Swiss Cheese & Safety

By: Nick Papadopoli

Some holes due to active failures

HAZARDS

Other holes due to latent conditions

Accident

SUCCESSIVE LAYERS OF DEFENSES
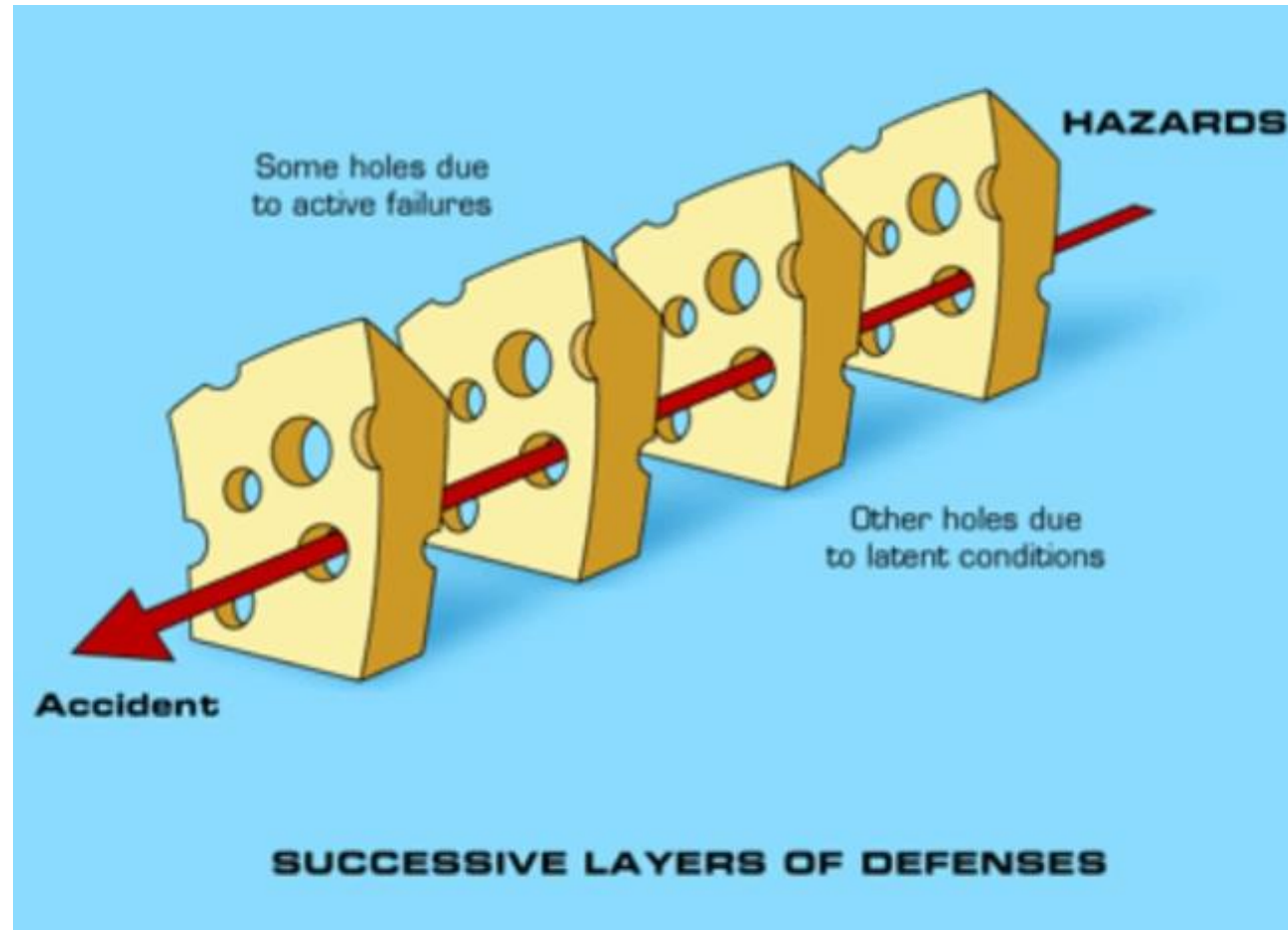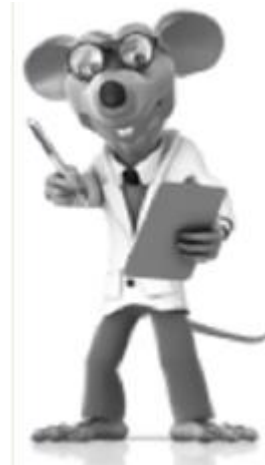
The Purpose & Plan

