

Risk Management

Preventing the unlikely event
that could destroy your business

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Preventing the unlikely event that could destroy your business

Even the unexpected requires rigor commensurate with its impact

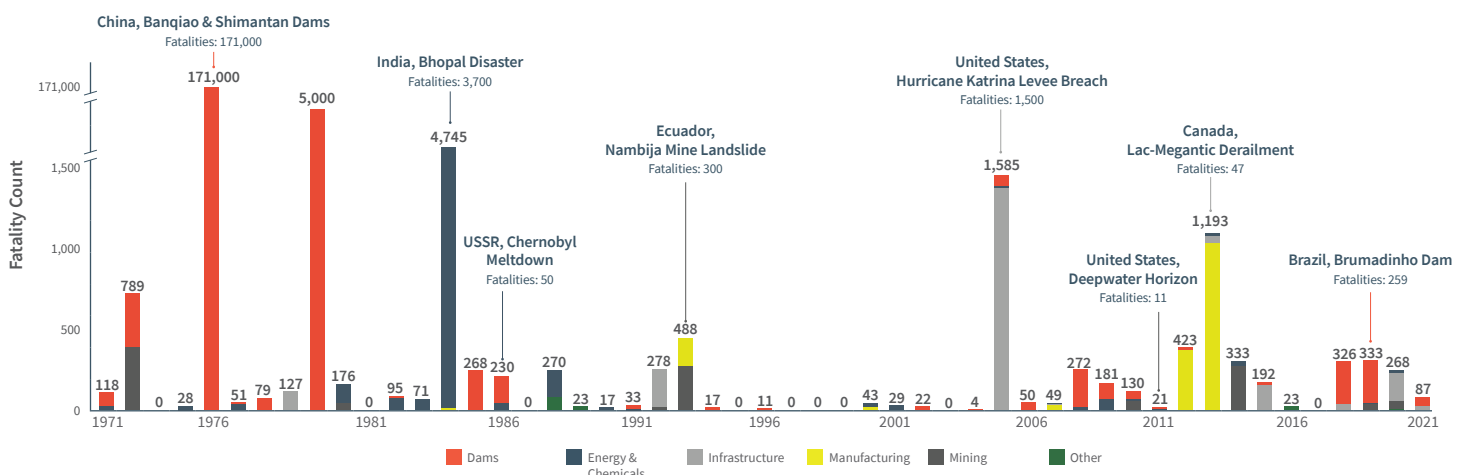
While most firms find it difficult to prepare for high impact, low likelihood events, COVID-19 shows that even rare events such as a global pandemic can occur suddenly and wreak havoc. Similarly, the pandemic has shown that, while actions such as lockdowns, government stimulus, and vaccines can mitigate the impact of a catastrophic event, implementing barriers that once seemed onerous to prevent an incident from occurring can be time and money well spent.

Traditional risk management approaches consider the intersection of impact and likelihood to arrive at an overall risk rating. Applied across the range of risks applicable to a given company or asset, this rating is generally used to prioritize risk mitigation; sorting the list from highest to lowest provides a simplistic way to determine where to start to focus risk management effort. Though this is a reasonable approach, it contains inherent deficiencies that necessitate assessing risks from a different perspective: ignoring likelihood and only considering impact.

High impact, low likelihood events such as pandemics are common in each of Hatch's three sectors: Metals, Energy, and Infrastructure. Continuous improvements in regulations and occupational health and safety practices have led to decreasing lost time incidents. Yet measured by fatalities, catastrophic events show no such pattern of decline; fatalities during the 2010s in Hatch's catastrophic events database outweigh those in each of the previous three decades.

While the possibility of a catastrophic event occurring can rarely be eliminated, many companies are taking steps to minimize risk exposure by reducing both the likelihood and impact of what could otherwise cripple or even destroy their business. Corporate executives are taking notice too. In 2011, an earthquake and tsunami caused a series of meltdowns at Tokyo Electric Power Company's Fukushima Daiichi nuclear power plant. Five years later, three of the company's executives were indicted for criminal negligence causing death. Though all three were found not guilty, the verdict wasn't reached until eight years after the accident. In 2013, the Australian state of Queensland redefined corporate directors' liability to include instances where executives fail to take all reasonable steps to prevent over one hundred offenses including public, environmental, and heritage protection.

