

Extreme weather events:

How hard lessons strengthen resilience
against the next big event



Disasters have much in common besides the devastation of lives and property they leave behind. They all teach some of the same hard lessons, whether the destruction comes from floods, fires, windstorms or other events.

Those lessons are as valuable as they are difficult for disaster risk management professionals, making it urgent to use them to better prepare for the possibility of the next big event. Learning what went well and what didn't is a particularly helpful exercise at a time when businesses, their employees and communities face the growing likelihood that they will be touched by some form of disaster. In fact, the World Economic Forum's Global Risk Report 2018 ranks extreme weather events as the No. 1 global risk in terms of likelihood and second in terms of impact.

But uncovering what went wrong isn't enough. Once an honest assessment of how the event was managed has been completed, the lessons that have been revealed must be turned into action.

Relying on years of first-hand experience and extensive research, Zurich has brought to light a number of lessons that can be used to prepare for any sort of calamity in virtually any part of the world. Using its Post-Event Review Capability (PERC) methodology, the insurer is able to illustrate strikingly similar challenges faced by risk managers regardless of where they operate or the particular hazards they face.



PERC = Post-Event Review Capability

Why is PERC needed?

PERC studies provide guidance at a time when the number of disasters and their magnitude are growing at an unprecedented rate. While there has been a decline in disaster mortality (in relative terms) over the last decade, in most places there has not been significant success in halting the substantial increase in economic losses. There are profound knock-on effects to economic growth and development as well as to the general well-being of society.

Several of the studies reviewed the science on the increasing frequency and severity of climate hazards, especially extreme precipitation and storm surges. Future climate scenarios were laid out in PERC studies on European floods and across all the studies it was learned that if a certain level of protection is to be maintained (e.g. a 1-in-100-year flood, equal to the 1% annual probability), relying on historical data is not enough. Hazards change and planning must take this into account.



Extreme weather events



The **top** global risk in terms of likelihood and **second** in terms of impact.



World Economic Forum's Global Risks Report 2018

PERC's Cumulative Key Findings

Zurich's PERC analysis of global disasters left no doubt that disaster risk management professionals all face several universal truths when it comes to attitudes and actions around preparing for and responding to natural hazards. The research clearly shows that:

- Disaster risk management is playing catch-up to an increasingly larger exposure to natural hazards.
- Globally, spending on response is far greater than investment in pre-emptive risk reduction strategies. Where money is invested on prevention, it typically goes to protecting physical structures rather than more cost-effective risk management such as environmental planning.
- Infrastructure protection already in place – levees, for example – can produce a false sense of security.
- Few incentives exist to encourage “building back better” and including resilience into the rebuilding process.
- The neediest in society are often neglected before and after disasters.

Why and how PERC helps

PERC studies can be carried out by businesses affected by disasters or with help from an insurer or other business partner. The studies can offer guidance on how to create resilient facilities and plans that protect employees and property while strengthening business continuity planning, including that for related critical supply chains.

While the 12 PERC studies carried out by Zurich focused on flood events holistically, the methodology is applicable to other hazards or other focus points (i.e. individual facilities or businesses) and the lessons gleaned from the work apply to any organization with an interest in strengthening its disaster risk management approach.

An in-depth PERC study focuses on the resilience of people, supply chains, systems, legal and cultural norms before, during and

after a disaster. It examines the various steps of the disaster risk management cycle. PERC findings then create an analysis of what happened and why at a holistic, i.e. event or watershed, level. In particular, the PERC analysis takes a close look at:

- Attempts to manage and mitigate disaster risk
- How organizations and communities respond immediately after an event to protect lives and property
- What is done to aid recovery, including actions to help people cope with the impacts of the disaster, restore services and support reconstruction efforts
- Critical gaps and opportunities, particularly actionable opportunities to reduce risk and build long-term resilience.

In this report, risk managers and other risk professionals will learn how to address many of the challenges they encounter in preparing for and responding to disasters. It shows how PERC studies help mine lessons from disasters and put them to use in making businesses and other organizations more resilient against future events.

Zurich knows that prevention is a better risk management strategy than recovery alone. By putting to work these lessons condensed from PERC analyses of a dozen disasters across the globe, along with advice on business continuity planning, organizations will not only reduce their exposure to disastrous events but will also be more resilient in the face of such potential shocks.

