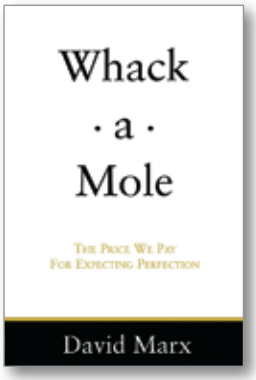
Erring on the Safe Side

Organizations need to distinguish among inadvertent error, at-risk behavior and deliberate noncompliance.



BOOKS

The Perfect Is the Enemy of the Best

Whack-a-Mole: The Price We Pay for Expecting Perfection

Marx, David. Plano, Texas, U.S.: By Your Side Studios. 221 pp. References, index.

"Whack-a-Mole" is an arcade and electronic game. The mole, a burrowing animal, pokes its head out of a hole and the player tries to "whack" it with a paddle before it disappears back into the ground, only to reappear at another hole.

Too much of the effort to improve safety resembles the whack-a-mole game, says Marx, a systems engineer. We try to find a visible actor who made an error that contributed to the accident, and punish that individual. "Bad outcome must mean bad actor," he says. "Whack that bad actor and the game is won." But another person committing the same, or a similar, error pops up at a different location.

"While we've learned in the game to lie in wait for the adverse event to pop up, ready to strike when we see the harm occur, we have largely given up on accountability for our personal choices," he says. "The game has made our performance all about the outcome." Not only does reacting mainly to outcomes offer minimal benefits in the big picture, Marx says, but it contributes to complacency because less than optimal behavior *usually* doesn't lead to harmful consequences; it just worsens the odds slightly. But when those odds are multiplied by many flights and flight hours, the accident rate increases.

"We spend far too little time addressing the system design that got us there and the behavioral choices of the humans in those systems that might have ultimately contributed to the adverse outcome," Marx says.

No one wants to be punished. No one wants to contribute to an accident. So why do people keep violating rules they are aware of and committing errors that someone has already been penalized for?

Does a mistake mean, Marx asks, "that we're all unintelligent or unprofessional, or perhaps just too lazy to give it our full effort? No. It simply demonstrates our human fallibility — even in the face of a relatively simple task of little consequence. We are not perfect machines."

"To err is human" is an indisputable cliché, but Marx says that there are additional, more-subtle reasons that people act in ways that go counter to safety.

For one thing, the evaluation depends on whether you are the doer or the observer. If you are the doer, you believe you can judge whether the extra risk you take is serious or negligible. You can calculate whether the odds are with you when you continue driving through the intersection as the traffic light changes from green to yellow. You know that you should unplug an electrical appliance by grasping the plug at the socket, not from several feet away by yanking on the cord. But which of us could take an oath that we have never disconnected the vacuum cleaner by pulling on the cord?

"Or we observe and decide that the increased risk is not worth the reward," Marx says. "While our friend engaged in the behavior may see it differently, we label it 'at-risk,' a label that implies a difference of opinion on the trade between risk and reward."

Sometimes observers expect us to take on a little extra risk and indicate their displeasure if we do not. This can be easily demonstrated by driving at exactly the speed limit in the fast lane of the highway. We "should" drive at more or less the same pace as the other cars in the lane, even if they are speeding … until we contribute to an accident, after which the other drivers will claim indignantly that we were going too fast.

In addition, once there is an accident or serious incident, the tendency of most organizations is to formulate a new rule prohibiting or restricting whatever behavior was involved. That gets added to the list of rules, regulations, guidelines, recommendations, best practices and helpful hints we are expected to know and practice. We can scarcely draw breath without consulting a mental manual telling us what to do and not to do. We aren't even supposed to *relax* spontaneously. We are told to sleep only at regular hours. Passengers on a long-haul flight should not touch alcohol, the health experts warn.

"I have only known a few people in my life that even give the impression of following all the rules," Marx says. "The rest of us are just trying to get by, just trying to get through the day without having a catastrophic failure. We look at those never-ending requirements and recommendations, and we choose. Is it laziness? No. Is it an uncaring attitude for those around us? No. It is instead the recognition that we cannot do it all. Sometimes, it's the recognition that the rules are inconsistent and that to follow one requires violating another."