- Presentation is designed to initiate thinking
- Watch short videos & graphics
- Interactive (mic or chat)
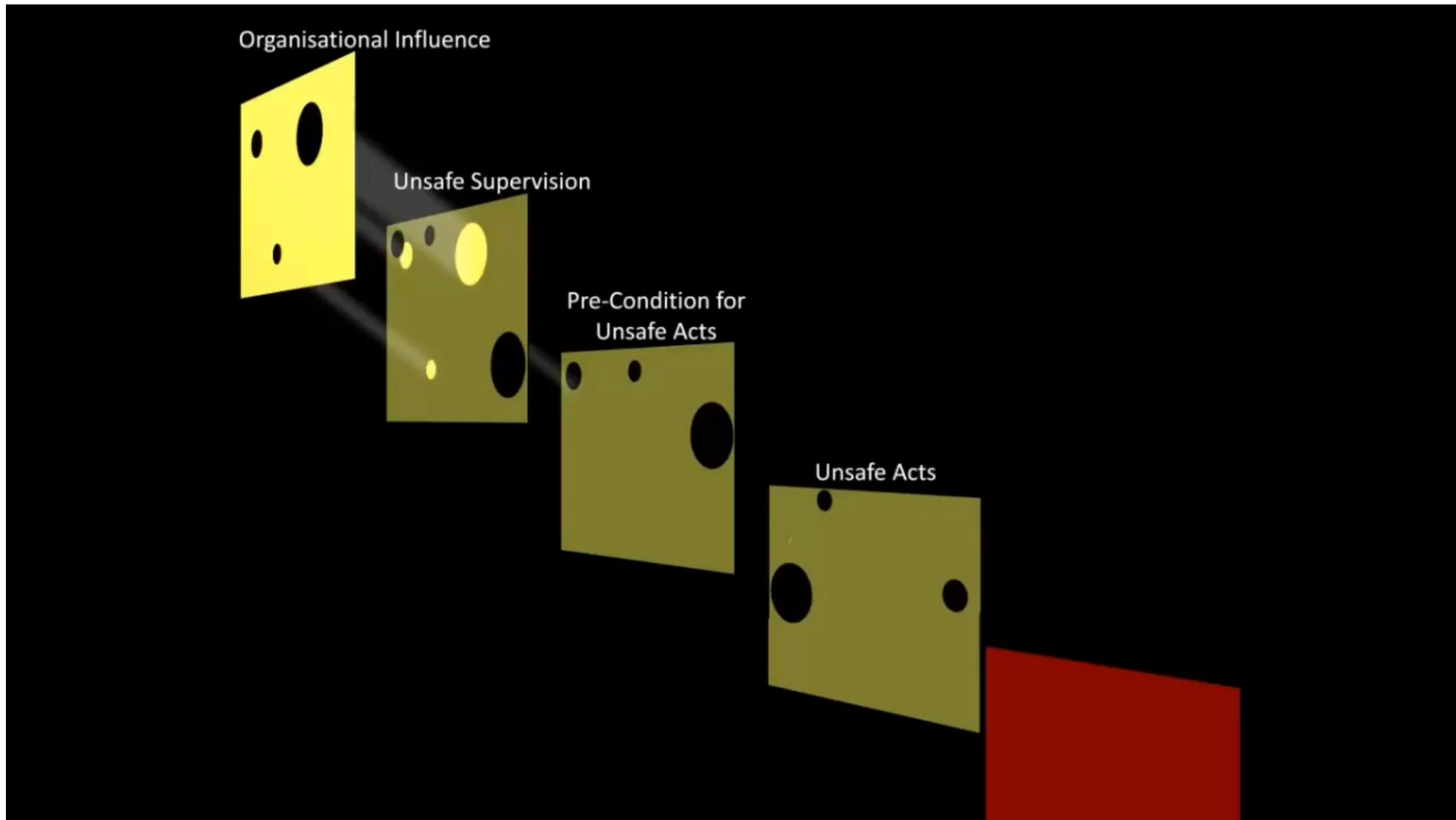- Review / Discussion / Comments

Why this?

- The "Swiss Cheese Model" is a term used to describe risk management and human error.

- Understanding the Swiss Cheese Model helps build resilience.