Beyond its legal responsibility, it's in every firm's interest to prevent such events. A catastrophic event impacts a company's global reputation (reports of such events are rarely confined to the local media) and its social license to operate. As more firms seek to identify and control catastrophic risks, they're realizing they need to look beyond having the best procedures. They must also examine the intermingling influences of design, change management, and their organization's structure on the risk posed by catastrophic events that could adversely impact their businesses.



Risk identification

How do you identify the risks that could impact your dynamic business?

The first challenge companies face in addressing catastrophic risks is identifying them. A corporate team can be influenced by personal biases when addressing risks. Humans inevitably draw on their life experiences creates bias when contemplating what's possible in the future. One's past is a poor guide when trying to discern all possible catastrophic events, not to mention the failure modes that could lead to those events. Thankfully most people haven't experienced even a single catastrophic event in their lifetime, and certainly no one has experienced every possible one. To overcome such biases and other impediments to comprehensive risk identification, companies can turn to history to see the catastrophic events that have occurred at similar operations in the past.

After identifying the risks, firms must identify the root cause(s) of the material unwanted event (MUE). Preventive barriers must be put in place to reduce the likelihood of an event occurring. In 2013, for example, an unattended freight train carrying crude oil rolled down a hill and derailed in Lac-Mégantic, Québec. The accident caused an explosion and fire that killed forty-seven people and destroyed more than thirty buildings. This MUE would not have occurred if the train had been parked on a rail siding with a derailer to prevent it from rolling off the siding and down the track.

Even the best preventive barriers should be supported by mitigating ones. If every possible effort is made to prevent an MUE and it occurs for reasons unforeseen, mitigations that reduce the impact of the MUE can be the difference between an unfortunate event and a catastrophic one.

For example, ensuring that local emergency responders are trained to handle crude oil-fueled fires can ensure a prompt, effective response.

If a company can successfully identify its catastrophic risks and determine the best controls (neither of which are certainties) these can be “baked-in” through risk-focused asset and system design. Where this isn't possible, procedures, the weakest barrier, can be implemented to establish critical preventive and mitigating barriers.

But what happens when there is a change?

Even the best barrier can be confounded by the ever-changing nature of any business. To completely address any risk, companies must consider the whole life cycle of their assets; from design, through construction, into operations, to decommissioning, and ending in the case of some assets with post-closure monitoring. Effective barriers, developed at the project stage, must be maintained until the complete elimination of a risk; some risks, such as tailings dam failures, persist well beyond the operating life of an asset. This requires comprehensive change management.

What about organizations that aren't operating at the highest level? Companies with governance shortfalls that enable adherence to procedures to lapse or changes to occur without consideration for their prospective impact will struggle to control their greatest risks, and leave their business, their people, and the environment exposed to their greatest hazards.



The Lac-Mégantic disaster

How an untrained third-party was able to disable a non-redundant critical control

One of the worst rail disasters in Canadian history occurred in the early morning of July 6, 2013. At around 1:15 a.m., an unmanned train, transporting seventy-two tankers filled with crude oil, derailed and crashed in the downtown area of Lac-Mégantic, a small town in Québec. The train, which was traveling at more than 100 km/h when it crashed, quickly burst into flames causing explosions that killed forty-seven people and resulted in the evacuation of more than 2,000 residents from their homes.

The train was left unattended for the evening and parked on a downward slope in Nantes (about 10 km northwest of Lac-Mégantic). The train engineer in charge failed to apply a sufficient number of handbrakes prior to leaving the train unattended, trusting that the air braking system, maintained by the locomotive's engine, would keep the train from moving.

