



*Enhancing Safety  
through NTS  
Training in  
Aviation*

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# Why NTS Still Matters ?



Around 70% of aviation accidents involve human factors rather than technical failure (ATSB, 2020).



Errors usually stem from teamwork, communication, situational awareness, and decision-making breakdowns.



Crew Resource Management (CRM) introduced in the 1980s transformed safety by embedding NTS into pilot training (Flin, O'Connor, & Crichton, 2008).



NTS are not “soft” skills; they are critical safety skills that prevent incidents and save lives.



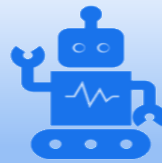
# Research Purpose



Objective 1: Review current NTS training practices in aviation.



Objective 2: Identify weaknesses in evaluation and consistency across operators.



Objective 3: Look over *the horizon* to anticipate emerging challenges such as AI, remote operations, and generational change.



Focus is on ensuring NTS training evolves in parallel with technological and workforce developments.

# *Methodology*

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**Literature review:** ICAO, CASA, ATSB reports, peer-reviewed journals.

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**Analytical frameworks :** SHELL model (Edwards, 1972): Human interaction with software, hardware, environment, and liveware.

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**Threat and Error Management (TEM):** Training focus on anticipating, trapping, and mitigating threats.

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**Case studies:** Qantas Flight 32, Airbus DragonFly, Sweden's remote towers, Lufthansa VR training, Cathay Pacific CRM.

# *Current Findings*



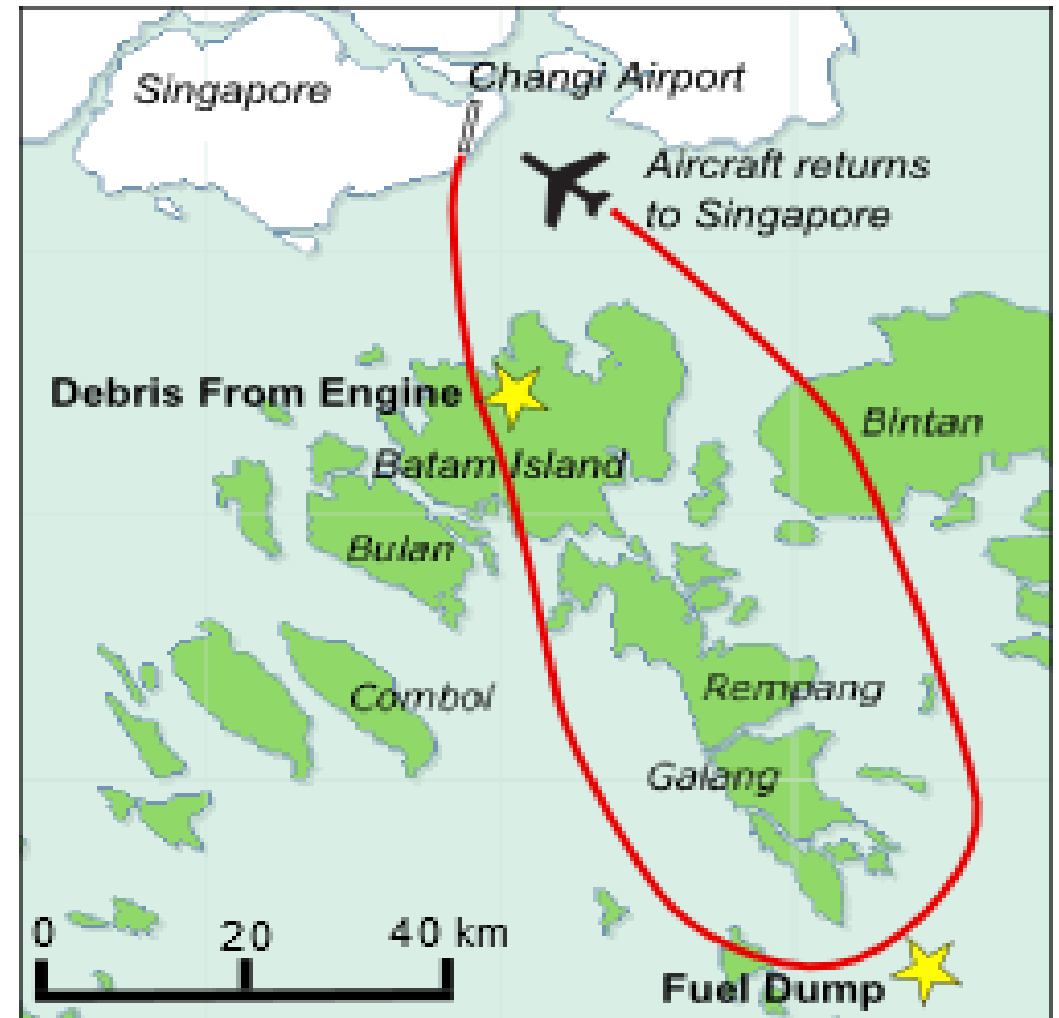
- Structured NTS training improves communication, hazard recognition, and teamwork (Flin et al., 2008; CASA, 2021).
- Effective approaches: scenario-based simulations, behavioral markers (e.g., NOTECHS), and structured debriefs.
- Key Gaps:
  - Inconsistency: Some operators use detailed behavioral scales; others rely on vague checklists.
  - Integration issues: NTS training often siloed, not linked into Safety Management Systems.



