

Aircraft Survivability and Lithium Battery Risk - Prevention, Containment, and Operational Response.

From Theory to Practice: Applying Survivability
Strategies to Flight Operations and Risk Management.

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30 years in Aviation – Airline, Corporate Aviation and Manufacture
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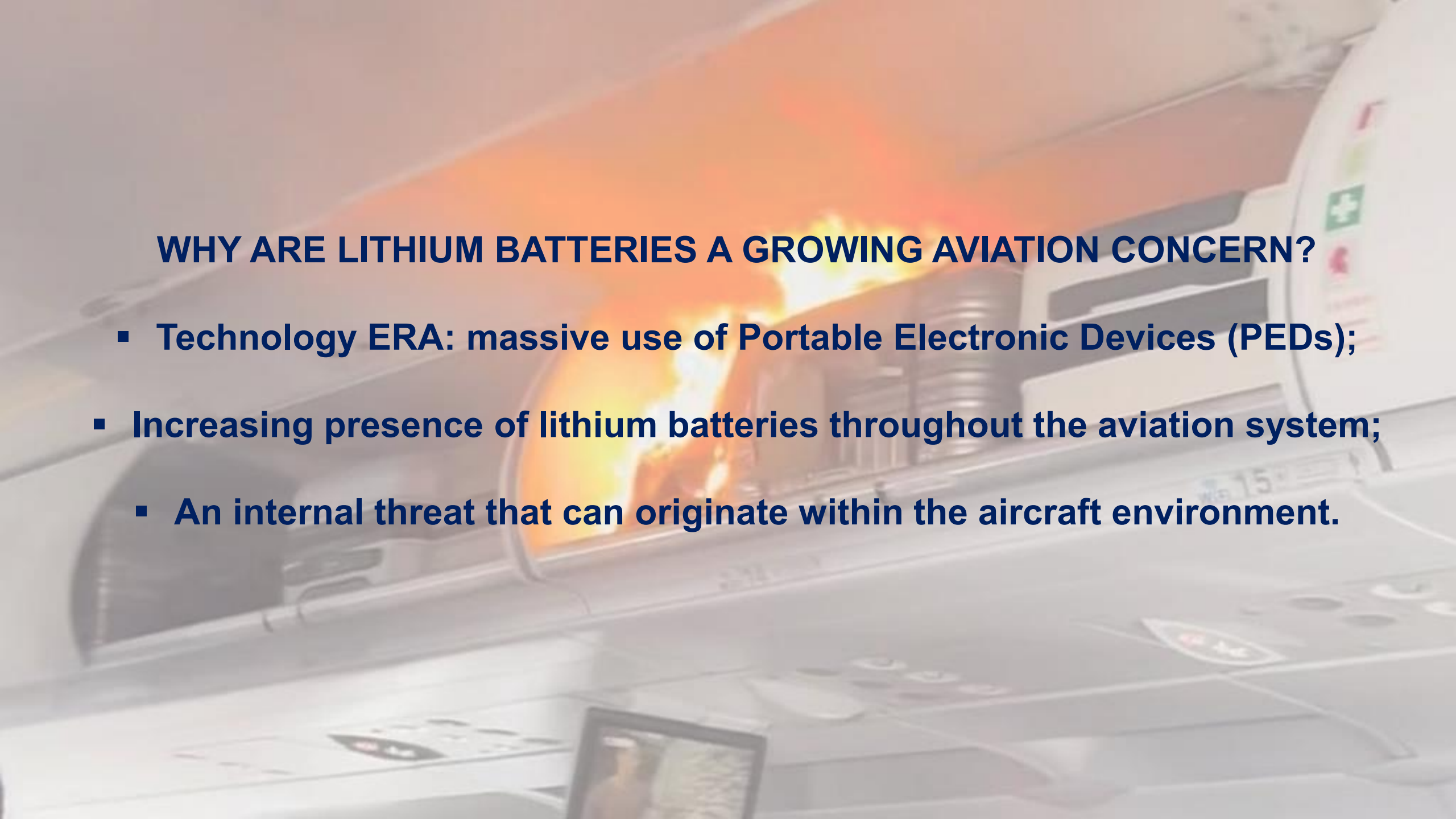


