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An Epidemiological Approach Against the Phantom Safety Syndrome

Reflections following the Washington airport accident on January 19, 2025

In this "Industrial Safety Tribune", Jean Pariès, former scientific director of Foncsi and former deputy head and investigator-in-charge at the BEA (French Bureau of Enquiry and Analysis for Civil Aviation Safety), shares some thoughts following the preliminary NTSB report on the mid-air collision that occurred on January 29, 2025, in Washington. Is it too soon to issue recommendations? Was this accident predictable? Does it reveal a deeper dysfunction in certain safety models? By revisiting this accident and analyzing the initial reports, Jean Pariès introduces a lesser-known concept: the "phantom safety syndrome".

On January 29, at 8:48 PM local time, a mid-air collision occurred near Washington's Reagan National Airport between a Bombardier CRJ700 regional jet operated by PSA Airlines (a subsidiary of American Airlines), and a Sikorsky UH-60 Black Hawk helicopter of the US Army. The airplane was on final approach to runway 33, while the helicopter was conducting a training flight and transiting near the threshold of the same runway. The accident was especially striking due to live footage from a surveillance camera being broadcast worldwide.

Donald Trump's Interpretation

The following morning, during a self-organized press conference with no concrete information about the accident's scenario, Donald Trump offered the world his "opinion" on the incident. According to him, air traffic controllers were not the "brilliant geniuses" they should have been — "of the highest standard of intelligence and psychology" — because, under the Obama and Biden administrations, the FAA (Federal Aviation Administration) had enforced an anti-discrimination and pro-diversity recruitment policy. As a result, Trump claimed, the control towers had become overrun by individuals with disabilities: *"including hearing and vision impairments, missing limbs, partial and total paralysis, epilepsy, severe intellectual disabilities, psychiatric disorders, and dwarfism — all supposedly qualified to control the aircraft flowing into our country. […] Then there was a group within the FAA — another story — that determined the workforce was too white and made a concerted effort to change that within the administration, and to do so immediately. This was under the Obama administration, just before I came in. And we took care of African Americans, Hispanic Americans — we took care of everyone at a level never seen before."*

Regarding the helicopter pilots, Trump simply stated: *"There was a piloting problem. The night was very clear, visibility was optimal. The American Airlines aircraft had its landing lights on. I could see it on the Kennedy Center video. […] I have helicopters. You can stop a helicopter very quickly. It could have climbed or descended. It could have turned, but the turn it made was clearly the wrong one, and it did almost the opposite of what it was told to do…"*. In short, the

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world is reassured. The man who once suggested making COVID patients drink bleach has lost none of his talent, and aviation safety in the United States is about to take a giant leap forward.

The NTSB Preliminary Report

About a month later, on March 7, in the same city of Washington, the NTSB (National Transportation Safety Board) published its Preliminary Investigation Report on the accident, as well as an Urgent Safety Recommendation Report. The clarity and rigor with which these documents were written — and presented to the press by NTSB Chair Jennifer Homendy — are truly remarkable. All NTSB communications regarding the investigation are accessible on their website's dedicated page, showcasing the organization's professionalism at its highest level.

Still, one might ask: isn't the NTSB doing the same thing as Trump — drawing conclusions before knowing the full story? After all, it published a preliminary report, which, while already rich in established facts, explicitly states that it is far from defining the precise accident scenario — let alone its causes. Yet it also issued urgent recommendations, calling for the immediate suspension and complete reassessment of intensive helicopter traffic serving VIPs in Washington.

> **"The simultaneous release of very preliminary findings and urgent recommendations is a well-established practice in accident investigation, especially in aviation."**

We can be reassured: this apparent similarity is superficial. The NTSB's approach is in fact the absolute antithesis of Trump's performance. The simultaneous release of very preliminary findings and urgent recommendations is a well-established practice in accident investigation, especially in aviation. It illustrates the coexistence and interplay of two distinct but complementary analytical approaches used to draw lessons from an accident. However, this distinction isn't always easy to grasp — and this NTSB case offers a highly instructive example. I will use it as a pedagogical opportunity in what follows. We'll also see how this distinction extends beyond retrospective event analysis to include proactive detection of hidden failure modes — notably what I call the "phantom safety syndrome", which the Washington accident also exemplifies.

