Data Report for Evidence-Based Training

Amendment (2021)

NOTICE

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Table of Contents

Executive Summary

The IATA EBT Data Report, 1st Edition, published in August 2014, states that EBT will continue to evolve as a result of continuous feedback and the incorporation of new evidence as it becomes available. Hence, four years after its publication, in view of the rapid changes in aircraft technology and in the operational environment, a review of the latest data was necessary to assess the relevance of the EBT curriculum. Moreover, there was also a need to look at the training data now available from operators that have implemented EBT since its endorsement by ICAO in 2013. To support IATA in this analysis, an EBT subgroup under the umbrella of the IATA Pilot Training Task Force (PTTF), constituted of representatives from operators and Approved Training Organizations (ATOs) who have implemented and conducted EBT programs, was created.

The work of the subgroup was conducted between 2018 and 2021 and led to the publication of this Amendment. The Amendment explains the revision process, the methodology applied, and the results of the EBT Subgroup's studies and recommendations. This Amendment is not intended to replace the EBT Data Report, 1st Edition, but to assess the relevance of the EBT curriculum by looking at the latest data available. As elaborated in Section 3 of this Amendment, the new data (2010–2020) analyzed largely corroborates the training topics prioritization of the EBT Data Report, 1st Edition, to manage the most common threats and errors encountered in flight operations.

Nevertheless, the analysis of the new data available has also demonstrated the need for some modifications to the EBT curriculum. Hence, this Amendment recommends four changes to the 'EBT recurrent assessment and training matrix'. First, the repositioning of certain training topics from the ICAO Doc 9995 'EBT recurrent assessment and training matrix', e.g., 'competencies non-technical' (CRM), 'compliance', 'surprise', etc. It is recommended that these topics be repositioned within an 'EBT/CBTA Overarching Principles' section, which focusses on how an EBT curriculum should be designed and delivered. These EBT Overarching Principles should still form part of the matrix, but not as standalone topics. Second, some modifications are also recommended to the frequency of certain training topics, e.g., moving Windshear from a frequency C to a frequency B for Generation 4 Jet. Third, integration of a topic within another training topic, e.g., 'Loss of communications' to be integrated within the training topic 'ATC' as example scenario elements. Fourth, the removal of the need to complete certain training topics solely using In-seat instruction. Section 4 in the Amendment contains the details of all the recommended changes.

It is to be noted, that whilst the EBT Data Report, 1st Edition, lacked data on Generation 4 aircraft, the majority of the data collected and analyzed for this Amendment was from Generations 3 and 4 jets: 94% of the pilots who completed the Training Criticality Survey (TCS) operated those two generations of aircraft jets; 77% of the reports analyzed for the EBT Accident-Incident Study and over 59% of the IATA Global Aviation Data Management (GADM) data, were from these two generations of jets only. However, although there was little data available on generations 3 and 2 turboprop to recommend any changes to the EBT curriculum for these categories of aircraft, the analyses and recommendations provided in this Amendment still address the needs of 90% of all operators.

This Amendment also aims at enhancing the applicability of the EBT Data Report and at providing a way forward to ensure the maximum objectivity and sustainability for data analysis. Therefore, this Amendment proposes solutions to collect the valuable training data resulting from the expansion of the Competency-Based Training and Assessment (CBTA) programs, including Evidence-Based Training.

EBT is a dynamic program that requires the continuous revision of new evidence, as it becomes available, to ensure the relevance of its curriculum. IATA's vision for the future is to achieve a continuous dynamic process that will allow for a regular and consistent assessment of new trends in both safety and training data, which may point to the prevalence of new threats and errors requiring a revalidation or modification of the EBT curriculum. The IATA Global Aviation Data Management (GADM) databases have provided substantial and qualitative data for this Amendment and should be one of the primary sources of the dynamic data review process that is envisaged for the future.

Acknowledgement

The revision of the EBT Data Report, 1st Edition, and the rigorous analysis of the different data sources that have led to the conclusions and recommendations made in this Amendment, required a substantial amount of work and the support from various industry stakeholders, without which the publication of this Amendment would not have been possible.

Therefore, IATA wants to acknowledge the critical and valuable contribution of the IATA Pilot Training Task Force (PTTF) members, the EBT Subgroup (EBT SG) members and the representatives of the following airlines, international organizations, approved training organizations, National Civil Aviation Authorities, research institutions and organizations:

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Royal Netherlands Aerospace Centre (NLR)
Seguridad Aérea Española
Singapore Airlines
Transport Canada
Vueling
Wizz Air

Publications

Document	Date
ICAO Annex 1, Personnel Licensing Thirteenth Edition, July 2020	ICAO Annex 1, Personnel Licensing Thirteenth Edition, July 2020
ICAO Annex 6, Operation of an Aircraft, Part I, International	ICAO Annex 6, Operation of an Aircraft, Part I, International
ICAO Doc 9868, Procedures for Air Navigation Services	ICAO DOC 9868, Procedures for Air Navigation Services –
EASA Aircrew and Air Operations regulations including EBT	EASA Aircrew and Air Operations regulations including EBT
ICAO Doc 10011 Manual on Aeroplane Upset Prevention and Recovery Training	2014
ICAO Doc 9995, Manual of Evidence-based Training	2013, corrigendum No1 06 January 2014
IATA EBT Implementation Guide	2013

Acronyms

ACAS	Airborne Collision Avoidance System
ACTF	Accident Classification Task Force
ADX	Accident Data Exchange (ADX) database (IATA)
ATSB	Australian Transport Safety Bureau
AOC	Air Operator Certificate/ Air Operator Certificate holder (operator)
AQP	Advanced Qualification Program
ATC	Air Traffic Control
ATO	Approved Training Organization
ATQP	Alternative Training and Qualification Program
BEA	Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile
CAA	Civil Aviation Authority
CASA	Civil Aviation Safety Authority of Australia
CBTA	Competency-Based Training and Assessment
CRM	Crew Resource Management
EASA	European Union Aviation Safety Agency
EBT	Evidence-Based Training
EBT SG	EBT Subgroup
EVAL	Evaluation Phase
FCTS	Flight Crew Training Standards
FDA	Flight Data Analysis
FMS	Flight Management System
FOQA	Flight Operations Quality Assurance
FSTD	Flight Simulation Training Device
GADM	Global Aviation Data Management
GPWS	Ground proximity warning system
ISI	In-seat Instruction
LOSA	Line Operational Safety Audit
MT	Maneuvers Training PhaseN
NAA	National Aviation Authorities
NPA	Notice of Proposed Amendment (EASA)
NTSB	National Transportation Safety Board
OB	Observable Behavior
OEB	Operations Engineering Bulletin

OEM	Original Equipment Manufacturer
OSD	Operational Suitability Data
OTT	Operations Training Transmission
PF	Pilot Flying
PM	Pilot Monitoring
SBT	Scenario-Based Training Phase
SMS	Safety Management Systems
SOP	Standard Operating Procedure
STEADES	IATA Safety Trend Evaluation, Analysis and Data Exchange System
TASE	Training Area of Special Emphasis
TCAS	Traffic Collision Avoidance System
TCS	Training Criticality Survey
TEM	Threat and Error Management
TP	Turboprop
TSB	Transportation Safety Board of Canada
UAS	Undesired Aircraft State
UPRT	Upset Prevention and Recovery Training

Definitions

Adapted competency model. A group of competencies with their associated description and performance criteria adapted from an ICAO competency framework that an organization uses to develop competency-based training and assessment for a given role.

Assessment. The determination by an instructor or evaluator as to whether a candidate meets a required competency standard under given conditions, by collecting evidence from observable behaviors. Assessment takes place during instruction and evaluation.

Competency. A dimension of human performance that is used to reliably predict successful performance on the job. A competency is manifested and observed through behaviors that mobilize the relevant knowledge, skills and attitudes to carry out activities or tasks under specified conditions.

Competency-based training and assessment (CBTA). Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards.

Competency standard. A level of performance that is defined as acceptable when assessing whether or not competency has been achieved.

Conditions. Anything that may qualify a specific environment in which performance will be demonstrated.

Contributing factors. Actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

> **Note:** The EBT Data Report, 1st Edition, defined a 'factor' as a reported condition affecting an accident or incident and provided a list of 40 factors (see page 28).

Evidence-based training (EBT). Training and assessment based on operational data that is characterized by developing and assessing the overall capability of a pilot across a range of competencies (competency framework) rather than by measuring the performance in individual events or maneuvers.

EBT module. A session or combination of sessions in a qualified FSTD as part of the 3-year cycle of recurrent assessment and training.

Error. An action or inaction by an operational person that leads to deviations from organizational or the operational person's intentions or expectations.

Error management. The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequences of errors and mitigate the probability of further errors or undesired states.

Evaluation. For the purpose of this document, evaluation means the summative assessment of a trainee performance or the evaluation of the training system.

Evaluation phase (EVAL). Refers to the phase where a first assessment of competencies is performed in order to identify individual training needs. On completion of the evaluation phase, any areas that do not meet the minimum competency standard will become the focus of the subsequent training. The evaluation phase comprises a complete mission as a crew but not necessarily a complete flight.

Event. A combination of a task or a sub-task and the conditions under which the task or sub-task is to be performed.

Facilitation technique. An active training method, which uses effective questioning, listening and a non-judgmental approach and is particularly effective in developing skills and attitudes, assisting trainees to develop insight and their own solutions and resulting in better understanding, retention and commitment.

Flight crew member. A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

ICAO competency framework. A competency framework, developed by ICAO, is a selected group of competencies for a given aviation discipline. Each competency has an associated description and observable behaviors.

Instructional systems design (ISD). A formal process for designing training which includes analysis, design and production, and evaluation.

Instructor. A person authorized to provide training and to conduct evaluations.

Maneuvers training phase (MT). Refers to the phase where skill retention is trained (body memory actions). Flight path control may be accomplished by a variety of means including manual aircraft control and the use of auto flight systems.

Observable behavior (OB). A single role-related behavior that can be observed and may or may not be measurable.

> **Note:** 'Behavior' refers to the way a person responds, either overtly or covertly, to a specific set of conditions, and which is capable of being measured.

Performance criteria. Statements used to assess whether the required levels of performance have been achieved for a competency. A performance criterion consists of an observable behavior, condition(s) and a competency standard.

Resilience. The ability of a flight crew member to recognize, absorb and adapt to disruptions.

> **Note:** Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events as defined by the US National Academies of science, engineering and medicine.

Scenario (event-set). Relatively independent segment of training made up of several events.

Note: EBT Example Scenario element. This provides the EBT operator with an example of how they might train a topic. These are just for guidance and the operator could chose to use their own data to suggest other scenarios.

Mixed implementation. Implementation of a mixed EBT program means that some portion of a recurrent assessment and training is dedicated to the application of EBT. This is a means of achieving a phased implementation where, for example, the CAA regulations or rules permit such a program as part of the operator's specific training and assessment but preclude such a program for the revalidation or renewal of pilot licenses. This phased implementation recognizes the potential for such an EBT program to be developed and implemented in advance of any future enabling regulatory changes, which may then permit total implementation.

Scenario-based training phase (SBT). Refers to the largest phase in the EBT program. It is designed to maximize crew's exposure to a variety of situations that develop and sustain a high level of competency and resilience. The scenario for this phase should include critical external and environmental threats, to build effective crew interaction to identify and manage errors. A portion of the phase will also be directed towards the management of critical system malfunctions.

Threats. Events or errors that occur beyond the influence of an operational person, increase operational complexity, and must be managed to maintain the margin of safety.

Threat management. The process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats and mitigate the probability of errors or undesired states.

Training objective. A clear statement that is comprised of three parts, i.e., the desired performance or what the trainee is expected to be able to do at the end of training (or at the end of particular stages of training), the performance standard that must be attained to confirm the trainee's level of competence, and the conditions under which the trainee will demonstrate competence.

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Section 1—Introduction

1.1 Background

The Evidence-Based Training project is one of the major achievements of the IATA Training and Qualification Initiative (ITQI) launched in 2007. EBT was endorsed by ICAO in 2013, with the publication of Doc 9995, Manual of Evidence-based Training. To support operators with EBT implementation, a co-branded IATA/ICAO/IFALPA 'Evidence-Based Training Implementation Guide' was also published in 2013.

EBT is a major safety initiative that arose from an industry-wide consensus that, in order to reduce the airline accident rate, a strategic review of recurrent and type-rating training for airline pilots was necessary. A review of available data sources, their scope, and relative reliability was undertaken. This was followed by comprehensive analyses of the data sources chosen, with the objective of determining the relevance of existing pilot training and to identify the most critical areas of training focus according to aircraft generation (see Appendix 1).

The publication of the EBT Data Report, 1st Edition, in 2014 was the result of the corroboration of independent evidence from multiple sources, which included flight data analysis, reporting programs and a statistical treatment of factors reported from an extensive database of aircraft accident reports.

To ensure regulatory support, objective consolidation of empirical data, which provided substantial evidence that training and checking practices were not, of themselves, fulfilling the safety needs of the industry, was critical. The EBT Data Report, 1st Edition, provides the results of the study and analyses of a wide range of available data sources, which demonstrated that training methodologies could and needed to be significantly improved. The data also highlighted important differences between what was considered as six different aircraft generations.

The whole concept of the ITQI EBT project was to enhance flight safety, through data collection and analysis, and the use of the pilot competencies as countermeasures against the threats and errors encountered in flight operations. The aim of EBT is to develop, maintain and assess the competencies required to operate safely, effectively, and efficiently in a commercial air transport environment, while addressing the most relevant threats according to evidence collected in accidents, incidents, flight operations and training.

For decades the industry has been using the completion of maneuvers such as rejected take-off, go-around from minima with the critical engine inoperative, etc., as performance measurements for recurrent training and checking. The paradigm shift developed by EBT is that assessments, necessary during all forms of recurrent training and instruction, as well as evaluation, should be determined according to performance in the defined areas of competency, and not simply by the achievement of a defined outcome in a specific maneuver.

1.2 Objective

The primary objective of this Amendment was to build on the foundations of the EBT Data Report, 1st Edition, using the latest evidence from aircraft safety data, airline operational and training data, in order to establish whether there was a need to recommend changes or modifications to the EBT curriculum as published in ICAO Doc 9995, Manual of Evidence-based Training.

Therefore, over a period of more than two years, IATA conducted a complete review and thorough analysis of the EBT Data Report, 1st Edition. This review was necessary to respect one of the underpinning philosophies of EBT, which is to continue to evolve as a result of continuous feedback and the incorporation of new evidence as it becomes available. Therefore, the latest safety, operational and training data was collected and analyzed for this Amendment, according to the key principles established in the EBT Data Report.

This Amendment used basically the same three categories of data that were used in the EBT Data Report, that is the EBT Accident-Incident Study (EBT A&I Study), the Training Criticality Survey and an equivalence to the EBT Evidence Table, which consists of data from multiple sources, including flight data analysis, IATA Global Aviation Data Management (GADM), IATA safety reports, and different safety and training studies from IATA and other international organizations. Additionally, the data and recommendations from AOCs and ATOs, that now have experience implementing and conducting EBT programs, have been a valuable and important contribution to this Amendment.

The secondary objective of this amendment was to enhance the applicability of the EBT Data Report and to provide a way forward to ensure maximum objectivity and sustainability for data analysis. This objective has been achieved by implementing more robust protocols for the EBT A&I Study in regard to the analysts' standardization and the capture of their analyses' results. Additionally, this Amendment provided an opportunity to start applying the methodology of the EBT A&I Study – Stage 2 to the GADM Accident Data Exchange (ADX) data, and to afterwards perform a correlation between the analysis results of the two data sources. This correlation permitted to ensure the quality and validity of the results of both data sources. Beyond those quality assurance aspects, the experience has demonstrated that the EBT A&I Study Stages 1 and 2 are applicable to other data streams as long as compatible taxonomies are used. Therefore, the extension of the EBT A&I Study methodology to the majority of the safety and training data streams should permit a continuous and more robust update of the EBT curriculum by analyzing, via a statistical methodology, large volumes of worldwide safety and training data.

1.3 Structure

The principles of the EBT Data Report have been followed, in terms of data sources, but a few changes have been introduced in an effort to enhance some aspects of the data collection, as will be seen in Section 3 of this Amendment, and to harmonize the EBT data collection and the safety data. The support of the EBT Subgroup, composed of major airlines and ATOs that have implemented and conducted EBT programs has been extremely valuable in this exercise as they provided the expertise to map the threats and errors, as per IATA's safety taxonomy, to the EBT training topics. The results of this mapping exercise are provided in Section 4 of this Amendment.

Therefore, this Amendment broadly follows the structure of the IATA EBT Data Report, 1st Edition. It is structured as a report of the objectives, methodology, analysis, conclusions, and recommendations resulting from the review of the EBT Data Report, 1st Edition, and the analyses of the latest safety, operational and training data.

The Amendment is divided into the following sections:

- Introduction
- Context, global expansion of CBTA within the aviation system
- Methodology and data sources
- Analysis and results
- Recommendations
- Appendices

1.4 Targeted audience

The contents will be useful to the following entities:

- National Aviation Authorities (NAAs)
- Operators (AOCs)
- Approved training organizations (ATOs)
- Course developers
- Pilots' representative bodies

Note: Where necessary, to better explain the connection between the EBT Data Report, 1st Edition, and this Amendment, certain extracts of the Data Report have been included within the Amendment. This has only been done when it was felt it would be beneficial to provide some background information or a brief review of the conclusions or methodology used in the EBT Data Report, 1st Edition. For the full and complete explanation of any area, refer directly to the EBT Data Report, 1st Edition.

Section 2—Context, global expansion of CBTA within the aviation system

2.1 Definitions

CBTA is defined as training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards.

The goal of competency-based training and assessment is to provide a competent workforce for the provision of a safe and efficient air transportation system. CBTA is a training methodology sustained by robust course design, instructor qualification and data collection to continuously enhance the training efficiency and effectiveness.

As experience with CBTA has grown, the aviation industry has realized that CBTA is a better way to develop a competent workforce when compared to the traditional task- or hours-based training and checking.

CBTA is applicable to all spectrum of pilot training, from pilot aptitude testing, pilot initial licensing training, instructor/evaluator training and operator training.

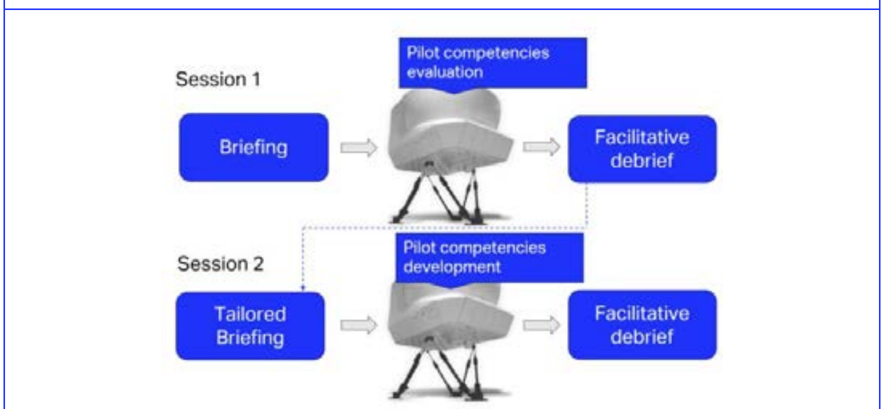
EBT is defined as assessment and training based on operational data that is characterized by developing and assessing the overall capability of a pilot across a range of competencies rather than by measuring the performance in individual events or maneuvers.

EBT is a CBTA program that uses specific training topics as vehicles to develop the pilot competencies. The training topics and their associated frequency were defined during the EBT design phase by analyzing both safety and training data from a worldwide perspective.

EBT emphasizes training versus checking and promotes learning from positive performance.

With EBT, pilots are more competent and confident to exercise their role within an operation.

Illustration of an EBT module sequence



Today, EBT is a CBTA program applicable to operator recurrent training only.

2.2 Context

In 2006, ICAO supported a performance-based approach to training with the publication of standards for the multi-crew pilot license (MPL), which is the first license competency-based training and assessment (CBTA) compliant.

In 2013, CBTA principles were extended to operator recurrent training with the publication of the ICAO, Doc 9995, Manual of Evidence-based Training (EBT).

In 2016, ICAO published Amendment 5 to Doc 9868, Procedures for Air Navigation Services — Training (PANS-TRG), General provisions for competency-based training and assessment. This defined the role of the pilot competencies in the context of Threat and Error Management (TEM) and provided a basis for the further development of CBTA.

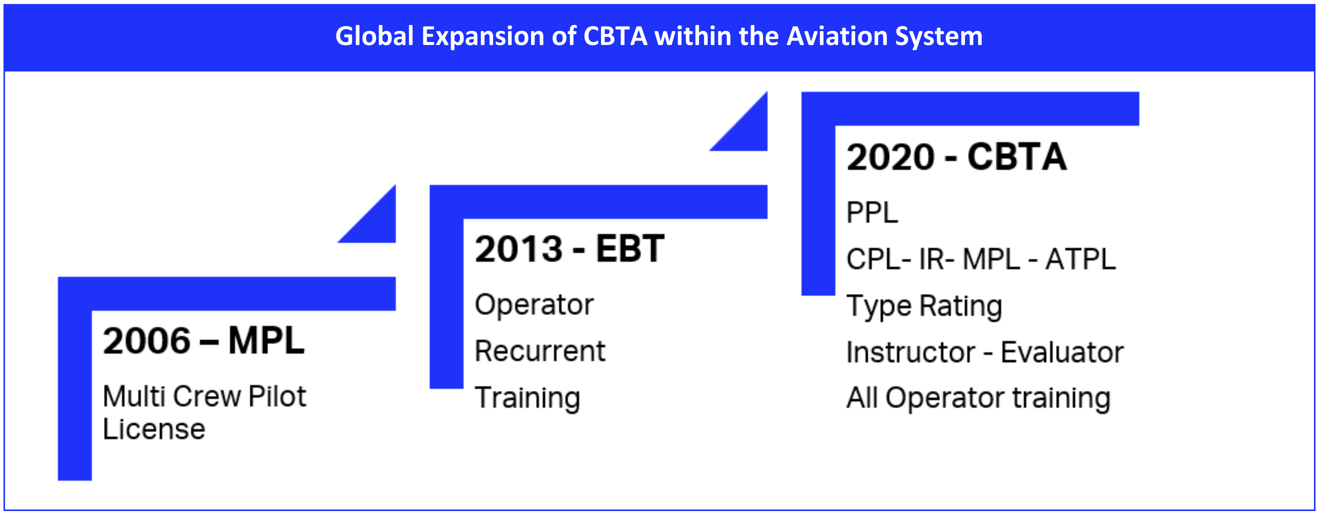
In 2020, ICAO published Amendment 7 to PANS-TRG (Doc 9868). This formalized the global expansion and applicability of CBTA principles to all licensing training (ICAO Annex 1) and operator training (ICAO Annex 6).

These CBTA standards support the IATA Total Systems Approach (TSA), which stands for the application of CBTA across all aviation disciplines in general, and to all modules and roles of a pilot's entire career. Hence, the defined competencies for pilots, instructors and evaluators should consistently be applied throughout pilot aptitude testing, initial (ab-initio) training, type rating training and testing, command upgrade, recurrent and evidence-based training and instructor and examiner selection and training.

In the last 15 years, many regulators have implemented CBTA principles and standards. The following examples illustrate, among others, the global expansion of CBTA across the world:

- MPL was adopted in Europe as common standard by the Joint Aviation Regulations (JARs) in 2006.
- EBT, since the publication of ICAO Doc 9995, Manual of Evidence-based Training in 2013, has been accepted as an alternative means of compliance to recurrent training and checking by several Civil Aviation Authorities (e.g., the General Civil Aviation Authority (GCAA) of the United Arab Emirates).
- The Australian Civil Aviation Safety Regulations (CASR) introduced competency-based training standards for all CASA flight crew qualifications in 2014.
- EASA introduced EBT principles in 2016 and baseline EBT requirements were officially adopted by the European Commission in December 2020.
- EASA launched Rulemaking Task (RMT 0194) to introduce CBTA principles in the Aircrew regulation (expected results in 2022).

Summary:



2.3 Competencies and Threat and Error Management

Competencies are defined by ICAO as a dimension of human performance that is used to reliably predict successful performance on the job. A competency is manifested and observed through behaviors that mobilize the relevant knowledge, skills and attitudes to carry out activities or tasks under specified conditions.

The pilot competencies are the following:

Pilot competencies	
• Application of Knowledge [KNO] • Application of Procedures and Compliance with Regulations [PRO]* • Aeroplane Flight Path Management, automation [FPA] • Aeroplane Flight Path Management, manual control [FPM]	• Communication [COM] • Situation Awareness and Management of Information [SAW] • Leadership and Teamwork [LTW] • Workload Management [WLM] • Problem Solving and Decision Making [PSD]

***Note:** EASA introduced a change to the abbreviation of ‘Application of procedures and compliance with the regulations’, changing it from APK to PRO, as a result of a comment received to the NPA. Moreover, the old abbreviation (APK) refers to ‘Application of procedures and knowledge’. This was not deemed appropriate for EASA due to the introduction of ‘Application of knowledge’ as a competency (Reference: AMC1 ORO.FC.231(b) — Application of procedures and compliance with regulations [PRO]). Since this Amendment uses the nine pilot competencies, it was appropriate to also use the abbreviation ‘PRO’ for ‘Application of Procedures and Compliance with Regulations’.

The pilot competencies were officially introduced as a new standard to measure the pilot performance during the design phase of EBT, between 2008 and 2013, when the design of EBT took place. The detailed pilot competency set is provided in Appendix 11.

The pilot competencies encompass what was previously known as technical and non-technical skills to include the CRM skills of workload management, situational awareness, decision making, communication and leadership, which are of upmost importance to ensure flight safety.

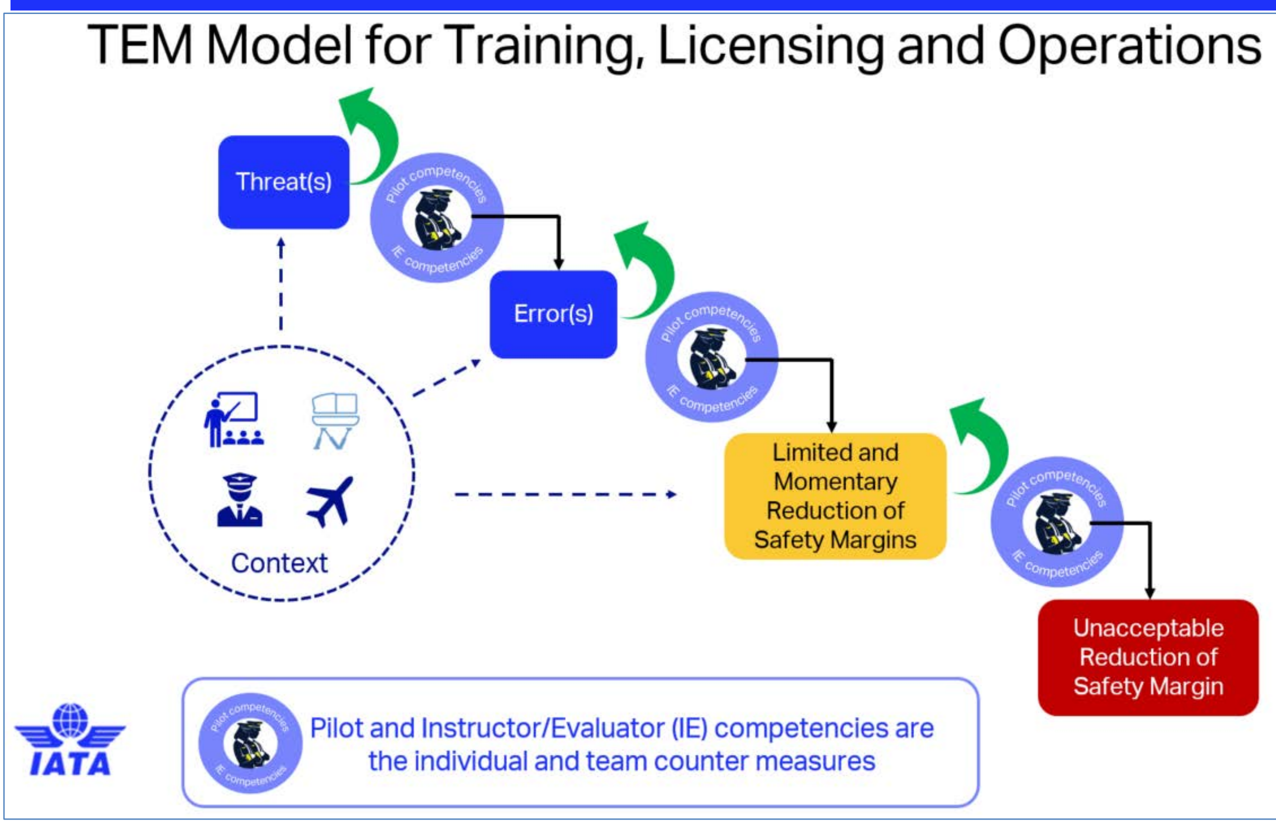
IATA also led the definition of a pilot instructor-evaluator competency set that was endorsed by ICAO in 2018. See detailed instructor/evaluator competency set in Appendix 12.

Under CBTA, Threat and Error Management (TEM) is naturally and fully embedded in the training curriculum. The pilot and Instructor and Evaluator (IE) competencies provide individual and team countermeasures to threats and errors to avoid a reduction of safety margins during training and operations.

Summary:

From a Human Performance perspective

Competencies = Countermeasures in TEM



Please see Appendix 13 for the full explanation on the adjustment of the TEM model for training, licensing, and operations purposes.

2.4 Training system performance

CBTA is a performance-based training program that integrates, per design (Instructional System Design), a continuous monitoring and evaluation of the course.

Under CBTA, the training system performance is measured and evaluated through a feedback process in order to validate and refine the curriculum, and to ascertain that the organization's program develops pilot competencies and meets the training objectives.

The typical CBTA feedback process should use defined training metrics to collect data in order to:

- identify trends and ensure corrective action where necessary
- identify collective training needs
- review, adjust and continuously improve the training program
- further develop the training system
- standardize the instructors

The typical metrics include but are not limited to:

- differences in success rates between training topics
- grading metrics
- trainee's and instructor's feedback, which provides individual perspective as to the quality and effectiveness of the training
- differences in success rates between different trainee cohorts
- distribution of errors for various training topics, scenarios and aircraft class or types
- distribution of level of performance within the range of competencies and outcomes
- instructor inter-rater reliability data (concordance)

Moreover, regulators and industry have agreed that the feedback process should be included in the AOC and/or ATO Safety Management System and compliance monitoring.

2.5 Safety enhancement expectations

The shift in terms of safety benefit from traditional prescriptive task-based training to CBTA is mainly due to the extension of the scope and nature of the training, and the enhancement of the measurement of the performance.

Traditional training, which is hour driven and task based, focuses on training mainly three technical elements: handling skills, automation management and application of procedures. The content of the traditional skill test or proficiency check is based on the restitution of exercises where the measurement of pilot performance is mainly based on a set of fixed predetermined criteria represented by the flight path deviation numeric tolerances.

In contrast, CBTA aims at assessing, developing, and enhancing the pilot competencies (see Appendix 11) and the instructor/evaluator competencies (see Appendix 12). CBTA also uses more scenario-based training for increased realism, and facilitation techniques by the instructor to support the pilot's development. This enhances the pilots' competence and increases their confidence. Under a CBTA program, the pilots are more resilient when managing unexpected situations in everyday operations.

Moreover, under CBTA the performance of the pilot is determined with more accuracy by using objective, observable performance criteria that state whether (or not) the desired level of performance has been achieved.

Additionally, the training metrics sustaining the monitoring and enhancement of the CBTA training system's performance constitute the core of the CBTA training data that should be collected and analyzed by the CAAs, ATOs and AOCs.

These training metrics are required under CBTA programs and have been developed originally under modern training programs such as Advance Qualification Programs (AQP) under the FAA, and Alternative Training and Qualification Programs (ATQP) under EASA.

To illustrate the specific value of the training data issued from a CBTA-EBT program, it is important to remember that:

- Competency is a dimension of human performance that is used to reliably predict successful performance on the job. A competency is manifested and observed through behaviors that mobilize the relevant knowledge, skills and attitudes to carry out activities or tasks under specified conditions, and
- From a human performance perspective, the competencies represent the individual and team countermeasures to manage the threats and errors and avoid the reduction of safety margins.

Therefore:

- The more competencies' Observable Behaviors (OBs) are timely demonstrated when required, the better the threat and error management should be. This should lead to the maintenance of the safety margins.
- Per opposition, the competencies' Observable Behaviors (OBs) that have not been demonstrated when they were required, could result in the mismanagement of the threats and errors. This could lead to a reduction of safety margins.

Hence, the training metrics relate directly to threat and error management, recognition, and recovery of the potential reductions of safety margins that may have happened during training or evaluation.

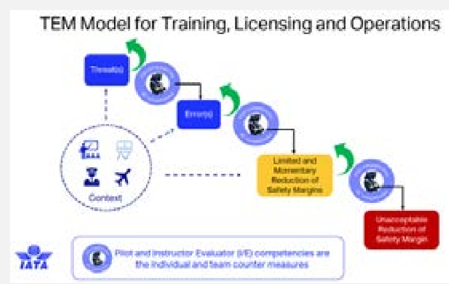
As an example, the following grading metrics (comprising four categories of metrics) have been introduced within the European regulatory framework in the context of baseline EBT implementation.

Example of grading metrics mandated by the Evidence-Based Training European Regulation
Level 0 (competent metrics): The information whether the pilot(s) is (are) competent or not.
Level 1 (competency metrics): Level of performance reflected by numeric grade of the competencies (e.g., 1 to 5).
Level 2 (observable behavior metrics): The instructor records OBs predetermined or required by the organization (Regulatory or Policy requirements).
Level 3 (TEM metrics): The instructor records Threats, Errors or Reduction of Safety Margin predetermined or required by the organization.

The collection and analysis of these CBTA-EBT training metrics within the global Safety Management System should, first, enhance a proactive hazard identification, second, support a more predictive approach to hazards identification by providing visibility on the individual and the team countermeasures (the competencies) to efficiently manage the threats encountered and errors committed in both training and operational contexts.

The obvious value of these training metrics, from a single organization perspective, becomes exponential when organizations are interacting with each other. This is the case when AOCs rely on ATOs to provide the pilot workforce. The AOC and the ATO should collaborate to exchange the relevant elements of each organization's CBTA training metrics. As a very basic example, the AOC should provide to the ATO (in charge of the AOC's pilot training) the most relevant threats encountered in operations, for the ATO to introduce these threats within the flight training sessions of the type rating course.

Summary

Example of hazard identification methodology expansion			
Reactive	**Reactive/Proactive**	**Proactive**	**Proactive/Predictive**
E.g., Analysis Accidents-Incidents	E.g., Analysis of event including Undesired Aircraft States	E.g., Analysis of Threat and Error Management	E.g., Analysis of CBTA-EBT Training metrics
			

2.6 Inner Loop and Outer Loop data terminology

The EBT Data Report, 1st Edition, referred to 'internal training feedback loop' and 'external training feedback loop'. These references describe, from an operator's perspective, the data that is collected and analyzed within or outside the training department. Consequently, ICAO Doc 9995 qualified the data collected and analyzed within the operator's training department as the 'inner loop', and the data collected and analyzed within the operator's safety management system and flight operations department as the 'outer loop'.

CBTA, including EBT, has expanded across the world and has been implemented by many ATOs and AOCs. The training data has become more and more integrated into each organization's Safety Management System (SMS). Therefore, all the relevant data streams collected by an organization are analyzed under the umbrella of the ATO's or AOC's SMS. Hence, since 2018 the 'inner loop' relates to the organization's own training, operational and safety data collection and analysis, while the 'outer loop' relates to the relevant data streams that are available outside the organization, which include international organizations' data, state safety recommendations, OEM guidance, etc.

This latest interpretation has been retained by IATA and is reflected within the European EBT regulatory framework of EASA.

The following illustrates the evolution of the meaning of 'inner loop' and 'outer loop'.

