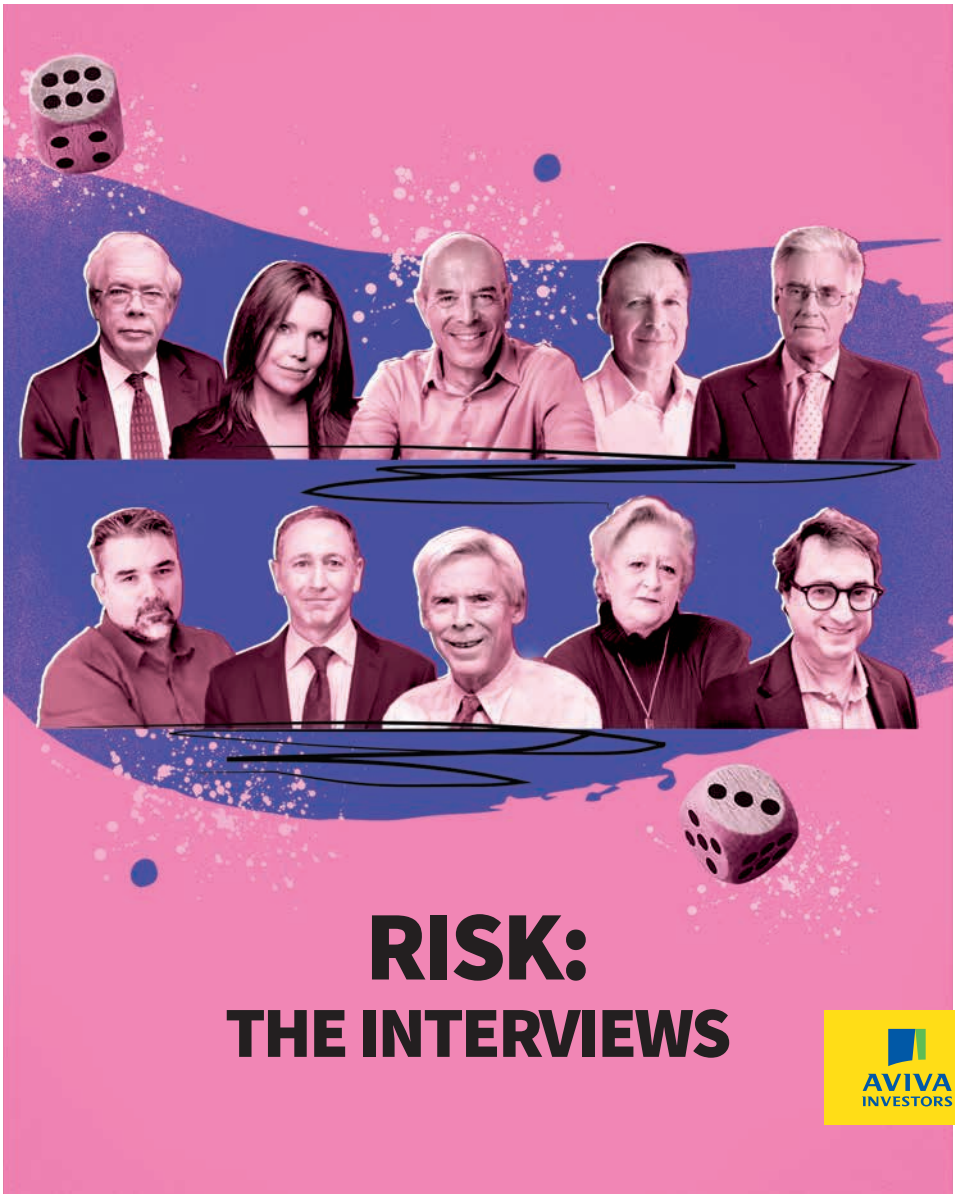
AIQ

THE RISK EDITION



RISK:
THE INTERVIEWS

AVIVA INVESTORS

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The butterfly defect

It started in Wuhan in central China, where a wild animal passed a novel coronavirus to a human host. Within months, the disease had spread around the world, rocking markets, shuttering businesses and overwhelming healthcare systems.

The pandemic has proved how quickly a single event can disrupt a globalised economy. The academic Ian Goldin, one of the experts featured in this special interview supplement, calls it the "butterfly defect": the systemic vulnerability at the heart of the modern world.

To gain a better understanding of the nature of risk in this devilishly complex environment, we've canvassed opinion from beyond the usual financial sources. In these pages you'll read insights from a probability theorist, an economist, a scientist and a professional poker player, among others.

At a time when no individual has all the answers, we believe that listening to a range of experts is the best way to stay alert to new threats. We hope you'll find these conversations informative, engaging and – at times – challenging, just as we have.

Enjoy the read.

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THE DECISION MAKER

ANNIE DUKE

Annie Duke is a World Series of Poker champion, speaker and consultant on decision making, and author of the upcoming book *How To Decide*. She discusses how biases influence our decisions, and the importance of diverse perspectives.

How do you analyse the decision-making process?

When you think about what route to take, you are predicting that 'route A' will get you there faster than 'route B' – but we understand it is not a guarantee. We are trying to think about what the future might hold, but we have to imagine several futures. It is a three-step process. The first is comparing options, then trying to figure which is the most likely to get me where I want to go. The third is to mitigate the risks, because sometimes things won't go my way.

What are some of the biggest mistakes we make when it comes to risk?

One of the biggest mistakes is saying we should have seen things coming. Sometimes there is sufficient information to warrant you seeing something coming – in the sense that you should have recognised it was a *possibility.* Nothing is ever guaranteed.

Once the world starts observing a particular outcome, hindsight makes it seem like the only thing that could have occurred, and therefore we should have seen it coming. Both looking ahead and backwards, we should not think about the world as if there is only one possible outcome. We should try to imagine as many possibilities as we can, examine them all, and then try to take lessons.

How can we make better decisions in situations of uncertainty?

There are two influences on the way our decisions turn out. The first is luck. If I think about a decision where 98 per cent of the time I will have a good outcome but two per cent of the time something bad will happen, once I make the decision the outcome is a matter of luck. Luck is very interesting from a decision-making standpoint: you need to really embrace it.

The other influence is imperfect information. All sorts of imperfect information influence our decisions – some of it inaccurate and some of it missing. When we make decisions by modelling the future, the more predictive our models can be, the better our decisions. In contrast, when there isn't much information, our model predictions will be very wide.

One can assume models will tighten as we get more information, but bad things can happen in the meantime. It is common to think that given enough time we can obtain certainty over our decisions. But we can't. You need to start thinking about decisions as a trade-off between time and certainty, and become comfortable with being uncertain at the moment you make a decision.

We also delay painful choices. This is one of the big findings of Daniel Kahneman and Amos Tversky's work on prospect theory. Essentially, if you owe me 100 dollars and I ask if you want to flip a coin, double or nothing, not only will you say yes but you will pay me for the opportunity. On the flipside, if *I owe you* 100 dollars and offer to flip a coin, you will refuse and ask for your 100 dollars then and there. There is a clear asymmetry.

We can think about it in the same way in terms of our choices around lockdowns during COVID-19.

They were painful and nobody seemed to adopt 'the earlier, the better' approach and these behavioural quirks played a key part.

How important is diverse thinking in decision making?

You want to have different perspectives because our beliefs are flimsy. If you think about it, there is a universe of things you don't know. What you want to do is take a 'random walk' through that universe in a way that maximises your ability to collide with corrective information.

