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HUMAN FACTORS IN CIVIL AVIATION SAFETY OVERSIGHT

(Presented by the International Federation of Air Traffic Safety Electronics Associations)

EXECUTIVE SUMMARY

This information paper explores the critical influence of Human Factors on the safety, performance, and reliability of Air Traffic Safety Electronics Personnel (ATSEPs), whose role is central to ensuring the integrity of Communication, Navigation, and Surveillance (CNS) systems. As civil aviation undergoes rapid digital transformation, understanding and mitigating Human Factors such as fatigue, communication breakdowns, and interface challenges is essential to maintaining operational continuity and system resilience. Drawing on documented incident analyses, regional guidance from the ICAO Asia/Pacific Office, and global best practices, the paper advocates for the integration of Human Factors into ATSEP training, operational protocols, and policy frameworks. This approach aligns with ICAO standards and supports the development of a robust, safety-driven air traffic management ecosystem

Strategic Goals:	This working paper relates to *Every Flight is Safe and Secure.*
Financial implications:	
References:	Annex 19 – *Safety Management* Doc 9683, *The Human Factors Training Manual* Doc 10151, *Human Performance (HP) Manual for Regulators* Doc 10057, *Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment* ICAO APAC Regional ATSEP Human Factors Guidance Material – Version 2.0 (June 2025) CNS SG/29, Twenty-Ninth Meeting of the Communications, Navigation and Surveillance Sub-group under the ICAO Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG).

1. INTRODUCTION

1.1 With increasing automation, expanding airspace usage, and rising traffic volumes, the demand on air traffic safety electronics personnel (ATSEPs) has never been greater. Their role in ensuring the integrity of communication, navigation, and surveillance (CNS) systems places Human Factors at the heart of aviation safety.

1.2 ATSEPs ensure the reliability and safety of CNS infrastructure. As aviation technology evolves with greater reliance on automation, addressing Human Factors such as workload, fatigue, situational awareness, and communication becomes increasingly critical. Organizations must proactively incorporate Human Factors into training, operations, and policy frameworks to foster a resilient air traffic management ecosystem. This aligns with principles outlined in *Human Performance (HP) Manual for Regulators* (Doc 10151) and ICAO Annex 19 – *Safety Management*, which emphasize the integration of Human Performance and safety management systems (SMS) into State safety programmes (SSPs).

1.3 Basic training objectives outlined in *The Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment* (Doc 10057) provide a foundation for ATSEP understanding of Human Factors concepts, including workload, communication, and fatigue. When delivered through Competency-Based Training and Assessment (CBTA) methods as defined in ICAO *Procedures for Air Navigation Services — Training* (PANS-TRG, Doc 9868), this harmonized approach ensures that ATSEPs not only acquire essential Human Factors knowledge but also apply it effectively in operational contexts.

2. HUMAN FACTORS CHALLENGES IN ATSEP OPERATIONS

2.1 Fatigue and cognitive load

a) Shift rotations and overnight duties elevate fatigue levels, reducing vigilance.

b) Emergency troubleshooting under time pressure often strains cognitive resources.

c) Studies indicate that shift workers operating beyond 12 hours have a 42 per cent increased risk of attention lapses.

d) Sleep-deprived personnel are 30–50 per cent more likely to commit configuration errors under operational stress.

2.2 Communication and organizational culture

a) Ineffective shift handovers and unclear incident escalation procedures contribute to latent failures.

b) A punitive culture discourages incident reporting, hindering feedback loops essential for improvement.

c) Language barriers and technical jargon complicate cross-functional coordination, especially in multinational settings.

d) Consideration of Crew Resource Management (CRM) principles and use of SBAR frameworks can help improve communication clarity.

2.3 Automation and interface design

a) CNS systems sometimes use outdated or poorly designed interfaces, increasing error potential.

b) Automation dependency may erode proactive monitoring and manual skills required for anomaly resolution.

c) Lack of intuitive alerts and cluttered UIs affect situational awareness.

3. INCIDENT ANALYSIS AND LESSONS LEARNED

3.1 Case study: Radar Outage at New York ARTCC (2015)

3.1.1 During scheduled maintenance in 2015, the New York ARTCC experienced a radar outage due to an electrical failure when switching between primary and backup systems. Contributing Human Factors included:

a) fatigue following extended overnight shifts;

b) incomplete shift handover documentation; and

c) overreliance on automated alerts without manual cross-checking.

3.1.2 Key takeaways:

a) prioritize redundancy testing protocols;

b) implement standardized documentation templates; and

c) introducing fatigue monitoring programs.

3.2 Case study: ICAO Asia/Pacific Human Factors Study (2025)

3.2.1 The ICAO APAC Regional ATSEP Human Factors Guidance Material – Version 2.0 (June 2025) mapped operational stressors and proposed mitigations. Highlights include:

a) identification of key stressors: irregular shifts, low managerial engagement, poor ergonomics;

b) creation of the Stress Factor Mapping Document (SFMD) for targeted interventions;

c) new guidance on supervisory roles and leadership influence on safety culture; and

d) checklist-based assessment tools for ANSPs to conduct Human Factors evaluations.

3.2.2 Key takeaways:

a) Map and address region-specific stressors.

b) Emphasize supervisory engagement and support.

c) Utilize practical Human Factors evaluation tools at ANSP level.

3.2.3 Endorsed by CNS SG/29, these guidelines reflect and complement ICAO's broader human performance framework as described in ICAO Manual on Human Performance (Doc 10151) and the systemic safety oversight approach mandated by Annex 19.

4. GLOBAL BEST PRACTICES

4.1 Recommended international approaches

Key approach	Tools and methods
Human Factors in certification & recurrent integrations Training	Format Human Factors modules, CBTA
Human-centered interface design	Adaptive alerts, ergonomic User interface (UI) layout
Self-assessment & cultural interventions	Leadership engagement, Human Factors checklists

4.2 Actionable measures

a) Incorporate fatigue modeling into shift scheduling.

b) Deploy Human Factors simulation workshops and tabletop exercises.

c) Establish "Just Culture" environments that promote error reporting and learning.

d) Embed Human Factors professionals into system design and oversight roles.

5. CONCLUSION

5.1 Human Factors are critical to the safety and performance of Air Traffic Safety Electronics Personnel (ATSEP) operations. Aviation authorities should proactively address risks stemming from fatigue, ineffective communication, automation dependency, and organizational culture. By integrating validated regional guidance such as the ICAO APAC Regional ATSEP Human Factors Guidance Material (Version 2.0, June 2025) with global standards from the ICAO Manual on Human Performance (Doc 10151) and Annex 19: Safety Management, stakeholders can significantly strengthen resilience across Communication, Navigation, and Surveillance (CNS) systems.

5.2 As aviation systems continue to evolve, States and ANSPs must institutionalize Human Factors within operational frameworks. Future-proofing CNS safety depends on continuous learning, robust training pathways like CBTA, and data-driven Human Performance strategies

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