EBT Data Report, 1st Edition
• Training data, including the elements and structure of transition courses, recurrent training and line flights under supervision, in addition to measurements of system performance. This type of data provides information relating to the effectiveness of the training system, the instructor and trainees, and, for the purposes of the EBT Data Report, is known as the 'internal training feedback loop'. • Operational and safety data – operators are required to collect data from operations, and this is sometimes used to analyze and determine risk mitigations through training. This is combined with subsequent measurement of the effectiveness of remedies. Also known as the 'external training feedback loop'.
ICAO Doc 9995
5.2.5 Data, methods and tools. The data collection and analysis generally need to cover various types of data, both from within the training activity (inner loop) and from the flight operations and safety management system (outer loop). Data analysis can be as simple as analysing the operator's mission and making sure that operator-specific threats are accounted for in the training programme.
European regulatory framework
GM3 ORO.FC.231(a) Evidence-based training 1. Inner loop i. Individual evidence based on training data (e.g., grading metrics, training reports, questionnaires, etc.), analysed either for an individual pilot or a group of pilots (for example, all first officers, all B747 pilots, all pilots flying an Airbus model, etc.). ii. Operator-specific evidence gathered through the safety management process in accordance with ORO.GEN.200. 2. Outer loop Evidence gathered **from** external sources such as authorities (e.g., state safety plan, etc.), OEMs (e.g., OEBs, OSD, safety documentation such as getting to grip, etc.), etc. **GM1 ORO.FC.231(i)** Evidence-**based training** INTERNAL AND EXTERNAL EVIDENCE a) Operator evidence (inner loop) 1. Pilot data (individual or group); 2. Population-based data according to the training metrics determined in the training system performance; 3. Evidence identified or recognized through the safety management process covered in ORO.GEN.200. b) External evidence from the authority and manufacturers (external loop) 1. Revision of existing rules and regulations, updated versions of the EBT data report, state safety plan; 2. Training needs derived from updated OSD (if appropriate for ground training), etc.

Section 3— Methodology and data sources

3.1 Methodology

As stated in the introduction of this Amendment, the primary objective of the Amendment is to build on the foundations of the EBT Data Report, 1st Edition, using the latest evidence from aircraft safety data, airline operational data and training data, in order to establish whether there is a need to recommend changes or modifications to the EBT curriculum, as published in ICAO Doc 9995, Manual of Evidence-based Training.

Over a period of more than two years, IATA conducted a review and analysis of the EBT Data Report, 1st Edition, and the latest safety, operational and training data, according to the key principles established in the EBT Data Report. The data analysis processes, and consequential results have been peer-reviewed by experts in pilot training drawn from AOCs, ATOs, pilot associations and National Aviation Authorities (NAA), in order to provide transparency and to bring a qualitative and practical perspective.

Whilst the intent was not to reproduce the three-category structure used in the EBT Data Report, 1st Edition (Table below), the same or equivalent (where possible) data sources that were used to produce the Evidence Table have been used and analyzed for this Amendment. The EBT A&I Study and the Training Criticality Survey (TCS) also constitute an integral and fundamental part of the analyses conducted for this Amendment. These two data sources have been complemented by the GADM safety data for correlation and quality control purposes.

	EBT Data Report, 1st Edition	Amendment
Category 1	Evidence Table	EBT SG data analysis, Safety/Training Studies
Category 2	Accident and Incident Analysis	EBT A&I Study, GAM ADX
Category 3	TCS (Not included in the final results)	TCS

The Evidence Table of the EBT Data Report, 1st Edition, which consisted of data from multiple sources, including flight data analysis, LOSA reports, IATA safety reports, STEADES, different safety and training studies (e.g., an AQP study, Factors that Influence Skill Decay and Retention…), etc., has not been reproduced in this Amendment. Nevertheless, the integrity of the methodology behind the Evidence Table has been maintained through the analysis of similar or equivalent data sources used to create the table: flight data analysis, the IATA Global Aviation Data Management (GADM) database, different safety and training studies published in the recent years by IATA and other international organizations, and the results of the analysis and studies conducted by the EBT Subgroup, based on their experience implementing and conducting an EBT program.

Note that the table above, Categories 1, 2 and 3, is for reference purposes only. Section 3.2 below, will only refer to data sources and the order in which these sources are presented does not necessarily reflect the order of the three listed Categories. The data sources used in this Amendment will be examined and presented in the following order.

Data sources analyzed for this Amendment

Section	Sources
3.2.1	EBT Accident and Incident Study
3.2.2	IATA Global Aviation Data Management (GADM)
3.2.3	Training Criticality Survey
3.2.4	EBT Subgroup Study
3.2.5	Safety/Training Studies and Reports

The primary objective of this Amendment being to look at the latest evidence from aircraft safety data, airline operational data and training data, to establish whether there is a need to recommend changes or modifications to the EBT curriculum, the first source of data that was analyzed in the context of the revision of the EBT Data Report were the accident-incident reports (2008-2017); which analysis results produced the EBT A&I Study. The results of this study were then compared to the GADM ADX data analysis (for a similar period of time), in order to establish corroboration or differences between the two data sources results.

The Training Criticality Survey (TCS), the third data source analyzed in this Amendment, provides the pilots' perspective into the global analysis of this Amendment, on the most common threats and errors encountered in operations, and on how effective training could be as a mitigation measure in preventing the accident or incident from occurring, or in reducing or mitigating its severity.

The results of the above analyses were then shared with the EBT Subgroup, comprising operators, approved training organizations and other industry experts who have implemented and/or conducted EBT training, for their revision and comparison with the results of their own EBT programs and training data. The studies conducted by the EBT SG constituted the fourth data source for this Amendment.

The fifth component of the data sources are the safety and training studies and reports from IATA and other international organizations, which provide further insight into the results of the safety, operational and training data analyzed for this Amendment.

EBT Subgroup (EBT SG)

Since ICAO's endorsement of EBT with the publication of Doc 9995, Manual of Evidence-based Training, in 2013, several National Aviation Authorities (NAAs) have introduced EBT within their regulatory framework, and a significant number of operators have implemented EBT programs or were in the process of implementing EBT at the time of the drafting of this Amendment.

Hence, IATA dedicated specific expertise to form an EBT Subgroup under the umbrella of the IATA Pilot Training Task Force (PTTF), comprising representatives from the PTTF and other experienced EBT mixed implementation operators and training organizations. To take advantage of this valuable expertise in implementing and delivering EBT programs, IATA conducted several workshops in 2018, 2019 and 2020, in Frankfurt, Denver and Madrid. Representatives from airlines, ATOs, NAAs, research institutes and organizations, and IFALPA, participated in these workshops or contributed to the analysis of the most recent data. The names of these organizations have been listed in the Acknowledgement section of this Amendment.

The EBT SG met in person and via video conferencing on a regular basis to discuss key areas of the EBT training program. The objective being to use the expertise and experience of this group to assess the relevance of the EBT training curriculum and, if required, potentially recommend modifications.

Safety Group (SG) and Accident Classification Task Force (ACTF)

Before entering into the details of the data sources in section 3.2 below, it would be important to describe here the role of the IATA Safety Group and, in particular, the Accident Classification Task Force (ACTF).

The IATA Safety Group (SG) monitors aviation safety problems identified by airlines, and develops recommendations and strategies to continuously improve safety, such as promotion of the use of flight data mentoring programs. It acts as an advisor body to IATA Safety, the Flight and Ground Operations Advisory Council (SFGOAC), IATA Management and to other relevant IATA bodies on matters that relate to the optimization of airline safety. The SG will also indicate how to implement those measures in a rational, coordinated and cost-effective manner. It coordinates its activities and recommendations with the appropriate operational groups likely to implement such recommendations, as required.

The ACTF is a Task Force reporting to the SG and is comprised of industry safety experts and managed by IATA. The ACTF meets on a regular basis to review, validate and classify each accident, e.g., the 2020 workplan for ACTF was to meet on a quarterly basis. The group analyzes accidents, identifies contributing factors, determines trends and areas of concern relating to operational safety, and develops prevention strategies.

The results of their accident analysis classification are recorded in the IATA Accident Data Exchange (ADX) and incorporated in IATA's flagship annual Safety Report. For this Amendment, 563 reports (from 2010 to 2020) were extracted from ADX and analyzed.

Harmonization of the safety and training taxonomies

An important issue that emerged during the revision of the EBT Data Report and the analysis of the IATA Accident Data Exchange (ADX) data is the differences in the taxonomies used, in particular the flight crew countermeasures used by the ACTF versus the pilot competencies used in the EBT program. As explained in Section 2 above, under EBT the pilot competencies provide the individual and team countermeasures against threats and errors encountered in operations. The revision of the EBT Data Report has brought to light the misalignment between the safety and training taxonomies, which, to improve data comparison and data sharing and ultimately enhance safety, should be aligned.

Consequently, IATA has started working with the ACTF to address this misalignment and to work towards a harmonization of the safety and training taxonomies. This harmonization is part of the recommendations made in this Amendment in Section 5.

The taxonomy alignment exercise was also part of the analysis performed by the EBT Subgroup in the threats and errors mapping and grouping exercise mentioned earlier, which is further explained in Section 3.2 below.

3.2 Data Sources

This section goes into the details of the data sources used for this Amendment and into the specific methodology applied in the analysis of the different data sources; highlighting and explaining equivalences and differences in the methodologies applied in this Amendment versus the EBT Data Report, 1st Edition.

Data Streams and Data Sources

It is important to specify that although the EBT Data Report, 1st Edition, distinguished between Data Streams and Data Sources, as listed in the table below, with various elements pertaining to both columns, e.g., Training Studies and Scientific Reports under Data Stream are equivalent to the specific individual studies and reports listed in the column Data Sources, e.g., Factors that Influence Skill Decay and Retention, the distinction between data streams and data sources has not been made in this Amendment. This Amendment only refers to data sources.

EBT Data Report, 1st Edition, Data Streams and Data Sources

Data Stream	Data Sources
Cockpit Observation Reporting	LOSA Report
Flight Data Analysis (FDA)	EBT Accident & Incident Study (AIS)
Accident-Incident Analysis	EBT Flight Data Analysis
Training Studies	UK CAA Accident Reports
Airline Pilot Survey on Training Effectiveness	IATA Safety Report
Scientific Reports	AQP Study
Training Criticality Survey (TCS)	ATQP Installation Data
	STEADES Training Query
	Airline Pilot Survey on Training Effectiveness
	Factors that Influence Skill Decay and Retention
	Automation Training Practitioner's Guide
	The interface Between Flight Crew & Modern Flight Deck Systems
	Long Aircraft Type/Variant differences on Landing
	A Study of Normal Operational Landing Performance
	TAWS – 'Saves'
	Augmented CAST Accident Study
	Training Criticality Survey (TCS)
	Correlation of Risk between TCS and AIS

To be able to correlate the data, to identify equivalences and differences, where possible, the same or equivalent data sources used in the EBT Data Report, 1st Edition, have been used in this Amendment. Some of the data sources, in particular with regard to the studies previously used, were either no longer available or superseded by other studies, e.g., UK CAA Cap 776 is no longer available. Also, some data repository platforms have been superseded by more effective analysis tools, e.g., the IATA Safety Trend Evaluation, Analysis & Data Exchange System (STEADES) was superseded in 2019 by the IATA Incident Data Exchange (IDX).

Data sources analyzed in this Amendment

Section	Sources
3.2.1	EBT Accident and Incident Study
3.2.2	IATA Global Aviation Data Management (GADM)
3.2.3	Training Criticality Survey
3.2.4	EBT Subgroup Study
3.2.5	Safety/Training Studies and Reports

3.2.1 EBT Accident and Incident Study

Two-stage analysis

This amendment retained a similar process to the original EBT A&I Study, which is a two-stage analysis. The following section presents the enhancements that were implemented to improve the quality of the data collection during Stage 1 of the analysis.

Stage 1 involves the analysis of accident-incident reports by a team of qualified analysts. This team of experts analyzes the reports and identifies any threats, errors, and pilot competencies (where the pilot competencies were weak as countermeasures) that have been identified as contributive factors in the accident or incident.

Additionally, the analysts rate to what degree, training may have mitigated the results of the accident or incident, that is, the potential effect of FSTD training in preventing the accident or incident from occurring or mitigating the severity of the event.

Stage 2 of the study is based on the results of Stage 1, and involves an analysis (globally and individually), within the six generations of aircraft. The process enables the prioritization of training topics by training criticality from a generational perspective, using the dimensionality of risk, clustering, and effectiveness of training.

EBT Accident-Incident Study – Stage 1

Report sources – Accident investigation agencies

For the EBT Data Report, 1st Edition, the primary source of accident-incident reports was the National Transportation Safety Board (NTSB) database. A total of 3045 accident and incident reports were considered over a period from 1962 up to 2010. Reports in this targeted group were omitted from the analysis if they were considered incomplete. Approximately

4% of the reports catalogued by the NTSB in the targeted category were not analyzed for this reason. Where the NTSB was not the investigating authority of record, the official report or references to the official report were used.

For this Amendment, the number of Accident Investigation Agencies was expanded and included the NTSB, BEA, TSB, EASA's Safety Department, and ATSB. A total of 770 accident-incident reports, from 2008 to 2017, were considered, out of which 184 were retained and analyzed for the EBT A&I Study. The reports that were not considered for this analysis were either rejected due to insufficient information or because they were written in a foreign language unknown to the analysts. A significant number of reports was kept for statistical purpose only since the accident or incident did not involve any action from the flight crew, e.g., ground events (24%), turbulence (20%), cabin safety events (5%), etc.

Analysts' pre-requisites and methodology

For the EBT Data Report, 1st Edition, a total of 27 pilot-analysts participated in Stage 1 of the Accident-Incident Study. Two different pilot experts independently analyzed each accident or incident. The first analysis was conducted by a pilot currently or previously qualified on the aircraft type (the analyst), the second was conducted by a pilot (the checker) qualified on type, or on an aircraft of the same generation. The only exception to this was for several Generation 2 turboprop types, where it was not possible to find type qualified pilots. In these few cases, experienced analysts on similar types from the same generation were used. The group worked in excess of 2,000 man-hours reading and analyzing accident and incident reports. Any discrepancy between the first and second analysis was noted, then reconciled by a separate team of three pilots, at least two of which working together to reconcile the differences. The reconciliation team was limited to the same three pilots for the entire study.

For this Amendment, three analysts first analyzed independently the reports, then regrouped to compare and to agree on the final analysis results to be captured in the online tool that was specifically developed for the EBT A&I Study. This process permitted to increase the quality and the reliability of the analysis by ensuring data collection accuracy and correctness.

The prerequisite to be an analyst for the Amendment was to be an instructor currently or previously type-rated on the aircraft type involved in the accident-incident report, or to be at least an instructor currently or previously type-rated on the aircraft generation involved in the accident-incident report. For Generation 2 turboprop types, where it was not possible to find type qualified pilots, three experienced analysts on similar types from the same generation analyzed the accident-incident reports.

Fourteen teams of three analysts were created for a total of 42 analysts. The majority of the members of these teams of analysts were representatives from airlines members of the IATA Pilot Training Task Force (PTTF). The average time to complete each report analysis was 60 minutes.

In case of discrepancies among the analysts, the analysts' results would be reviewed and reconciled by a separate team of three analysts, the IATA Reconciliation Team.

Analysts standardization training

For the EBT Data Report, 1st Edition, the analyst received only a guidance to perform the analysis.

For this Amendment, a standardization training program for the analysts was developed. The objective was two-fold.

Firstly, to ensure the quality of the data collected, the analysts were provided:

- Proper awareness and knowledge about the Threat and Error Management (TEM) model and the role of the pilot competencies as countermeasures within the TEM model
- Practical guidance to perform the accident-incident analysis, and in particular how to identify the contributing factors (threats, errors, deficient countermeasures) in the accident-incident reports
- Practical hands-on exercise to validate the analysts' competency to perform the analysis
- Practical guidance to capture and record the data post-accident-incident report analysis

The following are the standardization materials and the procedures and reference documents booklet that were developed and provided to the analysts.

Standardization materials
The analysts underwent a standardization training, which consisted of three standardization tutorials: • Tutorial 1: Accident-Incident Analysis Standardization • Tutorial 2: Case Study – Amsterdam Bird Strike • Tutorial 3: Filling the Analyst Tool
Procedures and reference documents booklet
A 'Guidance for Analysts' booklet was created and provided to the analysts to support the standardization, the report analysis, and data capturing using the Analyst Tool. (See Appendix 2 for the full content of the booklet.)

Secondly, this standardization training was developed by IATA with the longer-term goal of achieving a more robust approach to data collection by harmonizing the safety and training taxonomies. There is a global harmonized consensus on the threats, errors and UAS taxonomy in safety, but no consensus on the flight crew countermeasures. Under a CBTA-EBT program these flight crew countermeasures are the pilot competencies. The content of these tutorials allows for a better understanding of the TEM model and the pilot competencies as countermeasures to threats and errors to avoid undesired aircraft states.

Hence, the longer-term objective would be to promote/share this standardization training and the Analyst Tool with NAAs and the ATOs/AOCs' safety departments, to support their safety investigation processes, achieve harmonization between the safety and training taxonomies, and allow for more efficient data collection, analysis, and comparison.

Taxonomy

In the EBT Data Report, 1st Edition, the EBT Accident-Incident Study is a factor analysis consisting of the recording of factors related to the event. A factor was defined as a condition affecting an accident or incident with which the flight crew had to cope. The criterion for inclusion in the analysis was if a factor was mentioned directly in the report or if in the analyst's expert opinion, the report logically implied the presence of a factor. These factors may or may not be considered directly causal but should be relevant to the event. Forty (40) factors were defined by the EBT Working Group, and described in character as threats, errors and 'end-states' with the potential to become the focus of FSTD based training.

Factors in EBT Data Report, 1st Edition, Accidents-Incidents Study	
Ground Equipment	Runway Incursion
Ground Maneuvering	Poor Visibility
Runway/Taxi Condition	Upset
Adverse Weather/Ice	Wake Vortex
Windshear	Terrain
Crosswind	Birds
Air Traffic Control	Engine Failure
Navigation	Minimum Equipment List
Loss of Communications	Fire
Traffic	System Malfunction
Operation/Type Specific	Crew Resource Management
Cabin	Physio
Compliance	Workload Distraction Pressure
Deficiency in Manuals	Manual Aircraft Control
Deficiency in Operational Data	Dangerous Goods
Deficiency in Charts	Loading, Fuel, Performance
Deficiency in Check Lists	Mismanaged-AFS
Deficiency in Data Bases	Mismanaged Aircraft State
Deficiency in Procedures	Mismanaged System
Fatigue	Pilot Incapability

For this Amendment, the EBT Subgroup decided to use the 68 threats and errors from the IATA taxonomy, as defined in the IATA Safety Report (Annex 2 Accident Classification Taxonomy), and to use the pilot competency set (See Appendix 11) as the flight crew countermeasures. The IATA threats and errors taxonomy associated with the pilot competencies, reflects the latest amendments to the ICAO PANS-TRG (Doc 9868), which defines the role of the competencies as countermeasures within the TEM model.

The alignment of the safety taxonomy (IATA threats and errors) with the training taxonomy (pilot competencies) was applied as a general concept for this Amendment, and in particular, for the EBT A&I Study and the TCS. This permitted, first, to validate the practicality of the concept (pilot competencies as countermeasures in the TEM model), and second, to plant the seed for the worldwide adoption of the concept for training, licensing, operation, and accident-incident analysis purposes.

EBT A&I Study – Amendment IATA Taxonomy of Threats and Errors	
E -Environmental Threats	**H - Aircraft Handling Errors**
E01 Meteorology	H01 Manual Handling/Flight Controls
E02 Lack of Visual Reference	H02 Ground Navigation (Surface nav)
E03 Air Traffic Services	H03 Automation (Settings/Selections)
E04 Birds/foreign objects	H04 Systems/Radio/Instruments (Settings/Selections)
E05 Airport Facilities	H99 Other
E06 Navaids (Malfunction, lack or unavailable /uncalibrated)	**P - Procedural Errors**
E07 Terrain/Obstacles	P01 SOP Adherence/Cross-Verification
E08 Traffic	P02 Checklist
E99 Other	P03 Callouts
A - Airline Threats	P04 Briefings
A01 Aircraft Malfunction	P05 Documentation
A02 MEL item (with operational implications)	P06 Failure to go-around after destabilization on approach
A03 Operation pressure	P99 Other
A04 Cabin events	**C – Communication Errors**
A05 Ground events	C01 Crew to External Communication
A06 Dispatch/paperwork	C02 Pilot to Pilot Communication
A07 Maintenance events	C03 CPDLC
A09 Manual/Charts/Checklists/Procedures/Databases	
A99 Other	
B- Psychological/Physiological Threats - Physio	
B01 Fatigue	
B02 Optical Illusion/Visual Mis-Perception	
B03 Spatial Disorientation and Spatial / Somatogravic Illusion	
B04 Crew Incapacitation	

Note: The complete and detailed list of the IATA threats and errors taxonomy can be found in Appendix 3 of this Amendment.

Analyst tool

For the EBT Data Report, 1st Edition, the results of the accident-incident reports analyses performed by the analysts were recorded in an Excel spreadsheet.

For this Amendment, to facilitate the work of the analysts and minimize the risk of error when recording the results of their analysis, an online tool was developed to capture the results of their accident-incident reports analysis.

EBT Accident-Incident Study – Stage 1 comparison table

The table below provides an overview on the differences highlighted above between the methodology applied in the EBT Data Report, 1st Edition, and the methodology applied in this Amendment.

	EBT Data Report, 1st Edition	Amendment
Accident Investigation Agencies	NTSB (primary source)	NTSB, ATSB, TSB, BEA, EASA
Analysts Optimal Prerequisite	2 pilots currently or previously qualified on the relevant type	3 instructors currently or previously type-rated on the aircraft
Analysts Minimal Prerequisite	2 type-rated pilots on the aircraft generation	3 instructors currently or previously type-rated on the aircraft generation
Analysts' standardization training	Only guidance provided	Standardization training (tutorials and case study) provided
Analysis methodology	Factors analyzed	IATA threats and errors taxonomy
Analysis quality assurance process	Analysis by analyst 1 followed by a validation by analyst 2	Independent analysis performed by 3 analysts followed by a collaborative validation by the same 3 analysts
In case of non-agreement in the findings among the analysts	Review by the Reconciliation Team of 3 pilots	Review by the Reconciliation Team (3 senior instructors having extensive experience in CBTA/EBT programs)
Number of analysts needed	27 analysts	42 analysts
Tool for analysts	Excel spreadsheet	Online tool, the 'Analyst Tool'

EBT Accident-Incident Analysis – Stage 2

The purpose of the Stage 2 analysis is to utilize the results from Stage 1 to analyze accidents and incidents in each aircraft generation and across all generations. The process results in the prioritization of training topics by training criticality from a generational perspective, using the dimensionality of risk, clustering, and effectiveness of training.

The ordering of risk for a given threat or error per aircraft generation is the Relative Risk Ranking (RRR), which allows the translation of the data into training topics prioritization.

Relative Risk Ranking (RRR)

This Amendment applied the same methodology of the Relative Risk Ranking (RRR) to the results of Stage 1 of the EBT A&I Study, as applied in the EBT Data Report, 1st Edition. This was important to be consistent and to allow for a comparison between the data from the EBT A&I Study produced for this Amendment and the results of the EBT Data Report, 1st Edition. This allowed an analytical approach to comparing these different sets of data in regard to risk ranking.

The RRR is an algorithm that allows the prioritization of the threats, errors, and the training criticality. Specifically, RRR is the ordering of risk for a given factor (in the EBT Data Report, 1st Edition), and threats, errors and competencies (in this Amendment), in each aircraft generation.

Note:

- Whilst this Amendment considered competencies within the analysis of the EBT A&I Study, this data was not used to form any recommendation. However, the intention is to use this approach for the further development of the data capture and analysis process.
- The 'factor clustering' and 'training effect' dimensions could not be applied to the GADM ADX data analysis as the data does not provide the level of detail required to perform this type of analysis. Therefore, to produce a valid and qualitative comparison between the GADM ADX analysis and the results of the EBT A&I Study of this Amendment, only the RRR process was applied to the GADM ADX data analysis. (The results of this analysis are provided in Section 4 in this Amendment.)

The RRR is the result that gives the relative value for each of the threats and errors. This data can be normalized in two ways.

- The percentages of all accidents, fatal accidents and incidents for each generation. This is important as it shows the frequency of occurrence within each generation of aircraft, indicating likelihood, a component of risk that is one of the dimensions of training criticality, which is subsequently calculated.
- Normalizing by 1M TOs (1 million take-offs) relates to a more universal and comparable reference. It is useful in showing trends across aircraft generations (and/or time periods.) It also has the notion of probability, i.e., what is the probability within a certain time interval and/or generation of encountering a particular threat or error than may contribute to an accident or incident.

To ensure consistency between the various data sources, only the normalized per million results were considered for this Amendment.

The frequency (likelihood) of a given threat and error was multiplied by a different value depending on severity (fatal, non-fatal, incident) to obtain the final Relative Risk Ranking (RRR).

Example of the RRR process. (The full list can be found in Appendix 4.)

Relative Risk Ranking Normalized Per million flights										
Threats or Errors	Frequency						Frequency x Severity			
	% of recent events			(0.01) % x 5			Separately at 3 Severity Levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal accidents	Incidents	Fatal Accidents (5)	Non-fatal Accidents (3)	Incidents (1)	**Total risk**
H01 Manual Handling/Flight Contxrols	2.32%	11.59%	7.53%	0.12	0.58	0.38	0.58	1.74	0.38	**2.69**
P03 Procedural Errors Callouts (error in callout or omission of callout)	2.32%	8.11%	8.11%	0.12	0.41	0.41	0.58	1.22	0.41	**2.20**
C02 Communication Errors Pilot-to-Pilot	2.32%	6.95%	7.53%	0.12	0.35	0.38	0.58	1.04	0.38	**2.00**
P01.01 Intentional	1.16%	8.11%	4.63%	0.06	0.41	0.23	0.29	1.22	0.23	**1.74**
P01.02 Unintentional	1.16%	6.95%	7.53%	0.06	0.35	0.38	0.29	1.04	0.38	**1.71**
H03 Automation (Settings/Selections)	1.74%	5.21%	5.21%	0.09	0.26	0.26	0.43	0.78	0.26	**1.48**
P06 Procedural Errors Failure to Go-Around	1.16%	5.21%	4.05%	0.06	0.26	0.20	0.29	0.78	0.20	**1.27**
E03 Environmental Threats Air Traffic Services	1.16%	4.63%	4.05%	0.06	0.23	0.20	0.29	0.70	0.20	**1.19**
E02 Environmental Threats lack of Visual Reference	1.74%	3.48%	1.74%	0.09	0.17	0.09	0.43	0.52	0.09	**1.04**
E01.02 Poor Visibility (degraded visual environment)	0.58%	5.21%	1.74%	0.03	0.26	0.09	0.14	0.78	0.09	**1.01**
P04 Procedural Errors Briefings	1.16%	2.90%	4.63%	0.06	0.14	0.23	0.29	0.43	0.23	**0.96**

Specifically, the RRR is the ordering of risk for a given factor (in the EBT Data Report, 1st Edition), threats and errors (in this Amendment) for each aircraft generation. For example, the error H01 Manual Handling/Flight Controls in the table above is ranked first in the total risks for generation 4 jets. Note that the percentage of occurrence of Manual Handling is 2.32% for fatal accidents, 11.59% for non-fatal accidents and 7.53% for incidents.

The word 'Relative' refers to the notion that the resulting value is only valid relative to the generation for which it is calculated and cannot be compared cross generationally except in terms of order or ranking.

For consistency in the ranking process, so that risk will have the same range as in the Training Criticality Survey (TCS) (Section 3.2.3 below), the percentages are normalized so that the values are between 0 and 5. This is simply done by multiplying the percentages by 5 and moving the decimal point two places to the left.

Because risk is generally measured in terms of likelihood times severity, a value must be assigned for severity to be able to calculate the RRR. Again, it was decided to choose a five-point scale for the values to be consistent with the TCS. The severity values are defined by the seriousness of the event in which the factor was involved and are as follows:

- Fatal accidents – 5
- All accidents – 3
- Incidents – 1

Then likelihood and severity are multiplied for each factor and the risk values are summed to provide a total risk for the factor relative to a given generation. This ranking is useful for comparative purposes across generations, phases of flight and to be able to correlate to other risk rankings of sets or subsets incorporating the same factors. The RRR is not only a ranking of the factors, but also a proportional representation of the importance of a factor in terms of the classical notion of risk within (or relative to) the generation of aircraft.

Example

Threats or Errors	Frequency						Frequency x Severity			
	% of recent events			(0.01) % x 5			Separately at 3 Severity Levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal accidents	Incidents	Fatal Accidents (5)	Non-fatal Accidents (3)	Incidents (1)	**Total risk**
H01 Manual Handling / Flight Controls	2.32%	11.59%	7.53%	0.12	0.58	0.38	0.58	1.74	0.38	**2.69**

Calculation:

Fatal = (2.32/100) × 5 = 0.12 × 5(severity) = 0.58
Non-fatal = (11.59/100) × 5 = 0.58 × 3(severity) = 1.74
Incident = (7.53/100) × 5 = 0.38 × 1(severity) = 0.38
Therefore, the RRR = 0.58 +1.74 + 0.38 = 2.69

Clustering and training effect

When producing the results for the EBT Data Report, 1st Edition, the analysis also considered 'Factor Clustering' and the 'Training effect', below is an extract and definition.

Clustering and Training effect of each factor

1. *Factor clustering – the extent to which a factor clusters with other factors is important from a training point of view. Factors that cluster significantly can be considered more important to address in training because they appear in complex and difficult situations, potentially requiring a higher level of competency than simpler and more straight forward events.*
2. *Training Effect is a measure of the mitigation that training could have on accidents and incidents. When deciding how important training is to cope with a situation, it is not only important to identify what needs to be addressed, but also how effective the training remedy is for that situation.*

Refer to the EBT Data Report, 1st Edition, for a full explanation.

For this amendment, the EBT A&I Study reproduced initially these elements of the analysis, but for the purpose of correlation between the EBT A&I Study and both the GADM ADX analysis and the TCS results, it has been necessary to exclude the clustering and training effect, and to consider only the EBT A&I Study RRR Stage 2 results. Practically, the clustering and training effect introduce some elements of subjectivity, therefore, the EBT SG decided to only consider the RRR statistical results for analysis and comparison between data sources, to ensure that an objective analytical procedure was followed. Nevertheless, the trainability aspects of each threat and error were considered by the EBT SG experts during the 'mapping' exercise (see section 4.4.3.).

3.2.2 IATA Global Aviation Data Management (GADM)

The IATA Global Aviation Data Management (GADM) program is a data management platform which integrates all sources of operational data received from various channels. These include IATA-unique programs, which all feed into a common, interlinked database structure. GADM offers a comprehensive, cross-database analysis, supporting a proactive data-driven approach for advanced trend analysis and predictive risk mitigation.

GADM is the only aviation safety database on a global level, with IATA serving as a custodian trusted by the industry to do this. This presents many benefits and opportunities, e.g., easy-to-use central repository of aviation accident information with easily extractible statistics based on many variables (ADX).

The following are the different GADM platforms:

Flight Data eXchange (FDX) is one of GADM's programs encompassing an aggregated de-identified database of flight data.

- The purpose of the FDX program is to provide members with a comparative overview to highlight areas of flight safety concern, with benchmarking available at a global, regional and airport level. It allows participating airlines to identify commercial flight safety issues comparatively for standard aviation risk areas.
- Airlines can then benchmark their performance against the aggregate of other operators with similar/same aircraft types and among their own, or other regions.

Making use of global and regional trend data analytics to set Safety and Security Performance Targets, the **Incident Data eXchange (IDX)** is IATA's safety and security incident data management program.

- The IDX program is a worldwide, aggregated, de-identified database of incident reports, including flight operations, cabin, ground operations safety and security occurrences. It offers a secure environment providing participants with a seamless experience to view aggregated data against standards and benchmarked with other counterparts.
- In just one year, the IDX program managed to create a customer base of 69 airline participants, which represents more than 10% of worldwide commercial aviation traffic. IDX benefits include the ability for users to:
    - Access de-identified safety and security information
    - Benchmark themselves at the regional and global level
    - Anticipate operational challenges and risks at specific airports
    - Identify critical incident trends whilst setting targets for improvement

The **Accident Data Exchange (ADX),** a commercial aviation accident repository for aviation safety professionals and researchers, provides a unique set of content to make it easy to access integrated commercial aviation accident information. Each accident is classified with the applicable contributing factors that caused the event.

- It is also a centralized repository to download the available official reports released after the final investigation. Moreover, ADX provides rate-based information, which consists in normalizing accident numbers with global sectors, to perform analysis that are statistically relevant.
- ADX allows the easy extraction of statistics based on many variables, such as airport, aircraft, date, country, phase of flight, accident category, severity, type of operations, and much more.

The accidents included in ADX are all the events that meet the following criteria:

- Person(s) have boarded the aircraft with the intention of flight (either flight crew or passengers).
- The intention of the flight is limited to normal commercial aviation activities, specifically scheduled/charter passenger or cargo service. Executive jet operations, training, and maintenance/test flights are excluded.

- The aircraft is turbine-powered and has a certificated Maximum Take-off Weight (MTOW) of at least 5,700 kg (12,540 lbs).
- The aircraft has sustained major structural damage that adversely affects the structural strength, performance or flight characteristics of the aircraft and would normally require major repair or replacement of the affected component exceeding $1 million USD or 10% of the aircraft's hull reserve value, whichever is lower, or the aircraft has been declared a hull loss.

The GADM database assesses and collates all accidents and incidents from around the world. As explained in Section 3.1, these reports are analyzed and classified by the IATA Accident Classification Task Force (ACTF).

ADX Dashboard

To support the EBT Data Report revision, the GADM Team created a specific EBT dashboard within the Accident Data Exchange (ADX) database. This provided the ability to compare other data sources results against the GADM data very quickly and accurately.

The dashboard enables the filtering of the data in a variety of ways:

- By year
- By aircraft generation and type (jet or turboprop)
- By flight phase
- By ACTF TEM categories

Example of the ADX EBT dashboard

3.2.3 Training criticality survey (TCS)

Background

The primary goal of the TCS is to capture the pilots' feedback on the threats and errors encountered in operations and on how effective training could be as a mitigating measure. The TCS also permits to provide corroboration and correlation across multisource data results such as the EBT A&I Study and the GADM ADX analysis. Whilst the safety data may suggest that for example 'Adverse Weather' is a significant threat; the results of the TCS allows us to assess whether pilots also perceive this as a major threat to flight safety. It is important to always corroborate one data set against another data source; in this case, what the pilots perceive as some of the most significant threats and errors in their area of operation against what the safety data is indicating.

The TCS was also designed to highlight any gaps or omissions in the training programs that other sources may not have the ability to identify or respond to quickly enough.

Targeted audience

The TCS developed for the EBT Data Report, 1st Edition (TCS-2011), was targeted at pilot instructors. A total of 167 pilot instructors completed the survey.

The TCS developed for this Amendment (TCS-2020), targeted all pilots, not only pilot instructors; 563 pilots completed the survey.

Format and structure

The format of the TCS-2011 was an Excel spreadsheet that the respondents had to complete. It contained 161, 3-part questions concerning 40 factors (see Section 3.2.1 above) over all phases of flight. In addition, the potential threats and errors that could occur in all flight phases were listed separately in a phase, defined as Phase Φ. The factors used in the survey were defined by the experts and were specific to flight phases and considered relevant to training.

To facilitate the completion of the survey, the format of TCS-2020 was an online survey. It contained an introductory six-part background question (position, region, duties, etc.) and 47 'seven-part' questions concerning the threats and errors encountered in operations and which pilot competencies were considered by the pilots as critical to manage those threats and errors.

Note: Although there are 68 threats and errors in the IATA Safety Taxonomy, the TCS contained only 47 questions on the threats and errors because some of them were grouped under one single question in the TCS. For example, the IATA Safety Taxonomy provides more granularity in regard to 'C01 Communication Error', which is split into: C01.01 With ATC, C01.02 With cabin crew, C01.03 With ground crew, and C01.04 With dispatch. In the TCS these were all grouped under the question 'Communication Errors': Flight Crew to External Communication: with ATC/Cabin Crew/Ground Crew/Dispatch".

Background information – aircraft type and generation

Because the objective was to identify the highest risk threats and errors encountered in operations and to correlate these by aircraft generation, in the background section of the survey the respondents were asked to indicate the type of aircraft they were operating at the moment of completing the TCS.

The responses to TCS-2011 included most of the aircraft generations and aircraft types/variants but there were no respondents for Generation 1 Jet.

