Resilience, ASRS, and the Narrative about Human Error

International Confidential Aviation Safety Systems
November 12th, 2024

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Human Systems integration division

System Wide Safety

A Word about Resilience

- Reliable
- Robust
- Resilient

System Wide Safety

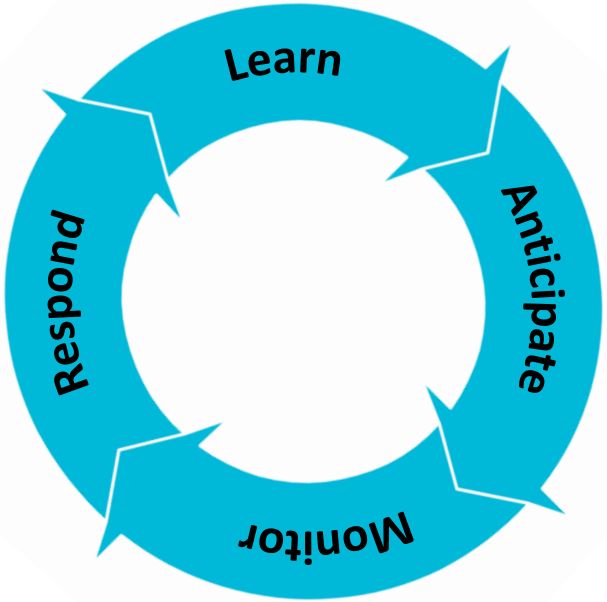
A Word about Resilience

- Anticipate
- Monitor
- Respond
- Learn

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Cycle of
Resilient Performance



Weather as an added variable

Captain and I were on a flight from DFW to ZZZ. We were given the usual route on our flight release with nothing special. However, during our taxi, we were advised to monitor the re-route frequency for there was a change in our flight plan due to weather. The Captain stopped the aircraft, advised tower of our intentions and we began to monitor. This is where the confusion occurred. The ATC worker in the reroute frequency said something along the lines of "Aircraft X, amendment to your route …

ACN: 2038123

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Weather as a stressor

We had been picking our way through thunderstorms and were heading towards ZZZZZ into ZZZ at 12,000 ft. We had been talking with ATC about the deviations for weather and had just let them know we were back towards ZZZZZ. Shortly after this radio call ATC called us and said descend and maintain 10,000 ft. I read this back to them with our call sign. The Captain put 10,000 ft. into the FCU and we started down. When we started down I was thinking we are still a ways from ZZZZZ and we normally cross ZZZZZ at 14,000 ft. We were off our normal course into ZZZ because of the deviations and I thought maybe this is what the controller wanted? As we descended though I thought the terrain looked too close. I was about to key up the mic and ask ATC to confirm the altitude they wanted us to descend to when they called us back and told us we took another aircraft's clearance and we needed to climb back to 12,000 ft…

ACN: 2032417

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Dealing with the weather

Being vectored for approach to Runway XX from the west. Aircraft initially at 8,000 feet and 210kts. We were vectored north of convective activity and issued a descent. Our radar showed small convective activity and we asked and received clearance to deviate left 10 degrees which was enough as per our radar display. Our radar however, without time to alter course, then showed the convective activity to be much larger. I made the required PAs to passengers and Flight Attendants who were already seated. I attempted to alter course but was unable in time to avoid the convective activity. The aircraft initially pitched up exceeding the autopilot capability and I had to take over as Pilot Flying. Our altitude deviation was well in excess of 300 feet high and our speed might have exceeded 250 knots but never exceeded the aircraft limits. We rolled initially but not more than 30 degrees. While I had some control of the aircraft throughout and manually regained pitch after the autopilot disengaged, I initially was unable to control the altitude without the probability of aircraft over speed as we were climbing and accelerating; thrust was idle, aircraft rapidly accelerating and climbing.

ACN: 2021352

Dealing with the weather (and equipment)

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Avoiding the weather

During the initial climb we had a ECAM caution AIR ENG1 BLEED ABNORM PR. Captain was the flying pilot. After ECAM actions completed, I was flying pilot. After the Captain's conversation with Maintenance and Dispatch, the Captain and company made the decision to return to ZZZ as part of the ECAM was to stay out of icing conditions. There were several thunderstorms in the area and difficult to stay out of known and unknown icing. At night. An overweight landing was made as per procedures in the QRH to a safe landing.

