How to Avoid Catastrophe

Failures happen. But if you pay attention to near misses, you can predict and prevent crises.

by Catherine H. Tinsley, Robin L. Dillon, and Peter M. Madsen

MOST PEOPLE THINK OF “near misses” as harrowing close calls that could have been a lot worse—when a firefighter escapes a burning building moments before it collapses, or when a tornado miraculously veers away from a town in its path. Events like these are rare narrow escapes that leave us shaken and looking for lessons.

But there’s another class of near misses, ones that are much more common and pernicious. These are the often unremarked small failures that permeate day-to-day business but cause no immediate harm. People are hardwired to misinterpret or ignore the warnings embedded in these failures, and so they often go unexamined or, perversely, are seen as signs that systems are resilient and things are going well. Yet these seemingly innocuous events are often harbingers; if conditions shift slightly, or if luck does not intervene, a crisis erupts.

Consider the BP Gulf oil rig disaster. As a case study in the anatomy of near misses and the consequences of misreading them, it’s close to perfect. In April 2010, a gas blowout occurred during the cementing of the Deepwater Horizon well. The blowout ignited, killing 11 people, sinking the rig, and triggering a massive underwater
spill that would take months to contain. Numerous poor decisions and dangerous conditions contributed to the disaster: Drillers had used too few centralizers to position the pipe, the lubricating “drilling mud” was removed too early, managers had misinterpreted vital test results that would have confirmed that hydrocarbons were seeping from the well. In addition, BP relied on an older version of a complex fail-safe device called a blowout preventer that had a notoriously spotty track record.

Why did Transocean (the rig’s owner), BP executives, rig managers, and the drilling crew overlook the warning signs, even though the well had been plagued by technical problems all along (crew members called it “the well from hell”)? We believe that the stakeholders were lulled into complacency by a catalog of previous near misses in the industry—successful outcomes in which luck played a key role in averting disaster. Increasing numbers of ultradeep wells were being drilled, but significant oil spills or fatalities were extremely rare. And many Gulf of Mexico wells had suffered minor blowouts during cementing (dozens of them in the past two decades); however, in each case chance factors—favorable wind direction, no one welding near the leak at the time, for instance—helped prevent an explosion. Each near miss, rather than raise alarms and prompt investigations, was taken as an indication that existing methods and safety procedures worked.

For the past seven years, we have studied near misses in dozens of companies across industries from telecommunications to automobiles, at NASA, and in lab simulations. Our research reveals a pattern: Multiple near misses preceded (and foreshadowed) every disaster and business crisis we studied, and most of the misses were ignored or misread. Our work also shows that cognitive biases conspire to blind managers to the near misses. Two in particular cloud our judgment. The first is “normalization of deviance,” the tendency over time to accept anomalies—particularly risky ones—as normal. Think of the growing comfort a worker might feel with using a ladder with a broken rung; the more times he climbs the dangerous ladder without incident, the safer he feels it is. For an organization, such normalization can be catastrophic. Columbia University sociologist
HOW TO AVOID CATASTROPHE

Diane Vaughan coined the phrase in her book *The Challenger Launch Decision* to describe the organizational behaviors that allowed a glaring mechanical anomaly on the space shuttle to gradually be viewed as a normal flight risk—dooming its crew. The second cognitive error is the so-called outcome bias. When people observe successful outcomes, they tend to focus on the results more than on the (often unseen) complex processes that led to them.

Recognizing and learning from near misses isn’t simply a matter of paying attention; it actually runs contrary to human nature. In this article, we examine near misses and reveal how companies can detect and learn from them. By seeing them for what they are—instructive failures—managers can apply their lessons to improve operations and, potentially, ward off catastrophe.

**Roots of Crises**

Consider this revealing experiment: We asked business students, NASA personnel, and space-industry contractors to evaluate a fictional project manager, Chris, who was supervising the launch

**Idea in Brief**

Most business failures—such as engineering disasters, product malfunctions, and PR crises—are foreshadowed by near misses, close calls that, had luck not intervened, would have had far worse consequences. The space shuttle Columbia’s fatal reentry, BP’s Gulf oil rig disaster, Toyota’s stuck accelerators, even the iPhone 4’s antenna failures—all were preceded by near-miss events that should have tipped off managers to impending crises.

