



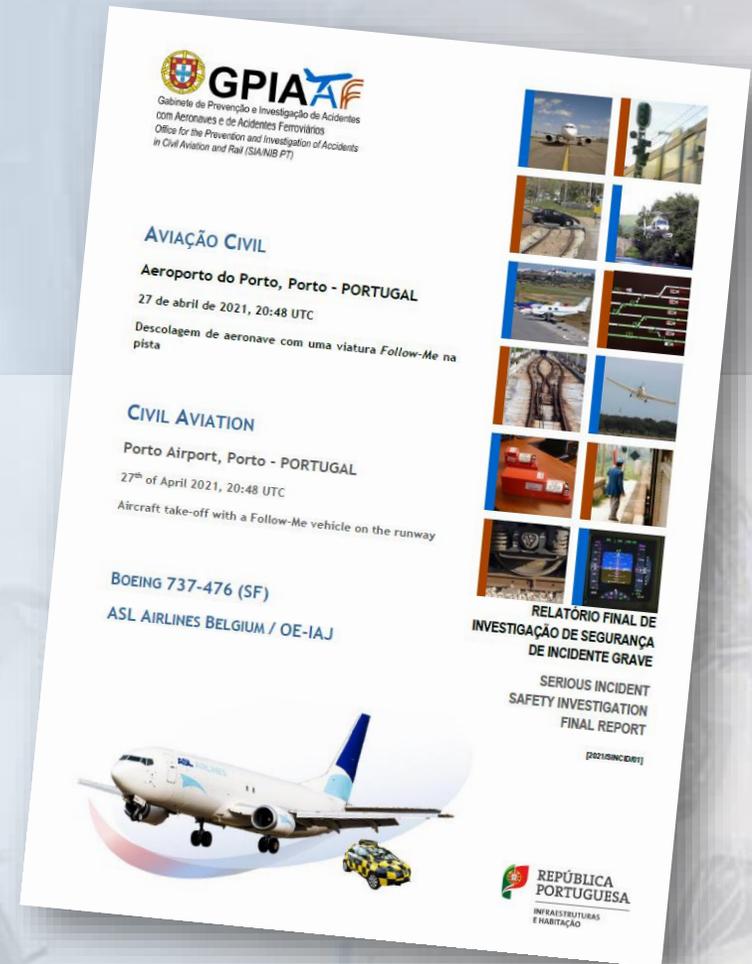
GPIA 

Gabinete de Prevenção e Investigação de Acidentes
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**INVESTIGATING ORGANISATIONAL FACTORS IN
ATM/ATS DOMAIN**

INVESTIGATING ORGANISATIONAL FACTORS IN ATM/ATS DOMAIN

- Overview & Findings of LPPR/LPPD ATM investigations
- Other similar ATM events
- Common underlying factors
- MS and SMS in the ATM/ATS domain
- Historical context
- Concluding remarks



- Single controller on duty non-stop for about 4 hours in the tower – aerodrome and approach control services.
- Follow-me vehicle had received authorisation from ATC to perform a runway inspection at 20:35 UTC.
- A short while (\approx 12mins) later the controller cleared a Boeing 737, bound for Liege, for take-off from runway 35.
- The vehicle driver was at the other end of the runway, facing South – questioned ATC about the lights.
- Vehicle vacated the runway onto the grass, aircraft took-off safely.

Porto (LPPR) EVENT – 27 April 2021, 20:48 UTC

Aircraft authorised to take-off with a Follow-Me vehicle on the runway performing a runway inspection



Porto (LPPR) EVENT – Scope of investigation



- The ATC operation and its respective organisational factors,
- Procedures involved in ground operations coordination,
- The human factors involved,
- Technical factors and the availability of equipment,
- Risk management measures regarding runway incursions.