ACN: 2017620

Avoiding the weather (with equipment problem)

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A Word about Weather Resilience

- It's almost never just the weather!

  (ATC, equipment, ramp/MX/dispatch/cabin)
- Resilient strategies may not be weather-specific
- If you can - stop!

  STOP= Stop – Think – Options – Plan
- If it doesn't feel right – check!
- If you are not sure – ask!
- If you can avoid it – do!
- Don't hesitate to exercise your authority.
- And sometimes, you just have to hold on, so keep flying!

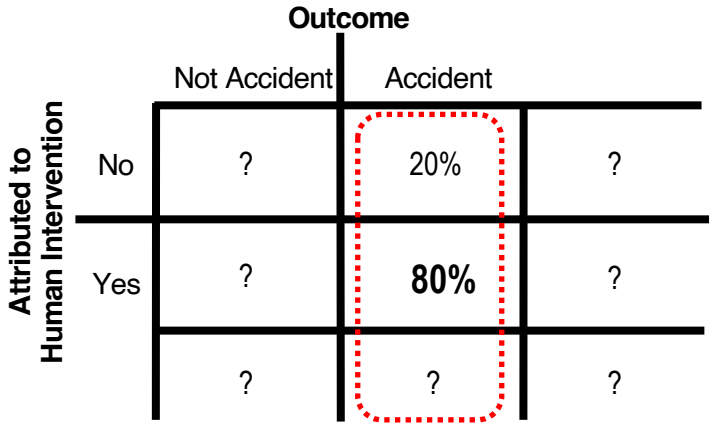
How to “Change the Narrative…”

A quick thought experiment

- Human error has been implicated in up to 80% of accidents in civil and military aviation[1]

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- Pilots intervene to manage aircraft malfunctions on 20% of normal flights[2]

Attributed to Human Intervention	Outcome: Not Accident	Outcome: Accident	
No	80%	20%	?
Yes	**20%**	**80%**	?
	?	?	?

A quick thought experiment

- Human error has been implicated in up to 80% of accidents in civil and military aviation[1]
- Pilots intervene to manage aircraft malfunctions on 20% of normal flights[2]
- World-wide jet data from 2007-2016[3]
  - 244 million departures
  - 388 accidents

Attributed to Human Intervention	Outcome: Not Accident	Outcome: Accident	
No	80%	20%	?
Yes	**20%**	**80%**	?
	243,999,612	**388**	**244,000,000**

(1) Weigmann & Shappell, 2003; (2) PARC/CAST, 2013; (3) Boeing, 2017

A quick thought experiment

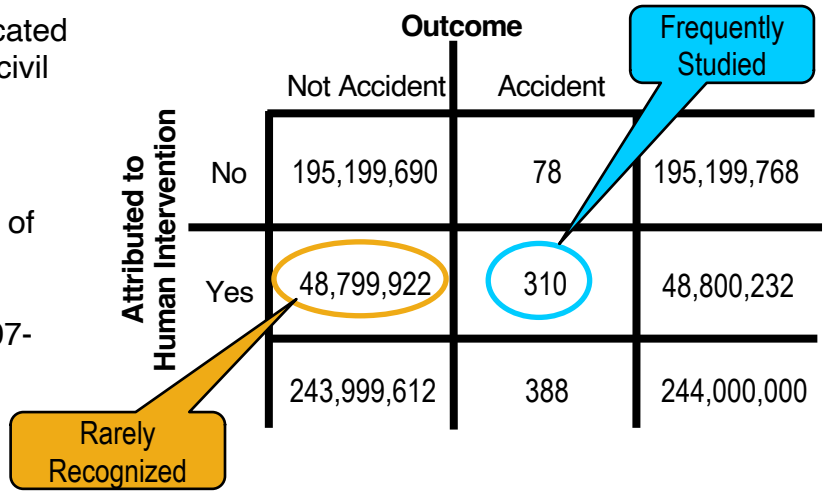
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Attributed to Human Intervention	Outcome: Not Accident	Outcome: Accident	
No	195,199,690	78	195,199,768
Yes	48,799,922	310	48,800,232
	243,999,612	388	244,000,000

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Pilots *Produce* Safety Far More Often than They *Reduce* It