A small fire broke out on the train's main locomotive at approximately 11:50 p.m. that same evening. Firefighters responded to the call, put out the fire, and turned off the locomotive's engine, which shut down the compressor for the air brake system. This meant the train's air brakes were no longer working, and the handbrakes alone couldn't stop the train from freely travelling down the sloped track toward Lac-Mégantic.

The derailment led to changes in rail transport safety rules and legal action against the company and employees involved in the incident.



Risk ratings and their inherent deficiency

Why risks must be also viewed through an impact-only lens to protect your business

A traditional risk matrix will treat an almost certain, minor impact event with the same urgency as an unlikely, severe impact event. Both are not only high risks, but also score a risk rating of ten when their impact and likelihood scores are multiplied. But do these two events represent an equal risk to the business?

		Impact				
		1. Negligible	2. Minor	3. Moderate	4. Major	5. Severe
Likelihood	5. Almost Certain	Medium	High	High	Very High	Very High
	4. Likely	Medium	Medium	High	High	Very High
	3. Possible	Low	Medium	Medium	High	High
	2. Unlikely	Low	Low	Medium	Medium	High
	1. Rare	Low	Low	Medium	Medium	High

Traditional risk matrix

In standard practice, impact and likelihood ratings are multiplied together to achieve an overall score. Even when the guidance given to risk workshop participants is typical, the non-linear nature of potential impacts means the long tail of rare to possible severe events (i.e., unlikely likelihood 2, impact 5, score of 10) is treated with the same urgency as an almost certain first aid (likelihood 5, impact 2, score of 10). Both must be addressed, but the devastating impact of a severe event is not captured by this approach. Multiple fatalities, severe asset and environmental destruction, and other events on the “shut-down-the-business” scale should not be considered 2.5 times more impactful on a business than a first aid event.

Likelihood ratings are equally non-linear, and determination of appropriate ratings often suffers from many of the biases described later in this report. Without proper quantitative data and expert guidance to support likelihood ratings, it’s very difficult to differentiate between

events that have a 1% chance of occurring and those that have a 5% chance. These likelihood percentages are often the guidance for rare and unlikely events, respectively.

In a multi-asset organization, implementing a standardized risk approach can help corporate directors understand the relative magnitude of risks at each asset in their portfolio. As a company acquires or develops more assets, the risk of a major failure at each asset remains the same, but the likelihood of occurrence for each event common across assets rapidly increases. A one in one-hundred-year event should occur on average once every ten years in a group of ten similar assets. This makes corporate level risk management critical. No executive should be comfortable expecting a severe event every ten years. Severe impact events must be controlled regardless of likelihood, and this requires a different approach than the traditional risk matrix.

Risk management terminology

Refamiliarize yourself with some of the nuanced terminology of risk management

Hazard: Anything with the potential for harm in the context of people, assets, or the environment. A hazard is typically any energy source or toxin that, if released in an unplanned way, can cause damage.

Risk: A potential occurrence that could cause loss or injury. The magnitude of a risk is usually measured by the combination of its likelihood and impact.

Material unwanted event: An event in which the potential impact is large enough to warrant the highest level of attention (e.g., a fatality or massive financial loss).

Critical control: A barrier that's crucial to preventing the event or mitigating the consequences of an event. The absence or failure of a critical control would significantly increase the risk despite the likely existence of the other controls.

Prevention barrier: A barrier that reduces the likelihood of an unwanted event occurring.

Mitigating barrier: A barrier that eliminates or reduces the consequences of the unwanted event.

Bow-tie diagram: An analytical method for identifying and reviewing controls intended to prevent or mitigate a specific unwanted event.

Reliability: The degree to which the result of a measurement, calculation, or specification can be depended on to be accurate.

