The expert view: counterfactual analysis & disaster risk

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Interviewee: Gordon Woo – Catastrophist

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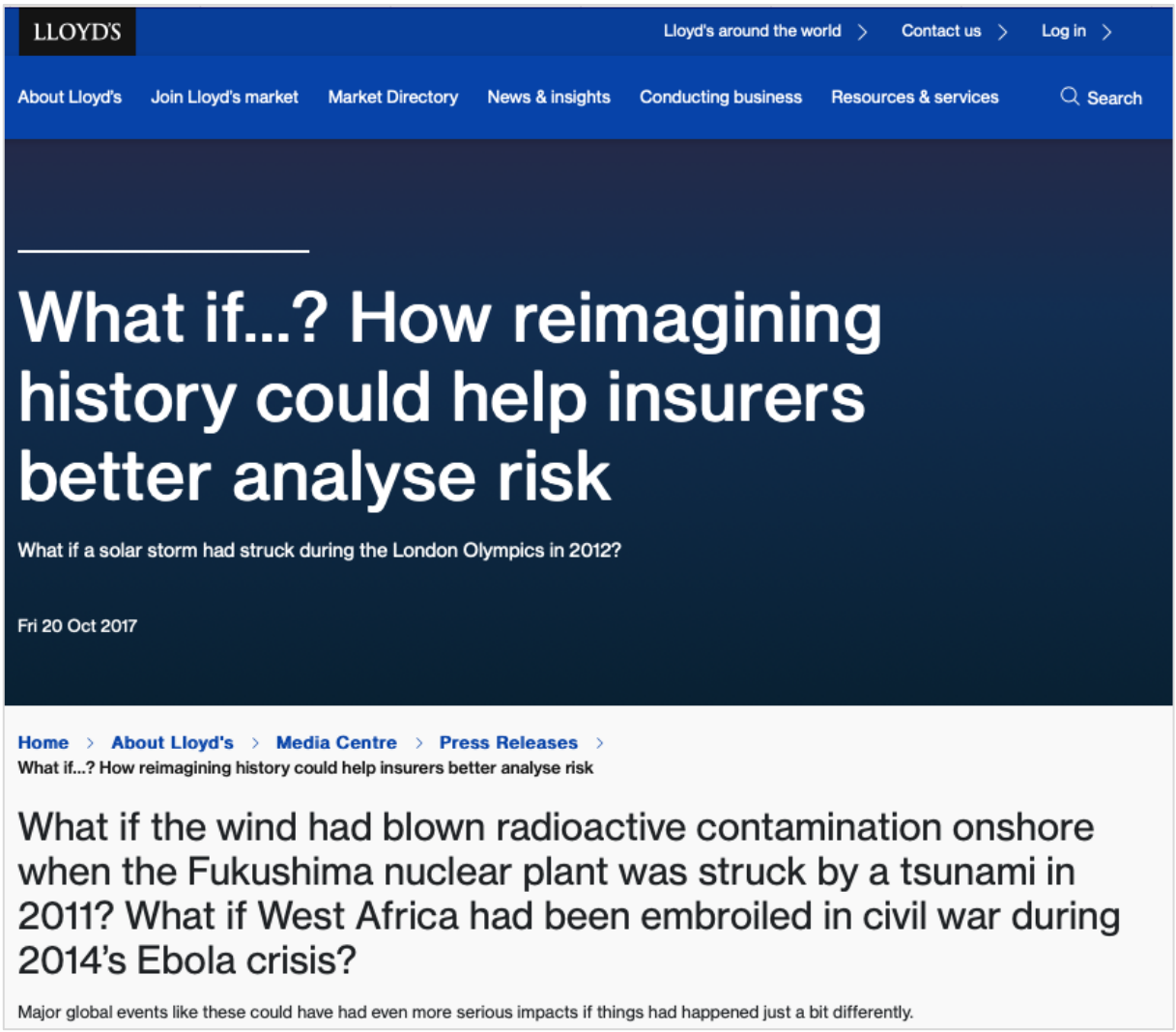

What if…? How reimagining history could help insurers better analyse risk (Image: Lloyds)

Gordon,

Thank you very much for making the time to discuss counterfactual analysis with me and how it can be used to help people to avoid disasters. It's been a few years since we last held an interview discussion on this subject, and I have appreciated our ongoing discussions on how to best use counterfactual analysis. Can we start by summarising your background, and the work and research you undertake?