The problem is the way we walk through that universe is not actually random. We see mainly what agrees with our pre-existing views and find all sorts of ways to dismiss any information that happens to disagree. This is also true for teams. Teams form an identity by reaching consensus quickly because it feels good. What often happens is that we hire for a diverse group but then ask everybody to think the same.

The other reason why diversity is important is that we know data does not equal truth. Two people can look at the same set of facts and come up with different conclusions, because people have different models. Your best view of the world is to take all those models and allow them to collide, because none of them are going to be wrong or right. They are all going to be better or worse in different ways.

This is important in strengthening the beliefs that inform our decisions. Creating a cultural shift in team identity towards tolerance of diverse perspectives is also crucial to improving things. Another way is to use a system solution. Let's say I want the team's opinion on GDP growth in Q2. Instead of asking the question in a meeting, I email each member of my team and ask them to email me back privately. There can't be any groupthink because they cannot possibly know if they are agreeing with me, or with one another.

I now have the whole range, which I then put into a document with no names, so you don't have the high-status influence, and I send it to the group. Now everybody will understand the opinions of the group, and you will get that spread of knowledge. What is nice about that system is that it creates the cultural shift as well, because people start to see the value in seeking a diversity of opinion.

How should we think about risk?

If you don't embrace uncertainty, you cannot possibly think appropriately about risk. This ties in to two points. First, by not accessing a diverse range of opinions, it is likely that you will miss risks: nobody wants to be the negative person on the team, so you need to create comfort for people who may have a more pessimistic view.

> *If you don't embrace uncertainty, you cannot possibly think appropriately about risk*

Second, we will always underestimate the worst-case scenarios, partly because we imagine we have more control over the outcome than we do. One way to address that is to get your whole team to imagine we fail and the probability of it happening. That helps you to see the downside could be worse, and more probable, than you think.

People tend to avoid that, but it allows you to do three things. One, you may change your decision in order to de-risk. Two, you might look whether hedges are available. And three, sometimes hedges aren't available, and you wouldn't change your decision, but you can have an action plan ready. Otherwise, when the downside happens you waste time and generally decisions are poor. Having the ability to plan is incredibly valuable ●

THE DISASTER RISK EXPERT

ROBERT GLASSER

Dr Robert Glasser was formerly the United Nations Secretary General's special representative for disaster risk reduction and head of the UN Office for Disaster Risk Reduction. He is currently a visiting fellow at the Australian Strategic Policy Institute. He explains how the rising number and intensity of natural hazards is creating an "era of disasters" and discusses mitigation and adaptation strategies.

Can you tell us more about the rise of disaster risk globally?

Two main factors are increasing disaster risk. The first is that many investments in infrastructure are being made without sufficiently incorporating risk. With such poorly risk-informed investments, it is not surprising more infrastructure is being destroyed and the financial costs of disaster risk are going up.

The second is climate change, whose impacts are only just becoming visible. Climate change is increasing the frequency and severity of many hazards. Infrastructure investments need to take account not only of the historical risk of hazards, but also of how climate change is altering the risks. In the US, if you look at Hurricane Harvey , something like half of the homes destroyed by that were situated outside the one-in-500-year threat area.

The patterns of hazards are also changing. In Australia, in a warming world, recent scientific research suggests cyclones will begin tracking further south to parts of the country including the Gold Coast, a big tourist area with high-rise buildings that have not been designed for extreme cyclones.

How are governments responding to the potential knock-on effects?

In Australia, we are beginning to think about simultaneous and consecutive disasters, partly because we are seeing it happen before our eyes. In Queensland, our most hazard-prone state, over half the local communities over the past three years have had three or more disasters. For them, the cascading impacts are already huge; they partly recover from one and are hit by another.

Generally, it is still difficult for countries to come to terms with this. As usual, the countries hit by disasters more often are the furthest along in risk and disaster planning. For example, in Bangladesh, where they can see the changing impacts of climate through the annual monsoonal flooding, they are fundamentally incorporating flood risk protection in their investments and economic planning.

For countries not yet seeing these things, it is hard enough to get them to prepare for historical hazards like the historical chance of flooding, let alone for the fact history is no longer reliable because the frequency and severity is increasing non-linearly and very quickly.

Has a lack of preparedness worsened the impact of COVID-19?

We have seen in this pandemic that governments are not very good at responding to threats when they don't seem imminent. We had so much warning, with repeated calls about bird-flu, swine flu, SARS, MERS: there were plenty of false alarms. Governments did spend more money when each of those viruses struck, but very quickly the funding went away, rather than devoting consistent, significant funding to address this scale of threat.

On the other hand, once it was imminent, countries did respond remarkably and in unprecedented ways,

as has been seen with the lockdowns, bailouts and all the rest.

What should we do to adapt our communities and businesses to the era of disasters?

First, we need to understand the risks, and there are two dimensions to this. One is what we know historically about those disasters, then adding the climate piece as we cannot rely on the past anymore. That is really tricky because you can get some useful information from climate scientists on, for instance, the risk of extreme weather in a particular part of the country, but we would need much better information to provide climate risk information at levels and with degrees of certainty that are useful for planning in regional and local communities.

The second step is to incorporate this understanding of the risk within our investments. That is important for new investments, but we also need to think about the infrastructure already in place that is not resilient. There are steps you can take, even though addressing it in existing infrastructure is much more difficult.

There is another element, which is dependent on your level of analysis. Governments can think about risk in terms of economic assets and lost life, while local communities might point to a large company providing jobs and income as the source of resilience, and some remote areas may be dependent on the expertise of a single person. It may be a small point, but it is interesting to realise that where we sit defines how we look at resilience.

How is the compounding of natural hazards affecting the probability of large-scale catastrophes?

Take the food security crisis in 2010-2011. Droughts and fires in Russia, Ukraine and parts of China, as well as floods in Canada and Australia, combined to destroy the wheat crop. That led to countries hoarding wheat and hiking the price of food, which resulted in food riots in North Africa. That was a contributory factor behind the Arab Spring.

In a similar example of a negative feedback loop, at 1.5 degrees of warming most coral reefs – which are fish nurseries for perhaps ten per cent of the world's species – will have died, depleting tropical food supplies. Scientists have also determined that fish species are already moving towards the poles to escape warming waters. At two degrees Celsius of warming, this will result in a decrease of up to 60 per cent in fisheries' yields in the tropics. And, as coral reefs disappear, so will the protection they offer coastal areas against storm surges, exposing millions of people to more extreme weather. Combine these with the impact warming will have on agriculture, and the food security risks become enormous.

> *"Governments are not very good at responding to threats when they don't seem imminent"*

If you put all those things together, it is extremely likely we will see these cascading impacts happening relatively quickly. They will happen in a given year, but also in consecutive years, and the individual events will, in effect, become one big event as the interval of time between them shortens.

Will companies and governments adapt in time?

The business community, and the financial sector particularly, is moving faster than governments on climate risk. I suspect, as these disasters happen more often and the impacts become bigger, regulators will begin requiring corporations to disclose their exposure to climate risks and how they are addressing the risks. Ultimately, this will accelerate the movement of hundreds of billions of dollars towards more resilient infrastructure. It will change the whole system because asset owners will want to make sure they have something to offer investors that is resilient to climate and disaster risk.

The politics on climate change are also going to change. It is going to become politically compelling to act because the number of these disasters is increasing so quickly.