The responses to TCS-2020 covered only Generations 3 and 4 Jet, and Generations 2 and 3 Turboprop aircraft. The complete list of aircraft types operated by the respondents can be found in Appendix 5.

Methodology

Phase(s) of flight

In TCS-2011, the respondents were asked to assess each threat and error per phase of flight.

In TCS-2020, pilots were asked to select only one phase of flight, the one where, in their opinion, the threat or error could have the greatest impact on the safety of the flight, if mismanaged. Firstly, the decision to select only one phase of flight was taken to get direct visibility on the most critical phase of flight in regard to threat and error management, with the aim to generate better training topics scenarios. Secondly, the expectation was to increase the rate of completion of the TCS by the pilots, by reducing the length of the survey and the time to complete the survey to approximately one hour.

Threats and Errors – Ranking

In both editions of the TCS, the defined threats and errors were evaluated on a scale of one to five, according to likelihood of occurrence; severity of outcome, and the benefit training could have in mitigating the outcome.

The table below shows the parameters used in both editions of the TCS. They are identical for 'Likelihood' and 'Severity' but differ slightly for 'Training Effect', as highlighted in blue below. Taking into consideration that TCS-2020 was targeted at the whole pilot population and not only at instructors, some 'slight changes' were deemed necessary. For example, it was necessary to include 'unknown' as a legitimate choice of answer. It was also deemed reasonable to combine 'significant' and 'critical' under 'high effect' due to their high degree of similarity, which had the benefit of maintaining the one to five ranking scale in TCS-2020.

Likelihood: The probability that the pilot will experience a Threat or Error, requiring his/her intervention. 1. **Rare** – once in a career or less 2. **Unlikely** – a few times in a career 3. **Moderately likely** – once every 3–5 years 4. **Likely** – probably once a year 5. **Almost certain** – more than once a year
Severity: Describes the most likely outcome based on the assumption that the pilot has not received training to manage the defined event. 1. **Negligible** – insignificant effect not compromising safety

2. **Minor** – reduction in safety margin (but not considered a significant reduction)
3. **Moderate** – safety compromised or significant reduction in safety margin
4. **Major** – aircraft damage and/or personal injury
5. **Catastrophic** – significant damage or fatalities

TCS-2011 (EBT Data Report)	TCS-2020 (Amendment)
Training benefit considers the effect of training in reducing the severity of the event:	
• Unimportant – training does not reduce severity • Minor – enhances performance in managing an event • Moderate – having no training compromises safety • Significant – safe outcome is unlikely without effective training • Critical – essential to understanding the event and coping with it	• Unknown – unknown • No Effect – training has no effect • Low Effect – enhances performance in managing an event • Medium Effect – having no training compromises safety • High Effect – safe outcome is unlikely without effective training

Pilot Competencies

Because many operators started using the pilot competencies after ICAO's endorsement of EBT in 2013, with the publication of Doc 9995, it made sense, in TCS-2020, to ask the respondents to select the competencies that would, in their opinion, contribute to reduce or mitigate the severity of the event.

The respondents could select as many competencies as considered necessary from section (a) in the table below, but only a maximum of two competencies from section (b). The rationale behind the restriction to two competencies from section (b) was to make the pilot select the most critical competencies as countermeasures to reduce or mitigate the severity of the event, and to avoid a natural tendency to over assign them.

Competencies (Choose any that may reduce or mitigate the severity.)	
(a) Select all that apply:	(b) Select maximum 2:
• **Application of** knowledge (Demonstrates knowledge and understanding of relevant information, operating instructions, aircraft systems and the operating environment.) • **Application of procedures and compliance with regulations** (Identifies and applies appropriate procedures in accordance with published operating instructions and applicable regulations.) • **Aeroplane Flight Path Management, automation** (Aeroplane Flight Path Management, automation.)	• **Communication** (Communicates through appropriate means in the operational environment, in both normal and non-normal situations.) • **Situation awareness and management of information** (Perceives, comprehends and manages information and anticipates its effect on the operation.) • **Leadership and teamwork** (Influences others to contribute to a shared purpose. Collaborates to accomplish the goals of the team.)

• **Aeroplane Flight Path Management, manual control** (Controls the flight path through manual control.)	• **Workload management** (Maintains available workload capacity by prioritizing and distributing tasks using appropriate resources.) • **Problem solving and decision making** (Identifies precursors, mitigates problems; and makes decisions.)

TCS – Comparison table

The table below provides an overview of the differences highlighted above between TCS-2011, conducted for the EBT Data Report, 1st Edition, and TCS-2020 conducted for this Amendment.

	TCS-2011 (EBT Data Report)	TCS-2020 (Amendment)
Flight phases analyzed	All	Only one
Targeted pilot population	Instructors only	All pilots
Number of surveys completed	167	563
Taxonomy	40 Factors	IATA safety taxonomy (68)
Pilot competencies	No question about the pilot competencies	The respondents were asked to select the critical competencies as countermeasures to reduce or mitigate the severity of the event in regard to flight safety
Analysis results	None of the results were used in the overall data analysis and conclusions because the data sample was felt to be less than sufficient in terms of size and symmetry	Results were considered sufficient to be considered in the overall data analysis

To ensure consistency with the EBT Data Report, 1st Edition, the same methodology of analyzing and ranking the results of the TCS was applied to TCS-2020.

The defined threats and errors were evaluated on a scale of 1 to 5, according to likelihood of occurrence; severity of outcome, and the benefit training could have in mitigating the outcome. These three parameters are more fully described below.

Calculation methodology (multiplication factor)

Multiplication Factor	Likelihood	Severity	Training Benefit
1	Rare	Negligible	Unknown
2	Unlikely	Minor	No Effect
3	Moderately likely	Moderate	Low Effect
4	Likely	Major	Medium Effect
5	Almost certain	Catastrophic	High Effect

The process described above is then repeated for 'severity' and 'training benefit'. The sum of each of these results creates the total ranking for that threat or error within the total TCS survey results. In the case of the example provided below, 'Manual handling error', this total is 53.9705, which ranks this error at number 10 in the total TCS ranking results.

This establishes which threats and errors the pilots consider to be of highest risk and to have the highest potential impact on the safety of the flight. The results of this analysis can then be compared to those of the EBT A&I Study and the GADM ADX analysis to assess whether the individual pilots' perception concur with, or differ, from the results of the other sources.

Example of calculation methodology generation 4 Jet

Q241. Select the **likelihood** of a Manual Handling error (The probability that a Manual Handling error will require your intervention.)	
Answer Choices	**Responses**
1 - Rare - Once in career or less	11.28%
2 - Unlikely - Few times in career	25.81%
3 – Moderate - Once every 3-5 years	27.07%
4 - Likely - Probably once a year	22.06%
5 - Almost Certain - More than once a year	13.78%
Section Total	**15.0625**
Q242. Rate the potential **severity** of a Manual Handling error (The most likely outcome of the event in regard to flight safety.)	
Answer Choices	**Responses**
1 - Negligible - Insignificant effect not compromising safety	0.50%
2 - Minor - Reduction in safety margin (but not considered as significant reduction)	14.54%
3 - Moderate - Safety compromised or significant reduction in safety margin	41.85%
4 - Major - Aircraft damage and/or personal injury	29.57%
5 - Catastrophic - Significant damage or fatalities	13.53%
Section Total	**17.0530**

Q243. **Training Benefit** (Consider the effect of training in reducing the severity of the event.)	
Answer Choices	**Responses**
U – Unknown - Unknown	1.00%
N - No Effect – Training has no effect	0.25%
L - Low Effect - Training enhances performance in managing an event	11.28%
M - Medium Effect - Having no training compromises safety	35.59%
H - High Effect - Safe outcome is unlikely without effective training	51.88%
Section Total	**21.8550**
Result	**53.9705**

Example of calculation details:

Referring to Question 241on 'Manual handling' error, in the Table above 'Example of calculation methodology Generation 4 Jet', the first step to establish the relative risk ranking for this error, regarding the likelihood, is to take the results for each of the five rankings and apply the following calculation:

$(11.28 \times 5/100) \times 1 + (25.81 \times 5/100) \times 2 + (27.07 \times 5/100) \times 3 + (22.06 \times 5/100) \times 4 + (13.78 \times 5/100) \times 5 = 15.0625$

The first digits in each parenthesis, e.g., 11.28, 25.81, etc., represent the percentage of pilots that selected that ranking for 'likelihood'; that is either 'rare', 'unlikely', 'moderate', 'likely', or 'almost certain'. These percentages are then multiplied by 5 and divided by 100. This total is then multiplied by the appropriate factor (i.e., 1, 2, 3, 4, 5), the 'Multiplication Factor' in the first column in table above, Calculation methodology (multiplication factor).

The same calculation is completed for each question within the TCS and a ranking table produced.

3.2.4 EBT Subgroup Study

The EBT SG brought a new and extremely valuable element to this Amendment. The data analyzed for the EBT Data Report, 1st Edition, covered a significant time frame (over 40 years) while this Amendment analyzed more current data (last 10 years) and included a completely new data source provided by the experience of the EBT SG in conducting EBT programs.

During the various meetings and working sessions, the members of the EBT SG were tasked to analyze their own data to:

- Review the relevance of the current EBT training topics against their training data and identify any new threats and/or errors trends
- Review the EBT training topics frequencies
- Suggest improvements in the example scenarios
- Perform a threats and errors mapping exercise
- Review the results from the other data sources

The results of these analyses were then compared against the other data sources used in the Amendment to corroborate their conclusions or identify any potential differences.

3.2.5 Safety/Training Studies and Reports

The following studies and reports, published by IATA and other international organizations were considered within this Amendment because of their relevance to corroborate the findings or to bring another perspective or dimension to the safety, operational and training data analyzed. All the studies and reports included within this Amendment have a direct link to flight safety and the continued assessment and development of the EBT program.

A brief description of these studies is provided in this section. The details of the findings in the studies and reports are provided in Section 4 – Analysis and results, and the executive summaries and links to the documents themselves are provided in Appendix 6 of this Amendment.

Aircraft Handling and Manual Flying Skills Survey Report (IATA 2020)

Accident analysis data from January 2013 through December 2017 shows that among the 339 fatal and nonfatal accidents, manual handling was a contributing factor in 94 (34%) accidents. To gain greater insight and understanding on this issue, IATA conducted a survey on Aircraft Handling and Manual Flying Skills to capture the pilot's subjective feedback about their manual flying practices during operator training and during everyday line operations. The survey was sent to more than 8,000 people in the aviation industry, among which 5,650 completed the survey.

The survey was designed to cover the following four main sections:

- Pilot demographic information
- Airline automation policy
- Manual flying pilot practices
- Training policy during both line operations and simulator sessions

The report concludes that the survey results confirm that a significant number of pilots have experienced a degradation of their manual handling skills, and a subsequent over-reliance and dependence on automation.

Loss of Control In-Flight Accident Analysis Report (IATA 2019)

This report evaluates the contributing factors from recent LOC-I accidents and presents information designed to help the industry implement mitigation strategies.

An analysis of the IATA Global Aviation Data Management (GADM) accident database, focusing on worldwide commercial jet and turboprop aircraft over a period of 10 years (2009 through 2018), was conducted to identify accidents that were classified as LOC-I.

As stated in the report, LOC-I accidents are almost always catastrophic; 94% of the accidents analyzed involved fatalities to passengers or flight crew. This category of accident resulted in more fatalities than any other category (2,462 of 4,075) in the reporting period. Given their severity, LOC-I accidents have been identified by IATA and industry representatives as one of the highest priorities for safety intervention and risk mitigation.

LOC-I refers to accidents in which the flight crew was unable to maintain control of the aircraft in flight, resulting in an unrecoverable deviation from the intended flight path. LOC-I can result from factors affecting piloting performance, engine failures, adverse meteorological conditions, stalls/upsets or other circumstances that interfere with the ability of the pilot to control the flight path of the aircraft. It is one of the most complex accident categories, involving numerous contributing factors that act individually or, more often, in combination. These contributing factors include latent conditions in the system, external threats to the flight crew, errors and undesired aircraft states resulting from mismanaged threats and errors.

The report provides dynamic and interactive data from 64 LOC-I accidents that occurred over the 10 years spanning from 2009 through 2018.

IATA Safety Reports 2010–2019

Each year IATA produces a Safety Report that provides the industry with a significant review of the accidents over the past year and compares this data to previous years. This helps identify key threats to the industry, which is directly linked to the objectives of this Amendment. The past ten years of IATA Safety Reports were taken into consideration in this Amendment, with particular focus on the past five years, since the structure of these latest reports allows for better comparison and analysis of the threats and errors across aircraft types, than the structure of the previous reports.

Unstable Approaches, Risk Mitigation Policies, Procedures and Best Practices, 3rd Edition (IATA / IFALPA / IFATCA / CANSO)

The objective of this manual is to reiterate the importance of a stable approach and to encourage pilots to make the proper go-around decision if the approach exhibits any element of an unstable approach.

The data contained in the document indicates that of the 375 commercial aircraft accidents recorded in the IATA GADM Accident Database during the five-year period from 2012 to 2016, failure to go-around was a factor in 10% of accidents. 230 accidents, or 61%, occurred during the approach-and-landing phase, of which 19 resulted in 376 fatalities.

Ensuring a stable approach is the first line of defense available to flight crew against accidents in the critical flight phases of approach and landing. After this first line of defense is crossed, the ability to perform a go-around is a crucial factor in preventing an unwanted outcome during or after the approach.

The manual stresses the need for a continuous improvement to stable approach policy compliance, including discontinuation of an unstable approach, in order to reduce the risk of an accident.

ICAO Safety Report – 2020

A Coordinated, Risk-based Approach to Improving Global Aviation Safety

The 2020 edition of the Safety Report provides a high-level summary of ICAO's achievements to enhance aviation safety in 2019 and updates on key safety performance indicators with reference to the 2015–2019 time period. It also includes initiatives to support States manage safety risks during the COVID-19 pandemic.

ICAO promulgates Standards and Recommended Practices (SARPs) to facilitate harmonized regulations in aviation safety, security, efficiency and environmental protection on a global basis. Today, ICAO manages over 12 000 SARPs across the 19 Annexes and five Procedures for Air Navigation Services (PANS) to the Convention on International Civil Aviation (Chicago Convention), many of which are constantly evolving in tandem with latest developments and innovations. ICAO serves as the primary forum for co-operation in all fields of civil aviation among its 193 Member States.

Improving the safety of the global air transport system is ICAO's guiding and most fundamental strategic objective. The Organization works constantly to address and enhance global aviation safety through the following coordinated activities:

- Policy and Standardization
- Monitoring of key safety trends and indicators
- Safety Analysis
- and Implementing programmes to address safety issues.

The ICAO Global Aviation Safety Plan (GASP) presents the strategy in support of the prioritization and continuous improvement of aviation safety. The GASP sets the goals and targets and outlines key safety enhancement initiatives (SEIs) aimed at improving safety at the international, regional and national levels.

The report states that ICAO identified five high-risk categories of occurrence (HRCs) as global safety priorities in the 2020–2022 edition for the ICAO Global Aviation Safety Plan (GASP):

- controlled flight into terrain (CFIT)
- loss of control in-flight (LOC-I)
- runway excursion (RE)
- runway incursion (RI)
- mid-air collision (MAC)

ICAO Runway Safety Programme – Global Runway Safety Action Plan, 1st Edition, November 2017

The Global Runway Safety Action Plan provides recommended actions for all runway safety stakeholders, with the aim of reducing the global rate of runway excursions and runway incursions.

The ICAO runway safety programme involves substantial collaboration with partner organizations including: Airports Council International (ACI); the Civil Air Navigation Services Organisation (CANSO); the European Aviation Safety Agency (EASA); European Organisation for the Safety of Air Navigation (EUROCONTROL); the United States Federal Aviation Administration (FAA); the Flight Safety Foundation (FSF); the International Air Transport Association (IATA); the International Council of Aircraft Owner and Pilot Associations (IAOPA); the International Business Aviation Council (IBAC); the International Coordinating Council of Aerospace Industries Associations (ICCAIA); the International Federation of Airline Pilots' Associations (IFALPA); and the International Federation of Air Traffic Controllers' Associations (IFATCA).

The Runway Safety Programme promotes the establishment of Runway Safety Teams (RSTs) at airports as an effective means to reduce runway related accidents and incidents. The document states that the requirement for airports to establish a RST was one of the main outcomes of the first ICAO Global Runway Safety Symposium held in Montréal, Canada, in May 2011. The establishment of effective RSTs has helped to significantly reduce the runway safety related risks globally since 2011, with over 200 international airports world-wide having registered an RST with ICAO.

IATA Runway Safety Accident Analysis Report 2010–2014

Runway safety has become a significant area of interest for the industry due to the frequency of accidents in the runway environment; these include runway excursions, runway collisions, undershoot/overshoots, tail strikes and hard landing events.

The report indicates that runway/taxiway excursion is the most frequent category of accidents, representing 22% of all accidents over the period of 2010 – 2014. There is an average of 18 runway/taxiway excursions of commercial air transport aircraft worldwide per year. Excursions can lead to loss of life and/or injury to persons either on board the aircraft or on the ground and can result in damage to aircraft, airfield or off- airfield equipment including other aircraft, buildings or other items struck by the aircraft.

The report concludes that the most common precursors to runway safety accidents were ineffective braking due to contaminated runways, gear malfunctions, unstable approaches, wet and contaminated runways in combination with gusts/strong/cross- or tailwinds, and late or ineffective deployment of retardation devices.

Performance Assessment of Pilot Compliance with Traffic Collision Avoidance System Advisories Using Flight Data Monitoring Guidance Material – 2nd Edition (IATA/EUROCONTROL)

Similar to the first edition of the guidance material, this second edition has been prepared jointly by IATA and EUROCONTROL and is designed to support the understanding of the Traffic Alert and Collision Avoidance System II (TCAS II), and to provide updated information and guidance on technical and operational issues applicable to TCAS Resolution Advisory (RA) in order to facilitate operational monitoring. This guidance also provides brief information on the future ACAS X, short training animations, as well as an assessment of pilot compliance with RAs using radar data.

The guidance provides recommendations in order for TCAS to deliver its safety objective, e.g., operators to ensure that approved pilot training programs are implemented for initial and recurrent training, that procedures are in place for pilots to report a TCAS event and/or problems with TCAS performance, that pilots understand the potential risks of an improper response to an RA, etc.

In its conclusions, the document states that when an RA is generated, correct action must be taken promptly. In addition to the recommendations listed in the guidance, initial/recurrent training as well as simulator training will enhance flight crew understanding of how the TCAS system works, how they should respond to RAs, as well as the limitations of TCAS. The pilot's response is a key component of the TCAS system.

IATA Guidance Material for Improving Flight Crew Monitoring – 1st Edition (2016)

The manual states that analyses of accidents and incidents often show that better monitoring by the crew could have prevented them. Analyzing the root causes, determining where the monitoring process broke down and enhancing flight crew monitoring are critical to improve safety.

This manual serves as guidance material for operators to better understand the concept of monitoring, the flight crew monitoring functions and roles, and current practices for integrating monitoring knowledge and skills into flight training programs, such as ab-initio, conversion, upgrading, type rating and recurrent training. It provides practical guidance for defining pilot roles and responsibilities for monitoring during line operations, for training monitoring tasks and skills, and for instructors to properly teach monitoring.

The manual also explains how monitoring is a key enabler for Threat and Error Management (TEM); monitoring resides in the TEM countermeasures. Monitoring is embedded in all pilot competencies; it is not a pilot competency in itself, but a fundamental component of each existing pilot competency and each competency is stimulated by effective monitoring.

Global Action Plan for the Prevention of Runway Excursions (2021) (coordinated by EUROCONTROL and the Flight Safety Foundation)

INTRODUCTION AND BACKGROUND

This document contains Part 1 and Part 2 of the Global Action Plan for the Prevention of Runway Excursions (GAPPRE).

Part I contains the agreed recommendations to the following civil aviation organisations: aerodrome operators, air navigation service providers (ANSPs), aircraft operators, aircraft manufacturers, regulators, the International Civil Aviation Organization (ICAO) and addressees of the research and development (R&D) recommendations (States, international organisations and the industry).

Part 2 provides explanatory and guidance material, and related best practices for the recommendations listed in this document. The guidance and explanatory material (GEM) are provided as appendixes to this document.

The recommendations and the (GEM) were developed by six dedicated working groups and were extensively reviewed and validated by:

- Airports Council International — World (ACI World);
- The Civil Air Navigation Services Organisation (CANSO);
- The European Union Aviation Safety Agency (EAA); and,
- The International Air Transport Association (IATA).

The development of the GAPPRE recommendations is based on the following principles:

- Provide recommendations that address actions beyond regulatory compliance — the recommendations in this action plan are not exhaustive in managing the runway excursion risk and resilience. It is fundamental that organisations shall be compliant to international, regional and national rules and regulations.
- Base recommendations on consensus — a recommendation is included in the action plan only if there was a consensus for it during the drafting and the subsequent validation process.
- Embrace further data analytics — suggest to actors that they make better use of existing data and fuse and analyse larger volumes of heterogeneous data.
- Address both longitudinal and lateral runway excursions.
- Include runway excursion mitigations.
- Promote technology embedded in systemic solutions promote technological solutions that are clearly integrated with the respective training, procedures, standardisation, certification and oversight.
- Provide R&D recommendations for issues with clear potential high-risk mitigation benefits but without the maturity to be implemented within the next 10 years.
- Promote a set of selected proven efficient solutions, which are not yet standard (still not used by all actors) but that have been proven to be efficient in reducing the risk of runway excursions, based on data analysis and lessons learnt.
- Provide functional recommendations — leave the design of specific implementation solutions to the industry.
- The verb “should” is used to signify that, while a recommendation does not have the force of a mandatory provision, its content has to be appropriately transposed at the local level to ensure its implementation.

The development of the GEM is based on the following principles:

- Provide further context to the targeted audience in order to facilitate the implementation of the recommendations contained in Part 1.
- Provide explanation, wherever possible, of the recommendation drivers.
- Incorporate advice for both normal and non-normal operation within the GEM targeted at the operational actors.
- Use the principles of conservatism and defence in depth.
- Address organisations such as aircraft operators, airports and ANSPs rather than individuals like pilots and air traffic controllers.

The GEM content should not be seen as limiting or prescriptive. It is based on best practices and materials shared by the industry in support for GAPPRE implementation. The boundaries set by national regulators and internationally accepted provisions should be respected.

The organisations to which this action plan is addressed should:

- Organise a review of the respective recommendations and assess their relevance against their local conditions and specific context.
- Consult the best practices for implementing the selected recommendations and seek support, if needed, from the GAPPRE coordinating partners.
- Conduct an appropriate impact assessment (including safety assessment) when deciding on the specific action to implement the recommendations.
- Implement the specific action/change and monitor its effectiveness.
- Share the lessons learnt with the industry.

Section 4—Analysis and results

One of the most important principles of this Amendment, which is consistent with the EBT Data Report, 1st Edition, was to ensure that there was no bias towards any individual data source. All the findings needed to be data driven, evidence based and corroborated. This means that the results of the analysis of one data source needed to be corroborated by the results of the other data sources analyzed in this Amendment to ensure the validity of the results and to substantiate the potential recommendation for a change to the EBT curriculum.

This section presents the analysis and the results from the five data sources used in this Amendment, as listed and described in Section 3.2.

4.1 EBT Accident-Incident Study (EBT A&I Study)

As mentioned in Section 3, a total of 770 accident-incident reports (from 2008 to 2017), from five different Investigation Agencies, were reviewed for this Amendment, out of which 184 were retained and analyzed for the EBT A&I Study.

The reports that were not considered for this analysis were rejected for one or more of the following reasons:

- The flight crew were not involved (e.g., ground events (24%), turbulence (20%), cabin safety events (5%), etc.)
- The report contained insufficient information
- The report was authored in a foreign language not known by the analysts

Fourteen teams of analysts from airlines member of the IATA Pilot Training Task Force (PTTF), the EBT SG and from OEMs, who all underwent a standardization training provided by IATA, analyzed the reports and recorded the results of their analysis through an online tool, the Analyst Tool. This tool was provided by IATA to facilitate the recording of the analysts' data and to minimize potential errors in the reporting of the results.

From their analysis of the accident-incident reports, the analysts identified the threats and errors (as per IATA's safety taxonomy) that were contributing factors in each event. The analysts also identified and recorded the pilot competencies that were deficient as countermeasures to manage the threats and/or errors. However, the results of this competency identification have not always been used, on purpose, to permit consistent comparison between data sources e.g., the actual safety taxonomy relates to flight crew countermeasures that are different to the pilot competencies representing the countermeasures under the training taxonomy. This misalignment did not provide for a direct comparison between the results of the EBT A&I Study and the GADM ADX analysis. The capture of the pilot competencies data will support the evolution of the analysis process for subsequent amendments.

The results of the accident-incident reports analysis were then submitted to an algorithm that established the prioritization of the threats and errors; the Relative Risk Ranking (RRR). As explained in Section 3.2 above, the RRR is the ordering of risk for a given threat or error, per aircraft generation. See Section 3.2.1 for the full details of the analysis methodology applied.

The table below shows the number of accident-incident reports that were analyzed per aircraft generation

Generation	EBT A&I Study	%
2 Turbo Prop	19	10.33%
3 Turbo Prop	12	6.52%
2 Jet	10	5.43%
3 Jet	81	44.02%
4 Jet	62	33.70%
Total	184	100%

The table below is an extract of the results of the RRR for Generation 4 Jet

Threat and Error – EBT A&I Study Gen 4	Total risk
H01 Manual Handling/Flight Controls	2.694
P03 Procedural Errors Callouts (error in callout or omission of callout)	2.201
C02 Communication Errors Pilot-to-Pilot	1.999
P01.01 Intentional	1.738
P01.02 Unintentional	1.709
H03 Automation (Settings/Selections)	1.477
P06 Procedural Errors Failure to Go-Around	1.274
E03 Environmental Threats Air Traffic Services	1.188
E02 Environmental Threats Lack of Visual Reference	1.043
E01.02 Poor Visibility (degraded visual environment)	1.014

The table below is an extract of the results of the RRR for Generation 3 Jet

Threat or Error – EBT A&I Study Gen 3	Total risk
H01 Manual Handling/Flight Controls	4.993
C02 Communication Errors Pilot-to-Pilot	3.541
P03 Procedural Errors Callouts (error in callout or omission of callout)	3.506
P01.02 Unintentional	3.081
P01.01 Intentional	2.444
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	2.444
P06 Procedural Errors Failure to Go-Around	2.267
B01 Fatigue	1.842
E02 Environmental Threats Lack of Visual Reference	1.523
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.487

See Appendix 4 for the full results for both Generations 3 and 4 Jet aircraft.

The raw results from the RRR analysis shown in the two tables above largely support the maintenance of the current EBT training matrix and training frequency, for both Generations 3 and 4 Jet aircraft.

There are some differences between the results from EBT Data Report, 1st Edition, and those from the EBT A&I Study performed for this Amendment, but a direct comparison is not always possible due to the use of different taxonomies (factors in the 1st Edition versus IATA ACTF taxonomy for the Amendment). Therefore, the RRR raw results have been further analyzed and correlated by the EBT SG against the results of the other data sources.

4.2 IATA Global Aviation Data Management (GADM)

The volume of data included and available within the GADM database is significant. The extractions from the GADM ADX database produced a total of 563 events (from 2010 to 2020), covering approximately the same timeframe as for the EBT A&I Study. These are accidents classified by the ACTF and recorded in the GADM ADX database.

Note: The difference in the number of reports, between the EBT A&I Study and the GADM ADX analysis, for approximately the same period of time, can be explained by the fact that the EBT A&I Study was based on the final reports produced by five investigation bodies, while GADM ADX database contains the analyses of reports from around the world.

The table below shows the number of accident reports analyzed per aircraft generation

Generation	GADM ADX	%
2 Turbo Prop	138	24.51%
3 Turbo Prop	47	8.35%
2 Jet	41	7.28%
3 Jet	213	37.83%
4 Jet	124	22.03%
Total	563	100%

The GADM ADX analysis was conducted with the same methodology and algorithm as for the EBT A&I Study, which permitted to compare the results of the EBT A&I Study and the GADM ADX analysis. This is further explained in Section 4.2.1 below.

The table below is an extract from the results of the RRR for Generation 4 Jet

Threat and Error – GADM ADX Generation 4	Total risk
H01 Manual Handling/Flight Controls	2.201
P01.01 Intentional	1.361
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.159

Threat and Error – GADM ADX Generation 4	Total risk
P06 Procedural Errors Failure to Go-Around	0.840
P03 Procedural Errors Callouts (error in callout or omission of callout)	0.840
C02 Communication Errors Pilot-to-Pilot	0.811
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	0.782
E06 Environmental Threats Navaids	0.753
E01.02 Poor Visibility (degraded visual environment)	0.753
P01.02 Unintentional	0.724

The table below is an extract from the results of the RRR for Generation 3 Jet

Threat and Error – GADM ADX Generation 3	Total risk
H01 Manual Handling/Flight Controls	4.250
P01.01 Intentional	2.550
P06 Procedural Errors Failure to Go-Around	1.948
E01.02 Poor Visibility (degraded visual environment)	1.948
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.842
A07 Maintenance events	1.806
C02 Communication Errors Pilot-to-Pilot	1.629
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	1.487
A01.03 Landing Gear/Tires	1.417
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	1.381

See Appendix 4 for the full results for both generations 3 and 4 Jet.

The raw results from the GADM ADX analysis, after the RRR analysis, largely support the maintenance of the current training matrix and training frequency, for both Generations 3 and 4 Jet aircraft.

There are some differences between the results from the EBT Data Report, 1st Edition, and those from the GADM ADX results, but a direct comparison is not always possible due to the use of different taxonomies (factors 1st Edition versus IATA ACTF taxonomy for the amendment). Therefore, the RRR raw results were further analyzed and correlated by the EBT SG during the consolidation of the data sources results.

4.2.1 Correlation between EBT A&I Study and GADM Accident Data (ADX) analysis

One of the objectives of this Amendment was to develop a far more dynamic system whereby the safety trends within the industry can be integrated efficiently and with maximum objectivity, into the EBT program.

This Amendment provided an opportunity to start applying the methodology of the EBT A&I Study – Stage 2 to the GADM ADX analysis, and to afterwards perform a correlation between the results of the two data sources. This correlation ensured the quality and validity of the results of both data sources.

The table below shows the number of accidents, per aircraft generation analyzed, for both the GADM ADX analysis and the EBT A&I Study.

Generation	GADM ADX	%	EBT A&I Study	%
2 Turbo Prop	138	24.51%	19	10.33%
3 Turbo Prop	47	8.35%	12	6.52%
2 Jet	41	7.28%	10	5.43%
3 Jet	213	37.83%	81	44.02%
4 Jet	124	22.03%	62	33.70%
Total	563	100%	184	100%

The application of the EBT A&I Study – Stage 2 statistical analysis methodology to the GADM ADX data analysis, as described in Section 3 in this Amendment, also ensured, with a large degree of confidence, that the results of the GADM ADX analysis were consistent and robust.

Although there are some differences when comparing the prioritization of the most relevant threats and errors, the two sets of results still provide evidence, as reflected in the tables below, that the results are consistent and that both data sources should be considered when making any recommendations in this Amendment.

The prioritization difference resulting from the RRR analysis can be explained by the difference in the number of events between the two sources; by the fact that GADM ADX is composed exclusively of accidents; and also because the GADM ADX analysts did not undergo the exact same standardization as the EBT A&I Study analysts.

RRR Comparison

The tables below are extractions from the Relative Risk Ranking (RRR) results from the GADM ADX analysis and the EBT A&I Study results. The results clearly show the correlation between the two sets of data in terms of highest ranked threats and errors. Appendix 4 provides the full details of the RRR results for Generations 3 and 4 Jet.

Generation 4 Jet – RRR comparison

Threat and Error – GADM Gen 4	Total risk	Threat and Error – EBT A&I Study Gen 4	Total risk
H01 Manual Handling/Flight Controls	2.201	H01 Manual Handling/Flight Controls	2.694
P01.01 Intentional	1.361	P03 Procedural Errors Callouts (error in callout or omission of callout)	2.201
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.159	C02 Communication Errors Pilot-to-Pilot	1.999

Threat and Error – GADM Gen 4	Total risk	Threat and Error – EBT A&I Study Gen 4	Total risk
P06 Procedural Errors Failure to Go-Around	0.840	P01.01 Intentional	1.738
P03 Procedural Errors Callouts (error in callout or omission of callout)	0.840	P01.02 Unintentional	1.709
C02 Communication Errors Pilot-to-Pilot	0.811	H03 Automation (Settings/Selections)	1.477
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	0.782	P06 Procedural Errors Failure to Go-Around	1.274
E06 Environmental Threats Navaids	0.753	E03 Environmental Threats Air Traffic Services	1.188
E01.02 Poor Visibility (degraded visual environment)	0.753	E02 Environmental Threats Lack of Visual Reference	1.043
P01.02 Unintentional	0.724	E01.02 Poor Visibility (degraded visual environment)	1.014

Generation 3 Jets – RRR comparison

Threat or Error – GADM Generation 3	Total risk	Threat or Error – EBT A&I Generation 3	Total risk
H01 Manual Handling/Flight Controls	4.250	H01 Manual Handling/Flight Controls	4.993
P01.01 Intentional	2.550	C02 Communication Errors Pilot-to-Pilot	3.541
P06 Procedural Errors Failure to Go-Around	1.948	P03 Procedural Errors Callouts (error in callout or omission of callout)	3.506
E01.02 Poor Visibility (degraded visual environment)	1.948	P01.02 Unintentional	3.081
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.842	P01.01 Intentional	2.444
A07 Maintenance events	1.806	E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	2.444
C02 Communication Errors Pilot-to-Pilot	1.629	P06 Procedural Errors Failure to Go-Around	2.267
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	1.487	B01 Fatigue	1.842
A01.03 Landing Gear/Tires	1.417	E02 Environmental Threats lack of Visual Reference	1.523
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	1.381	E01.03 Gusty Wind/Windshear/Wake Turbulence	1.487

The above demonstrates that the GADM ADX analysis results are compatible with the EBT A&I Study results and can therefore be considered as a valid data source for this Amendment.

The differences identified between the GADM ADX analysis and the EBT A&I Study results were investigated by the EBT SG, as will be detailed in Section 4.4. Further analysis and comparison with the other data sources was required to validate the results and to determine whether any changes to the EBT training topics, or to their frequency, should be recommended.

As a summary, the correlation between the EBT A&I Study and GAM ADX data analysis permitted to:

1. Validate that the EBT A&I Study methodology is applicable to the GADM ADX data analysis
2. Ensure the quality control of the EBT A&I Study
3. Confirm the prioritization of the identified threats and errors

4.3 Training Criticality Survey (TCS-2020)

As explained in Section 3, the objective of the TCS was to capture the pilots' feedback on how effective training could be as a mitigating measure against the threats and errors they encounter in operations.

In total, 563 surveys were completed by a large and diverse spectrum of the pilot community. With 563 respondents, the results of TCS-2020 were deemed sufficient, from a statistical perspective, to be incorporated in the final conclusions and recommendations of this Amendment, which was not the case with TCS-2011, which only had a total of 166 respondents.

The TCS-2020 respondents operated 26 different aircraft types over generations 3 and 4 Jet and generations 2 and 3 Turboprop (TP) aircraft. It provided an adequate number of responses from generations 3 and 4 Jet pilots to enable the analysis. However, there were only ten generation 3 TP and four generation 2 TP surveys completed. Whilst this data was analyzed, the sample size was too small to contribute to the recommendations of this Amendment. See Appendix 5 for a full breakdown of the TCS-2020 results.

The table below provides the breakdown of responses per aircraft generation

Aircraft Generation	Number of completed surveys
4 Jet	399 out of 563 = 70.87%
3 Jet	133 out of 563 = 23.63%
3 Turbo Prop	10 out of 563 = 1.78%
2 Turbo Prop	4 out of 563 = 0.72%

In order to be able to compare the results of TCS-2020 with the results of the EBT A&I Study and the GADM ADX analysis, the same ranking methodology was applied, as used in the EBT Data Report, 1st Edition, which is described in 3.2.3.

The survey results ranked the following as the top 10 threats and errors, for generations 3 and 4 Jet. The complete results can be found in Appendix 5.