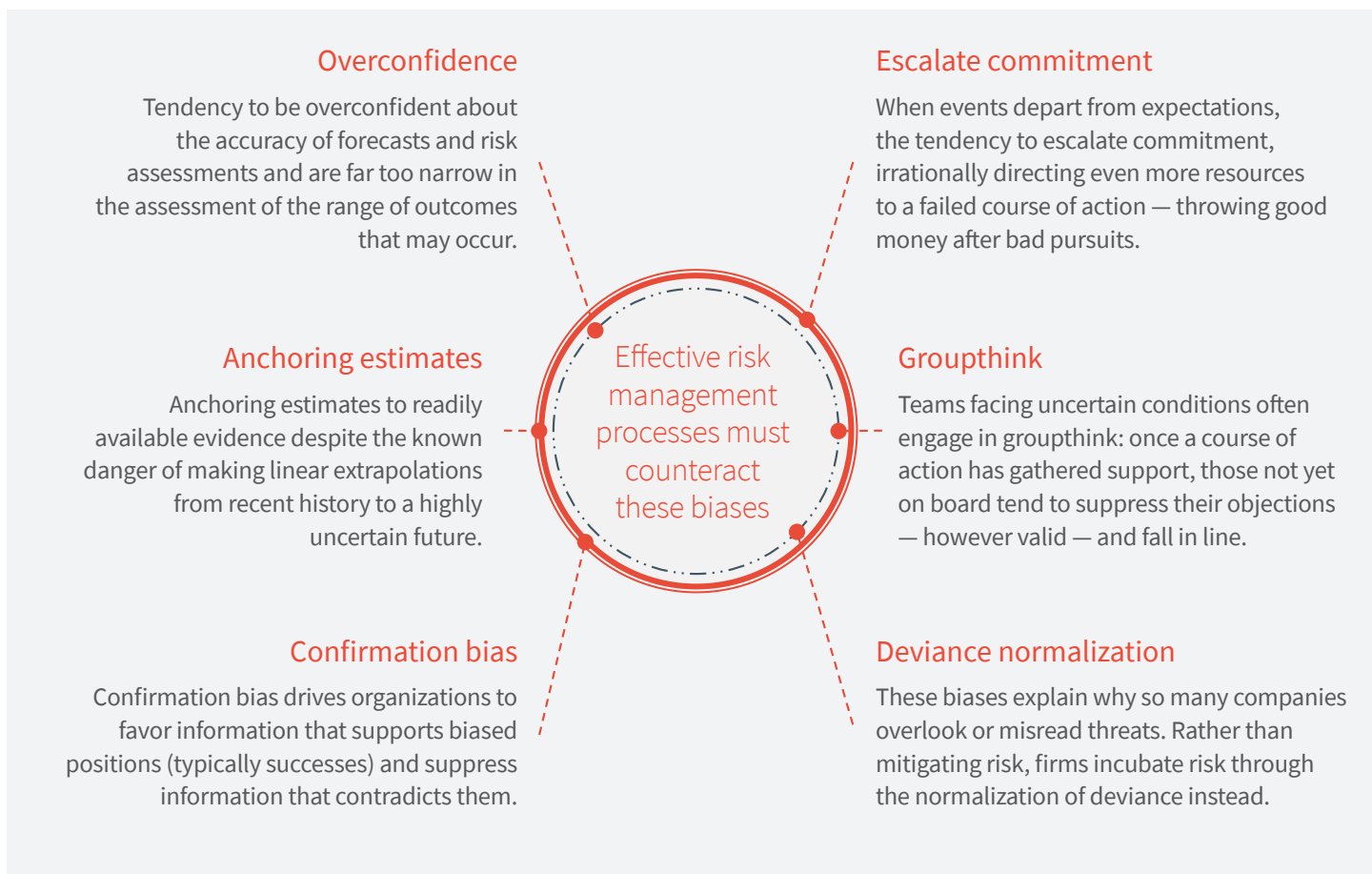
Failure tree analysis: A deductive procedure that uses a graphical tree diagram to describe how combinations of events can cause unwanted events. Failure tree diagrams incorporate symbols for both events and gates. Gates are depicted with Boolean logic symbols, which describe how events passing through a gate can combine to produce the top level, materially unwanted event.



