnect, and how ground motions attenuate through soil layers and over large distances. “Soil plays a very important role in the earthquake risk modeling picture,” says Lee. “Soil deposits can amplify ground motions, which can potentially magnify the building’s response leading to severe damage.”

The 2016 M7.8 earthquake in Kaikoura, on New Zealand’s South Island, is a good example of a complex rupture where fault segments connected in more ways than

had previously been realized. In Kaikoura, at least six fault segments were involved, where the rupture “jumped” from one fault segment to the next, producing a single larger earthquake.

“The Kaikoura quake was interesting in that we did have some complex energy release moving from fault to fault,” says Glenn Pomeroy, CEO of the California Earthquake Authority (CEA). “We can’t hide our heads in the sand and pretend that scientific awareness doesn’t exist. The probability has increased for a very large, but very infrequent, event, and we need to determine how to manage that risk.”

## San Andreas correlations

Looking at California, the updated models include events that extend from the north of San Francisco to the south of Palm Springs, correlating exposures along the length of the San Andreas fault. While the prospect of a major earthquake impacting both northern and southern California is considered extremely remote, it will nevertheless affect how reinsurers seek to diversify different types of quake risk within their book of business.

## IN KAIKOURA, AT LEAST SIX FAULT SEGMENTS WERE INVOLVED, WHERE THE RUPTURE “JUMPED” FROM ONE FAULT SEGMENT TO THE NEXT

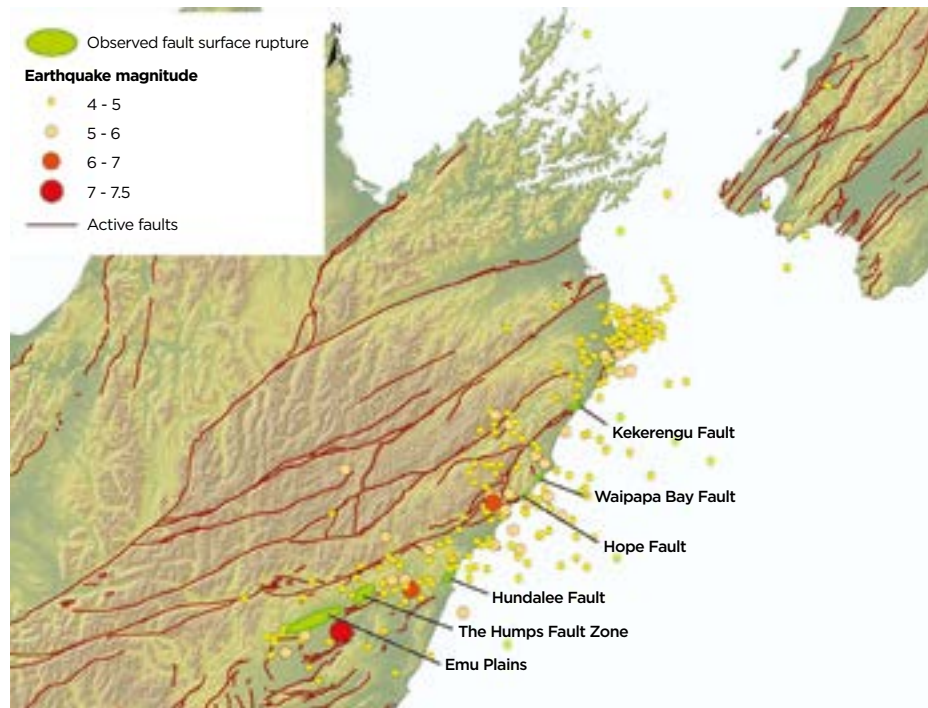
“In the past, earthquake risk models have considered Los Angeles as being independent of San Francisco,” says Paul Nunn, head of catastrophe risk modeling at SCOR. “Now we have to consider that these cities could have losses at the same time (following a full rupture of the San Andreas Fault).”

“However, it doesn’t make that much difference in the sense that these events are so far out in the tail ... and we’re not selling much coverage beyond the 1-in-500-year or 1-in-1,000-year return period. The programs we’ve sold will already have been exhausted long before you get to that level of severity.”

While the contribution of tail events to return period losses is significant, ➔

## Kaikoura illustrates complex fault ruptures

Faults identified by GNS Sciences as experiencing surface fault rupture in the Kaikoura Earthquake



looked at the possibility of creating some sort of post-event risk-transfer mechanism.

“A few years ago, for instance, we had a proposal in front of the U.S. Congress that would have created the ability for the CEA to have done some post-event borrowing if we needed to pay for additional claims,” he continues. “It would have put the U.S. government in the position of guaranteeing our debt. The proposal didn’t get signed into law, but it is one example of how you could create an additional claim-paying capacity for that very large, very infrequent event.”

The CEA leverages both traditional and non-traditional risk-transfer mechanisms. “Risk transfer is important. No one entity can take it on alone,” says Pomeroy. “Through risk transfer from insurer to (re)insurer the risk is spread broadly through the entrance of the capital markets as another source for claim-paying capability and another way of diversifying the concentration of the risk.

“We manage our exposure very carefully by staying within our risk-transfer guidelines,” he continues. “When we look at spreading our risk, we look at spreading it through a large number of (re)insurance companies from 15 countries around the world. And we know the (re)insurers have their own strict guidelines on how big their California quake exposure should be.”

The prospect of a higher frequency of larger events producing a “fatter” tail also raises the prospect of an overall reduction in average annual loss (AAL) for (re)insurance portfolios, a factor that is likely to add to pricing pressure as the industry approaches the key January 1 renewal date, predicts Nunn. “The AAL for Los Angeles coming down in the models will impact the industry in the sense that it will affect pricing and how much probable maximum loss people think they’ve got. Most carriers are busy digesting the changes and carrying out due diligence on the new model updates.

“Although the eye-catching change is the possibility of the ‘big one,’ the bigger immediate impact on the industry is what’s happening at lower return periods where we’re selling a lot of coverage,” he says. “LA was a big driver of risk in the California quake portfolio and that’s coming down somewhat, while the risk in San Francisco is going up. So (re)insurers will be considering how to adjust the balance between the LA and San Francisco business they’re writing.”

as Nunn explains, this could be more of an issue for insurance companies than (re)insurers, from a capitalization standpoint. “From a primary insurance perspective, the bigger the magnitude and event footprint, the more separate claims you have to manage. So, part of the challenge is operational — in terms of mobilizing loss adjusters and claims handlers — but primary insurers also have the risk that losses from tail events could go beyond the (re)insurance program they have bought.

“It’s less of a challenge from the perspective of global (re)insurers, because most of the risk we take is on a loss limited basis — we sell layers of coverage,” he continues. “Saying that, pricing for the top layers should always reflect the prospect of major events in the tail and the uncertainty associated with that.”

He adds: “The magnitude of the Tohoku earthquake event is a good illustration of the inherent uncertainties in earthquake science and wasn’t represented in modeled scenarios at that time.”

While U.S. regulation stipulates that carriers writing quake business should capitalize to the 1-in-200-year event level, in Canada capital requirements are more conservative in an effort to better account for tail risk. “So, Canadian insurance companies should

have less overhang out of the top of their (re)insurance programs,” says Nunn.

### Need for post-event funding

For the CEA, the updated earthquake models could reinvigorate discussions around the need for a mechanism to raise additional claims-paying capacity following a major earthquake. Set up after the Northridge Earthquake in 1994, the CEA is a not-for-profit, publicly managed and privately funded earthquake pool.

“It is pretty challenging for a stand-alone entity to take on large tail risk all by itself,” says Pomeroy. “We have, from time to time,

**“(RE)INSURERS WILL BE CONSIDERING HOW TO ADJUST THE BALANCE BETWEEN THE LA AND SAN FRANCISCO BUSINESS THEY’RE WRITING”**

— PAUL NUNN, SCOR

## AGRICULTURE

# THE LAY OF THE LAND

China has made strong progress in developing agricultural insurance and aims to continually improve. As farming practices evolve, and new capabilities and processes enhance productivity, how can agricultural insurance in China keep pace with trending market needs? EXPOSURE investigates

**T**he People’s Republic of China is a country of immense scale. Covering some 9.6 million square kilometers (3.7 million square miles), just two percent smaller than the U.S., the region spans five distinct climate areas with a diverse topography extending from the lowlands to the east and south to the immense heights of the Tibetan Plateau.

Arable land accounts for approximately 135 million hectares (521,238 square miles), close to four times the size of Germany, feeding a population of 1.3 billion people. In total, over 1,200 crop varieties are cultivated, ranging from rice and corn to sugar cane and goji berries. In terms of livestock, some 20 species covering over 740 breeds are found across China; while it hosts over 20,000 aquatic breeds, including 3,800 types of fish.<sup>1</sup>

### A productive approach

With per capita land area less than half of the global average, maintaining agricultural output is a central function of the Chinese government, and agricultural strategy



Aerial view of  
Terraced rice fields,  
Yuanyang, China

has formed the primary focus of the country's "No. 1 Document" for the last 14 years.

To encourage greater efficiency, the central government has sought to modernize methods and promote large-scale production, including the creation of more agriculture cooperatives, including a doubling of agricultural machinery cooperatives encouraging mechanization over the last four years.<sup>2</sup> According to the Ministry of Agriculture, by the end of May 2015 there were 1.393 million registered farming cooperatives, up 22.4 percent from 2014 — a year that saw the government increase its funding for these specialized entities by 7.5 percent to ¥2 billion (US\$0.3 billion).

Changes in land allocation are also dramatically altering the landscape. In April 2017, the minister of agriculture, Han Changfu, announced plans to assign agricultural production areas to two key functions over the next three years, with 900 million mu (60 million hectares) for primary grain products, such as rice and wheat, and 238 million mu (16 million hectares) for five other key products, including cotton, rapeseed and natural rubber.