PERC report (from June 2013 to June 2018)	Country(ies)
Central European floods, 2013: A retrospective	Germany (focus), Austria, Czech Republic, Switzerland
Floods in Boulder, 2013: A study of resilience	United States
After the storm: How the UK's flood defenses performed during the surge following Xaver in 2013	United Kingdom
Balkan floods of 2014: Challenges facing flood resilience in a former war zone	Bosnia and Herzegovina, Serbia, Croatia
Emmental, Switzerland floods of 2014: On a hot, sunny day, a flood alert!	Switzerland
Urgent case for recovery: What we can learn from the Karnali River Floods in Nepal, 2014	Nepal
Morocco floods of 2014: What we can learn from Guelmim and Sidi Ifni	Morocco
Columbia and Charleston floods, South Carolina, 2015	United States
Cumbria, 2015	United Kingdom
Flash Floods 2016	Germany
Peru 2016	Peru
Peru coastal floods 2017	Peru
Houston, 2017 (To be released on June 21)	US

Table 1: Zurich PERCs conducted 2013–2018

Putting PERC's key findings into practice before the disaster



Rather than relying too heavily on disaster response, the PERC studies show that a better approach involves preventing the build-up of assets in high-hazard areas. The studies revealed, however, that there is little evidence that disaster risk is considered in most investment decision-making and land-use planning that could result in an accumulation of assets. For example, the PERC analysis of 2014 flooding in Nepal revealed that the risk of increased flooding from a planned hydropower plant had not been taken into consideration. In Germany, where flash floods caused heavy damage in 2016, the country experienced difficulties in controlling building in unmapped flood hazard zones.

PERC studies make clear that it is vital for companies to understand their supply chain vulnerabilities and interconnected risks. Floods in Thailand in 2011, which inundated thousands of square miles, swamping huge industrial estates where multinationals produced a variety of goods, brought down entire supply chains of companies that relied on electronic components and automobile parts. The disaster rippled through the global economy and provided powerful lessons on the necessity of supply chain contingency planning.

It is crucial to understand potential single points of failure within a supply chain. Even at the product design stage, it is important to consider the suppliers and supplies at risk and whether a concentration of exposure is created in a particular area. For example, the failure of an electrical substation as a result of floods could impact a number of key facilities, as seen in the German and the UK floods.

In cases where there is a window of opportunity just before an event, (hurricanes and some flood types), the preparedness and early-action parts of business contingency plans can provide for movable assets to be relocated.



Zurich's post-event investigations show that just a few hours' warning is enough to move a significant portion of a company's assets to safer ground. Key to making such efforts work is a contingency and emergency plan that is triggered as soon as warnings indicate an event is likely to occur and one that carefully outlines how and where to move assets.

A contingency and emergency plan can also help protect a company's financial results. It may, for example, allow for securing inventory following a disaster quicker than a competitor can do so.

Planning is a sound investment

The payoff for such planning was evident when Cyclone Xaver in 2013 battered the flood defenses that had been installed on Zurich's recommendations at an assisted living facility in the United Kingdom. A flood emergency and contingency plan was triggered before the storm arrived, allowing residents to remain upstairs on the property. Critical equipment was moved out of harm's way, significantly reducing property losses and system down time.

Apart from the social benefits of allowing residents to remain on the property, an estimated USD 10,100 invested in flood defenses and costs for the contingency plan yielded savings of around USD 135,500. The value of the approach is stark when compared to a similar operation in the same neighborhood that was exposed without a contingency plan and suffered a shutdown and costly clean-up and recovery expenses.

Context of the UK example

USD 10,100 invested in flood defenses
= USD 135,500 savings

Early warnings and awareness are effective

PERC studies also show that early warning systems save lives. The presence of a system alone, however, is not enough to ensure that it will function as it should. It must be structured to properly consider the threat of disaster and be quickly and efficiently communicated to those in harm's way.

While strong flood defenses paid off for some in the U.K., poorly designed and maintained levees and ineffective warning systems in Balkan and Moroccan floods in 2014 left trusting but unsuspecting populations exposed to devastation. Trust in levees had also backfired in low-lying areas of Germany and Austria where residents were lulled into a false sense of security only to be shocked when they suffered severe flooding.

Community engagement and inclusion of vulnerable groups is essential to building strong disaster risk management awareness and planning. For example, a PERC study on flooding in central Europe revealed that the implementation and success of retention spaces is dependent on a community's agreement that they be developed. Without community involvement, such preventive measures are difficult or impossible to implement.