~280 metros de separação
||| ~280 meters separation

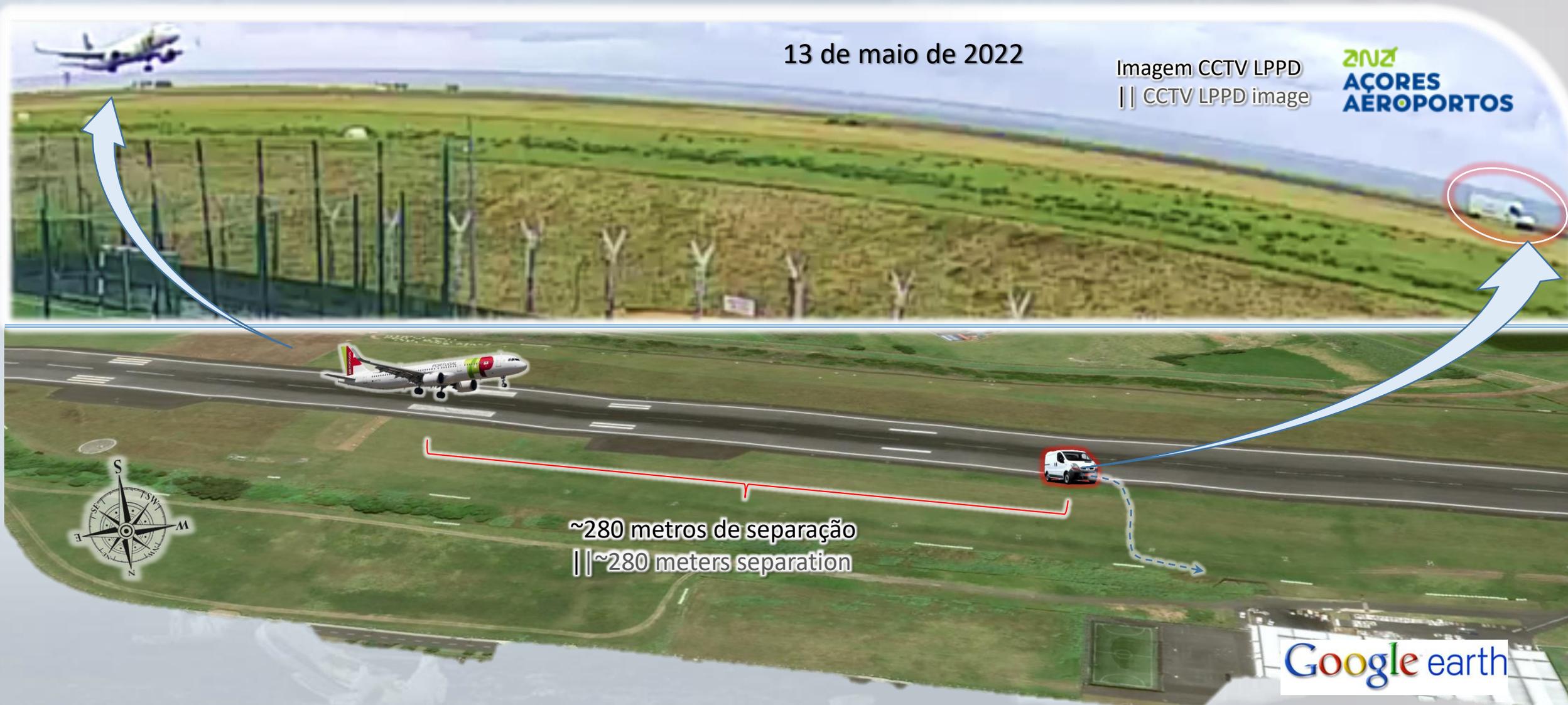
Ponto de descolagem estimada

- Review of Tower procedures (personnel / RI avoidance)
- Visits to other Towers
- CCTV and badge access records
- Reconstruction of the event
- Detailed review of the ANSP's SMS
- Review of similar events
- Review of regulations, EAPPRI, industry studies and best practices



Ponta Delgada (LPPD) EVENT – 13 May 2022, 10:00 UTC

Go-around initiated due to the presence of a maintenance van on the runway



Ponta Delgada (LPPD) EVENT – Scope of investigation



- Single controller in the tower,
- Opposite runway operation
 - SATA Dash8 RNP AR procedure to RWY12
 - TAP A321 LOC procedure to RWY30 (GS INOP)
- High workload,
- Mx team authorized to enter runway to perform work on ILS,
- A321 cleared to land.