- To create a culture where risks are managed proactively through constant vigilance.
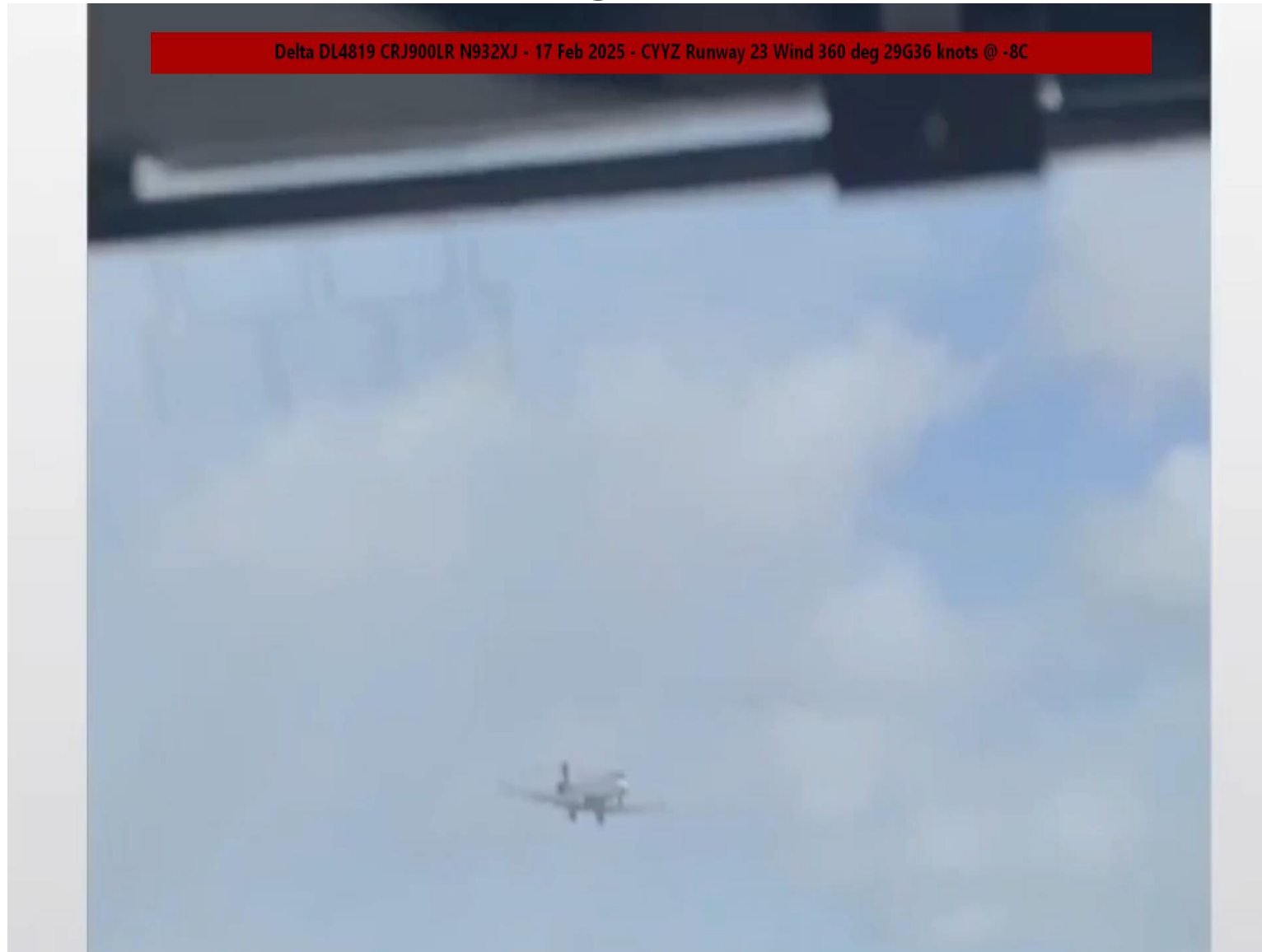
Swiss Cheese Model

Source: Prof. James Reason

Delta CRJ900LR Landing Crash CYYZ – 17 Feb 2025

Delta DL4819 CRJ900LR N932XJ - 17 Feb 2025 - CYYZ Runway 23 Wind 360 deg 29G36 knots @ -8C

