

GREY SWANS AND BLACK ELEPHANTS: WHY WE KEEP GETTING SURPRISED AND WHAT WE CAN LEARN FROM THEM

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SAS Super Week 2020

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Consulting



Agenda

- Catastrophic complexity, swans, elephants, and butterflies
- Big mistakes and examples of catastrophic complexity
- Grey swans
- Evolving the risk management paradigm



**Catastrophic
complexity,
swans,
elephants,
and
butterflies**

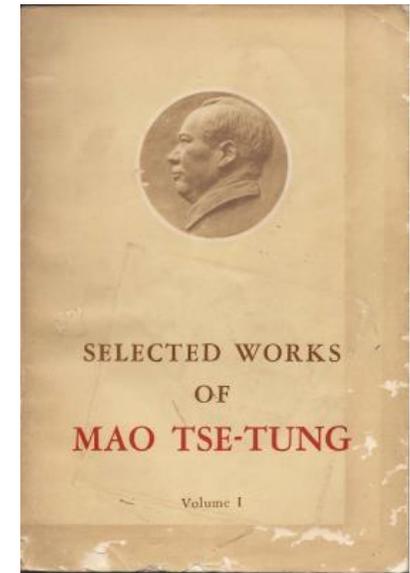
“A Black Swan has three attributes: unpredictability, consequences, and retrospective explainability.”

- Nassim Taleb



“Everything under heaven is in utter chaos; the situation is excellent.”

- Mao Tse-tung



David Brooks

The New York Times

Opinion

Drilling for Certainty



By David Brooks

May 27, 2010



In the weeks since the Deepwater Horizon explosion, the political debate has fallen into predictably partisan and often puerile categories. Conservatives say this is Obama's Katrina. Liberals say the spill is proof the government should have more control over industry.

But the real issue has to do with risk assessment. It has to do with the bloody crossroads where complex technical systems meet human psychology.

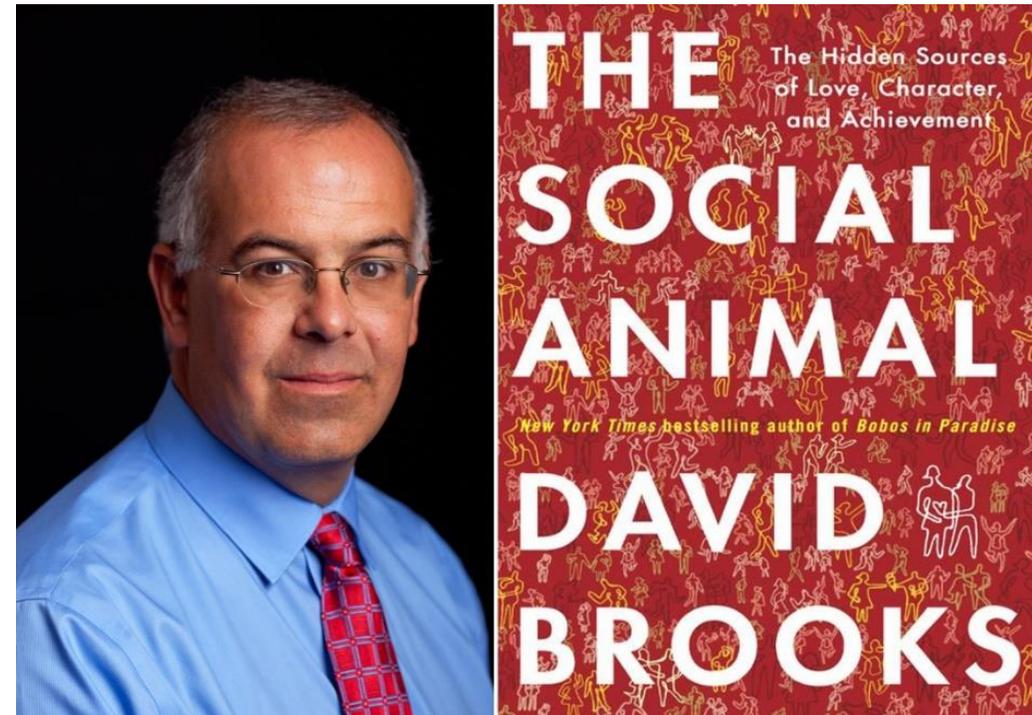
Over the past decades, we've come to depend on an ever-expanding array of intricate high-tech systems. These hardware and software systems are the guts of financial markets, energy exploration, space exploration, air travel, defense programs and modern production plants.

These systems, which allow us to live as well as we do, are too complex for any single person to understand. Yet every day, individuals are asked to monitor the health of these networks, weigh the risks of a system failure and take appropriate measures to reduce those risks.

If there is one thing we've learned, it is that humans are not great at measuring and responding to risk when placed in situations too complicated to understand.