Businesses, large and small, are urged to stress employee preparedness at home as well as on the job to ensure that they remain safe and are able to continue working remotely if possible. Raising employee awareness a day or two prior to an event by asking about stockpiles of food, backup power or lodging and the security of key documents can potentially lower losses and hasten a return to work.

Some companies, such as Houston-based technology services firm IronEdge Group, make preparedness a part of business as usual. IronEdge incorporates "disaster recovery" days on a regular basis into their daily routines. Leadership will spontaneously announce drills – "It's flooding today, work from home" – to practice employee readiness for the real thing. The drills reveal whether workers are prepared to work remotely by taking home laptops and other necessary equipment. When preparedness becomes routine, employees will be able to comfortably maintain key business operations during a disaster.

Risk reduction as a result of post-event lessons can pay off in a big way, as Bombardier learned in 2013 after its Bautzen, Germany plant was inundated by floodwaters three years earlier.

In 2010, the company suffered heavy losses at its light-rail plant when the Spree River broke its banks and swamped the surrounding area. Around 90% of the plant was flooded, with water as high as five feet in some places. Extensive damage to the plant included the destruction of high-precision equipment used to make light-rail vehicles and a number of vehicles under construction were scrapped. The loss amounted to USD 155 million.

Not long after the floodwaters receded, Bombardier, with help from Zurich's risk engineering experts and others, began making changes to protect against heavy losses should a similar event occur. In 2013, it did, with disastrous flooding that took lives and caused billions of dollars in property damage.

This time, the plant was spared, with the water held back by fortifications that included retention walls and flood banks constructed in the wake of the 2010 flood. Three years after a huge loss from a very similar event, Bombardier's loss amounted to zero.



Putting PERC's key findings into practice after disaster strikes



Supporting the local community

One of the central lessons that emerged from the PERC studies is that successful response operations are mostly reliant on institutions. That means businesses, whether affected or not by a disaster, have a support role to play in their communities.

Providing equipment, access to food and showers, covering hotel room costs, assisting with cleanup and offering paid time off for employees can go a long way towards supporting a community and creating a culture of assistance.

Businesses should account for this type of support as part of their continuity and preparedness planning so that financial resources are available and help can be provided as quickly as possible.

PERCs also highlighted significant concerns about the potential disincentive for undertaking risk reduction in those cases when government fully reimburses recovery costs (a problem also known as a "moral hazard"). In situations where ex-post government indemnification is made available even to those who could have but did not choose to buy financial flood protection such as insurance, it is very difficult to motivate citizens to take preventive action.

Financial resilience includes insurance coverage

Proper insurance coverage will speed recovery, providing funds quickly to aid in rebuilding. Among the options available to businesses, multi-hazard policies can be particularly effective, providing coverage for damages from floods, fires, sewage backup and other hazards. Failure to have adequate coverage in place could lead to problems that would cripple businesses. Losses could include not just damage to property but the potential cost of being unable to operate for weeks or months while repairs are underway.

Insurance protection is one part of financial resilience that companies must consider before they are touched by a disaster. Just as important is retaining a customer or supplier base that will continue to buy or supply products and maintain an income stream. Without a plan to continue at least partial operations, re-attracting clients will be difficult and lost revenues impossible to make up quickly.

It is worth noting that there has been criticism about the role of insurance as a risk management strategy for natural hazards. As pointed out in the research "*Paul O'Hare et al.: Insurance as maladaptation: Resilience and the 'business as usual' paradox.* *Environment and Planning C: Government and Policy 2015*",

insurance as a strategy of risk management emphasizes peace of mind, financial compensation and swift restoration to business as usual. Yet, even as it accomplishes these important objectives, insurance can actually serve to embed risky behavior and inhibit change after disasters.

The research notes that insurance can dampen the incentive to manage disaster risk if it is written to return a business or organization to the status quo and does not encourage behavior that would better mitigate the exposure.

Building back better?

The phrase "building back better" has become a staple of the disaster risk management community. Common sense dictates that rebuilding to the same level of risk after a disaster would be futile and a wasted opportunity to strengthen resilience. But even as that notion is well understood, achieving it is not without challenges.

PERC studies recommend that "building back better" should be a general part of risk management strategy. That way, a desire to be up and running quickly and minimize business interruption does not get in the way of a recovery that will ensure facilities are strengthened before they are reopened.

Additional PERC key findings that need attention

Many of the PERC studies, particularly those that focused on developing countries, highlighted the imbalance between the investing of resources into disaster prevention versus amounts allocated to response. Individuals, businesses, communities, civil society organizations and governments all suffer from disincentives which lead to a lack of investment in pre-event risk reduction. There can, for example, be water management policies in place that can prevent effective flood management around the use of dams and water release. Correcting these disincentives requires many stakeholders to tackle the problem together.