Marx believes that organizations should differentiate among three categories: "Human error is the inadvertent action. At-risk behavior is, generally, the knowingly non-compliant place where there's a difference of interpretation around the behavior, where the observed believes they are still in a safe place but the observer judges otherwise. The reckless behavior is the choice to consciously disregard a substantial and unjustifiable risk. These are three different behaviors arising from three different causal mechanisms."

But many organizations, like many individuals, have only two criteria when something bad happens. *How* bad was it? *Who* was to blame? "The question is whether this strategy gets us where we want to be," Marx says. "Throughout this book, I make the argument that there are really only two inputs impacting our ability to avoid adverse events. The first is the design of the system in which we put ourselves … . The second input is the behavioral choices of the people within those systems. What we do not have such immediate control over are the human errors that we make, nor the adverse outcomes we produce, even when trying our best."

There are two basic categories of system design, Marx says: "We either take control and ask others to comply, or we delegate an outcome and leave the system design to others. … In some areas, particularly in high-risk industries, it's critical that personal preference not rule the day."

He cites the crash on takeoff of American Airlines Flight 191 at Chicago O'Hare International Airport on May 25, 1979, killing all 271 passengers, the crewmembers and two people on the ground. "In the case of Flight 191, the plane's left engine was changed 55 days before the catastrophic loss of the aircraft," Marx says. "In their investigation, the [U.S. National Transportation Safety Board] found that American Airlines maintenance technicians had developed an alternative means for removing the engine, based in part on perceived time constraints at the maintenance facility. Tragically, this alternate method physically stressed the pylon mounts on the wing, inadvertently fracturing the attachment bolts. As the aircraft rolled down the runway, the forces of engine thrust and the weight of the engine itself caused the engine to separate from the aircraft."

Marx says he has no doubt that in most aspects of aviation operations, following the prescribed regulations, rules and procedures is the best way — in fact, the only way. We do not want creative maintenance technicians designing brilliant short cuts that work fine until one day they don't. Usually we do not want pilots to be creative in the cockpit. Emergencies might sometimes be an exception, but even emergencies have checklists that were written by engineers and safety specialists who were able

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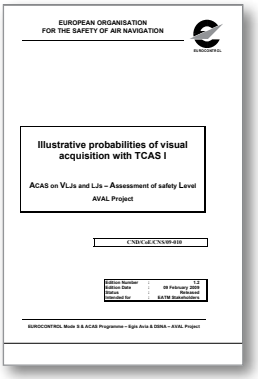
to think the scenario through without hurry, consult with others and conduct tests.

In a professional setting such as the aviation industry, most errors do not involve conscious or irresponsible violation of rules, regulations and procedures. And Marx is skeptical of the value of organizational codes of conduct that fail to make the necessary distinctions about causes of behavior.

He quotes from an actual, though de-identified, "progressive discipline policy" of one major U.S. airline. While acknowledging that some provisions are reasonable and necessary, he sees others as promoting the whack-a-mole approach. For example, "Any employee involved in any mishap resulting from a judgment error but who notifies management in a timely fashion (within 10 minutes of the mishap) will be disciplined as follows: For the first offense in an 18-month period, a letter of discipline will be retained in the employee's personnel file for 18 months, *and* the employee will receive five days off without pay. Any employee involved in two mishaps will be terminated."


EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION

Illustrative probabilities of visual acquisition with TCAS I

ACAS on VLJs and LJs – Assessment of safety Level

AVAL Project

The honest employee who would like to confess and possibly help prevent the same kind of error from recurring in the organization will be whacked for it. "It's a provision that appears to make human error a very serious offense," Marx says. "Given the penalties, employees are unlikely to volunteer that they made a 'judgment' error."

Alternatively, Marx says, "Surely we can create a disciplinary policy that allows the station manager to take action when he sees reckless behavior, while also promoting an open learning culture around more basic human fallibility."

