

UNCERTAIN BUT INEVITABLE: THE EXPERT-POLICY- POLITICAL NEXUS AND HIGH-IMPACT RISKS

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April 2021



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EXECUTIVE SUMMARY

Risk management is an essential function of governments, through which they are expected to protect citizens and environmental, infrastructural, and economic assets against major hazards and threats.¹ The public places responsibility with their national and local governments to avoid certain classes of risk or to manage their impacts within acceptable boundaries. However, all levels of political governance struggle with determining the appropriate level of investment necessary to prepare for or mitigate the negative consequences of rare but foreseeable, high-impact events. The issue needs to be under constant review and revision, yet governments and societies remain poorly prepared for such events. Often the risk class has been recognised within expert communities as important, but the necessary protective, resilience-enhancing and preparative measures have not been taken. Why is this so?

Even if experts and policy analysts agree that a risk exists, there is too often a disconnect between scientific and policy *awareness* and the actual policy and investment *actions* that are needed to be adequately prepared. Within the policy and political processes, resistance to taking potentially expensive pre-emptive actions is common when events cannot be assured to happen in a given timeframe, even if they will inevitably occur at some point. Further complicating this issue is the complacency that can arise if such an event has not occurred for quite some time, perhaps in a lifetime. The result is that some risks are downplayed or even ignored. This paper explores the reasons for this gap.

In general, such inaction or delay (and the resulting inadequate risk management) does not relate to deficiencies in our ability to identify hazards and assess risks. Rather it primarily involves human factors of communication and judgement, the nature of political and policy decision-making, and the cognitive biases and variable risk perceptions of different actors. Further, in contrast to the private sector where accountabilities for risk management are generally clear, ambiguities allow political and policy accountability to become diffuse, and too-often unassignable. The issues are particularly compounded when dealing with the uncertainty associated with rare, complex and multifaceted events. The emergence of epistemic threats² in the misinformation age further compounds both risk assessment and response.

For effective risk management, governments should take a systematic and transparent approach to risk identification. Transparency is at the heart of a trusted relationship between governments and citizens, and that trust is particularly critical in crisis management. Many countries have now developed and published some form of national risk register that outlines their countries' major risks. Ideally, such a register details a range of potential consequences that might flow from various hazard events, including those that can interact and cascade to create a crisis. A comprehensive and accessible risk register can serve as an essential tool for informing decisions and actions, both in policy and in the public domain.

However, undertaking and maintaining a systematic risk assessment and compiling a register is not sufficient. Governments must not only *identify* but also *prepare* for potential risks systematically and transparently, and ensure clear accountabilities. And they must communicate their understandings to their publics, agencies, local bodies and the private sector to increase awareness and public acceptance, or buy-in, of needed investment and actions. They must consider the importance of pre-emptive investment in promoting resilience and mitigating risks of events that could have severe impacts, even if the expected frequency of occurrence is low. The simple fact is ignorance or denial of the potential for high-impact events will inevitably *someday* lead to catastrophic outcomes. Therefore, politicians, policymakers, experts and citizens need to be better aligned in understanding these types of risk if they are to be dealt with effectively.

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- 1 For a general introduction to risk see Gluckman, P. and Bardsley, A. (2016) *Making decisions in the face of uncertainty: Understanding risk*. https://www.pmcsa.org.nz/wp-content/uploads/PMCSA-Risk-Series-Paper-1_final_2.pdf and <https://www.pmcsa.org.nz/wp-content/uploads/PMCSA-Risk-paper-2-Nov-2016-.pdf>
 - 2 Harmful influences on information production and dissemination that lead to the erosion of trust in evidence and expertise.

In considering the level of preparative investment to make, judgement will always be needed because there will always be some, often significant, uncertainty around the risk. But the starting point must be a willingness to recognise bounded rationality³ and the need to overcome inevitable biases, to consider the probability that catastrophic events always occur sooner than one might hope. We need to acknowledge what we *don't know*, and that we *can't know* everything about a risk. We know some risks will not be identified in exactly the right way, so risk assessment must think about common types of consequences (or impacts) that stem from a variety of hazards. It must consider how they are interconnected,⁴ including second- and higher-order effects, and make plans about how to deal with them. In many situations, preparations for one type of event can significantly support actions needed for others.

This paper uses recent New Zealand experiences as examples, although the underlying principles are generic. It does not focus on a particular event but instead explores the general issues that have been of concern by both the expert and components of the policy community.

3 Bounded rationality describes how humans make decisions because of limits in our thinking capacity, information availability, and time. Instead of making the 'best' choices, we often make choices that are satisfactory. <https://thedeclarationlab.com/biases/bounded-rationality/>

4 Also including international dimensions of connectedness.

INTRODUCTION

Risk management, and particularly disaster risk management, is a critical obligation and function of all governments. The prevention of avoidable risks, the mitigation of risks that cannot be avoided (i.e. risk reduction), and the strengthening of resilience to reduce losses from damaging events, are key components of this responsibility. The Sendai Framework for Disaster Risk Reduction (United Nations 2015), as a core part of the post-2015 global agenda and endorsed by 187 countries, including New Zealand, emphasised the broad range of risks that governments need to be prepared for. The importance of expert and formal risk assessment was emphasised and has been the subject of ongoing work via the UN Office for Disaster Risk Reduction (UNDRR).

Responsibility lies with national and/or local governments to be aware of and prepare for high-impact events to either avoid them or manage their impacts within acceptable boundaries. Given the risk to, and the role of, many other stakeholders, governments also need to ensure appropriate awareness, coordination and capacities within communities, organisations and businesses. But a recurrent and understandably difficult problem for all levels of government is determining what level of investment in preparedness is desirable and necessary to mitigate the impacts of adverse events and crises given limited budgets and competing urgent demands. This includes expenditure on creating redundant systems (e.g. backup data sources, redundancy in utilities, etc.), enhancing resilience (e.g. continuity of government plans, investing in floodplain protection and/or managed retreat from at-risk areas), and preparing for addressing unavoidable impacts in cases where crisis management and recovery will be needed.

It is a challenge for the policy-political process to decide (a) what kinds of events to focus on, (b) what severity and frequency to prepare for, and (c) what level of investment to make. Such decisions must be made in the context of often significant uncertainty around both the likelihood and impact of a particular class of event, the level to which the actions will ultimately reduce the risk, and with the knowledge that such investment may affect the ability to manage other risks.

When events are frequent such as flooding in specific water catchments, decisions to invest in mitigation through flood banks are relatively straightforward. However, when there is a small risk of severe rainfall in a catchment that does not have a history of frequent flooding, the decision to invest in costly infrastructure to guard against future floods is more difficult. The rarer the event, the less likely such a protective investment will be made. But if costs of such (possible) flooding are very high, for example flooding of a central business district, the cost-benefit judgement may be swayed in favour of building flood banks, even if the probability is very low.⁵ The dilemma for policymakers is clear: if an investment is made and is not needed, it could be seen as a wasteful use of taxpayer money. Yet if flooding is known to be possible (however remote the chance), and indeed it occurs, and no preventive action was taken, the politicians and policymakers will endure citizen anger, not to mention high financial, social and other costs.

Addressing this policy challenge hinges on two quite distinct issues – knowledge and transparency around potential and existing risks; and the institutional challenges to overcome in responding to the potential of rare events, including new classes of risk that may have emerged. For example, cybersecurity has only emerged as a major threat in the past 15 years (World Economic Forum 2020), and epistemic threats⁶ (e.g. disinformation campaigns) are becoming increasingly complex to manage (Seger et al. 2020).

5 In the case of floods, there are also consequences of building protective structures, in that they can create overconfidence by reducing societal memory of flooding, resulting in more socioeconomic development occurring in flood-prone areas.

6 Epistemic threats can be defined as detrimental influences to information production and dissemination, including misinformation and disinformation campaigns that lead to the erosion of trust in expertise. They can create threats in themselves in undermining democracy and can compromise management of other crises, as in the case of anti-vaccination campaigns in the midst of dealing with an infectious disease outbreak such as measles. Technologies have greatly accelerated the risks of epistemic threats impacting on national wellbeing.

Risk management is more than simply risk identification and documentation – critically, the risk identification step also requires identifying a ‘risk owner’, an agency, or person assigned as responsible for ‘managing’ the risk. Each risk is assessed for how likely an event will occur and the scope and magnitude of its possible consequences (Standards NZ 2009). At this stage, the traditional ‘ACTA’ framework (Avoid/Control/Transfer/Accept) offers four possible risk management strategies:

- **Avoid** – eliminate the cause of risk or avoid exposure (can risk be avoided by doing something differently?)
- **Control** – take action to reduce the probability or impact of the risk
- **Transfer** – allocate some risk responsibility to other parties (e.g. through insurance)
- **Accept** – take no action but make contingency plans in case an event occurs.

This frames the general challenge for governments. Even when risks are known, identifying accountability, and deciding what combination of these risk management responses to use (including making investments) is often far from straightforward. Transparency around risks and who is accountable for them is an ongoing issue, particularly for the types of complex and cascading risks that are becoming more and more prevalent in our increasingly globally connected world. In the context of the range of risks generally considered,⁷ no single or ministry can be responsible. A well-defined, non-ambiguous, whole of government approach is needed, which will most likely require a more formal and apolitical process to be established.

