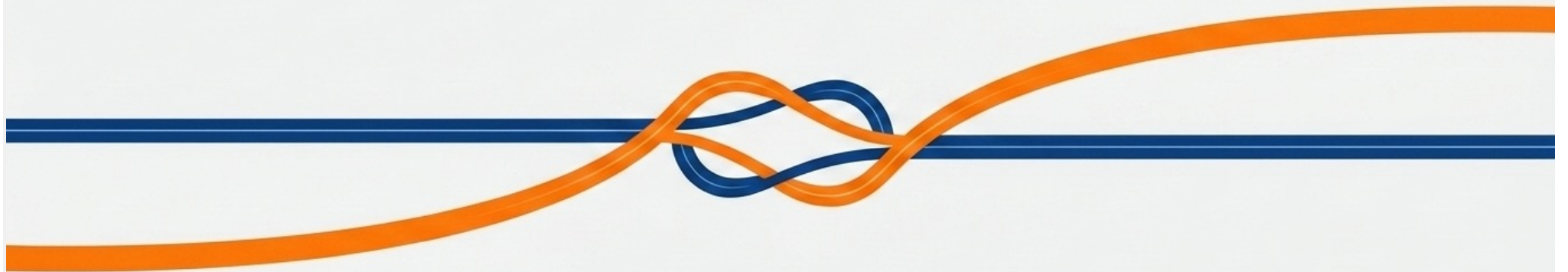
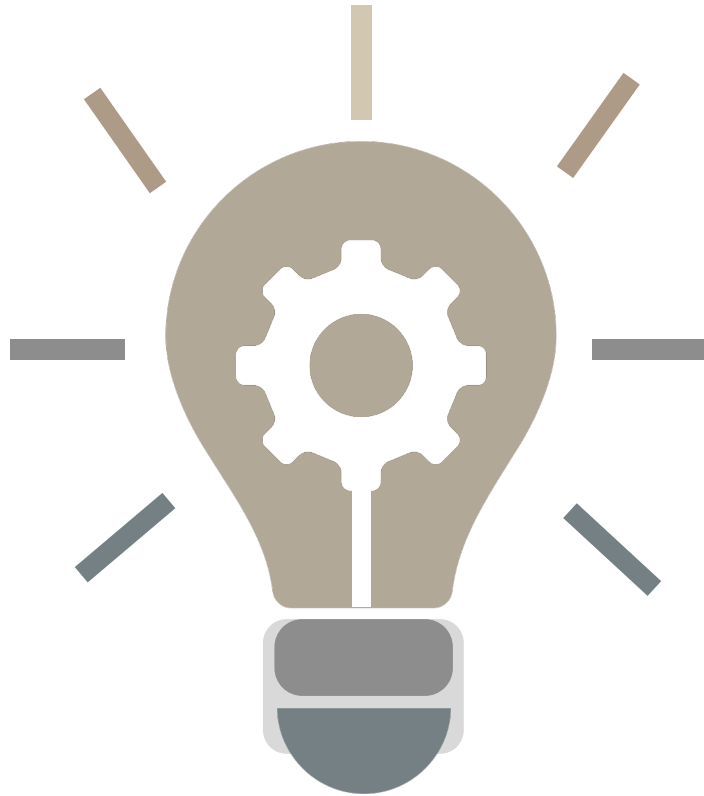


