Introduction to Risk Profiling in Aviation SMS to Support Management of Change - MoC

Sofema Aviation Services (SAS) Takes a deep dive into the MoC best practices.

Introduction

In the context of Safety Management Systems (SMS), risk profiling enables a structured investigation into the safety implications of business decisions.

- It serves as a bridge between "Business Reality" (e.g., restructuring, cost-cutting) and "Safety Obligations," treating economic factors as distinct hazards that must be managed with the same rigour as technical failures.

How to Perform Risk Profiling: A Structured Approach

Risk profiling for change management (MoC) involves a step-by-step process to identify, analyze, and control hazards *before* they manifest. The provided documents outline a specific workflow for this assessment:

Step 1: Define the Change and the "Transition Period"

Risk profiling begins by clearly defining the "Future State" (the end goal) and, critically, the **Transition Period**.

- **The Transition Risk:** This is the interval between the old state and the fully implemented new state. It is often the riskiest phase because procedures are hybrid, and confusion is high.

- **Assessment Question:** You must ask, "How will we operate *during* the change?" (e.g., operating from temporary containers during a hangar move) .

Here are two detailed examples illustrating Step 1: Define the Change and the "Transition Period" within an EASA-compliant risk profiling process. These examples focus on the critical "middle phase" where operational risks are often highest due to hybrid procedures and confusion.

Example 1: Infrastructure Change – Relocating to a New Maintenance Hangar
Based on guidance from source.

- ***The Change (Scope): Moving Base Maintenance operations from the current "Hangar A" to a newly built "Hangar B" to increase capacity.***
- ***The Future State (Goal): All base maintenance activities, tooling stores, and logistics are fully operational within Hangar B. Hangar A is decommissioned.***
- ***The Transition Period: The 14-day window where maintenance work continues on aircraft, but equipment and stores are physically being moved between buildings.***

- *Transition Risks (The "Hybrid" Phase):*
    - *Tool Control: Mechanics may be working in Hangar B while the main tool store is still in Hangar A (or in transit). This creates a risk of unrecorded tool usage or "shadow boards" being incomplete.*
    - *Temporary Facilities: Maintenance staff may be operating out of temporary shipping containers or portable offices during the move, lacking standard lighting or connectivity.*
    - *Emergency Response: Fire exits or eye-wash stations may not be fully commissioned in the new zones while work has already commenced.*

- *Assessment Question: "How will we maintain strict Tool Control (Part-145.A.40) and access to technical data during the 48 hours when the server and physical stores are being relocated?"*

Example 2: System Change – Migration to New MRO Software

Based on guidance from source.

- *The Change (Scope): Switching the organization's maintenance tracking and logistics software from "Legacy System X" to "New System Y."*
- *The Future State (Goal): "New System Y" is the sole source of truth for aircraft airworthiness status and stock levels. "Legacy System X" is archived and read-only.*
- *The Transition Period: A 3-month "parallel run" phase where staff are required to input data into both systems to ensure the new system is stable before the old one is turned off.*
- *Transition Risks (The "Hybrid" Phase):*
    - *Data Mismatch: There is a high risk that a component change is logged in the new system but forgotten in the old one (or vice versa), leading to a discrepancy in the aircraft's legal status.*
    - *Cognitive Load & Fatigue: The workload for certifying staff effectively doubles because they must perform data entry twice. This increases the likelihood of error due to time pressure or fatigue.*
    - *Confusion of Authority: Staff may be unsure which system is the "legal" record during a discrepancy.*

- *Assessment Question: "During the parallel running phase, if the two systems disagree on an aircraft's status, which system is the 'master' for releasing the* *aircraft to service, and how do we prevent fatigue from the double-entry workload?"*

Step 2: Hazard Identification (Business Triggers)

Identify hazards using the **"Three Pillars" of Business Impact**. When a change occurs, assess its impact on these three specific areas:

- 1. Resources: Will the change affect the availability or competence of staff, tools, or facilities?.
- 2. Management Direction: Will the change alter policies, processes, or training strategies?.
- 3. Management Control: Will the change weaken supervision or oversight (e.g., removing a layer of middle management)?.
- **Economic Reality:** Acknowledge that financial pressure (e.g., "We need to cut costs by 10%") is a hazard source that can lead to reduced training or extended shifts.