With the unprecedented bushfires in Australia that are clearly linked to climate change, even the government, which is a strong supporter of fossil fuels, is changing its response. If something similar happens again in the next two years, the momentum will keep building towards more ambitious action ●

THE ECONOMIST

JOHN KAY

John Kay is one of Britain's foremost economists, whose long and varied career has spanned academia, policy and the corporate world. Kay's latest work, co-authored with former Bank of England governor Mervyn King, is *Radical Uncertainty: Decision-making for an Unknowable Future*. He talked to *AIQ* about risk, uncertainty and the longer-term implications of COVID-19.

Your book draws a distinction between risk and uncertainty – why is this important?

In 1921, two large books were published on this subject by John Maynard Keynes and Frank Knight. What they meant by risk were things that could be described probabilistically, whereas uncertainty referred to things that couldn't be defined probabilistically.

What's happened since then – and the financial sector is the extreme example – is that the distinction has effectively been elided, and the historic definition of risk and uncertainty is no longer seen as relevant.

We strongly dispute the contention that all uncertainty can be described probabilistically. We choose to define risk and uncertainty in the way ordinary people do. Risk is when something bad materialises. Uncertainty, on the other hand, can be good or bad; when you go on holiday and try a new restaurant, or meet new people, you don't know what's going to happen. It might be pleasant, or it might not. Risk arises when something jeopardises your reference narrative; the way you thought you were going to live your life.

Your book focuses on "radical uncertainty…a world of uncertain futures and unpredictable consequences". Is COVID-19 an example?

COVID-19 is absolutely an example of radical uncertainty. The pandemic is not what Nassim Taleb calls a Black Swan, an event you can't anticipate because you can't imagine the event. You definitely could imagine a pandemic; indeed, we somewhat presciently wrote in the book that a pandemic would happen. But we didn't know when or where.

Are you confident policymakers will be able to deal with the economic fallout from COVID-19?

No. The health and economic risks are bound together. There seems to be a widespread belief that, before long, we will be able to announce the health risk is over and we can get back to normal. It's not going to be like that; the most likely scenario is that this continues in one way or another for the next one to two years. We can't be confident in policymakers' responses, as we simply don't know how this virus will evolve and what the economic consequences are going to be. Our argument is we should stop pretending to have more knowledge about the world than we actually do.

You write that at times of radical uncertainty, decision-makers should ask: "What is going on here?" How should we go about answering that under the current circumstances?

In business, politics and finance, you're repeatedly confronted with unique situations. Even if the pandemic is not a unique situation – it isn't; it is something that has happened before and will happen again – this pandemic has unique features. You need to recognise that, and by asking 'what is going on here' you can address the whole context of what is happening.

Would you point to any institutions or industries that are managing risk and uncertainty well?

The food retailing sector has responded fairly robustly and effectively to the current crisis, whereas a lot of other business sectors have been shown to have supply chains for which even a slight disruption creates problems.

There is a big set of issues there. To protect yourself against this kind of disruption, you have to find a structure that is robust and resilient, and for that you need to have what engineers would think of as 'modularity' – i.e. a system built in such a way that when one part fails it doesn't bring down the whole system. You also need redundancy, which means not trying to run things with the minimum margins of safety you can get away with.

In most of business, we've tended to regard these kinds of things as signs of inefficiency. The siloing of financial services activities was effectively abolished in the 1980s. Since then you've had banks and insurers talking about 'surplus capital', as if it's possible for financial businesses to have too much money.

Your book draws attention to bogus probabilities and flawed algorithms. Why are computer-based models ill-suited to conditions of radical uncertainty?

Because the models are constructed by people who assume they have knowledge that they don't have and couldn't possibly have. We talk in the book about the failure of risk management in the financial sector. During the financial crisis, [then Goldman Sachs CFO] David Viniar famously said: 'We were seeing things that were 25-standard deviation moves several days in a row.' Which of course isn't what happened: what he meant, or should have meant, was that this series of events looked impossible based on the Goldman Sachs model.

The lesson is that you cannot derive a probability about the world from a probability that's developed in a model. The database with which Goldman Sachs built its model came from a period in which banks didn't go bust.

How about the implications for investors today?

Investment firms face a dilemma: they have to maximise returns for clients while allowing companies the space to build resilience against uncertain events, perhaps through the kind of investments that won't show up on a quarterly earnings statement.

Investment intermediaries, asset managers, have the problem of being accountable to financial advisors and investment consultants who are constantly engaging in these kinds of very short-term comparisons, which will not demonstrate the advantages of widespread diversification. And widespread diversification is not something you approach by calculating betas in the way portfolio models typically do, but by asking the 'what is going on here' question, and by understanding the underlying determinants of asset price returns.

> *"You cannot derive a probability about the world from a probability that's developed in a model."*

Reducing risk is not the same thing as achieving certainty, and that has huge implications for portfolio management and planning. I sometimes say that someone who knows he is going to be hanged tomorrow has certainty but not security. That may sound like a joke, but when you look at pension funds that, either collectively or on behalf of individuals, are largely invested in bonds, you see that's more or less precisely what they are doing – offering the certainty of a low standard of living in retirement. That's not risk management.

Could the painful lessons learned during this crisis be applied to avert other global threats?

Only if we look at this crisis in a way that generates general, rather than specific, lessons. If you take climate change, there is quite an exaggerated faith placed in climate models that have all the characteristics of the bad models that I've described. The best approach is to recognise we don't really know what's going to happen, and therefore we need to have strategies that are robust and resilient. We basically need to be doing the equivalent of buying options, which is a matter of looking at fundamental technologies. We shouldn't be paying attention to people who claim without foundation that they know what's going to happen to the climate ●

THE GLOBALISATION EXPERT

IAN GOLDIN

Globalisation is a double-edged sword. Ian Goldin, professor of globalisation and development at the University of Oxford and author of *The Butterfly Defect*, discusses the systemic risks that have built up as an array of interconnections have spread their wings of influence across the globe.

Why did COVID-19 take the majority by surprise?

When I wrote *The Butterfly Defect* in 2014, I came to see that the super spreaders of 'good' globalisation are also super spreaders of the 'bad'.

The financial crisis demonstrated how systemic risk works in the 21st century. It was inevitable that a pandemic would arise and spread extremely quickly, because the factors that create pandemics – meat (wild meat in particular) being produced so near to human settlements, poor sanitary conditions near airports and so on – were all in place. That we narrowly escaped SARS, Ebola and other potential pandemics in recent years was just luck.

Poor global governance made a pandemic more likely. Governments around the world have not empowered multilateral organisations like the World Health Organisation (WHO) to do what was necessary to stop one.

How are we going to manage pandemic risk better, with WHO in crisis?

WHO, like other global institutions, has been starved of the necessary skills, technology and resources to deal with a global pandemic. It also has its own governance issues and needs to be reformed.

I would like to see a NATO-like equivalent of a rapid-response taskforce able to go to any jurisdiction in the world at short notice and identify the virus, then isolate and seal it off. Effective monitoring capabilities would be required. For this to happen, a workable global agreement would need to be in place allowing for fast, accurate and transparent information to be reported.

None of this has happened, which is one of the reasons why the risks have increased.

Who is responsible for these failings?

Responsibility should be placed firmly at the door of the biggest governments: China, the US, Europe and the UK. We are the main shareholders of these global institutions and have allowed them to wither and become ineffective. We have also prevented them interfering in our national affairs. Governments have not given supranational organisations the power to see what is happening in their kitchens. This is not only true for pandemics, but also for money laundering, tax evasion, cyber risks, climate change and other areas.

Could a breakdown in the US-China relationship exacerbate the economic fallout from the coronavirus pandemic?