Productivity levels are also being boosted by enhanced farming techniques and higher-yield crops, with new varieties of crop including high-yield wheat and "super rice" increasing annual tonnage. Food grain production has risen from 446 million tons in 1990 to 621 million tons in 2015.<sup>3</sup> The year 2016 saw a 0.8 percent decline — the first in 12 years — but structural changes were a contributory factor.

### Insurance penetration

China is one of the most exposed regions in the world to natural catastrophes. Historically, China has repeatedly experienced droughts with different levels of spatial extent of damage to crops, including severe widespread droughts in 1965, 2000 and 2007. Frequent flooding also occurs, but with development of flood mitigation schemes, flooding of crop areas is on a downward trend. China has, however, borne the brunt of one the costliest natural catastrophes to date in 2017, according to Aon Benfield,<sup>4</sup> with July floods along the Yangtze River basin causing economic losses topping US\$6.4 billion. The 2016 summer floods caused some US\$28 billion in losses along the river;<sup>5</sup> while flooding in northeastern China caused a further US\$4.7 billion in damage. Add drought losses of US\$6 billion

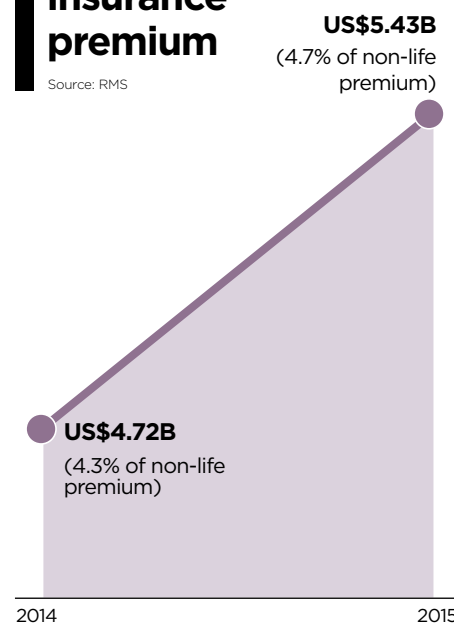


## "OFTEN COMPANIES NOT ONLY DO NOT KNOW WHERE THEIR EXPOSURES ARE, BUT ALSO WHAT THE SPECIFIC POLICY REQUIREMENTS FOR THAT PARTICULAR REGION ARE IN RELATION TO TERMS AND CONDITIONS"

— LAURENT MARESCOT, RMS

### Agricultural insurance premium

Source: RMS



and the annual weather-related losses stood at US\$38.7 billion.<sup>6</sup> However, insured losses are a fraction of that figure, with only US\$1.1 billion of those losses insured.

The region represents the world's second largest agricultural insurance market, which has grown from a premium volume of US\$100 million in 2006 to more than US\$6 billion in 2016. However, government subsidies — at both central and local level — underpin the majority of the market. In 2014, the premium subsidy level ranged from between 65 percent and 80 percent depending on the region and the type of insurance.

Most of the insured are small acreage farms, for which crop insurance is based on a named peril but includes multiple peril cover (drought, flood, extreme winds and hail, freeze and typhoon). Loss assessment is generally performed by surveyors from the government, insurers and an individual that represents farmers within a village. Sub-

sidized insurance is limited to specific crop varieties and breeds and primarily covers only direct material costs, which significantly lowers its appeal to the farming community.

One negative impact of current multi-peril crop insurance is the cost of operations, thus reducing the impact of subsidies. "Currently, the penetration of crop insurance in terms of the insured area is at about 70 percent," says Mael He, head of agriculture, China, at Swiss Re. "However, the coverage is limited and the sum insured is low. The penetration is only 0.66 percent in terms of premium to agricultural GDP. As further implementation of land transfer in different provinces and changes in supply chain policy take place, livestock, crop yield and revenue insurance will be further developed."

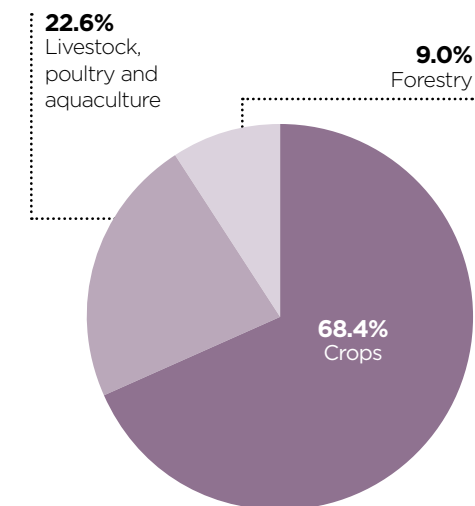
As He points out, changing farming practices warrant new types of insurance. "For the cooperatives, their insurance needs are very different compared to those of small household farmers. Considering their main income is from farm production, they need insurance cover on yield or event-price-related agricultural insurance products, instead of cover for just production costs in all perils."

### At ground level

Given low penetration levels and limited coverage, China's agricultural market is clearly primed for growth. However, a major hindering factor is access to relevant data to inform meaningful insurance decisions. For many

### Premium composition (2014)

Source: RMS



### China's agricultural sector

Source: Ministry of Agriculture of the People's Republic of China



**135 million**

hectares of arable land



**1,200**

crop varieties cultivated



**20**

species of livestock covering **740** breeds



**20,000**

aquatic breeds, including 3,800 types of fish

insurers, the time series of insurance claims is short, government-subsidized agriculture insurance only started in 2007, according to Laurent Marescot, senior director of model product management at RMS.

"This a very limited data set upon which to forecast potential losses," says Marescot. "Given current climate developments and changing weather patterns, it is highly unlikely that during that period we have experienced the most devastating events that we are likely to see. It is hard to get any real understanding of a potential 1-in-100 loss from such data."

Major changes in agricultural practices also limit the value of the data. "Today's farming techniques are markedly different from 10 years ago," states Marescot. "For example, there is a rapid annual growth rate of total agricultural machinery power in China, which implies significant improvement in labor and land productivity."

Insurers are primarily reliant on data from agriculture and finance departments for information, says He. "These government departments can provide good levels of data to help insurance companies understand the risk for the current insurance coverage. However, obtaining data for cash crops or niche species is challenging."

"You also have to recognize the complexities in the data," Marescot believes. "We accessed over 6,000 data files with government information for crops, livestock and forestry to calibrate our China Agricultural Model (CAM). Crop yield data is available from the 1980s, but in most cases it has to be calculated from the sown area. The data also needs to be processed to resolve inconsistencies and possibly de-trended, which is a fairly complex process. In addition, the correlation between crop yield and loss is not great as loss claims are made at a village level and usually involve negotiation."

### A clear picture

Without the right level of data, international companies operating in these territories may not have a clear picture of their risk profile.

"Often companies not only have a limited view where their exposures are, but also of what the specific policy requirements for that particular province are in relation to terms and conditions," says Marescot. "These are complex as they vary significantly from one line of business and province to the next." ➔

In April, China announced the launch of an expansive disaster insurance program spanning approximately 200 counties in the country's primary grain producing regions, including Hebei and Anhui.

The program introduces a new form of agriculture insurance designed to provide compensation for losses to crop yields resulting from natural catastrophes, including land fees, fertilizers and

## THE DISASTER PLAN

crop-related materials.

China's commitment to providing robust disaster cover was also demonstrated in 2016, when Swiss Re announced it had entered into a reinsurance protection scheme with the government of Heilongjiang Province and the Sunlight Agriculture Mutual Insurance Company of China — the first instance of the Chinese government capitalizing on

a commercial program to provide cover for natural disasters.

The coverage provides compensation to farming families for both harm to life and damage to property as well as income loss resulting from floods, excessive rain, drought and low temperatures. It determines insurance payouts based on triggers from satellite and meteorological data.

Speaking at the launch, Swiss Re president for China John Chen said: "It is one of the top priorities of the government bodies in China to better manage natural catastrophe risks, and it has been the desire of the insurance companies in the market to play a bigger role in this sector. We are pleased to bridge the cooperation with an innovative solution and would look forward to replicating the solutions for other provinces in China."



global positioning systems — are commonly used in China for agriculture claims assessments. Using a smartphone app linked to remote control CCTV in livestock farms is also very common. These digital approaches are helping farmers better manage risk." Insurer Ping An is now using drones for claims assessment.

There is no doubt that as farming practices in China evolve, the potential to generate much greater information from new data streams will facilitate the development of new products better designed to meet on-the-ground requirements.

He concludes: "China can become the biggest agricultural insurance market in the next 10 years. ... As the Chinese agricultural industry becomes more professional, risk management and loss assessment experience from international markets and professional farm practices could prove valuable to the Chinese market."

### References:

1. Ministry of Agriculture of the People's Republic of China
2. Cheng Fang, "Development of Agricultural Mechanization in China," Food and Agriculture Organization of the United Nations, [https://forum2017.iamo.de/microsites/forum2017.iamo.de/fi/leadadmin/presentations/B5\\_Fang.pdf](https://forum2017.iamo.de/microsites/forum2017.iamo.de/fi/leadadmin/presentations/B5_Fang.pdf)
3. Ministry of Agriculture of the People's Republic of China
4. Aon Benfield, "Global Catastrophe Recap: First Half of 2017," July 2017, <http://thoughtleadership.aonbenfield.com/Documents/201707-if-1h-global-recap.pdf>
5. Aon Benfield, "2016 Annual Global Climate and Catastrophe Report," <http://thoughtleadership.aonbenfield.com/Documents/20170117-ab-if-annualclimate-catastrophe-report.pdf>
6. Ibid.

A further level of complexity stems from the fact that not only can data be hard to source, but in many instances it is not reported on the same basis from province to province. This means that significant resource must be devoted to homogenizing information from multiple different data streams.