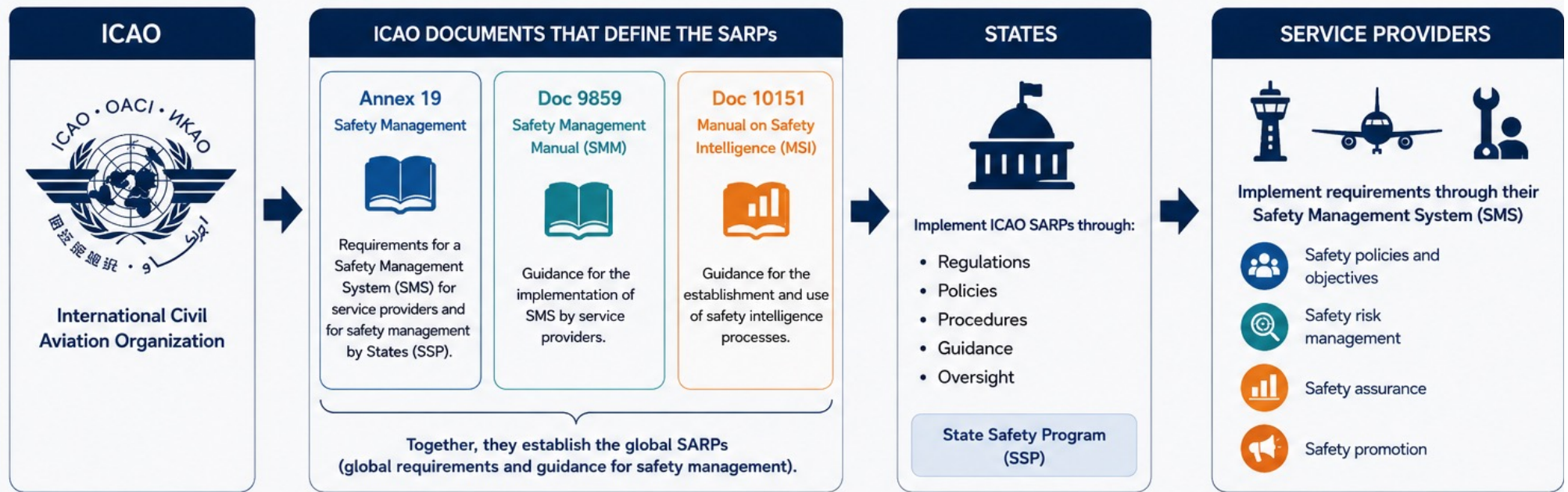
Barriers to the Adoption of FRAM in Aviation Safety Management

Practical implications for ICAO SMS and SSP frameworks



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FRAMily 2026





The 4 Components of SMS/SSP

Both provider SMS and State SSP are structured around the same 4 interrelated and continuous components.



The Complexity of Aviation Systems



Traditional Management (Safety-I)

- Focuses on investigating occurrences after accidents or serious incidents.
- Searches for linear failures and isolated root causes.



The Modern Necessity (Safety-II)

- Highly dynamic systems with tight coupling between functions.
- Requires capturing everyday performance variability.

The Promise: FRAM provides the exact systemic lens that modern aviation requires to understand emergent outcomes.

The Language of Regulation: Understanding SMS and SSP

The two foundational safety frameworks of the International Civil Aviation Organization (ICAO):

SMS (Safety Management System)



What it is: The internal safety management system of a single enterprise (e.g., an airline).

Focus: Identifying and managing risks within its own operations.

SSP (State Safety Programme)



What it is: The State or Regulator's program to oversee safety at a national level.

Focus: Regulatory oversight of the entire interconnected aviation ecosystem.

The Adoption Paradox



FRAM
(Academic Theory)



**Operational
Practice**



The Theory

FRAM is widely recognized in academic literature as the ideal systemic method for aviation complexity.