Causal Analysis vs. Critical Model Review

I mentioned the coexistence and interplay of two types of analyses in the feedback process. The first is causal analysis, aimed at understanding failure — identifying the causes of the incident/accident in order to formulate safety recommendations that aim at eradicating those causes and reduce recurrence probability.

The second is a critical analysis of the safety model — questioning, based on empirical evidence, the validity of the strategy and underlying principles that are supposed to ensure safety. The goal is to first clarify the safety model — the assumed conditions for success — and then ask: "Given what we've learned from these incidents/accidents, can we still trust this safety model and continue similar operations with tactical fixes, or must we stop everything (e.g., grounding the Boeing 737 Max) and rethink the strategy?"

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These two approaches are clearly complementary. Understanding the causes of an accident helps assess the likelihood of recurrence and answer the key question: "Is this serious — or is this very serious?" Conversely, knowing about a generic weakness in the safety model can guide the search for causes in a specific case.

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But the two approaches also differ in how they relate to urgency. Often — and sometimes necessarily — one must wait for a detailed understanding of an accident's immediate causes before implementing targeted corrections. However, one cannot wait to implement protective measures and correct systemic flaws. That's why urgent recommendations are issued as soon as they appear justified by the causal analysis, even before it is complete. It's also why an approach other than causal analysis is often useful or even necessary to validate or invalidate the safety model — and that's where the critical model analysis comes into play.

Clinical vs. Epidemiological Analysis

To better understand these approaches and their relationship, consider a different domain where the goals are also to diagnose problems (illnesses) from more or less obvious signals (symptoms) and correct the situation (treatment): healthcare. Doctors conduct clinical analyses: they examine an individual patient, detect symptoms, ask about context, gather information about ongoing outbreaks, produce a diagnosis, and propose treatment. Epidemiologists, on the other hand, perform… epidemiological analyses: they consolidate all doctors' diagnoses, track how their frequency and distribution evolve over time and space, and rely on transmission laws and knowledge about diseases' severity and contagiousness.

Equating "causal" and "clinical", as well as "critical" and "epidemiological" analysis may be more metaphorical than scientific, but it's a fruitful comparison — it highlights the scale and perspective differences between the two. Viewed through this lens, the two NTSB documents illustrate the connection well.

The Preliminary Report focuses on collecting facts and context — the first step in clinical analysis: symptom gathering, before the diagnosis. The Urgent Recommendations, on the other hand, stem mostly from an epidemiological analysis. Indeed, at that stage, the direct or organizational causes of the accident aren't yet known. The recommendations examine how the safety model — meant to protect joint helicopter transit and final approach operations on runway 33 — actually functioned, and what level of risk was explicitly or implicitly accepted. This becomes both an analytical and statistical critique.

The Helicopter Trajectory Window at Washington Airport

The NTSB's *Urgent Recommendation* Report includes a key diagram showing, in vertical cross-section, the relative position of the standardized helicopter flight envelope beneath the nominal aircraft approach path.

The dashed inclined line represents the nominal final approach trajectory of aircraft over the Potomac River toward runway 33, as defined and displayed to flight crews by the PAPI (Precision Approach Path Indicator). This trajectory is viewed from the helicopter "Route 4" path — nearly a 90° angle. The vertical axis shows altitude, the horizontal axis, distance to the runway threshold. The gray block represents the window through which helicopter trajectories are supposed to pass (perpendicular to the diagram's plane).

What this graph shows is crucial. Even if helicopters strictly respect the maximum regulatory altitude of 200 feet, the vertical separation with aircraft is only about 75 feet — and even less if the helicopter shifts closer to the runway threshold, which is quite possible since lateral positioning relative to the riverbank is not specified in the procedure. Furthermore, the PAPI defines the nominal trajectory of the pilot's eye. It is never followed perfectly, and the actual trajectory may therefore be slightly below. And moreover, in the final approach pitch attitude, a significant part of the aircraft is located several meters below the pilots' eyes.