"We've devoted a lot of effort to ensuring the homogenization of all data underpinning the CAM," Marescot explains. "We've also translated the information and policy requirements from Mandarin into English. This means that users can either enter their own policy conditions into the model or rely upon the database itself. In addition, the model is able to disaggregate low-resolution exposure to higher-resolution information, using planted area data information. All this has been of significant value to our clients."

The CAM covers all three lines of agricultural insurance — crop, livestock and forestry. A total of 12 crops are modeled individually, with over 60 other crop types

represented in the model. For livestock, CAM covers four main perils: disease, epidemics, natural disasters and accident/fire for cattle, swine, sheep and poultry.

### The technology age

As efforts to modernize farming practices continue, so new technologies are being brought to bear on monitoring crops, mapping supply and improving risk management.

"More farmers are using new technology, such as apps, to track the growing conditions of crops and livestock and are also opening this to end consumers so that they can also monitor this online and in real-time," He says. "There are some companies also trying to use blockchain technology to track the movements of crops and livestock based on consumer interest; for instance, from a piglet to the pork to the dumpling being consumed."

He says, "3S technology — geographic information sciences, remote sensing and

## RISK MODELS

# QUANTIFYING THE RESILIENCE DIVIDEND

New opportunities arise for risk capital providers and city planners as the resilience movement gets analytical. EXPOSURE explores the potential

A hundred years ago, a seven-and-a-half-mile seawall was built to protect San Francisco from Mother Nature. It gave the city's planning department the confidence to develop today's commercially and culturally rich downtown.

But that iconic waterfront is under threat. The aging seawall has serious seismic vulnerability. Almost \$80 billion of San Francisco property is exposed to sea level rise.

To ensure his city's long-term resilience, Mayor Ed Lee commissioned a plan to design and fund the rebuild of the seawall. A cost of \$8 million for the feasibility study last year and \$40 million for the preliminary design this year is just the beginning. With an estimated price tag of up to \$5 billion, the stakes are high. Getting it wrong is not an option. But getting it right won't be easy.

San Francisco is no outlier. Investing in resilience is in vogue. Citizens expect their city officials to understand the risks faced and deal with them. The science is there, so citizens want to see their city planning and investing for a robust, resilient city looking fifty or a hundred years ahead. The frequency and severity of natural catastrophes continues to rise. The threat of terror continues to evolve. Reducing damage and disruption when the worst happens has become an imperative across the political spectrum.

Uncertainty around various macro trends complicates the narrative: sea level rise, coastal development, urban densification, fiscal constraints, "disaster deductibles." Careful planning is required. An informed under-

standing of how the right intervention leads to a meaningful reduction in risk is higher than ever before on the City Hall agenda.

This has various implications for risk capital providers. Opportunities are emerging to write more profitable business in catastrophe-exposed areas. Municipal buyers are looking for new products that link risk transfer and risk reduction or deliver more than just cash when disaster strikes.

The innovators will win, thinks John Seo, co-founder and managing principal of Fermat Capital Management. "Considerable time and thought must be invested on what to do with funds, both pre- and post-event.

"All municipalities function on a relatively fixed annual budget. Risk transfer smooths the costs of catastrophe risk, which lessens the disruption on ongoing spending and programs. Ideally, risk transfer comes with a plan for what to do with the funds received from a risk transfer payout. That plan is just as valuable, if not more valuable, than the payout itself."

### Resisting a shock in New Orleans

This innovative approach to resilience has become central to New Orleans under Mayor Mitch Landrieu. Partnering with utilities and reinsurance experts, the city examined its drinking water, sanitation and rainwater evacuation facilities to determine their vulnerability to major storms. This analysis provided the basis for investments to ensure these facilities could withstand a shock and continue operating effectively. ➔

**"IDEALLY, RISK TRANSFER COMES WITH A PLAN FOR WHAT TO DO WITH THE FUNDS RECEIVED FROM A RISK TRANSFER PAYOUT"**

— JOHN SEO,  
FERMAT CAPITAL  
MANAGEMENT

# QUANTIFYING THE ECONOMIC IMPACT OF SEA LEVEL RISE IN SAN FRANCISCO

In May 2016, RMS published the findings of an analysis into the likely economic impact of sea level rise (SLR) in San Francisco, with the aim to inform the city’s action plan. It found that by the year 2100, \$77 billion of property would be at risk from a one-in-100-year extreme storm surge event and that \$55 billion of property in low-lying coastal zones could be permanently inundated in the absence of intervention.

The city’s Sea Level Rise Action Plan, which incorporated RMS findings, enabled San Francisco’s mayor to invest \$8 million in assessing the feasibility of retrofitting the city’s seawall. The city subsequently commissioned a \$40 million contract to design that retrofit program.

**Property Value at Risk in San Francisco**

	Private Property	Public Property	Total Property Value Exposed
66" SLR	\$20 billion	\$35 billion	\$55 billion*
108" (66" SLR + 100-year extreme tide)	\$39 billion	\$37 billion	\$77 billion*

Source: San Francisco Sea Level Rise Action Plan / RMS

\*Figures have been rounded for purposes of the report

“In New Orleans, the city’s pumps are a critical piece of infrastructure. So, the question was: can you create a better nexus between an engineering company with man-power and thought-power to help keep those pumps going, to prepare them in advance of a catastrophe, and align insurance contracts and risk so we are continuing service delivery,” explains Elizabeth Yee, vice president of city solutions at 100 Resilient Cities.

The aim is to focus on disaster response and business continuity, in addition to risk financing. “If there’s an earthquake it’s great the city might receive \$10 million to help repair the airport, but what they really need is an airport that is up and running, not just \$10 million,” says Yee. “So, there needs to be a way to structure insurance contracts so they better help continue service delivery, as opposed to just providing money.”

There is also the need to reflect the impact of strengthened infrastructure when modeling and pricing the risk. But this isn’t always an easy journey.

In the city of Miami Beach, Mayor Philip Levine decided to raise its roads, so the barrier island’s thoroughfares stay open even in a flood. While the roads remain dry, this intervention has brought some unwelcome consequences.

City residents and business owners are concerned that the runoff will flood adjacent properties. Irrespective of where the water from the streets goes, it is no longer clear whether in-force insurance policies would pay out in the event of flood damage. The ground floor is no longer technically the ground floor. It is now a basement as it sits below the street level which one local restaurateur found out when Allstate denied his \$15,000 claim last year.

“That’s an example of the kind of highly nuanced problem government agencies are grappling with all over the world,” explains Daniel Stander, global managing director at RMS. “There are often no quick and easy answers. Economic analysis is essential. Get it wrong and well-intentioned intervention can actually increase the risk — and the cost of insurance with it.

“The interventions you put in place have to reduce the risk in the eyes of the market,” he continues. “If you want to get the credit for your resilience investments, you need to make sure you understand your risk as the market does, and then reduce your risk in its eyes. Get it right, and communities and economies thrive. Get it wrong, and whole neighborhoods become uninsurable, unaffordable, unlivable.”

**Retrofitting shelters in Berkeley**

Through its partnership with 100 Resilient Cities, RMS is helping a growing number of cities determine which resilience interventions will make the biggest difference.

Knowing that a major Hayward fault rupture would displace up to 12,000 households,

with up to 4,000 seeking temporary shelter, the city of Berkeley engaged RMS to ascertain whether the city’s earthquake shelters would withstand the most probable events on the fault. A citywide analysis highlighted that the shelters perform, on average, worse than the surrounding buildings from which residents would flee. The RMS analysis also found that a \$17 million seismic retrofit investment plan is substantially more cost-effective and environmentally friendly than rebuilding or repairing structures after an earthquake.

“We’ve encouraged our chief resilience officers who are new to a city to learn about their exposures,” explains Yee. “From that baseline understanding, they can then work with someone like RMS to carry out more specific analysis. The work that RMS did with Berkeley helped them to better understand the economic risk posed by an earthquake, and ensured the city was able to secure funding to upgrade earthquake shelters for its residents.”