~280 metros de separação

|||~280 meters separation

Similar circumstances to LPPR event

Identified Safety Issues (HFACS Taxonomy)

LATENT FAILURES

<p>Organisational Influences</p>	<p>Resources Management</p> <p>Staff management</p> <p>Equipment limitations</p>	<p>Organisational process</p> <p>Inadequate procedures</p> <p>Safety/Risk management process</p>	<p>Organisational Climate</p> <p>Structure:</p> <p>Delegation of authority</p> <p>Culture:</p> <p>Norms and rules</p> <p>Values, beliefs and attitudes</p> <p>Policies:</p> <p>Lessons from past</p>
<p>Unsafe Supervision</p>	<p>Inadequate supervision:</p> <p>Professional guidance and oversight</p> <p>Loss of supervision SA</p>	<p>Acting over the identified issues:</p> <p>Failure to correct inappropriate behaviour</p> <p>Failure to initiate corrective actions</p>	<p>Supervisory violations:</p> <p>To enforce rules and regulations</p> <p>Planned inappropriate operations</p>
<p>Preconditions for Unsafe Acts</p>	<p>Environmental factors:</p> <p>Nightly</p> <p>Equipment design</p>	<p>Adverse mental state:</p> <p>Complacency</p> <p>Loss of SA</p>	<p>Practices:</p> <p>Poor CRM</p> <p>Personal Readiness</p>
<p>Unsafe Acts or Operations</p>	<p>Errors:</p> <p>Skill based errors, Decision errors</p>		<p>Violations:</p> <p>Routine Violations</p>

Independent and reliable aids to ATC: Lack of visual and aural cues for the Rwy occupied status. The ATC rwy status awareness depended only on unreliable, controller-centric manual procedures.

Industry best-practice as laid down in [Eurocontrol's European Action Plan for the Prevention of Runway Incursions \(EAPPRI\) v3.0](#) recommend Air Traffic Control to use technology, such as:

- Stop-bars H24
- RIMCAS
- Multilateraton (MLAT)

To effectively mitigate against the risk of Runway Incursions, as a complement to existing controller procedures and memory aids.



Position logs: Misrepresented data was being recorded and submitted to central functions in a tool which was configured in such a way at Porto tower that historic records could be inserted, altered and erased without any control or traceability.

ATS.OR.320 Air traffic controllers' rostering system(s)

- (a) An air traffic control service provider shall develop, implement and monitor a rostering system in order to manage the risks of occupational fatigue of air traffic controllers through a safe alternation of duty and rest periods. Within the rostering system, the air traffic control service provider shall specify the following elements:
- (1) maximum consecutive working days with duty;
 - (2) maximum hours per duty period;
 - (3) maximum time providing air traffic control service without breaks;
 - (4) the ratio of duty periods to breaks when providing air traffic control service;
 - (5) minimum rest periods;
 - (6) maximum consecutive duty periods encroaching the night time, if applicable, depending upon the operating hours of the air traffic control unit concerned;
 - (7) minimum rest period after a duty period encroaching the night time;
 - (8) minimum number of rest periods within a roster cycle.

Supervisors' prerogative stand-down members of their team: The exercise of a Supervisor's prerogative to tactically manage his team is based on procedures which are ambiguous such that in practice the make-up of teams is done irrespective of the plan for the period they have been rostered for, without guidance material and risk analysis. This means that in practice, the Supervisors as interested party, manage the make-up of their teams irrespective of the plan for the period they have been rostered for and often exercise 'tactical management' prior to the start of the shift itself.