Gordon: *In my role for Moody's RMS, I focus on catastrophe risks. It's an area I have been working in for over thirty years, advising financial institutions, governments and businesses. My research and activities lead me to look at disaster threats that include natural hazards such as wildfire, severe storms, flooding, seismic activity, volcanoes, windstorms and flood hazard assessments, through to human-caused threats and risks of terrorism, explosions and infrastructure failures.*

In terms of some of the work I carry out with others, several years ago I served on the Blackett Committee reviewing Black Swan events for the UK government chief scientist. In 2017 I was delighted to be part of a team to produce a report for Lloyds of London, What if…? How reimagining history could help insurers better analyse risk, which discusses the lessons we can learn and the knowledge we can gain from using counterfactual analysis.

I continue to be involved in academic activity since graduating from the University of Cambridge and completing a PhD at Massachusetts Institute of Technology (MIT). I am a visiting professor at University College London (UCL), and an adjunct professor at Nanyang Technological University (NTU) in Singapore.

I have also authored a couple of books: The Mathematics of Natural Catastrophes; and Calculating Catastrophe.

Gareth: Thanks for this overview, Gordon. I remember us participating in a Counterfactual Analysis Workshop in August 2019 at Nanyang Technology University (NTU) in Singapore, which was very interesting and insightful (it helped me advance my own thinking and use of counterfactual analysis).

Counterfactual analysis workshop held at NTU in Singapore, August 2019 (photo: G Byatt)

Can we start with your views on ***downward*** counterfactuals and ***upward*** counterfactuals, and why counterfactual analysis benefits from being split in this way? An upward counterfactual focuses on how events that happen could have had better outcomes (as described in a paper on this subject published in Frontiers). A downward counterfactual focuses on how an event or a situation might have been **even worse** than it was.

Do we look carefully enough at downward counterfactuals, given the preference of people to look back at events and situations with an upward (positive) lens?

Gordon: *I believe the world would benefit with more use of downward counterfactuals, applying it to all types of events and near misses. A key point about a downward counterfactual is that it can help to prevent negative surprises. Disasters keep happening around the world, and we keep being taken by surprise, despite all the debate about them. A downward counterfactual is not about being negative, it's about thinking through plausible situations to help prevent bad or terrible outcomes. One aspect I am aware of is that the term "counterfactual" does not always translate well in other languages. I haven't solved this conundrum.*

Gareth: On a positive note, I do hear the word "counterfactual" often used when I hear experts and commentators speak about disasters and risks around the world. On your valid point about how the term counterfactual translates in other languages, when I took part in a disaster risk forum in Bordeaux, France, in October 2023 I was used the term "contrefactuel", which seemed to be a reasonable translation. That's only an anecdotal example, of course.

When it comes to looking at examples of downward counterfactuals, I still refer to your co-authored Lloyds 2017 report, What if…? How reimagining history could help insurers better analyse risk. The many examples it contains about occurred events that could have had different outcomes shows the value of downward counterfactuals. I also appreciated reading your co-authored July 2023 paper on downward counterfactuals and cascading risks that was published in Frontiers, Downward counterfactual analysis of multi-risk cascades. In this paper you talk about how we don't research near misses often enough.

What are the key principles you adhere to when applying counterfactual analysis?

