

Gathering Safety Intelligence from Relevant Safety Events



ICAO SMP

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System Wide Safety

A quick thought experiment



- Human error has been implicated in up to 80% of accidents in civil and military aviation¹



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



A quick thought experiment



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A quick thought experiment



- Human error has been implicated in up to 80% of accidents in civil and military aviation¹
- Pilots intervene to manage aircraft malfunctions on 20% of normal flights²
- World-wide jet data from 2007-2016³
 - 244 million departures
 - 388 accidents

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

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



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		Outcome		
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Attributed to Human Intervention	No	195,199,690	78	195,199,768
	Yes	48,799,922	310	48,800,232
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Pilots *Produce* Safety Far More Often than They *Reduce* It



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Frequently Studied (points to 310)

Rarely Recognized (points to 48,799,922)



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



- Human error is responsible for up to 70% of aircraft accidents and mishaps

$$\frac{48,799,922}{310} = 157,419$$

- Pilots intervene to prevent aircraft malfunctions 157,419 times for every 310 flights

- World-wide aircraft accidents in 2016³

- 244 regional
- 388 commercial

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

Frequently Studied

195,199,768

48,800,232

244,000,000

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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System Wide Safety

Revisiting Our Assumptions on Human Performance



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And 100% of successful operations are due to human capabilities!



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Pilots intervene in various ways on 100% of flights!



System Wide Safety

Revisiting Our Assumptions on Human Performance



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This is a *conservative* estimate!

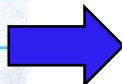


Revisiting Our Assumptions on Human Performance



$$\frac{48,799,922}{310} = 157,419$$

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



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

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

This is a *conservative* estimate!

This estimate is more indicative of operational realities!



So what counts as a “relevant” safety event?



Expanding the notion of a Safety Event

- Expanding our understanding of what constitutes a relevant “safety event” beyond losses of safety.
- Traditional safety thinking is focused on learning from failures and errors (Safety I).
- How is safety successfully created and sustained (Safety II)?
- Can we leverage that congruently with what we learn from when safety breaks down (LAO)?



Expanding the notion of a Safety Event



- Expanding the sampling rate.
- Expanding the representativeness of the data collected.
- Expanding our ability to make informed trade offs between minimizing the bad and maximizing the good.
- Expanding our ability to measure safety (there is no such thing as a “non-event”).



Expanding the notion of a Safety Event



Sampling representative safety data at high rate helps organizations :

- increase opportunities and frequencies of learning.
- recognize slow changes.
- respond before unwanted events occur.
- understand the adaptations frontline personnel make to keep the system operating.

This promotes the design of effective policies, procedures, and technologies.



System Wide Safety

State of the practice in aviation



- FSF LAO initiative
- ENAIRE, Lufthansa, JAL, AAL, Delta, Southwest, Frontier, IndiGo, EUROCONTROL, Cathay Pacific, etc.
- Research initiatives at NASA and academia
 - <https://ntrs.nasa.gov/api/citations/20190033462/downloads/20190033462.pdf>
 - https://corescholar.libraries.wright.edu/cgi/viewcontent.cgi?article=1018&context=isap_2021

There are also expanding related initiatives in healthcare



System Wide Safety

Is it possible to learn from a single event?



The Safety Times

Investigating Incidents is Wrong!

Dangerously misleading!

RESILIENCE POST

**There is nothing
to be learnt from
a single event!**

Is it possible to learn from a single event?



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RESILIENCE POST

**There is nothing
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The importance of something is only possible to judge when it is seen in perspective (FSF, 2022). To have perspective we will need to learn about the entire spectrum of 'things' and to learn continuously in time. **This means to consider realised events, or events that happen, as drawn from a distribution of possible events. In this way, a true understanding requires attention to the whole distribution of possible events, including those that did not occur.** This is learning by distributions, it builds understanding of what is the underlying distribution and helps to know if what you observe is an outlier and how it related to the entire performance and, ultimately, how it can be better managed. **This is Learning from All Operations.**

An Example from GAPPRI

Air Traffic Controller changed the departure runway while the aircraft was already taxiing and cleared the aircraft to taxi to the runway holding positions.

Flight crew **stopped the aircraft taxiing** and got engaged in the preparation, rebriefing, performance calculations and settings **while the aircraft was stationary**

The flight crew stopped the aircraft at the runway holding position.