In the first place, people have trouble imagining how small failings can combine to lead to catastrophic disasters. At the Three Mile Island nuclear facility, a series of small systems happened to fail at the same time. It was the interplay between these seemingly minor events that led to an unanticipated systemic crash.

<https://www.nytimes.com/2010/05/28/opinion/28brooks.html>



The New York Times

Drilling for certainty – The Deepwater Horizon

- On the Deepwater Horizon debacle, “...the bloody crossroads where complex technical systems meet human psychology”
- Humans often design systems which:
 - let small failings lead to catastrophic disasters
 - allow ourselves get acclimated to risk
 - place too much faith in elaborate backup devices
 - match complicated systems with complicated governance
 - spread good news and hide bad news
 - are overcome by “Groupthink”
- “We have constructed a world in which the potential for high-tech catastrophe is embedded in day to day life”; he referred to this as “**catastrophic complexity**”



CBS News

Nassim Taleb and Gregory F. Treverton



January/February 2015
ESSAY

The Calm Before the Storm

Why Volatility Signals Stability, and Vice Versa

Nassim Nicholas Taleb and Gregory F. Treverton

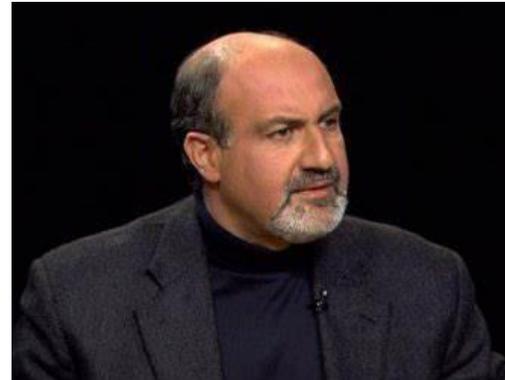
*NASSIM NICHOLAS TALEB is Distinguished Professor of Risk Engineering at New York University's Polytechnic School of Engineering and the author of **Antifragile: Things That Gain From Disorder** [1]. GREGORY F. TREVERTON is Chair of the U.S. National Intelligence Council. From 2009 to 2014, he was Director of the RAND Corporation's Center for Global Risk and Security (where he wrote this article). This essay is adapted from a RAND risk-methodology report funded by the U.S. government.*

Even as protests spread across the Middle East in early 2011, the regime of Bashar al-Assad in Syria appeared immune from the upheaval. Assad had ruled comfortably for over a decade, having replaced his father, Hafez, who himself had held power for the previous three decades. Many pundits argued that Syria's sturdy police state, which exercised tight control over the country's people and economy, would survive the Arab Spring undisturbed. Compared with its neighbor Lebanon, Syria looked positively stable. Civil war had torn through Lebanon throughout much of the 1970s and 1980s, and the assassination of former Prime Minister Rafiq Hariri in 2005 had plunged the country into yet more chaos.

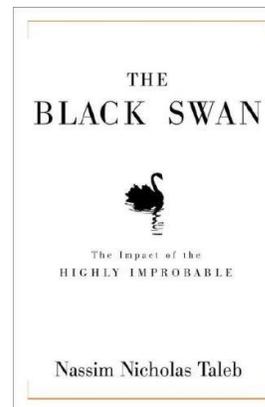
But appearances were deceiving: today, Syria is in a shambles, with the regime fighting for its very survival, whereas Lebanon has withstood the influx of Syrian refugees and the other considerable pressures of the civil war next door. Surprising as it may seem, the per capita death rate from violence in Lebanon in 2013 was lower than that in Washington, D.C. That same year, the body count of the Syrian conflict surpassed 100,000.

Why has seemingly stable Syria turned out to be the fragile regime, whereas always-in-turmoil Lebanon has so far proved robust? The answer is that prior to its civil war, Syria was exhibiting only pseudo-stability, its calm façade concealing deep structural vulnerabilities. Lebanon's chaos, paradoxically, signaled strength. Fifteen years of civil war had served to decentralize the state and bring about a more balanced sectarian power-sharing structure. Along with Lebanon's small size as an administrative unit, these factors added to its durability. So did the country's free-market economy. In Syria, the ruling Baath Party sought to control economic variability, replacing the lively chaos of the ancestral souk with the top-down, Soviet-style structure of the office building. This rigidity made Syria (and the other Baathist state, Iraq) much more vulnerable to disruption than Lebanon.