Source: Pilot from waiting aircraft

DCA Mid-Air Collision UH-60 & CRJ700 — 29 Jan 2025
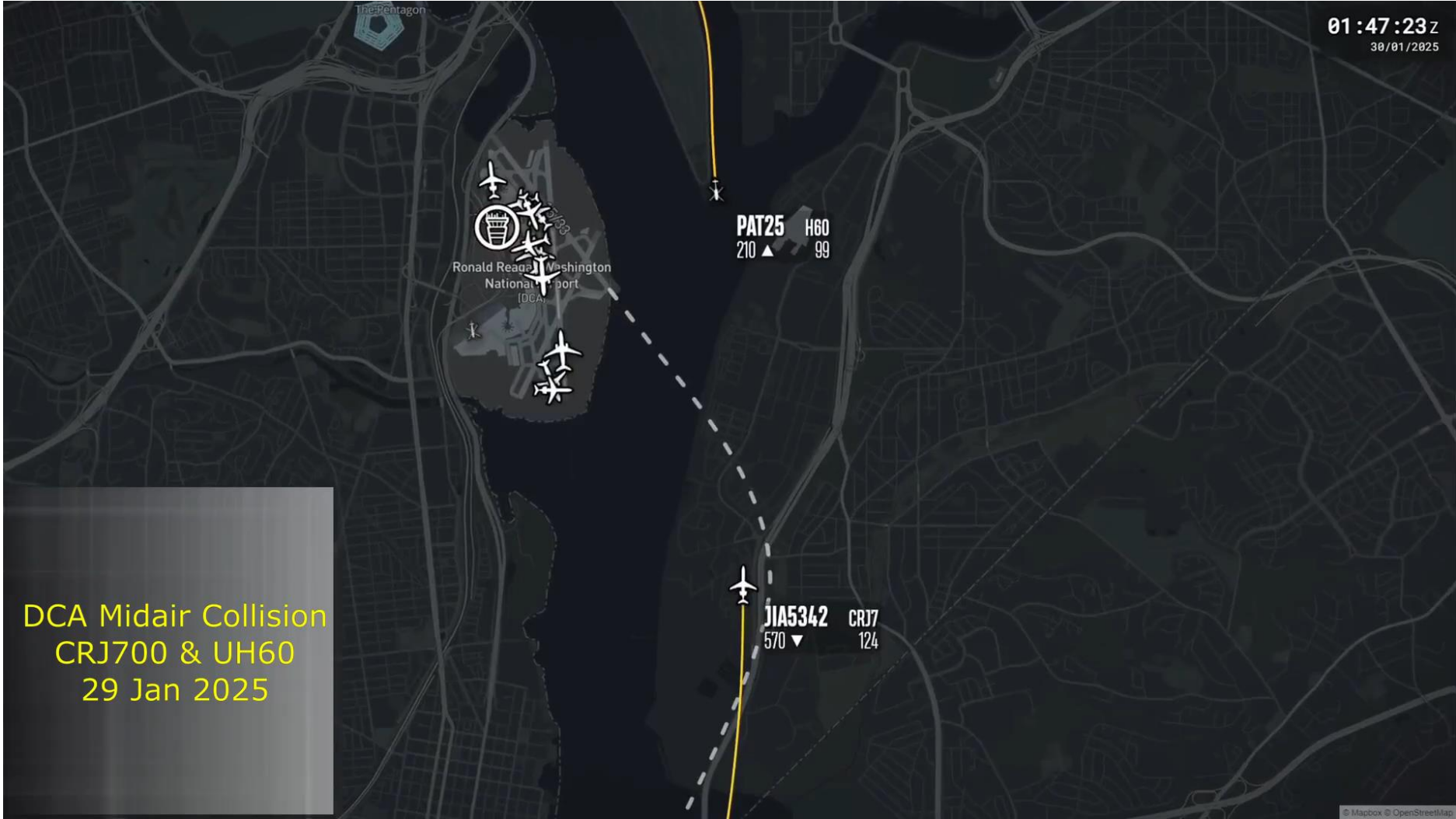
Source: AirTrafficVisualised YouTube Channel

The "Swiss Cheese" Man

James Tootle Reason

- Passed away: 05 February 2025

- Was a British professor of psychology at the University of Manchester, from where he graduated & was a tenured professor until 2001.

- Developed a conceptual framework known as the "Swiss Cheese Model" for the description of accidents based on the notion that accidents will happen only if multiple barriers fail, thus creating a path from an initiating cause all the way to the ultimate, unwanted consequences.

- 12 Principles of Error Management

Key Elements

1. Defensive Layers:
   These layers represent safety barriers, procedures, and safeguards designed to prevent failures. Examples include policies, personal minimums, training, technology, checklists, and emergency protocols.

2. Holes in the Cheese:
   These weaknesses may arise due to human error, system design flaws, or external conditions. They can be caused by factors like fatigue, miscommunication, procedural non-compliance, or equipment failure.