Further, governments also need to consider that in an increasingly interconnected world, risks and crises are more and more interlinked,⁸ and this applies particularly to high-impact risk phenomena. This means that any single event occurring in New Zealand can trigger multiple and complex reactions globally, across time and space, with humanitarian and diplomatic implications. Likewise, events occurring in other countries can have significant effects at home. Therefore, a national risk assessment must consider potential vulnerabilities from a global perspective. It will also require new ways of identifying and ‘negotiating’ risks on a continuing and agreed basis internationally.⁹

This paper focuses primarily on rare but potentially very high-impact events that can be anticipated to occur at some point, but for which the probability estimates of such occurrence in any particular time window are very uncertain. Their inherent uncertainty and infrequency generate debate over the level of mitigation that should be undertaken. We refer to such events as ‘*high-impact, inevitable but rare events*’ (HIREs). Examples include a major space weather event (see Box 1), a major tsunami, or a major viral pandemic. These events have clear transnational dimensions, highlighting the need for nations to collaborate on an ongoing basis to identify, monitor and mitigate the extreme impacts.

In addition to events triggered by natural and biological hazards, other kinds of HIREs will at some stage almost certainly happen. Classes of hazards that can have catastrophic impacts (depending on their scale and the populations and assets that are exposed) are outlined in the Appendix. An example is a large-scale industrial failure with cascading impacts across sectors. Such an event occurred in Auckland in 1998, when the gas-filled underground power lines, installed 40 years prior and past their replacement date, failed, plunging the city into a five-week electrical power crisis that caused enormous socioeconomic disruption. Some other events, such as a large meteor strike, a reversal of the earth’s magnetic field, or a massive super-volcanic eruption from the central volcanic plateau, are seen as so improbable or impossible to prepare for that no preparation is undertaken. This type of event is not considered further.

Box 2 defines some important risk-related terms as they are used in the context of this discussion.

7 The Sendai Framework and subsequent expert input classifies hazards under the following headings: meteorological and hydrological, extraterrestrial, geohazard, environmental, chemical biological, technological and societal; For a breakdown on hazard categories for governments to consider see Sendai Framework, et al. (2020). *Hazard definition and classification review: Technical Report*.

8 For example, there have been cases where malicious or delinquent actors have magnified issues and created confusion associated with a terrorist event by false reports and claims in social media even as an event is unfolding.

9 This is the subject of a UK-based, international project to construct a ‘Systems Architecture for Managing Global Threats’ (Kent, R. et al. (2020). Towards an international architecture for managing global hazards: Summary report for workshop participants).

Box 1: What is space weather?

The core of the sun generates energy (both heat and light) through the process of nuclear fusion, in which enormous pressures fuse hydrogen nuclei to form helium. The sun's surface is also very active with powerful magnetic forces and as these reorganise, often close to a sunspot, they can lead to a solar flare. Most are of no significance to life and activity on Earth. However, if large enough, it can lead to massive releases of solar material and activity called a coronal mass ejection (CME), and if directed towards Earth, these emissions of electromagnetic radiation, energetic charged particles, and magnetised plasma can affect the electromagnetic conditions surrounding Earth. Such solar activity affecting Earth is referred to as a 'space weather' event. These events can disrupt critical infrastructure components both in space and on the ground, including satellites, GPS systems, and electrical transmissions grids. Solar flares, solar radiation storms and geomagnetic storms occur with some frequency, linked in part to the 11-year sunspot cycle, although the potentially dramatic global impacts of a severe space weather event have not been experienced to date.

The collapse of the Hydro-Quebec system in Canada due to geomagnetic disturbances in March 1989 is an oft-cited example of the impact of severe space weather, having left almost 6 million people without power for nine hours. The entire Quebec power grid collapsed 90 seconds after the geomagnetic storm reached Earth. In 2003, the 'Halloween storms' were associated with the loss of the Japanese ADEOS2 satellite, interference with high-frequency (HF) radio communications, radiation exposure to air passengers and crew and diversion of flights away from polar regions, a power outage in Sweden, high-voltage transformer damage in South Africa, and disruption of directional drilling for oil and gas in Alaska.

But these events pale in comparison to the superstorms of 1921 (which disabled telegraph services) and the Carrington event of 1859, which could cripple electrical and digital communications infrastructure around the globe if it were to happen today. Predicted contemporary impacts of a Carrington-level event include power outages to 20–40 million people in the US for durations from 16 days to one to two years, with a cost estimate in the trillions of dollars. Major and potentially lasting disruptions of space-based and earth-based critical infrastructures for communication and transportation (navigation and traffic control) and cascading impacts on other sectors are also to be expected. The likelihood of such an event is estimated between 6 and 12% in the next ten years.

A major event nearly occurred on July 23 2012, when spacecraft detected a very large CME that missed hitting Earth. Observations of the properties of the CME indicate that it was larger than the 1859 Carrington event and significantly larger than the 1989 Quebec storm. The CME travelled at ~2500 km/second and would have taken 19 hours to arrive in Earth's vicinity. Such an event would likely have devastating impacts across the world.

UNCERTAINTY AND INERTIA: THE CHALLENGE OF HIGH-IMPACT RARE EVENTS

Common to HIREs is that while experts generally understand their potential range of impacts and inevitability, the capacity to predict when an event might occur is limited to a very rough estimate of frequency. For the reasons discussed below, this uncertainty can often lead to assigning a lower level of priority, especially in the political decision-making processes related to investments for prevention and mitigation. This is partly because policy responses for prevention often (wrongly) presuppose relatively precise scientific knowledge of probabilities of harmful events. And scientists often feel their job is done once advice is proffered, without taking responsibility for how it is interpreted.

Clear communication of the complexity and uncertainty in the data or information to policymakers, and their ability to interpret it, is desirable but often lacking (SAPEA 2019, van der Bles et al. 2019).

For example, when single numbers are given in probability estimates in order to justify ‘prevention’ measures, they can obscure the uncertainties underlying such estimates. Uncertainty often cannot be quantified, however, and ‘precaution’ should be invoked, but investment on precautionary grounds also needs to rest on scientific input. This may be in the form of incomplete data, preferably in conjunction with credible/plausible scientific scenarios.

Additionally, as discussed below, many psychological and tactical incentives can lead the policy decision away from a precautionary approach and towards a more cavalier approach to risk tolerance. The frequent delays in making investment decisions around infrastructure highlight a bias against taking a precautionary approach. Often the need for investment in the foreseeable future is clear, even if precise knowledge of the timing of acute need (i.e. timing of failure) is lacking. But typically, other priorities take precedent until events occur or other acute pressures force decisions to be made, and action taken. A stark example is the September 2020 Auckland Harbour Bridge incident, when a truck hit a support structure causing the closure of the four central bridge lanes for several days, throwing commuter traffic into chaos. The event drew renewed attention to the fact that the growth

Box 2: Some key definitions

Asset = anything of human value; includes people/populations, systems, communities, the built domain, the natural domain, economic activities and services, trust and reputation

Disaster risk management = a strategy to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses

Exposure = people, property, systems, or other assets present in hazard zones or exposed to hazards that are thereby subject to potential losses

Hazard = something (or process, phenomenon, or human activity) with an intrinsic capacity to cause harm; any source of potential harm, including loss of life or injury, property damage, social and economic disruption, or environmental degradation.

Hazard event = the manifestation of a hazard in a particular place during a particular period of time

High-impact rare event = a severe/extreme event that happens very infrequently but is known to be possible

Likelihood = the chance that something (e.g. a hazard event) might happen. Likelihood can be defined and measured objectively or subjectively, and can be expressed either qualitatively or quantitatively, depending on the hazard.

Resilience = having the ability to resist, survive, adapt and/or even thrive in response to hazard events. Resilience can be defined in terms of societal, economic, infrastructure, environmental, cultural capital, social capital, and/or governance components.

Risk = the combination of the likelihood of occurrence and the magnitude of impact (consequences) of a hazard event on people or things that they value (assets).

Risk assessment = the identification, analysis, evaluation and prioritisation of risks

Risk management = assessing risks and applying resources to minimise, monitor and control the probability or impact of hazard events

Risk owner = a person or entity that has been given authority and responsibility to manage a particular risk

Vulnerability = the characteristics and circumstances of an asset (including people and communities) that make it susceptible to, or protected from, the impacts of a hazard. Circumstances include the extent of exposure to the hazard.

of the North Shore over the last 50 years has vastly outstripped the transport infrastructure, leaving Auckland's economy hostage to a single harbour crossing with minimal backup or alternative access to the central business district. Indeed, it is now becoming clear that the aging bridge infrastructure will soon lead to restrictions on its use (Trigger 2020). Yet planning for the foreseeable need for a second harbour crossing remains conceptual and politically contested, rather than proceeding to an active action plan.¹⁰

Similarly, when a digger broke the fuel pipeline to Auckland in 2017, the lack of redundancy of supply lines for delivering fuel to Auckland, and especially to the airport, came as a surprise to many, not least in Government (DIA 2019). There had been a loss of institutional memory and no investment to maintain the preceding mechanism involving unloading fuel at the Auckland wharf, which could serve as a back-up and ensure the supply chain's resilience. Although a petroleum industry consortium privately owns the pipeline,¹¹ the Government plays an important role, through legislation and regulation, in managing the risks associated with loss of such critical infrastructure (and in keeping the public and the environment safe from harm from events such as oil spills). The event highlighted a serious lack of foresight on the risks, a lack of practical contingency arrangements, and a failure of integrated resilience and redundancy planning by both the fuel industry and Government.