Counteracting risk bias

Risks are difficult to address due our inherent biases; to effectively manage risks, organizations must identify and counteract these biases

Everyone struggles with their own biases when discussing risks. At a minimum, it's helpful to be aware of some of the most common risk management biases, but even better is actively seeking to counteract them.



When seeking to identify risks, industry-wide datasets covering periods of years, or better yet decades, can be useful in counteracting confirmation bias, anchoring, and overconfidence by providing an unbiased dataset against which to challenge views of likelihood. If the same catastrophic event happened to your three biggest competitors in the last ten years, thinking it less than 1% likely in a given year needs to be re-evaluated. These can also be useful to identify risks; what may be unthinkable to you could have already happened in your industry.

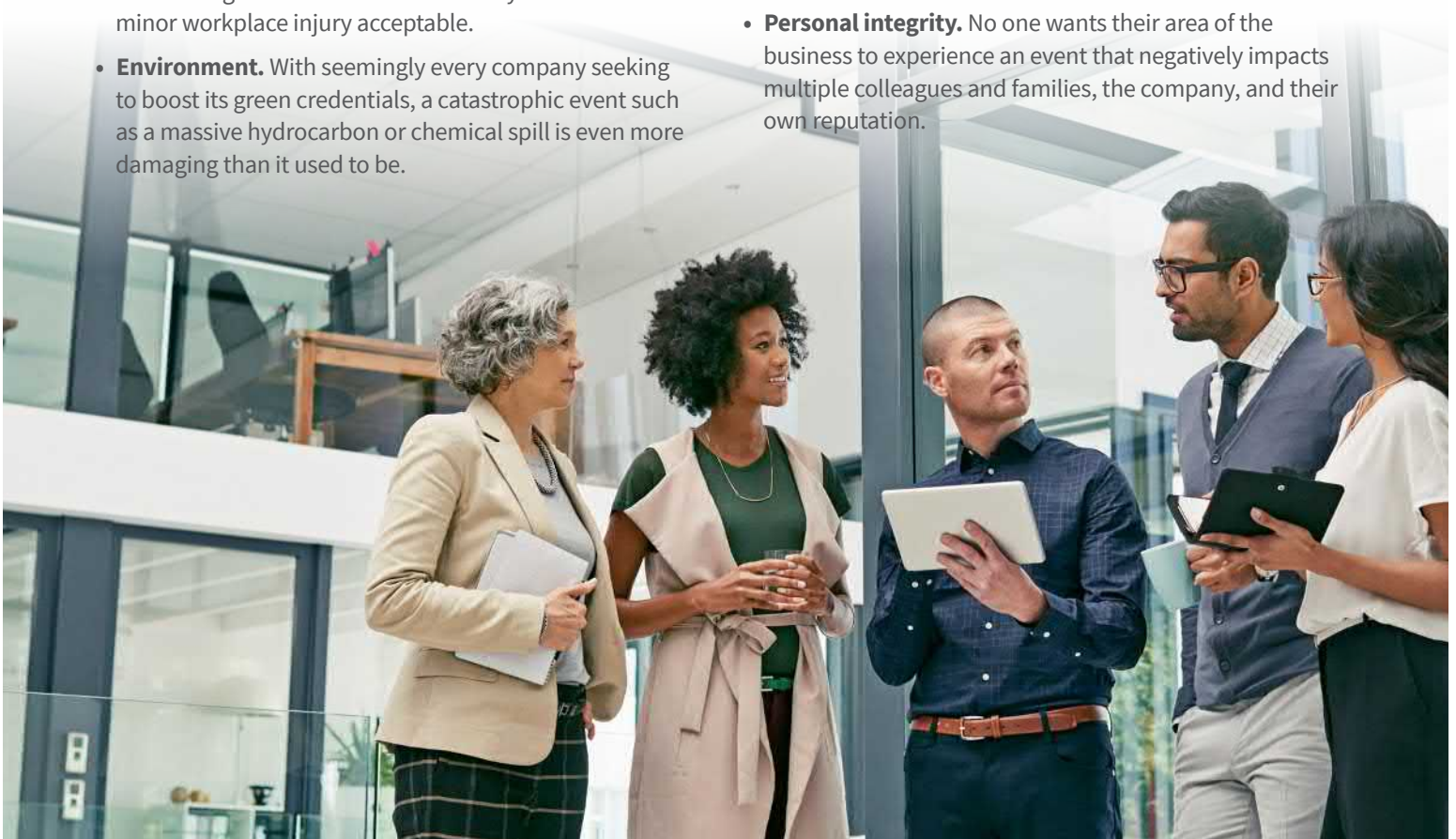
Groupthink can be countered in several different ways. Individual questionnaires prior to a risk workshop can elicit a broader range of responses than asking the same question of the same group in a meeting. Coaching senior leaders to respond last in a group discussion, and asking the most junior to respond first, can prevent everyone falling in line with the boss. Bringing an independent voice to the discussion, either from outside the department or outside the firm, can provide a new perspective. If prepared to play the role, an outside voice can play devil's advocate, and work against a wide range of biases.