ATS.OR.210 Safety criteria

(a) An air traffic services provider shall determine the safety acceptability of a change to a functional system, based on the analysis of the risks posed by the introduction of the change, differentiated on basis of types of operations and stakeholder classes, as appropriate.

(b) The safety acceptability of a change shall be assessed by using specific and verifiable safety criteria, where each criterion is expressed in terms of an explicit, quantitative level of safety risk or another measure that relates to safety risk.

(c) An air traffic services provider shall ensure that the safety criteria:

(1) are justified for the specific change, taking into account the type of change;

(2) when fulfilled, predict that the functional system after the change will be as safe as it was before the change or the air traffic services provider shall provide an argument justifying that:

- (i) any temporary reduction in safety will be offset by future improvement in safety; or
- (ii) any permanent reduction in safety has other beneficial consequences;

(3) when taken collectively, ensure that the change does not create an unacceptable risk to the safety of the service;

(4) support the improvement of safety whenever reasonably practicable.

Sterile control room concept: Absence of effective measures which are conducive to a sterile control room (similar to sterile cockpit)

- Television in control rooms
- Mobile phones and other personal electronic devices being used by controllers whilst on duty
- No pertinent conversations and socializing in the control tower
- Etc.

Compliance Monitoring: An effective and independent Compliance Monitoring function is a requirement under Part-ATS (Management System). No such function exists at NAV Portugal. Compliance Monitoring responsibilities are dispersed within the different DSS areas and elsewhere in the organisation.

Without an effective and independent Compliance Monitoring function, there can be no:

- Effective internal auditing of key operational areas, units and functions, including DSS, the Management System (SMS, Document Control, etc.) and oversight of compliance with both internal/external rules and regs.
- Implementation of industry best practices/state-of-the-art, convergence and harmonisation of best practices across units, transversal application of lessons learned.
- Etc.

Safety Review Board: SRB and routine SRB meetings are a requirement under Part-ATS (Management System). Evidence revealed that no SRB meeting had ever taken place at NAV Portugal.

- 10 August 2019, Jeddah

A330 was cleared for take-off from runway 34L even though a vehicle conducting a runway inspection was still on the runway. Airfield Operations Officers (AOOs), in the inspection vehicle, were not monitoring the tower frequency and failed to hear ATC clearing the A330 for take-off. Took evasive action. Estimated separation 120m.

- RI EVENTS at Schiphol

Several events investigated by the DSB.

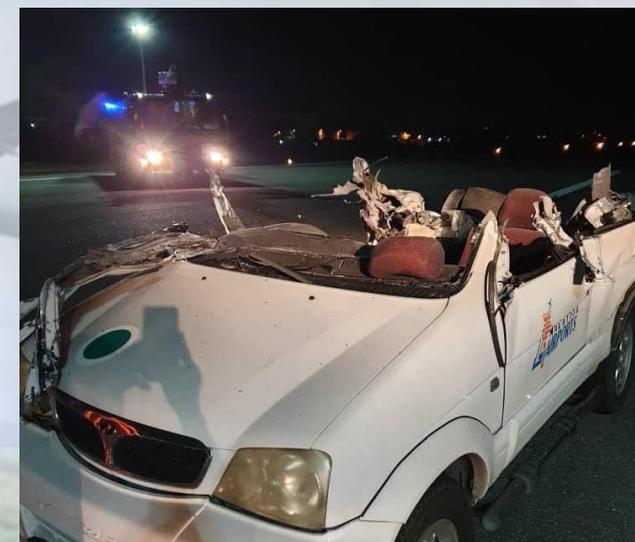
In December 2010, a Norwegian Air Shuttle Boeing 737-300 had been cleared for take-off from Schiphol's runway 24 when it flew over a bird control vehicle on the runway.