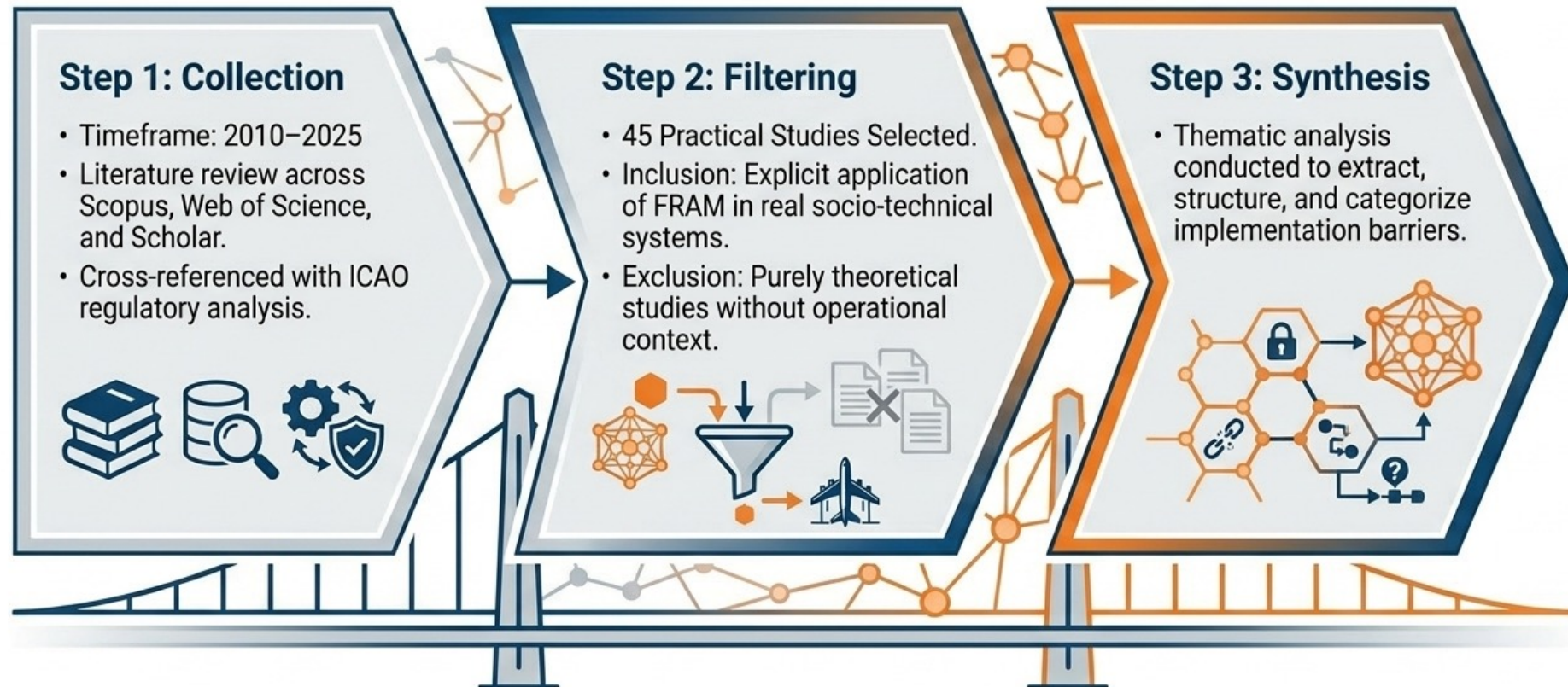
The Practice

Its actual operational adoption by airlines and regulatory bodies remains virtually nonexistent.

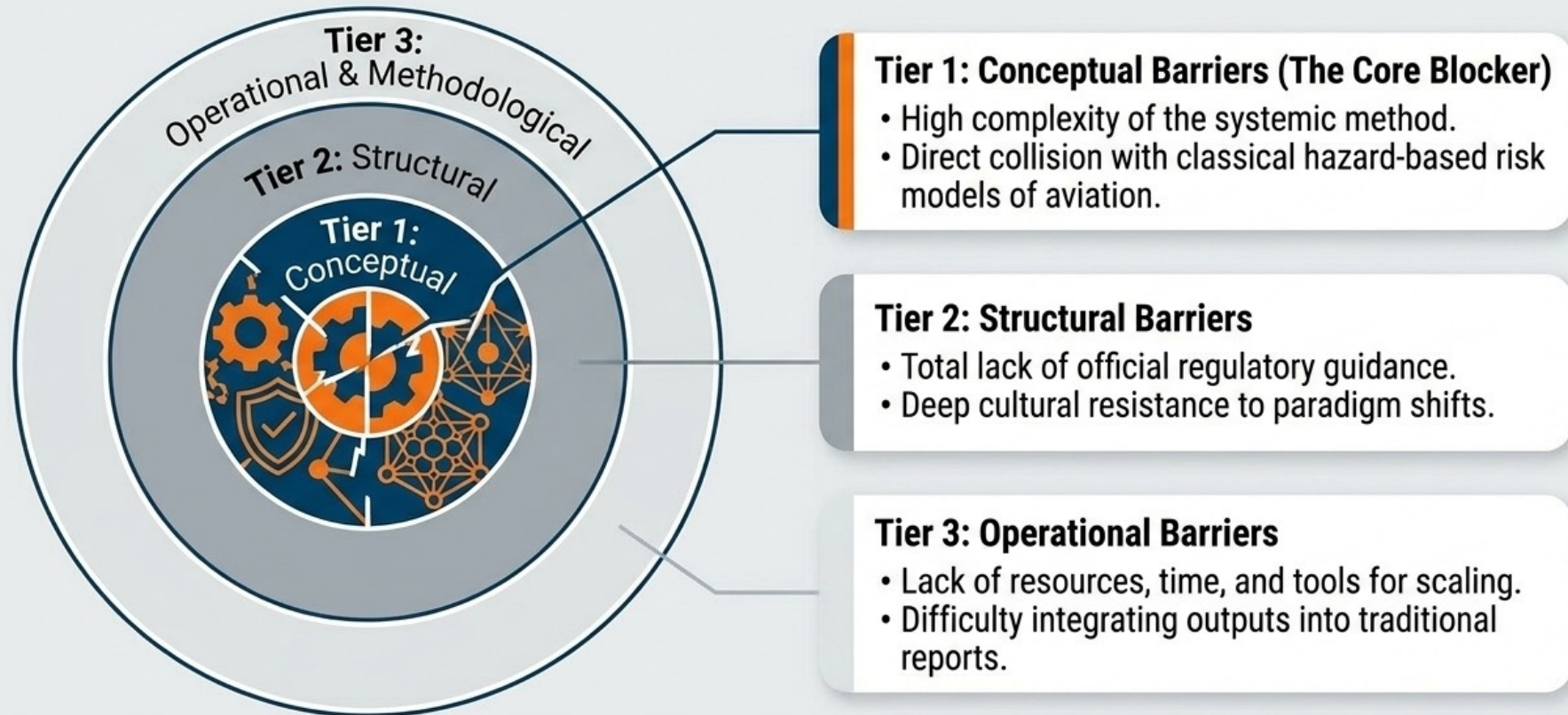
The Central Question: Why does an industry obsessed with safety resist an advanced systemic method?