Many organizations where errors can have severe consequences are moving in the direction of a "just culture," which encourages people to report hazards but still maintains a reasonable accountability. Marx says that such a policy — minus the legal jargon — would tell the employee:

> *You are a fallible human being, susceptible to human error and behavioral drift. As your employer, we must design systems around you in recognition of that fallibility. When errors do occur, you must raise your hand to allow the organization to learn. When you make a mistake, you will be consoled. When you drift into a risky place, believing that you are still safe, we will coach you. When you knowingly put others in harm's way, we will take appropriate disciplinary action.*
>
> *— Rick Darby*

REPORTS

Putting TCAS to the Test

Illustrative Probabilities of Visual Acquisition with TCAS I: ACAS on VLJs and LJs — Assessment of Safety Level

Eurocontrol. Edition 1.2. Feb. 9, 2009. 70 pp. Available via the Internet at <www.eurocontrol.int/msa/public/standard_page/ACAS_AVAL.html>.

The airborne collision avoidance system (ACAS) is the International Civil Aviation Organization's general term for on-board avionics that reduce the risk of midair collisions. In Europe, use of ACAS II is required for civil turbine engine airplanes with a maximum takeoff weight of 5,700 kg/12,500 lb or a passenger seating capacity of more than 19.

"The advent of very light jets (VLJs) and light jets (LJs), aircraft weighing less than 5,700 kg, means that in the near future there may be a significant population of aircraft which fall outside the thresholds of the current ACAS II mandate to include these aircraft," the report says.

Eurocontrol has been studying whether it would be appropriate to extend ACAS II requirements to include VLJs and LJs. The project is called AVAL (ACAS on VLJs and LJs — Assessment of Safety Level).

It has been suggested that the appropriate level of equipment for VLJs and LJs is traffic alert and collision avoidance system (TCAS) I, which provides traffic advisories on a cockpit display, rather than TCAS II version 7.0, which provides resolution advisories (RAs) in addition to traffic advisories. TCAS I would warn of a collision hazard, but evasive action would depend on the traditional see-and-avoid principle.

The question is, how well does TCAS I work for VLJs and LJs as a see-and-avoid aid? The AVAL project Work Package 8 used a comparatively simple model of visual acquisition in a

set of scenarios to quantify the probability of the pilot seeing a collision threat, both with and without TCAS I.

The visual acquisition model described mathematically the factors involved in a potential collision, the "collision geometry." The factors included the speed of the pilot's own aircraft, the speed of the threat aircraft, the angle between the tracks of the converging aircraft, the closing speed, the apparent direction of the threat and the angle from which the threat is viewed.

The report says that the study found that TCAS I "can undoubtedly enhance the prospect of visually acquiring a collision threat in certain scenarios":

- "It is most effective against the larger aircraft types (medium and large passenger aircraft) … ;
- "It is less effective against the smaller aircraft types (general aviation, military fast jets and VLJs) … ; [and,]
- "It is particularly ineffective against small-sized threats with high closing speeds in which there is virtually no prospect of visual acquisition, even when equipped with TCAS I, at the highest closing speeds."

TCAS I's effectiveness is "markedly decreased" when visibility is degraded by weather, the report says: "Even at the limit of visibility for [visual flight rules], the usefulness of TCAS I as an aid to visual acquisition is severely curtailed, even against the larger-sized threats. This effectiveness will obviously be further reduced, ultimately to nil, in [instrument meteorological conditions]."

The study also showed that even though TCAS I can under some conditions enhance the likelihood of the pilot visually acquiring a collision threat, the collision threat would not be reduced if the two aircraft use incompatible avoidance maneuvers. "The effect is most marked in TCAS I–equipped aircraft against threats which are equipped with ACAS II," the report says.

— Rick Darby

WEB SITES

Open Source

NTSB Electronic Reading Room, <www.ntsb.gov/Info/foia_fri.htm>

The U.S. National Transportation Safety Board (NTSB) has begun posting all accident investigation public dockets on a Web site. The NTSB says, "This effort serves to further bring the [NTSB] into compliance with a number of legislative and executive mandates aimed at improving the U.S. government's use of electronic media to foster a more open and transparent government."