Gordon: *Whenever an event or a situation leads to a disaster, I always ask myself: Were there any recorded near misses (perhaps from many years ago, not just recently) before it happened, and were lessons from them taken on board?*

There are many near misses and small-scale events that we can learn from if we make the time to do so, yet time and again we do not capture and record them or learn from them. Often, when something big happens it catches us by surprise, but when we trace back what has occurred before, near misses often provided warning signs. If near misses can be spur action, a disaster could be avoided.

Consider one example during 2023 (unfortunately, I could name many disaster event examples in this year) – the terrible wildfires that struck Maui in August 2023. Evidence of a wildfire near miss on Maui from 2018 exists. In that year a wildfire event occurred when a hurricane drove a wildfire towards Lahaina. Fortunately, this event in 2018 did not cause a catastrophic outcome. It is an example of the importance of asking ourselves a question when near misses occur: What if it had been worse?

According to some reports, insufficient action was taken after 2018 to consider the implications that a larger wildfire would have had. The 2018 event was a close call from which a downward counterfactual could be developed. One aspect would be to consider how emergency evacuation would need to work in a fast, large wildfire. Evacuation action differs depending on what people need to do to escape an area – evacuating an area in response to the threat of a tsunami requires getting to higher ground. In the case of a wildfire, you want people to go towards the sea, so it needs a different type of warning that people recognise and respond quickly to. Plus, what if there are obstacles in their way – power lines and / or trees and / or other objects could be blocking the path to escape. How can and how should blockages be dealt with as quickly as possible? If power lines are down, can they be quickly deactivated so that they do not block egress?

My main point through describing this example about Maui is that, by spending time to look at a downward counterfactual after a near miss or a small-scale event, those involved in preparing for disasters can ask themselves if they would be ready for a much larger event that could cause a disaster.

I wonder if monitoring near misses requires a dedicated team of people, who can also engage with people around the world who can benefit from learning about near misses and minor events. This kind of analysis, to look at how near misses could have been worse, aligns squarely with your work in avoiding disasters, I think.

Gareth: This type of thinking does indeed align to our Disasters Avoided work, in particular to two of six factors we have identified that are key to avoiding disasters: having the right mindset and having good data.

Regarding the tragic 2023 Maui wildfire disaster, I came across a local news article in October 2023 that describes the lack of focus on an After Action Review after the 2018 event (other pieces have also been written). Whilst I know it's not easy to make the time looking back at scenarios and near misses, doing a thorough job to analyse them can foster valuable discussions about the strength of a control environment. Gathering data about near misses takes time, and it not always easy.

***Gordon:** It is indeed hard to keep track of near misses. We have unfortunately seen other terrible disasters in 2023, which might have been prevented if circumstances had been different. Consider the Derna dam collapses that happened in Libya in September 2023, which cost thousands of lives. In 2022, a paper was published by a Libyan Hydrologist, Abdul Wanis Ashour, who pointed out that a flood which occurred in 1959 would have breached these dams (which were built in the 1970s).*

He has been writing about these dams since 2010, I believe. Should the Libyan authorities have taken his analysis on board and focused on improving them, including inspections to check that they were in good working order? Applying counterfactual analysis and asking What if? is about seeing and responding to risks like this before they become major events.

Gareth: I read your blog post, Counterfactual Perspective on the Derna Flood Disaster, that you published on the RMS website. This example makes me wonder about applying counterfactual analysis to critical infrastructure (of which dams are part) through good governance, including maintenance.

Gordon: *Good governance is vital for critical infrastructure. As the same Libyan Hydrologist described in an interview with the BBC World Service in September 2023, when the Derna dams were built in 1970 there was consideration given to whether a third dam should be built alongside them. If a third dam had been built the collective capacity to absorb heavy rainfall would have been greater. A report created in 1970 recommended building three dams, not two, but the government of Libya chose to build two, which as it turned out were not strong enough to withstand the heavy rainfall from Storm Daniel.*

Gareth: The Derna dams resulted in a tragic loss of life. Do you think counterfactual thinking should be integrated and stitched into government policy – perhaps making it a requirement at certain points of the lifecycle of all critical infrastructure? I wonder if it should also be applied to disaster threats on a national and state level. I am not suggesting that counterfactual thinking can prevent all disasters, but I wonder if stitching it into government policy can help governance be as effective as possible.