COVID-19: An inevitable, high-impact event

The COVID-19 pandemic is a salient example of a rare event in terms of extreme impact, but one that was in many respects very predictable. Like many other countries, the New Zealand Government found itself relatively unprepared for pandemic human disease, despite epidemiologists predicting for years the inevitability of a human viral pandemic of at least the scale of the current coronavirus crisis (Brownlie et al. 2006)

“The likelihood of future epidemics or pandemics of influenza or other ARIs (acute respiratory infections) is regarded as high, although the consequences of such events is inherently uncertain, mainly because the virulence of new strains of ARI-causing viruses or bacteria cannot be known in advance. Even so, it is anticipated that new ARIs could spread around the world very rapidly (in weeks) and could cause millions of deaths worldwide, and tens of thousands in the UK alone.”

– Office of Science and Innovation, UK, 2006

While the particular virus could not have been accurately predicted, there has been no shortage of warnings from the epidemiological and public health community that a major scale zoonotic outbreak was inevitable (Morse et al. 2012, Fan 2018). The risk of zoonotic disease of epidemic potential will continue to grow due to changes in the human-animal-environment interface, particularly the increasing contact of humans with wildlife, and represents a highly significant and growing threat to global health (Jones et al. 2008). An estimated 75% of pathogens capable of causing human disease are zoonotic (of animal origin), including all flu viruses (Jonas 2013). We have indeed had a spate of outbreaks in recent years including Ebola, SARS, MERS, swine fever, bird flu, Nipah and Zika viruses, all of which could have caused greater damage, but overall (despite the difficulties of context and the horrifically high mortality in Western Africa) these were relatively well contained, largely because of their biological properties. The distinguishing properties of SARS-CoV-2 transmission, infectivity and virulence – which were not unimaginable nor unimagined – have created challenges that are magnified in an increasingly globalised world.

Despite epidemiological warnings, including predictions of a ‘Spanish ‘flu’ scale event with a significant chance of occurring in any decade (Madhav 2013), there has been a general lack of preparation for a

10 See, for example: Waka Kotahi (2020) *Additional Waitematā Harbour connections*. <https://www.nzta.govt.nz/projects/awhc/>

11 Three major fuel companies (BP, Mobil, and Z Energy) own, control, or have exclusive use of all the infrastructure making up this supply chain, through a complex series of joint ventures and commercial agreements.

truly global pandemic, and most countries have taken a relatively *ad hoc* approach to responding to COVID-19. In many high-income countries, there was a false sense of security, some engendered by naïve extrapolation from experiences with SARS or previous influenza emergences, some by simplistic assessments of risk preparedness through the misleading Global Health Security Index (Kaiser et al. 2020). The International Health Regulations were last reviewed in 2005 (WHO 2005). It is clear that these regulations, and the powers of the WHO as the responsible international agency, are inadequate to respond to the current situation (Gluckman and Gillespie 2020; Independent Panel 2021). In light of this, will the authority of the WHO be strengthened? Are additional global agreements needed, and would such changes reflect a growing awareness of risk interdependencies?

20/20 hindsight, but poor foresight

It is always easy to apply hindsight and reflect on the predictable nature of Auckland's current water crisis, the 2017 fuel crisis, or the harbour crossing bottleneck highlighted by the recent bridge damage, and ask why these were not addressed. Similarly, we can ask why our pandemic planning was not adequate to handle the early stages of the COVID-19 crisis, when we lacked sufficient stocks of personal protective equipment and struggled to ramp up testing capacity and contact tracing. We are prone to inevitable enquiries, commissions and post-mortems after high profile events, often with political rather than learning motives, but the question we seek to address here is different and more fundamental. Why, across all these types of high-impact scenarios that can be identified and predicted (in terms of likelihood but not timing), is there a general tendency to delay action, or even to ignore the issue?

Major tsunamis, human health pandemics, and space weather events have already happened in the last 200 years and will occur again. A Carrington-scale space weather event (see Box 1) is predicted to have up to a 35–50% chance of occurring in the next 50 years. (Chapman 2020) Given such an event's implications, with all its flow-on effects on electrical grids, digital infrastructure, avionics and communications, some countries regularly go through practice scenarios to prepare for an occurrence. Domestically in New Zealand, highly impactful events including earthquakes, severe floods and forest fires, major infrastructural accidents, biosecurity failures, extreme terrorist events, and so forth also need to be considered. Such events are known to happen, but for some of these we remain poorly prepared – the necessary protective, resilience-enhancing and preparative measures have not been taken consistently. The cliché of “a disaster waiting to happen” is unfortunately too often true.

Two challenges for policy

Two challenges thus emerge for governments. The first is ensuring that a comprehensive and up-to-date risk assessment process has been carried out and continually updated. The second is ensuring that the appropriate level of policy development and investment is made in response to that process. But how is an ‘appropriate level’ determined? And how do we know an assessment is comprehensive? Decision makers often fail to think creatively enough about the breadth of expertise needed to make decisions on both of these issues, or to cast a wide enough net to find it, to ensure they make optimal risk preparedness or investment decisions. Which fields might bring valuable insight? What knowledge is most relevant? For example, at this stage in the pandemic there is an increasing need for social science and behavioural science input. There is also a matter of poor problem definition. Policymakers and advisers frequently struggle to reach a mutual understanding of the problem, sometimes because of imprecise or ineffective communication, and sometimes because of cognitive biases.

There is a danger that ‘bounded rationality’ (the limited scope of knowledge of any individual or group, and over-confidence in assumptions of knowledge) may restrict the assessment or comprehension of risk, if a pluralistic approach is not taken. However, even if a range of experts has identified risks of rare but significant events, there is too often a disconnect between this awareness and the actual policy and

investment actions required to lower the risk or adequately prepare for the possible impacts. Despite the high likelihood that a potentially catastrophic event will occur someday, political decision-making on how to deal with the risk may be repeatedly delayed or deficient. The most common reasons for these delays are not technical, rather they involve human factors of:

- communication;
- the functioning of the evidence-policy interface;
- the nature of politics and policymaking;
- pervasive cognitive biases; and
- variable perceptions of risk.

Issues pertaining to organisational and inter-organisational (both national and international) structures and behaviour are also important factors.

The issues can be analysed from three overlapping perspectives: (1) risk identification, assessment and communication, (2) human factors, and (3) policy and political dimensions.

RISK IDENTIFICATION, ASSESSMENT AND COMMUNICATION

Clearly, governments should ensure a systematic approach to risk identification, but that realisation is in fact recent, and remains patchy. Even within the policy community, there can be resistance to the effort required, and deep scepticism of its value. Globally the Sendai framework has not led to priority actions by many governments to systematise risk assessment and disaster preparedness. While risk assessments may occur internally within a specific agency,¹² in reality, even if there is a lead agency, most classes of risk either span multiple agencies – as COVID-19 has amply demonstrated – or do not fall under the responsibility of any particular agency (e.g. a space weather event).¹³ Emerging risks relating to technological development can trigger consequences that span multiple domains and sectors, and require a different governance approach (IRGC 2015).

There is also a need to consider how many small problems can conspire to cause one very large problem. This is perhaps one of the trickiest aspects of risk assessment – seeing the linkages between hazards, vulnerabilities, exposure, and behaviour of people and systems that can compound risks. The emergence of epistemic threats that interfere with systems of information production and dissemination present a challenge to all democracies and are made greater if ignored, even though solutions are difficult (Seger et al. 2020). In this regard, the roles of the central agencies such as the Department of Prime Minister and Cabinet (DPMC) and the National Assessment Bureau become important.¹⁴ The National Intelligence and Risk Coordination team within DPMC has recently taken the lead to deliver a national risk approach, alongside the delivery of the national security and intelligence priorities.

Natural hazards and unnatural disasters

Hazard events such as earthquakes, tsunami and geomagnetic storms (space weather events) are natural phenomena, but the disasters that arise from them are generally man-made. They result from exposures and vulnerabilities in our communities, our built environment, our social and institutional structures, and our economic systems. Disasters triggered by natural hazard events have been

12 For example, in New Zealand the Ministry of Primary Industries (MPI) will naturally focus on biotic risks such as biosecurity incursions, or the Ministry of Business, Innovation and Employment (MBIE) on the risk of infrastructure breakdown.

13 For example in the USA, geomagnetic disturbance assessments and policy analysis involves both executive and legislative branches of the policy system along with several state departments and institutions (see Baker et al. 2014).

14 The National Assessment Bureau is part of the New Zealand security system that provides independent and impartial assessments on events and developments relevant to New Zealand's national security and international relations to inform government decision-making.

increasing – in part due to climate-change induced increase in the frequency and severity of extreme weather events (droughts, floods, storms, etc.) – but primarily because the increasing number of people and assets (and the value of those assets) that are exposed and vulnerable to such hazards (see Box 2 for some key definitions).