Scenario 1 – Business Triggers : Infrastructure Change – Relocating to a New Maintenance Hangar

Resources

- ***Availability of Tools: During the physical move, specific calibrated tools may be packed in transit crates, rendering them unavailable for urgent defects. This could lead to staff using "alternative" or unapproved tools to release an aircraft on time.***
- ***Staff Competence/Familiarity: Technicians are unfamiliar with the new hangar layout (e.g., location of fire suppression, power outlets, eye-wash stations). This "change in facilities" impacts their ability to react quickly to emergencies.***
- ***Facilities: The new hangar may have temporary lighting or heating issues during the first week. Poor lighting conditions are a direct hazard for visual inspections.***

Management Direction

- ***Process Alteration: The procedure for checking out tools will change. If the new electronic scanning system isn't ready, a temporary paper log might be used. Staff may not be trained on this temporary "hybrid" process, leading to lost tool control.***
- ***Training Strategy: New safety induction training for the new site is required. If this is rushed due to operational pressure, staff may miss critical safety information regarding the new site's hazards.***

Management Control

- *Supervision Gaps: Supervisors might be distracted by logistical issues (unpacking boxes, organizing offices) rather than overseeing maintenance on the floor. This distraction weakens the "management control" pillar.*
- *Oversight: Physical separation of the line office from the maintenance floor in the new layout might reduce the frequency of casual oversight/walkarounds by the Base Maintenance Manager.*
- *Economic Reality (The Root Cause)*
  - *Cost Pressure: If the move is driven by a desire to save rent (moving to a cheaper, smaller facility), there is a risk that the new space is physically congested. This "economic reality" creates a permanent hazard of hangar rash (aircraft colliding with equipment) due to reduced space.*
- *Downtime Costs: Management may pressure staff to keep the hangar operational during the move to avoid losing revenue.*
  - *This pressure to "keep working" while the environment is chaotic increases the risk of error.*

Scenario 2 Business Triggers: System Change – Migration to New MRO Software

Resources

- *Staff Availability: The "Transition Period" requires double-entry of data (old and new systems). This effectively reduces available man-hours for actual maintenance, as certifying staff spend 20% more time on computers. This resource shortage can lead to rushed inspections.*

- *Competence: Older mechanics who are excellent engineers but less "tech-savvy" may struggle with the new complex interface. Their competence on the tool (the software) drops, leading to data entry errors.*

Management Direction

- *Policy Change: The new software may enforce strict sequential steps for task sign-offs that were previously flexible.*
- *If staff aren't warned, they may get "locked out" of a task they have physically completed, leading to workarounds or frustration-driven violations.*

Process Confusion:

- ***Procedures for handling "workarounds" or bugs in the new software may be undefined during the launch, leaving staff to improvise solutions without guidance.***

Management Control

- ***Weakened Oversight: Supervisors may lose their ability to quickly scan "work in progress" because they don't yet know how to generate the right reports in the new system.***
  - ***They essentially become blind to the current status of the fleet during the transition.***
- ***Data Visibility: If the new dashboard isn't configured correctly, critical alerts (e.g., AD compliance due dates) might be missed by the CAMO department.***

Economic Reality (The Root Cause)

- ***Efficiency Drives: The software is likely being bought to "streamline" operations and perhaps reduce administrative headcount.***
- ***If admin support is cut before the software is fully proven to handle the workload, technical staff will be overburdened with admin tasks, distracting them from safety-critical work.***

Budget vs. Training:

- ***If the software license was expensive, the training budget might be slashed to compensate.***
- ***Rolling out complex software with only a "read-and-sign" email instead of classroom training is a financial decision creating a direct safety risk.***

Step 3: Risk Assessment (The Safety Case)

Once hazards are identified, perform a formal analysis (Safety Case) for significant changes.

- **Human Factors (HF):** Specifically assess the impact on human performance. Will new software increase cognitive load? Will a new roster pattern increase fatigue?.
- **Analysis Tools:** While the text suggests using standard probability/severity analysis , it also references specific methodologies like the **EASA 6 Step**, **Fishbone / 5 Why**, and **Bow-Tie analysis** for deeper profiling .

Scenario 1 Safety Case : Infrastructure Change – Relocating to a New Maintenance Hangar

The Hazard Selected for Analysis: *Unavailability of critical tooling during the 48-hour physical move.*

1. Human Factors (HF) Impact Assessment *The "Safety Case" must argue whether the human performance limits will be exceeded during this transition.*

- ***Time Pressure:*** *The pressure to release aircraft while tools are packed creates a "Can-Do" attitude trap. Mechanics may feel compelled to improvise rather than delay the aircraft.*
- ***Distraction:*** *The chaotic environment (people moving boxes, noise) increases the likelihood of "slip" errors during complex tasks.*
- ***Stress:*** *Uncertainty about where equipment is located increases frustration and lowers the threshold for violations (e.g., "I'll just use the generic torque wrench instead of the specific one").*