Yes, there is a real danger here. It has escalated the potential risks and could create a new Cold War. However, the one thing this pandemic should have taught us is that there is no wall high enough to keep out the great risks we face; pandemics or climate change or others. The tensions are further undermining our global institutions.

Is it too drastic to say that globalisation could go into reverse?

Yes. While there has been a dramatic slowdown which reflects the slowdown in economic activity globally,

COVID-19 is accelerating transformation; it is exacerbating trends that were happening anyway. So, some aspects of globalisation have leaped ahead, like tech and digital. Momentum in other aspects will increase again soon – in finance, for instance, because over 100 countries are embarking on bailouts. Supply chain fragmentation had already reached its peak a few years ago due to other trends, notably technology and automation.

One thing that will change as a result of COVID-19 will be the constraint of business travel in the longer term.

> *The pandemic is leading to a massive rethinking of priorities; some sacred cows have been thrown out*

How significant will the outcome of the US elections be for the China-US relationship?

I am not very optimistic. There are very few things that create agreement across the US political spectrum but bashing China is one of them. A Democratic win is unlikely to lead to fundamental change.

What positives do you see from the situation we find ourselves in?

There are several. The pandemic is leading to a massive rethinking of priorities; some sacred cows have been thrown out. Ideas of basic income, of massively increased government expenditures, and a greater recognition of the importance of government have all bubbled to the surface.

At the national level, there is a much healthier recognition of the importance of social cohesion and social welfare. The challenge is international too, as we need to recognise the importance of strong global cohesion to start to resolve some of these issues.

To what extent are you worried about ecological risks?

I am extremely worried. There is a real risk that we take the eye off the ball on climate – particularly given the amount of money being spent could allow a dramatic increase in expenditure toward policies that fail to promote green growth. Of course, one of the big realisations is that pandemic risk is inextricably linked to climate change given the zoonotic nature of many viruses.

In terms of industries and sectors, where do you see the most fragility?

There has been a huge amount of time and effort spent trying to stop another crisis emanating from the finance and banking system, with regulatory intervention including Solvency II and Basel III. But my view is that the financial system is no more robust than it was in 2008. Certainly, we are not going to have the same crisis as we did in 2008 – it never is like that. The potential for the financial system to fall apart as a result of another cause, like an even larger Hurricane Sandy or a pandemic, is greater than ever.

In terms of the internet, there has been some growth in resilience – more networks and alternative routes, for example. But given the limited number of cables between the UK and the US, that situation could soon change. Likewise, there are few cables running from the Mediterranean through to Asia, so there are clearly vulnerabilities in the system. We are also overly dependent on Russia for oil and gas, particularly gas.

The MBA mentality of 'just-in-time' efficiency is being challenged as well. But the inference we will move from this model to a 'just-in-case' one is a bit of stretch, because unless you change mark-to-market accounting and quarterly reporting and the way managers are incentivised, you cannot change the basic ethos based on stocks held or spare capacity in working capital tied up that is 'wasted'. Until spare capacity is seen as an asset not a liability, we cannot change the incentives facing managers, both in the private sector and the corporatized public sector, like hospital trusts.

So, this is going to require system-wide change, not simply saying we need more spare parts to guard against system fragility. I do not see this changing as a result of the pandemic; the change will come as a result of the other factors instead – like automation, technology and politics, as well as changes in accounting practices, regulations and shareholder behaviour ●

THE PROBABILITY SPECIALIST

SAM SAVAGE

Professor Sam L. Savage of Stanford University, author of *The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty*, helped pioneer the field of probability management while working with Royal Dutch Shell in 2005. He discusses how we can use scenario planning and probabilistic modelling to help us deal with complex risks.

Could you briefly summarise probability management?

In 2005, Royal Dutch Shell could easily simulate single projects, like oil exploration. However, aggregating those individual simulations together to account for the interrelated uncertainties of the entire portfolio was an issue. Probability management allows you to do that. This technique represents each uncertainty as an array of auditable, simulated outcomes and metadata called a stochastic information packet (SIP), which can be added to simulate the risk-return distribution of the portfolio.

Can you explain that in terms of financial markets?

Think of the efficient frontier in finance. You need a process of optimising the trade-off between risk and return, which can then be applied to individual circumstances. Any point along the efficient frontier depends on your corporate risk attitude, so you need to understand that in order to choose correctly. Risk is in the eye of the beholder.

What about pandemic risk?

Think of several efficient frontiers. Imagine trying to mitigate the risks: safety; liability; and cost. Every efficient frontier is at a different cost, with each curve representing the trade-off curve between residual safety risk and residual liability risk. You really have three stakeholders – safety advocates, liability advocates and financial advocates. They are negotiating.

At one end, there is no risk at all, but it will cost a lot of money. At the other end, the number of deaths will be overwhelming, but the cost would be minimal. There must be a sweet spot. However, if you don't go through the process of optimising the trade-off between the risk and return, then you could wind up with a suboptimal outcome.

Why is it so hard for organisations to prepare for risks they should have seen coming, like the pandemic?

First of all, I am a free-market guy. Very closely related to the financial markets are the prediction markets. They got Trump wrong, they got Brexit wrong and they got COVID-19 wrong. So, we were blind-sided. And yet, you can be sure the market was picking up some signals as this crisis was unfolding. For example, if China had been hoarding personal protective equipment before the pandemic really hit, then there would have been signals to reflect that. You can't hoard something without changing the price of that, right? And you could have picked up on some of these signals. As an efficient market advocate, I think markets are pretty efficient, but they are not completely efficient. There are signals here and there, and we should be watching them very closely.

If there are so many signals, how do you know which are important?

Artificial intelligence and machine learning would be my first approach. We have a lot of data. The problem is that, in a lot of cases, they are highly non-linear. And that means they are subject to chaos. So how should you monitor the obvious signals? You are not trying to figure out what is going to happen in the long term – you want to figure out whether things are about to go chaotic. This is essentially the butterfly effect, where minute influences can have huge effects on non-linear systems.

Can financial markets exhibit chaotic behaviour?

They can, absolutely. Typically they don't, but an example would be the sudden correlation of everything when markets all drop at once: that is a chaotic system. And even though you might not be able to predict it, you can do scenario analysis. You need to know what you would do if an unlikely scenario would happen. At Royal Dutch Shell, they didn't think the Soviet Union would collapse before it happened but they knew what to do if it did happen. That is scenario analysis.

Cybersecurity attacks present another unpredictable risk. If you can't predict it, how do you manage it?

This risk is different from all the rest. You cannot treat cybersecurity threats as you would a nuclear meltdown in a power generation plant. It frustrates me and other modellers when we see people modelling cybersecurity like the threat of a nuclear meltdown in a power generation plant. The nuclear reactor is not out to get you. If the core melts down, there is something wrong with the physics. In cybersecurity, you have an intelligent adversary. You simply cannot get through this without invoking game theory.

You mentioned game theory. Can you explain why gamers are generally better at managing risk?

The best risk modellers are gamers because they learned the game by playing the game, not by concentrating on writing down in advance what they were going to do. They didn't sit there and read a book, and then decide how to do it. They learned to ride a bicycle by riding a bicycle. They didn't waste time by writing a bicycle mission statement or making sure they have the right bicycle outfit. I often get this when people come to me for assistance: they just want to write about bicycles, they don't necessarily want to ride a bicycle.

> *"The best risk modellers are gamers because they learned the game by playing the game"*

How would you model climate change risk?

With climate change models, I wouldn't recommend using just one; there are many. They are huge and humongous, and almost collapsing under their own weight, but they contain a lot of valuable information – so long as you don't use an average. Take economic modelling around the world due to sea level rise. What you can do is write out a SIP library, write it in the cloud in an open, standard way that allows everybody to have access for free.