In January 2012, a Fokker 70 received take-off clearance for runway 24 after another aircraft had completed crossing runway 06/24 via intersection S2. At that moment a bird patrol vehicle was still on the runway.

Other similar ATM events cont.

- 18 March 2019, Kuala Lumpur

Challenger 300 cleared to land on runway while maintenance vehicles were still present. Vehicle authorized to enter runway for lighting Mx. Work. Subsequently two other vehicles comprising an escort vehicle and a maintenance vehicle were allowed by to enter the runway to do the painting for the runway centreline. Lighting Mx vehicle reports work completed and leaves runway. Controller records runway works completed. Shift handover: normal ops.



~280 metros de separação
||| ~280 meters separation

Common theme in most of these events

- **Lack of proper SA (Tower, aircraft, vehicles)**
 - Typically, different frequencies in use or aeronautical frequency not being monitored (vehicles).
 - Inadequate equipment in vehicles or signal coverage across the airfield.
 - Safety systems not working or inhibited (e.g. Inursion alarms – RIMCAS or Surface Movement Radar – SMR).
- **Controller-dependant memory aid procedure**
 - Not followed, burdensome, ineffective, does not account for multiple objects on or crossing the RWY (e.g. Schiphol and KL).
- **Single controller**
 - Lack of possible monitoring – second pair of eyes (ears) / buddy check.
 - No redundancy in case of incapacitation, physiological break etc.
 - Rudimentary systems require controller redundancy / Smart/integrated towers have technological safeguards and alerts.

- **Local factors**
 - Silo mentality (management) - my Tower, my way!
 - Peer-pressure, lack of professionalism or recognition of criticality.
 - Lack of respect for the profession ('distractions', dependance of PEDs, non-pertinent conversations, socializing in the control tower).
- **Organisational factors**
 - Ineffective safety leadership, centrally.
 - Inadequate SMS/Compliance Monitoring (Management System).
 - Highly bureaucratic and complex structure.
 - Fragmented and dispersed accountability.
 - Comprehensive procedures, some obsolete - ineffective implementation.
 - Absence of Just Culture and Safety Culture – Occurrences/'near-misses' go unreported.

- Historically, oversight was the responsibility of the NAA
- EUROCONTROL European Safety Regulatory Requirements (ESARRs) created with the establishment of the Safety Regulation Commission (SRC) in 1997.
 - ESARR 1: Safety Oversight in ATM
 - ESARR 2: Reporting and Assessment of Safety Occurrences in ATM
 - ESARR 3: Safety Management Systems in ATM
 - ESARR 4: Risk Assessment and Mitigation in ATM
 - ESARR 5: ATM Services' Personnel
 - ESARR 6: Software in ATM Systems

- The NAAs of EUROCONTROL member states were responsible for transposition of ESARR provisions into national safety regulatory requirements.
- ESARR implementation monitoring and support (ESIMS) programme created in 2002 – 2 phase
- A number of key ESARR provisions have been transposed into Community Law
- Most recently:

Commission Implementing Regulation (EU) 2017/373 of 1 March 2017

laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight

- Came into force 2 January 2020
- Part-ATS (Subpart A, Annex IV) includes specificities for Air Traffic Services to implement a Management System
- Similar to AIR OPS in terms of MS requirements (incl. SMS, CM, etc.)

Take Note!