Gordon: *I think there is plenty of scope to consider how counterfactual analysis can be integrated into public policy, however, it is not currently used this way. Most people – policy advisors and others – want to move on from near misses and events, not look at how they could have been worse.*

Consider the many examples of how counterfactual analysis can be applied to the COVID-19 pandemic. It was a global disaster that could have been even worse, had it not been for a small number of dedicated people who had been investigating vaccine solutions for years before the pandemic occurred.

The 2023 Nobel prize in Physiology or Medicine was awarded (in October 2023) to the pioneers of the MRNA vaccine, Katalin Karikó and Drew Weissman. Katalin had a professorship at the University of Pennsylvania (UPENN), and Drew, an immunologist, became a new colleague of hers a number of years ago. As it turns out, these two met at a photocopy machine, at a time when science involved a lot of photocopying! Drew was interested in dendritic cells, which serve an important role in immune surveillance and activating vaccine-induced immune responses. Katalin completed a PhD in MRNA and worked with Drew to develop a solution that prevented inflammation when using these types of vaccines.

They knew that they focused on different areas, and they linked up to study how different RNA types interact with the immune system.

Consider a downward counterfactual to COVID-19. If SARS-CoV-2 had emerged twenty years earlier, around the year 2000, even though Katalin was carrying out her work in the 1980s and 1990s, it is extremely unlikely that a vaccine would have been made available at scale so quickly, and then so quickly distributed around the world (whilst noting that this distribution was not evenly shared). The unavailability of a COVID-19 vaccine for several years after the emergence of the SARS-CoV-2 virus would be a thought-provoking, and a very worrying counterfactual to work through in detail. The COVID-19 pandemic was extremely hard on everyone, but what if it would have been even worse?

Gareth: Your example of how things could have been even worse for the world if circumstances surrounding COVID-19 had been different links back to our point just now about how governments can use counterfactual analysis, also considering that there have been and still are various inquiries by governments around the world that are looking at their handling of the pandemic.

In our 2018 interview, you talked about how health pandemics arise and the people it affects with a counterfactual lens can teach us a lot. Eighteen months after that interview, the COVID-19 pandemic happened. I recall in that interview you talked about how the 1918 flu pandemic could have unfurled differently if the previous pandemic of 1890 before it had occurred earlier or later. The peak mortality age in the 1918 flu pandemic was 28, and this could have been different, with different implications, if the 1890 pandemic had occurred earlier or later.

Gordon: *I remember our discussion about pandemics in 2018. Wherever I go, I aim to talk with people about the benefits of the counterfactual mindset and technique. Rather than ask "What else could have happened?" when something occurs (in whatever context we are talking about – a disaster, a business crisis or something else), I prefer to ask people "What is a downward counterfactual to this event / situation?"*

I have recently been liaising with a team at the University of Huddersfield, who have been supporting an analysis of the Sendai Framework for Disaster Risk Reduction 2015-2030. The Sendai Framework has a lot of common sense in it, and the recommendations it contains are logical. I wonder if a part of the Sendai Framework, or perhaps a new recommendation, could be focused on ensuring enough attention is given around the world to downward counterfactuals of near misses and disaster events that occur.

Gareth: This is an interesting point, Gordon, given that the Sendai Framework for Disaster Risk Reduction 2015-2030 Midterm review was conducted in 2023, and it stated that some of the targets it contains are not, as of 2023, on track to be achieved.

I wonder if a common approach to applying downward counterfactuals can be stitched into the work of multilateral agencies that support disaster risk work around the world. You and I have also talked about its application in the business world (for which the Lloyds report of 2017 provides many examples).