This presentation aims to:

- Present Aircraft Survivability Theory to the transportation of lithium batteries aboard civil aircraft;
- Relate the findings to ICAO, IATA, RASG and civil aviation authority requirements and guidance;
- Share practical actions to enhance aircraft survivability against lithium battery-related risks from a flight operations perspective.

Topics

- Trends
- Lessons Learned
- Common Issues
- Opportunities for Improvement
- Practical Actions



WHY ARE LITHIUM BATTERIES A GROWING AVIATION CONCERN?

- **Technology ERA: massive use of Portable Electronic Devices (PEDs);**
- **Increasing presence of lithium batteries throughout the aviation system;**
 - **An internal threat that can originate within the aircraft environment.**

INTERNATIONAL GUIDANCE, SAFETY BULLETINS AND PUBLICATIONS

- **ICAO**

Annex 18 The Safe Transport of Dangerous Goods by Air

Doc 9284 – Technical Instructions for the Safe Transport of Dangerous Goods by Air

- **IATA**

Dangerous Goods Regulations (DGR)

Lithium Battery Risk Assessment: Guidance for Operators and Passengers

- **FAA**

AC 120-80B - Firefighting of General and High-Energy In-Flight Fires (2023)

PackSafe for Passengers

- **EASA**

SIB: Passenger and Crew Awareness on the Risks of Lithium Batteries (2025)

- **RASG-PA**

Safety Issue Alert 02 - Lithium Battery Fires in Passenger Cabin (2025)



FAA – Lithium Battery Incident Data
Scan for updated information

CIVIL AVIATION AUTHORITIES

- DGAC DAN 121.106 (Chile) - [...]para combatir un incendio producto de baterías de litio es el mismo, sin importar si la batería es una recargable o no, o si es un pack de baterías. (2) Use inicialmente un extintor de halón, uno de halón reciclado o de agua para disminuir la gradiente térmica y prevenir que el fuego se expanda hacia otras baterías y materiales; y [...]
- ANAC ASO 0004-0/2025
Focus in comercial aviation, air transport recommendations for operators - safety promotion, capacitation and training, SMS and passenger awareness.

Regulations exist.

Recommendations exist.

Training exists.

Yet the risks and incidents continue.

EMERGING OPERATOR - SPECIFIC MEASURES

Recent changes introduced for power banks by airlines include:

- Enhanced passenger notification and acknowledgement.
- Certification in specific markets, such as the CCC.
- Use and charging limitations during flight.
- Quantity and capacity limits.
- Overhead-bin storage guidance.
- Visibility and accessibility during flight.
- Charging limitations during critical phases of flight.
- Specific procedures for abnormal battery indications.

However, these measures are not yet fully harmonized.



FROM ACADEMIC STUDY TO OPERATIONAL APPLICATION

Aircraft Survivability Applied to Lithium Battery Transport - Comparision Between Fixed and Rotary Wing

AS-705 – SURVIVABILITY DE AERONAVES DE ASA FIXA E DE ASAS ROTATIVAS



Aircraft Survivability aplicada ao transporte de baterias de lítio

Comparação entre aeronaves de asas fixas e rotativas

Por que o tema baterias de lítio na aviação tem sido tão estudado?



