57th CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGIONS

Incheon, Republic of Korea
4 – 8 July 2022

AGENDA ITEM 3: AVIATION SAFETY

SUPPORTING ENHANCEMENTS IN FLIGHT CREW COMPETENCY THROUGH HAZARD AND OCCURRENCE DATA ANALYSIS

Presented by Singapore, and co-sponsored by Australia, Bangladesh, Fiji, Indonesia, Japan, Malaysia, New Zealand, Sri Lanka, Thailand and the European Union Aviation Safety Agency (EASA)

SUMMARY

This paper proposes a three-pronged approach to supporting enhancements in pilot competency through the strengthening of occurrence reporting, the analysis of reports using the ICAO Competency-Based Training and Assessment (CBTA) framework and the development of targeted interventions to address underlying deficiencies.

SUPPORTING ENHANCEMENTS IN FLIGHT CREW COMPETENCY THROUGH HAZARD AND OCCURRENCE DATA ANALYSIS

1. INTRODUCTION

1.1 Aviation safety has continued to improve over the years, with accident rates dropping to a low of 1.23 per million flights[1] in 2021. The international aviation community has made significant progress in enhancing aviation safety through aircraft technology, design, maintenance, reliability, and safety management. This paper focuses on enhancing pilot competency as a means to address underlying contributing factors in serious incidents and accidents.

1.2 Pilot errors are often manifestations of underlying deficiencies in one or more pilot competencies. COVID-19 has exacerbated existing deficiencies in pilot competency, due to the significant reduction in flights and the resulting opportunities for line flying. While efforts have been made to address the impact on pilot competency in a training environment through dedicated reactivation programmes, recency training and safety promotion for flight crew, more can be done to restore and maintain pilot competency. Greater reliance is needed on the use of Threat and Error Management (TEM) countermeasures including Crew Resource Management (CRM) skills, to mitigate the consequences of pilot errors when they occur.

1.3 It is more important than ever to identify trends of pilot errors in flight operations. This identification should be data driven. Industry-wide digitisation combined with the implementation of Safety Management Systems (SMS) has made safety data more abundantly available and accessible than ever. The acquisition of appropriate and timely data that represent hazards, threats and safety occurrences is essential for creating a clear picture of the safety landscape in which the flight crew operates. This data should be appropriately processed and analysed to provide actionable safety insights.

2. DISCUSSION

2.1 A Three-Pronged Approach to Enhance Pilot Competencies

2.1.1 Singapore suggests a three-pronged approach to enhance pilot competencies:

2.1.1.1 Expanding the scope of safety reporting to include precursor events and those involving the successful application of TEM countermeasures by pilots that may have prevented a significant safety occurrence. Further analysis can then be made of these events to identify hazards, threats and deficiencies in pilot competencies;

2.1.1.2 Analysing reported safety occurrences involving pilot errors using ICAO's Competency Based Training Assessment (CBTA) framework to identify common underlying deficiencies in pilot competencies, so that targeted interventions can be developed; and

2.1.1.3 Sharing of findings in 2.1.1.1 and 2.1.1.2 amongst aviation stakeholders globally as hazards and deficiencies in pilot competencies may be applicable across borders.

2.2 Expanding the Scope of Occurrence Reporting

2.2.1 Most States require air operators to report significant flight safety occurrences in the form of Mandatory Occurrence Reports (MORs). The analysis of MORs often leads to identification of data trends and the reactive development of safety interventions designed to prevent recurrence, which may not necessarily address the underlying cause. MORs are usually reports of occurrences that are defined by significant safety outcomes. Occurrences in which these outcomes had been averted at the incipient stage,

1 This is a five-year rolling average accident rate (2017-2021). Source: IATA Safety Report 2021

are not usually required to be reported as MORs. This approach in reporting may have inadvertently led to blind spots in efforts to detect deteriorations in certain pilot competencies.