Study Objective: Identify implementation barriers and map how FRAM can fit into the rigid frameworks of SMS and SSP.

How We Mapped the Barriers



The Anatomy of Resistance: Why is FRAM blocked?



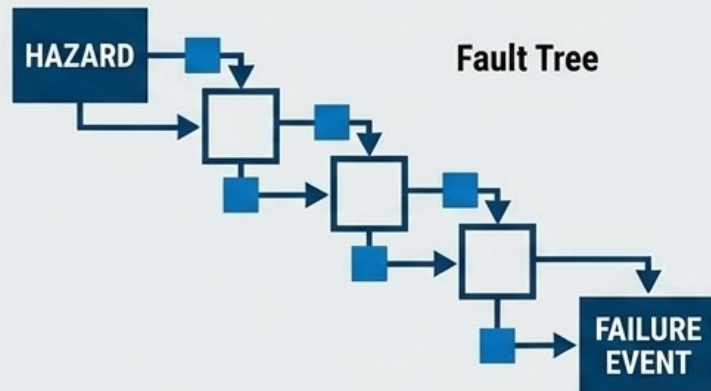
Alignment and Tension in SMS Pillars

SMS Pillar (What Aviation Does)	Alignment with FRAM
 Safety Policy (Defines rules and organizational culture)	 Limited Alignment (Supports global systemic understanding, but lacks direct operational hooks)
 Safety Risk Management (Searches for hazards and isolated root causes)	 Critical Misalignment (Strong conceptual tension; hazard-based vs variability-based)
 Safety Assurance (Continuously monitors daily operational performance)	 High Synergy (The perfect fit for evaluating functional variability and everyday work)
 Safety Promotion (Training, communication, and learning)	 High Alignment (Promotes learning based on work-as-done rather than work-as-imagined)



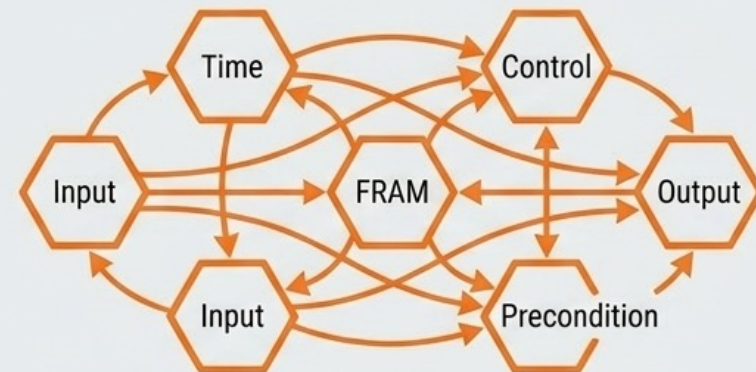
The Core Collision: **Linear Hazard** vs. **Variability**

Aviation Logic (Hazard-Based)



- Focuses on identifying dangerous components or adverse events.
- Assumes linear failure (direct cause and effect).
- Evaluated via quantitative severity/probability matrices.