Common motivations to focus on catastrophic risks

Why businesses (should) care about effectively managing catastrophic risks

There are numerous reasons businesses need to address catastrophic risks within their organization. Here are some of the most common we hear from clients:

- **Reputation and license to operate.** Some large companies can survive the reputational impact of a catastrophic event in their business, but many won't. A small company that causes catastrophic environmental damage is likely to see its license revoked, and local opposition can prevent it from ever being reinstated. Companies that rely on project finance to develop new assets may find their tattered reputation means bank debt is no longer an option.
- **Health & safety.** Sadly, there was a time when workplace injuries and even fatalities were commonplace, but no one leading a successful business today considers even a minor workplace injury acceptable.
- **Environment.** With seemingly every company seeking to boost its green credentials, a catastrophic event such as a massive hydrocarbon or chemical spill is even more damaging than it used to be.
- **Financial health.** A significant catastrophic event will typically involve asset damage, which is costly to repair, and can even prevent an asset from generating revenue. Companies can face additional financial hurdles depending on the nature of the event; damage to the environment, third-party property and loss of life can all result in fines and lawsuits.
- **Criminal prosecution.** Less often spoken about directly, concern about the criminal prosecution of executives can be inferred from conversations about catastrophic events (e.g., catastrophic tailings dam failures).
- **Operational performance.** Units and businesses with top performing safety organizations are often top performing financial businesses too. Strong risk management can be an indicator of strong team performance.
- **Personal integrity.** No one wants their area of the business to experience an event that negatively impacts multiple colleagues and families, the company, and their own reputation.