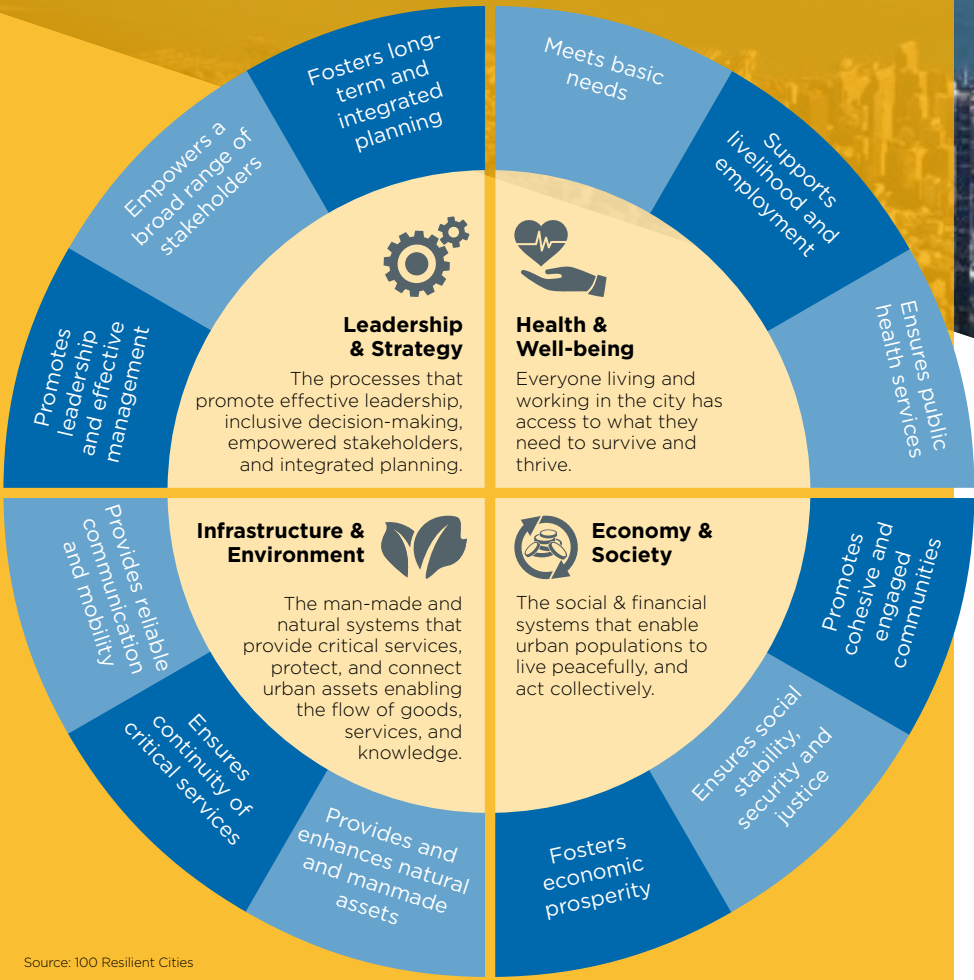
## Rewarding resilience

In parts of the world where the state or national government acts as (re)insurer-of-last-resort, stepping in to cover the cost of a catastrophe, there may be a lack of incentive to improve city resilience, warns Yee. “Many of the residents in my neighbourhood have elevated our homes, because we had fish in our yards after Hurricane Sandy,” she says. “But some of our neighbours have decided to wait until the ‘next one’ because there’s this attitude that FEMA (the Federal Emergency Management Agency) will just pay them back for any damage that occurs. We need to change the regulatory framework so that good behavior is incentivized and rewarded.”

In the U.S., FEMA has suggested the introduction of a “disaster deductible.” This would require recipients of FEMA public assistance

# City resilience framework

The City Resilience Framework, developed by Arup with support from the Rockefeller Foundation, helps clarify the primary factors contributing to resilient cities.



of premium income. “The insurance industry wants risk to be at an appropriate level,” says Stander. “There are parts of the world where the risk is so high, the industry is rightly reluctant to touch it. Informal neighborhoods throughout South America and South Asia are so poorly constructed they’re practically uninsurable. The insurance industry likes resilience interventions that keep risk insurable at a rate which is both affordable and profitable.”

“Besides, it’s not like you can suddenly make Miami zero-risk,” he adds. “But what you can do as a custodian of a city’s economy is prioritize and communicate resilience interventions that simultaneously reduce rates for citizens and attract private insurance markets. And as a capital provider you can structure products that reward resilient thinking, which help cities monetize their investments in resilience.”

Movements like Rockefeller Foundation–pioneered 100 Resilient Cities are both responding to and driving this urgency. There is a real and present need for action to meet growing threats.

In San Francisco, investments in resilience are being made now. The city is beyond strategy formulation and on to implementation mode. Shovel-ready projects are required to stem the impacts of 66 inches of sea level rise by 2100. For San Francisco and hundreds of cities and regions around the globe, resilience is a serious business.

# CRACKING THE CYBER CODE

It is difficult to gain an accurate picture of the global financial impact of cyber-related attacks. Recent studies have estimated annual global cyber-crime losses at anywhere from \$400 billion to upwards of \$3 trillion.

At the company level, the 2016 Cost of Cyber Crime and the Risk of Business Innovation report by the Ponemon Institute pegs the annual average cost of cybercrime per organization in the U.S. at \$17.4 million, up from \$15.4 million in 2015; well in front of Japan (\$8.4 million / \$6.8 million), Germany (\$7.8 million / \$7.5 million) and the U.K. (\$7.2 million / \$6.3 million).

In response, firms are ramping up information security spending. Gartner predicts the global figure will reach \$90 billion in 2017, up 7.6 percent on 2016, as investment looks set to top \$113 billion by 2020, with detection and response capabilities the main drivers.

## The insurance component

Set against the global cyber insurance premium figure — in the region of \$2.5 billion to \$4 billion — it is clear that such cover forms only a very small part of current risk mitigation spend. That said, premium volumes are steadily growing.

In the U.S., which accounts for 75 to 85 percent of global premiums, 2016 saw a 35 percent rise to \$1.35 billion, a figure based on statutory filings with the National Association of Insurance Commissioners, so not a total market figure.

“Much of the premium increase we are seeing is driven by the U.S.,” Geoff Pryor-White, CEO of Tarian, explains. “But we are also seeing a significant uptick in territories including the U.K., Australia and Canada, as well as in the Middle East, Asia and Latin America.

“Events such as the recent Wannacry and NotPetya attacks have not only helped raise cyber threat awareness, but demon-

As insurers strive to access the untapped potential of the cyber market, a number of factors hindering progress must be addressed. EXPOSURE investigates

strated the global nature of that threat. Over the last few years, most attacks have been U.S.-focused, targeting specific companies, whereas these events reverberated across the globe, impacting multiple different organizations and sectors.”

## Untapped potential

Insurance take-up levels are still, however, far from where they should be given the multibillion-dollar potential the sector offers.

One aspect hindering market growth is the complexity of products available. The Hiscox Cyber Readiness Report 2017 found that 1 in 6 respondents who did not plan to purchase cyber insurance agreed that “cyber insurance policies are so complicated — I don’t understand what cyber insurance would cover me for.”

As Pryor-White points out, cyber products, while still relatively new, have undergone significant change in their short tenure. “Products initially targeted liability risks — but to date we have not seen the levels of litigation we expected. The focus shifted to the direct cyber loss costs, such as crisis management, data recovery and regulatory fines. Now, as client concern grows regarding business interruption, supply chain risk and reputation fallout, so products are transitioning to those areas.”

He believes, however, that coverage is still too geared towards data-driven sectors

such as healthcare and financial institutions, and does not sufficiently address the needs of industries less data reliant. “Ultimately, you have to produce products relevant to particular sectors. NotPetya, for example, had a major impact on the marine and manufacturing sectors — industries that have not historically purchased cyber insurance.”

Limits are also restricting market expansion. “Insurers are not willing to offer the more substantial limits that larger organizations are looking for,” says Thomas Harvey, cyber product manager at RMS. “Over the last 12 months, we have seen an increase in the number of policies offering limits up to \$1 billion, but these are complex to put together and availability is limited.”

That underwriters are reticent about ramping up cyber limits is not surprising given levels of available cyber data and the loss potential endemic within “silent cyber.” A recent consultation paper from the U.K.’s Prudential Regulatory Authority stated that “the potential for a significant ‘silent’ cyber insurance loss is increasing with time,” and warned it extended across casualty and property lines, as well as marine, aviation and transport classes with the evolution of autonomous vehicles.

Robust exclusions are called for to better clarify coverage parameters, while insurers are urged to establish clearer cyber strategies and risk appetites, including defined markets,

**“WE’RE LOOKING BEHIND THE HEADLINE, UNDERSTANDING HOW THE ATTACK WAS CARRIED OUT, WHAT VULNERABILITIES WERE EXPLOITED AND MAPPING THIS RICH DATA INTO OUR MODELS”**

— THOMAS HARVEY, RMS



aggregate limits for sectors and geographies, and processes for managing silent cyber risk.

Exclusions are increasingly common in packaged policies, either for all cyberattack-related losses or specific costs, such as data breach or recovery. This is driving a strong uptick in demand for standalone policies as clients seek affirmative cyber cover. However, as Pryor-White warns, “The more standalone cover there is available, the more prevalent the aggregation risk becomes.”

## Getting up to cyber speed

Data is at the core of many of the factors limiting market expansion. Meaningful loss data is effectively limited to the last five to ten years, while the fast-evolving nature of the threat limits the effectiveness of that data. Further, rapid developments on the regulatory front are impacting the potential scale and scope of cyber-related losses.

“One of the main issues hindering growth is the challenge insurers face in assessing and managing risk correlations and the problems of accumulation. Models are playing an increasingly prominent role in helping insurers overcome these inherent issues and to quantify cyber risk,” says Harvey. “Insurers are not going into this sector blind, but have a more accurate understanding of the financial downside and are better able to

manage their risk appetite accordingly.”

While historical information is a foundational element of the RMS cyber modeling capabilities, each incident provides critical new data sets. “We’re looking behind the headline loss numbers,” Harvey continues, “to get a clear understanding of how the attack was carried out, what vulnerabilities were exploited and how the incident developed. We are then mapping this rich data into our models.”

The data-sourcing approach is very different from a traditional cat model. While securing property data from underwriting slips and other sources is virtually an automated process, cyber data must be hunted down. “You’re seeking data across multiple different sources,” he adds, “for a risk that is constantly expanding and evolving — to do that we’ve had to build new data-gathering capabilities.”

Partnership is also key to cracking the cyber code. RMS currently works with the Cambridge Centre for Risk Studies, a number of insurance development partners, and

additional technology and security companies to expand its cyber data universe.

“We’re bringing together insurance domain knowledge, cyber security expertise and our own specific modeling capabilities,” Harvey explains. “We’ve looked to build out our core capabilities and introduce a diverse skill-set that extends from experts in malware and ransomware, as well as penetration testing, through to data scientists and specialists in industrial control systems. We’re also applying new techniques such as game theory and Bayesian networks.”

Following the launch of its first cyber accumulation model in February 2016, the firm has expanded its capabilities on a number of fronts, including the ability to model silent cyber risk and the inclusion of a series of new cyber-physical risk scenarios.

Better data and more accurate modeling are also critical to the sector’s ability to raise limits to meaningful levels. “We’re seeing a lot of fairly dramatic potential loss numbers in the market,” says Pryor-White, “and such numbers are likely to make capital providers nervous. As underwriters, we need to be able to produce loss scenarios based on solid data provided through recognized aggregation models. That makes you a much more credible proposition from a capital-raising perspective.”