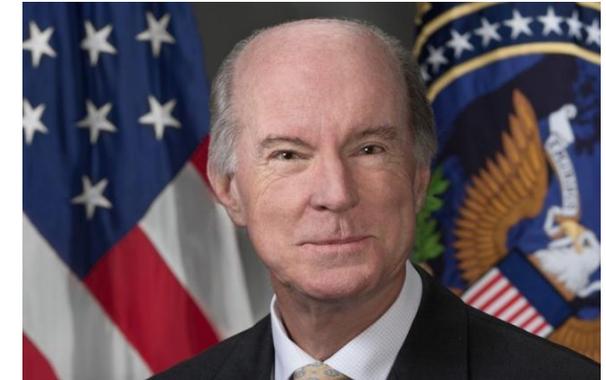
<https://www.foreignaffairs.com/articles/africa/calm-storm>



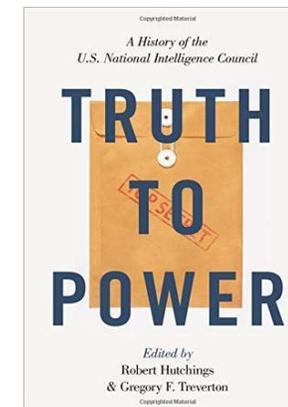
Business Insider



Nassim Taleb is Distinguished Professor of Risk Engineering at New York University's Tandon School of Engineering and author of "The Black Swan"



Leading Authorities

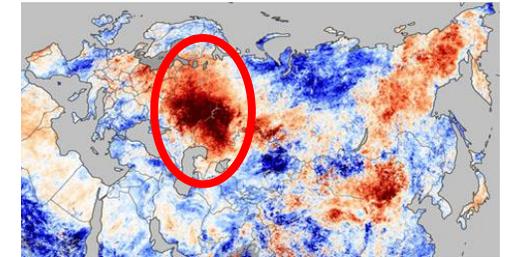


Gregory Treverton is the former Chair of the U.S. National Intelligence Council



The Calm Before the Storm

- Why volatility signals stability, and vice versa
- Past experience is a good indicator of “normal” risk, but a bad bellwether of tail risk
- Instead of trying to predict “black swan” events, it is more fruitful to focus on how systems can handle disorder
- Generally, systems which experience periodic and moderate amounts of change and disorder become more resilient, while ones which suppress change and natural cycles become fragile (e.g. periodic disorder is a vaccine against massive upheaval)
- **Do efforts to create stability sow the seeds for “black swan” events?**



From top: NASA, Foreign Policy, CNN

Black elephants

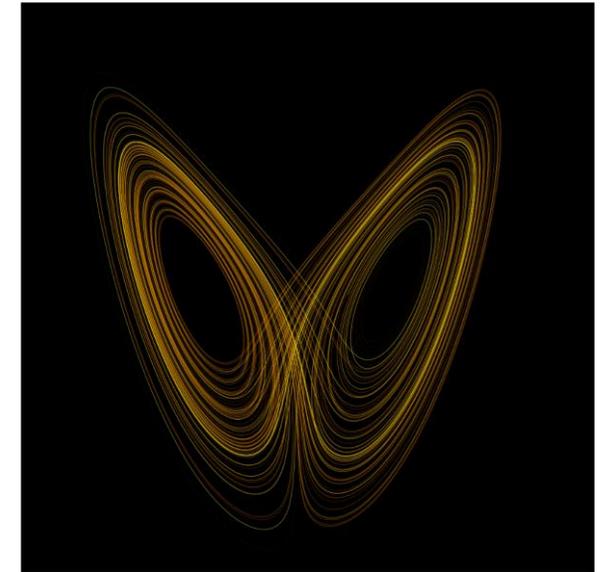
- A black elephant is a cross between “a black swan” (an unlikely, unexpected event with enormous ramifications) and the “elephant in the room” (a problem that is visible to everyone), something no one wants to address even though we know that one day it will have vast, black-swan-like consequences
- **“There are a herd of black elephants around, such as global warming, deforestation, ocean acidification, mass extinction and massive fresh water pollution”** (Adam Sweidan, 2014)
- Is COVID-19 an example of a black elephant?



<https://www.centerforhealthsecurity.org/event201/>

Butterflies

- The “butterfly effect” per Cambridge Dictionary:
 - Refers to a situation in which an action or change that does not seem important has a very large effect
 - Chaos theory relies on the idea of the "butterfly effect," that even slight imbalances in starting conditions lead to huge final variations in outcome because of the fundamental instability of the system
- Important to understand that **small, random events can have enormous consequences**
- Examples:
 - Gore vs. Bush
 - Archduke Ferdinand’s driver made a wrong turn in 1914
 - Lt. Col. Petrov chose not to report false missiles in 1983



A plot of Lorenz's strange attractor for values $\rho=28$, $\sigma = 10$, $\beta = 8/3$

Wikipedia

Big mistakes and examples of catastrophic complexity

“I’ve always believed that America’s government was a unique political system — one designed by geniuses so that it could be run by idiots. I was wrong. No system can be smart enough to survive this level of incompetence and recklessness by the people charged to run it.”