While we can't do anything to prevent natural hazard events from occurring, identifying and understanding the complex vulnerabilities of our socio-cultural systems is critical to the process of risk reduction and enhancement of resilience. The importance of this perspective is that it adds new dimensions of causation analysis to risk assessment that includes consideration of dynamic social and cultural assets. This in turn should be reflected in the process and the participants involved in risk identification and monitoring.

Slow changes

Not all risks arise from a singular acute event; the Auckland harbour bridge problem is primarily the result of Auckland's growth over several decades, ultimately precipitated by a relatively minor traffic incident. Climate change is an example of a 'slow problem,' where continuous small changes ultimately produce large effects and threaten to cross a 'tipping point' of irreversible ecological damage. However, the deterioration is occurring over time frames beyond those typical of government priority and budget-setting. Globally the challenges of sustainability, biodiversity loss and climate change have become increasingly acute precisely because many authorities do not prioritise long-term impacts but rather focus on short-term priorities. The challenge is to provide incentives to make longer-term anticipation a valued objective.

Such slow trends are difficult to deal with – they need to reach a critical level of sustained visibility and concern from the public before real action occurs. A lack of awareness or sense of alarm over possible consequences leaves problems to worsen until their impacts become severe and obvious, at which point our ability to respond is greatly diminished. The changes are predictable yet continually ignored. And if tipping points are crossed, the impacts may be catastrophic.

Evolutionary psychology suggests that our brains are not wired to respond to such slow-moving threats, as opposed to the strong emotional reactions evoked by clear and present dangers or intentional threats (Gifford 2011). This information availability bias skews our perception of, and ability to assess the risk. But even when we can see a risk evolving, there is also a tendency to place less value on future risks than current costs and benefits – a bias known as judgmental (or hyperbolic) discounting (Gattig and Hendrickx 2007). (See discussion below on cognitive biases.)

In New Zealand, much of the responsibility for reducing vulnerability and adapting to climate change is devolved to local and regional government. Despite knowledge of the potential impacts, insufficient and variable action has been taken, exemplified in delays by regional authorities in addressing the need for managed coastal retreat as a longer-term adaptation measure, and allowing continued seaside building in vulnerable areas. While some councils have produced reports,¹⁵ little action is as yet evident. These issues are complicated by questions around legal rights and responsibilities, and by the political challenge. (Hayward 2008). Epistemic threats in the form of misinformation and disinformation have also slowed progress towards effective decision-making in regards climate change. But underneath all of this is the need for alignment of a risk assessment and management approach across all levels of government. The establishment of the Climate Change Commission is a start to depoliticising the choices that need to be made.

15 For example, Waikato Regional Council; see: Turbott, C. (2006) *Managed Retreat from Coastal Hazards: Options for Implementation. Environment Waikato Technical Report 2006/48*. <https://www.waikatoregion.govt.nz/assets/WRC/WRC-2019/tr06-48.pdf>

Risk awareness and understanding

All agencies involved in risk management require a range of expert inputs in developing a comprehensive understanding of likelihood and impact of different kinds of hazard events, but often there are gaps in the advice sought, or in the integration of outside perspectives. For example, when the West African Ebola epidemic threatened to spread to major transport hubs and impact on global travel and trade, it was surprising how little work New Zealand had undertaken to ensure resilience of supply lines in the event of disruption of both shipping and air travel (Dennis et al. 2015). It is not clear that the lessons from the small amount of work done then have been fully incorporated into subsequent pandemic planning.

The simple fact is, what is not known cannot be prepared for. In 2012, when the Chief Science Advisor was advised from the UK that New Zealand needed to be prepared for a possible space weather event within the next 24 hours, it was apparent that no entity outside the aviation or defence sector had even considered the possibility of the impacts of space weather or understood its significance, despite several other countries regularly having exercises to prepare for such an event. This broad lack of knowledge across government of an event which is almost inevitably going to occur in the foreseeable future, and which could have devastating effects in an increasingly digitalised world, was concerning. It was this singular episode and the discussion that followed that led to the establishment of a Strategic Risk and Resilience Panel (SRRP) by DPMC in 2014 to consider how to enhance risk assessment. (DPMC 2016)

The SRRP recommended the development of a national risk register that would include both civil and security risks, including potentially an unclassified, public-facing component similar to that which had been published in the UK since 2008.¹⁶ As a result, an enormous multi-year effort was put into a systemic approach across government to look at risk in all domains, with the intent of preparing a risk register. This effort produced more than forty separate risk profiles that assessed event likelihood and the potential consequences of both 'maximum credible events' and more common higher-frequency events of different types.

When this systematic approach was eventually taken to risk identification, a number of hazards or risks were brought to the fore that had not previously been on the agenda. Space weather was a risk identified for which New Zealand had no contingency plans and no awareness across key agencies, and the relevant policy and response community was essentially ignorant of its potential impact. Similarly, the broad economic and social implications of an existential threat to the snapper fisheries of the upper North Island (due to onshore activities affecting seagrass loss in the West Coast harbours), had been largely unrecognised and thus inadequately addressed. These instances, and others highlight the importance of openness of inputs into a national risk assessment for comprehensiveness, reliability and usefulness.

However, a debate evolved, primarily in the political arena, about whether such a risk register should be public or confidential. Part of the debate was whether such a register, if publicised, had political and security implications which overrode public utility. However, while there may be some security-sensitive aspects and details in a confidential version of a risk register – risk identification should be largely an open process. This can assist with sensitising communities at large, through the education system and other channels, about risk, exposure, vulnerability, and what can be done to enhance resilience. Ultimately, this means that risks must be known not only to those responsible for overseeing the management, but to those who may be affected, so they can act to reduce their vulnerability and/or exposure to the risk, or prepare for possible consequences. In this regard there is merit in identifying security-related issues in a public-facing register, although some operational detail will clearly need to be excluded.

A draft public-facing risk report was eventually prepared, but was never released because of political biases and considerations – issues that spanned administrations.

¹⁶ The UK National Risk Register has been updated five times in publicly accessible form between 2008 and 2017.

The utility of risk registers

At a national level, a risk register should provide an overview of the classes of major risk that the government should respond to, and identify responsible actors/agencies involved in managing them.¹⁷ There are choices about how broadly to conceive of the risks. It would be theoretically possible to have an all-encompassing register, although that could result in overwhelming the audience, or alternatively having the risks expressed at a level that is too generic or vague to be useful. Multiple but more targeted registers may be advantageous in making the subsequent institutional responses easier to manage, but their siloed nature could also impede the response and lose the benefits of common oversight, consistency and public accessibility.

There are also issues in risk identification and risk communication that can fuel policy or political scepticism (Tyler and Gluckman 2020). Some risks can be perceived by those who do not have expertise as incredulous and/or overstated by experts. When lists become too long or experts clamour too much to make certain risks visible, there is a risk of being seen to ‘cry wolf,’ and thus not be heard. Generally, the identification of risks, their potential impact and the estimation of their probability is a matter for experts in risk assessment and those with domain expertise. Virologists and epidemiologists have the most appropriate expertise to assess the viral hazards that can lead to a pandemic, and seismologists are best placed to assess the earthquakes and tsunami hazards, but the risks associated with those events occurring also requires social scientists to assess social vulnerability, engineers and insurance experts to assess physical vulnerability and exposure, economists to consider fiscal consequences and other stakeholders to reach a full assessment of risk.

The most common approach to assessing risks is to develop a matrix that maps event likelihood and severity of consequences of a range of hazards, which assists in making decisions around what risks require action and what can be simply monitored. Assumptions have to be tested and models examined before risks can be placed on the impact/frequency matrix or heat map. Given the inevitable uncertainty in the knowledge, judgement is needed, and this creates the potential for push-back from non-experts who may have a variety of motives to want to reduce the urgency or severity of the assessment. But there may also be the perception that domain experts wish to overclaim certainty of a high-impact event to try and force policy action. Hence the process needs a range of expert inputs – no single discipline or expert can have the scope of knowledge to consider all possibilities in a balanced manner.

The logic behind risk assessments must be clear to those who are asked to act. It is therefore important to focus risk registers and analyses on those types of risk where governments must act – those that could cause a national-scale emergency. The UK National Risk Register (Cabinet Office 2017) demonstrates that a comprehensive approach is possible by focusing on risks that would require a centralised response, complemented by Community Risk Registers that are produced by emergency planners at the local level.¹⁸

There is also the question of the institutional home of a national risk register, and responsibility for ensuring it is continually monitored and updated. In the UK this role belongs to the Cabinet Office. There are strengths and weaknesses to different sorts of institutional homes in government for such a process, but having parliamentary protection may be important to ensure longevity and independence from partisan political considerations. Given the insights gained from the overlap between audit and risk management in the private sector (OECD 2014), the appropriate oversight body in New Zealand might

17 The difficulty comes with cascading risk. For example, a shipwreck may be seen initially as solely a maritime issue, then an environmental and conservation issue, and depending on what the ship was carrying other agencies might need to be involved. Depending on where the ship was wrecked, it may become a social and cultural issue, and potentially diplomatic and legal issues may also arise. This highlights the complexities of risk assessment and management and the need to have structures that get beyond agency silos.