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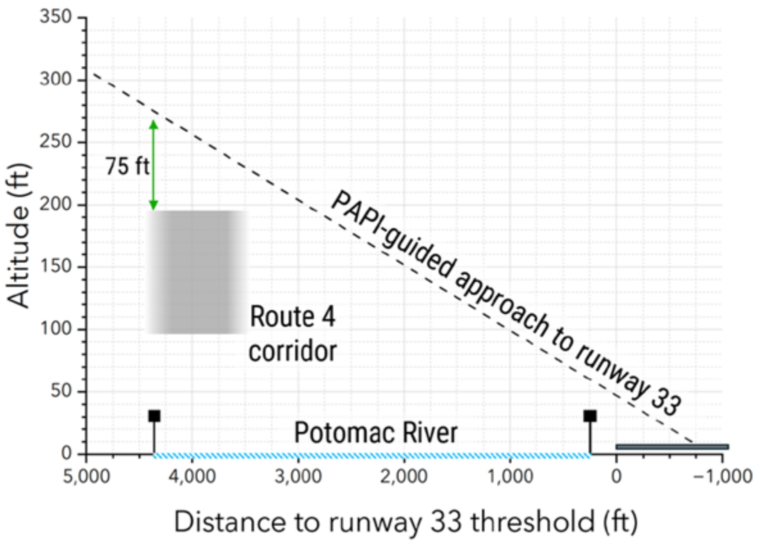

Figure 3. Cross section showing the notional separation between Route 4 and a PAPI-guided visual approach to runway 33, according to FAA charts and aerial photogrammetry analysis.

Consequently, the 200-foot helicopter transit altitude limit cannot in any case guarantee sufficient vertical separation. It can only act as a secondary risk mitigator. The primary principle must therefore be lateral separation, ensured when necessary, by altering the helicopter's path to cross behind the aircraft path — under air traffic control instruction. This implies an attentive controller, effective ground-to-air communication, and good visual identification of the aircraft by the helicopter crew. It appears that at least the last two conditions failed in this accident.

Rising Incidents Between Aircraft and Helicopters

A "loss of separation" occurs when both the lateral and vertical distances between two aircraft fall below predefined safety minimums — here, 1 nautical mile laterally (1,850 meters) and 400 feet vertically.

Between 2011 and 2024, an inventory of reported separation losses between helicopters and landing aircraft confirms the fragility of this collision-avoidance model. Over this period, voluntary safety reporting programs and FAA data identified 15,214 incidents (more than 1,000 per year!) involving lateral separation <1 NM and vertical separation <400 ft. 85 incidents featured lateral separation <500 meters and vertical separation <200 ft — considered severe separation losses. On average, each month, at least one conflict resolution alert was triggered — an immediate emergency avoidance instruction from the onboard TCAS (Traffic Collision Avoidance System), such as: "descend, descend" or "climb, climb".

Based on this, the NTSB concluded that simultaneous helicopter transit and aircraft landings on runway 33 represent an intolerable risk under current conditions. It therefore urged an immediate halt to the relevant helicopter route segment ("Route 4") and a complete redesign of helicopter-aircraft operations at Washington airport — regardless of the exact causes of the January 29 collision, which remain under investigation.

"It is not always necessary to understand an accident's detailed causality to define corrective actions."

This example clearly illustrates the dual nature of post-accident conclusions. It is not always necessary to understand an accident's detailed causality to define corrective actions. That doesn't mean causal analysis is useless — it remains essential to identify more targeted, usually tactical, fixes. Example: improving ground-air communication or aircraft positioning.

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However, detailed causal understanding can be slow or even unattainable — yet strategic, urgent corrections to the safety model may still be possible. In this case, the NTSB's epidemiological analysis will lead to a complete 4D redesign of relative flight trajectories, fundamentally altering exposure to risk. That's a strategic correction. An extended epidemiological approach could also examine the safety status of joint helicopter/aircraft operations at other airports beyond Washington D.C.

Why Didn't Anyone Change This Sooner?