- Thomas Friedman, New York Times

2008



Carrington Event – it happened before (technology) (I)

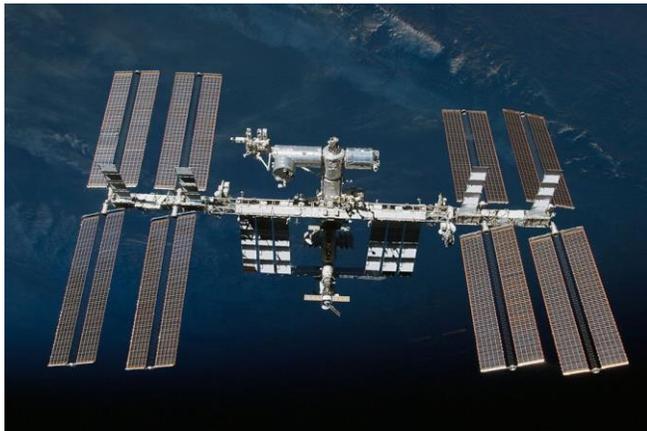


A STORM OF ELECTRICITY

TELEGRAPH WIRES USELESS FOR SEVERAL HOURS.

ONE OF THE MOST SEVERE DISTURBANCES FOR MANY YEARS, EXTENDING EVEN TO EUROPE—TELEPHONE WIRES ALSO OBSTRUCTED—BUSINESS DELAYED A GOOD PART OF THE DAY.

Yesterday's storm was accompanied by a more serious electrical disturbance than has been known for years. It very seriously affected the workings of the telegraph lines both on the land and in the sea, and for three hours—from 9 A. M. until noon—telegraph business east of the Mississippi and north of Washington was at a stand-still.



DAILY COURIER

WEDNESDAY, SEPTEMBER 14, 1859.

Northern Lights in the Tropics.

All our exchanges from the northern coast of the Island of Cuba—from the southern side we have none so late—come to us with glowing descriptions of the recent Aurora Borealis, which appears to have been as bright in the tropics as in the Northern zones, and far more interesting. At Havana it made its appearance a few minutes after nine o'clock, and in the most approved style, not as here, gradually crimsoning over the sky, but quick as thought it shot up, and in a moment spread over the whole Northern zone, from the horizon to the zenith. At first it was very brilliant, but at half-past nine it began to lose somewhat of its coloring, as it did of its length, and at ten it disappeared altogether. The sky was as clear as before.

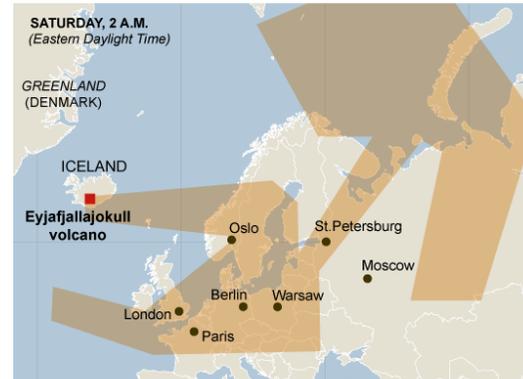
In 1859 a severe solar storm caused auroras visible as far south as the Caribbean and knocked out telegraph communications. A similar event today would cause massive damage to electrical grids, and satellite communications. Losses would be in the trillions and services might be disrupted for years.

Clockwise from upper left: NASA, Australian Broadcasting Corporation, Daily Courier, NASA

European air crisis – it happened before (technology) (II)



Estimated Spread of Volcanic Ash Cloud



Source: British Met Office

Volcanoes have been affecting Iceland for thousands of years; why did no one think about the risk they posed to jet airplanes?

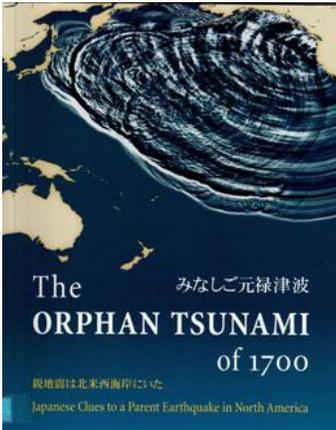
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KL1540	AMSTERDAM	06:00	CANCELLED
FR2332	KRAKOW	06:30	CANCELLED
LS257	PALMA	07:00	CANCELLED
TCX279K	FUERTEVENTURA	07:00	NEXT INFO AT 1500
BE350	GATWICK	07:55	CANCELLED
FR2501	PISA	09:10	CANCELLED
FR2484	VENICE TREVISI/SAN ANGELO	CANCELLED	
SZ481	BRISTOL	09:55	CANCELLED
BE172	SOUTHAMPTON	10:25	CANCELLED
KL1546	AMSTERDAM	10:30	CANCELLED
LS241	NICE	10:30	CANCELLED
FR153	DUBLIN	10:40	CANCELLED
BE730	BELFAST CITY	11:35	CANCELLED
NM327	ISLE OF MAN	12:05	CANCELLED
FR2334	KNOCK	13:20	CANCELLED

For information on liquids please refer to security notices. NO SMOKING It is against t



Clockwise from upper left: Royal Society, UK Met Office, Wikimedia, RT

Tohoku – it happened before (technology) (III)



Japan built a nuclear power plant in a known tsunami zone with a six-foot sea wall and failed to waterproof the backup generators.