2. Application of Analysis Tool: Bow-Tie Analysis Using the Bow-Tie methodology to profile the risk:

- ***Threat (Left Side):*** *Critical special tooling is locked in a transit crate between Hangar A and Hangar B.*
- ***Preventative Control (Barrier):*** *A "Tooling Availability Plan" ensuring essential tools are moved last or duplicates are rented. Status: Weak/Missing in this scenario.*
- ***Top Event (The Loss of Control):*** *Mechanic uses an unapproved alternative tool (e.g., standard pliers instead of a specialized crimping tool) to meet the deadline.*
- ***Recovery Control (Barrier):*** *Independent Inspection (duplicate inspection) detects the improper repair.*
- ***Consequence (Right Side):*** *Latent defect introduced into the aircraft system (e.g., wire chafing or loose fitting), leading to in-flight failure.*

3. Risk Probability & Severity (The Risk Profile)

- ***Probability: High (4)*** *during the transition days. The confusion and lack of access make the "workaround" highly probable.*
- ***Severity: Major (3)****. Using wrong tooling on critical systems (e.g., flight controls) can be catastrophic.*
- ***Conclusion:*** *The risk is* ***Unacceptable*** *without specific mitigation (e.g., embargoing heavy maintenance during the move days).*

Scenario 2 Safety Case: System Change – Migration to New MRO Software

The Hazard Selected for Analysis: *Cognitive Overload and Fatigue due to "Parallel Running" (Double Data Entry).*

*1. Human Factors (HF) Impact Assessment * **Cognitive Load:** Requiring staff to learn a new complex interface while maintaining the old one doubles the mental processing required for every task.*

- ***Fatigue:*** *If the same staff are doing the data entry, their effective shift length increases, or their rest periods decrease. Fatigue is a known precursor to "omission errors" (forgetting a step).*
- ***Normalization of Deviance:*** *If the new software is buggy, staff may habituate to clicking "Ignore" on warning pop-ups. This habit may persist even after the bugs are fixed.*

2. Application of Analysis Tool: Fishbone (Ishikawa) / 5 Whys Using Fishbone / 5 Whys to drill down to the root cause of a potential "Data Mismatch" error:

- ***Problem:*** *An Airworthiness Directive (AD) is marked "Complete" in the new system but "Open" in the old system.*
- ***Why?*** *The engineer forgot to update the legacy system.*
- ***Why?*** *They were interrupted by a supervisor during the update.*
- ***Why?*** *The update process now takes 20 minutes instead of 10 due to double-entry.*
- ***Why?*** *Management decided on a "full parallel run" to mitigate technical risk, without accounting for the **Human Resource** impact.*
- ***Root Cause:*** *The business decision to save money (by not hiring temporary data entry clerks) has transferred the risk to the certifying engineer.*

3. Risk Probability & Severity (The Risk Profile)

- ***Probability: Frequent (5)****. Data entry errors are almost guaranteed under high fatigue and interruption conditions.*
- ***Severity: Hazardous (4)****. If a life-limited part is not tracked correctly, it could remain in service beyond its safe life.*
- ***Conclusion:*** *The risk is **Unacceptable**. The "Safety Case" fails because the mitigation (parallel run) actually introduces a new hazard (fatigue) that is not being managed.*

Step 4: Define Mitigating Actions

If the risk profile is unacceptable, controls must be defined **before** implementation.

- **Example:** If a business decision reduces staff by 20%, a mitigation might be to strictly reduce the approved scope of work to prevent "time pressure" errors.

Scenario 1 Mitigation: Infrastructure Change – Relocating to a New Maintenance Hangar

The Identified Risk: High probability of using unapproved/alternative tooling due to critical equipment being in transit (locked in crates) during the 48-hour move.

Defined Mitigating Actions (Controls):

- *1. Reduce Approved Scope of Work (The "Circuit Breaker"):*
  - *Action: During the 5-day window surrounding the move (Transition Period), the organization will suspend all "Base Maintenance" (heavy checks) and limit activity to "Line Maintenance" (daily checks) only.*
  - *Rationale: This removes the demand for complex, specialized tooling, ensuring that the "economic reality" (keeping the hangar open) does not compromise safety.*

- ***2. Resource Duplication (Rent vs. Buy):***
  - *Action: Rent a duplicate set of "Critical Task" tooling (e.g., specific torque wrenches, rigging pins) for 1 week.*
  - *Rationale: This ensures that Hangar B is fully equipped before Hangar A is packed up, eliminating the "gap" in resource availability.*

- ***3. Physical Segregation of Work Zones:***
  - *Action: Establish a physical "Quarantine Zone" for the move. No aircraft are permitted to enter the new hangar bay until the Tool Store Manager has formally signed off that the store is 100% operational.*
  - *Rationale: This prevents the "creep" of starting work before the facility is legally ready.*

Scenario 2: System Change – Migration to New MRO Software

The Identified Risk: "Hazardous" level of fatigue and cognitive overload for certifying staff caused by the requirement to perform double data entry (Parallel Run) in both old and new systems.