At this point, common sense forces the obvious question: "If this was so clear, why did it take such a disaster to prompt change? Why didn't the same logic work before the accident?" The answer is complex and partly speculative. But we can't blame a lack of awareness — the NTSB simply used existing data. Nor may we blame FAA or airport authorities' negligence — even if U.S. culture accepts somewhat higher risk exposure than Europe (with stricter protections), this was VIP helicopter traffic, and U.S. aviation safety standards are world-class.

We must instead look at decision-making biases that distort or hide what becomes glaringly obvious after an accident. This has been well-studied in organizational psychology and cognitive science. Without diving into that literature here, I'll suggest a specific hypothesis about safety models, and a methodological remedy.

In early investigations of the Washington accident, significant attention was paid to whether the helicopter had respected the 200-foot altitude limit — as if vertical separation were the main safety principle. But, as we've seen from the trajectory analysis, this could not ensure safe separation. In other words, the safety model may have been partially fictitious: the system "worked," but perhaps not for the presumed reasons. The lack of past collisions was not due to the effectiveness of vertical separation enforced by a 200-foot flight ceiling — but rather due to the very low probability of vertical co-presence between a helicopter and an aircraft, meaning that lateral separation, managed if necessary by air traffic control, was doing most of the real anti-collision work.

The Phantom Safety Syndrome

This, in my view, illustrates an insidious, and ultimately not so rare, systemic safety failure mode, which I propose to call: "Phantom Safety Syndrome". This occurs when long-term positive safety outcomes appear to confirm the effectiveness of an official safety model, while in fact, success is mainly due to poorly understood — or even entirely unnoticed — contributing factors. In other words, the actual safety model is hidden. Consequently, while they may be fragile, these hidden contributors are not monitored or safeguarded.

"This occurs when long-term positive safety outcomes appear to confirm the effectiveness of an official safety model, while in fact, success is mainly due to poorly understood — or even entirely unnoticed — contributing factors."

The crash of AF 447 (Rio to Paris) falls into this pattern. Prior incidents involving total loss of airspeed indications were resolved successfully and largely seen as confirmations of the aircraft's certification assumptions: That the crew would properly understand the failure messages, enter the correct procedure (assumed to be effective), and that pilots had the skills to manually fly the aircraft at cruise altitude, possibly at night and in turbulent weather. But in reality, the success of past cases mostly depended on the crew doing nothing due to surprise and delayed understanding — with the aircraft's own inherent stability allowing it to ride out the failure. The situation was not truly understood, the procedure was not applied, and the aircraft was not flown — yet everything had appeared to "work".

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Can Phantom Safety Be Anticipated?

Anticipating the accident scenarios associated with “phantom safety” is a major challenge. We often speak of proactive safety and detecting early warning signals, but in practice, hopes of “reading weak signals” are often dashed. Why? Because we are speaking of detailed signals located deep within the causal tree, where the complexity and non-linearity of cause-effect relationships make prediction nearly impossible. In the case of phantom safety, the challenge is even greater: We can’t monitor every single safety principle in detail all the time. Our attention must be guided by alerts — and in these “phantom safety” cases, the alerts are muted by compensations we don’t even realize are happening.

We must therefore implement alert-generation mechanisms that are not purely cause based. This is where an epidemiological approach can play an essential role. In the Washington case, the NTSB’s post-accident recommendations were based on statistics on separation losses, and a critique of vertical separation as a valid safety mechanism. That sufficed after the accident — but was evidently not enough before. To be effective *proactively*, the alerting power of such findings must be strengthened. This means going beyond general statistics. A possible improvement could be to visualize separation loss points on a 3D map, filtered by contextual variables (time, day/night, weather). This might have revealed a cluster of high-risk events near runway 33, triggering a reassessment of the safety model before disaster struck.

In other words, a rigorous epidemiological approach—based on close monitoring of the safety model’s robustness in the face of known and foreseeable variations in the real world, and attentive to avoiding sampling bias—seems to offer some capacity to meet the challenge of proactivity. The implementation of such approaches may be facilitated and encouraged by the development of large-scale data collection and processing systems, as well as by advances in AI. However, it will not be possible to monitor every outbreak of every condition across the entire territory, and reasonable principles of prioritization will still need to be established.

Jean Pariès

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