Clockwise from upper left: Amazon, Blogspot, Wordpress, Blogspot

Thailand floods – unmodeled and unaware



From top: BBC, CNN

Many failed to anticipate the effect of the Thai floods because there were no flood models, **but just because a risk is not modelled does not mean it does not exist.**

Australian floods – managing one risk creates another

Water 2011, 3, 1149-1173; doi:10.3390/w3041149

OPEN ACCESS

water

ISSN 2073-4441

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Article

The 2011 Brisbane Floods: Causes, Impacts and Implications

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<https://research-management.mq.edu.au/ws/portalfiles/portal/16832889/mq-19234-Publisher+version+%28open+access%29.pdf>



Courier Mail

25-November-2020

A dam built in the 1970s to manage flood risk was allowed to reach full capacity following a prolonged drought; a strong La Niña developed, several large rain events occurred, the dam overflowed, and billions of dollars of losses occurred where they were not supposed to. **This illustrates the human factor in risk – how do you model the behavior of dam operators?**

Grey Swans and Black Elephants: Why we keep getting surprised and what we can learn from them

15



We were warned and we ignored it



Hurricane Pam Exercise Concludes

Release Date: July 23, 2004
Release Number: R6-04-093

BATON ROUGE, La. -- Hurricane Pam brought sustained winds of 120 mph, up to 20 inches of rain in parts of southeast Louisiana and storm surge that topped levees in the New Orleans area. More than one million residents evacuated and Hurricane Pam destroyed 500,000-600,000 buildings. Emergency officials from 50 parish, state, federal and volunteer organizations faced this scenario during a five-day exercise held this week at the State Emergency Operations Center in Baton Rouge.

The exercise used realistic weather and damage information developed by the National Weather Service, the U.S. Army Corps of Engineers, the LSU Hurricane Center and other state and federal agencies to help officials develop joint response plans for a catastrophic hurricane in Louisiana.

"We made great progress this week in our preparedness efforts," said Ron Castleman, FEMA Regional Director. "Disaster response teams developed action plans in critical areas such as search and rescue, medical care, sheltering, temporary housing, school restoration and debris management. These plans are essential for quick response to a hurricane but will also help in other emergencies."

"Hurricane planning in Louisiana will continue," said Colonel Michael L. Brown, Deputy Director for Emergency Preparedness, Louisiana Office of Homeland Security and Emergency Preparedness. "Over the next 60 days, we will polish the action plans developed during the Hurricane Pam exercise. We have also determined where to focus our efforts in the future."



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
OFFICE OF THE ASSISTANT SECRETARY FOR PREPAREDNESS AND RESPONSE

CRIMSON CONTAGION 2019 FUNCTIONAL EXERCISE
DRAFT AFTER-ACTION REPORT

OCTOBER 2019



FOR OFFICIAL USE ONLY

Res ipsa loquitur (Latin: "the thing speaks for itself")



Beirut blast - becoming acclimated to risk



From top: Irish Sun, News 18

Authorities allowed a huge amount of ammonium nitrate to be stored in a poorly ventilated warehouse for years. Despite risks being well known to authorities, no action was taken to reduce exposure. The resulting explosion leveled much of Beirut's port district.

Risk management observations

- These events (and many others like them) illustrate several important things about risk management (or the lack of it) in many situations:
 - Our world has become complex, interdependent, and subject to risks which are difficult to extrapolate from past events
 - A key issue is the collision of natural hazards and modern society
 - We often become too comfortable with our modeling and ignore risk that falls outside our models
 - Human factors are important and hard to model
- However, as we will see in the next section, we have a remarkable capacity to adjust to risk and mitigate it



Grey Swans



“Study the past if
you would define
the future”

- Confucius

The gold standard and free-floating exchange rates

- Gold standard widely used until 1971
 - Each country's paper currency is based on some fixed quantity of gold, exchange rates stable
 - In 1971 US abandoned standard and countries adopted floating exchange rates
- Significant disruptions occurred
 - Many firms caught (example Laker Airways)
 - Widespread disruption
- New tools
 - Foreign exchange hedging
 - Enterprise Risk Management (ERM)
 - Currency options, derivative markets