3. Alignment of Holes:
   When multiple barriers fail simultaneously due to existing weaknesses, an incident or accident occurs. The alignment represents a pathway through which a hazard can bypass multiple layers of protection.
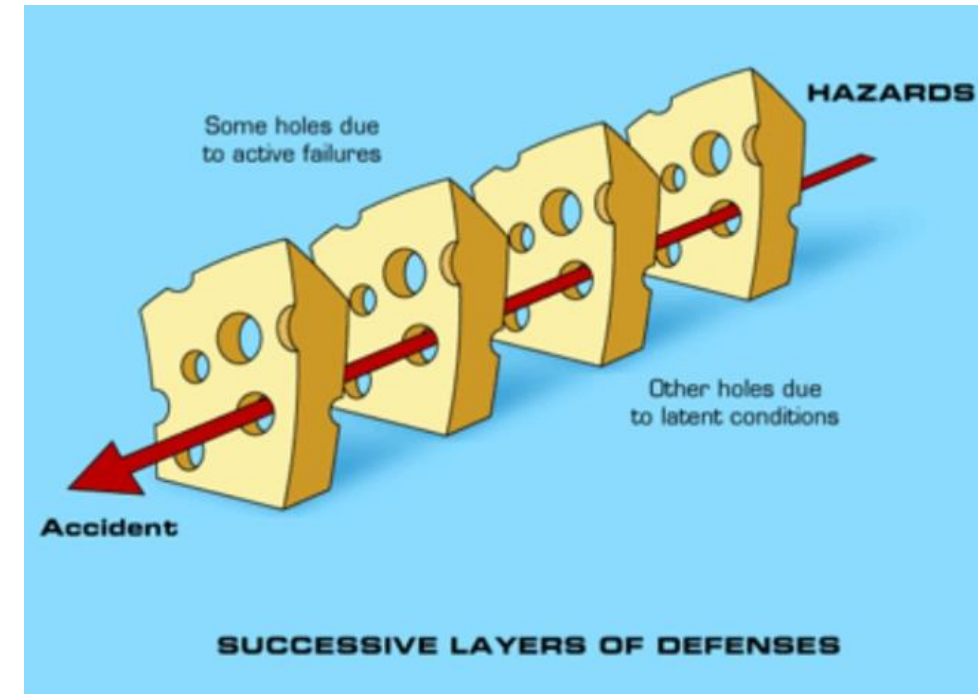
The 12 Principles of Error Management

1. Human error is both universal & inevitable

2. Errors are not intrinsically bad

3. You cannot change the human condition, but you can change the conditions in which humans work

4. The best people can make the worst mistakes

5. People cannot easily avoid those actions they did not intend to commit

6. Errors are consequences not causes

7. Many errors fall into recurrent patterns

8. Safety significant errors can occur at all levels of the system

9. Error management is about managing the manageable

10. Error management is about making good people excellent

11. There is no one best way

12. Effective error management aims as continuous reform, not local fixes

Unsafe Acts – Errors & Violations

- Decision Errors:
  These errors typically result from a lack of information, knowledge or experience.

- Skill-based Errors:
  These "doing" errors occur frequently during highly practiced activities.

- Perceptual Errors:
  Errors that occur during tasks that rely heavily on sensory information.

- Routine Violations:
  Often referred to as "bending the rules," tends to be habitual by nature, engaged in by others, and somewhat tolerated.

- Exceptional Violations:
  Isolated departures from SOPs, not typical.

Mitigating Risk

… is a critical aspect of ensuring safe flight operations.

- Pre-flight Planning
- Flight Training & Proficiency
- Aircraft Maintenance
- Weather Awareness
- Flight Planning & Decision Making
- Technology updates & backups
- Tech Proficiency
- Seek out the unknown (Curiosity)

- Risk Assessment
- Use of Checklists
- Effective Communications
- Emergency Preparedness
- Continuous Learning
- Personal Minimums
- Situational Awareness
- Risk Management Mindset

Risk Management

- Pilots who practice effective risk management have predetermined personal standards, and have formed habit patterns and checklists to incorporate them.

- Risk management is applied by identifying, monitoring, and managing potential components that affect risk, thereby allowing the pilot to be better prepared to mitigate risk.

- Pilots who understand the difference between what is "smart" or "safe" based on pilot experience and proficiency establish personal minimums that are more restrictive than the regulatory requirements.

  ➢ *For example, a pilot may legally fly in marginal VFR conditions at night even though low visibility and night hazards increase the risk for an incident or accident.*

- Poor risk management is a cause of many accidents. Thus, pilots should emphasize risk management in all types of operations.

Toronto CYYZ CRJ900 Crash – 17 Feb 2025 - FlightRadar24 ADSB

700	1670		117	225	-576	A	ADS-B	8	ADS-B
700	1670		115	225	-576	A	ADS-B	8	ADS-B
700				227	-704	N	ADS-B	8	ADS-B
700			117	225	-576	A	ADS-B	8	ADS-B
700	1670		113	225	-640	A	ADS-B	8	ADS-B
675	1670		113	225	-640	A	ADS-B	8	ADS-B
650	1670		111	225	-896	A	ADS-B	8	ADS-B
625	1670		111	225	-1024	A	ADS-B	8	ADS-B
625	1670		111	225	-1024	A	ADS-B	8	ADS-B
625	1670		110	225	-1024	N	ADS-B	8	ADS-B
625	1670		110	225	-1024	N	ADS-B	8	ADS-B
575	1670		110	225	-1024	A	ADS-B	8	ADS-B
575	1670		103	230	-256	N	ADS-B	8	ADS-B