I remember us also talking about a “parlour game”, in which an umpire gathers players around a table and, sequentially, players have to come up with ways in which the loss from a target significant historical event might have been incrementally (e.g. 10%) worse. They keep going till there is only one person left.

Gordon: *I think it would be very useful if the counterfactual terminology was more widely used (noting our point earlier about how it translates into other languages). Performing a downward counterfactual in an appropriately thorough way can help us think through how to avoid disasters. Maybe a parlour game can be one way to entice people to use this line of thinking (thanks for mentioning it).*

When it comes to human-made events such as dam failures and other types of infrastructure collapse, they are invariably caused by people ignoring the risk or not doing enough about it (for which poor governance is usually a contributing factor).

Gareth: We talked earlier about “the human condition” – that people do not like to consider how things could have been worse when something negative happens. Whilst noting this, are there efforts by some, at least, to highlight downward counterfactuals about near misses?

Gordon: *It is hard, for sure. It takes a lot of effort and hard work to find out about and compile good data on near misses and then to consider downward counterfactuals to them, as you mentioned just now. Near misses don’t end up being large events, so no costs (social, economic, or environmental) were incurred. Spending time thinking about them might, to some, seem like a waste of resources.*

There are examples of people looking at examples, though. I know you lived in Australia for many years: one of my colleagues has put together a presentation about this country during 2023, and I have been assisting with some counterfactual thinking on the natural hazards that Australia faces. There are some very interesting case studies in that country. As one example, there was an earthquake in Victoria a number of years ago, which got me wondering what might have happened if the quake had occurred close to or in the centre of Melbourne. How would this city handle such an event?

Gareth: I appreciate you mentioning disaster risk reduction efforts in Australia. As part of the Disasters Avoided initiative that I am working on with Ilan Kelman and Ana Prados, I am reviewing efforts being undertaken by many groups of people to reduce the risk of wildfire disasters (bushfires and grassfires) in this fire-prone country – noting that the risk of such events in the summer season of 2023/24 is noted by many experts to be high due to ENSO.

Flooding is another major hazard in parts of Australia, and it has caused much damage in recent years. I have been looking at occurred events and near misses in Australia, and thinking about how they could have been worse using downward counterfactuals.

Gordon: *Think about how events and near misses could manifest in different ways is an important part of how we should assess risk. Counterfactual thinking is a mindset, perhaps even a calling. Risk is all about uncertainty, so this way of thinking should benefit everyone who works in this profession, in all types of areas and sectors.*

Let me give you another example from November 2023 – the volcano eruption risk in Iceland. People were evacuated from Icelandic town of Grindavik, which is a good precaution. However the volcano situation unfolds, it will be worth running a downward counterfactual on it. People may remember what happened in 2010, when the Eyjafjallajökull volcano in southern Iceland erupted and spread a plume of ash across Europe. Much of European airspace was closed for six days because of its risk to aircraft.

Gareth: I appreciate that one of the key points to counterfactual thinking is to make the time to think broadly enough about alternative scenarios (we discussed the parlour game idea earlier which links to this). When we look at events that have occurred, it can be easy to get caught into a "loop of fate" when we carry out a root cause analysis, thinking that the way things occurred was bound to happen the way it did. In my work in the private sector with businesses in various industries I see how in the field of safety, paying attention to observations of good and bad behaviour (observations being examples of work in action) and thinking about the dangers in a mindset of "chronic unease" pays dividends.

Part of what we are doing in our Disasters Avoided is to look at success stories of how disasters have been and are being avoided. For example, I monitored the readiness of Bangladesh to be able to cope with Cyclone Mocha in 2023. As it turned out, Cyclone Mocha skirted the southern part of the country and vulnerable areas such as Cox's Bazaar were not as heavily impacted as they might have been (although it's important to recognise that there were definitely impacts). This is an example in my mind about the value of running a near miss and downward counterfactual analysis, to imagine how the country would have responded if the event had been a lot worse.