Generation 4 Jet Training Criticality Survey RRR results

Ranking	Ranking Score	Threat/Error	Question
1	60.127	Windshear/Gusty conditions/Wake turbulence	Q24. Select the likelihood of Windshear/Gusty Conditions/Wake Turbulence
2	58.423	Icing conditions	Q31. Select the likelihood of Icing conditions
3	58.322	Adverse weather	Q10. Select the likelihood of Adverse Weather
4	58.196	Terrain/Obstacle	Q87. Select the likelihood of Terrain/Obstacles
5	57.115	Poor visibility	Q17. Select the likelihood of Poor Visibility
6	55.954	Traffic	Q94. Select the likelihood of Traffic
7	55.302	Runway Taxi Conditions	Q66. Select the likelihood of Runway Taxi Conditions
8	54.511	Failure to Go-Around	Q304. Select the likelihood of a Failure to Go-Around
9	54.173	Operational Pressure	Q185. Select the likelihood of Operational Pressure
10	53.971	Manual Handling	Q241. Select the likelihood of a Manual Handling error

Generation 3 Jet Training Criticality Survey RRR results

Ranking	Ranking Score	Threat/Error	Question
1	59.886	Windshear/Gusty conditions/Wake turbulence	Q24. Select the likelihood of Windshear/Gusty Conditions/Wake Turbulence
2	58.385	Poor visibility	Q17. Select the likelihood of Poor Visibility
3	58.193	Adverse weather	Q10. Select the likelihood of Adverse Weather
4	58.045	Terrain/Obstacle	Q87. Select the likelihood of Terrain/Obstacles
5	56.77	Icing conditions	Q31. Select the likelihood of Icing conditions
6	55.151	Runway Taxi Conditions	Q66. Select the likelihood of Runway Taxi Conditions
7	54.248	Failure to Go-Around	Q304. Select the likelihood of a Failure to Go-Around
8	54.176	Traffic	Q94. Select the likelihood of Traffic
9	54.136	ATC	Q45. Select the likelihood of Air Traffic Services Threat
10	53.498	Operational Pressure	Q185. Select the likelihood of Operational Pressure

The raw results of TCS-2020, after the ranking process, support the maintenance of the current training matrix and training frequency, for both generations 3 and 4 Jet aircraft.

For example, four out the top five threats highlighted by the pilots, are related to environmental threats: windshear/gusty conditions/wake turbulence, poor visibility, adverse weather effects and icing conditions. This is in line with the current EBT training curriculum where these threats are addressed under weather related training topics with either an A or a B frequency.

Generation 4 Jet – RRR comparison

Comparing the RRR results of the EBT A&I Study, GADM ADX analysis and TCS ranking, for Generation 4 Jet, there is a global correlation between the three data sources, e.g., Manual handling/Flight controls, Procedural errors failure to go around and Poor visibility, appear in the three data sources as A frequency topics, in line with the EBT curriculum.

Generation 4		
EBT A&I Study	**GADM ADX Analysis**	**TCS Ranking**
H01 Manual Handling/Flight Controls	**H01 Manual Handling/Flight Controls**	Windshear/Gusty conditions/Wake turbulence
P03 Procedural Errors Callouts (error in callout or omission of callout)	P01.01 Intentional	Icing conditions
C02 Communication Errors Pilot-to-Pilot	E01.03 Gusty Wind/Windshear/Wake Turbulence	Adverse weather
P01.01 Intentional	**P06 Procedural Errors Failure to Go-Around**	Terrain/Obstacle
P01.02 Unintentional	P03 Procedural Errors Callouts (error in callout or omission of callout)	**Poor visibility**
H03 Automation (Settings/Selections)	C02 Communication Errors Pilot-to-Pilot	Traffic
P06 Procedural Errors Failure to Go-Around	E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	Runway Taxi Conditions
E03 Environmental Threats Air Traffic Services	E06 Environmental Threats Navaids	**Failure to Go-Around**
E02 Environmental Threats Lack of Visual Reference	**E01.02 Poor Visibility (degraded visual environment)**	Operational Pressure
E01.02 Poor Visibility (degraded visual environment)	P01.02 Unintentional	**Manual Handling**

Generation 3 Jet – RRR comparison

Comparing the RRR results of the EBT A&I Study, GADM ADX analysis and TCS ranking, for Generation 3 Jet, there is a global correlation between the three data sources, e.g., Procedural errors failure to go around, Gusty Wind/Windshear/Wake Turbulence and Adverse Weather, appear in the three data sources as A frequency topics, in line with the EBT curriculum.

Generation 3		
EBT A&I Study	**GADM ADX Analysis**	**TCS**
H01 Manual Handling/Flight Controls	H01 Manual Handling/Flight Controls	**Windshear/Gusty conditions/Wake turbulence**
C02 Communication Errors Pilot-to-Pilot	P01.01 Intentional	Poor visibility
P03 Procedural Errors Callouts (error in callout or omission of callout)	**P06 Procedural Errors Failure to Go-Around**	**Adverse weather**
P01.02 Unintentional	E01.02 Poor Visibility (degraded visual environment)	Terrain/Obstacle
P01.01 Intentional	**E01.03 Gusty Wind/Windshear/Wake Turbulence**	Icing conditions
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	A07 Maintenance events	Runway Taxi Conditions
P06 Procedural Errors Failure to Go-Around	C02 Communication Errors Pilot-to-Pilot	**Failure to Go-Around**
B01 Fatigue	A03 Operational pressure (operational time pressure/distraction/n-normal operations)	Traffic
E02 Environmental Threats lack of Visual Reference	A01.03 Landing Gear/Tires	ATC
E01.03 Gusty Wind/Windshear/Wake Turbulence	**E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)**	Operational Pressure

Three threats in the results of TCS-2020 appear to be slightly out of sync with the training topics prioritization of the EBT curriculum, and with the EBT A&I Study and the GADM ADX analysis. These are 'terrain', 'traffic' and 'runway and taxiway conditions'.

TCS-2020 – 'Out of sync ranking'		
Threat or Error	Gen 4 Jet Ranked	Gen 3 Jet Ranked
Terrain	4th	4th
Traffic	6th	8th
Runway and taxiway conditions"	7th	6th

'Traffic' is a C frequency training topic, whilst 'Terrain' and 'Runway and taxiway conditions' are B frequency for generation 4 Jet and C frequency for generation 3 Jet.

The TCS results would indicate that they should be trained as an A frequency training topic. Therefore, further analysis and comparison with the other data sources were required to determine whether any changes to the frequency of these three topics should be recommended.

4.3.1 Comparison of TCS-2020 rankings for 'Terrain', 'Traffic' and 'Runway and taxiway conditions' against GADM ADX RRR and EBT A&I Study RRR.

To analyze the TCS-2020 ranking results on 'Terrain', 'Traffic' and 'Runway and taxiway conditions', a comparison with other data sources was necessary. For the purpose of this analysis 'Windshear/gusty conditions/wake turbulence' (being ranked number one for generations 3 and 4 jet in the TCS), were used as a reference point.

The table below compares the number of events (Fatal, Non-Fatal and Incidents) and the RRR for each of the three above mentioned threats in the context of the GADM ADX analysis and the EBT A&I study.

Comparison of GADM ADX analysis and EBT A&I Study (Windshear/Terrain/Traffic/Runway and taxiway conditions) generation 4 Jet

Threat	**Generation 4 Jet**					
	GADM ADX Analysis			**EBT A&I Study**		
	Number of Events	Fatal/Non-Fatal/ Incident (%)	RRR	Number of Events	Fatal/Non-Fatal/ Incident (%)	RRR
Windshear/gusty conditions/wake turbulence	30 / 563	1 / 3 / 26	1.159	10 / 184	0 / 7 /3	0.695
Terrain	4 / 563	1 / 0 / 3	0.203	2 / 184	1 / 0 / 1	0.174
Traffic	5 / 563	0 / 0 / 5	0.145	2 / 184	0 / 0 / 2	0.058
Runway and taxiway conditions	8 / 563	0 / 0 / 8	0.232	1 / 184	0 / 0 / 1	0.029

Comparison of GADM ADX analysis and EBT A&I Study (Windshear/Terrain/Traffic/Runway and taxiway conditions) generation 3 Jet

Threat	Generation 3 Jet					
	GADM ADX Analysis			EBT A&I Study		
	Number of Events	Fatal/Non-Fatal/ Incident (%)	RRR	Number of Events	Fatal/Non-Fatal/ Incident (%)	RRR
Windshear/gusty conditions/wake turbulence	40 / 563	3 / 0 / 37	1.842	16 / 184	0 / 13 /3	1.487
Traffic	7 / 563	0 / 0 / 7	0.248	10 / 184	0 / 5 / 5	0.708
Terrain	4 / 563	1 / 0 / 3	0.248	6 / 184	2 / 2 / 2	0.637
Runway and taxiway conditions	30 / 563	0 / 1/ 29	1.133	9 / 184	0 / 5 / 4	0.673

The TCS-2020 – 'Out of sync ranking' table demonstrates that pilots perceive 'Traffic', 'Terrain' and 'Runway and taxiway conditions' as significant threats, while the Relative Risk Ranking (RRR) for these threats within both the GADM ADX analysis and the EBT A&I Study are low in comparison to the reference point 'Windshear/gusty conditions/wake turbulence'. Except for the GADM Generation 3 Jet 'Runway and taxiway conditions' results, which has a higher RRR than the other training topics.

A further analysis of these results, looking at other data sources, was deemed necessary, and was performed by the EBT SG. The results of this analysis are presented in section 4.4.2 (frequencies) and 4.4.5 (review the results from other data sources).

4.4 EBT Subgroup (SG) Studies

The EBT SG consists of AOCs and ATOs representatives that have implemented EBT. Their hands-on experience with EBT program implementation, delivery and associated data collection brought an extremely valuable new element to this Amendment.

In particular, the EBT SG experts conducted several studies to:

- review the relevance of the current EBT training topics against their training data
- review the EBT training topics frequencies
- perform a threats and errors mapping exercise
- suggest improvements in the example scenarios
- review the results from the other data sources

The EBT SG studies, and correlation with the other data sources, constitute the basis upon which the recommendations and practical solutions proposed in this Amendment are founded, in order to maintain the relevance of the EBT curriculum and to ensure the sustainability for future amendments through a reliable process. Hence, one of the main roles of the EBT SG was to review and corroborate the relevance of the EBT training topics against their own training data.

4.4.1 Review the relevance of the current EBT training topics

Each EBT SG member was tasked with reviewing the current EBT training curriculum and assessing it against their own safety and training data, to determine whether there was evidence to demonstrate a need to consider adding new training topics to the EBT curriculum.

The results of this study by the EBT SG confirmed that the current training topics are adequate to mitigate the majority of the risks they encounter in operations. Moreover, the EBT SG indicated that enrolling into an EBT program allows them sufficient flexibility to integrate additional training elements and also to develop suitable scenarios that will address the specific risks identified by their safety management system.

Nevertheless, during the curriculum review, the EBT SG identified the need for:

- An EBT/CBTA Overarching Principles section
- Guidance on 'Operations or type specific'
- Retitling the training topic 'ISI Monitoring, cross checking, error management, mismanaged aircraft state'
- Integrating the training topics- Loss of communications into ATC

4.4.1.1 EBT/CBTA Overarching Principles section

The EBT SG highlighted the fact that several training topics are foundational components of any CBTA program as they relate directly to the pilot competencies.

In particular, the following training topics are no longer trained in isolation since Amendment 7 to ICAO Doc 9868 (PANS-TRG) clarified the relation between CRM training, pilot competencies and the TEM model and provided guidance for CBTA course design and development regarding the integration of TEM and surprise elements with the goal to enhance pilot resilience.

- Competencies non-technical (CRM)
- Compliance
- Workload, distraction, pressure
- Monitoring and cross-checking
- Surprise
- Aircraft system management

These training topics form an integral and crucial part of designing and delivering an EBT program, however, within an EBT/CBTA program, they should not be treated as standalone training topics as most of them are embedded in the observable behaviors (OBs) of the pilot competencies, which should be trained throughout each EBT module. This fact was considered by the EBT SG as a corroborative element to explain that there is often little or no guidance in ICAO Doc 9995 as to how to train these topics (see extraction in Appendix 7).

The EBT SG reviewed the above listed training topics in light of the CBTA-EBT principles and provided for each training topic the rational for the need to produce an EBT/CBTA overarching principles section to ensure that each EBT module integrates these essential components.

Training topic 'Pilot Competencies'

The fundamental aim of EBT is to develop, maintain and assess the pilot competencies required to operate safely, effectively, and efficiently in a commercial air transport environment, while addressing the most relevant threats and errors according to evidence collected in accidents, incidents, flight operations and training. The CRM skills listed below and referred to the training topic 'Competencies non-technical' in the EBT Data Report 1st Edition are fully embedded in the pilot competencies.

- Problem Solving and Decision Making (PSD)
- Workload Management (WLM)
- Leadership and Teamwork (LTW)
- Situation Awareness and Management of Information (SAW)
- Communication (COM)

The EBT SG therefore noted that it is not necessary to have a standalone training topic related purely to non-technical competencies (CRM). The training topic should refer to the complete set of the nine pilot competencies.

ICAO Doc 9995 States:

ICAO Doc 9995 – Recurrent Assessment and Training Matrix
Competencies non-technical (CRM) This encapsulates communication; leadership and teamwork; problem solving and decision making; situation awareness; workload management. Emphasis should be placed on the development of leadership, shown by EBT data sources to be a highly effective competency in mitigating risk and improving safety through pilot performance.

Moreover, in 2017, the IATA Pilot Training Task Force (PTTF) conducted an analysis among several international organizations representing airlines and training organizations. The aim of the analysis was to assess the potential differences in the implementation of the TEM model and to harmonize the use of the competencies within the TEM framework. This analysis resulted in the following conclusions.

The PTTF recognized TEM as the overarching concept in training and operations.

- Pilot competencies represent the set of individual and team countermeasures
- CRM skills are embedded in the pilot competencies
- CRM training supports the development of the pilot competencies as countermeasures in the TEM concept

The output of this work was adopted by ICAO through Amendment 5 to PANS-TRG which states that, from a CBTA perspective, the competencies of the approved adapted competency model provide individual and team countermeasures to threats and errors and undesired aircraft states. CRM skills are embedded in the approved adapted competency model. Therefore, CRM training supports the development of the competencies as countermeasures in the TEM concept.

Hence, ICAO formalized the fact that TEM is the overarching safety concept; the competencies of the approved adapted competency model provide the individual and team countermeasures against threats and errors to avoid undesired aircraft states.

As a consequence, the EBT SG decided to produce an overarching statement to ensure that the nine pilot competencies, which include the CRM skills (referred to the training topic 'Competencies non-technical' in the EBT Data Report 1st Edition), are covered with an A frequency.

The full description of the competencies and associated observable behaviors can be found in Appendix 11 of this Amendment.

Compliance

Compliance means conforming to rules, procedures, limitations, and clearances. An operator will typically require that flight crews comply with all operational procedures and instructions unless there is an urgent and compelling reason not to do so.

Nevertheless, intentional non-compliance remains a substantial problem and was ranked among the highest errors in the RRR results of both the EBT A&I Study and the GADM ADX analysis. While the level of crew non-technical competency has shown signs of improvement over the most recent periods examined, non-compliance remains a serious weakness in current operations. It has decreased somewhat in the last 15 years but not at the same rate as accidents have.

There are many potential reasons for crews to deviate routinely from SOPs. These include attempts to optimize operations, particularly in time-constrained situations. Complacency due to familiarity is another factor. Under a CBTA program compliance relates through several Observable Behaviors of the competency 'Application of procedures and compliance with regulations' but some elements of compliance are sustained by competencies such as 'Application of knowledge', 'Leadership and teamwork' and 'Workload management'.

The data shows significant correlation between non–compliance and important increases in the risk of undetected errors and undesired aircraft states. The failure of crews to execute a Go-Around under conditions when the SOP requires it is a very significant area of intentional non-compliance. There are substantial signs of non-compliance with checklists and call-out protocols. Pilots admit to call-out and checklist deviations on a regular basis, as well as the failure to adhere to approach procedures and execute Go-rounds when required.

The IATA Safety Report 2019 states that between 2015 and 2019 'SOP Adherence/SOP cross-verification' or non-compliance, was a factor in:

- 32% of all accidents
- 58% of all fatal accidents
- 28% of non-fatal accidents

Crew discipline has always been assumed to be a pillar supporting operational safety, but now the data shows its breakdown. Crews must understand that intentional non-compliance correlates highly with errors resulting in undesired aircraft states, and that compliance failures also rank high as contributive factor in accident data.

Crews are trained to comply and demonstrate adherence to SOPs but detecting and addressing non-compliance is not a feature of the existing training programs. Data indicates that effective training and appropriate focus on areas such as leadership can help address non-compliance. Instructors should ensure that observed non-compliances are taken as learning opportunities throughout the EBT program.

There are different types of non-compliance and their consequences, which are normally aligned with the Threat and Error Management model:

- Non-intentional non-compliance without consequences. For example, an error that is detected and corrected.
- Non-intentional non-compliance with consequences. For example, an error that is not detected, but the consequence is then mitigated.
- Intentional non-compliance without consequences. For example, an intentional non-compliance that does not lead to a reduction in safety margins.
- Intentional non-compliance with consequences. For example, an intentional non-compliance that leads to a reduction in safety margins.

If one of the above occurs, the expected outcome from the flight crew would be:

- Recognize that a non-compliance has occurred
- Make a verbal announcement
- Take appropriate action
- Restore a safe flight path if necessary
- Manage the consequences

Given that a non-compliance is initiated by the flight crew and might occur at any point in an EBT module, it is not possible to list example scenario elements. ICAO Doc 9995 states:

ICAO Doc 9995
Compliance failure. Consequences of not complying with operating instructions (e.g., SOP).
This is not intended to list scenarios, but instructors should ensure that observed non-compliances are taken as learning opportunities throughout the programme. In all modules of the programme, the FSTD should as far as possible be treated like an aircraft, and non-compliances should not be accepted simply for expediency.

Therefore, 'compliance' should not be a separate training topic as it is embedded throughout EBT training via the development of several competencies. However, EBT module designers should consider scenarios where workload management or decision making might lead the flight crew to make an error or an intentional non-compliance. This can be highlighted in lesson plans or session guides, but instructors should be alert to recognize non-compliance throughout an EBT module. Any non-compliance that is recognized should then be used as a learning opportunity, by using a facilitated debrief to identify the root cause and learning outcome.

Workload, distraction, pressure

The competency 'Workload management' (WLM) clearly sets out the OBs that are required to demonstrate competency in this area. Considering that the principles of EBT are CBTA, this would support the recommendation for not treating 'Workload management' as a separate training topic.

ICAO Doc 9995 States:
This is not considered a topic for specific attention on its own, but more as a reminder to programme developers to ensure that pilots are exposed to immersive training scenarios which expose them to manageable high workload and distractions during the course of the EBT programme, at the defined frequency. Manage available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances.

Based on the precept 'learn from the positive', the overall goal is to strengthen the resilience of pilots in coping with demanding, but manageable training scenarios. The EBT course developers are responsible for designing a program that exposes pilots to scenarios in which they can develop and learn, by applying all the competencies, with a particular emphasis on workload management (WLM).

High workload, distraction and pressure can arise through various means, from a system malfunction, adverse weather or low performing ATC controller, or a combination of these. Therefore, WLM is a fundamental principal of scenario building, rather than a stand-alone training topic to strengthen and develop the pilots' resilience.

Monitoring and cross-checking

As explained in Section 2.2, the CBTA principles have greatly evolved since the publication of the EBT Data Report and ICAO Doc 9995. Amendment 7 to ICAO Doc 9868 now provides a competency framework for aeroplane pilots that operators can use to develop their own adapted competency model.

'Monitoring and cross-checking' are currently part of the training topic 'ISI Monitoring, cross checking, error management, mismanaged aircraft state' in ICAO Doc 9995. However, 'monitoring' and 'cross-checking' are embedded in six of the competencies, PRO, FPA, FPM, PSD, SAW and WLM, through ten different observable behaviors, and cross-checking forms part of WLM.

This supports the EBT SG's recommendation not to consider 'monitoring and cross-checking' as a standalone training topic but to be embedded throughout the entire EBT training program, as the competencies are the individual and team countermeasures to manage the threats and errors encountered in operations.

Surprise

Since the publication of ICAO Doc 9868, Amendment 7, the following guidance to course designer is applicable: 'The CBTA program should integrate threat and error management and surprise elements throughout the complete course syllabus'. Therefore, The EBT SG considered that placing the training topic 'surprise' under the EBT/CBTA Overarching Principles section is a more appropriate place for this topic, given the importance of having some elements of surprise integrated into all training modules. Even though the EBT A&I Study, the GADM data analysis and the TCS results did not capture any events directly connected to 'surprise', due to the fact that there are no associated specific elements within the IATA safety taxonomy, the EBT SG experts considered that 'surprise' have often contributed to accidents and incidents by generating a sudden and irreversible decrease of the pilot performance.

ICAO Doc 9995 States:
The data analyzed during the development of the EBT Data Report, 1st Edition, and of the EBT concept indicated substantial difficulties encountered by crews when faced with a threat or error, which was a surprise, or an unexpected event. The element of surprise should be distinguished from what is sometimes referred to as the "startle factor", the latter being a physiological reaction. Wherever possible, consideration should be given towards variations in the types of scenario, times of occurrences and types of occurrence, so that pilots do not become overly familiar with repetitions of the same scenarios. Variations should be the focus of EBT programme design, and not left to the discretion of individual instructors, in order to preserve programme integrity and fairness.

As aircraft design and reliability improve, the likelihood of crews facing specific malfunctions and events reduces. Isolated and unexpected events become more problematic as reliability improves, while attending to the overall system may become more complex. A lack of effective procedural and conceptual knowledge of automation often leads to surprises in operations. Data indicates that cognitive tasks have potential for skills decay, and flight path control in dynamic situations is often more demanding, especially where there are attendant distractions from the environment, the system or ATC.

Pilots reported that they often face operational unforeseen situations for which they have not been trained. In modern generation aircraft, the accident and serious incident data shows an increase in poor situation awareness when things go wrong.

Despite all the data, current training is driven by highly prescriptive regulatory requirements based on evidence from early jets and training programs containing many elements, most of which are highly predictable. Data from operations and training indicate that crews face substantial problems when dealing with unexpected events, for example executing an unanticipated all engine operative go-around, simply because they are unexpected and often performed in conditions not experienced in training.

Given the above, surprise should not be seen as a standalone training topic in any specific module of an EBT program but rather as an aspect of scenarios to be integrated in as many modules as possible throughout the program. As with workload, distraction and pressure, it can be expected that surprise will form part of many different scenarios, such as terrain, adverse wind, unstable approaches, aircraft systems malfunctions, automation management, go-around, upset recovery, pilot incapacitation, etc. Effective integration of surprise in multiple training scenarios will reduce the negative impact of surprise on the pilot, not only in the specific situations covered by the scenarios, but in any situation, and will contribute to enhance pilot resilience. The development of pilot resilience being one of the four cornerstones of an EBT program.

Aircraft system management

Under a CBTA program Aircraft system management relates directly to the competencies 'Application of procedures and compliance with regulations' and 'Application of knowledge'. Aircraft system management describes the normal system operation, based on defined instructions and standard operating procedures. The underlying foundation for successfully managing aircraft systems is knowledge of systems and understanding of the interactions between systems. Knowing and understanding aircraft systems, enables a pilot to be competent in operating and managing the systems in accordance with the operator's standard operating procedures.

Aircraft system management is not a training topic on its own but can be clearly observed in the operation of the aircraft's systems during normal and abnormal operations. Crew would demonstrate compliance with procedures in accordance with published operating instructions using the appropriate system knowledge during the EBT training event.

Crews should be exposed to the normal aircraft system management during scenarios, with the intention of developing and challenging the underpinning knowledge of systems and not merely the application of normal procedures.

ICAO Doc 9995 states:

ICAO Doc 9995 - Recurrent Assessment and Training Matrix
Normal system operation according to defined instructions. The instructor should focus on learning opportunities when system management non-compliances manifest themselves during scenarios. Any non-compliance that is recognized should then be used as a learning opportunity, by using a facilitated debrief to identify the root cause and learning outcome.

Conclusion

As a result of the study conducted by the EBT SG, the above training topics were identified as not being standalone topics but rather embedded throughout all the EBT modules. They should be trained and assessed consistently throughout any EBT/CBTA program, and should form part of an EBT/CBTA Overarching Principles section with an associated frequency A.

4.4.1.2 Guidance on 'Operations or type specific'

The EBT SG also considered that the operational and type specific aspects of the training topic 'Operations or type specific' should be distributed across the EBT modules of the triannual program

The EBT SG's understanding is that the 'Operations or Type Specific' training topic should be developed by the EBT course designer considering the following:

- OEM operational and training guidance that are present in the Operational Suitability Data (OSD) in particular the Training Area of Special Emphasis (TASE) and the Flight Crew Training Standards Manual (FCTS)/Operations Training Transmissions (OTT), or the Flight Crew Training Manual and Flight Operations Technical Bulletins and Type Rating Training Manual for specific events and focus competencies.
- Operator data indicating a need to provide specific or additional training. The evidence may come from 'inner loop' data, including safety reports, flight data analysis, flight deck observations and training metrics. The evidence will also come from the feedback system within the program.
- Operator or type-specific scenario elements should be included in the EBT program to address these specific or additional training needs. They can usually be included within existing training topics from the assessment and training matrix. However, an operator may include scenario elements that are additional to the generic program, according to the evidence and identified training needs, or for points of interest they wish to emphasize.

For these reasons, this training topic should remain within the curriculum as a C frequency, The evidence will guide the operator as to whether an element requires frequent inclusion (B frequency), infrequent inclusion (C frequency) or is a one-off point of emphasis.

4.4.1.3 Retitle the training topic 'ISI Monitoring, cross checking, error management, mismanaged aircraft state'

There are two recommendations related to this training topic.

- Retitling 'ISI Error management, mismanaged aircraft state and monitoring and cross-checking' in ICAO Doc 9995, Recurrent Assessment and Training Matrix
- Repositioning the 'monitoring' and 'cross-checking' aspect of this training topic under the EBT/CBTA Overarching Principles section, as described in Section in 4.4.1.1.

Retitling the training topic 'ISI Monitoring, cross checking, error management, mismanaged aircraft state'

In ICAO Doc 9995, Recurrent Assessment and Training Matrix, this topic is titled 'ISI Monitoring, cross checking, error management, mismanaged aircraft state". However, the EBT SG highlighted the fact that in-seat instruction (ISI) is a means to conduct the training, not a training topic in itself, and, therefore, recommended reviewing the title of this training topic.

This is supported by the European EBT Regulation, in the EASA Explanatory Note to Decision 2021/002/R.

GM2 ORO.FC.231(a)(2) Evidence-based training ***Explanatory note to GM2 ORO.FC.231(a)(2)***
EBT PROGRAMME — IN-SEAT INSTRUCTION (ISI) With regard to the training topic 'monitoring, cross checking, error management, and mismanaged aircraft state', Doc 9995 titles the topic as in-seat instruction (ISI). EASA believes there is an inconsistency because ISI is a means to deliver a training topic and not a training topic (see definition of ISI). Therefore, ISI is removed from the training topics. Furthermore, the IATA data report for EBT does not identify that the means and the only means to deliver such topic (monitoring, cross-checking, error management, mismanaged aircraft state) should be ISI.

This highlighted the need to re-evaluate where 'error management, mismanaged aircraft state and monitoring and cross-checking' fits most effectively within the EBT program, as these can be trained by other means than ISI. This is also substantiated in the European EBT Regulation.

AMC2 to AMC6 ORO.FC.232 EBT programme assessment and training topics **Explanatory note to AMC2 to AMC6 ORO.FC.232** **Summary of amendments to Appendices 2 to 6 to Doc 9995:**
Feedback from operators implementing mixed EBT has highlighted that ISI is not the only means of training this operational risk; therefore, an increased flexibility in regard to the means to deliver this training topic was introduced.

As explained under section 4.4.1.1, the EBT SG also pointed to the fact that 'monitoring and cross-checking', which currently sit within the training topic 'Monitoring, cross checking, error management, mismanaged aircraft state' are embedded in the Observable Behaviors (OBs) of the pilot competencies, and as such should not sit as part of a standalone topic in the Recurrent Assessment and Training Matrix.

The EBT SG recommended retitling the training topic 'ISI Monitoring, cross checking, error management, mismanaged aircraft state' as 'Error management, mismanaged aircraft state' and to transfer the training topic 'monitoring and cross checking' under the EBT/CBTA Overarching Principles section.

This recommendation is supported by the following extract from EASA Explanatory Note to Decision 2021/002/R.

GM2 ORO.FC.231(a)(2) Evidence-based training ***Explanatory note to GM2 ORO.FC.231(a)(2)***
It also has to be noted that effective monitoring and error detection as well as error management, mismanaged aircraft state, compliance and cross-checking topics are also embedded in the observance of the behavioural indicators. This way, they are present in all of the EBT FSTD sessions, and any observance of deficiencies should be taken as a learning opportunity, identifying the root cause/contributing factor, and discussed during the subsequent 'facilitated debriefing'.

EASA Annex III to ED Decision 2021/002/R

AMC and GM to Part-ORO of Regulation (EU) No 965/2012 Issue 2, Amendment 17

- The scenarios should be realistic and relevant and should be used for the purpose of demonstration and reinforcement of effective monitoring.
- Modules in the FSTD should be treated like those in an aircraft so that trainees have the opportunity to develop the competency with the practice of the right techniques and attitudes related to these topics through pilot performance, and that instructors have the opportunity to assess and train these topics in a realistic environment. As shown by the EBT data report, these topics are of key importance to improve safety in operations.

The pilot should be able to:

- Recognise mismanaged aircraft state.
- Observe the pilot's behaviour: how the pilot is mitigating errors, performing cross-checking, monitoring performance and dealing with a mismanaged aircraft state, in order to ensure that observed deviations, errors and mistakes are taken as learning opportunities throughout the programme.
- Monitor flight path excursions. Detect errors and threats through proper cross-checking performance.
- Make appropriate interventions either verbally or by taking control if applicable.

4.4.1.4 Integrate the training topic 'Loss of communications' into 'ATC'

The EBT SG study determined that the training topic 'Loss of communications' should be integrated into the training topic 'ATC'.

The EBT SG stated that this is no longer a threat with the advent of far more robust methods of air-ground communication. There are now more communication systems redundancy built into the modern flight deck (satellite communications, CPDLC, etc.). It was also noted by the EBT SG that training this topic in an FFS is neither effective nor a good use of resources and that the method for dealing with any loss of communications may be better taught by other means, e.g., flight crew notices, computer-based training (CBT), etc.

Moreover, whilst there is no direct threat, within the IATA safety taxonomy, that relates to this training topic, the results of the TCS placed Q262. *Select the likelihood of a Systems/Radios/Instruments* error at position 34 out of 46 in the total TCS ranking results, indicating that this is perceived by the pilots as being very low risk.

The EBT SG concluded that this should not form part of a standalone training topic but should be integrated within the training topic 'ATC' as an example scenario. Further example scenarios could be developed by the operator to help mitigate this threat.

4.4.2 Review the EBT training topics frequencies

The EBT SG conducted a study, using their own training and safety data, to establish whether the frequencies of the training topics of the EBT curriculum were still relevant, or if some changes should be recommended.

As a result of their study, the frequencies of the following two training topics were identified by the EBT SG as requiring further investigation:

- Upset Prevention and Recovery Training (UPRT)
- Traffic

The results of their study where then compared to the results of other data sources used in this Amendment and, in some instances to new standards or regulatory requirements, to either support or not support the results of their study and their recommendations.

4.4.2.1 Training Topic 'Upset Prevention and Recovery Training (UPRT)'

The EBT SG highlighted the importance of training UPRT on a regular basis and proposed increasing the frequency of this training topic from a frequency C to a frequency B for generations 3 and 4 Jet.

The EBT SG also recommended renaming the training topic 'Upset Recovery' as 'Upset Prevention and Recovery Training (UPRT)'. UPRT should be trained every year in line with a B frequency. The operator will be responsible for ensuring that the prevention and recovery training elements are compliant with their national regulatory requirements and aligned with ICAO Doc 10011 recommendation.

The recommendation from the EBT SG is further supported by the IATA LOC-I report published in 2019 which states that LOC-I was in the top three fatal events over the period of 2016-2019. Below is an extract from this report.

Loss of Control In-Flight Accident Analysis Report, Edition 2019

Loss of Control – Inflight (LOC-I) is the most significant cause of fatal accidents in commercial aviation. LOC-I occurs when an aircraft deviates from the intended flight path or an adverse flight condition places an aircraft outside the normal flight envelope, with the pilot unable to maintain control of the aircraft.

An analysis of the IATA Global Aviation Data Management (GADM) accident database was conducted to identify accidents that were classified as LOC-I. The study focused on worldwide commercial jet and turboprop aircraft over the last 10 years (2009 through 2018). The results indicated that:

- There were 64 LOC-I accidents identified over the 10-year reporting period.
- 94% of LOC-I accidents involved fatalities to passengers and/or flight crew.
- LOC-I resulted in more fatalities than any other accident category (2,462 of 4,075). It surpassed Controlled flight into Terrain (CFIT), and Runway Excursions as the leading cause of fatalities in commercial aviation accidents.
- LOC-I accidents ranked the second highest in terms of hull losses after Runway Excursion accidents.
- LOC-I is one of the accident categories with the lowest survivability ratio.

The European EBT Regulation proposes new provisions allowing the training of this topic in all phases of the EBT modules.

AMC2 to AMC6 ORO.FC.232 EBT programme assessment and training topics **Explanatory note to AMC2 to AMC6 ORO.FC.232** **Summary of amendments to Appendices 2 to 6 to Doc 9995:**
Training topic 'upset prevention training' — extensive amendments are introduced. Doc 9995 was published before Doc 10011 'UPRT manual', and therefore Doc 9995 does not provide the latest training exercises for UPRT. The new provision proposed in AMC8 ORO.FC.231 point (a) requires compliance with AMC1&2 ORO.FC.220&230. The new text allows training this topic in the MT and Scenario-Based Training (SBT) of the modules, thus providing more flexibility. EASA excluded this training topic (recovery) from the evaluation phase. The reason agreed by the experts consulted by EASA was that in the evaluation phase, every skilled pilot will avoid in the upset prevention stage the need to go into a recovery from upset; therefore, in order to avoid negative training, the recovery part should be avoided in the evaluation phase. Furthermore, the experts consulted by EASA found some of the recovery example scenario elements described in Doc 9995 to be example scenario elements related to prevention; therefore, EASA transferred them to the training topic of upset prevention — frequency B. For instance, the example scenario element "Demonstration of the defined normal flight envelope and any associated changes in flight instruments, flight director systems, and protection systems. This should take the form of an instructor-led exercise to show the crew the points beyond which an upset condition could exist" is located in Doc 9995 in the training topic 'upset recovery'; however, in AMC1 ORO.FC.220&230 table 1 and in Doc 1001 'UPRT manual', this example scenario element is located in the prevention part; therefore, the conclusion of EASA and its experts was to move it to upset prevention.

The EBT SG concluded that there is sufficient evidence to support increasing the training frequency of UPRT from a C to a B frequency for both generations 3 and 4 Jet.

4.4.2.2 Training Topic 'Traffic'

An EBT operator's safety data indicated that the training of 'traffic' events could be increased from a C frequency to a B frequency. The data indicated that approximately 20% of the 'traffic' events that occurred during line operations were mismanaged and resulted in an Undesired Aircraft State (UAS).

The IATA-Eurocontrol document 'Performance Assessment of Pilot Compliance with Traffic Collision Avoidance System Advisories Using Flight Data Monitoring Guidance Material', 2nd Edition, also indicates that the recognition and recovery from ACAS events is poorly managed. See details in Appendix 6 – Training Studies.

The results of TCS-2020, Section 4.3, also indicated that 'Traffic' is a constant consideration for pilots and thus appeared high on the list of threats.

However, of the 1494 ACAS RA events recorded over a three-year period, 2018-2020, in the IATA GADM (IX/FDX) data; none of these events resulted in an accident.

Further investigations and discussions with the EBT SG, as to the root-cause of the mismanaged aircraft state indicated that whilst training ACAS recovery in the FFS has benefits, it is rarely a repeated or retested event during the recurrent program. Thus, indicating that the crew are proficient in the required competencies (APK, PRO, FPA and FPM).