Coreia do Sul - 29/jan/2025



Prof. Cel. Rodolfo Sampaio

INTRODUÇÃO



Acidentes e eventos

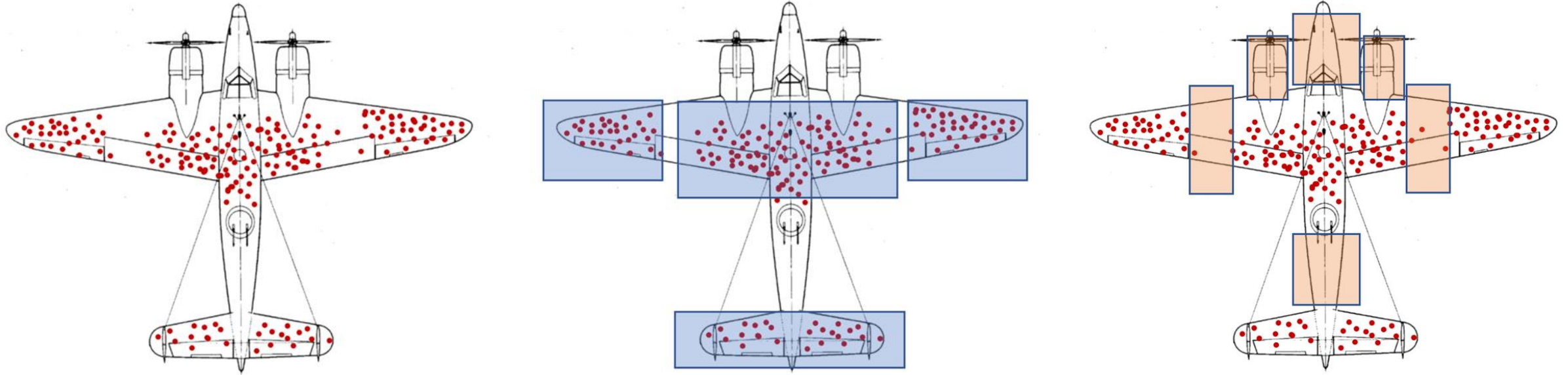
- **Air Canada 797 (02/jun/83)**
 - Fumaça no toalete traseiro
 - 23 ocupantes faleceram devido inalação fumaça tóxica
 - Instalação detectores de fumaça toaletes e treinamento de tripulantes
- **Air China (18/out/25)**
 - Atuação da tripulação
 - Divergência de atuação perante as práticas recomendadas
 - Passageiros atrapalham a atuação de combate ao fogo