This global SIP of sea level rise could be accessed by individual regions, which in turn would calculate their own SIPs of economic impact based on local knowledge of factors such as the hydrology, tide basin and storm surges. The resulting SIPs would be coherent in that they reflected the same sea level conditions on each trial and could be added together to estimate the global economic impact. The data and the technology are there, it is a matter of getting everyone on board ●

THE ENTREPRENEUR

MARGARET HEFFERNAN

Margaret Heffernan is an academic, entrepreneur and author. Her latest book, *Uncharted: How to Map the Future Together*, explores how organisations and individuals can find their bearings in an unpredictable world.

Your book Uncharted discusses risks that are "generally certain but specifically ambiguous". Does COVID-19 fit this description?

It's a perfect description for the coronavirus pandemic. The phrase describes, among other things, all epidemics: they are generally certain, in the sense that epidemics have always happened, and there's no reason to believe they will stop happening; they are specifically ambiguous, because there is no profile of an epidemic. They are inherently unpredictable. We don't know when they will break out, where they will break out, or what the disease will be.

How can organisations respond to this kind of uncertainty?

If you can't plan for it, you have to think about how to prepare for it. We've seen in the news recently that many countries, notably the US and the UK, had preparedness documents and strategies which, tragically, were overlooked, or not implemented or funded, or – in the case of the US – actually disbanded. What those examples show is that it is possible to prepare. It's possible to ask the question, 'If this comes to pass, what will we wish we had been doing before?' – and start doing it.

You criticise efficient 'just-in-time' corporate models. Do you think the pandemic will lead to changes in the way supply chains and globalised businesses are run, to make them more resilient against sudden disruption?

I've seen a change already. I've talked to business leaders who are seriously discussing among themselves about how to create a measure of resilience and put that on the balance sheet. The idea that such preparation should be part of officially required regulated reporting, in order to it be a level playing field, is gaining traction.

Going forward, we will have to think about resilience in a more sophisticated way, and I'm confident it can be done. It is something all stakeholders have a right to expect: shareholders, employees, communities, trading partners and suppliers. Do I want to do business with this company if it isn't resilient? Do I want to invest time effort and money doing business with a company that isn't prepared for the future in a professional and sane way? This is a conversation that has already begun.

The book highlights the problems with computer-driven risk models. What are the key flaws, and what can humans do that machines cannot?

The single biggest problem with models is the tendency to mistake them for reality. It is in the nature of models that they leave a lot out; they have to, otherwise they would be as big as the thing they model. The difficulty comes from the fact models contain value judgements about what's important and what isn't. Some of the things that come into models may be objective, but many will not be – the model might reflect a view profit margins matter more than turnover, for example: that's a value judgement.

How do the flaws in models affect decision-making?

People in government, people in decision-making positions in corporations, want levels of certainty that models purport to provide. The problem is that all of the real risk, the systemic risk, appears to go away, and the possibility of picture-perfect decisions starts to feel available. The truth is since every single forecast can only have probabilities attached to it – and those probabilities will always be under 100 per cent – the opportunity to make the perfect decision is always elusive. We have to make trade-offs and try to make the best decisions we can in light of the information we have, but that information will keep changing, and very few models can keep up with that pace of change.

You argue scenario planning can be a good way to manage risk under conditions of uncertainty – why is this technique effective?

Companies do scenario planning for two reasons. One is it is a very chastening reminder of uncertainty in everything we do. It's a profoundly effective way of surfacing possibilities that can't be seen any other way. The other reason is that the act of doing it liberates a lot of intellectual energy that otherwise lies latent within the organisation. Every business leader I work with wishes the quality of debate within their organisation were higher. One of the unexpected by-products of scenario planning is it throws off a far higher quality of informed debate; it is not just a swapping of opinions.

The book explores the success of 'cathedral projects' such as the European Organisation for Nuclear Research (CERN). What can they teach us about risk management?

One of the things they teach us is that many organisations fail to be genuinely ambitious. They have become so wedded to precision planning – which is intellectually constraining – that they become reluctant to have a bigger idea for the corporation. Cathedral projects show us that ambitious guiding principles can organise good choices and preparedness and planning.

What's interesting is that this was really the original intent of the discussion around 'purpose' in organisations: the notion we need to have a big ambitious idea about why this company has a vital contribution to make to society, and how. What's really disillusioning is to see how this concept of purpose has been dragged, hijacked and instantly devalued into sloppy taglines that mean nothing. It's the fastest example I've come across of an idea that has been turned into cynical slogans.

> *Every corporation exists within an ecosystem, and the corporation can only be as resilient as the society that it inhabits.*

How can we devise a more valuable idea of corporate purpose?

There's a fundamental thing here, which is that no organisation in the world can function without society. We need educated people; we need roads and energy and light; the rule of law; health; clean air. These sorts of things are not optional extras. Every corporation exists within an ecosystem, and the corporation can only be as resilient as the society that it inhabits. The health of the organisation depends on the health of the ecosystem, and the health of the ecosystem depends on the health of each individual company. Serving both is what purpose is meant to be about.

Cathedral projects prove you can do this long term, without becoming slack about operational excellence or indeed financial probity. In the last 20 years, we've become very small-minded about what success looks like, and the consequences are all around for us to see. Filthy air. Frightening climate. Huge volatility in the economic system. Significant volatility in the social system. Generalised anxiety about how we tackle these issues ●

THE TECHNOCRAT

LORD ADAIR TURNER

Once described as the UK's 'technocrat supreme', Adair Turner is perhaps best known as the former chairman of the Financial Services Authority. With the world heading for the deepest recession in nearly a century, Lord Turner tells *AIQ* central banks should bite the bullet and finance governments directly to stimulate economies.

You have written about the benefits of monetary finance. Are you a convert to the ideas of Modern Monetary Theory?

There is a subtle, but important, distinction. At one level, MMT is a bit of a misnomer. It's not 'modern' at all. It was all laid out by Milton Friedman in his 1948 article *A Monetary and Fiscal Framework for Economic Stability*. If the central bank printed money and either directly distributed it to individuals or gave it to the government to spend, you would stimulate the economy. That is so obvious that I don't think anybody could really deny it.

It is also pretty obvious the impact on aggregate nominal demand depends on how much you do. If Donald Trump suddenly told the Federal Reserve to print ten million one-dollar bills, scatter them from a helicopter and let people pick them up and spend them, the impact on inflation and nominal GDP would be negligible because $10 million is such a trivial part of a $20 trillion economy.

If, on the other hand, he ordered them to print $100 trillion, the result would be hyperinflation. It is as simple as that. It depends how much you do.

Why is there so much resistance to monetary financing from central banks?

If you think we shouldn't be doing monetary finance now because it will cause inflation, then we shouldn't be cutting interest rates and we shouldn't be doing quantitative easing (QE) and we shouldn't be providing liquidity to banks. Those are all ways of stimulating nominal demand.

That is why most orthodox economists engage in obfuscation, pretending monetary finance is in some sense impossible. They are terrified that if we admit it is possible, politicians will do it to excess and we will end up with Weimar Republic or Zimbabwe situations – in other words, you will never be able to do a limited amount.

The interesting questions about monetary finance are therefore not about the technical possibility. Instead, they relate to political controllability. Is this something so dangerous if used in excess that we should create barriers against using it at all? That is the key question.