So why are the crews still failing to manage 20% of the events? The EBT SG determined that 'Surprise' has a significantly greater effect during the line events, in comparison with recurrent training in an FSTD and, therefore, this may be the root cause of the mismanaged event.

The EBT SG determined that more frequent training within the EBT program may not reduce the number of mismanaged events on the line but caveated the statement by adding that each operator has the flexibility to increase the frequency should their data suggest it.

One solution would be to have more realistic TCAS training scenarios to better train the event in an FSTD, as well as more example scenarios elements to support this training. FSTDs have limited capabilities to display real traffic situations and are not always able to provide scenarios during a turn or even during climb/descend. A TCAS scenario is designed to be triggered and properly delivered under specific circumstances such as unaccelerated level flight, etc. Consequently, the flight crew can recognize in advance the TCAS Resolution Advisory (RA) event within the flight profile. The surprise effect often observed in the real-world, TCAS RA, cannot realistically be produced in FSTD training. As technology advances, FSTD manufacturers are encouraged to enhance the simulation devices capabilities to deliver realistic scenarios, taking into consideration the expertise and safety recommendations of the ATOs/AOCs.

The EBT SG concluded that TCAS should remain a C frequency training topic, but with the caveat, that should an operator identify a trend in their safety data, this topic could be trained more frequently. The EBT SG also recommended that the scenarios include any new technological developments that support flight safety enhancements; for example, auto TCAS training.

4.4.3 Threats and errors mapping exercise

Another major contribution to this Amendment by the EBT SG and other EBT SMEs, was the 'mapping' of the threats and errors of the IATA safety taxonomy to the EBT training topics.

Each member of the EBT SG was tasked with determining which training topics they would consider using to train each of the 68 threats and errors of the IATA ACTF taxonomy. The individual results were then compiled and reviewed by the EBT SG to reach a consensus on the final results.

For example, the EBT SG mapped:

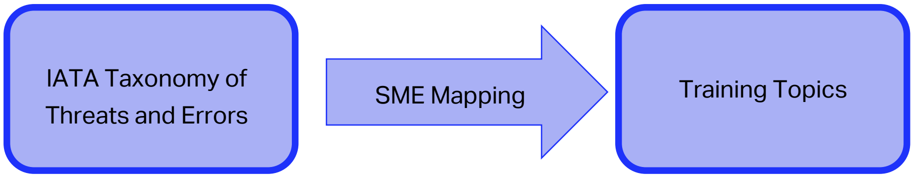
- Threat E04 of the IATA safety taxonomy 'Icing Conditions' to the training topic 'Adverse Weather'.

The EBT SG was also asked to identify those threats and errors that could not be trained (or had limited training benefit) in an FSTD.

For example, the EBT SG identified:

- P05.04 Incorrect or missing logbook entries. The EBT SG determined that there is limited value to use an FSTD to train this event.

The following flowchart is a representation of the process described above.



The table below is an extract of the mapping exercise performed by the EBT SG.

Note: Not all the threats and errors produced a mapped training topic and the explanation behind these variances can be found with the full results in Appendix 8.

Extract of the results of the Threats and Errors Mapping exercise

ERRORS (flight crew deviation)	SME Mapping to EBT Training Topic
H – Aircraft Handling Errors	
H01 Manual handling / Flight Controls	Manual Aircraft Control
H02 Ground Navigation (Surface nav)	Navigation
H03 Automation (settings/selections)	Automation management
H04 Systems/Radio/Instruments (settings/selections)	Aircraft System management
H99 Other	N/A
P – Procedural Errors	**SME Mapping to EBT Training Topic**
P01 SOP adherence/ cross-verification (see breakdown)	
P01.01 Intentional	Compliance
P05 Documentation (see breakdown)	
P05.01 Incorrect weight and balance/ fuel information	Managing loading, fuel, performance errors
P05.02 Incorrect ATIS/ clearance	Error management
P05.03 Misinterpreted items on paperwork	FSTD limited value
P05.04 Incorrect or missing logbook entries	FSTD limited value
P06 Failure to Go-Around	Unstable Approach
P06.01 Failure to go-around after destabilization on approach	Go-Around management
P06.02 Failure to go-around after a bounced landing	Go-Around management
P99 Other	N/A
A – Airline Threats A01 Aircraft Malfunction (see breakdown)	**SME Mapping to EBT Training Topic**
A01.01 Uncontained Engine failure	Engine failure
A01.08 Avionics, flight instruments	Aircraft system malfunction
A01.09 Autopilot/ FMS	Automation management

Threats and errors grouping and ranking

After completion of the mapping exercise, the different threats and errors that have been mapped to the same training topic are then grouped under that training topic. The Relative Risk Ranking (RRR) score of each of the grouped threats and errors are then summed to produce a ranked table of training topics.

For example:

- Error H03 Automation (settings/selections) and threat A01.09 Autopilot/ FMS of the IATA taxonomy highlighted in yellow in the table above, were mapped to the training topic – 'Automation Management'. Therefore, the RRR score for this error and this threat is summed together (along with any other threats and errors that have been mapped to this same training topic) to produce a ranked list.

The following flowchart represents the process described above.

Note: The mapping and grouping of the threats and errors into training topics, is also an important step towards developing a more dynamic and autonomous EBT program, as it will enable a better connection between the GADM data (using the IATA safety taxonomy) and the EBT Training Curriculum. This will make it possible to extract and analyze GADM data, on a more regular basis, to identify far more effectively any new industry trends, without having to wait for a complete review process.

4.4.3.1 Mapped and Grouped Results

Mapped and Grouped Results using the RRR values – Generation 4 Jet

GADM ADX Generation 4		EBT A&I Generation 4	
Grouped Total	**Training Topics**	**Grouped Total**	**Training Topics**
3.041	Compliance	7.820	Compliance
2.201	Manual Aircraft Control	3.939	Competencies non-technical (CRM)
1.274	Adverse weather	2.694	Manual Aircraft Control
1.188	Competencies non-technical (CRM)	1.912	Adverse weather
1.159	Windshear recovery	1.767	Aircraft system malfunction
0.840	Unstable Approach	1.477	Automation management
0.753	Approach, visibility close to minimum	1.274	Unstable Approach
0.434	Aircraft system malfunction	1.188	ATC

0.463	ATC	1.014	Approach, visibility close to minimum
0.377	Automation management	0.927	Error management
0.319	Workload, distraction, pressure	0.695	Windshear recovery
0.261	Fire and smoke management	0.521	Aircraft System management
0.232	Runway or taxiway conditions	0.492	Upset recovery
0.232	Engine failure	0.434	Workload, distraction, pressure
0.203	Terrain	0.203	Fire and smoke management
0.203	Upset recovery	0.203	Engine failure
0.145	Traffic	0.174	Terrain
0.116	Navigation	0.087	Managing loading, fuel, performance errors
0.116	Aircraft System management	0.058	Traffic
0.087	Managing loading, fuel, performance errors	0.029	Runway or taxiway conditions
0.058	Error management	0.029	Navigation

Mapped and Grouped Results using the RRR values – Generation 3 Jet

GADM ADX Generation 3		EBT A&I Generation 3	
Grouped Total	Training Topics	Grouped Total	Training Topics
5.631	Compliance	12.466	Compliance
4.250	Manual Aircraft Control	6.552	Competencies non-technical (CRM)
3.223	Adverse weather	4.993	Manual Aircraft Control
2.656	Competencies non-technical (CRM)	4.321	Adverse weather
2.585	Aircraft system malfunction	2.267	Unstable Approach
2.019	Workload, distraction, pressure	1.487	Windshear recovery
1.948	Approach, visibility close to minimum	1.346	Aircraft system malfunction
1.948	Unstable Approach	1.275	ATC
1.842	Windshear recovery	1.204	Upset recovery
1.133	runway or taxiway conditions	1.133	Approach, visibility close to minimum
1.098	ATC	1.133	Error management
0.885	Managing loading, fuel, performance errors	1.098	Automation management
0.815	Error management	0.921	Aircraft System management
0.815	Upset recovery	0.708	Traffic
0.673	Fire and smoke management	0.673	runway or taxiway conditions
0.637	Automation management	0.637	Terrain
0.354	Engine failure	0.637	Managing loading, fuel, performance errors
0.319	Aircraft System management	0.567	Fire and smoke management
0.283	Terrain	0.390	Workload, distraction, pressure
0.248	Traffic	0.354	Navigation

0.177	Navigation	0.319	Pilot incapacitation
0.071	Pilot incapacitation	0.106	Engine failure

The mapped and grouped results largely support the maintenance of the current training matrix and training frequency, for both generations 3 and 4 Jet aircraft. See Appendix 9 for the full set of results and analysis.

These results are then compared with the results of the other data sources, to identify if any change to the EBT curriculum may be required. They also serve to establish whether the current training topics frequencies are still relevant. For example: Manual Aircraft Control, Compliance, Competencies non-technical (CRM) and Adverse weather all appear in the top four rankings of the above results. This confirms the need to continue to train these topics with an A frequency.

Note: The mapping exercise contained some challenges, as the taxonomy of threats and errors and the EBT training topics are not completely aligned, as explained in Section 2. For example, the EBT SG did not map any threat or error against 'Monitoring and cross-checking' as this training topic was not considered as a 'standalone' topic for this revision, as it is embedded within multiple competencies, in their observable behaviors (OBs). The same with 'surprise', which was not considered as a standalone topic in this Amendment, but as something that should be interwoven throughout the EBT training modules.

Nevertheless, the comparison of the mapped and grouped results from the EBT A&I Study with those from the GADM ADX analysis provides further validation of the two data sources. It also provides a simple and rapid method of comparison between the results from the EBT A&I Study and the GADM ADX analysis and the current EBT training curriculum, which may also support the next stage of EBT data collection and analysis.

However, these results still needed to be validated against the other sources analyzed in this Amendment, and any inconsistency or anomaly with the current EBT training curriculum identified and investigated. This exercise was performed by the EBT SG, and the results are presented under Section 4.4.5.

4.4.4 Suggest improvements in the example scenarios

The EBT SG pointed to the fact that some of the current example scenario elements are now dated and that, in light of the developments in CBTA in the recent years, the example scenarios and competency mapping should be reviewed. They suggested that a process may be necessary to support and standardize the creation of new scenarios.

Approximately 50% of the EBT SG indicated that they use the scenarios provided in Doc 9995, the other 50% creates their own scenarios. After some analysis, it was established that this tended to be linked to the maturity of the operators' EBT program. The longer the operator has been running the program the more likely they are to have developed their own set of scenarios to support the delivery of the training topics.

As a result of this analysis, the EBT SG agreed that there is a need to provide the industry with a development process to facilitate the creation of new scenarios. Nevertheless, the EBT SG also provided several new scenarios to support the EBT curriculum, which can be found in Appendix 10. A more structured process to develop the scenarios will form part of the revision of the IATA EBT Implementation guide. This revision work is due to start in 2021.

4.4.5 Review the results from the other data sources

The consolidation process was conducted by the EBT SG and included a review of all the five data source results. The EBT SG was tasked with identifying any anomalies created from the results, which could indicate that the frequency by which a training topic is trained within the EBT curriculum may need to be changed. Below are their findings which highlighted the need to further investigate the frequencies of the following training topics:

- Terrain
- Windshear
- Runway and taxiway conditions

4.4.5.1 Terrain

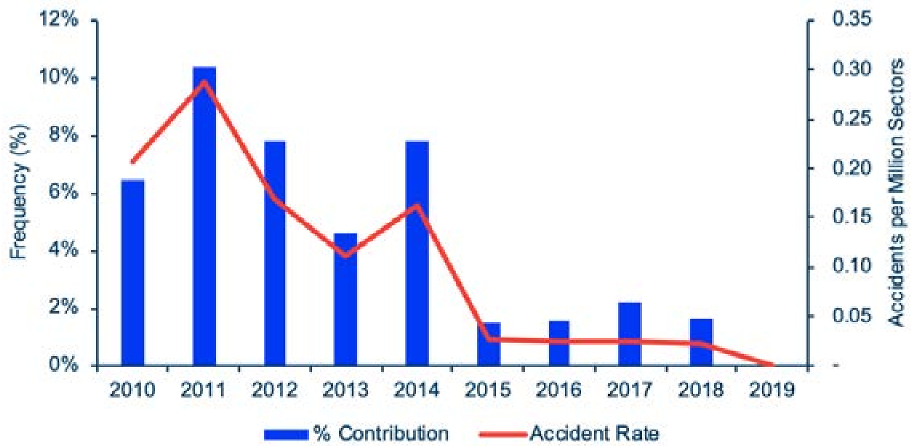
The IATA safety reports define 'Controlled Flight into Terrain' as: *In-flight collision with terrain, water or obstacle without indication of loss of control. Cases where an aircraft hits an obstacle (e.g., power lines) on final approach, performs a go-around and successfully lands will also count toward Controlled Flight into Terrain (CFIT).*

The results of the TCS-2020 (Section 4.3 above) indicated that pilots perceive 'terrain' as a high-risk threat, while the results of the EBT A&I Study and GADM ADX analysis results did not rank 'terrain' as such a high-risk threat. Therefore, these results needed to be further investigated.

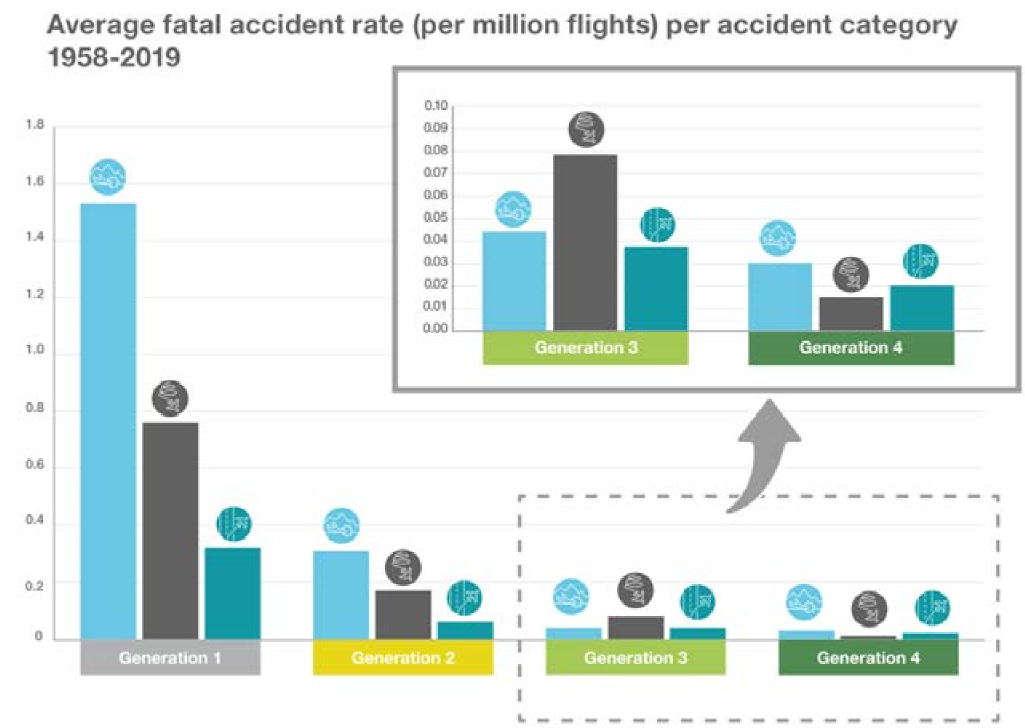
When the results from the TCS are taken in context with the feedback from the EBT SG and discussions with other industry SMEs, it becomes clearer why pilots attribute such high risk to terrain. Pilots are trained to constantly be 'terrain aware', which is linked to the Competency – Situation Awareness and Management of Information (SAW). Often added to this, is the complexity of the recovery manoeuvre, which would also explain why pilots perceive 'terrain' as such a high-risk threat.

Whilst terrain is, and will always be, a significant threat to flight safety, over the past ten years the number of events linked to CFIT has steadily reduced. This could be attributed to a combination of several factors such as improved inflight training and more robust onboard countermeasures.

The IATA Safety Report 2019 states that over the five-year period from 2015 to 2019, four CFIT accidents occurred, three of which were fatal, causing a total of 124 fatalities (75% of the CFIT accidents were on turboprop aircraft). In 2019, there were zero CFIT accidents. In 2018, there was one fatal CFIT accident, resulting in 66 fatalities. The graph below indicates the percentage of all accidents that were CFIT over the past 10 years.



Based on the above evidence, the EBT SG concluded that there is no need to increase the frequency of 'terrain' to an A frequency, as would be suggested by the results of the TCS. However, a review of the evidence by the EBT SG indicates that there is no clear difference between aircraft generations and therefore the EBT SG recommends that the frequency by which 'Terrain' is trained be increased from a frequency C to a frequency B for generation 3 Jet, bringing it in line with generation 4 Jet. This was further supported by data provided by Airbus in the table below.



4.4.5.2 Windshear

As stated in the IATA Safety Report 2019, Windshear (IATA Taxonomy Code E01.03 Gusty Wind/Windshear/Wake Turbulence) contributed to 21% of all accidents between 2015 and 2019.

The results of the EBT A&I Study, GADM ADX analysis and TCS ranking analysis, and the mapped and grouped results presented above, clearly corroborate the safety data presented in the Safety Report, as to the high risk that 'Windshear' poses to airline operations.

Whilst the industry is aware that the current FSTD fidelity may not be truly representative of the real world, training is seen as a significant way to mitigate this threat.

A review of the evidence also indicated that there is no clear difference between aircraft generations. Therefore, the EBT SG recommends that the frequency by which 'Windshear' is trained be increased from a frequency C to a frequency B for generation 4 Jet, bringing it in line with generation 3 Jet.

4.4.5.3 Runway and taxiway conditions

Whilst the RRR and the mapped and grouped results in this Amendment do not provide a definitive and clear indication of the severity of the risk associated with this threat, the studies and reports on runway and taxiway excursions, do provide some significant evidence into the severity of this threat.

Data provided by Airbus' also indicates that 80% of excursions are due to some form of runway contaminant, but that there may also be other factors that contribute to the excursion, such as cross winds, windshear, deterioration of visibility, FPM, etc. An important point to note is that the Airbus data does not seem to discriminate between generations 3 and 4 jet aircraft regarding runway or taxiway conditions.

The IATA Safety Reports 2019 states: *'Accidents related to runway excursions accounted for 25% of all accidents during the last five years (2015-2019), resulting in the second highest percentage of fatal accidents (11%) and 55 deaths. The Runway Excursion accident category represented 32% of all accidents in 2019 and included two fatal accidents with three fatalities.'*

A review of the evidence indicates that there is no clear difference between aircraft generations and therefore the EBT SG recommended that the frequency by which 'Runway and taxiway conditions' is trained be increased from a frequency C to a frequency B for generation 3 Jet, which brings it in line with generation 4 Jet.

The following summary presents a global overview on the various studies conducted by the EBT SG.

Summary of the EBT SG studies and associated results		
Section	**Study**	**Results**
4.4.1	To review the relevance of the current EBT training topics against their training data	• Produce and EBT/CBTA Overarching Principles section • Retitle 'Error management, mismanaged aircraft state and monitoring and cross-checking' • Integration / combination of certain training topics
4.4.2	To review the EBT training topics frequencies against their training data	Recommend frequency update for the following training topics: • UPRT • Traffic

Summary of the EBT SG studies and associated results		
Section	**Study**	**Results**
4.4.3	To perform a threats and errors mapping exercise	• Threats and errors mapped to the EBT training topics • Task completed but further development of the process recommended
4.4.4	To suggest improvements in the example scenarios	• Additional example scenarios provided in Appendix 10 • Provide recommendation for scenario development process in the IATA EBT Implementation guide
4.4.5	To review the results from all the data sources	Corroborate whether a change to the following training topics should be recommended: • Terrain • Windshear • Runway and taxiway conditions

4.5 Training Studies and Reports

The training studies and reports below, provided further information, evidence, and data to support the other safety, operational and training data sources analyzed in this Amendment. This section provides a brief extract of the studies or reports and the connection to the analyses of this Amendment and the EBT training curriculum.

4.5.1 Aircraft Handling and Manual Flying Skills (IATA 2020)

An analysis of the accident data conducted by IATA identified an increase in manual handling errors. To better understand the issues and why many pilots are reluctant or unable to practice manual flying, a survey was conducted by IATA on aircraft handling and manual flying skills in order to capture the pilots' subjective feedback on their airline's automation policies and manual flying practices during everyday line operations and during operator training.

The overall results of the survey from 5,650 respondents indicated that pilots consider manual handling critical to maintain the confidence and skills needed to control the aircraft in an abnormal situation. Some of the comments made by the respondents indicate that:

- Good manual flying skills remain essential to achieve safe line operations
- Manual flying skills need to be trained and maintained, irrespective of the aircraft generation
- Manual flying skills can be lost if they are not practiced on a regular basis
- Pilots should have the possibility to revert to basic hand flying when situation permit
- Pilots should be trained to revert to manual flying when automation fails or during an emergency
- Pilots need to maintain manual flying skills to a high degree of proficiency and must develop confidence in their ability to do so

As to the areas in which the pilot respondents feel less competent, as it relates to manual handling, the report indicates that most of the respondents feel less competent in the areas associated with handling failures affecting flight controls, as well as high speed/high altitude handling. Also, a large majority of the survey respondents, 91.90%, indicated that training should put more emphasis on the unexpected transition from automatic flight to manual flying, and vice versa.

It is interesting to note that a good number of respondents confirmed that they had never encountered unstable approaches due to manual handling in the last 5 years. According to the report, respondents do not make any direct link between manual flying and unstable approaches. The main contributing factors to unstable approaches remain unexperienced pilots, poor aircraft management, failure to appropriately monitor automation, late ATC clearances, etc.

The report also states that respondents recognize the need for more manual handling practice dedicated in simulator training and in line operations. Although the majority of the respondents indicated that training only in FSTD (including FFS) is not sufficient to enhance or compensate for the lack of manual flying, it is recognized that a combination of both FSTD and line flying is the best way to maintain manual flying skills, as certain things cannot be practiced in line. The simulator is a good tool to allow pilots to face situations they are unlikely to encounter in line operations and to enhance their competence in a safe, controlled environment.

The results of the EBT A&I Study indicated that 113 (61.5%) of the 184 reports analyzed, included an element of manual flying as contributive factor to the accident or incident.

The results of the 'Aircraft Handling and Manual Flying Skills' survey further support maintaining the A frequency of 'manual aircraft control', 'automation management', and 'unstable approaches' and 'go-around management' of the EBT curriculum.

The results of the Aircraft Handling and Manual Flying Skills survey also highlight the importance of training the pilots in manual handling at high flight levels. Therefore, manual handling at high altitudes should be included in the EBT example scenario elements and new scenarios developed.

4.5.2 Loss of Control In-Flight Accident Analysis Report (IATA 2019)

This report highlights the severity of the events following a LOC-I. The study, covering a 10-year period from 2009 through 2018, indicates that LOC-I resulted in more fatalities than any other accident category (2,462 of 4,075). It surpassed Controlled flight into Terrain (CFIT) and Runway Excursions as the leading cause of fatalities in commercial aviation accidents.

Currently UPRT is a frequency C topic in the EBT curriculum, but the risks associated with UPRT are significant. The current UPRT training program is extensive and requires the operator to include a considerable amount of practical and theoretical training to take place within a recurrent training program. To complete these requirements, the operator must integrate this training topic more frequently than every three years.

This study supports the data and the recommendation made by the EBT SG, in Section 4.4.2 above, to increase UPRT to a frequency B, which is also in alignment with the European EBT Regulation.

4.5.3 IATA Safety Reports 2014-2019

Each year IATA produces a Safety Report which highlights both the most prevalent accident categories and the most common threats and errors. The reports from 2014 to 2019 were used to corroborate the evidence from the other data sources in this Amendment.

The tables below highlight the results from 2014-2019, the first table per year and the second one per five-year periods (results in the IATA Safety Reports are often broken down into five-year periods).

Accident rate and top 3 accident categories

Year	Accident rate (per million sectors)	Accident Category	
		Fatal	Non-Fatal
2019	1.13	LOC-I	Runway Excursion
		Hard Landing	In-Flight damage
		Other	Gear-up landing
2018	1.35	LOC-I	Runway Excursion
		Runway Excursion	Ground damage
		CFIT	Gear-up landing
2017	1.08	CFIT	Runway Excursion
		LOC-I	In-Flight damage
		Undershoot	Ground damage

Top 3 Threats and Errors (Jet and Turboprop)

Year	Jet Aircraft		Turboprop Aircraft	
	Threats	Errors	Threats	Errors
2014 – 2019	Meteorology	Manual Handling	Meteorology	Manual Handling
	Aircraft Malfunction	SOP Adherence	Aircraft Malfunction	SOP Adherence
	Wind/Wind shear/Gusty wind	Callouts	Wind/Wind shear/Gusty wind	Callouts
2014 – 2018	Meteorology	Aircraft Malfunction	Aircraft Malfunction	Manual Handling
	Aircraft Malfunction	SOP Adherence	Meteorology	SOP Adherence
	Maintenance Events	Callouts	Wind/Wind shear/Gusty wind	Callouts
2013 – 2017	Meteorology	Aircraft Malfunction	Aircraft Malfunction	Manual Handling
	Aircraft Malfunction	SOP Adherence	Meteorology	SOP Adherence
	Maintenance Events	Callouts	Gear/Tire	Pilot-to-Pilot communication

The data in the reports indicates that LOC-I and CFIT have some of the highest number of fatalities each year but are relatively rare events. Globally, the IATA safety reports support the EBT SG recommendation to align the training frequency for UPRT for both generations 3 and 4 Jet, to a B frequency, and also the importance of developing scenarios that permit manual handling at high altitude (e.g., flight phase: cruise).

4.5.4 Unstable Approaches, Risk Mitigation Policies, Procedures and Best Practices, 3rd Edition (IATA / IFALPA / IFATCA / CANSO)

This is the third edition of this study and it continues to reflect the importance of stringent guidance, by way of SOPs, by the operator to the pilots. This guidance is not always followed, and effective reporting and monitoring needs to be put in place to ensure compliance.

The IATA/IFALPA/IFATCA/CANSO study states that of the 375 commercial aircraft accidents recorded in the IATA GADM Accident Database during the five-year period from 2012 to 2016, failure to go-around was a factor in 10% of the accidents. 230 accidents, or 61%, of the total accidents occurred during the approach-and-landing phase, of which 19 resulted in 376 fatalities.

There continues to be a number of accidents and incidents linked to runway excursion, overshoot or undershoot where a contributing error was the failure to execute a go-around. Between 2015 and 2019, unstable approaches accounted for 11% of all accidents, and the failure of the crew to perform a go-around 6%.

More recent data from the IATA GADM shows that of the 262 commercial aircraft accidents recorded in the GADM Accident Database (ADX) during the five-year period from 2016 to 2020, failure to go-around was a factor in 11% of accidents. 162 accidents, or 62%, occurred during the approach-and-landing phase, of which 17 of resulted in 264 fatalities.

This study corroborates the importance of maintaining ‘Unstable Approaches’ within an EBT program as a frequency A training topic, as is also supported by the EBT SG.

4.5.5 ICAO Safety Report – 2020

A breakdown of the five high-risk categories of occurrences (HRCs) in 2019 and the respective distribution of fatalities, fatal accidents and accidents are shown in Chart 14 below. Accidents related to runway excursion (RE) accounted for 14.9 per cent of all accidents in 2019 and included half of all fatal accidents with 44 fatalities. There was one fatal accident related to loss of control in-flight (LOC-I) that represented 16.7 per cent of the fatal accidents with 26 fatalities. There were no accidents related to controlled flight into terrain (CFIT), mid-air collision (MAC) and runway incursion (RI) in 2019. In addition, there were 80 HRCs of serious incidents reported by ICAO Member States as required by Annex 13 in 2019.

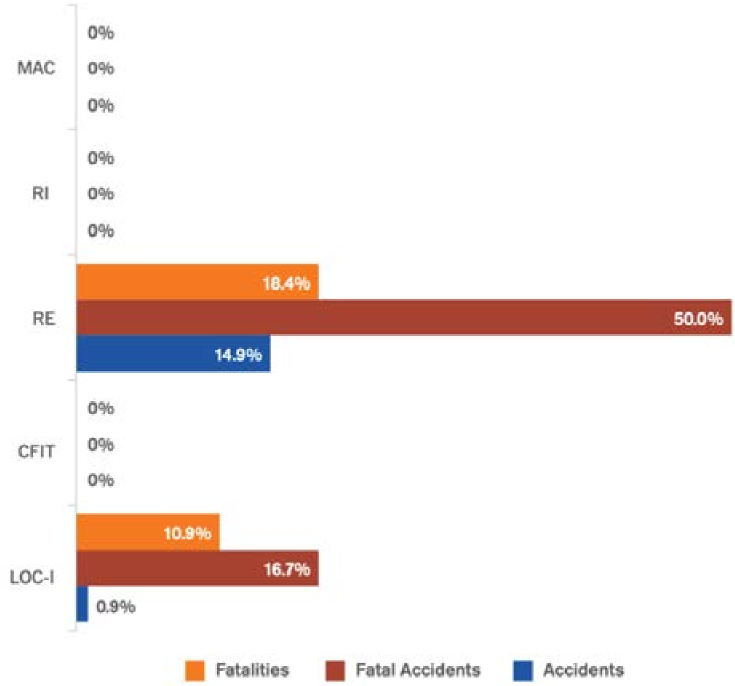


Chart 14. High-risk category accident overview

This data reflects the importance that the EBT curriculum should place on runway excursions, within the training topic – Runway and Taxiway conditions. The ICAO report supports the EBT SG recommendation to align the training topic 'Runway and taxiway conditions' as a B frequency for both generations 3 and 4 Jet.

4.5.6 ICAO Runway Safety Programme – Global Runway Safety Action Plan 2017

Since the 1st ICAO Global Runway Safety Symposium held in Montreal, Canada, in May 2011, ICAO and the Runway Safety Programme (RSP), the RSP partners have been working together to minimize and mitigate the risks of runway incursions, runway excursions and other events linked to runway safety.

In January 2017, the RSP partners established a Runway Safety Action Plan Working Group (RSAP-WG) with the aim to review the RSP achievements, objectives, and priorities, and to develop a global runway safety action plan to be unveiled at the 2nd Global Runway Safety Symposium in Lima, Peru, 20-22 November 2017. The objectives of the RSAP-WG included:

- Review runway related accident and serious incident data
- Conduct a safety risk assessment of runway safety accident occurrence categories
- Identify the runway safety risk priorities and high-risk accident categories
- Identify appropriate global mitigation actions
- Develop a Global Runway Safety Action Plan

Through a review and analysis of runway safety occurrence data and risk analysis, the RSAP-WG identified runway excursions and runway incursions as the main high-risk occurrence categories. This Global Runway Safety Action Plan provides recommended actions for all runway safety stakeholders, with the aim of reducing the global rate of runway excursions and runway incursions.

The report continues to highlight the threats and errors that occur during ground operations, which supports the need to include elements of runway and taxiway conditions within the EBT training curriculum. This may not necessarily be within the FSTD environment, but the pilots should be continually made aware of the need for vigilance, and that any significant threat identified at airfields needs to be communicated in an effective manner.

Globally, the ICAO action plan supports the EBT SG recommendation to align 'Runway and taxiway conditions' training topics as a B frequency for both generations 3 and 4 Jet.

4.5.7 IATA Runway Safety Accident Analysis 2010-2014

The report analyses accidents resulting in hull loss, or substantial damage, to all jet and turboprop aircraft greater than 5,700kg, from January 2010 to December 2014; a total of 415 accidents worldwide. Of these 415 accidents, 90 were classified as runway/taxiway excursions. These accidents are the primary focus of this report.

The graph below, extracted from the report, shows the percentage of accident categories in relation to the total number of accidents; runway/taxiway escursion, representing 22% of this total.

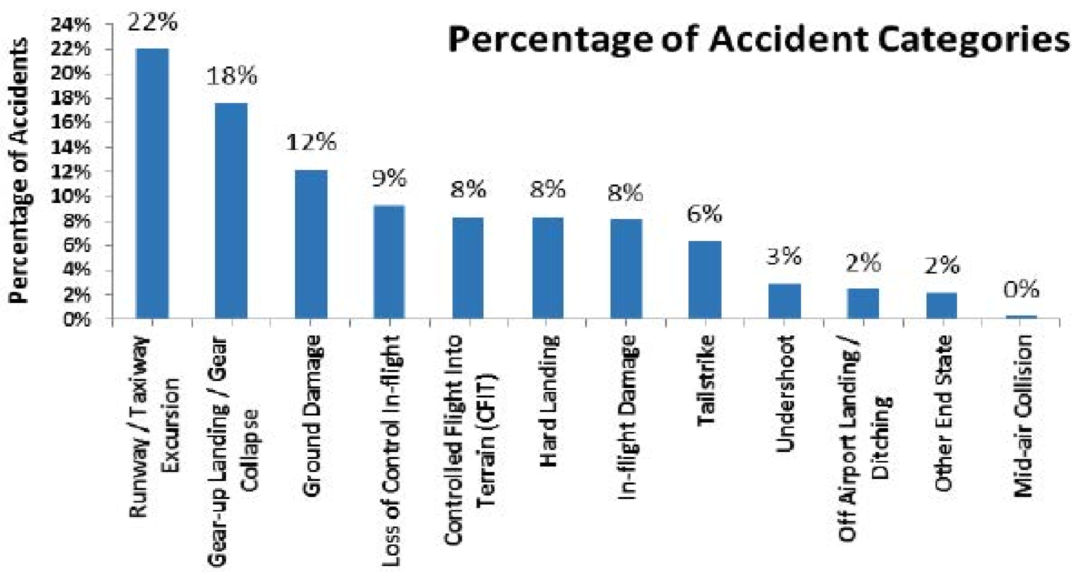


Figure 2: Percentage of Commercial Accident Categories in Relation to Total Accidents[1]

The study also shows that although runway excursion has the highest accident frequency, it has the lowest number of fatalities, as shown in the table below.

[1] Runway Safety Accident Analysis Report, 1st Edition, IATA, page 3

Accident Category	Number of Accidents	Fatal Accidents	Fatalities
Loss of Control In-flight (LOC-I)	38	37	1,242
Controlled Flight Into Terrain (CFIT)	34	31	707
Runway / Taxiway Excursion	90	5	174

Table 1: Top Three Fatal Accident Categories[2]

Runway Excursions, Loss of Control In-flight and Controlled Flight into Terrain are identified in this report as the top three high risk categories of accidents to be addressed by IATA.

Some of the data reported in this study indicates that:

- From 2010 to 2014, 159 accidents (or 39% of all commercial accidents) occurred in the runway environment. The most frequent type was runway excursion with 87 accidents (or 55% of all runway safety accident over that period).
- An average of 19.8 runway safety accidents per year involving jet aircraft, 15.6 of which occurred in the landing phase.
- Landing excursion occurrences outnumbered take-off excursion occurrences for both jet and turboprop aircraft.

The data identified a number of contributing factors to each of the runway excursion accident types, some relating to the preceding approach, others to the ground roll. On the approach, these included unstable approaches and the effect of wind, whilst on the ground they included insufficient runway remaining, runway contamination, late deployment of retardation devices or loss or aircraft control. The landing excursion risks where significantly increased when there was for example, aircraft malfunction, wind/windshear/gusty wind, poor visibility, continued landing after unstable approach, non-adherence to SOPs and deficient SOP cross-verification, etc.

The most common threats identified in the report as contributing factors to a runway safety accident were: meteorology, wind factor, airport facility, contaminated runway and poor braking action, ground based nav-aid malfunction and aircraft malfunction.

The most common errors identified in the report as contributing factors to a runway safety accident were: failure to adhere to SOPs, manual handling/flight controls and failure to go around after an unstable approach.

Although not examined in detail, because already addressed in other IATA safety documentation and guidance, there is a section dedicated to unstable approaches in the study; unstable approaches frequently being precursors to runway excursions. The report makes reference to another study that concluded that has many as 97% of unstable approaches recorded worldwide did not result in a go around.

The report states that the most robust operational mitigation against runway excursions, which constitute the majority of runway safety accidents, is effective recognition and decision making in respect to unstable approaches. If an approach

[2] Runway Safety Accident Analysis Report, 1st Edition, IATA, page 5

cannot be stabilized a go around must be performed, followed by a second stable approach or diversion to a more suitable runway.