In the past, members of the public were required to make formal requests for information related to investigations through the Freedom of Information Act (FOIA). This recent change makes materials previously approved for release available to everyone. Interested parties are now able to view information related to specific accident investigations online, in full text and at no cost. Most documents may be printed or downloaded.

At the NTSB's Electronic Reading Room Web page under "Accident Dockets" are links to a directory of accidents listed by date and location. Opening a specific accident docket or file reveals a list of materials produced during the accident investigation — interviews and testimonies, regulatory and guidance documents, photographs, cockpit and data recorder transcriptions, maintenance records, and many other resources and items of evidence. Currently, accident dates range from June 2007 to the present. Dockets containing newly released information are flagged.

The Electronic Reading Room also contains links to the NTSB's accidents database; NTSB investigation manuals, procedures and guides; investigation documents related to the four Sept. 11, 2001 hijacked aircraft; and more.

Other information at the Web site

includes contact information for the NTSB records management division, identification of accessibility technology for researchers with special needs and the NTSB's policy for submitting FOIA requests.

— *Patricia Setze*

One Accident, Two Interpretations

The Erebus Story, <www.erebus.co.nz>

The New Zealand Air Line Pilots' Association (NZALPA) has launched a commemorative Web site marking 30 years since the fatal accident involving Flight TE 901 on Mt. Erebus, Antarctica. Capt. Mark Rammell, NZALPA president, says that "this site is dedicated to those lost to Erebus; our goal for this site is to ensure that the memories of those who perished are never forgotten. We have not set out to apportion blame but to show that even in the most tragic of accidents the lessons learned eventually lead to improvements in air safety."

The accident resulted in the deaths of 257 people aboard a McDonnell Douglas DC-10 for a sightseeing flight on Nov. 28, 1979. Audio and video recordings of events following the accident, news articles, photographs and a four-part television mini-series can be reviewed in the resources section of the Web site. A bibliography includes books, articles and Web sites devoted to the Erebus accident. Much of the information may be viewed online at no cost.

The Web site reflects the controversy that surrounded the accident, investigations and subsequent reports. Two investigations produced two accident reports — the official accident report by the Office of Air Accidents Investigation and a subsequent Royal Commission of Inquiry report. Differences in investigation procedures between the two organizations and their differing conclusions are discussed in detail.

The first investigation led to the Chippindale report, named after Ron Chippindale, chief investigator of air accidents. That report "determined the probable cause of the accident was the decision of the captain to continue the flight at low level toward an area of poor surface and horizontal definition when the crew was not certain of their position and the subsequent inability to detect the rising terrain which intercepted the aircraft's path."

Before the Chippindale report had been completed and released, the attorney general ordered a commission of inquiry to determine the cause of the accident; culpability for the accident; adequacy of existing laws, safety board investigational procedures and civil aviation authority actions; safety concerns related to the accident or arising from the investigation; and other issues. The commission's report, named after Justice Peter Mahon, determined that "the dominant cause of the accident was the act of the airline in changing the computer track of the aircraft without telling the aircrew."

The site may not intend to apportion blame, but the discussion of the Chippindale report reveals the writer's judgment in statements such as the following:

- "Chippindale makes the statement in paragraph 2.20 that the whiteout conditions made the snow slope appear to the pilots as 'an area of limited visibility.' Justice Mahon's coverage of the issue shows a far greater understanding of the illusion presented to the crew; [and,]
- "Whilst Mr. Chippindale pays scant attention to the reason for (or the consequences of) the error, paragraphs 224–255 of Justice Mahon's report detail his attempts to untangle Air New Zealand's obfuscation of those events. It is difficult reading, and one is left unable to disagree with the judge's infamous 'litany of lies' assessment."

Both reports are available in full text with annexes, photographs and graphics. They may be read online, downloaded or printed at no cost.

— *Patricia Setze*