18 It should be noted that in the context of COVID-19, conflicts arose in the UK between local and central authorities attempting to deal with tiers of authority and responsibility in the midst of the crisis.

be the Office of the Auditor-General,¹⁹ but with capacity and structures in place to ensure international linkages to assess (and deal with) the potential for crises that cross borders.

Public visibility

Publishing a version of the register in a publicly accessible format (e.g. a national risk report) provides transparency and creates a sense of responsibility for policymakers and politicians. Such transparency is desirable in a democracy and serves to hold the system to account. It also serves to build trust between government and its citizens – trust that becomes essential when a crises actually occurs.

A public risk report ensures a system-wide overview both within government and across local and central governments – an integration that typically does not exist elsewhere. Such a report is an opportunity to present the different risks in a digestible form that illustrates the connections between event types and possible synergies in risk prevention, mitigation, adaptation and response efforts across government. It can assist in overcoming the various biases and incentives that lead to risks being ignored. Without such an overarching framework for reporting on the register, there is a risk that the profiles developed by different agencies will not be updated in a consistent manner (nor in a way that seeks input from other affected agencies), if at all.

If used as intended, a national risk register should function for planning by multiple parties beyond central government, including local government, the private sector, non-governmental organisations (NGOs) and civil society. It benefits all of these parties to be aware of what the central government identifies as hazards that should be prepared for, what agencies are involved, how they are managing the risk, and what other actors (including themselves) can contribute. A public report on key findings of the register is thus critical. This should be updated regularly, in line with updates to the risk profiles in the register. Such periodic reports then serve to maintain awareness not only for government agencies, but also for individuals and organisations wishing to be better prepared for risks and emergencies that will affect them. Public reports also invite feedback from a broader audience that can improve future versions of the register. The UK experience has shown the value of engaging the academic community and being open in the process of risk identification (Stock and Wentworth 2019). The importance of engaging with the private sector also needs to be recognised in the risk identification process.

Challenges – dealing with uncertainty and complexity

Key to effective risk identification and management is understanding the range of risks that might exist, the frequency/probability and maximum realistic impact of hazard events, and what factors make human, physical, social or economic assets more or less vulnerable to them. One of the challenges is that, depending on the type of event, estimates of impact are often uncertain, and ascertaining the probability of occurrence may also be actuarially possible for only some event types (e.g. climatological, hydro-meteorological, and geological hazards) and not others.

Further, the language around probability can be difficult and confusing for those not immersed in risk analysis. For example, if an event is labelled as a “one-in-a-hundred-year event” and it occurred last year, this does not mean it will be 99 years until the next one – there is approximately 1% chance that it might still occur next year. Similarly if an event is given a 10% chance of happening in the next 10 years, it might happen tomorrow or might not occur for a century or more into the future. In some cases, past history may help estimate probability, in others the context may have shifted significantly, thus changing risk profiles in terms of both probability and impact. For example, the impact of climate change is clearly changing the frequency and severity estimates for some forms of event (IPCC 2012).

In any case, it is rarely possible to make deterministic predictions about timing. It is important to stress that the managing of these types of risks should not be dominated solely by the formal actuarial

19 Among other activities, the Auditor-General produces reports on risk management expenditures (e.g. ‘Analysing government expenditure related to natural hazards’, Office of the Auditor-General, 2020).

tools and methods currently in use. The policy implication is that what is needed is an open kind of risk assessment that allows reasonable judgement to enter and supplement such formal tools. A risk register should be scientifically informed but should not be restricted by the scientific preoccupation with quantification and precision. The Sendai Declaration, for example, allows for indigenous/traditional knowledge to enter the risk assessment process, (United Nations 2015) which can enhance not only the assessment, but the social acceptance of the risk information.

Beyond the uncertainties around likelihood, it is also, of course, impossible to detail every way an event might occur or play out. For example, there are multiple ways in which a major utility infrastructure failure could occur, including a natural disaster, an industrial accident, a cybercrime or from a terrorist event. While prevention would be different, much of the response would be the same irrespective of cause, as would resilience enhancement through developing robust backup systems.

A well-prepared risk identification and management system therefore copes with such uncertainties by exploring classes of incidents and developing guidelines applicable to the different types of hazards. It is important to note that an effective risk register is not a simple catalogue of threats with narrowly targeted solutions. We confront multiple interconnected risks and vulnerabilities and solving 'simple' risk issues in isolation can have unintended negative consequences. It is therefore critical to consider how to deal with various plausible, interconnected, and potentially catastrophic consequences, whatever the chain of events that might lead to them.

This means the risk team and the policy and political community must understand the potential for chaotic and complex behaviour and prepare for a range of cascading impacts, while promoting a degree of flexibility to respond to the unknown. It means profiling both classes of risk and classes of impact, and developing a set of preparatory actions and flexible responses to impacts in a system-wide manner. Exercises with appropriate inputs from beyond the narrow policy community become important. This should allow the system as a whole to deal with uncertainties that cannot be formally registered, but that are essentially recognised in an anticipation process which builds adaptive capacity to change and the ability to 'think on one's feet'.

Newly emerging risks require a different kind of governance and management compared with managing familiar risks (IRGC 2015). Central to this is to understand and act on the factors that contribute to risk emergence or amplification, and this requires collaboration between actors and stakeholders across the risk management system and knowledge disciplines.

Risk assessment and management thus sits at the interface of multiple knowledge domains, values systems, perspectives and institutional responsibilities. It requires a transdisciplinary approach that considers the broad cultural, socio-technological and socioeconomic contexts of the risks, and takes account of behavioural and perceptual aspects. Challenging problems should be catalysts for the development of transdisciplinary teams (including indigenous knowledge holders),²⁰ which offer greater opportunity for introducing evidence from external stakeholders (Ismail-Zadeh et al. 2016). This enhances knowledge production and allows a better conceptualisation of both present and future social, economic, environmental and governance processes relating to risk.

Using formal risk assessment processes in government

Risk assessment is but one of a range of futures-focused tools a government should be using. In essence, a risk register is a transparent and formal mechanism for recording identified risks and possible impacts, alerting those with interests and responsibilities to the need for either preventative or resilience-enhancing measures, and identifying how and by whom a response should be led and

20 The Sendai Framework specifically calls for "the use of traditional, indigenous and local knowledge and practices, as appropriate, to complement scientific knowledge in disaster risk assessment and the development and implementation of policies, strategies, plans and programmes of specific sectors, with a cross-sectoral approach".
<https://sustainabledevelopment.un.org/frameworks/sendaiframework>

managed. It is the processes of preparing and responding to the register that are key to its value. Provided there is a plurality of inputs and expertise in risk analysis; risk registers are very powerful. Indeed, they are the only systematic tool that can provide input to governments in undertaking their most basic of responsibilities: preparing for (and where possible mitigating) risks of events that will harm people, the environment and the economy.

However, it is noted that even with a comprehensive risk assessment, some events cannot be foreseen or cannot be averted – such as a meteor strike. And while many impacts can be mitigated against, this often requires a coordinated, cross-sectoral strategy and understanding across multiple parties. Earthquakes are an example. Before 2011, the potential for significant areas of eastern Christchurch soils to liquify upon ground shaking was already well identified and was the subject of a report to the authorities (Environment Canterbury 2004). This, and the history of multiple episodes of steeple damage to the iconic Anglican Cathedral in the 150 years since it was first built, surely should have pointed out that Christchurch was earthquake-prone (Rice 2010). But this had not stopped planning consents for large-scale housing development in the pre-identified region that ultimately did liquify in response to a rather moderate earthquake. The scientific knowledge had been ignored, and the lack of formal iterative and evaluable processes of hazard and risk identification for Christchurch, in retrospect, contributed to the enormous economic and social costs Christchurch faced. This example highlights the importance of a coordinated understanding of risk (and mitigation actions) across the multiple layers of governance. A risk register in the public domain ensures accessibility and transparency to all stakeholders; a hidden technical report cannot suffice.

HUMAN FACTORS: WHY THE RESISTANCE TO ACTION?

In the private sector, where accountabilities tend to be direct and unavoidable, risk registers are taken very seriously as a core part of corporate governance. But accountability is less clear in the interface between policy agencies and elected ministers. Indeed avoiding responsibility can be an ‘art form’ for the policymakers and politicians. No doubt one of the reasons formal risk analyses are not necessarily popular within these communities is that they make such avoidance much harder.

Resistance to taking expensive action on events that cannot be assured to happen is in fact a recurrent reality within the policy and political processes. Lack of preparedness may stem from the perception that the probability of an event occurring is extremely low, or that the likely time horizon is too distant, giving it low political salience. It may even be believed that mitigation efforts against the potential consequences of an extreme event will be futile (Lee and et al. 2012). The former UK Cabinet Minister and academic Sir Oliver Letwin used a fictional case study of a major space weather event (Letwin 2020) to highlight the bureaucratic and particularly political impediments to crisis preparation for an event that is beyond most peoples’ imagination, and yet has been identified through national risk assessments as inevitable to occur at some point.