The next question becomes: Are you willing to use this tool as a last resort? I would say yes. The negative side effects of running incredibly low and negative interest rates for a long period eventually kick in. We should ensure monetary finance is only used in extreme circumstances, and in a very tightly disciplined fashion. An independent central bank following an inflation target should determine when it is used.

It should be used as a tool of demand management in specific deflationary circumstances where your rate of nominal GDP growth is sluggish and where the other tools available to central banks have been exhausted.

How do we cure ourselves of our addiction to debt?

If, in 2009, developed nations had agreed to spend the equivalent of three per cent of GDP for three years, financed with money not debt, we would have

been in a better place. We would have ended up with less leverage and higher interest rates earlier. GDP would have grown faster. We also would have returned to normal interest rates sooner and had less of a public and private debt overhang.

Disciplined, one-off monetary finance should be thought of as an alternative to credit finance, because money is not credit. Straight monetary finance does not create a debt contract into the future, it is simply money. We have been terrified of increasing high-powered money on a permanent basis to finance public deficits. And as a result, we have relied on private credit, but that is an unstable way to stimulate the economy as it creates vulnerability in the future – exactly what Milton Friedman argued back in 1948.

If, in the current circumstances, we were to run a deficit equivalent to ten per cent of GDP and finance it with monetary finance, it wouldn't produce excessive inflation. However, if we said 'why don't we run ten per cent deficits and monetary finance them every year for the next 20 years', this would produce excessive inflation. There is a massive distinction.

Looking ahead to an economic recovery, is there an argument central banks need to normalise monetary policy faster, regardless of the consequences?

Unless inflation is going above target, I don't think they should. All central bank policy should be contingent on situation and circumstance.

To be clear, I believe in central bank independence and inflation targeting. I just think there are better tools to achieve the end goal. We will end up doing forms of monetary finance anyway, while continuing to deny it. Look at Japan, where despite large fiscal deficits, the central bank buys the debt through QE and continues to pretend these operations are temporary and they will be reversed.

Should governments use this crisis as an opportunity to provide much-needed upgrades to infrastructure?

Governments' first priority should be to support consumption because a lot of people have been involuntarily unemployed or furloughed. It makes sense to support people's income.

Faced with this crisis, we should also be reinforcing investments in renewable energy and fibre-optic networks so people who have learnt how to work at home can continue to work in a more effective fashion. The issue is that these kind of projects cannot be started overnight.

> *Faced with this crisis, we should be reinforcing investments in renewable energy and fibre optic networks*

Governments should try to overcome this by identifying the projects that are shovel ready. At the local government level there will be a need to refurbish properties, and similarly with overdue improvements to hospitals or schools – these could be accelerated to help get the construction sector going as much as possible.

Do you see any danger the current downturn might threaten financial stability?

I don't see another financial crisis as an imminent threat. Although some banks have got bigger, that isn't a fundamental issue. The real question is 'have they got more capital?' The answer is yes, they now have plenty of capital.

As Chair of the International Financial Stability Board's policy committee, I was intimately involved in all the debates about bank capital. We did several things: tightened up the definition of what counts as capital, the numerator of the capital ratio; changed the definition of risk-weighted assets; increased the required ratio; introduced a counter-cyclical capital buffer and a capital conservation buffer on top of the basic ratio; and implemented a globally-systemic surcharge.

The big global banks at the core of the global banking system now have effective capital ratios that are approximately four or five times higher than they were in 2008. This has put us in a good position and is why I don't see another financial crisis as a huge threat ●

THE RISK ENGINEER

WARREN BLACK

Warren Black is a qualified engineer, risk professional and complex systems theorist. He established Complexus in 2016 to research how risks need to be controlled within complex organisations, projects and programmes. He discusses whether current risk management practices are adequate in a world transitioning into the Fourth Industrial Revolution.

Complex risks have increased in the last few decades. How did this emerge?

Complex systems and related phenomena have always been part of our existence, from the beginnings of the Earth. How the sun interacts with the tides – that's a complex system. How the rainforest keeps the flora and fauna alive is another complex system. We've always been aware of complex systems.

But they have only become part of our mainstream conversation and corporate agendas in the computer age. As the world moves closer to the Fourth Industrial Revolution (an extended period of mass-scale technological, political and societal change), complex systems have in turn become more and more visible to the typical practitioner.

Of particular relevance is how, within the next 30 years, we will live on a fully digital Earth. The whole world is going to be a series of interconnected, complex, intelligent systems – collecting data, storing data, analysing data, sharing data and adapting to data. That's the way the world is moving.

How could this impact the way governments, companies and societies manage risk?

Seven or eight years ago, I found myself head of risk for one of the largest natural gas programmes in the world. My team and I observed that the speed at which risks were emerging, changing and adapting was so quick we couldn't keep up using conventional risk management tools and analysis. We recognised there was something missing; that if you took a stock-standard risk management approach, it just didn't work. These standards assumed risks were linear and could be managed in a step-by-step manner: identify the risk, measure the risk and treat the risk.

That works fine if you're dealing with a simple, logical and cause-and-effect risk. But if you're dealing with a highly dynamic risk, which creates continuous shifts in relationships, then the idea of identifying, measuring and treating the risk in a linear, step-by-step fashion does not work because the risk is continually adapting and changing.

Consider how at the highest level of complexity you have chaos. Nothing can be predicted or proactively controlled when there is chaos, so conventional risk management techniques don't work in environments of advanced complexity.

What are the implications of this complexity?

For the last six years, I've been focusing on how we control risks in complex, dynamic, systems-driven environments. As fate would have it, in 2020 COVID-19 hit. I didn't predict the coronavirus, but I did say that as the world gets more and more systemically complex and interconnected, the scale of the risks we will experience will increase and have global implications. Today we have COVID-19, but tomorrow it could be a global supply-chain disruption. A year or two from now, somebody could hack the Internet. How many professions would come to a complete standstill if the Internet went down? And it is not implausible somebody could hack the Internet given

how sophisticated technology is becoming.

Nothing is happening on a localised scale anymore. Our risks are now more systemically complex, more adaptive, more agile. Conventional risk management techniques don't work at this level, and for that reason risk management has some catching up to do to deal with the increased complexity, dynamism and systemic interdependencies in the world.

How do you think we should be responding to COVID-19?

If you take COVID-19, a global pandemic, we had decades of repeated, institutional warnings of the inevitability of a mass-scale, global pandemic. The World Health Organisation, the World Economic Forum, UNICEF and countless other bodies consistently warned us there was an inevitable global pandemic coming.

On top of that, we also had numerous dry-run misses: SARS in 2003; SARS in 2007; MERS in 2015 and countless others. Despite this, when COVID-19 did come along, the only mitigation effort we had ready was to put billions of people under house arrest, shut down economies and compromise our children's futures. We knew it was coming, yet we weren't prepared.

If this is how we are going to deal with every major pandemic or risk that comes down the line, we are in deep trouble. So, the single biggest thing we have to do differently is prepare a genuine, strategic, proactive response to all those macro-global threats that are both known and inevitable.

What are some of the key risks you see on the horizon?

There are all the natural risks of course; climate change is a big concern. If there is one thing we've learned from COVID-19, it's that we are not ready to deal with climate change. But it's not just climate change. There are numerous other risks, such as the growing disparity between the rich and the poor, which must be addressed.

If you were to ask me what the big organisational risks are, a big one is the impact of the Fourth Industrial Revolution. Many organisations and the people they employ don't truly understand how quickly the world is going to change in the next two decades. This creates a massive threat for the future workforce because it takes 20 to 30 years to build up expertise in a particular management discipline, and the world is changing so quickly there are not going to be enough skills and expertise to deal with the knowledge requirements in future.