The vulnerability of critical infrastructure needs to play a more prominent role

PERC studies on floods in central Europe, the Balkans, Nepal and Morocco describe worrisome circumstances where such vulnerabilities were ignored and the results were devastating. In Morocco, roads were built by dry stream beds and were destroyed by flooding. In the Balkan floods, an inundated power station resulted in hundreds of thousands of households being left without electricity during the disaster.

The German federal railway, Deutsche Bahn, noted in its 2013 annual report that “especially as a result of the floods in

Germany” its business operating profit fell by USD 35.3 million.

A critical rail line between Hanover and Berlin was flooded near Stendal, causing a 3.1 mile section to remain closed for around five months. The flooding caused significant delays for the 10,000 people who traveled daily on the Hanover-Berlin line and some rapid city-to-city rail services were canceled, including those serving Wolfsburg where Volkswagen is headquartered.

Rail traffic was strained by trains that were rerouted while a bridge was closed and only an emergency operation by the German army kept the transformer station serving the railway’s electricity grid from flooding, which would have worsened the disaster. Deutsche Bahn has said it believes some passengers may never return to the rail system after finding other means of transportation during the flooding and subsequent recovery.

The German government provided around USD 118 million to Deutsche Bahn through 2015 to cover the cost of repairing infrastructure, including railway stations.

Such cascading failures can send shock waves through local economies. It is key that in advance of a disaster, consideration has been made for the interaction of various infrastructure assets such as gas, electricity and transport.

Disasters do not respect jurisdictional boundaries. That means coordination between governments is essential. There are success stories, such as the one revealed by a PERC study of flooding in the Balkans in 2014. Response was well coordinated within Serbia, which has a relatively strong central government. By contrast, Bosnia and Herzegovina suffered from strong internal divisions that led to a far less efficient response.

A lack of cross-jurisdictional coordination is not only inefficient, it can also significantly hamper efforts to enhance disaster resilience.

The first line of defense to prevent environmental disasters should be planning and regulations. The use of environmental planning techniques to manage flood waters, for example, by such measures as reforestation in upper watersheds and static or controlled water retention areas, has been shown to be highly effective. The PERC study on European floods in 2013 bear this out with its focus on the role of park-like areas in Germany and Austria that serve to reduce flooding while providing recreational facilities at other times.

Reforestation was shown by a PERC study on the floods in Morocco to be an important action aimed at building resilience in areas where physical defenses have not been as effective as they could be because of a lack of such green infrastructure initiatives.

Event-return language is widely misunderstood and can lead to complacency and surprise when disasters occur. A common and potentially devastating misunderstanding can be seen in the often-heard statement: “Since there was a 1-in-100 year event five years ago, there will not be another of that magnitude for 95 years.”

Disaster risk should instead be communicated in terms of probability – instead of referring to a “1-in-100-year event,” one should say an event has “a 1 percent chance of occurring each year.” Furthermore, it should be stressed how devastating an event would be if it does occur.

The PERC studies found a striking need for improved forecasting. Meteorological and hydrological forecasting related to the central European floods was found to be lacking, while in Nepal and Morocco even modest improvements in rainfall observation and runoff measurement data would provide significant benefits.



Flood damage near Stendal, Germany

Conclusion

Developing a resilience strategy – what to consider

In developing a natural hazards resilience strategy, a meticulous check of data quality should precede the conventional risk management approach of a catastrophe modeling analysis. Special attention should be given to location (preferably latitude and longitude, rather than address) and age of the site. A hazard assessment, using global hazard maps, and a deterministic scenario-based approach may be used for those regions and perils not covered by the catastrophe models.

Besides information pertaining to accumulated annual loss, exceedance occurrence probability and other parameters used to design an insurance policy, high-risk single locations as well as concentrations of locations that could potentially be impacted by a single event should be identified.

Prioritization of these locations for the next step of the resilience strategy is based on the definition of “critical” in the organization. For example, “critical” may designate a location or region that fulfills one or more of the following criteria:

- **High concentration of values at one location**
- **Long replacement time for equipment or stock at a location**

- **The location is a significant contributor to the group value chain or revenue**
- **Large concentration of occupants**
- **A large area around the site could be impacted environmentally**
- **Multiple locations could be impacted by a single event**

Such a review and analysis pertains to operations or locations within the stakeholder’s own responsibility. Ideally, suppliers and critical infrastructure would be included in the analysis.