Is this good? How do we know?



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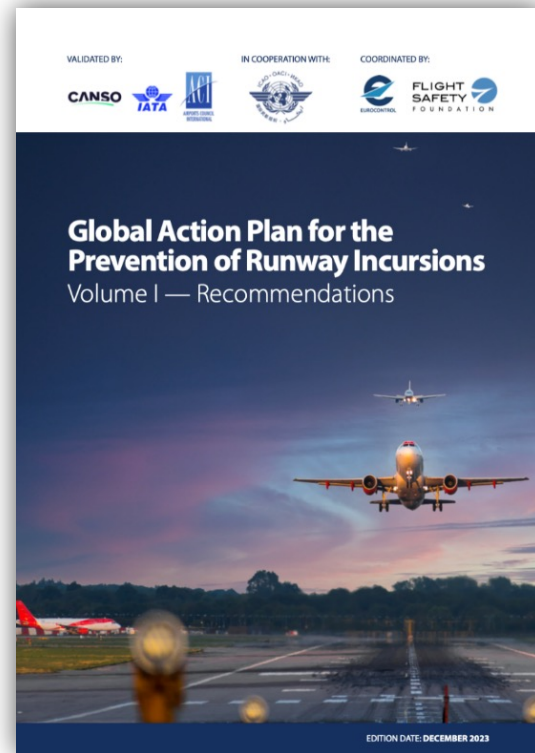
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Humans are inherently resilient. They naturally integrate information. Professionals view a single event not as an isolated occurrence but as an indicator, assessing what it reveals about safety assumptions and the architecture of protections.

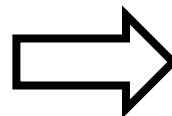


LAO Framework: Pressures, Adaptations, Manifestations

PRESSURES

AND

ADAPTATIONS



MANIFESTATIONS

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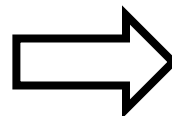
Upon reaching the runway holding
position, the flight crew overlooked
the fact that they had not received
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Flight crew **stopped the aircraft
taxiing** and got engaged in the
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The flight crew stopped the
aircraft at the runway holding
position.

Using the principles of Learning from All Operations:

AO13: Record and verbalise the clearance so that all crew members have a shared understanding of the routing, including when pilot-off-air.

AO9: When a take-off runway change is received whilst taxiing, the set-up, planning, performance calculations and re-briefings should be performed by flight crew without rushing and when the aircraft is stationary

ANSP19: When planning runway assignment change for departing or arriving traffic, consider the time the flight crew will need to prepare/rebrief. As far as practicable, change to the runway assignment to aircraft taxiing for departure should be avoided.

Learning from all operations is the only reliable way to sustain and improve safety where needed!

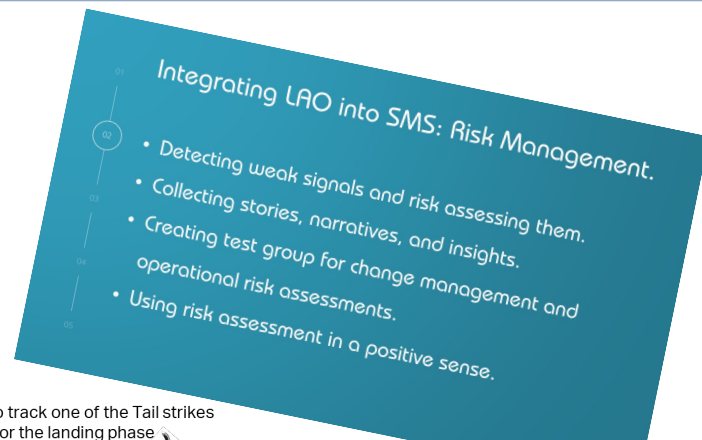
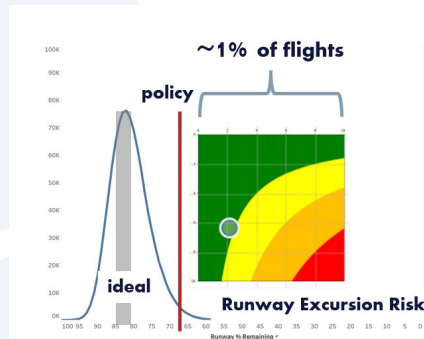
(Our organization doesn't explicitly do it - why are we still safe?)