## Data interrogation

“The amount of cyber-related data has increased significantly in the last 10 years,” he continues, “particularly with the implementation of mandatory reporting requirements — and the launch of the EU’s General Data Protection Regulation will significantly boost that as well as driving up insurance take-up. What we need to be able to do is to interrogate that data at a much more granular level.”

He concludes: “As it stands now, we have assumptions that give us a reasonable market view from a deterministic perspective. The next stage is to establish a way to create a probabilistic cyber model. As we learn more about the peril from both claims data and reporting of cyber events, we gain a much more coherent picture of this evolving threat, and that new understanding can be used to continually challenge modeling assumptions.”

## THE ONE THING

# WHAT ONE THING WOULD HELP... (RE)INSURERS GET CLOSER TO THE ORIGINAL RISK?

In each edition of EXPOSURE we ask three experts for their opinion on how they would tackle a major risk and insurance challenge. This issue, we consider how (re)insurers can gain more insight into the original risk, and in so doing, remove frictional costs. As our experts Kieran Angelini-Hurll, Will Curran and Luzi Hitz note, more insight does not necessarily mean disintermediation



**KIERAN ANGELINI-HURLL**  
CEO, Reinsurance at Ed

The reduction of frictional costs would certainly help. At present, there are too many frictional costs between the reinsurer and the original risk. The limited amount of data available to reinsurers on the original risks is also preventing them from getting a clear picture. A combination of new technology and a new approach from brokers can change this.

First, the technology. A trading platform which reduces frictional costs by driving down overheads will bridge the gap between reinsurance capital and the insured. However, this platform can only work if it provides the data which will allow reinsurers to better understand this risk. Arguably, the development of such a platform could be achieved by any broker with the requisite size, relevance and understanding of reinsurers' appetites.

However, for most, their business models do not allow for it. Their size stymies innovation and they have become dependent on income derived from the sale of data, market-derived income and 'facilitization'. These costs prevent reinsurers from getting closer to the risk. They are also unsustainable, a fact that technology will prove. A trading platform which has the potential to reduce costs for all parties, streamline the throughput of data, and make this information readily and freely available could profoundly alter the market.

Brokers that continue to add costs and maintain their reluctance to share data will be forced to evolve or watch their business migrate to leaner, more disruptive players. Brokers which are committed to marrying reinsurance capital with risk, regardless of its location and that deploy technology, can help overcome the barriers put in place by current market practices and bring reinsurers closer to the original risk.

**Brokers reluctant to share data will watch their business migrate to more disruptive players**



**WILL CURRAN**  
Head of Reinsurance,  
Tokio Marine Kiln, London

More and more, our customers are looking to us as their risk partners, with the expectation that we will offer far more than a transactional risk transfer product. They are looking for pre-loss services, risk advisory and engineering services, modeling and analytical capabilities and access to our network of external experts, in addition to more traditional risk transfer. As a result of offering these capabilities, we are getting closer to the original risk, through our discussions with cedants and brokers, and our specialist approach to underwriting.

The long-term success of reinsurers needs to be built on offering more than being purely a transactional player. To a large extent, this has been driven by the influx of non-traditional capital into the sector. Whereas these alternative property catastrophe reinsurance providers are offering a purely transactional product, often using parametric or industry-loss triggers to simplify the claims process in their favor, traditional carriers are able to differentiate by going beyond vanilla risk transfer.

Demand for risk advice and pre-loss services are particularly high within specialist and emerging risk classes of business. Cyber is a perfect example of this, where we work closely with our corporate and insurance clients to help them improve their resilience to cyber-attack and to plan their response in the event of a breach.

Going forward, successful reinsurance companies will be those that invest time and resources in becoming true risk partners. In an interconnected and increasingly complex world, where there is a growing list of underinsured exposures, risk financing is just one among many service offerings in the toolkit of specialist reinsurers.

**Traditional carriers are able to differentiate by going beyond vanilla risk transfer**



**LUZI HITZ**  
CEO, PERILS AG

The nature of reinsurance means the reinsurer is inherently further away from the underlying risk than most other links in the value chain. The risk is introduced by the original insured, and is transferred into the primary market before reaching the reinsurer – a process normally facilitated by reinsurance intermediaries.

I am wary of efforts to shortcut or circumvent this established multi-link chain to reduce the distance between reinsurer and the underlying risk. The reinsurer in many cases lacks the granular insight found earlier in the process required to access the risk directly.

What we need is a more cooperative relationship between reinsurer and insurer in developing risk transfer products. Too often the reinsurers act purely as capital providers in the chain and from the source risk, viewing it almost as an abstract concept within the overall portfolio.

By collaborating on the development of insurance products, not only will it help create greater alignment of interest based on a better understanding of the risk relationship, but also prove beneficial to the entire insurance food chain. It will make the process more efficient and cost effective, and hopefully see the risk owners securing the protection they want. In addition, it is much more likely to stimulate product innovation and growth, which is badly needed in many mature markets.

The focus in my opinion should not be on how to bring the reinsurer closer to the risk, but rather on how to bring all parties to the risk closer together. What I am saying is not new, and it is certainly something which many larger reinsurers have been striving to achieve for years. And while there is evidence of this more collaborative approach between insurers and reinsurers gaining traction, there is still a very long way to go.

**The focus should be on how to bring all parties to the risk closer together**

## FLOOD

As the reauthorization date for the National Flood Insurance Program looms, EXPOSURE considers how the private insurance market can bolster its presence in the U.S. flood arena and overcome some of the challenges it faces

# BREACHING THE FLOOD INSURANCE BARRIER

**A**ccording to Federal Emergency Management Agency (FEMA), as of June 30, 2017, the National Flood Insurance Program (NFIP) had around five million policies in force, representing a total in-force written premium exceeding US\$3.5 billion and an overall exposure of about US\$1.25 trillion. Florida alone accounts for over a third of those policies, with over 1.7 million in force in the state, representing premiums of just under \$1 billion.

However, with the RMS Exposure Source Database estimating approximately 85 million residential properties alone in the U.S., the NFIP only encompasses a small fraction of the overall number of properties exposed to flood, considering floods can occur throughout the country.

Factors limiting the reach of the program have been well documented: the restrictive scope of NFIP policies, the fact that mandatory coverage applies only to special flood hazard plains, the challenges involved in securing elevation certificates, the cost and resource demands of conducting on-site inspections, the poor claims performance of the NFIP, and perhaps most significant

the refusal by many property owners to recognize the threat posed by flooding.

At the time of writing, the NFIP is once again being put to the test as Hurricane Harvey generates catastrophic floods across Texas. As the affected regions battle against these unprecedented conditions, it is highly likely that the resulting major losses will add further impetus to the push for a more substantive private flood insurance market.

### The private market potential

While the private insurance sector shoulders some of the flood coverage, it is a drop in the ocean, with RMS estimating the number of private flood policies to be around 200,000. According to Dan Alpay, line underwriter for flood and household at Hiscox London Market, private insurers represent around US\$300 to US\$400 million of premium — although he adds that much of this is in “big-ticket policies” where flood has been included as part of an all-risks policy.

“In terms of stand-alone flood policies,” he says, “the private market probably only represents about US\$100 million in premiums — much of which has been generated in the last few years, with the opening up

## NATIONAL FLOOD INSURANCE PROGRAM

Source: FEMA, June 30, 2017

**4,950,560**

Number of policies in force

**US\$3,520,658,566**

Written premium in force

**US\$1,233,149,040,800**

Insurance in force overall

of the flood market following the introduction of the Biggert-Waters Flood Insurance Reform Act of 2012 and the Homeowner Flood Insurance Affordability Act of 2014.”

But it is clear therefore that the U.S. flood market represents one of the largest untapped insurance opportunities in the developed world, with trillions of dollars of property value at risk across the country.

“It is extremely rare to have such a huge potential market like this,” says Alpay, “and we are not talking about a risk that the market does not understand. It is U.S. catastrophe business, which is a sector that the private market has extensive experience in. And while most insurers have not provided specific cover for U.S. flood before, they have been providing flood policies in many other countries for many years, so have a clear understanding of the peril characteristics. And I would also say that much of the experience gained on the U.S. wind side is transferable to the flood sector.”

Yet while the potential may be colossal, the barriers to entry are also significant. First and foremost, there is the challenge

**“THE IDEA THAT A  
PROPERTY IS EITHER  
‘IN’ OR ‘OUT’ OF A  
FLOOD PLAIN IS NO  
LONGER THE KEY  
CONSIDERATION FOR  
PRIVATE INSURERS”**

— JACKIE NOTO, RMS

of going head-to-head with the NFIP itself. While there is concerted effort on the part of the U.S. government to facilitate a greater private insurer presence in the flood market as part of its reauthorization, the program has presided over the sector for almost 50 years and competing for those policies will be no easy task.

“The main problem is changing consumer behavior,” believes Alpay. “How do we get consumers who have been buying policies through the NFIP since 1968 to appreciate the value of a private market product and trust that it will pay out in the event of a loss? While you may be able to offer a ➔

product that on paper is much more comprehensive and provides a better deal for the insured, many will still view it as risky given their inherent trust in the government.”

For many companies, the aim is not to compete with the program, but rather to source opportunities beyond the flood zones. “It becomes much more about accessing the potential that exists outside of the mandatory purchase requirements,” believes Jackie Noto, U.S. flood product manager at RMS. “And to do that, you have to convince those property owners who are currently not located in these zones that they are actually in an at-risk area and need to consider purchasing flood cover. This will be particularly challenging in locations where homeowners have never experienced a damaging flood event.

“The idea that a property is either ‘in’ or ‘out’ of a flood plain,” she continues, “is no longer the key consideration for private insurers. The overall view now is that there is no such thing as a property being ‘off plain.’”

Another market opportunity lies in providing coverage for large industrial facilities and high-value commercial properties, according to Pete Dailey, vice president of product management at RMS. “Many businesses already purchase NFIP policies,” he explains, “in fact those with federally insured mortgages and locations in high-risk flood zones are required to do so.