Source: Brian Murray YouTube Channel

Toronto CYYZ CRJ900 Crash – 17 Feb 2025 - KML View

CYYZ 171900Z 27028G35KT 6SM R24L/3000VP6000FT/U BLSN BKN034 M09/M14 A2993 RMK CU6 SLP149

Source: Blancolirio YouTube Channel

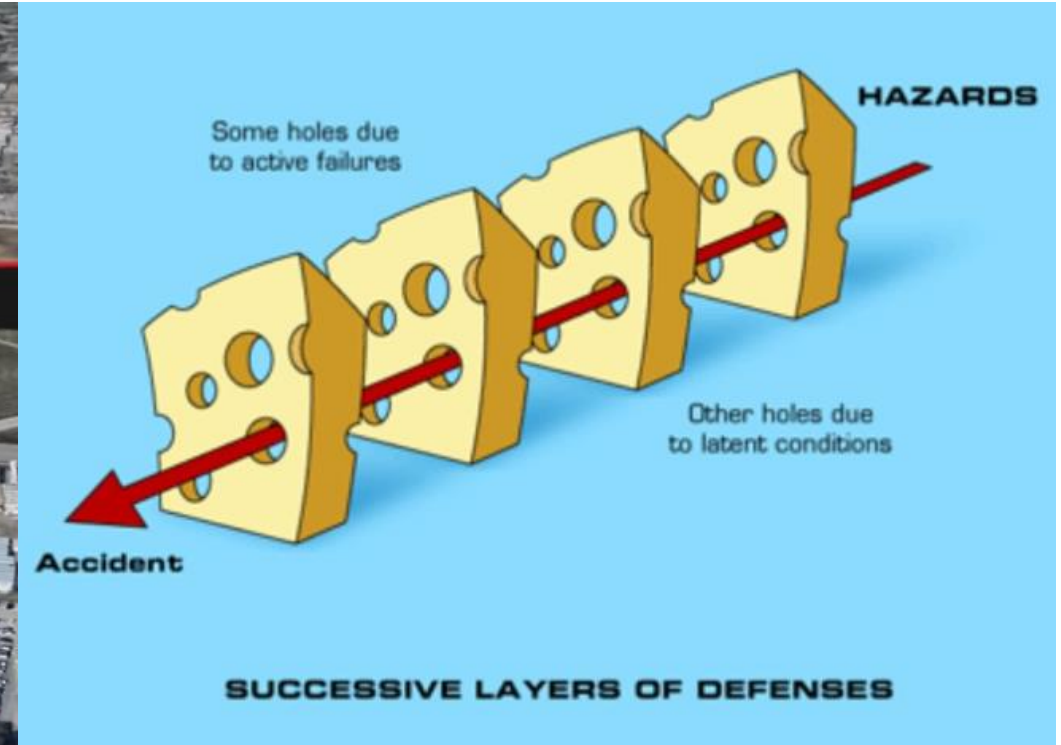# Toronto CYYZ CRJ900 Crash – 17 Feb 2025 - KML View