People do it...Organisations could do it more explicitly!

4 I's of implementing LAO:

- ☐ **Incremental:** start with small-scale implementations.
- ☐ **Integrated:** utilise and leverage what already exists in the SMS.
- ☐ **Informed:** learn from a spectrum of situations and conditions, gain insights from others, and communicate information at all levels.
- ☐ **Investing:** Allocate dedicated, earmarked resources—there will be a positive return not only for safety but for overall organizational performance.

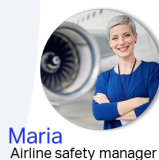
INTEGRATING LAO IN SMS - EXAMPLES



Performance Indicator



4 Potential

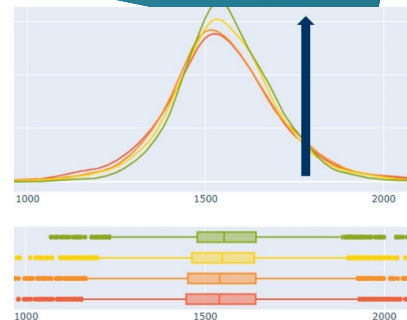


She wants to track one of the Tail strikes precursors for the landing phase



● In 68% of landings, the flare starts between [30-20 ft]

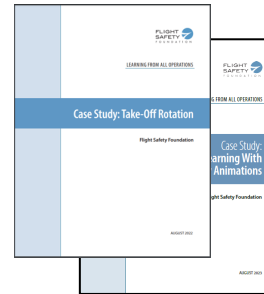
● In 20% of landings, the flare starts between [60-50 Ft]



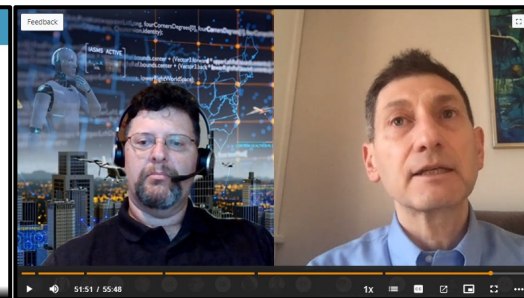
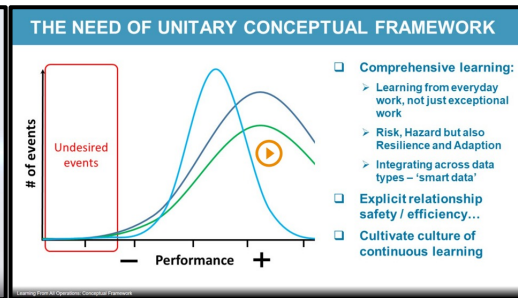
Learning from All Operations: Resources



Publications



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



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



System Wide Safety

Key Take-Aways



- When we characterize safety only in terms of errors and failures
 - We ignore the vast majority of human impacts on the system
 - We restrict opportunities to learn
 - Our design decisions and safety policies are affected
- When we *systematically* restrict opportunities to learn, not only do we learn less and less often, but we can draw misleading conclusions



Key Take-Aways



- Learning from all operations is critical to informing system designs, policies, and procedures that effectively preserve the capability for humans to intervene/adapt to sustain safe operations.
- We can “change the conversation” about safety
 - by recognizing that people are the primary source of resilience in the system,
 - by expanding our understanding and definition of what constitutes a “safety event.” (how about a “learning event”?),
 - and by demonstrating practical and sound new approaches to data collection and analysis, and to learning.





Thank you!

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System Wide Safety

Safety I and Safety II



Traditional Safety Thinking (Safety I)	Safety II Thinking
Focused on ensuring that “as few things as possible go wrong”	Focused on ensuring that “as many things as possible go right”
Humans are a source of errors and hazards: Control and correct	Humans are a source of flexibility and resilience: Learn and adapt
Variability is a threat—minimize it	Variability is normal—manage it
Focus on incident rates	Focus on learning
Focus on what we don’t want: injuries and incidents	Focus on what we do want: how safety is created; how problems are solved
Procedures are complete and correct	Procedures are under-specified and must be interpreted and adapted
Systems are well designed, work as designed, and are well maintained	Systems are complex and will degrade; there will always be flaws and glitches