Perceptions and biases

There are very big differences in how different people perceive risk (Slovic 1987). Individuals tend to use various heuristics (mental shortcuts) when making judgments about uncertainty, resulting in systematic biases in their assessment, such as overconfidence (see Table 1). Those not immersed in risk analysis or actuarial language will inevitably overlay their perceptions and biases on top of any formal analysis. While risk assessors and scientists may view risk in actuarial terms, most people perceive risk in subjective terms, and respond more to emotional cues than cognitive processes. This can become a recipe for confusion and resistance to using formal mechanisms such as risk registers.

Table 1. Cognitive biases and heuristics that affect human decision-making and risk assessment. Compiled and adapted from (Vlek and Keren 1992, Renn, Klinke et al. 2011, Gluckman and Bardsley 2016, Meyer and Kunreuther 2017, Renn 2017, Klintman 2019)

Bias or heuristic	Description
Availability	The bias of information availability and ease of recall: events that come immediately to people's minds are rated as more probable than events of less personal importance. Similarly, singular events experienced in person are regarded as more typical than information based on frequency of occurrence.
Amnesia	In some ways the opposite of 'availability': this is a tendency to forget too quickly the lessons of past disasters.
Anchoring effect	The tendency towards over-reliance on pre-existing information or the first information encountered when making decisions.
Avoidance of cognitive dissonance	Information that challenges part of a belief system will be either ignored or downplayed.
Confirmation	Evidence is searched for in ways that support existing beliefs, expectations, or desirable outcomes. Reflected in a tendency to accept at face value the conclusions of scientific studies that support prior opinions, and to reject conflicting studies as invalid.
Group think	The tendency to agree with a group opinion to maintain connection and identity with the group.
Herding	The tendency to base choices on the observed actions of others. This is related to group think but less about identifying with a group.
Inertia / status quo bias	In the face of uncertainty (e.g. about the potential benefits of investing in alternative protective measures) we tend to favour inaction over action. Related to loss aversion/ status quo bias.
Judgmental (or hyperbolic) discounting	The tendency to place less value on future risks than current costs and benefits.
Loss aversion	Bias towards avoiding loss leads us to stick with previous decisions – holding onto what we've got and maintaining the status quo rather than risk losing it by trying something new.
Motivated reasoning	Information, evidence or arguments are reframed in ways conducive to an individual's desires, needs, or goals.
Myopia	The tendency to focus on overly short future time horizons when appraising immediate costs and the potential benefits of protective investments.
Optimism	The tendency to underestimate the likelihood that losses will occur from future hazards. Related to the tendency to see familiar patterns and be blind to the unexpected.
Overconfidence	The tendency to overestimate the certainty of one's predictions.
Rational ignorance	The tendency to ignore or deny new information based on active and strategic calculations of the costs and opportunities that additional knowledge would entail, given our fixed goals.
Short-term thinking	Related to judgemental discounting, this is a tendency to focus on the near future at the expense of the long term.
Simplification	The tendency to selectively attend to only a subset of the relevant factors to consider when making choices involving risk.

Common cognitive biases and heuristics generally render actuarial assessments less influential to our decisions around how we view risk. A classic illustration of this was the increase in road traffic deaths in the North East USA in the year after the 9/11 terrorist attacks which destroyed the World Trade Centre. The lay perception was that flying was more dangerous than driving – so much so that more deaths in the 12 months following the attack were due to the shift from flying to driving in the North East USA than due to the terrorist attack itself (Ropeik 2004).

These human responses include tendencies that we all have: (1) to focus on short-term horizons to protect immediate investments and political capital, (2) to forget the lessons of past disasters, and (3) to underestimate losses from future hazards. Procrastination is a human trait that creates a tendency to maintain the *status quo* when there is uncertainty about the potential benefits of investing in alternate protective mechanisms. And as a species, we are good at rewarding people who fix problems but terrible at acknowledging a problem averted. These biases are among several²¹ outlined by Meyer and Kunreuther (Meyer and Kunreuther 2017) in their book “*The Ostrich Paradox*”, where they explore the issues of how people prepare or do not prepare for natural disasters such as hurricanes and other predictable but potentially disastrous events. They point out that while we are continually gaining knowledge and evolving technologies that help illuminate the future – and the potential for things to go wrong – we have not evolved to heed warnings and adequately protect ourselves and our communities. It is also clear that *knowing* of a risk and *doing something about it* are very different cognitive processes (Paton and McClure 2013). The degree to which people perceive issues as critical or relevant for them, and see a need to take action, will depend on more than just awareness of a risk, but will often involve a combination of the above factors. Further, once one has processed and accepted information that a threat is real and requires attention, there may still be a gap between an intention and action.

Policymakers and political decisions makers are affected by the same psychological processes as everyone else. The risk assessment processes described above are designed to overcome such biases. Yet ensuring that these biases do not dampen optimal decision-making remains a challenge at both the evidence-policy and policy-political interfaces. Indeed, risk is generally viewed through a distinctive lens by those facing the ballot box, and political worldviews may shape the policy and political interpretation of the risk landscape. This has been seen explicitly in different political responses to climate change. Similarly, the arguments observed in several jurisdictions over the handling of the COVID-19 pandemic have reflected value judgements being made over the balance between health, safety, individual freedoms, and economics (Coggon 2020).

We must accept that all the actors in the risk management process are human, exhibiting a broad range of psychological barriers and cognitive biases that need to be considered in moving to a more effective system of planning for resilience and mitigation.²² Understanding the ecosystem is critical to facilitating optimal decision-making and action.

POLICY AND POLITICAL DIMENSIONS

The policy community often includes deep domain expertise. It has a critical role to play in identifying gaps in risk assessment, in ensuring expert and pluralistic input, in testing estimates of likelihood and impact, and in identifying resilience-enhancing mitigation efforts. They have responsibilities in both prevention and intervention, and must consider the relative legislative support²³ and the responsibilities by agency, as well as the costs of actions that might be needed. However, determining costs vs benefits

21 Meyers and Kunreuther (2017) named the biases of myopia, amnesia, optimism, inertia, simplification and herding (see Table 1) as the ‘six core biases’ that lead to errors in preparedness for disasters.

22 For example – 20 years of risk perception research were reviewed over 20 years ago (see Boholm, A. (1998). “Comparative studies of risk perception: a review of twenty years of research.” *Journal of Risk Research* 1(2): 135–163.

23 For example – the powers of the Director General of Health needed legislative revision during the COVID-19 pandemic.

of preparing for uncertain but foreseen major events is difficult, because some consequences, such as reduced (or enhanced) social cohesion, psychosocial impacts and other non-economic goods, cannot be assigned a monetary value.²⁴ Policymakers then need to negotiate with the political community to accept the analysis and to make the necessary decisions. As the preceding discussion illustrates, there is a repeated history of failure at various levels in this process.

Knowledge, transparency, trust and accountability

The political process itself is biased away from placing high-impact but uncertain risks prominently on the agenda. In New Zealand, this was demonstrated by successive administrations not releasing a public version of the risk register, even after it was ultimately finalised in 2018. As opposed to suppressing risk analyses, transparency builds confidence and trust and is a general principle of democratic societies.²⁵ Indeed, the COVID-19 pandemic has illustrated the importance and value of trust in government and its officials, gained through transparency and clear communication about risks. Accessible risk analyses give populations comfort that their government is making appropriate preparations for their protection. As the OECD's Global Science Forum makes clear, the science-policy interface is essential, but the science-policy-community 'triangle' has to reflect consistency and accessibility (OECD Global Science Forum 2020).

The lack of endorsement for a formal risk assessment process, or the failure to act on advice of the potential for a major event, are manifestations of government resistance to preparing for HIREs. While the resistance may have many origins, perhaps the biggest and most generic cause relates to accountability. A key reason why government agencies (local and central) do not respond effectively to mitigate identified risks is that they are not held accountable *ex ante* for doing so, and a low frequency risk is likely to be on someone else's watch.

If something is not identified or if responsibilities are not clear, then there can be no accountability, political or otherwise for not preparing for it. Thus 'rational ignorance' is promoted (see Table 1, and Klintman 2019) – that is, it incentivises a psychological response that *it is best not to know*. Indeed, significant policy or political risk can be created if there is a risk register or policy advice noting that there is some likelihood of a high-impact event occurring, and which can be mitigated against by incurring pre-emptive investments, but no action has been taken. In the various Auckland infrastructure failures, it is easy to see the various parties seeking to avoid blame (Orsman 2020).

The consequences of failing to leverage or publicise the multi-year effort to develop a national risk register in New Zealand is that it reduces clarity as to institutional accountabilities. Consciously or not, such action (or more accurately, inaction) downplays the importance of risk assessment and management to protect New Zealand's human and other assets. It reduces the consciousness of the political processes to ensure a holistic all-hazards/all-risk mitigation strategy.

Experience suggests that unless the risk system is well defined and accountabilities are clear, a "whole-of-government" approach soon morphs into a "no-one-in-government" approach. No-one is held accountable, because accountability is amorphous. The types of risks that need to be managed must have specific agencies held explicitly accountable for coordinating mitigation actions, and those accountabilities need to be monitored – again with explicit reporting – by an independent agency (e.g. the Office of the Auditor General). Without these explicit accountabilities and highly transparent public monitoring, there will likely be little action to mitigate many of the risks on any risk register.