> *We have to prepare a genuine, strategic, proactive response to all those macro-global threats that are both known and inevitable*

If you're a company suddenly flooded by smart technologies, but only five per cent of your employees understand them, you are in trouble. The risk is that in five to ten years' time we will find the working world has far outstripped the available expertise and skill sets within the average organisation. In short, the speed at which technology is advancing is happening faster than the speed at which our labour capability is upskilling.

What should we be doing to futureproof societies and organisations?

I mentioned structured upskilling and training. If you are a company that employs 5,000 people, you can't replace 5,000 people overnight; you have to keep them relevant. That is a big part of futureproofing.

One of the things I recommend to my clients is to have five, ten and 30-year transformation plans. The best way to do that is to work with academic institutions and get them to map out how your industry is expected to change over those time periods. Once you can see how the industry is expected to change, you can start to build up adaptive workforces and capability development strategies. I see more organisations doing that, but not the majority and that is a concern ●

THE SCIENTIST

DIDIER SORNETTE

World-renowned risk expert Didier Sornette, professor on the Chair of Entrepreneurial Risks at the Swiss Federal Institute of Technology in Zurich, is perhaps best known for his theory of the "dragon-king": a sudden, catastrophic risk cascade. He talks to *AIQ* about COVID-19 and the principles of good risk management.

Could COVID-19 have been predicted, in the manner of a dragon-king event?

It was predictable in the same way an earthquake is predictable: we know another one is coming, but the timing is unclear. My concept of the dragon-king refers to processes in which we see progressive damage, or collective behaviour or processes, that can be diagnosed, and which can be identified by those with the relevant skills. Once the pandemic began to spread, it followed a contagion process with a tree-like structure, which was to some degree predictable thanks to epidemiological models. But predicting the original case – 'patient zero' – would have been impossible.

Why has COVID-19 brought such a massive policy response compared with previous pandemics?

We have entered a new regime, a 'phase of fear'. My premise is that the origin of this new phase can be identified around the time of 9/11. The terrorist acts revealed the changes in the way we see politics and were used to justify the Iraq intervention. It was the first time a single shock (of relatively minor amplitude, when put in the global context) synchronised large parts of the world in an extraordinary reaction with extraordinary consequences.

How can we ensure economies and societies are more resilient against these kinds of crises?

It is good we are defending ourselves against exogenous shocks by erecting protective barriers, but I would argue the first barrier should be about building a society populated by healthy individuals with healthy immune systems. The correlation between the severity of the illness and other comorbidity factors, such as obesity, diabetes and cardiovascular disease, has been well documented. We tend to be fatalistic, but can do something about it.

Could an escalating geopolitical crisis be a concern coming out of the pandemic?

COVID-19 might have triggered cooperation, collaboration and brotherhood: unfortunately, we have seen quite the opposite. You have two superpowers, we could say two 'empires', and the world is going to develop more and more in this 'bipolar' mode. My concern is that this competition will occur in a domain that is existential: imagine if there was a scarcity of some important commodity that, for example, China needed and the US blocked by using its navy. What is considered existential or threatening to a country's way of life or identity varies between countries. In the West we tend to think too much as 'Westerners'; we don't put ourselves into the minds of our friends or competitors often enough.

Does cybersecurity concern you, given the rise in remote working?

Risks are characterised by a distribution, and the concept of a 'fat tail' describes a distribution of returns that exhibit a tail that decays to zero much slower than the Gaussian distribution. Cyber risks

have the broadest, wildest swings in the fat tail. Stronger and stronger interconnection and 'fragilization', through optimising and just-in-time production, has made the system more efficient in the short term but left it more vulnerable to unforeseen shocks. I like to say that nature is more imaginative than mathematicians, physicists, engineers, specialists of all kinds. We are very often taken by surprise when a catastrophe occurs, as the path to it has usually not been imagined.

How does climate change compare with other global threats?

The planet is not in danger – it's we who are in trouble, in that we are endangering the ecosystem that supports us. If we disappear, after a period of destruction the planet will thrive again: just look at the area around Chernobyl, which is now a paradise for animals.

We need to steer the planet towards a more sustainable and harmonious future. There are many components to this. We don't speak enough about water stress, which is a huge problem. We need to speak about the pollution caused by synthetic chemicals that have entered the endocrine system of the human body and disturb the hormones that allow our organs to synchronise and coordinate. We need to transform our industry, our way of life, our ecological footprint so that we transition to sustainability. We need to focus not on risks in silos, but on the whole human-Earth system.

You have written that even the most complex systems have 'pockets of predictability'. How can we go about spotting these early warning signals?

Most crises, or transitions more generally, do not happen out of the blue but through what I summarise as a 'maturation' towards a tipping point – a catastrophe, using the language of mathematics, or a phase transition, using the language of physics.

Think of this analogy: you are a climber and you use a rope. The rope is made of many filaments. Suppose that due to stresses, some filaments are damaged; one by one they break. Your weight is still held by the rope, until enough filaments are damaged that the rope breaks and you fall. Your fall would have been predictable if you monitored the progressive damage and if you understood the underlying mechanics through which the load is shared by the remaining filaments. If you can model this and monitor the damage, you can diagnose the progressive maturation of this instability.

> *Nature is more imaginative than mathematicians, physicists, engineers, specialists of all kinds*

What are the applications of this kind of work?

I first started working on this at the beginning of the 1990s, in collaboration with the company that later became the European Aeronautic Defence and Space Company [now Airbus]. We were interested in understanding the predictability of the failure of pressure tanks in the European Ariane rocket. We subjected the pressure tanks to increasing pressure. Using acoustic gauges, we recorded the acoustic emissions that revealed tiny earthquakes in the matrix of the carbon fibres. These cracking sounds revealed delamination in the matrix, and the breaking of the little fibres. By monitoring the evolution of the cracking as revealed by the acoustic emissions, we were able to develop a model that reliably predicted the failure of the pressure tanks.

In a sense, this same procedure can be applied to develop a sufficiently predictive diagnostic in a range of fields, even illnesses. People don't develop a cancer out of the blue; they first have a recurrent inflammation induced by little stressors, which then evolves to chronic disease. Then, after 20-30 years, depending on the subject, it progresses to another severe phase, like cancer. A similar effect occurs in a financial bubble. The first stage is the development of a new technology, a nucleation phase, and then the first wave of investors arrives. More and more investors come to the market, attracted by the cumulative gain they have seen, and the market progresses as the positive feedback becomes more and more decoupled from the fundamental value. Common conceptualisations can be developed for predictions in each of these fields ●

THE SUPERFORECASTER

WARREN HATCH

Warren Hatch is CEO of Good Judgment Inc, a global network of superforecasters to help companies address complex problems, developed following research by Philip Tetlock and Barbara Mellers. Hatch explains what makes a superforecaster different and the importance of teamwork to deliver more robust outcomes.

Superforecasting emphasises the importance of using a variety of sources, teamwork, humility and accountability. How do they come together?

One thing the researchers tried was: do you do better as a forecaster working on your own, working in a prediction market, or working in teams?

They found forecasters working on their own – some of them quite brilliant – posted performance significantly below that of the other two conditions. Being able to interact with others and benefit from other views made a big difference. That was conclusion one: teamwork matters.

What kind of teamwork? In prediction markets, you will express your view by buying and selling a position about a question. You will have a view and you will buy and sell, but based on where the crowd is at the moment. You may have a completely different belief about the question, but you may observe what you think is a mismatch, or it's thinly traded and there is an inefficiency.