The problem is that near misses are often overlooked—or, perversely, viewed as a sign that systems are resilient and working well. That’s because managers are blinded by cognitive biases, argue Georgetown professors Tinsley and Dillon and Brigham Young University’s Madsen. Seven strategies can help managers recognize and learn from near misses: They should be on increased alert when time or cost pressures are high; watch for deviations in operations from the norm and uncover their root causes; make decision makers accountable for near misses; envision worst-case scenarios; be on the lookout for near-misses masquerading as successes; and reward individuals for exposing near misses.
of an unmanned spacecraft and had made a series of decisions, including skipping the investigation of a potential design flaw and forgoing a peer review, because of time pressure. Each participant was given one of three scenarios: The spacecraft launched without issue and was able to transmit data (success outcome); shortly after launch, the spacecraft had a problem caused by the design flaw, but because of the way the sun happened to be aligned with the vehicle it was still able to transmit data (near-miss outcome); or the craft had a problem caused by the flaw and, because of the sun’s chance alignment, it failed to transmit data and was lost (failure outcome).

How did Chris fare? Participants were just as likely to praise his decision making, leadership abilities, and the overall mission in the success case as in the near-miss case—though the latter plainly succeeded only because of blind luck. When people observe a successful outcome, their natural tendency is to assume that the process that led to it was fundamentally sound, even when it demonstrably wasn’t; hence the common phrase “you can’t argue with success.” In fact, you can—and should.

Organizational disasters, studies show, rarely have a single cause. Rather, they are initiated by the unexpected interaction of multiple small, often seemingly unimportant, human errors, technological failures, or bad business decisions. These latent errors combine with enabling conditions to produce a significant failure. A latent error on an oil rig might be a cementing procedure that allows gas to escape; enabling conditions might be a windless day and a welder working
near the leak. Together, the latent error and enabling conditions ignite a deadly firestorm. Near misses arise from the same preconditions, but in the absence of enabling conditions, they produce only small failures and thus go undetected or are ignored.

Latent errors often exist for long periods of time before they combine with enabling conditions to produce a significant failure. Whether an enabling condition transforms a near miss into a crisis generally depends on chance; thus, it makes little sense to try to predict or control enabling conditions. Instead, companies should focus on identifying and fixing latent errors before circumstances allow them to create a crisis.

Oil rig explosions offer a dramatic case in point, but latent errors and enabling conditions in business often combine to produce less spectacular but still costly crises—corporate failures that attention to latent errors could have prevented. Let’s look at three.

**Bad Apple**
Take Apple’s experience following its launch of the iPhone 4, in June 2010. Almost immediately, customers began complaining about dropped calls and poor signal strength. Apple’s initial response was to blame users for holding the phone the wrong way, thus covering...
the external antenna, and to advise them to “avoid gripping [the phone] in the lower left corner.” When questioned about the problem by a user on a web forum, CEO Steve Jobs fired back an e-mail describing the dropped calls as a “non issue.” Many customers found Apple’s posture arrogant and insulting and made their displeasure known through social and mainstream media. Several filed class action lawsuits, including a suit that alleged “fraud by concealment, negligence, intentional misrepresentation and defective design.” The reputation crisis reached a crescendo in mid-July, when *Consumer Reports* declined to recommend the iPhone 4 (it had recommended all previous versions). Ultimately Apple backpedaled, acknowledging software errors and offering owners software updates and iPhone cases to address the antenna problem.

The latent errors underlying the crisis had long been present. As Jobs demonstrated during a press conference, virtually all smartphones experience a drop in signal strength when users touch the external antenna. This flaw had existed in earlier iPhones, as well as in competitors’ phones, for years. The phones’ signal strength problem was also well known. Other latent errors emerged as the crisis gained momentum, notably an evasive PR strategy that invited a backlash.

That consumers had endured the performance issues for years without significant comment was not a sign of a successful strategy but of an ongoing near miss. When coupled with the right enabling conditions—*Consumer Reports*’ withering and widely quoted review and the expanding reach of social media—a crisis erupted. If Apple had recognized consumers’ forbearance as an ongoing near miss and proactively fixed the phones’ technical problems, it could have avoided the crisis. It didn’t, we suspect, because of normalization bias, which made the antenna glitch seem increasingly acceptable; and because of outcome bias, which led managers to conclude that the lack of outcry about the phones’ shortcomings reflected their own good strategy—rather than good luck.

**Speed warning**
On August 28, 2009, California Highway Patrol officer Mark Saylor and three family members died in a fiery crash after the gas pedal of
the Lexus sedan they were driving in stuck, accelerating the car to more than 120 miles per hour. A 911 call from the speeding car captured the horrifying moments before the crash and was replayed widely in the news and social media.