Challenge: Ensuring Aircraft Survivability in Civil Aviation

THE SURVIVABILITY BIAS - ORIGINAL THEORY

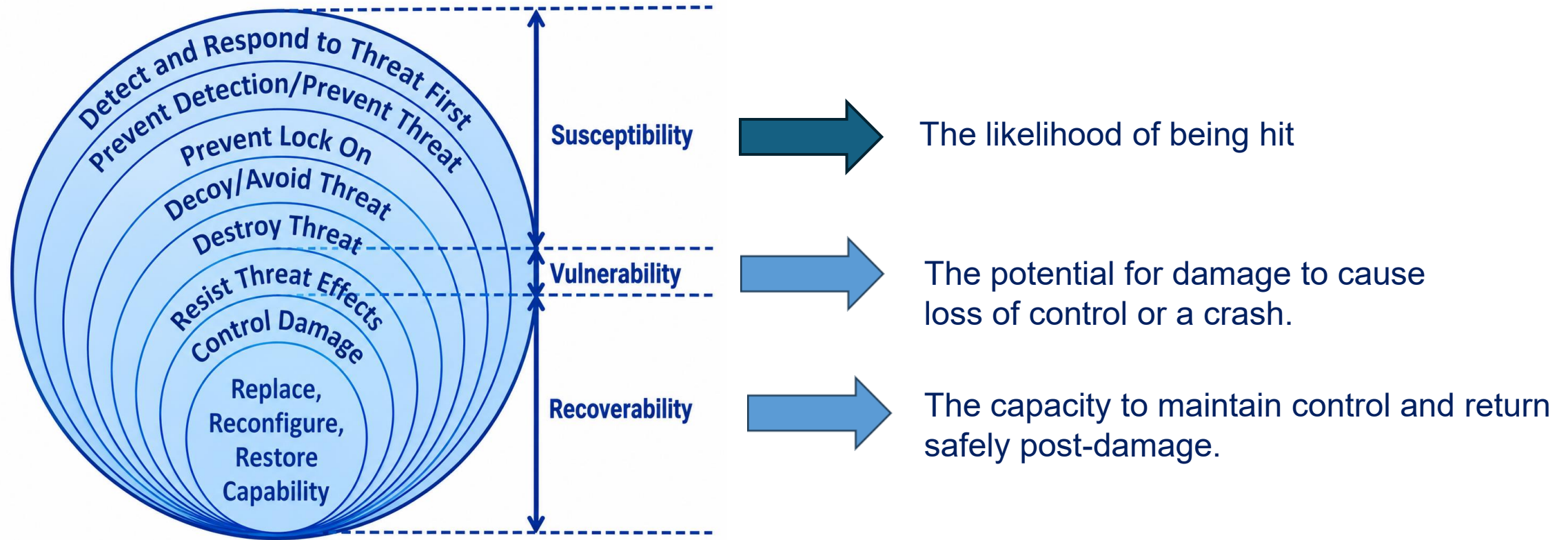
By Abraham Wald (1943) SRG



- 1. The Problem:** The military wanted to armor returning bomber planes based on where they had the most bullet holes.
- 2. The Insight:** The data only showed planes that survived. The wings or fuselage could take hits there and still fly home.
- 3. The Solution:** Engines and cockpit needed extra armor, meaning any plane hit there had been shot down.

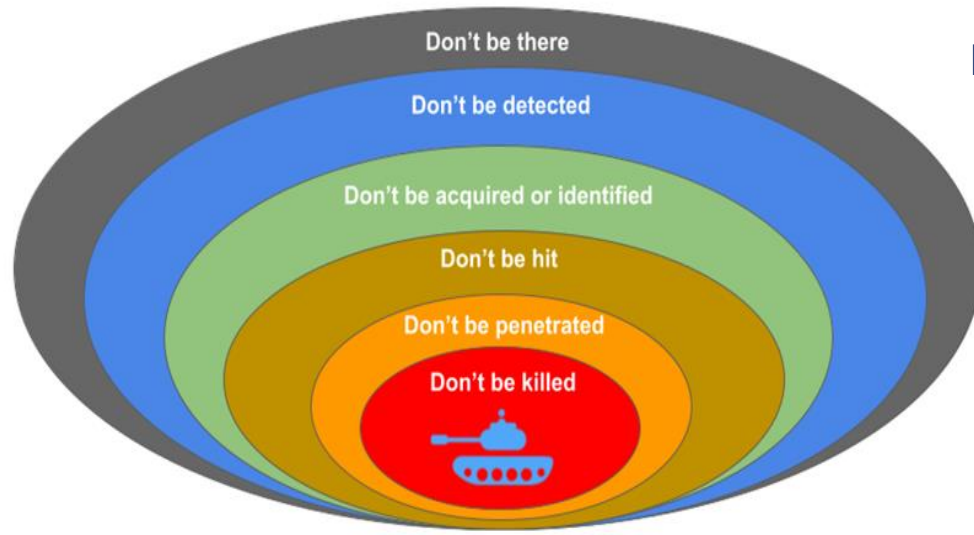
AIRCRAFT SURVIVABILITY

"A Method of Estimating Plane Vulnerability Based on Damage of Survivors".



SURVIVABILITY ONION – defense mechanisms in sequential

- Strategic mission planning to avoid threat airspace.
- Reduce detectability through camouflage.
- Prevent enemy lock-on through evasive maneuvers.
- Executing defensive maneuvers and evasive actions.
- Utilizing ballistic armor around critical components.
- Using redundant backup systems to survive.