The report concludes that the most common precursors to runway safety accidents were ineffective braking due to contaminated runways, gear malfunctions, unstable approaches, wet and contaminated runways in combination with gusts/strong/cross- or tailwinds, and late or ineffective deployment of retardation devices.

Globally, this IATA report supports the EBT SG recommendations to:

- maintain the 'Unstable approaches' training topic as an A frequency
- maintain the 'Adverse wind' training topic as a B frequency
- align 'Runway and taxiway conditions' as a B frequency training topic for both, generations 3 and 4 Jet

4.5.8 Performance Assessment of Pilot Compliance with Traffic Collision Avoidance System Advisories Using Flight Data Monitoring Guidance Material – 2nd Edition

Similar to the 1st Edition of the guidance material, this 2nd Edition has been prepared jointly by IATA and EUROCONTROL. It is designed to support the understanding of the Traffic Alert and Collision Avoidance System II (TCAS II), and to provide updated information and guidance on technical and operational issues applicable to TCAS Resolution Advisory (RA) in order to facilitate operational monitoring.

As stated in this guidance material, the risk of a mid-air collision is still present. When an RA is generated correct action must be taken promptly, any delayed or incorrect flight crew response negates the effectiveness of the RA, the crew's actions will be the most important single factor affecting the performance of the TCAS system. In some cases, pilots ignore RAs, or they respond in the opposite sense. The main reasons given for the noncompliance are proximity to the ground, presumed TCAS II malfunction, misinterpretation of RA alert, giving priority to ATC instruction or performing own avoidance maneuver (based on visual acquisition or own judgement). Inappropriate pilot responses severely impair TCAS's performance and increase the risk of a mid-air collision. The guidance recommends that operators ensure that their pilots receive, in addition to initial and recurrent classroom training, simulator training covering all the RAs and that their instructors select various RA scenarios on their simulators at any time during a simulator session.

This guidance material is in line with the EBT SG findings and supports the need for further investigation. Whilst it does highlight the fact that a number of TCAS events are mismanaged and the importance to train the pilots, it does not, however, provide any substantive evidence that increasing the training frequency will mitigate this threat, but it does support the need to improve the TCAS scenario within the FSTD and also for the instructor to include an element of surprise, when possible.

Therefore, the EBT SG recommends that AOCs continue to review their own safety data and increase the frequency by which this is trained within their own EBT programs, if they see evidence this will enhance the handling of TCAS events and improve safety.

4.5.9 IATA – Guidance Material for Improving Flight Crew Monitoring, 1st Edition

This manual serves as guidance material for AOCs to better understand the concept of monitoring, the flight crew monitoring functions and roles, and current practices for integrating monitoring knowledge and skills into flight training programs, such as ab-initio, conversion, upgrading, type rating and recurrent training. The manual provides practical guidance for defining pilot roles and responsibilities for monitoring during line operations, for training monitoring tasks and skills, and for instructors to properly teach monitoring.

The term monitoring, as used in this manual, is an overarching process requiring knowledge, skills and attitudes that enables flight crews to perform safely, effectively and efficiently. Monitoring includes the process of observing and creating a mental model, by seeking out available information to compare actual and expected aircraft state and is independent of assigned roles.

The manual states that analysis of accidents and incidents often show that better monitoring by the crew could have prevented them. Analyzing the root causes, determining where the monitoring process broke down and enhancing flight crew monitoring are critical to improve safety.

A review of the Observable Behaviors (OBs) of the pilot competencies, indicates that:

- Monitoring is embedded in six competencies (PRO, FPA, FPM, PSD, SAW and WLM) and appears in ten Observable Behaviors.

The guidance demonstrates how vitally important effective monitoring is and how monitoring is embedded in most of the pilot competencies, hence, supporting the EBT SG recommendation to reposition 'monitoring and cross-checking' outside of the training and assessment matrix, and to place them under the EBT/CBTA Overarching Principles section. This will ensure that 'monitoring and cross-checking' are trained and assessed throughout all the EBT modules sessions.

4.5.10 Flight Safety Foundation, Global Action Plan for the Prevention of Runway Excursions (2021)

Notwithstanding specific aviation risks in 2020 associated with the COVID-19 pandemic, the rate and number of runway excursions worldwide remained steady in the last decade. Data shows that the industry has reduced the rate of commercial aviation runway excursion accidents, but the absolute number of accidents and incidents and their severity still indicate a very high risk.

The report states that in a study of incident and accident data dedicated to this action plan process, IATA reported that between 2005 and the first half of 2019, 23 percent (283) of accidents in IATA's global accident database involved a runway excursion. This was the most frequent end state, followed by gear-up landing/gear collapse (15 percent) and ground damage (12 percent).

Managing the runway excursion risk is one of the best examples where different aviation segments cannot achieve success alone. Success in runway excursion risk and resilience management relies on a system of tightly coupled factors, and that system depends on a joint and coordinated effort of all the aviation players. The complexity of runway excursion prevention also comes from the fact that the effect of the risk and resilience factors is highly cumulative — runway condition maintenance and reporting, aircraft performance and operations, collaborative approach path management and adherence to robust policies for safe descent and approach planning, stabilized approach, safe landing and go-around are some examples.

The jointly owned risk requires joint solutions. This is why the industry came together, within a dedicated working group, to discuss and agree on the most important actions to address the runway excursion risk. The result is a list of recommendations that represent the industry's consensus on the best practices and intervention beyond simple regulatory compliance. The recommendations are mainly generic, and it will be up to the responsible organizations to decide specific details for possible implementation, after taking local conditions and specific context into account.

Addressing both the risk and the resilience factors has been a guiding principle of the working group that reviewed accident and incident data, single scenarios and best practices, and suggestions on risk and resilience management.

The recommendations provided in the report are the result of the combined and sustained efforts of organizations representing all segments of aviation. These organizations include, but are not limited to, aerodrome operators, air navigation service providers, aircraft operators, aircraft manufacturers, R&D organizations, regulators, international organizations, and associations.

Globally, the FSF Action Plan for the Prevention of Runway Excursions supports the recommendation of the EBT SG to align the frequency of the training topic 'Runway and taxiway conditions' to a B frequency for both, generations 3 and 4 Jet; the frequency of 'Runway and taxiway conditions' currently being a frequency C for generation 3 Jet in the current EBT curriculum.

Section 5—Recommendations

This section provides recommendations regarding the two main objectives of the EBT Data Report, 1st edition, update initiative, which were, first to establish whether there is a need to recommend changes or modifications to the EBT curriculum as published in ICAO Doc 9995, Manual of Evidence-based Training. Second, to propose a way forward to enhance the applicability and the sustainability of the EBT Data Report, which should facilitate the maintenance of the EBT curriculum over time.

5.1 Recommendations related to the EBT curriculum

The table provided below presents the recommended Assessment and Training Matrix for generations 3 and 4 Jet, considering the analysis of the results presented in Section 4.

As the largest part of the data collected and analyzed for this Amendment is from generations 3 and 4 Jet aircraft, this Amendment only makes recommendations related to these two aircraft generations. Significant data was available and analyzed from all generations for the EBT Data Report, 1st Edition, and there is no evidence to indicate that those results and conclusions are no longer valid and relevant regarding the other generations of aircraft.

However, the section below related to 'EBT/CBTA Overarching Principles' is relevant to all Generations of aircraft. Whilst this Amendment does not recommend any changes to the training frequencies or any training topics for Generation 2 and 3 turboprop or Generation 2 Jet, the EBT SG recommends that the EBT/CBTA Overarching Principles be applied. See section 5.1.4 for the full training matrix.

5.1.1 EBT/CBTA Overarching Principles

Based on the evolution of competency-based training and assessment since the publication of ICAO Doc 9995 in 2013, and the analyses of the different data sources used in this Amendment, the EBT SG recommended moving six topics from the Assessment and Training Matrix and placing them under an EBT/CBTA Overarching Principles section, as reflected in the table below. As explained in Section 4, these topics are embedded in the Observable Behaviors of the pilot competencies and should be an integral part of all EBT modules, not standalone training topics.

5.1.2 Frequencies

Regarding the frequencies of the EBT training topics, based on the evidenced collected and analyzed, the EBT SG recommends changing the frequencies of the following four topics:

- UPRT from C → B for both, generations 3 and 4 Jet
- Terrain from C → B for generation 3 Jet
- Windshear from C → B for generation 4 Jet
- Runway and taxiway conditions from C → B for generation 3 Jet

5.1.3 Example scenarios

The developments in CBTA in the recent years have also led the EBT SG to recommend the revision of the example scenarios provided in Doc 9995, as some of them are now dated. To this effect, some new example scenarios have been provided by the EBT SG. These can be found in Appendix 10 in this Amendment. The EBT SG also highlighted the need to provide the industry with a development process to facilitate the creation of their own scenarios. Therefore, a more structured process to develop scenarios will form part of the revision of the IATA EBT Implementation Guide. This revision work is due to start in 2021.

5.1.4 Recommended Recurrent Assessment and Training Matrix

The table below provides the recommended Recurrent Assessment and Training Matrix for generations 3 and 4 Jet.

Generations 3 & 4 Jet Training Topics

EBT/CBTA Overarching Principles (A frequency)

- ↗ Pilot Competencies
- ↗ Compliance
- ↗ Monitoring and cross-checking
- ↗ Surprise
- ↗ Workload, distraction, pressure
- ↗ Aircraft system management

A	B	C
Adverse weather	Adverse wind	ATC
Automation management	Aircraft system malfunction	Engine failure
Go-Around management	Approach, visibility close to minimum	Fire and smoke management
Manual aircraft control	Landing	Managing loading, fuel, performance errors
Error management, mismanaged aircraft state	Runway or taxiway condition	Navigation
Unstable approach	Terrain	Pilot incapacitation
	UPRT	Traffic
	Windshear recovery	*Operations or type specific

* Should be distributed across the EBT modules of the triannual plan.

5.1.5 Overview of studies conducted and related references

The table below is a consolidation of the studies performed by the EBT SG, which have led to the recommendations in this Amendment, and the references to the studies and analyses that support the recommended changes.

Study	Recommended Changes	References
Review of the current EBT curriculum	Repositioning the following training topics from the training matrix into an 'EBT/CBTA Overarching Principles' Section • Aircraft system management • Competencies non-technical (CRM), and also renamed 'Pilot Competencies' to include all nine pilot competencies • Compliance • Monitoring and cross-checking • Surprise • Workload, distraction, pressure	**Primary:** • EBT SG
Review of the current EBT curriculum	Re-title the training topic 'Error management, mismanaged aircraft state and monitoring and cross-checking' to 'Error management, mismanaged aircraft state' and therefore remove the need for this to be complete purely by ISI. Also reposition 'monitoring and cross-checking'; under the EBT/CBT Overarching Principles section.	**Primary:** • European regulation (Explanatory Note to Decision 2021/002/R) **Supporting:** • EBT SG
Review of the current EBT curriculum	Integration of the training topic 'Loss of communications' into the training topic 'ATC' as an example scenario.	**Primary:** • EBT SG **Supporting:** • EBT A&I Study • GADM ADX analysis
Review of the training frequency of each training topic	Change the following training topic frequencies: • Upset recovery, renamed UPRT – B Frequency – Gen 3 & 4 Jets • Terrain – B Frequency • Windshear – B Frequency – Gen 4 Jet • Runway or taxiway conditions – B Frequency – Gen 3 Jet **Note:** The latest data indicates that there is no significant difference between generations 3 and 4 Jet. These recommendations would align both matrixes.	**Primary:** • EBT A&I Study • GADM ADX analysis **Supporting** • TCS • EBT SG • Aircraft Handling and Manual Flying Skills Survey Report (IATA 2020) • Loss of Control In-Flight Accident Analysis Report (IATA 2019) • IATA Safety Reports 2010–2019 • ICAO Runway Safety Programme – Global Runway Safety Action Plan, 1st Edition, November 2017
Suggest improvements in the example scenarios	Some further example scenario elements can be found in Appendix 10	**Primary:** • EBT SG

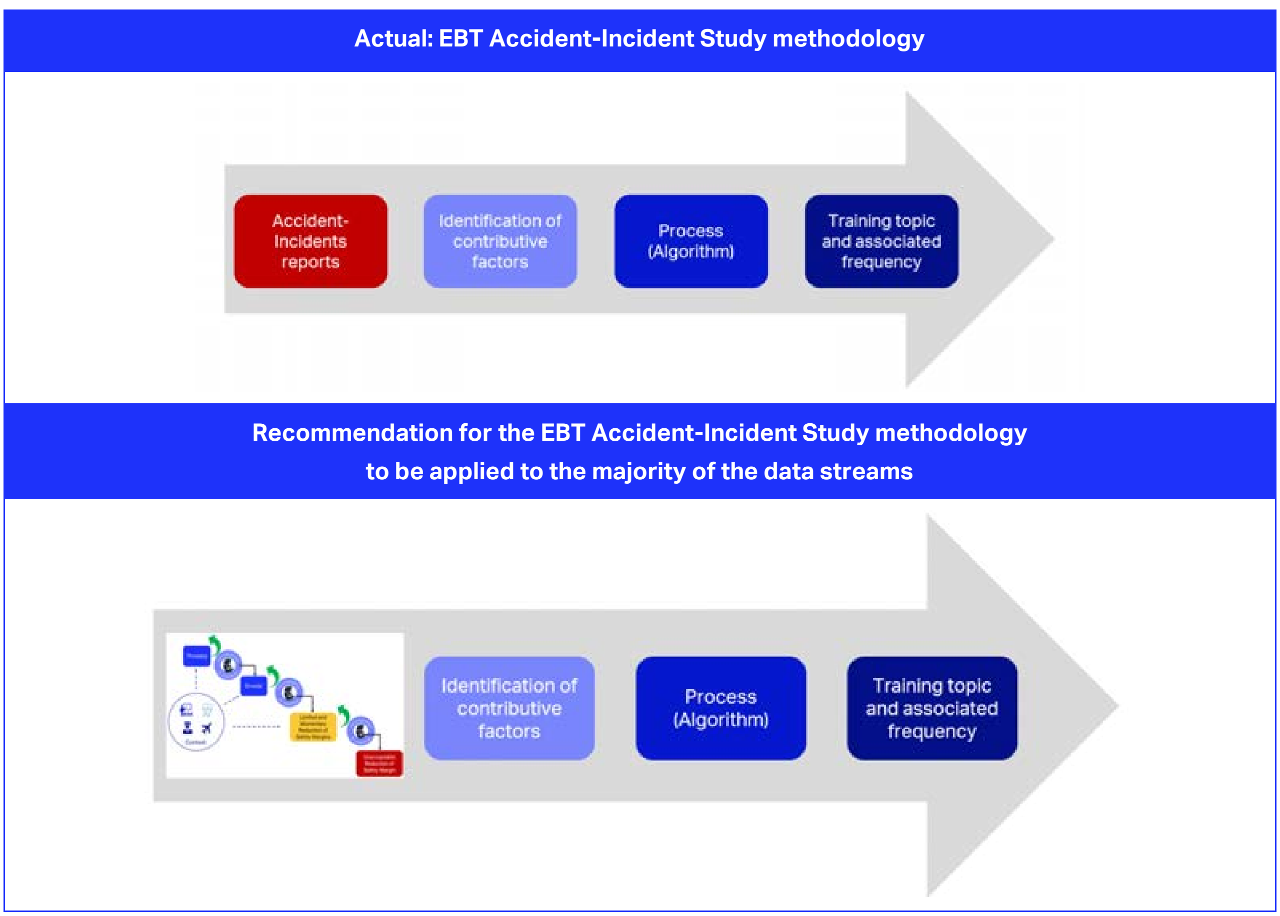
5.2 Recommendations related to the EBT Data Report update process

5.2.1 The IATA EBT Accident and Incident Study methodology to be expanded to other data sources

This Amendment provided an opportunity to start applying the methodology of the EBT A&I Study - Stage 2 to the GADM ADX data, and to afterwards perform a correlation between the results of the two data sources. This correlation permitted to ensure the quality and validity of the results of both data sources. Beyond those quality assurance aspects, the experience has demonstrated that the EBT A&I Study stages 1 and 2 are applicable to other data streams as long as compatible taxonomies are used.

Therefore, the IATA EBT Subgroup recommends extending the EBT A&I Study analysis methodology to lower consequence events such as the reduction of safety margins events captured via mandatory occurrence reporting. As an example, this methodology could also apply to LOSA observations and to Simulator Operations Quality Assurance (SOQA) data.

The extension of the EBT A&I Study methodology to the majority of the safety and training data sources should permit a continuous and more robust update of the EBT curriculum by analyzing, via a statistical methodology, large volumes of worldwide safety and training data.



5.2.2 Taxonomy alignment

Safety data has been categorized using taxonomies and supporting definitions so that the data can be captured and stored using meaningful terms. Common taxonomies and definitions establish a standard language that improve the quality of information and communication. The aviation community's capacity to focus on safety issues is greatly enhanced by sharing a common language that facilitates information sharing.

There are several common industry aviation taxonomies. Some examples include:

- ISIT (IATA Safety Incident Taxonomy): An occurrence category taxonomy that is part of IATA's accident and incident reporting system. ISIT sustains the IATA Global Aviation Data Management (GADM) program which is the world's most diverse aviation data exchange program. Data captured in GADM databases comprise accident and incident reports, ground damage occurrences and flight data from more than 470 different industry participants.
- ADREP (Accident/Incident Data Reporting) Taxonomy: An occurrence category taxonomy that is part of ICAO's accident and incident reporting system. It is a compilation of attributes and the related values that allow safety trend analysis on these categories.
- Commercial Aviation Safety Team (CAST)/International Civil Aviation Organization (ICAO) Common Taxonomy Team (CICTT): Task supported by IATA to develop common taxonomies and definitions for aircraft accident and incident reporting systems.

The safety taxonomies are generally sufficiently detailed but, unfortunately, safety taxonomies are not always consistent between databases. In which case, a data mapping should be used to standardize safety data and safety information based on equivalency.

The safety taxonomies are generally organized around generic components that allow the user to capture the nature of the contributive factors, the undesired aircraft state (UAS), and the end states, with a view to aid the identification, analysis, and coding. As an example, the generic components of the IATA Accident Classification Taxonomy are the latent conditions, the threats, the errors, the Undesired Aircraft State, the end states, and the flight crew countermeasures.

As elaborated in Section 2, the training metrics relate directly to threat and error management, recognition and recovery of the potential reductions of safety margins that may have happened during training or evaluation. Therefore, the generic components of the training data taxonomy should be similar to the safety data taxonomy, and these two taxonomies should merge whenever the taxonomy content satisfies both safety and training interests.

Hence, safety data should align with training data taxonomy in regard to flight crew countermeasures by adopting the pilot and instructor competencies. This step should be easy to achieve and could be supported by the standardization (2-hour computer-based training) provided by IATA Training and Licensing to the EBT Accident-Incident Study analysts.

Therefore, the training data should align with the safety data taxonomy in regard to threats, errors, undesired aircraft states and end states codification, while safety taxonomy should align with training data taxonomy in regard to the flight crew countermeasures codification represented by the pilot and instructor competencies' observables behaviors.

The template below illustrates, in a practical way, the integration of an extract of safety data taxonomy to collect the level 3 (TEM metrics) grading metric mandated by the EBT European regulation. As the training metrics are mainly captured by the instructors/evaluators in the training or operational dynamic environment, a simple transfer of the safety taxonomy within the training metrics would not be a reasonable solution.

It should be possible for ATOs and AOCs to adapt the level of granularity and to select the relevant taxonomy elements to be collected by each organization during operations and training.

Example of grading metrics mandated by the Evidence-Based Training European Regulation
Level 0 (competent metrics): The information whether the pilot(s) is (are) competent or not.
Level 1 (competency metrics): Level of performance reflected by numeric grade of the competencies (e.g. 1 to 5).
Level 2 (observable behavior metrics): the instructors record OBs predetermined or required by the organization (Regulatory or Policy requirements).
Level 3 (TEM metrics): the instructor records threats, errors or reduction of safety margin predetermined or required by the organization. Example of threats, errors, and reduction of safety margins extracts from safety taxonomy that the ATO/ AOC could define as relevant to be collected during a training or evaluation event. **1. Phase of Flight:** GND, TO, CLB, CRZ, DES, APP, LDG, GA **2. Threats or EBT Training Topics** [TT01 Adverse Weather, TT02 Adverse wind, TT03 System malfunctions…TT18 Workload, distraction, pressure] **E – Environmental Threats** **E01 Meteorology** E01.01 Thunderstorm E01.02 Poor Visibility/IMC E01.03 Gusty wind/ windshear E01.04 Icing conditions … **A – Airline Threats** **A01 Aircraft Malfunction** A01.01 Uncontained engine failure A01.02 Contained engine failure (incl overheat and prop fail) A01.03 Landing gear/ tires … **3. Errors** **H – Aircraft Handling Errors** H01 Manual handling/Flight Controls H02 Ground Navigation (Surface nav) H03 Automation (settings/selections) H04 **P – Procedural Errors** **P01 SOP adherence/ cross-verification**

P01.01 Intentional
P01.02 Unintentional
…

4.Reduction of safety margins
U – Aircraft Handling
U01 Abrupt Aircraft Control
U02 Vertical, Lateral or Speed Deviations
U03 Unnecessary Weather Penetration
U04 Unauthorized Airspace Penetration
U05 Operation Outside Aircraft Limitations U06 Unstable Approach
U07 Continued Landing after Unstable Approach

Summary:

Solution for the Alignment of Safety and Training Data Taxonomies	
Safety Taxonomy	**Training Taxonomy**
Threats & Errors	Training topic
Undesired Aircraft State & End State	Reductions of Safety Margins
Flight Crew Countermeasures	Pilot & Instructor Competencies (Annex 11 and Annex 12)

5.2.3 Training data repository and protection

As training data is part of the safety data within the safety management system, the protection requirements that apply to safety should be, de facto, applicable to the training data.

The objective of protecting training data is to ensure its continued availability, with a view to maintain or improve aviation safety by continuously enhancing pilots' and instructors' performance and further developing the training system. In this context, the importance of implementing protections cannot be overstated.

The protections are not intended to relieve sources of their safety related obligations or interfere with the proper administration of justice. Certain types of safety data and safety information that are protected under Annex 19 may, in certain circumstances are subject to other protection requirements. For example, Annex 19 specifies that when an investigation under Annex 13 has been instituted, accident and incident investigation records listed in Annex 13 are subject to the protections accorded in Annex 13, not those in Annex 19.

Even though there are a lot of similarities between safety and training in regard to the protection protocols, training data management is specific, as the States, the organizations, the pilots and the instructors have a particular interest in using it at the individual level.

To illustrate in a practical way the need to have access to training data at the individual level, let us have a look at the EBT program; that is, an operator's recurrent training program composed of six EBT modules across a three-year period (two EBT modules per year). It is to be noted that the EBT program permits the compliance with ICAO standards related to the license revalidation (Annex 1) and the pilot proficiency checks (Annex 6).

Each EBT module is clustered in three phases:

- The evaluation phase comprises a line-orientated flight scenario (or scenarios) to assess all competencies and **identify individual training needs**
- The manoeuvres training phase, comprising training to proficiency in certain defined manoeuvres
- The scenario-based training phase, comprising a line-orientated flight scenario (or scenarios) to develop competencies and **address individual training needs.**

To address the individual training needs during the scenario-based training phase in regard to the evaluation phase, there is an obvious individual pilot training data transmission between the evaluation and scenario-based training phases that should be managed in a controlled environment.

From a broader EBT perspective, the individual training data also supports the tailored training across the six EBT modules within the three-year program.

This example related to EBT provides the rationale for the need to access to individual training data:

- From a pilot's perspective: to get access to training tailored to his needs
- From an instructor's perspective: to deliver adapted training to the individual pilot's needs
- From an operator perspective: to adapt the training sessions to the individual's needs when necessary and to implement the instructor concordance assurance program (ICAP)
- From a State perspective: to access individual training records when necessary (license revalidation aspects) and perform oversight of the EBT training program to include the ICAP

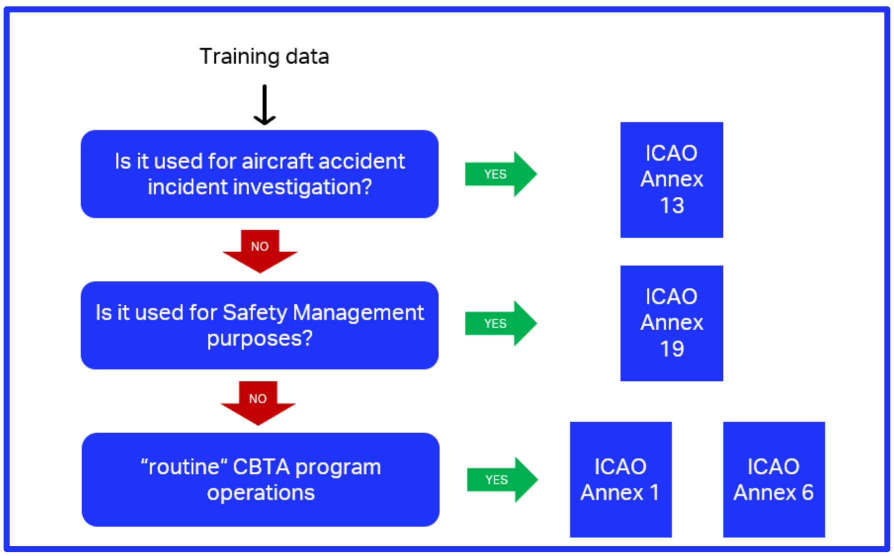
Beyond EBT, which is an operator CBTA recurrent training example, CBTA expansion for all licensing and operator implies the use of individual training data from the early stages of the pilot's career path, during the selection process (Pilot Aptitude Testing), during the initial and advanced licensing training, and during the operator training.

The benefits of CBTA are consequential to proper training data collection and analysis from a worldwide and regional perspective (e.g., EBT Data Report), from an organizational perspective (operator's pilot fleet specific population), but also from an individual perspective (tailored training to pilot or instructor needs).

Hence, CBTA training data should always be protected and used in a de-identify format for global safety management while some protocols should permit to use individual pilot data in the interest of the 'routine' CBTA program operations. 'Routine' CBTA program operations refer to CBTA program delivery and monitoring by an ATO/AOC and oversight by the CAA.

Therefore, the newly reconstituted ICAO Personnel Training and Licensing Panel should address this challenge and propose new standards levels in Annex 1 and Annex 6 for the protection of the CBTA training data in the context of 'routine' CBTA program operations, and their interrelation with Annex 13 and Annex 19 data protection standards should be clarified.

The following schematic provides general guidelines regarding the interaction between the protective frameworks in Annexes 1, 6, 13 and 19, and is meant to be used in consultation with the applicable provisions.



Additionally, the volume, the value, and the sensitivity of the upcoming CBTA training data will necessitate the creation of a new safe data repository that should permit to take advantage of it from a global safety perspective. As an example, the continuous updating of the EBT Data Report would be possible only if there is a common repository to collect the safety and training data of several operators. The training data repository(ies) should also be beneficial to ensure license recognition and global safety levels.

Summary:

Recommendation for the training data repository and protection
• ICAO Personnel Training and Licensing Panel to define the training data protection protocols
• Consider options for international training data repository setup and access

Appendix 1 – Aircraft Generation

Within the IATA ADX system, there is now data and analysis from a far larger range of aircraft types. For completion's sake and the continued expansion of the analysis process, these new types are now included in this Amendment.

Reference – EASA AMC1.ORO.FC.232

Aircraft Generation	Definition	Types
Generation 4 — Jet	From 1988. • EFIS cockpit — FMS equipped • FADEC • Fly-by-wire control systems • Advanced flight envelope protection • Integrated auto flight control system — navigation • performance, and terrain avoidance systems • Generation fatal accident average rate: 0,1/million flights	A318/A319/A320/A321 (including neo), A330, A340-200/300, A340-500/600, B777, A380, B787, A350, Bombardier C Series (A220), Embraer E170/E175/E190/E195, Tupolev Tu-134, Sukhoi Superjet 100-95
Generation 3 — Jet	From 1969 • EFIS cockpit — FMS equipped • FADEC • Integrated auto flight control system — navigation • performance, and terrain avoidance systems • Basic flight envelope protection — stick shaker/pusher • Generation fatal accident average rate: 0,2/million flights	A310/A300-600, B737-300/400/500, B737-600/700/800 (NG), B737 MAX, B757, B767, B747-400, B747-8, B717, BAE 146, MD11, MD80, MD90, 70, F100, Bombardier CRJ Series, Embraer ERJ 135/145 Avro RJ85/RJ100, Fairchild Dornier 328JET, Tupolev Tu-204 / Tu-214 Passenger, Canadair (Bombardier) CL-600 / 601 / 604 / 605 Challenger, Hawker 750/800/800XP/800SP, Ilyushin Il-96 Passenger
Generation 3 — Turboprop	From 1992 • EFIS cockpit — FMS equipped • EEC/ECU or higher engine control • Integrated auto flight control system • navigation • performance and terrain avoidance systems • Basic flight envelope protection — stick shaker/pusher	ATR 42-600, ATR 72-600, Bombardier Dash 8-400, BAE ATP, Saab 2000 Hawker Beechcraft 1900C Airliner, Fairchild Dornier 228, Hawker Beechcraft 1900D Airliner, Fairchild Dornier 328-100,
Generation 2 — Jet	From 1964. • Integrated auto-flight system. • EEC/ECU or higher engine control • Analogue/CRT instrument display	A300 (except A300-600), BAC111, Concorde, B727, B737-100/200, B747-100/200/300, DC9, DC10, F28, L1011 Tupolev Tu-154, Ilyushin Il-76, Tupolev Tu-134, Antonov An-72 / An-74, Ilyushin Il-62, Yakovlev

Aircraft Generation	Definition	Types
	• Basic flight envelope protection — stick shaker/pusher • Generation fatal accident average rate: 0,7/million flights	Yak-40, Yakovlev Yak-42 / Yak-142, Antonov An-124 Ruslan
Generation 2 — Turboprop	From 1964 • Analogue/CRT instrument display • EEC/ECU • Basic flight envelope protection — stick shaker/pusher • Integrated auto flight control system	ATR 42, ATR 72 (all series except - 600), BAE J-41, Fokker F27/50, Bombardier Dash 7 and Dash 8-100/200/300 Series, Convair 580- 600 Series, Shorts 330 and 360, Saab 340, Embraer 120 Fairchild (Swearingen) SA26 / SA226 / SA227 Merlin / Metro / Expediter Pass, Aircraft Industries (LET) 410 Passenger, Antonov An-28 / PZL Mielec M-28 Skytruck, BAE Systems Jetstream 31/32, Antonov An-30/32/38, BAE Systems (Hawker Siddeley) 748 / Andover, CASA / IAe 212 Aviocar, Fairchild (Swearingen) SA226 Freighter, Antonov An-140, Embraer 110 Bandeirante, Xian Yunshuji Y7
Generation 1 — Jet	From 1952 First commercial jets. • Manual engine control Analogue instrument display • Not integrated auto flight control system • Basic flight envelope protection — stick shaker/pusher, attitude warning • Generation fatal accident average rate: 3.0/million flights	DC8, B707

Appendix 2 – Guidance for analysts

Accident/Incident Analysis

THE ANALYST'S SUITCASE

In the package that you have received, please ensure that you have:

- The Amsterdam report
- The tutorials (standardization and case study)
- The excel spreadsheet (links to the reports)
- The PDF files of the reports
- The link to the Analyst Tool

Start by reading this guidance, the Amsterdam report pages 13-22 and 39-46, and then complete the tutorials. The methodology for the accident and incident report analysis is explained in section 4 of this guidance.

1. CONTEXT

The accident/incident analysis is a component of the EBT data report.

The EBT data report is the basis of the EBT curriculum endorsed by ICAO in 2013, with the publication of ICAO Doc 9995.

The following investigation bodies have contributed to the accident/incident reports that you will be analyzing: NTSB, ATSB, TSB, BEA and EASA safety department.

2. OBJECTIVE

The objective of this document is to provide you with relevant information to perform your analysis.

This guidance contains the principles and the key elements of the standardization training, therefore, it is the reference when performing your analysis or when using the Analyst Tool.

3. PRE-REQUISITES

3.1 Type-Rating

3.1.1 To be an analyst in this study, you must be an instructor currently or previously type-rated on the aircraft type involved in the accident/incident report.

3.1.2 If you do not comply with 3.1.1, you must at least be an instructor currently or previously type-rated on the aircraft generation involved in the accident/incident report.

3.2 Standardization training

3.2.1 The reading of this guidance must be done before starting the standardization training.

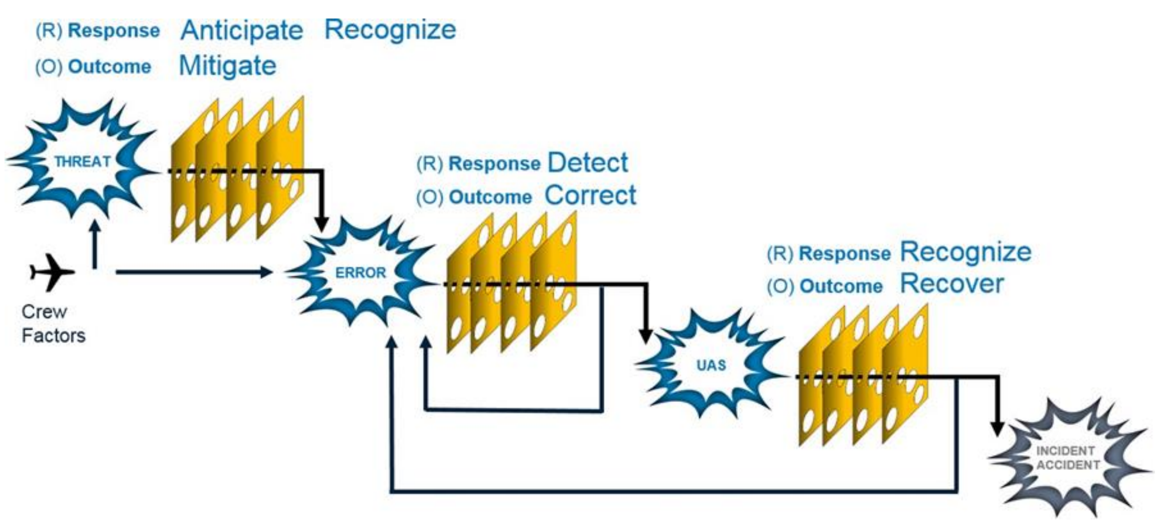
3.2.2 You must have completed the standardization training, including the case study, before starting the analysis of the accident/incident reports.

3.3 Threat and Error Management (TEM) Model and Pilot Competencies

The TEM model and the role of the pilot competencies, as individual and team countermeasures, are fully explained and illustrated during the standardization training.

We provide here an illustration of the model as a reference for your analysis.

TEM Model



METHODOLOGY

3.4 Reliability Principle

Each report has to be analyzed by a team of 3 analysts to maximize the reliability and objectivity of the analysis.

3.5 Analysis Methodology

3.5.1 Each analyst reads and analyses the report individually.

3.5.2 The 3 analysts meet.

3.5.3 When the 3 analysts meet, there are 2 possible scenarios:

Scenario A) The 3 analysts agree on the report analysis.

A.1) The 3 analysts insert the agreed analysis results into the Analyst Tool.

Caution: The 3 analysts must submit in the Tool only 1 analysis per report.

A.2) In the excel spreadsheet, write the names of the 3 analysts.

Scenario B) The 3 analysts do not agree on the report analysis.

B.1) The 3 analysts must submit via email the following content to the IATA Reconciliation Team at Training_Licensing@IATA.org:

- Date of accident or incident
- Report source
- Report reference number
- Details of the analysis agreements and disagreements (threats, errors, competencies, training effect, etc.)
- The 3 analysts names and email addresses

Note: The Reconciliation Team will perform an analysis of their own and assess the 3 analysts' results. The Reconciliation Team will conclude on the final analysis results and submit them in the Analyst Tool.

B.2) In the excel spreadsheet, write the names of the 3 analysts, and mark the Reconciliator column with an X.

Once all the reports have been analyzed, send the completed excel spreadsheet to IATA at Training_Licensing@IATA.org.

4. ANALYST TOOL

The following tables provide more details to facilitate the analysis and the associated data collection into the Tool.