2.2.2 One of the most effective tools to arrest errors at the incipient stage of an occurrence is the application of TEM countermeasures such as the graded assertiveness model. These TEM countermeasures are often the last line of defence to prevent slips, errors and mistakes that arise from deficiencies in pilot competency from developing into a safety occurrence. TEM countermeasures are highly effective tools, but may also mask underlying deficiencies in pilot competency similar to how enhancements and over-reliance on flight deck automation has masked deficiencies in pilot manual flying skills.

2.2.3 To illustrate, if one pilot experiences a breakdown of situational awareness due to mismanaged workload, a graded assertiveness model allows the other pilot to communicate concerns and resynchronise the flight crew's mental model. This is a normal and appropriate use of a TEM countermeasure but would likely go unreported. This example demonstrates a missed opportunity to address the root causes that led to the original pilot error.

2.2.4 Safety occurrences that are arrested at the incipient stage and consequently do not result in a significant safety outcome can be classified as precursor events. SMS best practices encourage the industry to report these precursor events voluntarily. However, States can do more to encourage the reporting of precursor events and successful TEM countermeasure deployment in sufficient detail for analysis, whilst appropriately de-identifying the individuals to encourage reporting. These reports can then be analysed using the CBTA framework to identify deficiencies in pilot competencies, and develop interventions to address them.

2.3 Analysing Safety Occurrences Involving Pilot Errors Using CBTA Frameworks

2.3.1 Effective analysis of safety data is greatly facilitated by the use of appropriate taxonomies. A commonly used taxonomy in the analysis of safety occurrences is the ICAO Accident/Incident Data Reporting (ADREP) taxonomy. The ADREP taxonomy has been useful in allowing the standardisation of the definitions and descriptions of occurrences, allowing for the aggregation of various sources of occurrence data for analysis. However, the ADREP taxonomy may not be best placed for the analysis of pilot errors and competency deficiencies.

2.3.2 ICAO PANS Doc 9868 – Training, Appendix 1 to Chapter 1, describes a framework of ICAO competencies, descriptors and observable behaviours utilised during the training and assessment of flight crew. The wide adoption of this CBTA framework throughout the industry demonstrates the value in using a common framework for the analysis of pilot competency. This framework is well-placed for the analysis of reported safety occurrences involving pilot errors, in order to identify common underlying deficiencies in pilot competencies.

2.3.3 Appendix A of this paper contains an illustration of the advantages in utilising the CBTA framework over the ADREP taxonomy specifically for the identification and analysis of pilot errors. As illustrated in Appendix A, a common threat such as runway change during taxi-out could lead two different event outcomes – a rejected take-off and a flight path deviation. Such occurrences would rightly be classified as unrelated events with little in common under the ADREP taxonomy. While both events are attributable to pilot error influenced by external factors, this would not be clear using the ADREP taxonomy categorisation. However, when the two events are analysed using the ICAO CBTA framework, clear common deficiencies in pilot competencies are evident which point to the need for intervention in this area.

2.3.4 Appendix B of this paper provides an illustration of the application of the CBTA framework to identity deficient or absent CBTA observable behaviours. Such analyses of pilot errors using the CBTA framework would be similar to the manner in which flight instructors utilise the framework to determine the competency of trainees.

2.4 Sharing and Implementation of Actionable Insights to Address Pilot Competency

2.4.1 Deficient pilot competencies identified through CBTA analysis of occurrence reports can then be addressed at various levels to enhance aviation safety. At the operator level, specific TEM countermeasures and training scenarios can be developed and implemented to address both the underlying deficient pilot competency and the possibility of recurrence. At the State level, deficient pilot competencies can be aggregated and analysed to identify trends and determine where broader industry interventions are necessary. States can share these identified trends and interventions through established regional information sharing programmes such as AP-SHARE.