From Hostile Threats to Aviation Risk due Lithium Battery in Aviation:

- Promoting safety culture in aviation.
- Restricting unacceptable electronic devices.
- Packaging, charge limitations and appropriate handling.
- Screening, boarding procedures, safety briefing and monitoring.
- Training, emergency response, fire-resistant and combat equipment.
- Crew coordination, maintaining operational control and land in safe.

Application of Established Survivability Concepts to Lithium Battery Risk in Aviation

Layer	Objective	Key Measures
Identify	Identify emerging hazards, exposure pathways, and potential risks	Safety report, trend monitoring, research and risk assessment
Avoid	Eliminate or reduce exposure to foreseeable lithium battery hazards	Carriage restrictions, passenger guidance, storage requirements, operator policies
Prevent	Reduce the likelihood of an adverse battery event occurring	Regulations, battery design and protection, inspection, passenger communication
Prepare	Increase operational readiness and response capability	SOPs, lithium battery fire containment equipment, ground/flight training, CRM
Detect	Enable early recognition of abnormal battery conditions or emerging events	Situational awareness, cabin monitoring, passenger reporting
Response	Contain and control the event and limit its operational consequences	Application of procedures, crew coordination, decision-making
Recover	Restore safe operational conditions and support recovery following the event	Safe landing, emergency evacuation, assistance to occupants, post-event support
Learning	Capture lessons learned, prevent recurrence, and strengthen the safety system	Occurrence review, system-wide integration, Safety Promotion, data sharing, continuous improvement

SUSCEPTIBILITY

How likely is the event to occur?

Actions that reduce the likelihood of lithium battery events reaching the aircraft.

LITHIUM BATTERY RISK SOURCES



AWARENESS & COMMUNICATION

- Passenger awareness & education
- Clear communication of requirements



SCREENING & CONTROL

- Compliance checks (capacity, quantity)
- Prohibited / restricted items control
- Security screening & visual inspection



OPERATOR PRACTICES

- Policies, procedures and SOPs
- Crew training and competency
- Passenger notification & acknowledgement



REGULATORY ALIGNMENT

- Compliance with ICAO, IATA, RASG & Civil Aviation Authorities
- Harmonization of requirements



Reduce the likelihood of the event before it reaches the aircraft.

VULNERABILITY

If it happens, how much can it affect the aircraft and operation?

Actions that limit the propagation and consequences when prevention fails.



DETECTION

- Smoke / heat detection
- Crew situational awareness
- Continuous monitoring



AIRCRAFT & OPERATIONAL DESIGN

- Cabin materials & design
- Ventilation & smoke control
- Emergency equipment and systems



CONTAINMENT

- Immediate isolation
- Fire containment tools
- Limit spread of heat and smoke



HUMAN PERFORMANCE

- Trained and prepared crew
- Effective CRM & communication
- Decision making under pressure



Limit propagation and consequences when prevention fails.

RECOVERABILITY

How effectively can the system respond, recover and learn?

Actions that maintain operational control, recover safely, and enable learning.



RECOVERABILITY → LEARNING

Recoverability is not only the ability to respond — it is the ability to learn and improve.



INTEGRATION OF FINDINGS INTO SMS



↖ **SMS connects and feeds back across all layers** ↗

Aircraft survivability provides the layered defense logic;
SMS provides the system to implement, monitor, and continuously improve those layers

HOW TO KEEP THE PASSENGER ENGAGED?

Were we properly informed about lithium battery requirements?

- Before the flight — Acknowledgement
- During boarding — Reinforcement & awareness
- After the flight — Feedback

PASSENGER AS PART OF THE SYSTEM:



AVOID · PREVENT · DETECT · RESPOND · LEARN

- **Lithium Battery Incident Data**
Versus
- **Intercepted Lithium Battery Exposures Data**



FROM EVIDENCE TO ACTION



Lithium battery risk is not confined to one aircraft, one operator, or one State. It is a shared aviation safety challenge.



Regional cooperation can transform individual occurrences into shared safety intelligence.

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Thank You!



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