In case of doubt on how to answer, contact Training_Licensing@IATA.org

ACCIDENT/INCIDENT IDENTIFICATION
EVENT DATE: Use format MM/DD/YY Use the date of the occurrence, not the date report issuance date.
REPORT SOURCE: Insert the name of the investigation body. For example: NTSB, TSB, BEA, etc. **REFERENCE NUMBER:** As indicated in the report.
SEVERITY: Fatal accident Non-fatal accident (Injuries, damage) Incident (including serious incident)
PHASE OF FLIGHT:

You should fill out the phase of flight from the information in the report. Use the initial phase of flight when the event occurs over several phases.

TXO=Pre-Flight and Taxi-Out (Flight preparation to completion of line-up)

TO=Take-Off (from the application of take-off thrust until the completion of flap and slat retraction) CLB=Climb (from the completion of flap and slat retraction until the top of climb)

CRZ=Cruise (from top of climb until top of descent)

DES=Descent (from top of descent until the earlier of first slat/flap extension or crossing the initial approach fix)

APP=Approach (from the earlier of first slat/flap extension or crossing the initial approach fix until 15m (50ft) AAL, including go-around)

LND=Land (from 15m (50ft) AAL until reaching taxi speed)

TXI=Post-Flight and Taxi-In (from reaching taxi speed until engine shutdown)

AIRCRAFT GENERATION:

Select the generation of aircraft.

Generation 4 Jet

A318/A319/A320/A321 (including neo), A330, A340-200/300, A340-500/600, B777, A380, B787, A350, Bombardier C Series, Embraer E170/E175/E190/E195

ACCIDENT/INCIDENT IDENTIFICATION

Generation 3 Jet

A310/A300-600, B737-300/400/500, B737-600/700/800 (NG), B737 MAX, B757, B767, B747-400, B747-8, B717, BAE 146, MD11, MD80, MD90, F70, F100, Bombardier CRJ Series, Embraer ERJ 135/145

Generation 3 Turboprop

ATR 42-600, ATR 72-600, Bombardier Dash 8-400, BAE ATP, Embraer 120, Saab 2000

Generation 2 Jet

A300 (except A300-600), BAC111, B727, B737-100/200, B747-100/200/300, DC9, DC10, F28, L1011

Generation 2 Turboprop

ATR 42, ATR 72 (all series except -600), BAE J-41, Fokker F27/50, Bombardier Dash 7 and Dash 8-100/200/300 Series, Convair 580-600 Series, Shorts 330 and 360, Saab 340

Generation 1 Jet

DC8, B707

AIRCRAFT TYPE:

Use the drop-down menu.

Use OTHER if it is not listed.

We ask to confirm the aircraft type to provide more granularity compared to the aircraft generation.

REGION OF THE WORLD:

Select the location where the accident/incident occurred.

See details in the Appendix if you have doubts about the region.

NAM: North America

LATAM/CAR: Latin America and the Caribbean EUR: Europe

AFI: Africa MENA: Middle East and North Africa CIS: Commonwealth of Independent States NASIA: North Asia ASPAC: Asia Pacific

*IATA Threats and Errors Taxonomy (See Appendix 3 in this Amendment)

*Pilot competencies (See Appendix 11 in this Amendment)

TRAINING EFFECT
Training effect is considered as the potential effect of FSTD training in preventing the accident or incident from occurring or mitigating the severity of the event. • **No effect** Not trainable in a simulator or 0 competencies trained • **Low effect** (1–3 competencies are trained) • **Medium effect** (4–6 competencies are trained) • **High effect** (7–9 competencies are trained)

Appendix 3 – IATA Threats and Errors Taxonomy

E – Environmental Threats
E01 Meteorology
E01.01 Adverse Weather Precipitation, Thunderstorm, rain, snow plus operations in high/low temperature conditions including low cloud ceilings.
E01.02 Poor Visibility Any situation where a degraded visual environment (DVE) presents a threat in relation to crew performance, including 'whiteout'/'brownout' on landing.
E01.03 Gusty Conditions – Windshear – Wake Turbulence Windshear without warning or mechanical turbulence associated with topography or structure Excessive crosswind, including tail wind, that affects control of the aircraft Wake vortex events affecting aircraft or crew performance)
E01.04 Icing Conditions Snow, ice, plus operations in high/low temperature (or high pressure altitude) conditions and including low cloud ceilings. Salt contamination.
E02 Lack of Visual Reference Darkness/Black hole effect. Environmental situation which can lead to spatial disorientation.
E03 Air Traffic Services Tough-to-meet clearance/restrictions. Rerouting. Language difficulties. Controller Errors. Failure to provide separation (air/ground)
E04 Birds/foreign objects Bird strike, resulting in damage or affecting performance of the flight, or avoidance maneuver related to bird activity
E05 Airport Facilities
E05.01 Poor signage/lighting, faint markings, rwy/txy closures Threats arising from aircraft movement up to the take-off holding point, and from landing to shutdown, including taxying, that influence crew or affect aircraft while maneuvering.
E05.02 Contaminated runways, taxiways, poor braking action Contamination or surface quality of the runway, taxiway including FOD.
E05.03 Trenches, ditches, intruding structures
E05.04 Ground Maneuvering Airport perimeter control/fencing/wildlife control Ground equipment (vehicles or towed equipment) parked or moving on ramp, including aircraft towing or any movement of ground equipment
E06 Navaids (Malfunction, lack or unavailable/uncalibrated)
E06.01 Malfunction, lack or unavailable Loss of GPS satellite signal; loss of RAIM when required; ANP less than RNP; loss of ground-based NAV source; aircraft lost or unsure of position; routing towards any waypoint or destination other than that intended.
E06.02 Uncalibrated
E07 Terrain/Obstacles Any automated or verbal alert, warning or caution of unsafe proximity to, or collision with, terrain or obstacle.

E08 Traffic TCAS RA or TA/ACAS, or visual observation of conflict, or traffic compression requiring evasive maneuvering.
E99 Other

A – Airline Threats
A01 Aircraft Malfunction Any internal failure(s) apparent or not apparent to the crew
A01.01 Uncontained engine failure
A01.02 Contained engine failure (including overheat and prop fail) Any engine failure or malfunction which causes loss of power and impacts flight performance.
A01.03 Landing gear/tires
A01.04 Brakes
A01.05 Flight Controls A01.05.01 Primary flight controls **A01.05.02 Secondary flight controls (flaps, spoilers)**
A01.06 Structural Failure
A01.07 Fire/Smoke Any fire, smoke or fumes, associated with fuselage, engine or aircraft systems Other fire causes (Cockpit/Cabin/Cargo)
A01.08 Avionics, flight instruments All avionics except autopilot and FMS – Instrumentation, including standby instruments
A01.09 Autopilot/FMS (Including A/THR, Autothrottle)
A01.10 Hydraulic system failure
A01.11 Electrical System Failure
A01.12 Fuel System Malfunction (including fuel leak)
A01.13 Air Conditioning/Pressurization Failures
A01.99 Aircraft Malfunction System Other
A02 MEL item (with operational implications)
A03 Operation pressure Operational time pressure -Distraction – Non-normal Operations (diversion)
A04 Cabin events Cabin events (e.g., unruly passenger) – Cabin crew Errors – Distractions/interruptions
A05 Ground events Aircraft loading events (affecting performances) – Fueling Errors – Improper deicing/anti-icing – improper ground support
A06 Dispatch/paperwork Incomplete or complex paperwork, including late changes or Errors (e.g., Loadsheet, NOTAMS or weather)
A07 Maintenance events Aircraft repairs on ground – Maintenance log problems – Maintenance Errors
A08 Dangerous goods

A09 Manual / Charts / Checklists / Procedures / Databases Deficiency within Manuals: technical or layout, conflict or omission. Incomplete, inappropriate, poorly designed charts or checklists Databases not up-to-date, missing information or containing coding Errors
A99 Other

B- Psychological/Physiological Threats – Physio
B01 Fatigue Issues affecting crew performance related to fatigue, whether recognized by the crew or not.
B02 Optical Illusion/Visual Mis-Perception
B03 Spatial Disorientation and Spatial / Somatogravic Illusion
B04 Crew Incapacitation Any incapacitation which impacts the performance of the non-affected pilot

H – Aircraft Handling Errors
H01 Manual Handling/Flight Controls Manual flying leading to vertical, lateral or speed deviations Incorrect Flaps/Speedbrakes/Autobrake/Thrust reverser/Power settings
H02 Ground Navigation (Surface nav) Attempting to turn down wrong taxiway/runway Missed taxiway/runway/gate Conflict with other aircraft whilst approaching, entering, holding or exiting runway (including runway incursion)
H03 Automation (Settings/Selections) Incorrect altitude, speed, heading, autothrust (autothrottle) settings, mode executed, or entries
H04 Systems/Radio/Instruments (Settings/Selections)
H99 Other

P – Procedural Errors
P01 SOP Adherence/Cross-Verification Failure to follow SOPs (including PF/PM task sharing) Sterile cockpit violations
P01.01 Intentional
P01.02 Unintentional
P01.03 Unknown
P02 Checklist Checklist performed from memory or omitted Wrong challenge and response Checklist performed late or at wrong time

Checklist items omitted
P02.01 Normal checklist (error)
P02.02 Abnormal checklist (error)
P03 Callouts Omitted/Wrong callout(s)
P04 Briefings Briefing does not address expected situation Omitted or incomplete briefing
P05 Documentation Pilot misinterpretation, incorrect or missing entries
P05.01 Incorrect weight and balance/ fuel information
P05.02 Incorrect ATIS/ clearance
P05.03 Misinterpreted items on paperwork
P05.04 Incorrect or missing log book entries
P06 Failure to go-around after destabilization on approach
P99 Other

C – Communication Errors
C01 Crew to External Communication Communication Errors or lack of communication from flight crew
C01.01 With ATC
C01.02 With cabin crew
C01.03 With ground crew
C01.04 With dispatch
C02 Pilot to Pilot Communication Miscommunication, Misinterpretation or lack of communication
C03 CPDLC

Appendix 4 – Aircraft Generation RRR Comparisons

EBT A&I Study Relative Risk Ranking Results Generation 4 Jet

Relative Risk Ranking Normalized Per million flights										
Threats or Errors	Frequency						Frequency × Severity			
	% of recent events			(0.01) % × 5			Separately at 3 Severity Levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal accidents	Incidents	Fatal Accident s (5)	Non-fatal Accident s (3)	Incidents (1)	Total risk
H01 Manual Handling/Flight Controls	2.32%	11.59%	7.53%	0.12	0.58	0.38	0.58	1.74	0.38	**2.69**
P03 Procedural Errors Callouts (error in callout or omission of callout)	2.32%	8.11%	8.11%	0.12	0.41	0.41	0.58	1.22	0.41	**2.20**
C02 Communication Errors Pilot-to-Pilot	2.32%	6.95%	7.53%	0.12	0.35	0.38	0.58	1.04	0.38	**2.00**
P01.01 Intentional	1.16%	8.11%	4.63%	0.06	0.41	0.23	0.29	1.22	0.23	**1.74**
P01.02 Unintentional	1.16%	6.95%	7.53%	0.06	0.35	0.38	0.29	1.04	0.38	**1.71**
H03 Automation (Settings/Selections)	1.74%	5.21%	5.21%	0.09	0.26	0.26	0.43	0.78	0.26	**1.48**
P06 Procedural Errors Failure to Go-Around	1.16%	5.21%	4.05%	0.06	0.26	0.20	0.29	0.78	0.20	**1.27**
E03 Environmental Threats Air Traffic Services	1.16%	4.63%	4.05%	0.06	0.23	0.20	0.29	0.70	0.20	**1.19**
E02 Environmental Threats lack of Visual Reference	1.74%	3.48%	1.74%	0.09	0.17	0.09	0.43	0.52	0.09	**1.04**
E01.02 Poor Visibility (degraded visual environment)	0.58%	5.21%	1.74%	0.03	0.26	0.09	0.14	0.78	0.09	**1.01**
P04 Procedural Errors Briefings	1.16%	2.90%	4.63%	0.06	0.14	0.23	0.29	0.43	0.23	**0.96**
A09 Manual/Charts/Checklists/Procedur es/Databases	0.00%	5.21%	3.48%	0.00	0.26	0.17	0.00	0.78	0.17	**0.96**
P01.03 Unknown	0.58%	3.48%	3.48%	0.03	0.17	0.17	0.14	0.52	0.17	**0.84**
P02.02 Non-Normal Checklist	0.58%	3.48%	1.74%	0.03	0.17	0.09	0.14	0.52	0.09	**0.75**

E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	0.58%	2.90%	3.48%	0.03	0.14	0.17	0.14	0.43	0.17	**0.75**
E01.03 Gusty Wind/Windshear/Wake Turbulence	0.00%	4.05%	1.74%	0.00	0.20	0.09	0.00	0.61	0.09	**0.70**
B01 Fatigue	1.16%	1.74%	2.32%	0.06	0.09	0.12	0.29	0.26	0.12	**0.67**
A07 Maintenance events	1.16%	1.74%	0.58%	0.06	0.09	0.03	0.29	0.26	0.03	**0.58**
H04 Systems/Radio/Instruments (Settings/Selections)	0.00%	2.90%	1.74%	0.00	0.14	0.09	0.00	0.43	0.09	**0.52**
C01.01 With ATC	0.58%	1.16%	2.90%	0.03	0.06	0.14	0.14	0.17	0.14	**0.46**
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	1.16%	0.58%	1.74%	0.06	0.03	0.09	0.29	0.09	0.09	**0.46**
P02.01 Normal Checklist	0.58%	1.16%	1.16%	0.03	0.06	0.06	0.14	0.17	0.06	**0.38**
B03 Spatial Disorientation and Spatial/Somatogravic Illusion	1.16%	0.00%	0.58%	0.06	0.00	0.03	0.29	0.00	0.03	**0.32**
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	0.00%	1.74%	1.16%	0.00	0.09	0.06	0.00	0.26	0.06	**0.32**
C01.02 With Cabin Crew	0.00%	1.74%	0.00%	0.00	0.09	0.00	0.00	0.26	0.00	**0.26**
A01.05.01 Primary Flight Controls	0.58%	0.58%	0.58%	0.03	0.03	0.03	0.14	0.09	0.03	**0.26**
E06 Environmental Threats Navaids	0.58%	0.58%	0.58%	0.03	0.03	0.03	0.14	0.09	0.03	**0.26**
A01.07 Fire/Smoke	0.00%	1.16%	0.58%	0.00	0.06	0.03	0.00	0.17	0.03	**0.20**
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.00%	1.16%	0.58%	0.00	0.06	0.03	0.00	0.17	0.03	**0.20**
C01.04 With Dispatch	0.00%	1.16%	0.00%	0.00	0.06	0.00	0.00	0.17	0.00	**0.17**
P05.02 Incorrect ATIS/Clearance	0.00%	1.16%	0.00%	0.00	0.06	0.00	0.00	0.17	0.00	**0.17**
B02 Optical Illusion/Visual Mis-Perception	0.00%	1.16%	0.00%	0.00	0.06	0.00	0.00	0.17	0.00	**0.17**
A01.03 Landing Gear/Tires	0.00%	1.16%	0.00%	0.00	0.06	0.00	0.00	0.17	0.00	**0.17**
A01.01 Uncontained Engine Failure	0.00%	1.16%	0.00%	0.00	0.06	0.00	0.00	0.17	0.00	**0.17**
E07 Environmental Threats Terrain/Obstacles	0.58%	0.00%	0.58%	0.03	0.00	0.03	0.14	0.00	0.03	**0.17**

A01.11 Electrical System Failure	0.00%	0.58%	1.16%	0.00	0.03	0.06	0.00	0.09	0.06	**0.14**
A01.10 Hydraulic System Failure	0.00%	0.58%	1.16%	0.00	0.03	0.06	0.00	0.09	0.06	**0.14**
A01.08 Avionics/ Flight Instruments	0.00%	0.58%	1.16%	0.00	0.03	0.06	0.00	0.09	0.06	**0.14**
A05 Ground events	0.00%	0.58%	0.58%	0.00	0.03	0.03	0.00	0.09	0.03	**0.12**
A01.12 Fuel System malfunction (including fuel leak)	0.00%	0.58%	0.58%	0.00	0.03	0.03	0.00	0.09	0.03	**0.12**
A01.06 Structural Failure	0.00%	0.58%	0.58%	0.00	0.03	0.03	0.00	0.09	0.03	**0.12**
E01.04 Icing conditions	0.00%	0.58%	0.58%	0.00	0.03	0.03	0.00	0.09	0.03	**0.12**
P05.04 Incorrect or missing log book entries	0.00%	0.58%	0.00%	0.00	0.03	0.00	0.00	0.09	0.00	**0.09**
P05.01 Incorrect Weight and BaLance/Fuel Information	0.00%	0.58%	0.00%	0.00	0.03	0.00	0.00	0.09	0.00	**0.09**
A04 Cabin events	0.00%	0.58%	0.00%	0.00	0.03	0.00	0.00	0.09	0.00	**0.09**
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.00%	0.58%	0.00%	0.00	0.03	0.00	0.00	0.09	0.00	**0.09**
A01.04 Brakes	0.00%	0.58%	0.00%	0.00	0.03	0.00	0.00	0.09	0.00	**0.09**
E08 Environmental Threats Traffic	0.00%	0.00%	1.16%	0.00	0.00	0.06	0.00	0.00	0.06	**0.06**
P05.03 Misinterpreted items on Paperwork	0.00%	0.00%	0.58%	0.00	0.00	0.03	0.00	0.00	0.03	**0.03**
H02 Ground Navigation	0.00%	0.00%	0.58%	0.00	0.00	0.03	0.00	0.00	0.03	**0.03**
A01.13 Air Conditioning/Pressurization Failures	0.00%	0.00%	0.58%	0.00	0.00	0.03	0.00	0.00	0.03	**0.03**
A01.02 Contained Engine Failure	0.00%	0.00%	0.58%	0.00	0.00	0.03	0.00	0.00	0.03	**0.03**
E05.02 Contaminated runways, taxiways, poor braking action	0.00%	0.00%	0.58%	0.00	0.00	0.03	0.00	0.00	0.03	**0.03**
C03 Communication Errors CPDLC	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
C01.03 With Ground Crew	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
P99 Procedural Errors Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
H99 Aircraft handling Errors Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
B04 Crew Incapacitation	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

A99 Airline Threats Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A08 Dangerous Goods	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A06 Dispatch/Paperwork	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A02 MEL item (MEL items with operational Applications)	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.99 Airline Threats Aircraft malfunction System Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E99 Environmental Threats Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E05.04 Ground Maneuvering	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E05.03 Trenches, ditches, intruding structures	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E04 Environmental Threats Birds	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

EBT A&I Study Relative Risk Ranking Results Generation 3 Jet

Relative Risk Ranking Normalized Per million flights										
Threats or Errors	Frequency						Frequency x Severity			
	% of recent events			(0.01) % × 5			Separately at 3 Severity Levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal accidents	Incidents	Fatal Accidents (5)	Non-fatal Accidents (3)	Incidents (1)	Total risk
H01 Manual Handling/Flight Controls	2.83%	25.50%	9.21%	0.14	1.27	0.46	0.71	3.82	0.46	**4.99**
C02 Communication Errors Pilot-to-Pilot	2.83%	17.00%	5.67%	0.14	0.85	0.28	0.71	2.55	0.28	**3.54**
P03 Procedural Errors Callouts (error in callout or omission of callout)	2.12%	17.71%	6.37%	0.11	0.89	0.32	0.53	2.66	0.32	**3.51**
P01.02 Unintentional	1.42%	15.58%	7.79%	0.07	0.78	0.39	0.35	2.34	0.39	**3.08**
P01.01 Intentional	0.71%	12.04%	9.21%	0.04	0.60	0.46	0.18	1.81	0.46	**2.44**
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	2.12%	9.92%	8.50%	0.11	0.50	0.42	0.53	1.49	0.42	**2.44**

P06 Procedural Errors Failure to Go-Around	1.42%	11.33%	4.25%	0.07	0.57	0.21	0.35	1.70	0.21	**2.27**
B01 Fatigue	3.54%	5.67%	2.12%	0.18	0.28	0.11	0.89	0.85	0.11	**1.84**
E02 Environmental Threats lack of Visual Reference	1.42%	6.37%	4.25%	0.07	0.32	0.21	0.35	0.96	0.21	**1.52**
E01.03 Gusty Wind/Windshear/Wake Turbulence	0.00%	9.21%	2.12%	0.00	0.46	0.11	0.00	1.38	0.11	**1.49**
A09 Manual/Charts/Checklists/Procedure s/Databases	1.42%	4.96%	4.25%	0.07	0.25	0.21	0.35	0.74	0.21	**1.31**
C01.01 With ATC	1.42%	3.54%	7.79%	0.07	0.18	0.39	0.35	0.53	0.39	**1.27**
P02.01 Normal Checklist	0.71%	6.37%	2.83%	0.04	0.32	0.14	0.18	0.96	0.14	**1.27**
E03 Environmental Threats Air Traffic Services	1.42%	4.25%	5.67%	0.07	0.21	0.28	0.35	0.64	0.28	**1.27**
E01.02 Poor Visibility (degraded visual environment)	0.71%	4.96%	4.25%	0.04	0.25	0.21	0.18	0.74	0.21	**1.13**
H03 Automation (Settings/Selections)	1.42%	3.54%	4.25%	0.07	0.18	0.21	0.35	0.53	0.21	**1.10**
P04 Procedural Errors Briefings	0.71%	4.96%	2.12%	0.04	0.25	0.11	0.18	0.74	0.11	**1.03**
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.71%	4.25%	2.83%	0.04	0.21	0.14	0.18	0.64	0.14	**0.96**
H04 Systems/Radio/Instruments (Settings/Selections)	0.71%	4.25%	2.12%	0.04	0.21	0.11	0.18	0.64	0.11	**0.92**
P01.03 Unknown	1.42%	2.83%	1.42%	0.07	0.14	0.07	0.35	0.42	0.07	**0.85**
B02 Optical Illusion/Visual Mis-Perception	0.00%	4.25%	3.54%	0.00	0.21	0.18	0.00	0.64	0.18	**0.81**
P02.02 Non-Normal Checklist	1.42%	2.12%	2.12%	0.07	0.11	0.11	0.35	0.32	0.11	**0.78**
E08 Environmental Threats Traffic	0.00%	3.54%	3.54%	0.00	0.18	0.18	0.00	0.53	0.18	**0.71**
E05.02 Contaminated runways, taxiways, poor braking action	0.00%	3.54%	2.83%	0.00	0.18	0.14	0.00	0.53	0.14	**0.67**
E07 Environmental Threats Terrain/Obstacles	1.42%	1.42%	1.42%	0.07	0.07	0.07	0.35	0.21	0.07	**0.64**
A01.07 Fire/Smoke	1.42%	1.42%	0.00%	0.07	0.07	0.00	0.35	0.21	0.00	**0.57**
C01.02 With Cabin Crew	0.00%	2.83%	0.71%	0.00	0.14	0.04	0.00	0.42	0.04	**0.46**

B03 Spatial Disorientation and Spatial/Somatogravic Illusion	1.42%	0.00%	0.71%	0.07	0.00	0.04	0.35	0.00	0.04	**0.39**
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	0.00%	2.12%	1.42%	0.00	0.11	0.07	0.00	0.32	0.07	**0.39**
P05.02 Incorrect ATIS/Clearance	0.71%	0.71%	1.42%	0.04	0.04	0.07	0.18	0.11	0.07	**0.35**
H02 Ground Navigation	0.00%	2.12%	0.71%	0.00	0.11	0.04	0.00	0.32	0.04	**0.35**
A08 Dangerous Goods	1.42%	0.00%	0.00%	0.07	0.00	0.00	0.35	0.00	0.00	**0.35**
E01.04 Icing conditions	0.71%	0.71%	1.42%	0.04	0.04	0.07	0.18	0.11	0.07	**0.35**
B04 Crew Incapacitation	0.71%	0.71%	0.71%	0.04	0.04	0.04	0.18	0.11	0.04	**0.32**
A01.06 Structural Failure	0.00%	2.12%	0.00%	0.00	0.11	0.00	0.00	0.32	0.00	**0.32**
P05.01 Incorrect Weight and BaLance/Fuel Information	0.71%	0.71%	0.00%	0.04	0.04	0.00	0.18	0.11	0.00	**0.28**
A01.08 Avionics/ Flight Instruments	0.71%	0.00%	2.12%	0.04	0.00	0.11	0.18	0.00	0.11	**0.28**
E06 Environmental Threats Navaids	0.00%	1.42%	1.42%	0.00	0.07	0.07	0.00	0.21	0.07	**0.28**
E05.04 Ground Maneuvering	0.00%	1.42%	1.42%	0.00	0.07	0.07	0.00	0.21	0.07	**0.28**
A07 Maintenance events	0.00%	1.42%	0.71%	0.00	0.07	0.04	0.00	0.21	0.04	**0.25**
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.00%	1.42%	0.00%	0.00	0.07	0.00	0.00	0.21	0.00	**0.21**
P05.03 Misinterpreted items on Paperwork	0.71%	0.00%	0.00%	0.04	0.00	0.00	0.18	0.00	0.00	**0.18**
A01.13 Air Conditioning/Pressurization Failures	0.71%	0.00%	0.00%	0.04	0.00	0.00	0.18	0.00	0.00	**0.18**
P05.04 Incorrect or missing log book entries	0.00%	0.71%	0.71%	0.00	0.04	0.04	0.00	0.11	0.04	**0.14**
A01.03 Landing Gear/Tires	0.00%	0.71%	0.71%	0.00	0.04	0.04	0.00	0.11	0.04	**0.14**
C01.04 With Dispatch	0.00%	0.71%	0.00%	0.00	0.04	0.00	0.00	0.11	0.00	**0.11**
A04 Cabin events	0.00%	0.71%	0.00%	0.00	0.04	0.00	0.00	0.11	0.00	**0.11**
A01.10 Hydraulic System Failure	0.00%	0.71%	0.00%	0.00	0.04	0.00	0.00	0.11	0.00	**0.11**
A01.05.01 Primary Flight Controls	0.00%	0.71%	0.00%	0.00	0.04	0.00	0.00	0.11	0.00	**0.11**
A01.01 Uncontained Engine Failure	0.00%	0.71%	0.00%	0.00	0.04	0.00	0.00	0.11	0.00	**0.11**

E05.03 Trenches, ditches, intruding structures	0.00%	0.71%	0.00%	0.00	0.04	0.00	0.00	0.11	0.00	**0.11**
C01.03 With Ground Crew	0.00%	0.00%	0.71%	0.00	0.00	0.04	0.00	0.00	0.04	**0.04**
C03 Communication Errors CPDLC	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
P99 Procedural Errors Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
H99 Aircraft handling Errors Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A99 Airline Threats Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A06 Dispatch/Paperwork	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A05 Ground events	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A02 MEL item (MEL items with operational Applications)	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.99 Airline Threats Aircraft malfunction System Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.12 Fuel System malfunction (including fuel leak)	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.11 Electrical System Failure	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.04 Brakes	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
A01.02 Contained Engine Failure	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E99 Environmental Threats Other	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
E04 Environmental Threats Birds	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

GADM ADX Relative Risk Ranking Results Generation 4 Jet

Threats or Errors	Relative Risk Ranking Normalized Per million flights									
	Frequency						Frequency x Severity			
	% of recent events			(0.01) % × 5			Separately at 3 Severity Levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal accidents	Incidents	Fatal Accidents (5)	Non-fatal Accidents (3)	Incidents (1)	Total risk
H01 Manual Handling/Flight Controls	2.32%	1.74%	27.23%	0.116	0.087	1.361	0.579	0.261	1.361	2.201
P01.01 Intentional	2.32%	0.58%	13.90%	0.116	0.029	0.695	0.579	0.087	0.695	1.361
E01.03 Gusty Wind/Windshear/Wake Turbulence	0.58%	1.74%	15.06%	0.029	0.087	0.753	0.145	0.261	0.753	1.159
P06 Procedural Errors Failure to Go-Around	0.58%	0.58%	12.16%	0.029	0.029	0.608	0.145	0.087	0.608	0.840
P03 Procedural Errors Callouts (error in callout or omission of callout)	1.74%	0.00%	8.11%	0.087	0.000	0.405	0.434	0.000	0.405	0.840
C02 Communication Errors Pilot-to-Pilot	1.74%	0.58%	5.79%	0.087	0.029	0.290	0.434	0.087	0.290	0.811
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	1.16%	0.58%	8.11%	0.058	0.029	0.405	0.290	0.087	0.405	0.782
E06 Environmental Threats Navaids	2.32%	0.00%	3.48%	0.116	0.000	0.174	0.579	0.000	0.174	0.753
E01.02 Poor Visibility (degraded visual environment)	1.74%	0.00%	6.37%	0.087	0.000	0.319	0.434	0.000	0.319	0.753
P01.02 Unintentional	0.58%	0.58%	9.85%	0.029	0.029	0.492	0.145	0.087	0.492	0.724
E03 Environmental Threats Air Traffic Services	0.58%	0.58%	4.63%	0.029	0.029	0.232	0.145	0.087	0.232	0.463
E02 Environmental Threats lack of Visual Reference	0.58%	0.58%	4.63%	0.029	0.029	0.232	0.145	0.087	0.232	0.463
H03 Automation (Settings/Selections)	1.16%	0.00%	1.74%	0.058	0.000	0.087	0.290	0.000	0.087	0.377
A07 Maintenance events	0.00%	0.58%	5.79%	0.000	0.029	0.290	0.000	0.087	0.290	0.377

A01.03 Landing Gear/Tires	0.00%	0.58%	4.05%	0.000	0.029	0.203	0.000	0.087	0.203	0.290
P04 Procedural Errors Briefings	0.58%	0.00%	2.32%	0.029	0.000	0.116	0.145	0.000	0.116	0.261
A01.07 Fire/Smoke	0.00%	0.58%	3.48%	0.000	0.029	0.174	0.000	0.087	0.174	0.261
A05 Ground events	0.00%	0.00%	4.63%	0.000	0.000	0.232	0.000	0.000	0.232	0.232
E99 Environmental Threats Other	0.00%	0.00%	4.63%	0.000	0.000	0.232	0.000	0.000	0.232	0.232
E05.02 Contaminated runways, taxiways, poor braking action	0.00%	0.00%	4.63%	0.000	0.000	0.232	0.000	0.000	0.232	0.232
B01 Fatigue	0.58%	0.00%	1.16%	0.029	0.000	0.058	0.145	0.000	0.058	0.203
E07 Environmental Threats Terrain/Obstacles	0.58%	0.00%	1.16%	0.029	0.000	0.058	0.145	0.000	0.058	0.203
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.00%	0.58%	2.32%	0.000	0.029	0.116	0.000	0.087	0.116	0.203
B02 Optical Illusion/Visual Mis-Perception	0.00%	0.00%	3.48%	0.000	0.000	0.174	0.000	0.000	0.174	0.174
A01.01 Uncontained Engine Failure	0.00%	0.58%	1.74%	0.000	0.029	0.087	0.000	0.087	0.087	0.174
E08 Environmental Threats Traffic	0.00%	0.00%	2.90%	0.000	0.000	0.145	0.000	0.000	0.145	0.145
E04 Environmental Threats Birds	0.00%	0.00%	2.90%	0.000	0.000	0.145	0.000	0.000	0.145	0.145
H02 Ground Navigation	0.00%	0.00%	2.32%	0.000	0.000	0.116	0.000	0.000	0.116	0.116
H04 Systems/Radio/Instruments (Settings/Selections)	0.00%	0.00%	1.74%	0.000	0.000	0.087	0.000	0.000	0.087	0.087
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	0.00%	0.00%	1.74%	0.000	0.000	0.087	0.000	0.000	0.087	0.087
A01.10 Hydraulic System Failure	0.00%	0.58%	0.00%	0.000	0.029	0.000	0.000	0.087	0.000	0.087
C01.03 With Ground Crew	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058
C01.01 With ATC	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058
P02.02 Non-Normal Checklist	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058
P02.01 Normal Checklist	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058
A01.02 Contained Engine Failure	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058

E05.04 Ground Maneuvering	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058
E05.03 Trenches, ditches, intruding structures	0.00%	0.00%	1.16%	0.000	0.000	0.058	0.000	0.000	0.058	0.058
P05.01 Incorrect Weight and BaLance/Fuel Information	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
P01.03 Unknown	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
B03 Spatial Disorientation and Spatial/Somatogravic Illusion	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A09 Manual/Charts/Checklists/Procedures/Databases	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A08 Dangerous Goods	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A06 Dispatch/Paperwork	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A02 MEL item (MEL items with operational Applications)	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A01.99 Airline Threats Aircraft malfunction System Other	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
A01.04 Brakes	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
E01.04 Icing conditions	0.00%	0.00%	0.58%	0.000	0.000	0.029	0.000	0.000	0.029	0.029
C03 Communication Errors CPDLC	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C01.04 With Dispatch	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C01.02 With Cabin Crew	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P99 Procedural Errors Other	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P05.04 Incorrect or missing log book entries	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P05.03 Misinterpreted items on Paperwork	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P05.02 Incorrect ATIS/Clearance	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H99 Aircraft handling Errors Other	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000

B04 Crew Incapacitation	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A99 Airline Threats Other	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A04 Cabin events	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.13 Air Conditioning/Pressurization Failures	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.12 Fuel System malfunction (including fuel leak)	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.11 Electrical System Failure	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.08 Avionics/ Flight Instruments	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.06 Structural Failure	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A01.05.01 Primary Flight Controls	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	0.000

GADM ADX Relative Risk Ranking Results Generation 3 Jet

Relative Risk Ranking Normalized Per million flights										
Threats or Errors	Frequency						Frequency x Severity			
	% of recent events			(0.01) % x 5			Separately at 3 Severity Levels			
	% of recent fatal accidents	% of recent non-fatal accidents	% of recent incidents	Fatal accidents	Non-fatal accidents	Incidents	Fatal Accidents (5)	Non-fatal Accidents (3)	Incidents (1)	Total risk
H01 Manual Handling/Flight Controls	8.50%	0.71%	40.37%	0.425	0.035	2.019	2.125	0.106	2.019	**4.250**
P01.01 Intentional	5.67%	1.42%	18.42%	0.283	0.071	0.921	1.417	0.212	0.921	**2.550**
P06 Procedural Errors Failure to Go-Around	2.83%	0.71%	22.67%	0.142	0.035	1.133	0.708	0.106	1.133	**1.948**
E01.02 Poor Visibility (degraded visual environment)	5.67%	0.00%	10.62%	0.283	0.000	0.531	1.417	0.000	0.531	**1.948**
E01.03 Gusty Wind/Windshear/Wake Turbulence	2.12%	0.00%	26.21%	0.106	0.000	1.310	0.531	0.000	1.310	**1.842**

A07 Maintenance events	1.42%	0.71%	26.91%	0.071	0.035	1.346	0.354	0.106	1.346	**1.806**
C02 Communication Errors Pilot-to-Pilot	4.96%	0.71%	5.67%	0.248	0.035	0.283	1.240	0.106	0.283	**1.629**
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	4.96%	0.00%	4.96%	0.248	0.000	0.248	1.240	0.000	0.248	**1.487**
A01.03 Landing Gear/Tires	0.00%	0.00%	28.33%	0.000	0.000	1.417	0.000	0.000	1.417	**1.417**
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	2.83%	0.71%	11.33%	0.142	0.035	0.567	0.708	0.106	0.567	**1.381**
P03 Procedural Errors Callouts (error in callout or omission of callout)	4.25%	0.00%	5.67%	0.212	0.000	0.283	1.062	0.000	0.283	**1.346**
E06 Environmental Threats Navaids	2.12%	2.12%	9.92%	0.106	0.106	0.496	0.531	0.319	0.496	**1.346**
E02 Environmental Threats lack of Visual Reference	4.25%	0.71%	3.54%	0.212	0.035	0.177	1.062	0.106	0.177	**1.346**
P01.02 Unintentional	2.83%	0.71%	7.79%	0.142	0.035	0.390	0.708	0.106	0.390	**1.204**
E05.02 Contaminated runways, taxiways, poor braking action	0.00%	0.71%	20.54%	0.000	0.035	1.027	0.000	0.106	1.027	**1.133**
E03 Environmental Threats Air Traffic Services	2.83%	0.71%	5.67%	0.142	0.035	0.283	0.708	0.106	0.283	**1.098**
B01 Fatigue	2.83%	0.71%	4.96%	0.142	0.035	0.248	0.708	0.106	0.248	**1.062**
P02.02 Non-Normal Checklist	2.83%	0.00%	1.42%	0.142	0.000	0.071	0.708	0.000	0.071	**0.779**
A01.07 Fire/Smoke	1.42%	0.71%	4.25%	0.071	0.035	0.212	0.354	0.106	0.212	**0.673**
H03 Automation (Settings/Selections)	1.42%	0.00%	5.67%	0.071	0.000	0.283	0.354	0.000	0.283	**0.637**
E04 Environmental Threats Birds	0.71%	0.00%	9.21%	0.035	0.000	0.460	0.177	0.000	0.460	**0.637**
A05 Ground events	0.00%	0.00%	10.62%	0.000	0.000	0.531	0.000	0.000	0.531	**0.531**
E05.03 Trenches, ditches, intruding structures	0.71%	0.71%	4.25%	0.035	0.035	0.212	0.177	0.106	0.212	**0.496**
E01.04 Icing conditions	1.42%	0.00%	2.83%	0.071	0.000	0.142	0.354	0.000	0.142	**0.496**
B02 Optical Illusion/Visual Mis-Perception	0.71%	0.71%	3.54%	0.035	0.035	0.177	0.177	0.106	0.177	**0.460**