Gordon: *Your point is certainly valid, and it links to the mindset we have been discussing. It brings me back to making the time to carefully think through counterfactuals. If we take the time to carefully review near misses and run counterfactuals on them, we can improve our ability to manage risk.*

I understand why major disasters are of particular focus for people to learn from, and we do need to learn from them to try to stop them happening again. It is also good to hear about your application of near miss thinking to Bangladesh.

Given the focus of the Disasters Avoided project, I wonder what can be learned from looking at a range of disasters that have occurred that might, if circumstances had been different, have been avoided.

Gareth: This is a good idea, Gordon. We are looking at examples of occurred disasters in some of our research.

I'd like to return to something we raised earlier, which is the criticality of good governance at all levels and in all aspects of decision-making (government, support agencies, development banks, businesses and others). Does government and the judiciary system that exists set the tone for how well governance is applied?

Gordon: *In my view, the biggest single factor in the scale of loss in a disaster is the rigour of government, and the elimination of corruption. Time and again when we see disasters, bad government leads to bad governance.*

Consider the impact of earthquakes around the world. Back in 2011, Nicholas Ambraseys and Roger Bilham wrote a paper (titled "Corruption Kills") which describes the correlation between corruption and earthquake damage. They found that, essentially, the greater the corruption that exists, the worse the outcomes from earthquakes (whilst this may seem intuitive; their paper analysed statistics in detail). When we consider corruption in governments, the Corruption Perceptions Index (CPI) produced by Transparency International offers a useful and instructive guide. We keep seeing major disasters occurring in corrupt countries.

The point about circumstances where corruption exists is that it overrides all the good advice and analysis about how to do things well. So, a focus on good governance which includes stamping out corruption is key to avoiding disasters. When a disaster does occur, one of the upwards (positive) counterfactuals that can be asked is, what if there had been better governance in place long before the threat became real?

Gareth: I remember our discussion a few years ago about how counterfactual analysis could help modellers look at earthquake scenarios in a broader way. I discussed this topic with an earthquake expert in September 2023.

In our 2018 interview you talked about the devasting 1999 earthquake in Turkey that is estimate to have killed more than 17,000 people – a terrible event that could have been even worse if it had extended past the rupture zone and impacted Istanbul. Tragically, Turkey and also Syria were struck by a catastrophic earthquake in February 2023, in which an estimated 55,000 people were killed. In both the 1999 and 2023 earthquakes, a great many buildings collapsed. Reports after the 2023 earthquake have claimed that lessons were not learned from the 1999 earthquake (earthquake experts have informed me that Turkey has good earthquake building codes, the key, as with elsewhere, is to ensure they are implemented)?

Gordon: *Regarding the disaster hazard that earthquakes pose, I appreciate you mentioning the paper I wrote about the awful outcomes of the 1999 earthquake in Turkey. A key message behind this paper is that, in my view, certain scenarios are missing from current earthquake hazard models. For example, the scenario of an earthquake rupturing across the fault line which runs through Istanbul is not included in many scenario earthquake models for Turkey, because a lot of models assume that when you have different rupture segments, they can't cross over. If you look at a map of the East Anatolian fault, the combination of segments which ruptured in the 1999 earthquake is almost certainly not included in any seismic model for Turkey.*

Gareth: The point about the use of models for assessing disaster risk is interesting, Gordon. It links with one of the factors we are reviewing in the Disasters Avoided initiative, about ensuring we have and use good data (which links to good governance).

Continuing with the example of earthquakes, New Zealand strikes me as a model for others to learn from. From what I understand from talking to people about earthquake risk analysis in Christchurch, New Zealand, whilst models did not indicate certain events having a high probability of occurrence, they still planned for the possibility of a major earthquake in the centre of the city because of the catastrophic consequences and impact that it could have. Had this not been the case, the outcomes of the 2011 Christchurch earthquake could have been much worse. This seems to me an example of combining good data with good governance to ensure good resilience is in place.