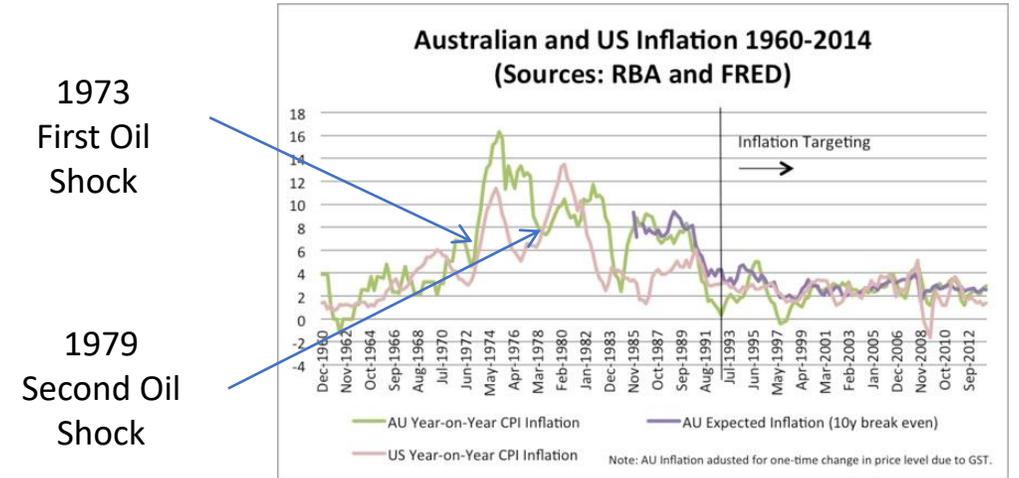
Source: <https://steemit.com/bitcoin/@bobgillvan/gold-volatility-vs-bitcoin-after-usd-left-the-gold-standard>



Airlinepictures.net

1970s oil crises and inflation

- Two oil shocks led to huge increases in oil prices and a large bout of inflation
- Many financial firms had mismatched assets and liabilities
- New techniques developed
 - Contractionary monetary policy
 - High interest rates
 - Use of inflation linked bonds
 - Asset/Liability matching (ALM)
 - Enterprise risk management (ERM)
- Have lessons of this era been forgotten?



Source: <https://theconversation.com/look-at-the-data-to-understand-the-risks-for-the-australian-economy-28311>

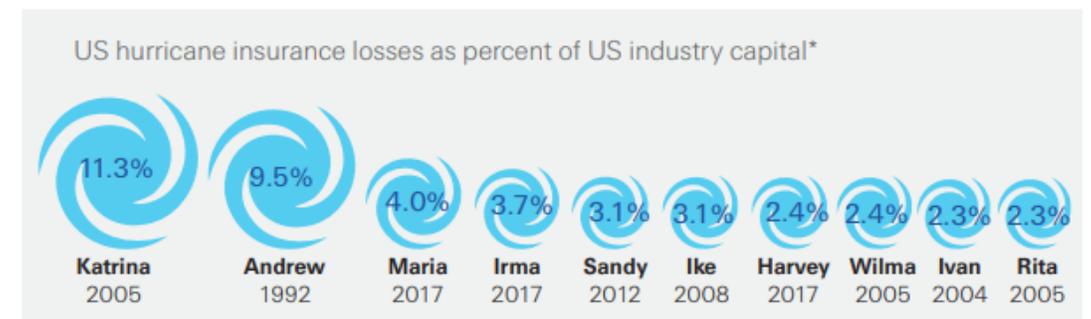


Hurricane Andrew - catastrophe risk management

- Andrew decimated insurers:
 - Destroyed 63,500 homes and damaged 124,000 others
 - 11 insurers became insolvent
 - 900,000 policyholders lost coverage
 - Massive rate increases
- Andrew demonstrated risk control failures:
 - Inadequate pricing techniques, previously based on “excess loss (wind) procedure”
 - Poor understanding of large loss potential
 - Cheap insurance = overdevelopment, poor building practices



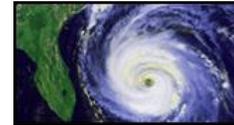
NOAA, Wikimedia



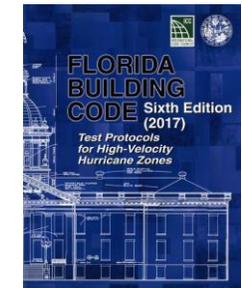
Source: Sigma (No 1 / 2018), Swiss Re Institute

After Andrew

- Government actions:
 - New regulatory structures for solvency and price regulation
 - Formation of government reinsurer, insurer, and stronger insolvency fund
 - Stronger building codes
- Insurer risk management improvements:
 - Sophisticated catastrophe models
 - Exposure management
 - New insurers and reinsurers
 - New pricing techniques
- Led to a recovery of the insurance market