The researchers found prediction markets tend to have an edge on questions that are close to resolving – a week or a month out – and will tend to converge with other kinds of forecasting sources.

That leaves the other one, which is teams, and it turns out teams have the edge most of the time. That is because they can bring to bear a diversity of views, where there is an incentive to share information. In prediction markets, there is arguably an incentive, not only to withhold information, but to distort it to help your position.

Not so with teams. We are working together, competing against other teams, so we want our team to succeed. And because there is an incentive to share information, that accelerates learning. If you find a piece of information and share it with the team, that means I don't have to go and find it myself, and I can go look for something else.

Where it really kicks in is when we have cognitive diversity. You come from a different background, your perception and cognitive approach might be different. What that means is you will find pieces of the mosaic we are trying to fill out that I might have never recognised. That is a very efficient process that outperforms the other ways to make predictions.

How do you ensure all voices are heard?

We tend to have anchoring, where everyone in a group tends to conform their views to what the high-status individual might be thinking, so a good way to provide a level playing field is through anonymity. We will go onto a forecasting platform and have no idea who the other team members are. All I know is the information they are bringing, so every voice is heard.

Not requiring consensus is important too, because it means we are all free to express our views. If some people have crazier-looking forecasts, that's ok, because it is not going to affect the median. If it turns out they are right, we are all going to learn and pay more attention. If they are not, we will go the other way.

What are some of the difficulties of superforecasting?

We are seeking to find a balance. If we have a diverse range of perspectives, we can analyse ourselves into paralysis and not get anything done. It is one of the advantages of having a framework. Having a specific forecast question to something meaningful – what is it we need to know? – will prevent us getting paralysed with our own thinking.

This idea of balance shows up in different ways too. One of the key things to do in forecasting is to take what Daniel Kahneman calls an outside view: that is to rely on external research – for example, historical data or comparisons with other countries – to synthesise into an initial forecast.

The reason we start with the outside view is once again to mitigate the risk we become anchored and only move incrementally from our initial forecast. That's why it is much better to start with an informed outside view. Then I want to bring in the inside view so there is balance.

What makes the difference between superforecasters and 'average' forecasters?

Forecasting is a process, and some steps are very effective and should be included. The other thing is just to do it and get feedback to improve.

Some characteristics tend to make people better forecasters. One of these is being good at pattern recognition – that mosaic we were talking about. Another big part is being actively open-minded. If you have a belief about the world, is it something to be tested, or something to be protected? Good forecasters will want to change their mind when new information comes in.

Good Judgment Inc has been experimenting with longer-term crowd-sourced forecasts. Can you tell us more?

We know from the data that forecasting of the sort we have been talking about can be very effective on horizons of up to one or two years because there is data for it. As you look further out it becomes hazier, and there will be a point at which you cannot improve the focus at all. But we have been finding ways that maybe can.

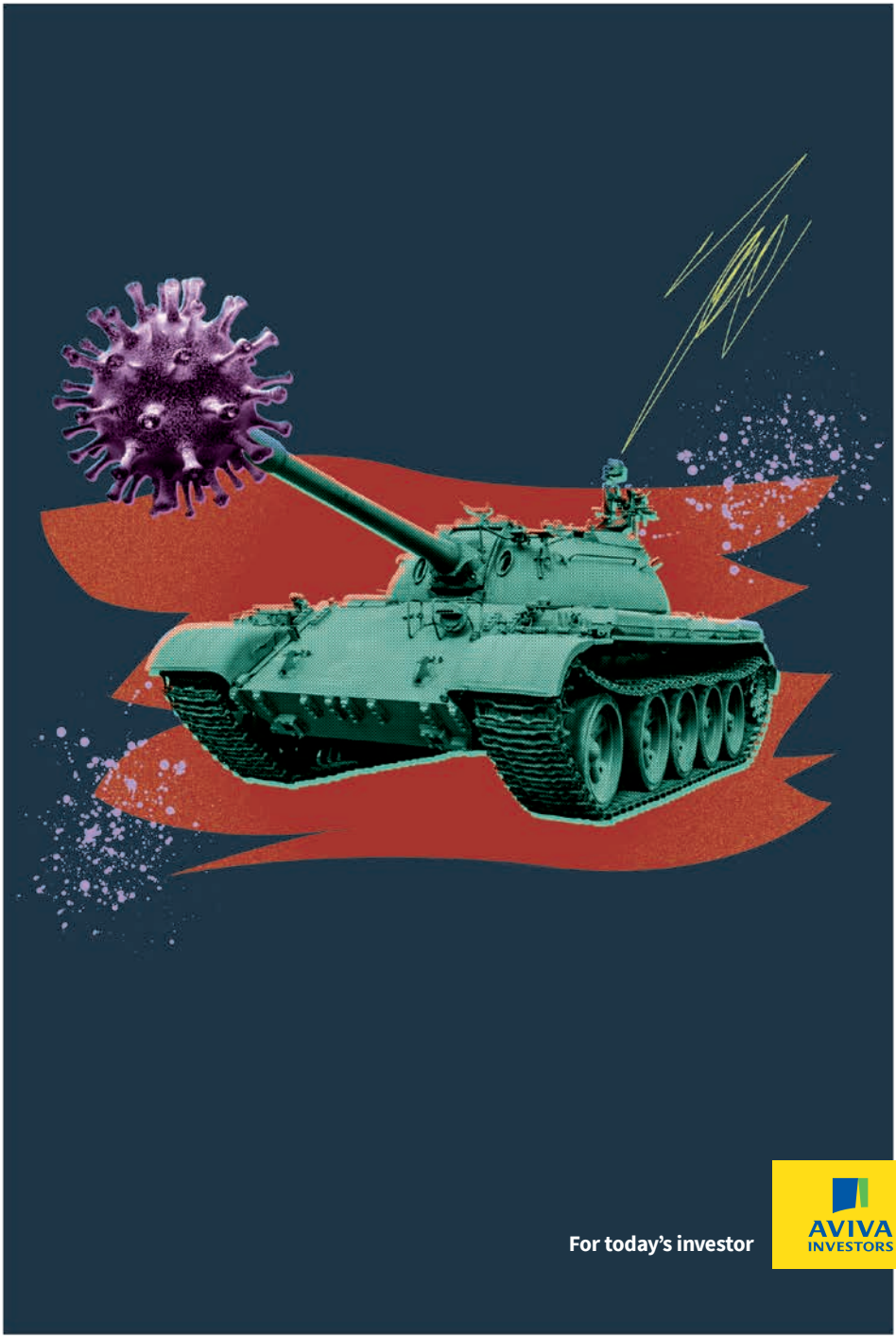
One is breaking down complex issues into smaller pieces with a set of forecasts for each, then putting them together into a cluster can tell you something useful. That is what we might do, for example, with the energy transition.

> *"Good forecasters will want to change their mind when new information comes in"*

The other option is to create a rough indicator. We may still develop a cluster of questions, but we will identify one that seems to be indicative of how a trend might unfold.

We have also started to look at another approach with capital market assumptions. Typical methodologies are model-driven, or make a series of projections on economic growth, population, productivity, inflation and wrap them up into capital market assumptions.

In all cases, what they are missing is what we know to be very effective: using the wisdom of the crowd. This is what our approach does, asking a large number of people for their assumptions over three and ten years to find the median. It is also an opportunity to discuss best practice and the relative value of different information. All comments are shared and voted on, and everyone then has the opportunity to make a final update to their assumptions. It goes really fast; it is really effective, and it is something that more firms are beginning to adopt ●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