Gordon: *The example of Christchurch in New Zealand is a useful example to discuss, linked to focusing on near misses. It's important to appreciate that there were near misses in New Zealand before the 2011 Christchurch earthquake, and that people did learn from them. I think this is an example of adopting a good mindset towards avoiding disasters.*

Gareth: In our Disasters Avoided emerging model of key factors, as I mentioned earlier, having the right mindset and good governance are two critical factors (along with four others: the right investment / funding, good data, meaningful inclusion and meaningful targets). When it comes to governance, I am thinking about the value of upward counterfactuals to disaster events, to look at what might have happened if government was better at the time.

Gordon: *I agree. Returning to our discussion about the COVID-19 pandemic, in many countries the death rate has been shockingly high. Government decisions around the world had a direct impact on their country's death toll.*

I wonder if, during government committees and policy reviews about how they responded to and handled the COVID-19 pandemic whether downward and upward counterfactuals are being reviewed in enough depth.

Upward counterfactuals have value in other ways. In my role at UCL, during 2023 I have co-supervised a Lebanese student who has undertaken an upward counterfactual review of the Beirut port explosion that occurred on 4 August, 2020. There are always opportunities to look at upward counterfactuals from disasters: many events and situations lend themselves to the question: "How could the outcome have turned out better than it did?"

Going back to our point about good governance, for all disaster case studies and lessons learned, including those where positive action has been taken to avoid a disaster (including your Disasters Avoided initiative), an upward counterfactual to consider is: How could the outcome have been different if the government of the time had been better with its management of governance? Whilst asking this question gets into the arena of politics, it is a key factor in how and why many disasters occur, and how others are avoided.

Gareth: Part of our Disasters Avoided work looks at governance in urban environments and its impact on avoiding disasters. Many cities and towns are not currently built to cope with the types of storms and fierce weather that is occurring in today's times – and I know there are some highly skilled people trying to change this in their local urban environments.

Looking at an urban resilience context, and the constant pressure to build on land that is at risk from various disaster hazards, I wonder if governments and municipal authorities can incorporate counterfactual analysis into their planning processes and their building codes. They could apply code limits such as designing for plausible windspeeds so that if applicants want to build on land, they need to show proper analysis of what could happen to contribute towards a knowledgeable decision. In a quest to maximise profit, developers knowingly build on flood plains, and they try to build as close as possible to known seismic fault lines. People often ignore advice to protect their home against wildfire hazards, although they live in known fire prone areas.

Gordon: *City and municipal teams face many challenges, and they have electorates who want to see short-term action. Most people who make decisions in democratic societies are elected for four or five years. Because of this, by default they tend to think about what might occur in the next five or perhaps ten years, not the next 50 years. If the probability of a big disaster threat is small, a default reaction is to look at it as someone else's problem in the future to deal with, and to hope it doesn't happen "on your watch".*

Where people live is a key factor in the ability of urban centres to avoid disasters. Giving people authorisation to live in flood plains, earthquake-prone areas or close to areas vulnerable to wildfire can have short-term benefits for votes, while knowing that the long-term vulnerability exists.

The impact of climate change on how and where we live is another example. Short-term politics has come into play in various parts of the world in 2023 as elections are held and loom for 2024.

Natural and human-made hazards continue to create disaster events and situations. It's a challenge that democracy needs to deal with and find a solution for. People typically vote for the present more than the future.

Gareth: Whilst we keep seeing disasters, we do at least see good examples of sensible disaster resilience and good work to avoid disasters in some geographies.

Are you seeing good examples of where counterfactual thinking has been applied, and how it has added value?