Up to this point, Toyota, which makes Lexus, had downplayed the more than 2,000 complaints of unintended acceleration among its cars it had received since 2001. The Saylor tragedy forced the company to seriously investigate the problem. Ultimately, Toyota recalled more than 6 million vehicles in late 2009 and early 2010 and temporarily halted production and sales of eight models, sustaining an estimated $2 billion loss in North American sales alone and immeasurable harm to its reputation.

Complaints about vehicle acceleration and speed control are common for all automakers, and in most cases, according to the National Highway Traffic Safety Administration, the problems are

**Toyota pedal problems**

*Errors in process or product design are often ignored, even when the warning signs clearly call for action. The more times small failures occur without disaster, the more complacent managers become.*

![Percentage of customer complaints having to do with speed control](chart.png)

*Source: National Highway Traffic Safety Administration*
caused by driver error, not a vehicle defect. However, beginning in 2001, about the time that Toyota introduced a new accelerator design, complaints of acceleration problems in Toyotas increased sharply, whereas such complaints remained relatively constant for other automakers (see the exhibit “Toyota pedal problems”). Toyota could have averted the crisis if it had noted this deviation and acknowledged the thousands of complaints for what they were—near misses. Here, too, normalization of deviance and outcome bias, along with other factors, conspired to obscure the grave implications of the near misses. Only when an enabling condition occurred—the Saylor family tragedy and the ensuing media storm—did the latent error trigger a crisis.

Jet Black and Blue
Since it began operating, in 2000, JetBlue Airways has taken an aggressive approach to bad weather, canceling proportionately fewer flights than other airlines and directing its pilots to pull away from gates as soon as possible in severe weather so as to be near the front of the line when runways were cleared for takeoff—even if that meant loaded planes would sit for some time on the tarmac. For several years, this policy seemed to work. On-tarmac delays were not arduously long, and customers were by and large accepting of them. Nonetheless, it was a risky strategy, exposing the airline to the danger of stranding passengers for extended periods if conditions abruptly worsened.

The wake-up call came on February 14, 2007. A massive ice storm at New York’s John F. Kennedy International Airport caused widespread disruption—but no carrier was harder hit than JetBlue, whose assertive pilots now found themselves stuck on the tarmac (literally, in some cases, because of frozen wheels) and with no open gates to return to. Distressed passengers on several planes were trapped for up to 11 hours in overheated, foul-smelling cabins with little food or water. The media served up angry first-person accounts of the ordeal, and a chastened David Neeleman, JetBlue’s CEO, acknowledged on CNBC, “We did a horrible job, actually, of getting
our customers off those airplanes.” The airline reported canceling more than 250 of its 505 flights that day—a much higher proportion than any other airline. It lost millions of dollars and squandered priceless consumer loyalty.

For JetBlue, each of the thousands of flights that took off before the competition during previous weather delays was a near miss. As the airline continued to get away with the risky strategy, managers who had expressed concern early on about the way the airline handled flight delays became complacent, even as long delays mounted. Indeed, the proportion of JetBlue weather-based delays of two hours or more roughly tripled between 2003 and 2007, whereas such delays remained fairly steady at other major U.S. airlines (see the exhibit “JetBlue tarmac trouble”).

Rather than perceiving that a dramatic increase in delays represented a dramatic increase in risk, JetBlue managers saw only successfully launched flights. It took an enabling condition—the ferocious ice storm—to turn the latent error into a crisis.
Recognizing and Preventing Near Misses

Our research suggests seven strategies that can help organizations recognize near misses and root out the latent errors behind them. We have developed many of these strategies in collaboration with NASA—an organization that was initially slow to recognize the relevance of near misses but is now developing enterprisewide programs to identify, learn from, and prevent them.

1. Heed high pressure

The greater the pressure to meet performance goals such as tight schedules, cost, or production targets, the more likely managers are to discount near-miss signals or misread them as signs of sound decision making. BP’s managers knew the company was incurring overrun costs of $1 million a day in rig lease and contractor fees, which surely contributed to their failure to recognize warning signs.

The high-pressure effect also contributed to the Columbia space shuttle disaster, in which insulation foam falling from the external fuel tank damaged the shuttle’s wing during liftoff, causing the shuttle to break apart as it reentered the atmosphere. Managers had been aware of the foam issue since the start of the shuttle program and were concerned about it early on, but as dozens of flights proceeded without serious mishap, they began to classify foam strikes as maintenance issues—rather than as near misses. This classic case of normalization of deviance was exacerbated by the enormous political pressure the agency was under at the time to complete the International Space Station's main core. Delays on the shuttle, managers knew, would slow down the space station project.