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Learn more: Holbrook, J. (2021). Exploring methods to collect and analyze data on human contributions to aviation safety. In *Proceedings of the 2021 International Symposium on Aviation Psychology.* https://aviation-psychology.org/wp-content/uploads/2021/05/ISAP_2021_Proceedings_FINAL.pdf

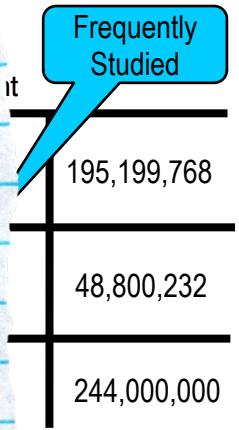
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Pilots intervene to keep flights safe from aircraft malfunctions ~157,000 times for every time that human error contributes to an accident!



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Revisiting Our Assumptions on Human Performance

- Human error has been implicated in 70% to 80% of accidents in civil and military aviation (Weigmann & Shappell, 2003)

Actually, 100% of accidents are due to human limitations!

More importantly, 100% of successful operations are due to human capabilities!







Revisiting Our Assumptions on Human Performance

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  Actually, 100% of accidents are due to human limitations!

  More importantly, 100% of successful operations are due to human capabilities!

- Pilots intervene to manage aircraft malfunctions on 20% of normal flights (PARC/CAST, 2013)

  Pilots intervene in various ways on 100% of flights!



Revisiting Our Assumptions on Human Performance

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This is a *conservative* estimate!

Revisiting Our Assumptions on Human Performance

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Pilots intervene to keep flights safe from aircraft malfunctions ~157,000 times for every time that human error contributes to an accident!

This is a *conservative* estimate!

$$\frac{\text{(All non-accidents)}\ 243{,}999{,}612}{388\ \text{(All accidents)}} = 628{,}865$$

Human capabilities keep flights safe more than **628,865** times for every time that a human limitation contributes to an accident!

This estimate is more indicative of operational realities!

How to "Change the Narrative…"

…that people are the safety problem

IMPLICATIONS

- Designs intended to "protect" the system from "error-prone" humans can design-out the capability for the human to effectively intervene/adapt, which is a far more common behavior.
- Designs intended to replace humans often fail to acknowledge or understand the capabilities that humans routinely contribute to safety, and therefore fail (or don't have the data/knowledge) to design that into the system.
- Designs that leverage a "safety pilot" who will only intervene to "save the day" in rare failure events fail to consider how our cognitive systems work and how they evolved to work. Such designs are setting up the safety pilot to fail.

How to "Change the Narrative…"

…that people are the safety problem

PROPOSED SOLUTION

- In today's aerospace industry, *data talks*
- When the only data that are available are about human failure, then data-driven designs only consider that humans fail
- To change the narrative, we need new data and new ways to examine data
  - Specifically, data on how (and the processes by which) humans *contribute* to safety

IMPACTS

- Safer system designs
- Increased organizational awareness
- Improved operational learning/training
- System safety that is robust and resilient to future changes

Approaches that Have Been Implemented

- **American Airlines** – Learning & Improvement Team (LIT)
- **Japan Airlines** – Resilience Operation Monitoring (ROM)
- **Southwest Airlines** – Safety & Learning Advancement Team (SLAT)
- **Delta Air Lines** - Integrating Learning From All Operations into the Components of a Safety Management System
- **Cathay Pacific** – Operational Learning Review (OLR)

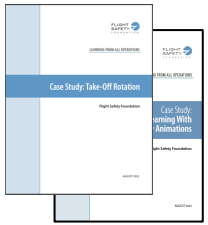
Learning from All Operations: Resources

Publications

FLIGHT SAFETY FOUNDATION

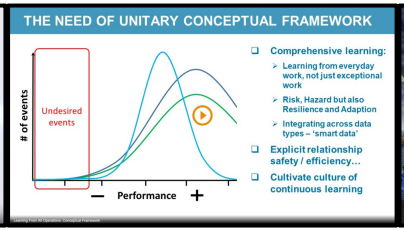






https://flightsafety.org/toolkits-resources/learning-from-all-operations/







https://nescacademy.nasa.gov/video/15d835918c84470bbf3177d0c4db65961d

Thank you!

Immanuel.Barshi@nasa.gov