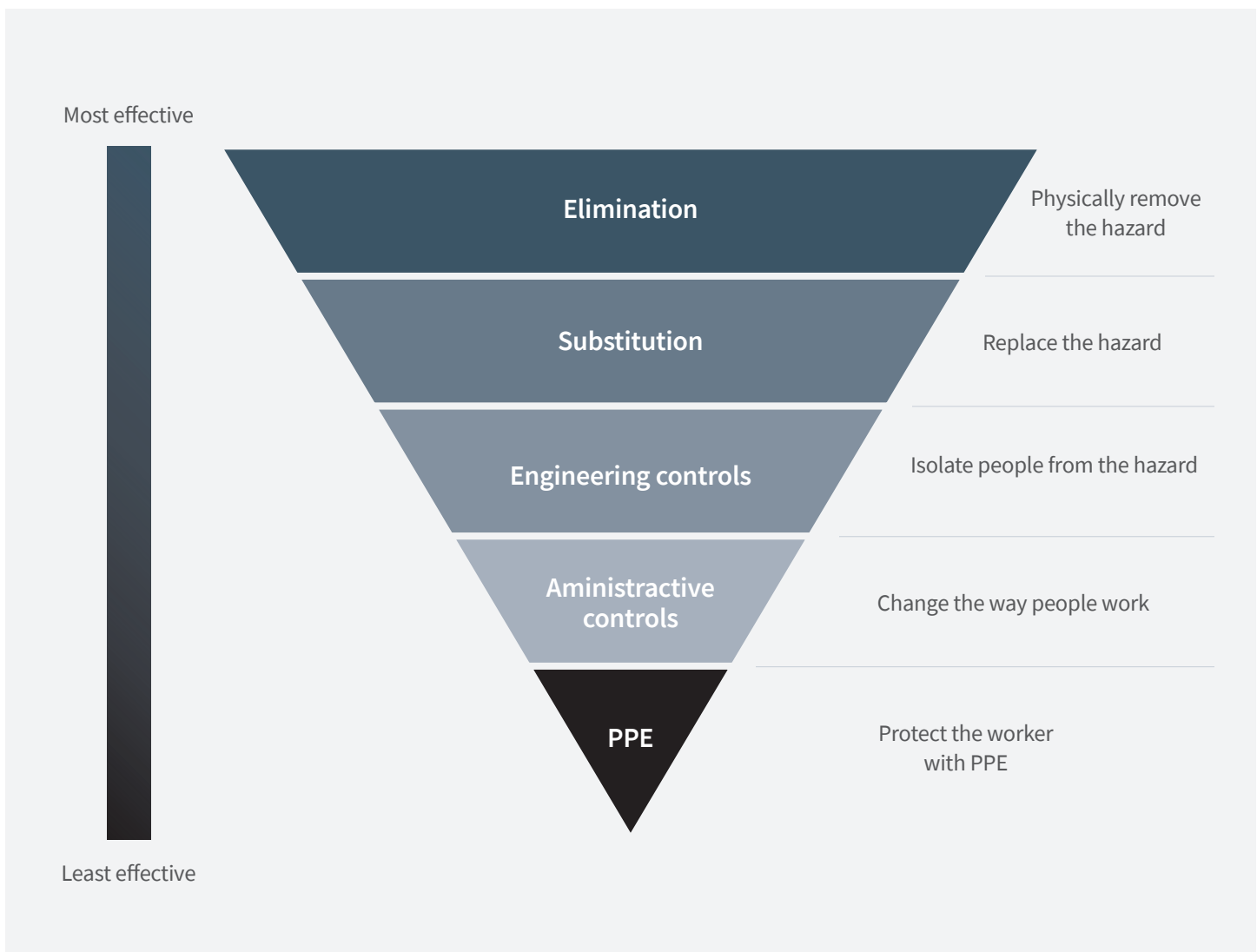
Hierarchy of controls

What to take away from this concept, and what not to

The hierarchy of controls is a common risk management concept, first developed by the United States National Institute for Occupational Safety and Health. Often represented by an inverted pyramid, from top to bottom it describes the most to least effective hazard controls. Naturally, eliminating a hazard is the most effective control, while Personal Protection Equipment (PPE) is the least. The challenge presented by this hierarchy is that in most existing assets, and often even those that only exist

on paper, elimination and substitution are difficult to impossible. This does not mean they shouldn't always be considered first, just that you will often be left relying on the least effective controls.

When discussing the hierarchy, ensure that no one on your team looks at the pyramid and decides that PPE isn't important because its least effective. You don't drive without your seatbelt because it isn't as effective at keeping you safe from a car crash as not driving at all.



Get a customized approach

Effectively controlling risk in industry, where no asset is the same, cannot be done through regulatory compliance alone

The improvement in workplace health and safety, and environmental performance that has happened over the last fifty years has been substantial. In the United States, the frequency of workplace injuries and illnesses in 2019 was 25% of what it was in 1972.¹ During the same period, reporting has also likely improved dramatically, suggesting an even larger improvement in national performance than statistics suggest.

Much of this improvement has occurred through enhanced safety standards, enforcement, and compliance. To understand the safety zeitgeist in the US workplace in 1972, consider the following. It had only been four years since the first federal law requiring all vehicles other than buses have seat belts, and it would be another twelve years before the state of New York made wearing seat belts mandatory. This incremental improvement in legislation, enforcement, and public compliance (who would ever consider driving a car without a seatbelt in the 2020s?) has greatly reduced US motor vehicle deaths per mile travelled; a 75% reduction over the last fifty years.