Florida Hurricane Catastrophe Fund



World Trade Center – 9/11

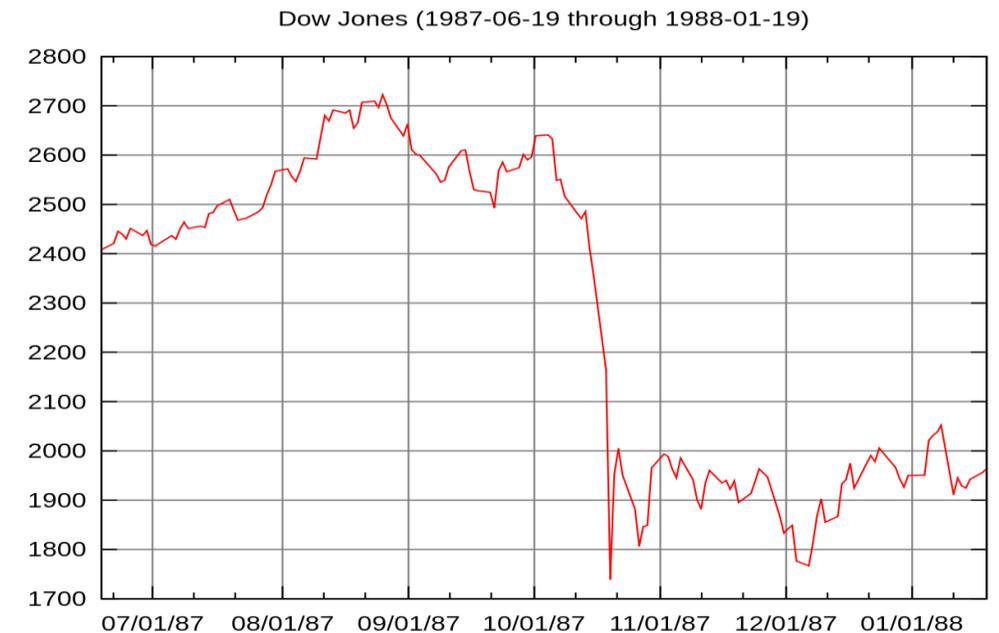
- Government response:
 - “War on terror”
 - Airport security screenings
 - Hardening of infrastructure
 - Huge investment in security
 - Risk pools (ARPC, Pool Re, TRIA)
- Insurer risk management improvements:
 - Terrorism models
 - Policy wordings
 - New pricing techniques
- Led to a partial recovery of the terrorism reinsurance market



*From Top: New York Daily News,
National September 11 Memorial*

Global Financial Crisis of 2007-2008

- Causes:
 - Exotic financial instruments (CDOs)
 - Banks taking excessive risk
 - US housing bubble
 - Relaxed regulation
- Response – stronger capital requirements:
 - Overhaul of financial regulation
 - Introduction of Basel III in 2010
 - Contingent capital requirements
 - Higher capital quality and larger buffers
 - Capital maintenance and reporting requirements
- Are similar issues lurking (google “CLO”)?



Source: https://favpng.com/png_view/stock-market-black-monday-wall-street-crash-of-1929-stock-market-crash-dow-jones-industrial-average-png/BGigWUhV

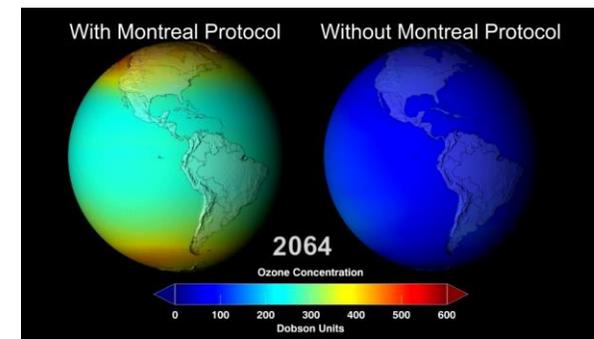
Lessons from the past – surprise, surprise

- There are many other examples of events like this
- Most or all these examples contain elements of black swans, black elephants, and butterflies; they also illustrate concepts of fragility and catastrophic complexity
- In each case the situation looked dire in the moment, but new institutions and tools emerged to manage risk
- There are lessons in these events for the current COVID-19 pandemic:
 - Risk is best understood through a combination of models and mindset
 - Complex systems are rife with interconnected risks
 - Human psychology is a key factor, and something very difficult to model
 - Risk mitigation and adaptation can transform seemingly impossible problems
 - Many risks are global; neither viruses nor carbon, for example, respect borders



A final thought...calamities can be avoided

- Y2K
- Montreal Protocol on Substances that Deplete the Ozone Layer
- Tylenol poisoning (1982) and tamper-resistant packaging
- “Nutrition Facts” labeling
- Depletion of fish stocks – cod recovery
- Lead paint phaseout
- 4 Florida hurricanes 2005
- Center for Near Earth Objects



From Top: Weekly World, NASA, NASA



Evolving the risk management paradigm

“Reports that say that something hasn't happened are always interesting to me, because as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. **But there are also unknown unknowns—the ones we don't know we don't know.** And if one looks throughout the history of our country and other free countries, it is the latter category that tend to be the difficult ones.”