Insurance and resilience

For those locations defined as critical, a deterministic scenario-based loss estimate should be developed, based on detailed information regarding site vulnerabilities both physical and organizational. Such an analysis is an essential component of the resilience strategy and would include an onsite assessment of the reliability and effectiveness of emergency response and business continuity plans, any peril-specific protection measures (seismic gas shut-off valves, mobile flood protection elements, etc.), quality of structures and other assessments.

While the information from a deterministic analysis does not provide detailed probabilistic information, it does define the measures to be implemented to reduce the severity of an event. In other words, the resilience strategy will include insurance, which supports the site in restoring operations after the event and the physical and organizational measures that reduce the impact of an event on the locations. With this information in hand, a medium- to long-term resilience strategy can be developed in which budgeting for capital expenditure projects (structural strengthening, flood protection measures), as well as reallocation of existing budget to such areas a maintenance of drainage systems, expert inspection of roofing systems, can be defined.

Catastrophe modeling plays a key role in strengthening resilience. By quantifying catastrophe risk with sophisticated models, Zurich gives businesses a better understanding of how they could be impacted by extreme weather events and provide capacity in line with risk appetite. The models provide an answer for extreme events that may not be in the historical record and are the basis to run what-if scenarios in the face of a changing climate.

Summary of risk management recommendations



1. Focus on prevention as a more effective risk management approach than recovery. Preparing for disasters by reducing the exposure while developing strong response and building continuity plans makes businesses more resilient to the threat of potential shocks.



4. Review insurance coverage. Proper multi-hazard coverage will speed recovery and allow businesses to be up and running faster, which means retaining a customer base rather than re-attracting one.



2. Understand high-value supply chain vulnerabilities and interconnected risks. In managing these risks, companies lessen the chance that a disaster will cause unexpected ripple effects that could shut down operations.



5. Conduct a post-event review if disaster strikes. Lessons from what worked and what didn’t will better prepare the organization for the next disaster, should it occur.



3. Stress employee preparedness at work and home. This ensures employees remain safe and are in a position to help keep the business running from a remote location if needed.

Company toolkit

Good News: the PERC approach is available to all organizations

The PERC methodology was specifically designed to turn the lessons learned from the consequences of disasters into actions that help businesses and communities become more resilient and recover quickly from devastating events. It is not enough to understand the dynamics of disaster risk and resilience, including what went wrong and what worked well, but that is the necessary first step.

PERCs are carried out relatively quickly and inexpensively, which means they are available while attention is still focused on questions around disaster risk, decisions are being made on reconstruction and disaster policies are being closely revisited.

As new information and insights into disaster risk and resilience become available, the PERC approach can be

easily adapted. Its flexibility allows it to be used for a wide range of scenarios while sticking to the core fundamentals of the approach. For example, there are opportunities for retrospective PERCs conducted remotely, mini-PERCs focusing on specific questions and PERCs that examine multiple events. While work so far has focused mostly on floods, the methodology can be applied to other hazards.

Zurich encourages all interested parties to apply the methodology and contribute to the repository of freely available material on success and insights from around the world. PERC studies and a manual that serves as a guide for conducting PERCs are available at <https://www.zurich.com/en/corporate-responsibility/flood-resilience/learning-from-post-flood-events>

How to conduct a PERC

Businesses and organizations that want to conduct a PERC on their own should start by conducting a desk review in order to get an overview of what has happened and where.

With the overview in hand, it is important to visit the affected area and speak with those who were involved in the disaster. Doing so provides a level of context, information and understanding that would be otherwise nearly impossible to obtain.