“However,” he continues, “most businesses with low-to-moderate flood risk are unaware that their business policy excludes flood damage to the building, its contents and losses due to business interruption. Even those with NFIP coverage have a US\$500,000 limit and could benefit from an excess policy. Insurers eager to expand their books by offering new product options to the commercial lines will facilitate further expansion of the private market.”

Assessing the flood level

But to be able to effectively target this market, insurers must first be able to ascertain what the flood exposure levels really are. The current FEMA flood mapping database spans 20,000 individual plains. However, much of this data is out of date, reflecting limited resources, which, coupled with a lack of consistency in how areas have been mapped using different contractors, means their risk assessment value is severely limited.

While a proposal to use private flood map-



Significant flood events				
Event	Year	No. of paid losses	Amount paid (US\$)	Average paid loss
Hurricane Katrina	August 2005	167,995	\$16,319,771,811	\$97,144
Hurricane Ike	September 2008	46,679	\$2,699,241,970	\$57,826
Superstorm Sandy	October 2012	131,502	\$8,596,226,779	\$65,370
Louisiana severe storms and flooding	August 2016	26,949	\$2,407,210,081	\$89,325

Source: FEMA

Note: a significant flood event is a flooding event with 1,500 or more paid losses

ping studies instead of FEMA maps is being considered, the basic process of maintaining flood plain data is an immense problem given the scale. “The fact that the U.S. is exposed to flood in virtually every location,” says Noto, “makes it a high-resolution peril, meaning there is a long list of attributes and inter-dependent dynamic factors influencing what flood risk in a particular area might be.

“Owing to 100 years of scientific research, the physics of flooding is well understood,” she continues. “However, the issue has been generating the data and creating the model at sufficient resolution to encompass all of the relevant factors from an insurance perspective.”

In fact, to manage the scope of the data required to release the RMS U.S. Flood Hazard Maps for a small number of return periods required the firm to build a supercomputer, capitalizing on immense Cloud-based technology to store and manage the colossal streams of information effectively.

With such data now available, insurers are in a much better position to generate functional underwriting maps. “The FEMA maps were never drawn up for underwriting purposes,” Noto points out. “What we are now able to provide is actual gradient and depth of flooding data. So rather than saying you are ‘in’ or ‘out,’ insurers can start the conversation by saying your property is exposed to

two to three feet of flooding at a 1-in-100 return period. The discussions can be based on the risk of flood inundation rather than less meaningful contour lines and polygons.”

No clear picture

Another hindrance to establishing a clear flood picture is the lack of a systematic database of the country’s flood defense network. RMS estimates that the total network encompasses some 100,000 miles of flood defenses; however, FEMA’s levy network accounts for approximately only 10 percent of this.

“Without the ability to model existing flood defenses accurately, you end up overestimating the higher frequency, lower risk events,” explains Noto. “It is very easy to bias a model with higher than expected losses if you do not have this information.”

To help counter this lack of defense data, RMS developed the capability to identify the likelihood of such measures being present and, in turn, assess the potential protection levels.

Data shortage is also limiting the potential product spectrum, Noto explains. “Take the correlation between storm surge and river flooding or surface flooding from a tropical cyclone event. If an insurer is not able to demonstrate to A.M. Best what the relationship between these different sources of flood risk is for a given portfolio, then it reduces the range of flood products they can offer.

“WE SOON REALIZED THAT TO FIRMLY ESTABLISH OURSELVES ... WE HAD TO DELIVER A POLICY OF SUFFICIENT VALUE TO ENCOURAGE CONSUMERS TO SHIFT FROM THE NFIP TO THE PRIVATE MARKET”

— DAN ALPAY, HISCOX LONDON MARKET

“Insurers need the tools and the data to differentiate the more complicated financial relationships, exclusions and coverage options relative to the nature of the events that could occur. Until you can do that, you can’t offer the scope of products that the market needs.”

Launching into the sector

In May 2016, Hiscox London Market launched its FloodPlus product into the U.S. homeowners sector, following the deregulation of the market. Distributed through wholesale brokers in the U.S., the policy is designed to offer higher limits and a wider scope than the NFIP.

“We initially based our product on the NFIP policy with slightly greater coverage,” Alpay explains, “but we soon realized that to firmly establish ourselves in the market we had to deliver a policy of sufficient value to encourage consumers to shift from the NFIP to the private market.

“As we were building the product and setting the limits,” he continues, “we also looked at how to price it effectively given the lack of granular flood information. We sourced a lot of data from external vendors in addition to proprietary modeling which we developed ourselves, which enabled us to build our own pricing system. What that enabled us to do was to reduce the process time involved in buying and activating a policy from up to 30 days under the NFIP system to a matter of minutes under FloodPlus.” This sort of competitive edge will help incentivize NFIP policyholders to make a switch.

“We also conducted extensive market research through our coverholders,” he adds, “speaking to agents operating within the NFIP system to establish what worked and what didn’t, as well as how claims were handled.”

Since launch, the product has been amended on three occasions in response to customer demand. “For example, initially the product offered actual cash value on

contents in line with the NFIP product,” he adds. “However, after some agent feedback, we got comfortable with the idea of providing replacement cost settlement, and we were able to introduce this as an additional option which has proved successful.”

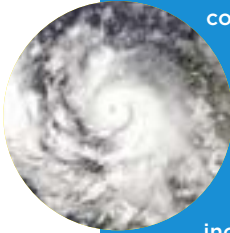
To date, coverholder demand for the product has outstripped supply, he says. “For the process to work efficiently, we have to integrate the FloodPlus system into the coverholder’s document issuance system. So, given the IT integration process involved plus the education regarding the benefits of the product, it can’t be introduced too quickly if it is to be done properly.” Nevertheless, growing recognition of the risk and the need for coverage is encouraging to those seeking entry into this emerging market.

A market in the making

The development of a private U.S. flood insurance market is still in its infancy, but the wave of momentum is building. The extent to which the decision reached on September 30 regarding the NFIP will give further impetus to this wave is yet to be seen.

Lack of relevant data, particularly in relation to loss history, is certainly dampening the private sector’s ability to gain market traction. However, as more data becomes available, modeling capabilities improve, and insurer products gain consumer trust by demonstrating their value in the midst of a flood event, the market’s potential will really begin to flow.

“Most private insurers,” concludes Alpay, “are looking at the U.S. flood market as a great opportunity to innovate, to deliver better products than those currently available, and ultimately to give the average consumer more coverage options than they have today, creating an environment better for everyone involved.” The same can be said for the commercial and industrial lines of business where stakeholders are actively searching for cost savings and improved risk management.



CLIMATE COMPLICATIONS

As the private flood market emerges, so too does the debate over how flood risk will adjust to a changing climate. “The consensus today among climate scientists is that climate change is real and that global temperatures are indeed on the rise,” says Pete Dailey, vice president of product management at RMS. “Since warmer air holds more moisture, the natural

conclusion is that flood events will become more common and more severe. Unfortunately, precipitation is not expected to increase uniformly in time or space, making it difficult to predict where flood risk would change in a dramatic way.”

Further, there are competing factors that make the picture uncertain. “For example,” he explains, “a warmer environment can lead to reduced winter snowpack, and, in turn, reduced springtime melting. Thus, in regions susceptible to springtime flooding, holding all else constant, warming could potentially lead to reduced flood losses.”

For insurers, these complications can make risk selection and portfolio management more complex. “While the financial implications of climate change are uncertain,” he concludes, “insurers and catastrophe modelers will surely benefit from climate change research and byproducts like better flood hazard data, higher resolution modeling and improved analytics being developed by the climate science community.”

## CASUALTY

As traditional (re)insurers hunt for opportunity outside of property catastrophe classes, new probabilistic casualty catastrophe models are becoming available. At the same time, as catastrophe risks are becoming increasingly “manufactured” or human-made, so casualty classes have the potential to be the source of claims after a large “natural” catastrophe

# A BURGEONING OPPORTUNITY

Just as the growing sophistication of property catastrophe models has enabled industry innovation, there is growing excitement that new tools available to casualty (re)insurers could help to expand the market. By improved evaluation of casualty class exposures, reinsurers will be better able to understand, price and manage their exposures, as well as design new products that cater to underserved areas.

However, the casualty market must switch from pursuing a purely defensive strategy. “There is an ever-growing list of exclusions in liability insurance and interest in the product is declining with the proliferation of these exclusions,” explains Dr. Robert Reville, president and CEO of Praedicat, the world’s first liability catastrophe modeling company. “There is a real growth opportunity for the industry to deal with these exclusions and recognize where they can confidently write more business.

“Industry practitioners look at what’s happened in property — where modeling has

led to a lot of new product ideas, including capital market solutions, and a lot of innovation — and casualty insurers are hungry for that sort of innovation, for the same sort of transformation in liability that happened in property,” he adds.

Perils — particularly emerging risks that underwriters have struggled to price, manage and understand — have typically been excluded from casualty products. This includes electromagnetic fields (EMFs), such as those emanating from broadcast antennas and cell phones. Cover for such exposures is restricted, particularly for the U.S. market, where it is often excluded entirely. Some carriers will not offer any cover at all if the client has even a remote exposure to EMF risks. Yet are they being over-apprehensive about the risk?

The fear that leads to an over application of exclusions is very tangible. “The latency of the disease development process — or the way a product might be used, with more people becoming exposed over time — causes there to be a build-up of risk that may result

in catastrophe,” Reville continues. “Insurers want to be relevant to insuring innovation in product, but they have to come to terms with the latency and the potential for a liability catastrophe that might emerge from it.”

### Unique nature of casualty catastrophe

It is a misconception that casualty is not a catastrophe class of business. Reville points out that the industry’s US\$100 billion-plus loss relating to asbestos claims is arguably its biggest-ever catastrophe. Within the Lloyd’s market the overwhelming nature of APH (asbestos, pollution and health) liabilities contributed to the market’s downward spiral in the late 1980s, only brought under control through the formation of the run-off entity Equitas, now owned and managed by Warren Buffett’s Berkshire Hathaway.