Despite renewed concern about foam strikes caused by a particularly dramatic recent near miss, and with an investigation under way, the Columbia took off. According to the Columbia Accident Investigation Board, “The pressure of maintaining the flight schedule created a management atmosphere that increasingly accepted less-than-specification performance of various components and systems.”

When people make decisions under pressure, psychological research shows, they tend to rely on heuristics, or rules of thumb,
and thus are more easily influenced by biases. In high-pressure work environments, managers should expect people to be more easily swayed by outcome bias, more likely to normalize deviance, and more apt to believe that their decisions are sound. Organizations should encourage, or even require, employees to examine their decisions during pressure-filled periods and ask, “If I had more time and resources, would I make the same decision?”

2. Learn from deviations

As the Toyota and JetBlue crises suggest, managers’ response when some aspect of operations skews from the norm is often to recalibrate what they consider acceptable risk. Our research shows that in such cases, decision makers may clearly understand the statistical risk represented by the deviation, but grow increasingly less concerned about it.

We’ve seen this effect clearly in a laboratory setting. Turning again to the space program for insight, we asked study participants to assume operational control of a Mars rover in a simulated mission. Each morning they received a weather report and had to decide whether or not to drive onward. On the second day, they learned that there was a 95% chance of a severe sandstorm, which had a 40% chance of causing catastrophic wheel failure. Half the participants were told that the rover had successfully driven through sandstorms in the past (that is, it had emerged unscathed in several prior near misses); the other half had no information about the rover’s luck in past storms. When the time came to choose whether or not to risk the drive, three quarters of the near-miss group opted to continue driving; only 13% of the other group did. Both groups knew, and indeed stated that they knew, that the risk of failure was 40%—but the near-miss group was much more comfortable with that level of risk.

Managers should seek out operational deviations from the norm and examine whether their reasons for tolerating the associated risk have merit. Questions to ask might be: Have we always been comfortable with this level of risk? Has our policy toward this risk changed over time?
3. Uncover root causes
When managers identify deviations, their reflex is often to correct the symptom rather than its cause. Such was Apple’s response when it first suggested that customers address the antenna problem by changing the way they held the iPhone. NASA learned this lesson the hard way as well, during its 1998 Mars Climate Orbiter mission. As the spacecraft headed toward Mars it drifted slightly off course four times; each time, managers made small trajectory adjustments, but they didn’t investigate the cause of the drifting. As the $200 million spacecraft approached Mars, instead of entering into orbit, it disintegrated in the atmosphere. Only then did NASA uncover the latent error—programmers had used English rather than metric units in their software coding. The course corrections addressed the symptom of the problem but not the underlying cause. Their apparent success lulled decision makers into thinking that the issue had been adequately resolved.

The health care industry has made great strides in learning from near misses and offers a model for others. Providers are increasingly encouraged to report mistakes and near misses so that the lessons can be teased out and applied. An article in Today’s Hospitalist, for example, describes a near miss at Delnor-Community Hospital, in Geneva, Illinois. Two patients sharing a hospital room had similar last names and were prescribed drugs with similar-sounding names—Cytotec and Cytoxan. Confused by the similarities, a nurse nearly administered one of the drugs to the wrong patient. Luckily, she caught her mistake in time and filed a report detailing the close call. The hospital immediately separated the patients and created a policy to prevent patients with similar names from sharing rooms in the future.

4. Demand accountability
Even when people are aware of near misses, they tend to downgrade their importance. One way to limit this potentially dangerous effect is to require managers to justify their assessments of near misses.

Remember Chris, the fictional manager in our study who neglected some due diligence in his supervision of a space mission? Par-
Little Near Misses and Small-Scale Failures

We’ve used dramatic cases such as oil spills and shuttle disasters to illustrate how near misses can foreshadow huge calamities.

But near misses are relevant to managers at all levels in their day-to-day work, as they can also presage lesser but still consequential problems. Research on workplace safety, for example, estimates that for every 1,000 near misses, one accident results in a serious injury or fatality, at least 10 smaller accidents cause minor injuries, and 30 cause property damage but no injury. Identifying near misses and addressing the latent errors that give rise to them can head off the more mundane problems that distract organizations and sap their resources.

Imagine an associate who misses deadlines and is chronically late for client meetings but is otherwise a high performer. Each tardy project and late arrival is a near miss; but by addressing the symptoms of the problem—covering for the employee in a variety of ways—his manager is able to prevent clients from defecting. By doing this, however, she permits a small but significant erosion of client satisfaction, team cohesiveness, and organizational performance. And eventually, a client may jump ship—an outcome that could have been avoided by attending to the near misses. Your organization needn’t face a threat as serious as an oil spill to benefit from exposing near misses of all types and addressing their root causes.