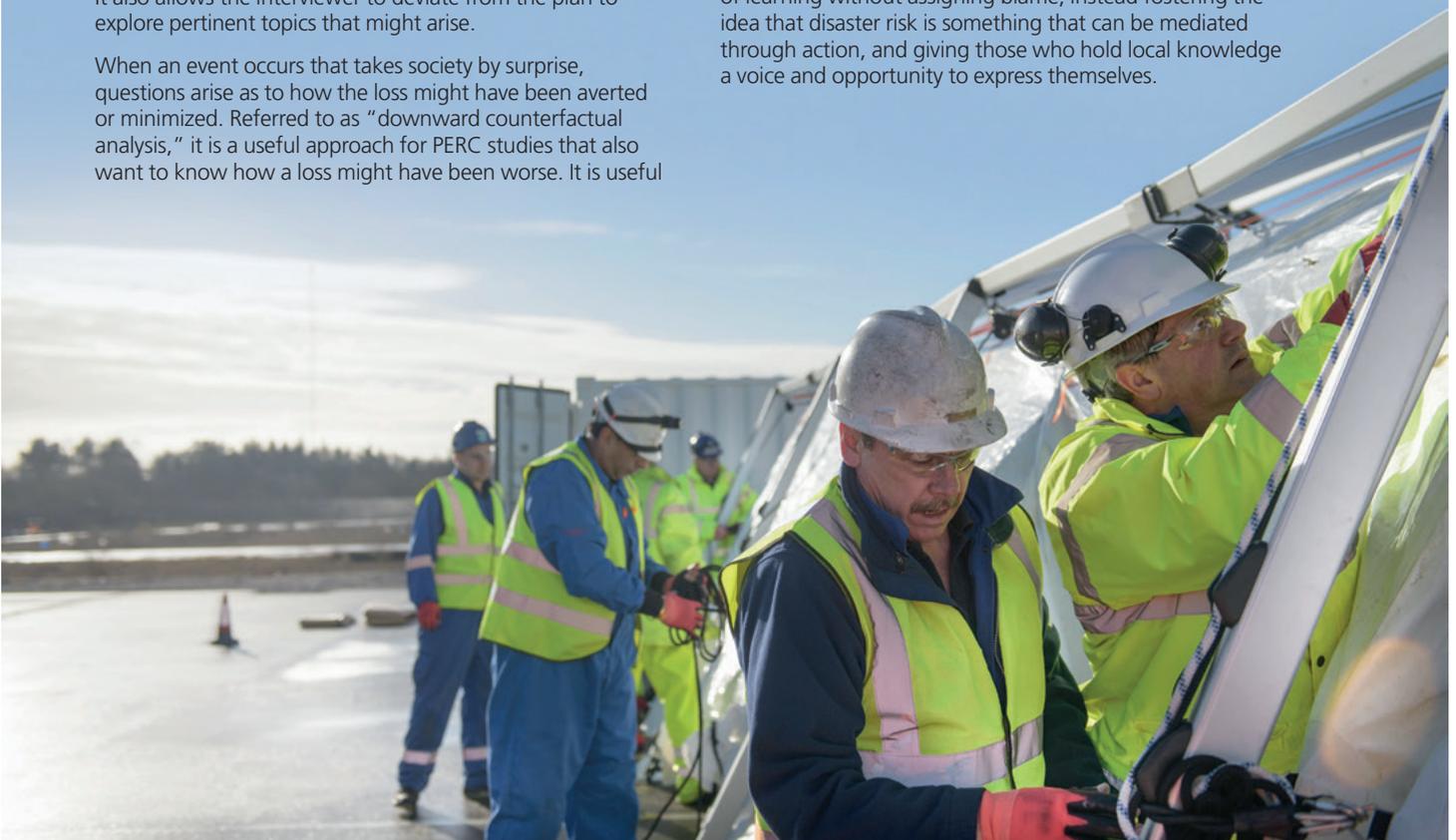
Interviews form the backbone of the PERC. The methodology uses a semi-structured interview process. Unlike formal interviews, which follow a rigid format of set questions, semi-structured interviews focus on specific themes, covering them in a conversational style. The loose format prompts interviewees to provide valuable information and stories that may not be anticipated by the PERC team. It also allows the interviewer to deviate from the plan to explore pertinent topics that might arise.

When an event occurs that takes society by surprise, questions arise as to how the loss might have been averted or minimized. Referred to as “downward counterfactual analysis,” it is a useful approach for PERC studies that also want to know how a loss might have been worse. It is useful

in providing insurers and risk managers with the ability to search for and analyze data that may be missed by traditional real-world event research. Such data can help identify unlikely but possible events.

Ideally, a PERC study should be conducted after the disaster response phase is over and during the recovery phase, but not so late that the momentum created by the disaster is lost. The PERC framework is not a linear process; rather, its structure helps identify and understand the different components that create a complex system and how these different components interact to generate outcomes. Conducting PERC studies means critically reflecting on information and responses from interviews and sorting them according to PERC’s logical framework.

It is important to note that this process promotes the notion of learning without assigning blame, instead fostering the idea that disaster risk is something that can be mediated through action, and giving those who hold local knowledge a voice and opportunity to express themselves.



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