Defined Mitigating Actions (Controls):

- ***1.*** *Resource Injection (Temporary Staffing):*
  - *Action: Hire 3 temporary "Data Entry Clerks" for the 3-month transition period to handle the input into the Old Legacy System.*

- *Rationale: This frees up the Certifying Staff to focus solely on the New System and the aircraft, effectively removing the "double workload" hazard while maintaining data integrity.*

- ***2. Extended Turnaround Times (Commercial Adjustment):***
  - *Action: Formally extend the standard "Man-Hour Planning" factor by 20% for all maintenance tasks during the transition. (e.g., A 10-hour job is now planned for 12 hours).*
  - *Rationale: This explicitly acknowledges the "learning curve" and "cognitive load" as a valid time cost, preventing time pressure-induced errors.*

- ***3. Enhanced Supervision (The "Firewall"):***
  - *Action: Appoint a dedicated "Migration Supervisor" on each shift whose only job is to troubleshoot software issues and approve "workarounds."*
  - *Rationale: This protects the floor supervisors from being distracted by IT issues, allowing them to maintain "Management Control" over the physical aircraft maintenance.*

Summary of the "Safety Case" Logic

For both scenarios, the mitigations follow the core MoC principle: If you cannot mitigate the risk (e.g., you can't hire temp staff), you must reduce the exposure (e.g., stop the maintenance work). You cannot proceed with "business as usual" if the risk profile is Red.

Step 5: Verification and Post-Implementation Review (PIR)

The profile is not static. You must verify if the change is working as planned.

- **Review:** Schedule a review (e.g., 3 months later) to ask: Did the change work? Did mitigations work? Did *unexpected* hazards pop up? .

Best Practices for Effective Risk Profiling

To move beyond compliance and ensure safety, organizations should adopt the following practices:

- **The "Pre-Mortem" Technique:** Before signing off on a change, hold a meeting where the team assumes the change has *already failed* and caused an accident. Asking "What happened?" in this context is a psychological trick that often reveals risks that standard assessments miss.

- **Scalability (The Tiered Approach):** Do not use a "sledgehammer to crack a nut".

  - **Level 1 MoC:** For simple changes (e.g., minor procedure updates), use a quick peer review and log.

    - **Level 2 MoC:** For complex changes (e.g., new base maintenance), require a full Safety Risk Assessment (SRA) and hazard log.

- **The "Stop & Think" Trigger:** Train staff to ask three simple questions: Is this different from yesterday? Does it affect people/procedures? Do we need to talk about it? .
- **Leading Indicators:** Use internal safety reports to detect "unplanned change." A spike in reports regarding "lack of tooling" or "fatigue" is a leading indicator that the operating environment has changed, even if no formal MoC was raised .
- **Cross-Functional Teams:** Avoid having a single Quality Manager fill out forms in isolation. Effective profiling involves end-users (mechanics, pilots) and safety experts reviewing the change together.

Challenges and Issues in Risk Profiling

The "Tick the Box" Culture

- This is described as the most dangerous failure mode. Organizations may have perfect MoC folders where every box is ticked, but the content is generic (e.g., Risks: "None", Mitigation: "N/A") .
- This leads to the illusion of safety because the organization is "compliant," while latent hazards remain active.

Siloed Thinking and Information

- In medium-to-large organizations, departments often do not share data.
- A change in the "Avionics Bay" roster might impact the "Engine Shop" if resources are shared, but this risk is missed if departments operate in silos .
- Managers often view changes in isolation (e.g., "We are just changing the tooling supplier") without realizing technical implications (e.g., different units of measurement) .

The "Clay Layer" of Middle Management

- While senior management sets policy and technicians report hazards, middle managers often face a conflict between "production targets" and "safety administration".
- They may suppress the identification of change to meet deadlines, acting as a "clay layer" that blocks effective risk profiling.

Timing and Retrospective Justification

In ineffective systems, the MoC form and risk profile are completed *after* the decision has been made or implemented. This turns the process into a retrospective justification rather than a "go/no-go" safety gate.

"Creeping Change" (Normalization of Deviance)

Gradual changes, such as the slow degradation of equipment or the gradual loss of experienced staff, are harder to profile than sudden changes. These slow shifts often go unnoticed until an incident occurs.

Next Steps

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