A related argument put forward by some is that governments do not want to raise fear in the minds of their citizens. But this is both patronising and illogical – citizens are well aware that bad things happen. Nothing in a risk register has not been illustrated in popular fiction or drama. Citizens understand

24 This is a generic issue in virtually all policy advice.

25 The reported actions of former US President Trump in underplaying the COVID-19 pandemic highlight the consequences of the opposite.

some things must be confidential, but trust and confidence can only be enhanced by citizens having access to the rationale for why governments do some things and not others. Indeed, democracy and social cohesion rely on enhanced transparency between citizens and those who govern. Ultimately, a national risk report both informs the public of the priorities governments have for risk reduction and management, and provides confidence that appropriate precautions are being taken.

Political risk aversion and prioritisation

There are, however, other obvious factors in play. It is inevitable that no matter how great their integrity, political actors will be biased towards putting off until tomorrow whatever can be put off – as in most other policy decisions, the question “Why do it now?” will always be asked. Politically or fiscally, the argument can be made that there will surely be enough time, or a better time, to deal with it later. As addressing electoral risk is usually at the top of the political mind, the obvious preference is to address voters’ immediate concerns, and do what they want *now*, not in the (uncertain) future. This is unfortunately exaggerated by the short nature of New Zealand’s electoral cycles, and is what Letwin terms the “*doctrine of the more pressing question*” (Letwin 2020). Things that almost certainly will not happen today will always be pushed down the policy and political queue in favour of meeting short-term goals. But beyond political timelines, risks also need to be considered against other competing priorities, and against both proximal and distal timelines that do not always intersect in ways that motivate action towards dealing with the identified risks. These various arguments, conscious or not, make it difficult for pre-emptive measures to be acted upon.

Related to this is the distinction between things that are *certain* to happen and those that *might* happen. People typically prioritise the former and push the latter away, even though it is prudent to act now, not later, on the probable. Globally we have seen how this has played out in the COVID-19 pandemic. The cynical might argue cogently that as prevention can get no political credit if it turns out not to be needed, there is little political mileage in being the champion of prevention and resilience. Further, for events with very high impact, it is unlikely that all significant consequences could ever be avoided, so the political system might be blamed in any case for doing an inadequate job – almost inevitably something will not go as predicted. So why take the risk of blame? To again quote Letwin “*there is never forgiveness for a good deed gone wrong*” (Letwin 2020).

Bad things will happen

Events which we have termed HIREs will, by definition will, occur someday, although exactly when is unknown, and it is certain that no matter how they have been prepared for, they will evolve differently than anticipated. Sometimes a risk may have been identified, but preparations have been made for a less severe occurrence because the ‘worst-case scenario’ has been disregarded. Hurricane Katrina in New Orleans in 2005 and the Tōhoku earthquake and tsunami (and Fukushima nuclear disaster) in Japan in 2011 are examples where preparations were made for significantly smaller-scale events, despite warnings that a larger event was possible, in fact inevitable, in both cases (Reed and Wilson 2004, Acton and Hibbs 2012). The preparation across most countries related to pandemics was similarly much less than what was needed, although an event of the magnitude of COVID-19 was well-predicted by the expert community.

Of course, it is always difficult to correctly project the specific characteristics of a crisis situation before it occurs. In fact, surprise is a defining element of crises – hazardous events don’t escalate to crises unless they come at a time or intensity beyond the expectations of those charged with managing the risk. Even when risks are identified and assessed systematically, and even if certain types of events can be prepared for, there will always be gaps between the desired state of preventive measures and reality. There is always an issue of ‘known unknowns’ – the fact that we know in advance that we don’t (and can’t) know everything, and that some risks will not be identified in the right way.

Prior to COVID-19, New Zealand had a pandemic management plan, but it was based on assuming that the most likely event would be pandemic influenza, despite the many other zoonoses that have emerged in the last two decades globally. The characteristics of influenza are sufficiently different from the novel coronavirus that New Zealand, like most other countries, found itself inadequately prepared. In fact, much of the early responses to COVID-19 across the world were biased by the expectation that the virus would either behave like a classic influenza virus or like the SARS virus. Both scenarios were wrong, but it led many countries to underestimate the urgency and severity of the threat, and to use strategies such as promoting herd immunity, which in retrospect were disadvantageous and have had tragic consequences. This highlights that strategic risk management is more than extrapolating into the future with a few scenario variations – it must include contingency plans and a capacity for adaptive policies and action.

Similarly, while the New Zealand Security and Intelligence Service was well aware of the risk of terrorism, it focused its mitigation efforts on threats of Islamic radicalism. It did not sufficiently consider the risk of white nationalism that drove the March 15 2019 Christchurch terrorist massacre. According to the Royal Commission of Inquiry into the terrorist attack (Royal Commission of Inquiry 2020), this was partly due to a lack of capacity in the system. But there was also a failure of cross-sector communication and engagement between public sector agencies involved in counter-terrorism efforts and anticipatory planning. Before the attack the terrorist threat-scape in New Zealand was considered relatively benign, and was not high on the list of national security and intelligence priorities. There was also limited social licence for intelligence and security activities in this area.²⁶

These examples again highlight that risk governance involves many non-governmental actors and requires expert input, and most of the major risks we face are embedded in the larger context of psychological and societal perceptions and processes (Renn, Klinke et al. 2011).

Institutional challenges

One challenge for government risk management is capacity-building and maintaining institutional memory around certain types of risk. In the absence of a structured risk-learning environment, it is typical for the responsibility to fall to strong personalities to drive through risk assessment-related work programmes in particular areas, rather than strengthening the system to coordinate and ensure this work across all of government. The resultant danger is that when these effective personalities move on, the work suffers. Combatting this relies on providing a defined whole-of-government budget and an enduring process for risk assessment.

Indeed it is clear that some broad institutional challenges to risk governance remain, and this is even more critical with regard to newly identified classes of risk – especially those associated with technological development and environmental degradation. There are risks of declining trust and social cohesion affecting democracies worldwide. Epistemic threats (where knowledge is not understood, used or manipulated) are rising and challenging horizontal and vertical trust in society, to the point of threatening democratic processes and values.

These issues highlight the need for effective anticipatory processes and futures thinking within the policy and academic communities. There are many tools available to assist, (Government Office for Science 2017) but New Zealand generally uses such tools inadequately relative to many countries. This reflects the general short-termism that dominates the policy community and within New Zealand society. The cultural paradigm, at least in Pākehā²⁷ society, has been one of “*she’ll be right*” – namely that we will

26 The Royal Commission report stated that “by the middle of the last decade, the subjects of counter-terrorism, intelligence and security had become politically and publicly toxic. There was little political ownership. Public sector leadership was fragmented through a decentralised national security system with the Public sector agencies involved in the counter-terrorism effort acting in ways that were only loosely co-ordinated.”

27 Pākehā is the term used in New Zealand to refer to non-indigenous peoples – generally those of European origin. The indigenous Māori community have a much stronger commitment to intergenerational thinking.

address a problem only after it emerges. Given the ambiguities discussed above, and the potential for avoidance of accountability, consideration should be given for establishing a more independent system, for example through a parliamentary commission such as the Office of the Auditor General.

LEARNING LESSONS

Achieving stability after a crisis involves drawing lessons from what has happened – and doing the work to ensure the public understands that learning is indeed happening, and that it involves them as well. The system as a whole needs to learn in order to increase resilience. Mistakes, missed signals, political failure, and system failure may be identified. But *post-hoc* assessment in the wake of a crisis is complicated by the challenges of accountability and attribution played out in the public domain. Attribution of blame or responsibility typically extends to the public sector and politics, stirs emotions, and affects how people interact with those involved in preparing for or managing the event. It also can hinder the ability to understand what actually went wrong or what could have been done better.

Nonetheless, it is essential that debriefs are held, that there are lessons learned and incorporated into revisions of risk analyses, communication and preparation. Developing mitigation plans for HIREs is complicated by their speculative nature – and also the fact that they have the potential to cause disruption that is outside normal/known experience. Individuals, with or without expertise, may fail to give weight to what seem like highly improbable events or may have an aversion to provide information for a decision if they feel uncertain about the evidence. Some risks fall between traditional boundaries of expertise, or are interconnected in complex ways that are only revealed in a crisis, so there is a need to canvass a broad range of experts and think systemically about these cascading risks in order to build resilience to them.

Indeed, one of the risks we face is epistemic risk²⁸ – which is essentially a risk that arises from not understanding the risks we face. This leads to wrong decisions being made, including doing nothing. Policymakers need confidence in the process of risk assessment in order to make decisions, but risk assessors face a significant challenge in establishing a threshold for epistemic risk that does not generate undesirable or unintended consequences. Overcoming this requires a transparent and honest assessment of the “extent of our ignorance” (Sahlin and Persson 1994).

Practise, practise, practise

Even in some countries that diligently compile risk registers, little is done to practise scenarios, and little investment is made to avert the risks. This could be countered by encouraging cross-party support for regular mandatory exercises to plan for and run scenarios on the top risks on the register, and to spend a designated budget annually on preparing for (and mitigating, where possible), the major long-term risks. Ideally, this would involve collaboration with relevant international governments (e.g. Australia) in risk preparedness, mitigation and scenario-practice where appropriate.