Participants gave him equally good marks for the success scenario and the near-miss scenario. Chris’s raters didn’t seem to see that the near miss was in fact a near disaster. In a continuation of that study, we told a separate group of managers and contractors that they would have to justify their assessment of Chris to upper management. Knowing they’d have to explain their rating to the bosses, those evaluating the near-miss scenario judged Chris’s performance just as harshly as did those who had learned the mission had failed—recognizing, it seems, that rather than managing well, he’d simply dodged a bullet.

5. Consider worst-case scenarios

Unless expressly advised to do so, people tend not to think through the possible negative consequences of near misses. Apple managers,
for example, were aware of the iPhone’s antenna problems but probably hadn’t imagined how bad a consumer backlash could get. If they had considered a worst-case scenario, they might have headed off the crisis, our research suggests.

In one study, we told participants to suppose that an impending hurricane had a 30% chance of hitting their house and asked them if they would evacuate. Just as in our Mars rover study, people who were told that they’d escaped disaster in previous near misses were more likely to take a chance (in this case, opting to stay home). However, when we told participants to suppose that, although their house had survived previous hurricanes, a neighbor’s house had been hit by a tree during one, they saw things differently; this group was far more likely to evacuate. Examining events closely helps people distinguish between near misses and successes, and they’ll often adjust their decision making accordingly.

Managers in Walmart’s business-continuity office clearly understand this. For several years prior to Hurricane Katrina, the office had carefully evaluated previous hurricane near misses of its stores and infrastructure and, based on them, planned for a direct hit to a metro area where it had a large presence. In the days before Katrina made landfall in Louisiana, the company expanded the staff of its emergency command center from the usual six to 10 people to more than 50, and stockpiled food, water, and emergency supplies in its local warehouses. Having learned from prior near misses, Walmart famously outperformed local and federal officials in responding to the disaster. Said Jefferson Parish sheriff Harry Lee, “If the American government had responded like Walmart has responded, we wouldn’t be in this crisis.”

6. Evaluate projects at every stage
When things go badly, managers commonly conduct postmortems to determine causes and prevent recurrences. When they go well, however, few do formal reviews of the success to capture its lessons. Because near misses can look like successes, they often escape scrutiny.
The chief knowledge officer at NASA’s Goddard Space Flight Center, Edward Rogers, instituted a “pause and learn” process in which teams discuss at each project milestone what they have learned. They not only cover mishaps but also expressly examine perceived successes and the design decisions considered along the way. By critically examining projects while they’re under way, teams avoid outcome bias and are more likely to see near misses for what they are. These sessions are followed by knowledge-sharing workshops involving a broader group of teams. Other NASA centers, including the Jet Propulsion Laboratory, which manages NASA’s Mars program, are beginning similar experiments. According to Rogers, most projects that have used the pause-and-learn process have uncovered near misses—typically, design flaws that had gone undetected. “Almost every mishap at NASA can be traced to some series of small signals that went unnoticed at the critical moment,” he says.

7. Reward owning up
Seeing and attending to near misses requires organizational alertness, but no amount of attention will avert failure if people aren’t motivated to expose near misses—or, worse, are discouraged from doing so. In many organizations, employees have reason to keep quiet about failures, and in that type of environment they’re likely to keep suspicions about near misses to themselves.

Political scientists Martin Landau and Donald Chisholm described one such case that, though it took place on the deck of a warship, is relevant to any organization. An enlisted seaman on an aircraft carrier discovered during a combat exercise that he’d lost a tool on the deck. He knew that an errant tool could cause a catastrophe if it were sucked into a jet engine, and he was also aware that admitting the mistake could bring a halt to the exercise—and potential punishment. As long as the tool was unaccounted for, each successful take-off and landing would be a near miss, a lucky outcome. He reported the mistake, the exercise was stopped, and all aircraft aloft were redirected to bases on land, at a significant cost.
Rather than being punished for his error, the seaman was commended by his commanding officer in a formal ceremony for his bravery in reporting it. Leaders in any organization should publicly reward staff for uncovering near misses—including their own.

Two Forces conspire to make learning from near misses difficult: Cognitive biases make them hard to see, and, even when they are visible, leaders tend not to grasp their significance. Thus, organizations often fail to expose and correct latent errors even when the cost of doing so is small—and so they miss opportunities for organizational improvement before disaster strikes. This tendency is itself a type of organizational failure—a failure to learn from “cheap” data. Surfacing near misses and correcting root causes is one of the soundest investments an organization can make.

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