As the APH claims crisis demonstrated, casualty catastrophes differ from property catastrophes in that they are a “two-tailed loss.” There is the “tail loss” both have in common, which describes the high frequency, low probability characteristics — or high return period — of a major event. But in addition, casualty classes of business are “long-tail” in nature. This means that a policy written in 2017 may not experience a claim until 20 years later, providing an additional challenge from a modeling and reserving perspective.

Another big difference between casualty class and property catastrophe from a modeling perspective is that the past is not a good indication of future claims. “By the time asbestos litigation had really taken off, it was already a banned product in the U.S., so it was not as though asbestos claims were any use in trying to figure out where the next environmental disaster or next product liability was going to be,” says Reville. “So, we needed a forward-looking approach to identify where there could be new sources of litigation.”

With the world becoming both more interconnected and more litigious, there is every expectation that future casualty catastrophe losses could be much greater and impact multiple classes of business. “The reality is there’s serial aggregation and systemic risk within casualty business, and our answer to that has generally been that it’s too difficult to quantify,” says Nancy Bewlay, chief underwriting officer, global casualty, at XL Catlin. “But the world is changing. We

now have technology advances and data collection capabilities we never had before, and public information that can be used in the underwriting process.

“Take the Takata airbag recall,” she continues. “In 2016, they had to recall 100 million airbags worldwide. It affected all the major motor manufacturers, who then faced the accumulation potential not only of third-party liability claims, but also product liability and product recall. Everything starts to accumulate and combine within that one industry, and when you look at the economic footprint of that throughout the supply chain there’s a massive potential for a casualty catastrophe when you see how everything is interconnected.”

**“CASUALTY INSURERS ARE HUNGRY FOR THAT SORT OF INNOVATION, FOR THE SAME SORT OF TRANSFORMATION IN LIABILITY THAT HAPPENED IN PROPERTY”** — ROBERT REVILLE, PRAEDICAT

RMS chief research officer Robert Muir-Wood explains: “Another area where we can expect an expansion of modeling applications concerns casualty lines picking up losses from more conventional property catastrophes. This could occur when the cause of a catastrophe can be argued to have ‘non-natural’ origins, and particularly where there are secondary ‘cascade’ consequences of a catastrophe — such as a dam failing after a big earthquake or for claims on ‘professional lines’ coverages of builders and architects — once it is clear that standard property insurance lines will not compensate for all the building damage.”

“This could be prevalent in regions with low property catastrophe insurance penetration, such as in California, where just one in ten homeowners has earthquake cover. In the largest catastrophes, we could expect claims to be made against a wide range of casualty lines. The big innovation around property catastrophe in particular was to employ high-resolution GIS [geographic information systems] data to identify the location of all the risk. We need to apply similar location data to casualty coverages, so that we

can estimate the combined consequences of a property/casualty clash catastrophe.”

One active instance, cited by Muir-Wood, of this shift from property to casualty coverages concerns earthquakes in Oklahoma. “There are large amounts of wastewater left over from fracking, and the cheapest way of disposing of it is to pump it down deep boreholes. But this process has been triggering earthquakes, and these earthquakes have started getting quite big — the largest so far in September 2016 had a magnitude of M5.8.

“At present the damage to buildings caused by these earthquakes is being picked up by property insurers,” he continues. “But what you will see over time are lawsuits to try and pass the costs back to the operators of the wells themselves. Working with Praedicat, RMS has done some modeling work on how these operators can assess the risk cost of adding a new disposal well. Clearly the larger the earthquake, the less likely it is to occur. However, the costs add up: our modeling shows that an earthquake bigger than M6 right under Oklahoma City could cause more than US\$10 billion of damage.”

Muir-Wood adds: “The challenge is that casualty insurance tends to cover many potential sources of liability in the contract and the operators of the wells, and we believe their insurers are not currently identifying this particular — and potentially catastrophic — source of future claims. There’s the potential for a really big loss that would eventually fall onto the liability writers of these deep wells ... and they are not currently pricing for this risk, or managing their portfolios of casualty lines.”

### A modeled class of business

According to Reville, the explosion of data and development of data science tools have been key to the development of casualty catastrophe modeling. The opportunity to develop probabilistic modeling for casualty classes of business was born in the mid-2000s when Reville was senior economist at the RAND Corporation.

At that time, RAND was using data from the RMS® Probabilistic Terrorism Model to help inform the U.S. Congress in its decision on the renewal of the Terrorism Risk Insurance Act (TRIA). Separately, it had written a paper on the scope and scale of asbestos litigation and its potential future course.

“As we were working on these two things it occurred to us that here was this US\$100



billion loss — this asbestos problem — and adjacently within property catastrophe insurance there was this developed form of analytics that was helping insurers solve a similar problem. So, we decided to work together to try and figure out if there was a way of solving the problem on the liability side as well,” adds Reville.

Eventually Praedicat was spun out of the initial project as its own brand, launching its first probabilistic liability catastrophe model in summer 2016. “The industry has evolved a lot over the past five years, in part driven by Solvency II and heightened interest from the regulators and rating agencies,” says Reville. “There is a greater level of concern around the issue, and the ability to apply technologies to understand risk in new ways has evolved a lot.”

**“WE FEEL THEY ARE NOT BEING PROACTIVE ENOUGH BECAUSE ... THERE’S THE POTENTIAL FOR A REALLY BIG LOSS THAT WOULD FALL ONTO THE LIABILITY WRITERS OF THESE DEEP WELLS”**

— ROBERT MUIR-WOOD, RMS

There are obvious benefits to (re)insurers from a pricing and exposure management perspective. “The opportunity is changing the way we underwrite,” says Bewlay. “Historically, we underwrote by exclusion with a view to limiting our maximum loss potential. We couldn’t get a clear understanding of our portfolio because we weren’t able to. We didn’t have enough meaningful, statistical and credible data.”

Then there are the exciting opportunities for growth in a market where there is intense competition and downward pressure on rates. “Now you can take a view on the ‘what-if’ scenario and ask: how much loss can I handle and what’s the probability of that happening?” she continues. “So, you can take on managed risk. Through the modeling you can better understand your industry classes and what could happen within your portfolio, and can be slightly more opportunistic in areas where previously you may have been extremely cautious.”

Not only does this expand the potential range of casualty insurance and reinsurance products, it should allow the industry to better support developments in burgeoning industries. “Cyber is a classic example,” says Bewlay. “If you can start to model the effects of a cyber loss you might decide you’re OK providing cyber in personal lines for individual homeowners in addition to providing cyber in a traditional business or technology environment.

“You would start to model all three of these scenarios and what your potential market share would be to a particular event, and how that would impact your portfolio,” she continues. “If you can answer those questions utilizing your classic underwriting and actuarial techniques, a bit of predictive modeling in there — this is the blend of art and science — you can start taking opportunities that possibly you couldn’t before.”

### TECH TALK

# QUANTUM LEAP

**T**he power locked within quantum mechanics has been recognized by scientists for decades, but it is only in recent years that its conceptual potential has jumped the theoretical boundary and started to take form in the real world.

Since that leap, the “quantum race” has begun in earnest, with China, Russia, Germany and the U.S. out in front. Technology heavyweights such as IBM, Microsoft and Google are breaking new quantum ground each month, striving to move these processing capabilities from the laboratory into the commercial sphere.

But before getting swept up in this quantum rush, let’s look at the mechanics of this processing potential.

### The quantum framework

Classical computers are built upon a binary framework of “bits” (binary digits) of information that can exist in one of two definite states — zero or one, or “on or off.” Such systems process information in a linear, sequential fashion, similar to how the human brain solves problems.

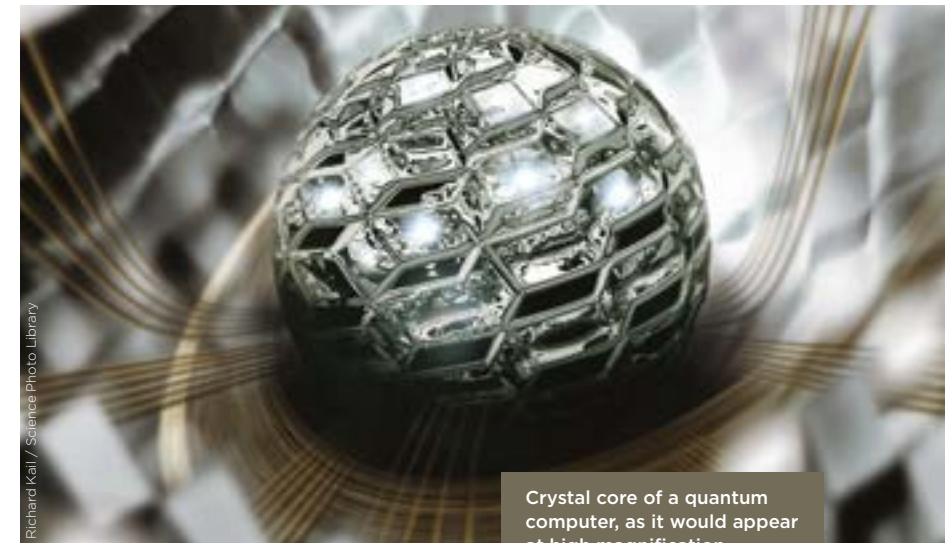
In a quantum computer, bits are replaced by “qubits” (quantum bits), which can operate in multiple states — zero, one or any state in between (referred to as quantum superposition). This means they can store much more complex data. If a bit can be thought of as a single note that starts and finishes, then a qubit is the sound of a huge orchestra playing continuously.

What this state enables — largely in theory, but increasingly in practice — is the ability to process information at an exponentially faster rate. This is based on the interaction between the qubits. “Quantum entanglement” means that rather than operating as individual pieces of information, all the qubits within the system operate as a single entity.