Wide-ranging scenario exercises can help prepare relevant actors to deal with the heat of a crisis, when decision-making is urgent. Experts, policy advisors and government must interact closely, but have different responsibilities and perspectives. The ability to stand back and assess the situation can be compromised by real or perceived pressure to make rapid decisions based on limited or siloed information. There is much to learn from the military in the concept of red teams as an alternate form of analysis, both in planning and in response management (Zenko 2015, Seger et al. 2020). The process of red-teaming involves standing up senior experts – who have access to all the data but are not involved in the management or accountability stream – and having them peer review decisions in real time. A red team can offer insights and suggest scenarios to think about, depending on different possible decision paths. In response mode, this heightens public confidence, especially in circumstances where full transparency is not possible.

28 Epistemic risk should be distinguished from epistemic threats – the former is about lack of understanding or uncertainty in our knowledge about the hazards, the latter is about manipulation of knowledge for adversarial purposes.

Improving the process

Lessons can be learned from failure, both our own and that of others. The Blackett Review of high-impact, low-probability risks, (Government Office for Science 2011) published in 2011, and a Chatham House report of 2012, drawing lessons from the Eyjafjallajökull eruption (Lee and et al. 2012), both provide recommendations that remain valid today. Critically, trust and transparency in the processes of risk assessment and management need to be continually assured, to in turn support continual improvement in resilience-enhancing behaviours.

Central to this is political recognition that risk assessment is a core obligation of all governments, but one that must occur through an apolitical process.²⁹ This may require establishing a coordinating body shielded from political interference. We have suggested that in New Zealand, the Office of the Auditor General (which reports to Parliament and not the Executive) might be the most appropriate body. Further improving trust and transparency in risk assessments and investment decisions requires:

1. That risk assessments must be ongoing and involving a broad range of expertise (external to government) to inform risk assumptions and consider emergent risk;
2. That the process is able to navigate conflicting interests and cognitive biases in the face of uncertainty;
3. That the assessments help facilitate policy and investment decision-making for promoting resilience and mitigating risk, which is particularly challenging in the evaluation of high-impact, low-probability risks versus other risks; and
4. That the mechanisms for risk identification, crisis preparation and response are transparent to all stakeholders, not least the public.

It is critical that those concerned with risk management understand that it is important not merely to identify risks, but also to enhance anticipatory and adaptive capacities by identifying and gaming the *plausible* – not just the *probable*. Creating robust processes for resilience to future risks thus involves:

1. Stress-testing risk mechanisms – governments working with industry bodies and safety regulators to test risk management practices in critical infrastructure sectors;
2. Undertaking exercises on risk scenarios to enhance preparedness for the unexpected;
3. Greater use of ‘red teams’ in both risk assessment and crisis response;
4. Identifying risk mitigation goals and metrics of movement towards those goals,³⁰ and continually reviewing mechanisms for assessing the effectiveness of risk mitigation strategies; and
5. Promoting anticipatory and futures-focused thinking.

Ultimately, improving risk communication and engagement between the public, the private sector, the policy community, and the expert community is critical. All these groups need to learn to understand their own biases in how they approach risk and take action to mitigate it or prevent it from eventuating. Good risk communication promotes critique and self-correction, includes and accounts for a wide range of sources of evidence, and acknowledges the limits of our knowledge.

New participatory and deliberative democracy tools may be part of the answer for engaging all stakeholders. Such tools can engender trust by opening deliberative discussion on citizens’ views of what of value is at risk, so they can see that things they care about are also driving the risk assessment and mitigation, and the associated investment. This can help both to support investment in risk prevention and engender behavioural change, thereby enhancing resilience.

²⁹ Despite the imperative for the risk assessment process to be apolitical, the response to that assessment will involve the political processes, as it is inherently a matter of values judgements.

³⁰ Politicians should be able to claim (show) some progress towards the goals. This allows them some protection, showing that they have taken action, while not being responsible to reach the impossible of an absolute response. Each administration should be taking measurable steps in the right direction to achieve the goal of better asset protection using an all-risk approach.

CONCLUSION

All governments need to manage risk first through good risk identification and assessment. They also need to invest adequately and pre-emptively in enhancing resilience and in mitigating events that may cause severe impacts, and that are sufficiently likely to happen at some point. Such risk assessments must be ongoing and comprehensive, avoiding siloed approaches. Judgement will always be needed about which risks and which impacts to address, but avoidance by denial or ignorance is not an appropriate approach.

While such attention to crisis anticipation and management is a critical role of government, too often known risks are not addressed with preventive measures to guard against events turning into crises. When this involves truly existential risks, such as climate change, cataclysmic technological threats and biological threats, the decisions that are made today will profoundly affect future generations (Pamlin and Armstrong 2015).

Politicians, policymakers and experts need to be better aligned to deal with complex, high-impact risks. The starting point must be a willingness to overcome biases, avoid rational ignorance, accept accountabilities, and ultimately to consider the probability that something bad might occur sooner than one might hope. Governments need to review their risk management strategies and investments in risk prevention/mitigation on an ongoing basis, drawing on a wide range of expertise. They must reduce the ambiguities that surround accountabilities for risk assessment. And decision makers must understand the values involved in order to act in full knowledge and awareness of stakeholder views.

A risk assessment process removed from political interference, and a regularly reviewed national risk register and public report, can inform national emergency planning and public awareness for preparedness, vulnerability reduction and resilience. Developing risk register scenarios can provide a framework for appreciating the trade-offs fundamental to long-term choice. This can serve to open the minds of decision makers so they pay attention to novel, less comfortable, weaker signals of change and prepare for the possibility of discontinuity and surprise. Updating the register outside of political cycles allows government to see realities that might otherwise be dismissed or overlooked, and publishing an accessible version for the public can similarly raise awareness. All actors, including local bodies, NGOs and the private sector need to understand what the government sees as important, and how they can play their role in risk mitigation.

It is a fundamental function of Government to act as the insurer of last resort, no matter what the timescale. Therefore there needs to be a systemic entrenchment of risk assessment and management over a wider timescale that transcends political timelines and whichever party holds the Treasury benches at any one point in time.

ACKNOWLEDGEMENTS

We thank senior members of the New Zealand Department of Prime Minister and Cabinet for their critical input. We thank Sir Oliver Letwin (UK) for discussions and his review of an earlier draft. We also thank the following reviewers for insightful comments on the penultimate draft:

Bapon Fakhruddin – Tonkin + Taylor NZ

Mark Ferguson – Science Foundation Ireland

Arthur Grimes – Victoria University of Wellington

Peter Ho – Centre for Strategic Futures, Singapore

Alik Ismail-Zadeh – Karlsruhe Institute of Technology, Germany

Sarb Johal – Independent psychologist in disaster recovery, NZ

Matthias Kaiser – University of Bergen, Norway

Randolph Kent – King's College London

David Mair – Joint Research Centre of the European Commission

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APPENDIX

Hazard types, sources and examples of events that can lead to disasters.

Hazard type	Hazard source	Hazard event (examples)
Natural hazards – meteorological	Atmospheric, hydrological or oceanographic origin – relating to weather and climate, and the resulting distribution of water resources.	<ul style="list-style-type: none"> • Severe storms/hurricanes/cyclones • Flooding • Coastal storm surge/coastal inundation • Drought • Heatwave • Wildfire
Natural hazards – geological	Earth’s geophysical processes (e.g. seismic and volcanic activity).	<ul style="list-style-type: none"> • Earthquake • Volcanic eruption • Major/multiple landslides • Tsunami
Natural hazards – extraterrestrial	Hazards originating outside of Earth (e.g. solar activity).	<ul style="list-style-type: none"> • Space weather event on Earth (solar flare, geomagnetic storm) • Meteor or asteroid strike
Environmental hazards	Degradation of natural systems and ecosystem services (air quality, water quality, land degradation, biodiversity loss); often accelerated by human activity.	<ul style="list-style-type: none"> • Ecosystem collapse / habitat loss leading to loss of valued food source • Climate change tipping point breached
Biological hazards	Hazards of organic origin (e.g. pathogenic microorganisms [bacteria, viruses], natural toxins, bioactive substances, parasites, animal vectors of disease, plant and animal diseases.	<ul style="list-style-type: none"> • Pandemic • Large scale food-safety incident • Major biosecurity incursion affecting agriculture or aquaculture
Technological	Hazards originating from technological or industrial conditions, dangerous procedures, infrastructure failures or specific human activities.	<ul style="list-style-type: none"> • Power grid failure • Large-scale industrial accident • Nuclear accident • Chemical spill
Malicious threats	Human actions causing harm intentionally or in the course of promoting own interests, including epistemic threats.	<ul style="list-style-type: none"> • Terrorism • Espionage and foreign interference • Major cyber incident • Maritime security threat • Disinformation campaign affecting social cohesion



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THANK YOU TO OUR SPONSORS

Anita Baldauf

David Levene Foundation

Norman Barry Foundation

The Tindall Foundation

Andrew and Elle Grant

The Gluckman Family

Kelliher Trust

Robert Lerner, Modena Trust

Bernard Sabrier

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