Gordon: *I have seen good and bad examples. In my work and travels I have spoken with many people who are interested in applying counterfactual thinking and analysis. The key to ensuring it becomes ingrained is for one or more decision-makers to see the value in it, and to endorse it for long enough so that it becomes a cultural habit for people (this is similar to implementing any type of change). One of the challenges is that people often change roles in organisations; they move on. Stitching it into the modus operandi and shared way of thinking is a challenge, and it requires an element of luck, to be honest.*

Gareth: Do you think counterfactual thinking should be described and recommended in some of the global reports produced by multilateral and international agencies on ways to reduce disaster risk and avoid disasters?

Gordon: *As we discussed earlier, I think there is benefit in the people who set policy and advise on it embedding counterfactual thinking into their activities. Many good reports and frameworks are produced, and it is laudable for the authors of these reports to aim for lofty aspirational targets. Counterfactual analysis can help us develop tangible targets and actions, and to pose hard questions that force us to look at a wide range of risks and vulnerabilities.*

Gareth: We've talked a lot in this interview about the role of government, and governance in general, to avoiding disasters. The role of businesses and owners of utilities (which may be privately or publicly owned) is also key. You have written about how counterfactual analysis could help them avoid major problems and perhaps even avoid bankruptcy. I wonder if counterfactual exercises to look at disasters involving both government (national, state and/or local) and the private sector could add value.

Gordon: *Counterfactual reviews with lots of different people add value. One example is the Californian energy utility business PG&E, which is featured in a 2023 paper I have co-authored.*
When the Tubbs fire occurred in 2017, PG&E was lucky that the fire wasn't started by a problem with their own infrastructure.

If PG&E was regularly using counterfactual analysis on disasters and near misses, their response to the Tubbs fire event could have been "We were lucky, we should pay for a comprehensive inspection of our lines and infrastructure to identify possible weaknesses", but they chose not to do this. A similar fire, the Camp fire, happened the following year in 2018, with dozens of fatalities, and PG&E was found to be at fault. If PG&E had performed a downward counterfactual soon after the Tubbs fire to ask: "What if we had been at fault?", maybe better controls could have been identified to avoid fire disasters. As of 2023, PG&E have buried many power lines in the ground, so action to reduce the risk has been undertaken.

This example shows how decision makers need to recognise when they have had some luck from a situation or an event, and what they need to do to ensure they don't keep running the gauntlet. I appreciate that it's hard when finance and profitability pressures are involved, but threats and vulnerabilities need to be properly assessed.

If you take a 100-year event approach, you could say that "It won't be my problem when it occurs because I will be long gone." Taking action on things that haven't happened is hard.

Gareth: I wonder if meaningful inclusion with the public can lead to taking action earlier?

Gordon: *There are things we can do which need not cost the earth. Little actions can make a big difference. What it needs first and foremost is the right mindset, followed by a commitment to act to reduce vulnerabilities.*

Someone needs to be given the time to find out what's going on around the world and to share and drive the sharing of thinking about how disaster events and near misses could have taken a different path.

As we discussed earlier, any type of disaster risk review can be more impactful when it includes a counterfactual review. A dossier of case studies about how disasters have been and are being avoided is good to learn from, ideally augmented by asking why we haven't avoided more disasters.

Gareth: This has been an interesting discussion, Gordon. Do you have any recommended reading or viewing for people about the use of and how to apply counterfactual analysis (in addition to your own research and publications including the Lloyds report and co-authored papers on the subject)?

Gordon: *The Man in the High Castle by Philip K. Dick (first published in 1962) is a work of counterfactual fiction which I have found well worth reading. There are some good history books that look at What if? type of thinking. There are also some good drama series on streaming services which can help us understand why certain things happen. I hope some of my papers are of interest to people as well.*

Gareth: Thank you very much for your time, Gordon. As you know, I am integrating counterfactual analysis into my research into examples of work to avoid disasters, which I am finding it extremely useful. I am discussing counterfactual analysis with a lot of people in different disciplines and contexts, and it is spurring some very insightful conversations.