2.4.2 Certain trends in pilot competencies, such as reliance on automation and pilot manual flying skills, transcend geographical boundaries. Insights into deficiencies in pilot competencies identified by States through CBTA framework analysis of occurrence reports can be shared amongst States. These insights can be consolidated by ICAO, for example by the Personnel Licensing and Training Panel (PLTP), to facilitate the development of targeted and consistent interventions worldwide using Evidence Based Training (EBT) and CRM training programmes to improve pilot competency. These consolidated insights into trends in pilot competency, precursor events and interventions can be shared by ICAO using circulars and training periodicals to reach States, industry partners and airlines.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

a) Encourage States to promote expanding the scope of reporting to include precursor events and the successful deployment of Threat and Error Management countermeasures by pilots as part of the State Safety Programme and Safety Management Systems;

b) Request ICAO and States to consider using the ICAO Competency Based Training Assessment framework as a basis for developing a taxonomy to facilitate the effective analysis of precursor events and safety occurrences involving pilot errors to identify deficiencies in pilot competency;

c) Request ICAO and relevant International Organisations to consolidate the analyses of pilot errors by States and industry, to provide insights and training recommendations for the enhancement of pilot competencies; and

d) Encourage the collaborative sharing of emerging safety trends and interventions related to pilot competency through existing regional sharing programmes and ICAO communication channels.

— END —

APPENDIX A

Threat/Hazard	Event Outcome	Event Categorisation	Competency Markers
Runway change during taxi-out	FMS programming completed but crew did not execute the changes. During initiation of the take-off, "RUNWAY DISAGREE" EICAS was displayed. Crew rejected the take-off at low speed	RTO (operational) / Take-off configuration warning ADREP: - NAV: Navigation Errors - Low speed rejected take-off - Wrong runway selected	1: Workload management (Time pressure / rush factor) 2: Situational Awareness (Breakdown of SA due to time pressure, crew became unaware of FMS status) 3: Application of procedures (Failure to complete FMS programming procedures, cross-checking and checklists)
	FMS programming completed and executed but crew turned in the wrong direction after departure.	Flight path deviation ADREP: - NAV: Navigation Errors - Navigation Error- Other - Altitude/Heading Confusion	

APPENDIX B

Example Report Narrative:

"During taxi out, a re-clearance for RWY 03 (change of runway) was issued. The pilot monitoring proceeded to make the necessary changes in the Flight Management System (FMS). By the time the changes were complete we had reached the runway holding point. In order not to further delay the flight, we accepted an immediate take-off clearance. On setting the thrust levers to TOGA, the EICAS displayed caution "RUNWAY DISAGREE". The take-off was aborted at low speed. The runway was vacated, the FMS programming corrected, and the runway change checklist completed. The subsequent take-off proceeded without incident."

Observable behaviour analysis

"By the time the changes were complete we had reached the runway holding point. In order not to further delay the flight, we accepted an immediate take-off clearance"

Summary: Under external time pressure, on time performance (OTP) was prioritised over the proper completion and cross-checking of the FMS programming.

Deficient ICAO CBTA observable behaviours:

- OB 8.2 - Plans, prioritizes and schedules appropriate tasks effectively
- OB 8.7 - Monitors, reviews and cross-checks actions conscientiously
- OB 8.9 - Manages and recovers from interruptions, distractions, variations and failures effectively while performing tasks

Associated ICAO CBTA competency marker: Workload management

“On setting the thrust levers to TOGA, the EICAS displayed caution "RUNWAY DISAGREE"”

Summary: The crew were unaware of the programming status of the FMS.

Deficient ICAO CBTA observable behaviours:

- OB 7.1 - Monitors and assesses the State of the aeroplane and its systems
- OB 7.4 - Validates the accuracy of information and checks for gross errors
- OB 7.5 - Maintains awareness of the people involved in or affected by the operation and their capacity to perform as expected

Associated competency marker: Situational awareness and management of information

“The runway was vacated, the FMS programming corrected, and the runway change checklist completed.”

Summary: By implication, the runway change checklist was not completed before the first take-off attempt which would have highlighted the issues with the FMS programming.

Deficient ICAO CBTA observable behaviours:

- OB 1.2 - Applies relevant operating instructions, procedures, and techniques in a timely manner
- OB 1.3 - Follows SOPs unless a higher degree of safety dictates an appropriate deviation
- OB 1.7 - Applies relevant procedural knowledge

Associated ICAO CBTA competency marker: Application of procedures and compliance with regulations