Yet legislation and standardization have their limits in an industrial setting. Cars are mass-produced to exacting standards to be used in the relatively controlled circumstances of onroad driving. Taking the same approach to standards or procedures is certainly useful, and can cover most situations, but not always the most catastrophic ones. A risk management approach that considers exclusive reliance on local standards or regulations to be sufficient is missing the mark. General regulations will not cover all the unique aspects of your bespoke assets.

An approach following the United States Occupational Safety and Health Administration's process safety management (PSM) guidelines is useful for industries beyond those that deal with hazardous chemicals, the industries for which the guidelines were first intended. PSM focuses on the use of procedures, technology, and management practices to prevent material unwanted events. Such an approach starts with seeking to understand all the hazards present, and the potential failures and impacts that lead to an uncontrolled hazard. Through this process, hazards present in your unique situation can be identified, along with the specific controls you have in place. Critically, it includes the concept of fault tree analysis, which can be expanded to a bow-tie analysis, useful for documenting preventative and mitigation barriers, and the procedures and individuals responsible for their maintenance. This approach, when supported by technical expertise in the underlying processes, is the most effective way to identify, prevent, and mitigate material unwanted events.



¹ United States Department of Labor, Occupational Safety and Health Administration, "Commonly Used Statistics", 2021, <https://www.osha.gov/data/commonstats>

How to get started

Identifying the biggest risks to your business is the first step to controlling them

To begin to control all the risks at your business, not just the catastrophic ones, the foundation must be compliance with all permits and regulations. In regions with laxer regulations, adherence to the most stringent global regulations should be part of the approach. To identify the hazards that permit compliance and regulation adherence don't address, it can help to look at history: both yours and your industry's. However, the best approach will include a deep understanding of the science behind the underlying hazards in your business.

A firm with dedication to incident reporting will sometimes see the leading indicators of a catastrophic event in their incident register. High-risk events must be reviewed to understand what additional preventative or mitigating barriers can be employed, and if the ones in place responded as expected. A look at the industry's largest failures can be a source of MUEs to be addressed at your own operation.

When starting a capital project, consider the potential material unwanted events in your design, and design in barriers that are hard to remove. Placing distance between hazards and people is cheapest and most effective when done at the outset. Not placing a walkway near a hazard is far more effective than cordoning it off with a thin chain that is easily stepped over.

Ensure that when working to identify, and ultimately control, the catastrophic risks in your business, you deploy the best team to address your firm's most critical task. To uncover the material unwanted events in the design and operation of your asset that aren't controlled by your procedures, consider employing those with experience in the design and operation of similar assets. Any outside team reviewing risks and controls will need to build a strong working relationship with the team managing those risks. A team of credible experts will find it easier to build that relationship.

How Hatch can help

Get real results, faster

We bring over sixty-five years of innovation and award-winning excellence in project and operational expertise to provide you with evidence-based advisory services that are effective and reliable. Using our blend of deep technical, social, environmental, and business expertise, we advise clients on a wide range of projects across the metals, energy, and infrastructure sectors to unlock greater value. When we combine world-class engineers and digital experts with management consultants and industry insiders, real innovation and action happens.

As we transition from the pandemic into a period of global growth, operators and investors will be faced with a plethora of opportunity and risk. Hatch can help bring clarity to what is sure to be a transformative decade.

Talk to our experts today.



About Hatch

Whatever our clients envision, our engineers can design and build. With over six decades of business and technical experience in the mining, energy, and infrastructure sectors, we know your business and understand that your challenges are changing rapidly.

We respond quickly with solutions that are smarter, more efficient, and innovative. We draw upon our 9,000 staff with experience in over 150 countries to challenge the status quo and create positive change for our clients, our employees, and the communities we serve.

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Ryan is Principal in Hatch's global head office near Toronto, Canada. He is currently leading a catastrophic risk management program for a large, global, diversified commodities firm.