From a computational perspective, this creates an environment where multiple computations encompassing exceptional amounts of data can be performed virtually simultaneously. Further, this beehive-like state of

Much hype surrounds quantum processing.

This is perhaps unsurprising given that it could create computing systems thousands (or millions, depending on the study) of times more powerful than current classical computing frameworks



Crystal core of a quantum computer, as it would appear at high magnification. Quantum computers, which are under development, involve optical and quantum properties of chemically doped crystals, like the one shown here

collective activity means that when new information is introduced, its impact is instantly transferred to all qubits within the system.

### Getting up to processing speed

To deliver the levels of interaction necessary to capitalize on quantum power requires a system with multiple qubits. And this is the big challenge. Quantum information is incredibly brittle. Creating a system that can contain and maintain these highly complex systems with sufficient controls to support analytical endeavors at a commercially viable level is a colossal task.

In March, IBM announced IBM Q — part of its ongoing efforts to create a commercially available universal quantum computing system. This included two different processors: a 16-qubit processor to allow developers and programmers to run quantum algorithms; and a 17-qubit commercial processor prototype — its most powerful quantum unit to date.

At the launch, Arvind Krishna, senior vice president and director of IBM Research ➔

## CRACKING THE CODE

Any new technology brings its own risks — but for quantum computing those risks take on a whole new meaning. A major concern is the potential for quantum computers, given their astronomical processing power, to be able to bypass most of today's data encryption codes. "Once 'true' quantum

computers hit the 1,000 to 2,000 qubit mark, they will increasingly be able to be used to crack at least 70 percent of all of today's encryption standards," warns Griffin, "and I don't need to spell out what that means in the hands of a cybercriminal." Companies are already working to pre-empt this

catastrophic data breach scenario, however. For example, PwC announced in June that it had "joined forces" with the Russian Quantum Center to develop commercial quantum information security systems. "As companies apply existing and emerging technologies more aggressively in the push

to digitize their operating models," said Igor Lotakov, country managing partner at PwC Russia, following the announcement, "the need to create efficient cyber security strategies based on the latest breakthroughs has become paramount. If companies fail to earn digital trust, they risk losing their clients."

and Hybrid Cloud, said: "The significant engineering improvements announced today will allow IBM to scale future processors to include 50 or more qubits, and demonstrate computational capabilities beyond today's classical computing systems."

IBM also devised a new metric for measuring key aspects of quantum systems called "Quantum Volume." These cover qubit quality, potential system error rates and levels of circuit connectivity.

According to Matthew Griffin, CEO of innovation consultants the 311 Institute, a major challenge is the simple fact that when building such systems, few components are available off-the-shelf or are anywhere near maturity.

"From compute to memory to networking and data storage," he says, "companies are having to engineer a completely new technology stack. For example, using these new platforms, companies will be able to process huge volumes of information at near instantaneous speeds, but even today's best and fastest networking and storage technologies will struggle to keep up with the workloads."

In response, he adds that firms are looking at "building out DNA and atomic scale storage platforms that can scale to any size almost instantaneously," with Microsoft aiming to have an operational system by 2020.

"Other challenges include the operating temperature of the platforms," Griffin continues. "Today, these must be kept as close to absolute zero (minus 273.15 degrees Celsius) as possible to maintain a high degree of processing accuracy. One day, it's hoped that these platforms will be able to operate at, or near, room temperature. And then there's the 'fitness' of the software stack — after all, very few, if any, software stacks today can handle anything like the demands that quantum computing will put onto them."

**Putting quantum computing to use** One area where quantum computing has major potential is in optimization challenges. These involve the ability to analyze immense data sets to establish the best possible solutions to achieve a particular outcome.

And this is where quantum processing could offer the greatest benefit to the insurance arena — through improved risk analysis.

"From an insurance perspective," Griffin says, "some opportunities will revolve around the ability to analyze more data, faster, to extrapolate better risk projections. This could allow dynamic pricing, but also help better model systemic risk patterns that are an increasing by-product of today's world, for example, in cyber security, healthcare and the internet of things, to name but a fraction of the opportunities."

Steve Jewson, senior vice president of model development at RMS, adds: "Insurance risk assessment is about considering many different possibilities, and quantum computers may be well suited for that task once they reach a sufficient level of maturity."

However, he is wary of overplaying the quantum potential. "Quantum computers hold the promise of being superfast," he says, "but probably only for certain specific tasks."

**"A MAJOR CHALLENGE IS THE SIMPLE FACT THAT WHEN BUILDING SUCH SYSTEMS, FEW COMPONENTS ARE AVAILABLE OFF-THE-SHELF"** — MATTHEW GRIFFIN, 311 INSTITUTE

They may well not change 90 percent of what we do. But for the other 10 percent, they could really have an impact.

"I see quantum computing as having the potential to be like GPUs [graphics processing units] — very good at certain specific calculations. GPUs turned out to be fantastically fast for flood risk assessment, and have revolutionized that field in the last 10 years. Quantum computers have the potential to revolutionize certain specific areas of insurance in the same way."

### On the insurance horizon?

It will be at least five years before quantum computing starts making a meaningful difference to businesses or society in general — and from an insurance perspective that horizon is probably much further off. "Many insurers are still battling the day-to-day challenges of digital transformation," Griffin points out, "and the fact of the matter is that quantum computing ... still comes some way down the priority list."

"In the next five years," says Jewson, "progress in insurance tech will be about artificial intelligence and machine learning, using GPUs, collecting data in smart ways and using the cloud to its full potential. Beyond that, it could be about quantum computing."

According to Griffin, however, the insurance community should be seeking to understand the quantum realm. "I would suggest they explore this technology, talk to people within the quantum computing ecosystem and their peers in other industries, such as financial services, who are gently 'prodding the bear.' Being informed about the benefits and the pitfalls of a new technology is the first step in creating a well thought through strategy to embrace it, or not, as the case may be."

# IN CASE YOU MISSED IT



RMS sits at the intersection of technology, science and domain experience, giving us a unique perspective on what's going on in the world of tech, modeling, and computing. "In Case You Missed It" is our round-up of the latest developments from Silicon Valley to Bangalore that EXPOSURE doesn't want you to miss. In this edition, Farhana Alarakhiya, vice president of products at RMS, picks her top three headlines

## 01. SHOW YOUR AGILITY

Startups are bold. Disruption comes from their agile use of data. Data analytics is the first tool they use to assess the market, to pick out gaps and niches they can enter, learn and serve better. Their survival and success depends on insight that they can act on. And established players can learn a great deal from their approach to the market. In our discussions with clients, it is clear that agile and effective data use are prime drivers for innovation. So, I was interested to hear about a recent startup, profiled in *Insurance Age*.

Data-savvy language runs through an interview with Phoebe Hugh, CEO and co-founder of Brolly, which offers a smartphone-driven, free personal insurance concierge. She states that "a single view of the customer is unattainable by most insurers and brokers due to technology constraints." She also warns intermediaries that "unless they evolve their proposition and differentiate themselves, they're in real danger of being completely cut out of the process." This is just one startup. Incumbents can do this, and need to start exploring solutions that can help allow 'startup' thinking to gain data agility and break down technological constraints.

## 02. AI IS THE NEW UI

According to the "Technology Vision for Insurance 2017" report from Accenture, 75 percent of insurance executives believe

artificial intelligence (AI) will transform or bring significant change to the industry over the next three years. Moving from buzzword territory into the business environment, 85 percent of executives say they will invest extensively in AI-related technologies over the next three years.

Everyone has bought into AI, but what will it do for the industry? AI all starts with analytics — big data that is addressable and accessible — then it requires analysis of the metrics that matter to you and your customer. AI and machine learning help you crunch data faster and pick up relevant patterns, predictive patterns. AI then comes into play, using your data analysis to provide cognitive muscle at scale to answer questions in real-time. Startup Tyche uses machine learning on casualty risk data to predict the riskiest 1 percent of policies that could account for 30 percent of claims.

But to bring AI to life, Accenture states that businesses must redesign their systems for analytics. Quality data is

essential for AI as it continuously learns how data interactions should evolve, requiring connections between systems, interfaces and different points of interaction.

## 03. 2018 AND GDPR

A compliance deadline looms on the horizon as the EU General Data Protection Regulation (GDPR) comes into force on May 25, 2018, replacing the already stringent privacy laws under the EU Data Protection Directive, which dates back to 1995. GDPR affects anyone involved with storing, controlling or processing data about EU residents, whether the organization operates inside or outside of the EU. Among other things, it requires organizations to report data breaches in a timely fashion and imposes fines of up to 4 percent of global turnover for failing to comply.

Insurers need to establish whether the data they hold is personally identifiable, which could lead to the identity of a single person. As with all compliance issues, avoiding the issue is not an option. As a recent KPMG white paper entitled "Ready for GDPR?" noted, the first step is to define your organization's data privacy strategy, establish your preparedness and get your action plan in place.

There is a real opportunity for organizations to demonstrate how they respect the privacy of individuals — and in so doing, gain a competitive edge. Cloud service providers are ahead of the game. Microsoft, for instance, offers solutions to identify what data you have and then control who has access to it.

### BIG NUMBERS

**92%**  
GDPR is in top priorities for data and privacy strategy for U.S. companies

Source: PwC GDPR preparedness survey Jan 2017

**61%**  
state they want to rely more on data analysis and less on intuition

Source: PwC Global Data and Analytics Survey

**US\$3.5B**  
Global cloud security spend by 2021

Source: Forrester Research



® RMS solutions help insurers, financial markets, corporations, and public agencies evaluate and manage risks throughout the world, promoting resilient societies and a sustainable global economy.

**Risk Management Solutions, Inc.**

7575 Gateway Blvd.

Newark, CA 94560, USA

[www.rms.com](http://www.rms.com)