- **ATS.OR.460** - Requirement to record background communication and aural environment at controller workstations
(in force since 27 January 2022)

Two of the worst aviation accidents in Europe in the 21st Century

- 8 October 2001, Milan Linate airport (LIML)
- **RI: SAS MD-87 / Private Cessna Citation CJ4 (118 Fatalities)**
- No functional Safety Management System was in operation.
- Safety audits resulted in poor communication between organizations on safety matters, late decisions and slow handling of safety issues with loss of important information with respect to incidents and deviations.
- The competence, maintenance and requirements for recent experience for ATC personnel did not fully comply with ICAO Annex 1. No recurrent training program for ATC personnel.
- Missing Runway Guard Lights; Surface Movement Radar was not operational for a long time.
- The punitive environment that existed and the fear of sanctions discouraged the self reporting of incidents and individual mistakes.
- No quality System was established regarding aero. Data, etc.
- No well functioning deviation reporting system was in operation.
- Runway 36 incursion alarms did not work as they had been switched off for many years to avoid unnecessary alarms triggered by wildlife or other airport vehicles.



Two of the worst aviation accidents in Europe in the 21st Century

- 1 July 2002, (near) Überlingen/Lake Constance, Germany
- **MAC: Bashkirian Airlines Tu-154 / DHL B757 (71 Fatalities)**
- Management and quality assurance of the air navigation service company did not ensure that during the night all open workstations were continuously staffed by controllers.
- Management and quality assurance of the air navigation service company (had accepted) for years that, during times of low traffic flow at night, only one controller worked and the other retired to rest.

From the Safety Recommendations (extracts):

- “[...] air traffic control service provider issues and implements procedure to undertake maintenance work on the ATC Systems stipulating operational effects and available redundancies.”
- “[...] air traffic controllers are imparted with the initial and recurrent training covering the theoretical and practical (simulator) emergency procedures.”
- “[...] ICAO should require ATS units - in addition to present regulations - to be equipped with a recording device that records back-ground communication and noises at ATCO workstations similar to a flight deck area microphone system.” **NB: Background to ATS.OR.460**
- “[...] radar system of the air traffic control service provider is technically equipped in a way that enables display updates within 8 seconds or less in en-route air-space.”
- “[...] air traffic control service provider are equipped with system recording and replay facilities in accordance (with) a recommendation of EUROCONTROL that enables a complete reconstruction of the surveillance data presentation, display settings and selections at controller display positions.”
- “[...] air traffic control service provider equips air traffic control units with telephone systems which in case of a failure or shutdown of the main telephone system reroutes incoming telephone calls automatically to the bypass telephone system.”
- “[...] the air traffic service provider takes appropriate action to assure an effective operation of their safety management system in as much as that international requirements (ICAO SARPs, EUROCONTROL ESARRs) are assured, and appropriate safety strategies, management techniques and quality procedures are incorporated and evaluated.”
- “[...] air traffic service provider conducts an evaluation of the staffing levels required. The evaluation should not be limited to identifying the number of personnel required but also consider the qualification and experience required of specialist functions.”
- “[...] air traffic service provider develops and implements refresher and safety related training compliant with ESARR 5 and adapted to the operating environment.”

And of course...

- 29 September 2006, *Mato Grosso* state, Brazil
- **MAC:** Gol Transportes Aéreos B738 / ExcelAire Embraer Legacy 600 (154 Fatalities)
- CENIPA concluded that the accident was caused by air traffic control (ATC) errors, combined with mistakes made by the American pilots on the Legacy, including a failure to recognize that their traffic collision avoidance system (TCAS) was not activated.
- NTSB determined that both flight crews acted properly and were placed on a collision course by ATC, deeming the Legacy pilots' disabling of their TCAS system to be only a contributing factor rather than a direct cause.
- The two aircraft collided almost head-on at 37,000 feet (11,000 m), approximately midway between Brasília and Manaus.



- Mishaps within the ATM/ATS domain have a strong potential for resulting in catastrophic consequences.
- The events which were investigated by GPIAAF revealed significant organisational issues which have common elements to ATM/ATS serious incidents and accidents of the past.
- Key attributes (genesis) of this activity and how it is organised are very similar across the world.
- Formal requirements for MS (SMS, CM, JC) are relatively new and shortcomings in effective implementation are not uncommon.
- SIAs can also support ATM/ATS domain on their safety journey as they have done in other domains of the air transport system.



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