# *Case Study 1: Qantas Flight 32 (2010)*

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- Airbus A380 engine explosion caused >50 system failures (ATSB, 2013).
- Crew overwhelmed with alarms and conflicting procedures.
- Outcome determined by NTS:
  - Calm leadership from Captain de Crespigny.
  - Clear cockpit communication and effective cross-checking.
  - Strong situational awareness under stress.
- Landed safely in Singapore with zero injuries.



- *Map showing flight path of Qantas Flight 32 on 4 November 2010*

# Looking Forward



NTS are proven and essential today.



But aviation is evolving : AI copilots, remote operations, digital training, multicultural workforces.



Challenge: How must NTS training adapt to remain effective in the future?



## *Challenge 1: AI & Automation*

- Next era: AI copilots and advanced decision-support systems (Airbus, 2023).
- Benefits: reduced workload, efficiency, improved safety in routine ops.
- Risks: over-reliance, complacency, loss of manual flying skills (de Boer & Dekker, 2017).
- New NTS:
  - Human-AI teamwork.
  - Adaptive monitoring and vigilance.
  - Decision-making about when to trust vs override automation.

# Case Study 2: Airbus DragonFly





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- Airbus DragonFly AI system demonstrates taxiing, obstacle recognition, and pilot assist.
  - Pilot role shifts from active operator → supervisor.
  - **NTS implications:**
    - Maintaining situational awareness when AI takes over.
    - Decision-making based on evaluating AI recommendations.
    - Communication adaptations to integrate AI into cockpit flow.





## *Challenge 2: Remote & Advanced Operations*

- Remote towers operational in Europe since 2015 (SESAR, 2021).
- Benefits: cost efficiency, centralized management.
- Challenges:
  - Reduced situational awareness.
  - Higher communication loads.
  - Handling abnormal events remotely.
- NTS training must prepare for distributed teamwork and digital trust.

# *Case Study 3: Sweden Remote Towers*

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- Centralized ATC from remote centres.
  - Controller manages multiple airports.
  - Efficiency benefits balanced by:
    - Increased communication load.
    - Risks to situational awareness in emergencies.
  - Training must evolve to support remote and multi-airport operations.



## Challenge 3: Digital & Experiential Training



- Limitations of simulators: high cost, limited frequency.
- New approaches:
  - VR/AR for immersive, scenario-based training.
  - AI-driven feedback for objective evaluation.
  - Biometric tools monitoring stress/workload
- Training shift: from periodic & subjective → continuous & data-driven.

## Case Study 4: Lufthansa VR Training

- Lufthansa Aviation Training integrates VR for abnormal/emergency procedures.
- Reported benefits:
  - Improved engagement.
  - Better teamwork outcomes.
  - Enhanced memory recall of emergency protocols.
- Cost-effective alternative to full-motion simulators.





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## *Challenge 4: Workforce & Culture*

- Tomorrow's pilots = Gen Z: digital natives, collaborative, less tolerant of rigid hierarchies.
- Increasingly multicultural flight decks.
- CRM originally developed in Western contexts → needs adaptation (Helmreich & Merritt, 2017).
- Future NTS training must reflect generational learning styles and cultural realities.

# *Case Study 5: Cathay Pacific CRM*

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- Multicultural crews created communication challenges.
  - Cathay Pacific redesigned CRM to include cultural awareness training.
  - Results: improved coordination, reduced miscommunication (Merritt & Helmreich, 1996).
  - Demonstrates need to tailor NTS training to workforce realities.



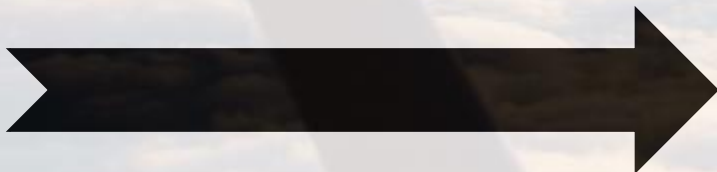
# *Future Directions*



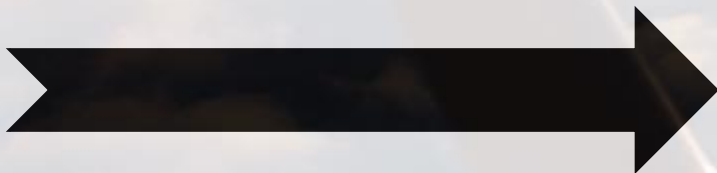
Standardize NTS evaluation globally.



Integrate AI, VR, and biometrics into core training



Shift focus: error prevention → resilience engineering.



Ensure relevance: generational, cultural, and technological adaptation.

# *Conclusion*

- NTS = proven foundation of safety.
- Future demands adaptation to AI, remote ops, digital training, and diverse workforces.
- Key takeaway:  
“Technical skills may fly the plane, but non-technical skills keep aviation safe in a changing world.”



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# *Thank You!!!*

*"THE BEST WAY TO PREDICT THE FUTURE IS  
TO CREATE IT."-PETER DRUCKER*