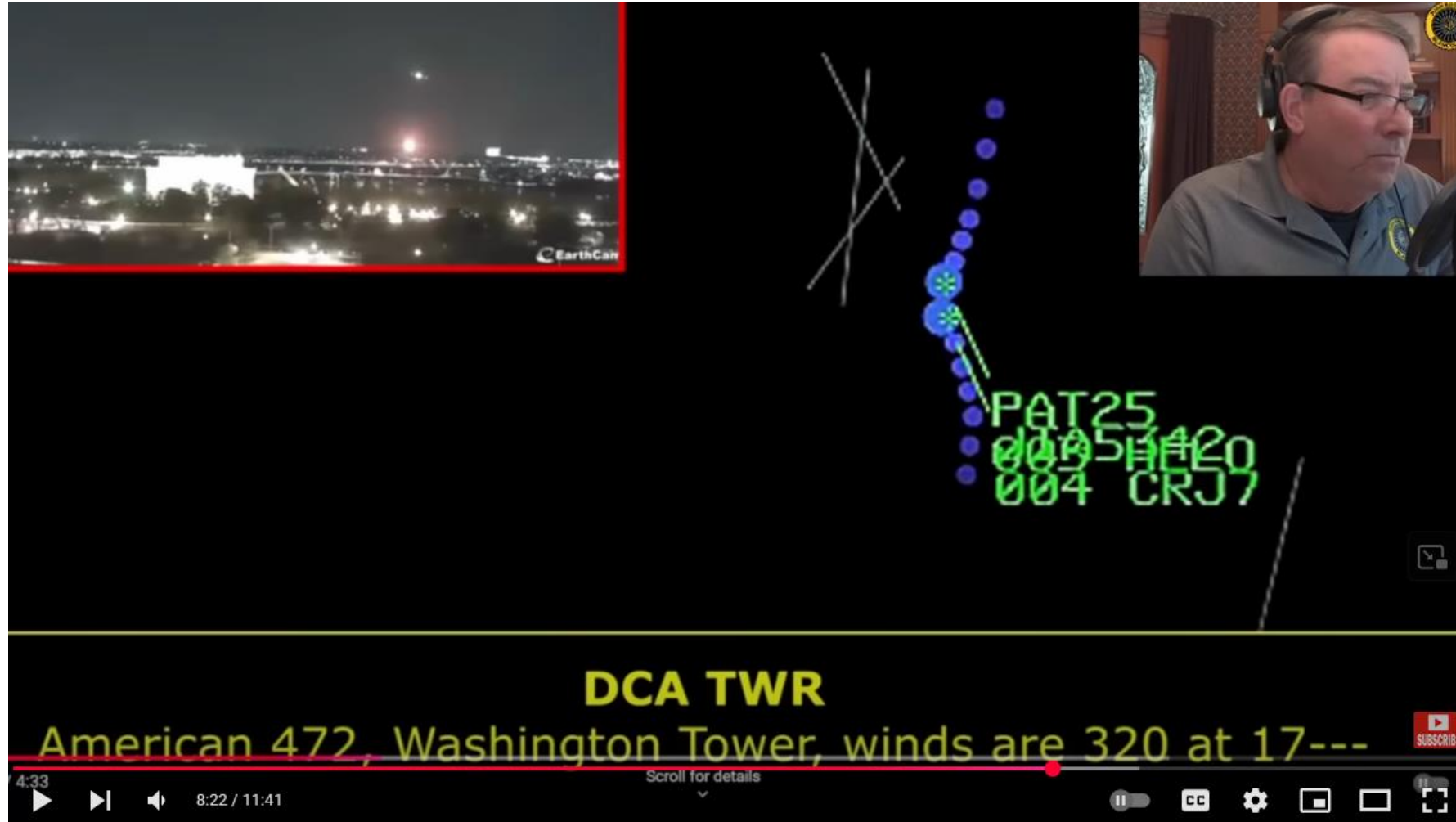Add Half The Wind Gust Factor To Your Final Approach Speed

- Winds 18KTG30
  (12 knot gust factor)
- Normal final approach speed: 80 knots
- New final approach speed: 86 knots

Failure to mitigate this Risk Factor?