FRAM Logic (Systemic)



- Focuses on everyday performance and normal functions.
- Analyzes tight coupling and emergent resonance.
- Evaluates how normal variability combines into outcomes.

The Window of Opportunity: The State Level (SSP)



While an airline's SMS focuses strictly on its own corporate boundaries, the State Safety Programme (SSP) manages the complete ecosystem.

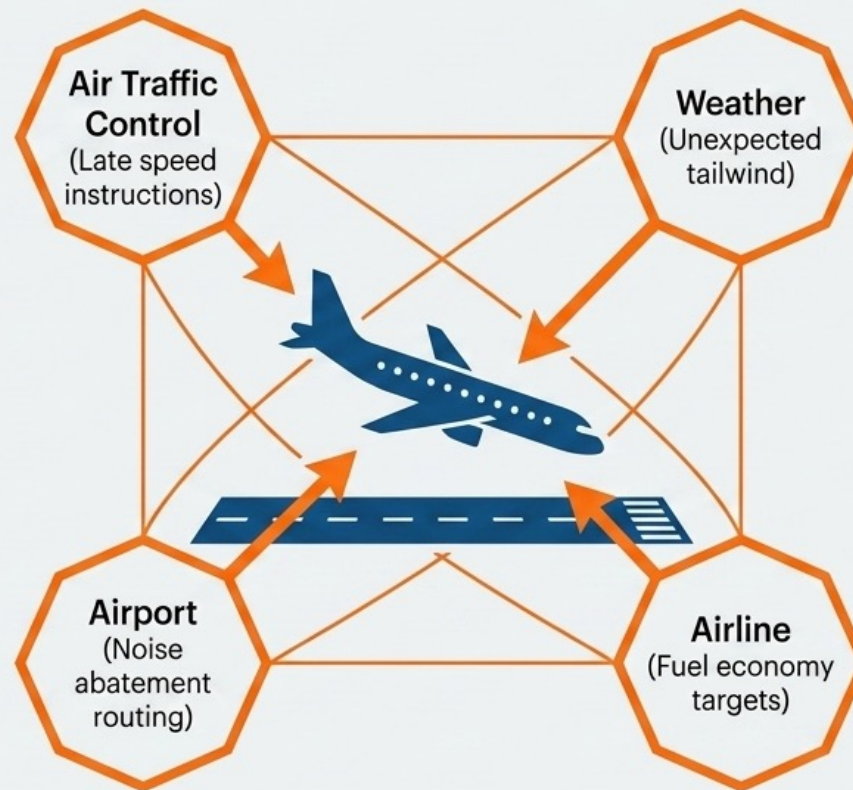
Why FRAM is the ideal tool for the Regulator:

- Maps transverse risks across multiple independent organizations.
- Connects the Airline, Air Traffic Control (ATC), and Airport Infrastructure.
- Extracts systemic intelligence from massive, multi-source government safety databases.

In Practice: The Unstable Approach Case

The Classical View

The aircraft arrives too fast/high for landing. A traditional linear investigation isolates the event as a 'Pilot Error' for failing to follow procedures.



The FRAM View (via SSP)

The event is not an isolated error, but the resonance of coupled variabilities. The system's constraints collapsed into the cockpit, setting the pilot up for failure.

Recommended Path for Regulatory Adoption



Final Considerations



FRAM is ready to step out of academic theory and consolidate itself as the essential instrument for overseeing complexity in global civil aviation.

- The limit of FRAM is not its utility, but its collision with linear hazard models.
- The most viable corporate entry door is the Safety Assurance pillar.
- State Safety Programmes (SSP) offer the most fertile ground for this transformation.



ICAO

Safety Risk Management Methodologies (SRM)

FRAM – Functional Resonance Analysis Method



Appendix 1 – Simple FRAM model of an aircraft take-off