- Donald Rumsfeld



McKinsey: Six problem-solving mindsets

Faced with an inscrutable problem? Try a more creative approach.

September 2020
McKinsey
Quarterly

Six problem-solving mindsets for very uncertain times

Even the most inscrutable problems have solutions—or better outcomes than have been reached so far. Here's how the best problem solvers crack the code.

by Charles Conn and Robert McLean

Great problem solvers are made, not born. That's what we've found after decades of problem solving with leaders across business, nonprofit, and policy sectors. These leaders learn to adopt a particularly open and curious mindset, and adhere to a systematic process for cracking even the most inscrutable problems. They're terrific problem solvers under any conditions. And when conditions of uncertainty are at their peak, they're at their brilliant best.

Six mutually reinforcing approaches underly their success: (1) being *ever-curious* about every element of a problem; (2) being *imperfectionists*, with a high tolerance for ambiguity; (3) having a *"dragonfly eye"* view of the world, to see through multiple lenses; (4) pursuing *occurrent behavior* and experimenting relentlessly; (5) tapping into the *collective intelligence*, acknowledging that the smartest people are not in the room; and (6) practicing *"show and tell,"* because storytelling begets action (exhibit).

Here's how they do it.

1. Be ever-curious

As any parent knows, four-year-olds are unceasing askers. Think of the never-ending "whys" that make little children so delightful—and relentless. For the very young, everything is new and wildly uncertain. But they're on a mission of discovery, and they're determined to figure things out. And they're good at it! That high-energy inquisitiveness is why we have high shelves and childproof bottles.

When you face radical uncertainty, remember your four-year-old or channel the four-year-old within you. Relentlessly ask, "Why is this so?" Unfortunately, somewhere



McKinsey
& Company

<https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/six-problem-solving-mindsets-for-very-uncertain-times>



A better crystal ball



A Better Crystal Ball

The Right Way to Think About the Future

J. Peter Scoblic and Philip E. Tetlock

Every policy is a prediction. Tax cuts will boost the economy. Sanctions will slow Iran's nuclear program. Travel bans will limit the spread of COVID-19. These claims all posit a causal relationship between means and ends. Regardless of party, ideology, or motive, no policymaker wants his or her recommended course of action to produce unanticipated consequences. This makes every policymaker a forecaster. But forecasting is difficult, particularly when it comes to geopolitics—a domain in which the rules of the game are poorly understood, information is invariably incomplete, and expertise often confers surprisingly little advantage in predicting future events.

These challenges present practical problems for decision-makers in the U.S. government. On the one hand, the limits of imagination create blind spots that policymakers tend to fill in with

J. PETER SCOBLIC is Co-Founder of Event Horizon Strategies, a Senior Fellow in the International Security Program at New America, and a Fellow at Harvard's Kennedy School.

PHILIP E. TETLOCK is Leonore Annenberg University Professor at the University of Pennsylvania. Co-Founder of Good Judgment, and a co-author of *Superforecasting: The Art and Science of Prediction*.



J. Peter Scoblic



Philip E. Tetlock

From Top: New America, Wharton Press

“When it comes to anticipating the future, then, the United States is getting the worst of both worlds. It spends untold sums of money preparing yet still finds itself the victim of surprise—fundamentally ill equipped for defining events, such as the emergence of COVID-19.”

<https://www.foreignaffairs.com/articles/united-states/2020-10-13/better-crystal-ball>

Improving forecasts

- Tetlock published a study in 2005 demonstrating experts had trouble outperforming “dart-tossing chimpanzees” when it came to predicting global events
- Hedgehogs vs. foxes: those who are surest often fare the worst
- Instead of asking experts to evaluate long-term scenarios as a whole:
 - Develop questions which pass the clairvoyance test (sharply defined)
 - Break down future states into a series of clear and forecastable signposts
 - Use “question clusters” which are diverse
 - Draw upon a group of experts instead of individuals
 - Regularly update scenarios and forecasts reflecting if events follow signposts
- Blend scenario analysis and probabilistic forecasts, “A scenario planner’s conviction that the future is uncertain need not clash with a forecaster’s quest to translate uncertainty into risk.”



Closing thoughts on managing risk

- There is no way we can anticipate what exposures may face us decades in the future, so we need to **design systems for resilience and adaptability**
- **Focus on building resilience:**
 - Opposability (be able to hold conflicting ideas in one's mind, be open to new ideas)
 - Adaptability (do not fear saying "I was wrong" or "I have changed my mind")
- **Study history** and see how new technology is affecting old perils
- **Think stochastically** – embrace uncertainty!
- Brooks – **develop new skills** to deal with catastrophic complexity
- Taleb and Traverton – **understand why volatility signals stability, and vice versa**
- McKinsey – **adopt a problem-solving mindset** based on their six approaches
- Scoblic and Tetlock – use **clusters of sharply defined questions**



**Thank you
Discussion**

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