HAZARDS

Some holes due to active failures

Other holes due to latent conditions

Accident

SUCCESSIVE LAYERS OF DEFENSES

Source: Blancolirio YouTube Channel

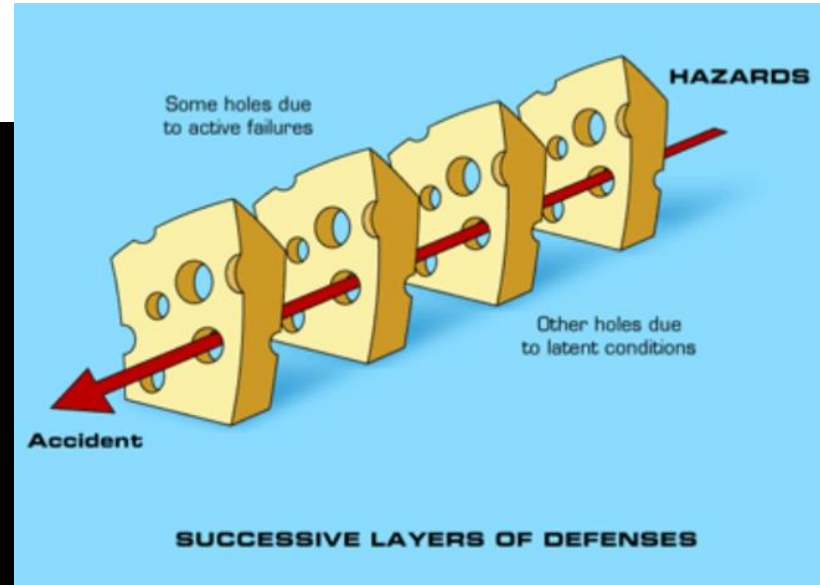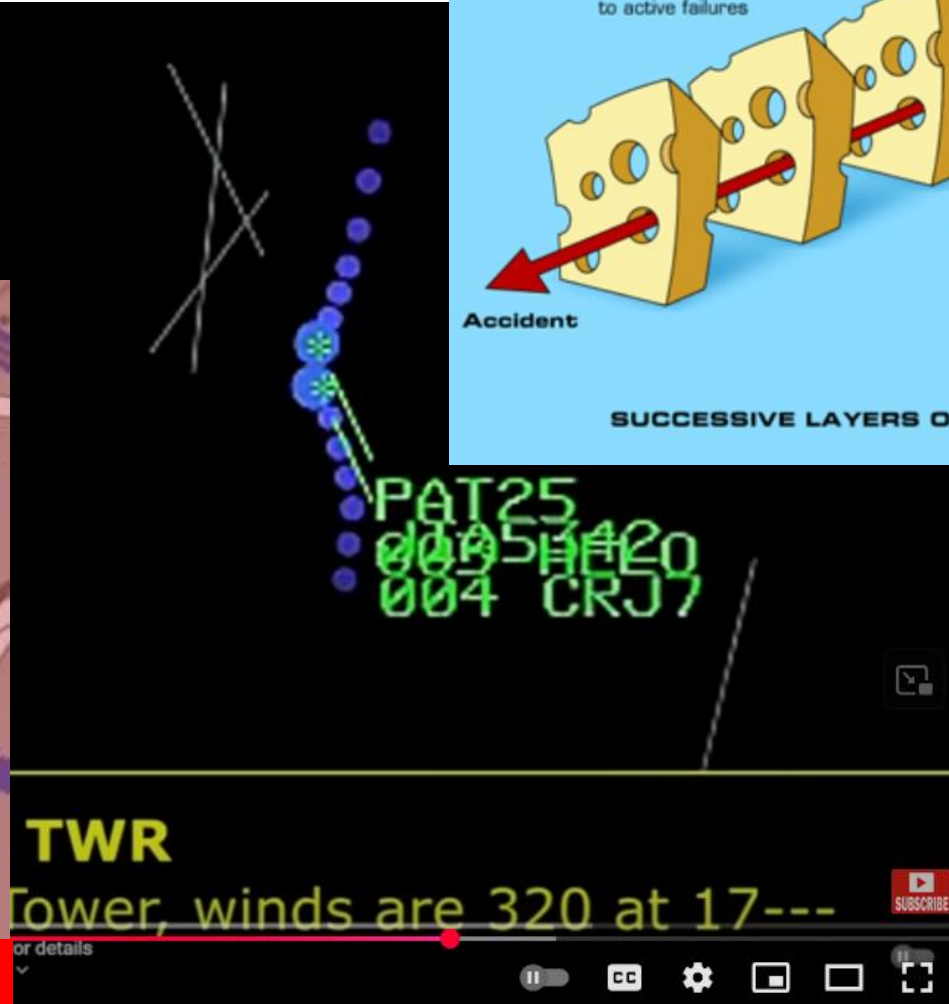# DCA CRJ700 – UH60 Midair – 29 Jan 2025

Source: Blancolirio YouTube Channel

DCA CRJ700 – UH60 Midair – 29 Jan 2025

Failure to mitigate this Risk Factor?

Source: Blancolirio YouTube Channel

Conclusion

- Accidents come in many sizes, shapes and forms. Thus, it's naïve to say that one model or one type of explanation will be universally applicable.

- Some accidents are really simple, and therefore only need simple explanations and simple models.

- Some accidents are complex, and need comparable models and methods to be analyzed and prevented.

- The bottom line is that a safe flight is a product of risk management. The higher the risk, the lower the safety.

KEEP THE BLUE SIDE UP!

Links:

James Reason's 12 Principles of Error Management
https://aerossurance.com/safety-management/james-reasons-12-principles-error-management/

Risk Mitigation: 13 Essential Strategies for Private Pilots
https://pilotrise.com/pilot-rise/risk-mitigation-13-essential-strategies-for-private-pilots/

Currency vs. Proficiency in Aviation: Understanding the Difference
https://pilotrise.com/flight-training/currency-vs-proficiency-in-aviation-understanding-the-difference/

Aviation Safety Network Report on CYYZ CRJ900
https://asn.flightsafety.org/wikibase/478376

What Caused The INSANE Descent Rate in Toronto?
Brian Murray - https://www.youtube.com/watch?v=UgIGFgeRDKk

Delta CRJ-900 Crash Toronto - 17 Feb. 2025
blancolirio - https://www.youtube.com/watch?v=oOYiQG43v64

DC Mid Air Update 2/3/25
blancolirio - https://www.youtube.com/watch?v=n9mAUks0krl

Mid-Air Collision Over Washington [ATC Audio]
AirTrafficVisualised - https://www.youtube.com/watch?v=0L7XT-U21nc

Discussion Comments