A06 Dispatch/Paperwork	1.42%	0.00%	2.12%	0.071	0.000	0.106	0.354	0.000	0.106	**0.460**
C01.01 With ATC	1.42%	0.00%	1.42%	0.071	0.000	0.071	0.354	0.000	0.071	**0.425**
P04 Procedural Errors Briefings	1.42%	0.00%	1.42%	0.071	0.000	0.071	0.354	0.000	0.071	**0.425**
A01.10 Hydraulic System Failure	0.71%	0.00%	4.25%	0.035	0.000	0.212	0.177	0.000	0.212	**0.390**
A01.08 Avionics/ Flight Instruments	1.42%	0.00%	0.71%	0.071	0.000	0.035	0.354	0.000	0.035	**0.390**
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.00%	0.71%	5.67%	0.000	0.035	0.283	0.000	0.106	0.283	**0.390**
B03 Spatial Disorientation and Spatial/Somatogravic Illusion	1.42%	0.00%	0.00%	0.071	0.000	0.000	0.354	0.000	0.000	**0.354**
A01.99 Airline Threats Aircraft malfunction System Other	0.71%	0.71%	1.42%	0.035	0.035	0.071	0.177	0.106	0.071	**0.354**
P01.03 Unknown	0.71%	0.00%	2.12%	0.035	0.000	0.106	0.177	0.000	0.106	**0.283**
A01.01 Uncontained Engine Failure	0.71%	0.00%	2.12%	0.035	0.000	0.106	0.177	0.000	0.106	**0.283**
E07 Environmental Threats Terrain/Obstacles	0.71%	0.00%	2.12%	0.035	0.000	0.106	0.177	0.000	0.106	**0.283**
P05.01 Incorrect Weight and Balance/Fuel Information	0.71%	0.00%	1.42%	0.035	0.000	0.071	0.177	0.000	0.071	**0.248**
H04 Systems/Radio/Instruments (Settings/Selections)	0.71%	0.00%	1.42%	0.035	0.000	0.071	0.177	0.000	0.071	**0.248**
E08 Environmental Threats Traffic	0.00%	0.00%	4.96%	0.000	0.000	0.248	0.000	0.000	0.248	**0.248**
E99 Environmental Threats Other	0.00%	0.00%	4.25%	0.000	0.000	0.212	0.000	0.000	0.212	**0.212**
C01.04 With Dispatch	0.71%	0.00%	0.00%	0.035	0.000	0.000	0.177	0.000	0.000	**0.177**
H02 Ground Navigation	0.00%	0.71%	1.42%	0.000	0.035	0.071	0.000	0.106	0.071	**0.177**
A09 Manual/Charts/Checklists/Procedures/Databases	0.71%	0.00%	0.00%	0.035	0.000	0.000	0.177	0.000	0.000	**0.177**
A08 Dangerous Goods	0.71%	0.00%	0.00%	0.035	0.000	0.000	0.177	0.000	0.000	**0.177**
A01.06 Structural Failure	0.00%	0.00%	2.12%	0.000	0.000	0.106	0.000	0.000	0.106	**0.106**
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.00%	0.00%	2.12%	0.000	0.000	0.106	0.000	0.000	0.106	**0.106**
P02.01 Normal Checklist	0.00%	0.00%	1.42%	0.000	0.000	0.071	0.000	0.000	0.071	**0.071**
B04 Crew Incapacitation	0.00%	0.00%	1.42%	0.000	0.000	0.071	0.000	0.000	0.071	**0.071**

A02 MEL item (MEL items with operational Applications)	0.00%	0.00%	1.42%	0.000	0.000	0.071	0.000	0.000	0.071	**0.071**
A01.04 Brakes	0.00%	0.00%	1.42%	0.000	0.000	0.071	0.000	0.000	0.071	**0.071**
A01.02 Contained Engine Failure	0.00%	0.00%	1.42%	0.000	0.000	0.071	0.000	0.000	0.071	**0.071**
P05.04 Incorrect or missing log book entries	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
P05.02 Incorrect ATIS/Clearance	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
H99 Aircraft handling Errors Other	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
A01.11 Electrical System Failure	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
A01.05.01 Primary Flight Controls	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
E05.04 Ground Maneuvering	0.00%	0.00%	0.71%	0.000	0.000	0.035	0.000	0.000	0.035	**0.035**
C03 Communication Errors CPDLC	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
C01.03 With Ground Crew	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
C01.02 With Cabin Crew	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
P99 Procedural Errors Other	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
P05.03 Misinterpreted items on Paperwork	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
A99 Airline Threats Other	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
A04 Cabin events	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
A01.13 Air Conditioning/Pressurization Failures	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
A01.12 Fuel System malfunction (including fuel leak)	0.00%	0.00%	0.00%	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**

RRR results comparison between GADM ADX analysis and EBT A&I Study – Generation 4 Jet

Threats and Errors (GADM ADX analysis)	Frequency × Severity Total risk
H01 Manual Handling/Flight Controls	2.201
P01.01 Intentional	1.361
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.159
P06 Procedural Errors Failure to Go-Around	0.840
P03 Procedural Errors Callouts (error in callout or omission of callout)	0.840
C02 Communication Errors Pilot-to-Pilot	0.811
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	0.782
E06 Environmental Threats Navaids	0.753
E01.02 Poor Visibility (degraded visual environment)	0.753
P01.02 Unintentional	0.724
E03 Environmental Threats Air Traffic Services	0.463
E02 Environmental Threats lack of Visual Reference	0.463
H03 Automation (Settings/Selections)	0.377
A07 Maintenance events	0.377
A01.03 Landing Gear/Tires	0.290
P04 Procedural Errors Briefings	0.261
A01.07 Fire/Smoke	0.261
A05 Ground events	0.232
E99 Environmental Threats Other	0.232
E05.02 Contaminated runways, taxiways, poor braking action	0.232
B01 Fatigue	0.203
E07 Environmental Threats Terrain/Obstacles	0.203

Threats and Errors (EBT A&I Study)	Frequency × Severity Total risk
H01 Manual Handling/Flight Controls	2.694
P03 Procedural Errors Callouts (error in callout or omission of callout)	2.201
C02 Communication Errors Pilot-to-Pilot	1.999
P01.01 Intentional	1.738
P01.02 Unintentional	1.709
H03 Automation (Settings/Selections)	1.477
P06 Procedural Errors Failure to Go-Around	1.274
E03 Environmental Threats Air Traffic Services	1.188
E02 Environmental Threats lack of Visual Reference	1.043
E01.02 Poor Visibility (degraded visual environment)	1.014
P04 Procedural Errors Briefings	0.956
A09 Manual/Charts/Checklists/Procedures/Databases	0.956
P01.03 Unknown	0.840
P02.02 Non-Normal Checklist	0.753
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	0.753
E01.03 Gusty Wind/Windshear/Wake Turbulence	0.695
B01 Fatigue	0.666
A07 Maintenance events	0.579
H04 Systems/Radio/Instruments (Settings/Selections)	0.521
C01.01 With ATC	0.463
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.463
P02.01 Normal Checklist	0.377

E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.203
B02 Optical Illusion/Visual Mis-Perception	0.174
A01.01 Uncontained Engine Failure	0.174
E08 Environmental Threats Traffic	0.145
E04 Environmental Threats Birds	0.145
H02 Ground Navigation	0.116
H04 Systems/Radio/Instruments (Settings/Selections)	0.087
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	0.087
A01.10 Hydraulic System Failure	0.087
C01.03 With Ground Crew	0.058
C01.01 With ATC	0.058
P02.02 Non-Normal Checklist	0.058
P02.01 Normal Checklist	0.058
A01.02 Contained Engine Failure	0.058
E05.04 Ground Maneuvering	0.058
E05.03 Trenches, ditches, intruding structures	0.058
P05.01 Incorrect Weight and Balance/Fuel Information	0.029
P01.03 Unknown	0.029
B03 Spatial Disorientation and Spatial/Somatogravic Illusion	0.029
A09 Manual/Charts/Checklists/Procedures/Databases	0.029
A08 Dangerous Goods	0.029
A06 Dispatch/Paperwork	0.029
A02 MEL item (MEL items with operational Applications)	0.029

B03 Spatial Disorientation and Spatial/Somatogravic Illusion	0.319
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	0.319
C01.02 With Cabin Crew	0.261
A01.05.01 Primary Flight Controls	0.261
E06 Environmental Threats Navaids	0.261
A01.07 Fire/Smoke	0.203
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.203
C01.04 With Dispatch	0.174
P05.02 Incorrect ATIS/Clearance	0.174
B02 Optical Illusion/Visual Mis-Perception	0.174
A01.03 Landing Gear/Tires	0.174
A01.01 Uncontained Engine Failure	0.174
E07 Environmental Threats Terrain/Obstacles	0.174
A01.11 Electrical System Failure	0.145
A01.10 Hydraulic System Failure	0.145
A01.08 Avionics/ Flight Instruments	0.145
A05 Ground events	0.116
A01.12 Fuel System malfunction (including fuel leak)	0.116
A01.06 Structural Failure	0.116
E01.04 Icing conditions	0.116
P05.04 Incorrect or missing log book entries	0.087
P05.01 Incorrect Weight and Balance/Fuel Information	0.087
A04 Cabin events	0.087

A01.99 Airline Threats Aircraft malfunction System Other	0.029
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.029
A01.04 Brakes	0.029
E01.04 Icing conditions	0.029
C03 Communication Errors CPDLC	0.000
C01.04 With Dispatch	0.000
C01.02 With Cabin Crew	0.000
P99 Procedural Errors Other	0.000
P05.04 Incorrect or missing log book entries	0.000
P05.03 Misinterpreted items on Paperwork	0.000
P05.02 Incorrect ATIS/Clearance	0.000
H99 Aircraft handling Errors Other	0.000
B04 Crew Incapacitation	0.000
A99 Airline Threats Other	0.000
A04 Cabin events	0.000
A01.13 Air Conditioning/Pressurization Failures	0.000
A01.12 Fuel System malfunction (including fuel leak)	0.000
A01.11 Electrical System Failure	0.000
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.000
A01.08 Avionics/ Flight Instruments	0.000

A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.087
A01.04 Brakes	0.087
E08 Environmental Threats Traffic	0.058
P05.03 Misinterpreted items on Paperwork	0.029
H02 Ground Navigation	0.029
A01.13 Air Conditioning/Pressurization Failures	0.029
A01.02 Contained Engine Failure	0.029
E05.02 Contaminated runways, taxiways, poor braking action	0.029
C03 Communication Errors CPDLC	0.000
C01.03 With Ground Crew	0.000
P99 Procedural Errors Other	0.000
H99 Aircraft handling Errors Other	0.000
B04 Crew Incapacitation	0.000
A99 Airline Threats Other	0.000
A08 Dangerous Goods	0.000
A06 Dispatch/Paperwork	0.000
A02 MEL item (MEL items with operational Applications)	0.000
A01.99 Airline Threats Aircraft malfunction System Other	0.000
E99 Environmental Threats Other	0.000
E05.04 Ground Maneuvering	0.000
E05.03 Trenches, ditches, intruding structures	0.000
E04 Environmental Threats Birds	0.000

RRR results comparison between GADM ADX analysis and EBT A&I Study – Generation 3 Jet

Threats and Errors (GADM ADX analysis)	Frequency x Severity Total risk
H01 Manual Handling/Flight Controls	4.250
P01.01 Intentional	2.550
P06 Procedural Errors Failure to Go-Around	1.948
E01.02 Poor Visibility (degraded visual environment)	1.948
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.842
A07 Maintenance events	1.806
C02 Communication Errors Pilot-to-Pilot	1.629
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	1.487
A01.03 Landing Gear/Tires	1.417
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	1.381
P03 Procedural Errors Callouts (error in callout or omission of callout)	1.346
E06 Environmental Threats Navaids	1.346
E02 Environmental Threats lack of Visual Reference	1.346
P01.02 Unintentional	1.204
E05.02 Contaminated runways, taxiways, poor braking action	1.133
E03 Environmental Threats Air Traffic Services	1.098
B01 Fatigue	1.062
P02.02 Non-Normal Checklist	0.779
A01.07 Fire/Smoke	0.673

Threats and Errors (EBT A&I Study)	Frequency x Severity Total risk
H01 Manual Handling/Flight Controls	4.993
C02 Communication Errors Pilot-to-Pilot	3.541
P03 Procedural Errors Callouts (error in callout or omission of callout)	3.506
P01.02 Unintentional	3.081
P01.01 Intentional	2.444
E01.01 Adverse Weather (precipitation, thunderstorm, rain, sw, etc.)	2.444
P06 Procedural Errors Failure to Go-Around	2.267
B01 Fatigue	1.842
E02 Environmental Threats lack of Visual Reference	1.523
E01.03 Gusty Wind/Windshear/Wake Turbulence	1.487
A09 Manual/Charts/Checklists/Procedures/Databases	1.310
C01.01 With ATC	1.275
P02.01 Normal Checklist	1.275
E03 Environmental Threats Air Traffic Services	1.275
E01.02 Poor Visibility (degraded visual environment)	1.133
H03 Automation (Settings/Selections)	1.098
P04 Procedural Errors Briefings	1.027
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.956
H04 Systems/Radio/Instruments (Settings/Selections)	0.921

H03 Automation (Settings/Selections)	0.637
E04 Environmental Threats Birds	0.637
A05 Ground events	0.531
E05.03 Trenches, ditches, intruding structures	0.496
E01.04 Icing conditions	0.496
B02 Optical Illusion/Visual Mis-Perception	0.460
A06 Dispatch/Paperwork	0.460
C01.01 With ATC	0.425
P04 Procedural Errors Briefings	0.425
A01.10 Hydraulic System Failure	0.390
A01.08 Avionics/ Flight Instruments	0.390
E05.01 Poor signage/Lighting, faint marking, rwy/txy closures	0.390
B03 Spatial Disorientation and Spatial/Somatogravic Illusion	0.354
A01.99 Airline Threats Aircraft malfunction System Other	0.354
P01.03 Unknown	0.283
A01.01 Uncontained Engine Failure	0.283
E07 Environmental Threats Terrain/Obstacles	0.283
P05.01 Incorrect Weight and Balance/Fuel Information	0.248
H04 Systems/Radio/Instruments (Settings/Selections)	0.248
E08 Environmental Threats Traffic	0.248
E99 Environmental Threats Other	0.212
C01.04 With Dispatch	0.177
H02 Ground Navigation	0.177
A09 Manual/Charts/Checklists/Procedures/Databases	0.177
A08 Dangerous Goods	0.177

P01.03 Unknown	0.850
B02 Optical Illusion/Visual Mis-Perception	0.815
P02.02 Non-Normal Checklist	0.779
E08 Environmental Threats Traffic	0.708
E05.02 Contaminated runways, taxiways, poor braking action	0.673
E07 Environmental Threats Terrain/Obstacles	0.637
A01.07 Fire/Smoke	0.567
C01.02 With Cabin Crew	0.460
B03 Spatial Disorientation and Spatial/Somatogravic Illusion	0.390
A03 Operational pressure (operational time pressure/distraction/n-normal operations)	0.390
P05.02 Incorrect ATIS/Clearance	0.354
H02 Ground Navigation	0.354
A08 Dangerous Goods	0.354
E01.04 Icing conditions	0.354
B04 Crew Incapacitation	0.319
A01.06 Structural Failure	0.319
P05.01 Incorrect Weight and Balance/Fuel Information	0.283
A01.08 Avionics/ Flight Instruments	0.283
E06 Environmental Threats Navaids	0.283
E05.04 Ground Maneuvering	0.283
A07 Maintenance events	0.248
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.212
P05.03 Misinterpreted items on Paperwork	0.177
A01.13 Air Conditioning/Pressurization Failures	0.177
P05.04 Incorrect or missing log book entries	0.142

A01.06 Structural Failure	0.106
A01.05.02 Secondary Flight controls (Flaps, spoilers)	0.106
P02.01 Normal Checklist	0.071
B04 Crew Incapacitation	0.071
A02 MEL item (MEL items with operational Applications)	0.071
A01.04 Brakes	0.071
A01.02 Contained Engine Failure	0.071
P05.04 Incorrect or missing log book entries	0.035
P05.02 Incorrect ATIS/Clearance	0.035
H99 Aircraft handling Errors Other	0.035
A01.11 Electrical System Failure	0.035
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.035
A01.05.01 Primary Flight Controls	0.035
E05.04 Ground Maneuvering	0.035
C03 Communication Errors CPDLC	0.000
C01.03 With Ground Crew	0.000
C01.02 With Cabin Crew	0.000
P99 Procedural Errors Other	0.000
P05.03 Misinterpreted items on Paperwork	0.000
A99 Airline Threats Other	0.000
A04 Cabin events	0.000
A01.13 Air Conditioning/Pressurization Failures	0.000
A01.12 Fuel System malfunction (including fuel leak)	0.000

A01.03 Landing Gear/Tires	0.142
C01.04 With Dispatch	0.106
A04 Cabin events	0.106
A01.10 Hydraulic System Failure	0.106
A01.05.01 Primary Flight Controls	0.106
A01.01 Uncontained Engine Failure	0.106
E05.03 Trenches, ditches, intruding structures	0.106
C01.03 With Ground Crew	0.035
C03 Communication Errors CPDLC	0.000
P99 Procedural Errors Other	0.000
H99 Aircraft handling Errors Other	0.000
A99 Airline Threats Other	0.000
A06 Dispatch/Paperwork	0.000
A05 Ground events	0.000
A02 MEL item (MEL items with operational Applications)	0.000
A01.99 Airline Threats Aircraft malfunction System Other	0.000
A01.12 Fuel System malfunction (including fuel leak)	0.000
A01.11 Electrical System Failure	0.000
A01.09 Autopilot / FMS (including A/THR, Autothrottle)	0.000
A01.04 Brakes	0.000
A01.02 Contained Engine Failure	0.000
E99 Environmental Threats Other	0.000
E04 Environmental Threats Birds	0.000

Appendix 5 – Training Criticality Survey Results

TCS pilots demographics

Duties	Responses	
Instructor	41.03%	231
Management Pilot	20.07%	113
No other duties	33.04%	186
Other (please specify)	5.86%	33
Region	**Responses**	
Africa (AFI)	4.09%	23
Asia Pacific (ASPAC)	13.85%	78
North Asia (NASIA)	0.89%	5
Commonwealth Independent State (CIS)	1.07%	6
Europe (EUR)	27.53%	155
Middle East and North Africa (MENA)	13.68%	77
Latin America and Caribbean (LATAM)	14.21%	80
North America (NAM)	24.69%	139
Experience	**Responses**	
Less than 2 years	0.53%	3
Between 2 to 5 years	4.97%	28
5 to 10 years	9.06%	51
10 to 15 years	16.34%	92
More than 15 years	69.09%	389

What type of aircraft do you currently operate?	Responses		Generation
A318/A319/A320/A321	29.66%	167	4J
A330	11.55%	65	4J
A340-200/300	0.36%	2	4J
A340-500/600	0.53%	3	4J
B777	10.12%	57	4J
A380	4.62%	26	4J
B787	8.70%	49	4J
A350	2.66%	15	4J

What type of aircraft do you currently operate?	Responses		Generation
Bombardier C Series	0.89%	5	4J
Embraer E170/E175/E190/E195	1.78%	10	4J
A310/A300-600	0.53%	3	3J
B737-300/400/500	0.71%	4	3J
B737-600/700/800 (NG)	12.61%	71	3J
B757	0.53%	3	3J
B767	3.91%	22	3J
B747-400	1.60%	9	3J
B747-8	1.07%	6	3J
B717	0.36%	2	3J
BAE 146	0.18%	1	3J
MD11	0.00%	0	3J
MD80	0.36%	2	3J
MD90	0.53%	3	3J
F70	0.00%	0	3J
F100	0.00%	0	3J
Bombardier CRJ Series	0.89%	5	3J
Embraer ERJ 135/145	0.36%	2	3J
ATR 42-600	0.00%	0	3TP
ATR 72-600	1.60%	9	3TP
Bombardier Dash 8 Q Series	0.18%	1	3TP
A300 (except A300-600)	0.00%	0	2J
BAC111	0.00%	0	2J
B727	0.00%	0	2J
B737-100/200	0.00%	0	2J
B747-100/200/300	0.00%	0	2J
DC9	0.00%	0	2J
DC10	0.00%	0	2J
F28	0.00%	0	2J
L1011	0.00%	0	2J
ATR 42	0.00%	0	2TP
ATR 72 (all series except -600)	0.71%	4	2TP
Embraer EMB-120	0.00%	0	2TP

What type of aircraft do you currently operate?	Responses		Generation
DC8	0.00%	0	1J
B707	0.00%	0	1J
Other (please specify)	3.02%	17	

What is your experience on that type	Responses	
Less than 300 hours	7.10%	40
Between 300 – 1000 hours	11.55%	65
Between 1000 – 3000 hours	26.47%	149
More than 3000 hours	54.88%	309
More than 5000 hours	0.00%	0
If 4000+ please specify	0.00%	0

Does your operator grade your performance using the pilot competencies?	Responses	
Yes	89.52%	504
No	10.48%	59

TCS Comparison of Terrain, Traffic and Windshear full results across all generations

TCS Survey results for Terrain

Q86. Phase of Flight (Select only one. Select the phase of flight where Terrain/Obstacles could have the greatest impact on the safety of the flight if mismanaged.)	
Answer Choices	**Responses**
Pre-Flight/Taxi – Flight preparation to completion of line-up	0.00%
Take-off – From the application of take-off thrust until the completion of flap and slat retraction	7.46%
Climb – From the completion of flap and slat retraction until the top of climb	1.42%
Cruise – From top of climb until top of descent	0.18%
Descent – From top of descent until the earlier of first slat/flap extension or crossing the initial approach fix	33.04%
Approach/Go-Around – From the earlier of first slat/flap extension or crossing the initial approach fix until 15 m (50 ft) AAL, including Go-Around	56.31%
Landing – From 15 m (50 ft) AAL until reaching taxi speed	1.60%
Taxi/Post-flight – From reaching taxi speed until engine shutdown	0.00%
Other (please specify)	0.00%

Q87. Select the likelihood of Terrain/Obstacles (The probability you will experience Terrain/Obstacles, requiring your intervention.)	
Answer Choices	**Responses**
1 - Rare - Once in career or less	25.75%
2 - Unlikely - Few times in career	28.77%
3 - Moderate - Once every 3–5 years	15.63%
4 - Likely - Probably once a year	14.39%
5 - Almost Certain - More than once a year	15.45%
Q88. Rate the potential severity of Terrain/Obstacles (The most likely outcome of the event in regards to flight safety.)	
Answer Choices	**Responses**
1 - Negligible - Insignificant effect not compromising safety	0.53%
2 - Minor - Reduction in safety margin (but not considered as significant reduction)	4.26%
3 - Moderate - Safety compromised or significant reduction in safety margin	15.45%
4 - Major - Aircraft damage and/or personal injury	14.92%
5 - Catastrophic - Significant damage or fatalities	64.83%
Q89. Training Benefit (Consider the effect of training in reducing the severity of the event.)	
Answer Choices	**Responses**
U - Unknown - Unknown	0.36%
N - No Effect - Training has no effect	0.18%
L - Low Effect - Training enhances performance in managing an event	6.39%
M - Medium Effect - Having no training compromises safety	28.24%
H - High Effect - Safe outcome is unlikely without effective training	64.83%
Q90. Competencies (Choose any that may reduce or mitigate the severity.)	
Answer Choices	**Responses**
Application of knowledge	65.72%
Application of procedures and compliance with regulations	79.40%
Aeroplane Flight Path Management, automation	71.58%
Aeroplane Flight Path Management, manual control	52.04%
Communication	21.67%
Situation awareness and management of information	96.45%
Leadership and Teamwork	18.29%
Workload Management	31.44%
Problem Solving and Decision Making	23.80%

TCS Survey results for Traffic

Q93. Phase of Flight (Select only one. Select the phase of flight where Traffic could have the greatest impact on the safety of the flight if mismanaged.)	
Answer Choices	**Responses**
Pre-Flight/Taxi - Flight preparation to completion of line-up	1.42%
Take-off - From the application of take-off thrust until the completion of flap and slat retraction	4.62%
Climb - From the completion of flap and slat retraction until the top of climb	18.83%
Cruise - From top of climb until top of descent	13.50%
Descent - From top of descent until the earlier of first slat/flap extension or crossing the initial approach fix	38.19%
Approach/Go-Around - From the earlier of first slat/flap extension or crossing the initial approach fix until 15 m (50 ft) AAL, including Go-Around	21.49%
Landing - From 15 m (50 ft) AAL until reaching taxi speed	0.89%
Taxi/Post-flight - From reaching taxi speed until engine shutdown	1.07%
Other (please specify)	0.00%

Q94. Select the likelihood of Traffic (The probability you will experience Traffic, requiring your intervention.)	
Answer Choices	**Responses**
1 - Rare - Once in career or less	6.75%
2 - Unlikely - Few times in career	23.27%
3 - Moderate - Once every 3-5 years	27.00%
4 - Likely - Probably once a year	27.53%
5 - Almost Certain - More than once a year	15.45%
Q95. Rate the potential severity of Traffic (The most likely outcome of the event in regards to flight safety.)	
Answer Choices	**Responses**
1 - Negligible - Insignificant effect not compromising safety	2.13%
2 - Minor - Reduction in safety margin (but not considered as significant reduction)	8.53%
3 - Moderate - Safety compromised or significant reduction in safety margin	36.59%
4 - Major - Aircraft damage and/or personal injury	17.23%
5 - Catastrophic - Significant damage or fatalities	35.52%
Q96. Training Benefit (Consider the effect of training in reducing the severity of the event.)	
Answer Choices	**Responses**
U - Unknown - Unknown	1.24%
N - No Effect - Training has no effect	3.20%

L - Low Effect - Training enhances performance in managing an event	17.05%
M - Medium Effect - Having no training compromises safety	39.25%
H - High Effect - Safe outcome is unlikely without effective training	39.25%
Q97. Competencies (Choose any that may reduce or mitigate the severity.)	
Answer Choices	**Responses**
Application of knowledge	52.40%
Application of procedures and compliance with regulations	79.04%
Aeroplane Flight Path Management, automation	67.67%
Aeroplane Flight Path Management, manual control	49.20%
Communication	56.66%
Situation awareness and management of information	87.74%
Leadership and Teamwork	11.01%
Workload Management	18.29%
Problem Solving and Decision Making	16.34%

TCS Survey results for Windshear/Windy conditions/Wake turbulence

Q24. Select the likelihood of Windshear/Gusty Conditions/Wake Turbulence (The probability you will experience Windshear/Gusty Conditions/Wake Turbulence, requiring your intervention.)	
Answer Choices	**Responses**
1 - Rare - Once in career or less	2.31%
2 - Unlikely - Few times in career	14.39%
3 - Moderate - Once every 3–5 years	15.99%
4 - Likely - Probably once a year	31.44%
5 - Almost Certain - More than once a year	35.88%
Q25. Rate the potential severity of Windshear/Gusty Conditions/Wake Turbulence (The most likely outcome of the event in regards to flight safety.)	
Answer Choices	**Responses**
1 - Negligible - Insignificant effect not compromising safety	0.89%
2 - Minor - Reduction in safety margin (but not considered as significant reduction)	10.30%
3 - Moderate - Safety compromised or significant reduction in safety margin	33.39%
4 - Major - Aircraft damage and/or personal injury	31.08%
5 - Catastrophic - Significant damage or fatalities	24.33%

Q26. Training Benefit (Consider the effect of training in reducing the severity of the event.)	
Answer Choices	**Responses**
U - Unknown - Unknown	0.18%
N - No Effect - Training has no effect	0.36%
L - Low Effect - Training enhances performance in managing an event	8.17%
M - Medium Effect - Having no training compromises safety	32.15%
H - High Effect - Safe outcome is unlikely without effective training	59.15%
Q27. Competencies (Choose any that may reduce or mitigate the severity.)	
Answer Choices	**Responses**
Application of knowledge	68.21%
Application of procedures and compliance with regulations	66.25%
Aeroplane Flight Path Management, automation	46.89%
Aeroplane Flight Path Management, manual control	84.55%
Communication	23.09%
Situation awareness and management of information	88.63%
Leadership and Teamwork	16.52%
Workload Management	22.02%
Problem Solving and Decision Making	39.61%

TCS results – Generation 4 Jet

Ranking	RRR Score	Question
1	60.127	Q24. Select the likelihood of Windshear/Gusty Conditions/Wake Turbulence
2	58.423	Q31. Select the likelihood of Icing conditions
3	58.322	Q10. Select the likelihood of Adverse Weather
4	58.196	Q87. Select the likelihood of Terrain/Obstacles
5	57.115	Q17. Select the likelihood of Poor Visibility
6	55.954	Q94. Select the likelihood of Traffic
7	55.302	Q66. Select the likelihood of Runway Taxi Conditions
8	54.511	Q304. Select the likelihood of a Failure to Go-Around
9	54.173	Q185. Select the likelihood of Operational Pressure
10	53.971	Q241. Select the likelihood of a Manual Handling error

Ranking	RRR Score	Question
11	53.099	Q45. Select the likelihood of Air Traffic Services Threat
12	53.058	Q129. Select the likelihood of Fire/Smoke
13	52.856	Q255. Select the likelihood of an Automation error
14	52.533	Q38. Select the likelihood of Lack of Visual Reference
15	51.993	Q269. Select the likelihood of SOPs Compliance
16	51.752	Q178. Select the likelihood of a MEL Item
17	51.728	Q234. Select the likelihood of Fatigue/Optical Illusion/Spatial disorientation/Pilot Incapacitation
18	51.514	Q290. Select the likelihood of a Briefings error
19	51.179	Q283. Select the likelihood of Omitted/Wrong Callout(s)
20	50.940	Q318. Select the likelihood of a Pilot-to-Pilot Communication error
21	50.740	Q311. Select the likelihood of a Communication error
22	50.539	Q276. Select the likelihood of a checklist error
23	50.303	Q52. Select the likelihood of Birds
24	49.587	Q199. Select the likelihood of Ground events
25	49.108	Q206. Select the likelihood of Dispatch/Paperwork Events
26	48.735	Q59. Select the likelihood of infrastructure threats
27	48.346	Q101. Select the likelihood of Engine Failure
28	47.618	Q248. Select the likelihood of a Ground Navigation error
29	47.393	Q297. Select the likelihood of a Documentation error
30	46.842	Q213. Select the likelihood of Maintenance events
31	46.717	Q192. Select the likelihood of Cabin events
32	46.139	Q122. Select the likelihood of a malfunction of Flight Controls
33	45.827	Q171. Select the likelihood of Air Conditioning/Pressurization Failures
34	45.765	Q262. Select the likelihood of a Systems/Radios/Instruments error
35	45.466	Q220. Select the likelihood of Dangerous Goods events
36	44.964	Q80. Select the likelihood of Navaids threats
37	44.825	Q164. Select the likelihood of a Fuel malfunction
38	44.347	Q136. Select the likelihood of a malfunction of Avionics/Flight instruments
39	44.236	Q73. Select the likelihood of Ground Maneuvering
40	44.145	Q150. Select the likelihood of a Hydraulic system failure
41	43.895	Q115. Select the likelihood of a Brakes Malfunction
42	43.610	Q108. Select the likelihood of a Landing gear/tires malfunction
43	42.958	Q157. Select the likelihood of an electrical system failure

Ranking	RRR Score	Question
44	42.733	Q227. Select the likelihood of Deficient manual/charts/checklists
45	42.593	Q143. Select the likelihood of a malfunction of Autopilot/FMS
46	39.598	Q325. Select the likelihood of a CPDLC error

TCS results – Generation 3 Jet

Ranking	RRR Score	Question
1	59.886	Q24. Select the likelihood of Windshear/Gusty Conditions/Wake Turbulence
2	58.385	Q17. Select the likelihood of Poor Visibility
3	58.193	Q10. Select the likelihood of Adverse Weather
4	58.045	Q87. Select the likelihood of Terrain/Obstacles
5	56.77	Q31. Select the likelihood of Icing conditions
6	55.151	Q66. Select the likelihood of Runway Taxi Conditions
7	54.248	Q304. Select the likelihood of a Failure to Go-Around
8	54.176	Q94. Select the likelihood of Traffic
9	54.136	Q45. Select the likelihood of Air Traffic Services Threat
10	53.498	Q185. Select the likelihood of Operational Pressure
11	53.348	Q255. Select the likelihood of an Automation error
12	53.198	Q241. Select the likelihood of a Manual Handling error
13	53.084	Q38. Select the likelihood of Lack of Visual Reference
14	51.958	Q269. Select the likelihood of SOPs Compliance
15	51.728	Q129. Select the likelihood of Fire/Smoke
16	51.242	Q283. Select the likelihood of Omitted/Wrong Callout(s)
17	51.054	Q276. Select the likelihood of a checklist error
18	50.641	Q234. Select the likelihood of Fatigue/Optical Illusion/Spatial disorientation/Pilot Incapacitation
19	50.492	Q311. Select the likelihood of a Communication error
20	50.417	Q178. Select the likelihood of a MEL Item
21	50.339	Q318. Select the likelihood of a Pilot-to-Pilot Communication error
22	50.301	Q52. Select the likelihood of Birds
23	49.435	Q290. Select the likelihood of a Briefings error
24	48.988	Q199. Select the likelihood of Ground events
25	48.613	Q206. Select the likelihood of Dispatch/Paperwork Events
26	48.494	Q101. Select the likelihood of Engine Failure

Ranking	RRR Score	Question
27	48.343	Q297. Select the likelihood of a Documentation error
28	47.968	Q213. Select the likelihood of Maintenance events
29	47.667	Q59. Select the likelihood of infrastructure threats
30	47.333	Q122. Select the likelihood of a malfunction of Flight Controls
31	47.181	Q248. Select the likelihood of a Ground Navigation error
32	46.916	Q171. Select the likelihood of Air Conditioning/Pressurization Failures
33	46.505	Q136. Select the likelihood of a malfunction of Avionics/Flight instruments
34	46.129	Q262. Select the likelihood of a Systems/Radios/Instruments error
35	45.191	Q143. Select the likelihood of a malfunction of Autopilot/FMS
36	44.926	Q150. Select the likelihood of a Hydraulic system failure
37	44.811	Q73. Select the likelihood of Ground Maneuvering threats
38	44.511	Q192. Select the likelihood of Cabin events
39	44.327	Q80. Select the likelihood of Navaids threats
40	44.324	Q115. Select the likelihood of a Brakes Malfunction
41	44.285	Q108. Select the likelihood of a Landing gear/tires malfunction
42	43.836	Q220. Select the likelihood of Dangerous Goods events
43	43.611	Q157. Select the likelihood of an electrical system failure
44	43.083	Q164. Select the likelihood of a Fuel malfunction
45	41.539	Q227. Select the likelihood of Deficient manual/charts/checklists
46	40.562	Q325. Select the likelihood of a CPDLC error

Appendix 6 – Studies and Reports Extracts

Note: The contents provided here are taken directly from the studies and reports themselves.

The links to the full documents are provided at the end of each study and report extraction.

Aircraft Handling and Manual Flying Skills Report (IATA 2020)

Executive Summary

Today's modern aircraft are operated using highly sophisticated automation. Automation is a useful tool for pilots and has, without doubt, improved safety, operational efficiency and precise flight path management. However, it was found that continuous use of automation does not strengthen pilots' knowledge and skills in manual flight operations and in fact could lead to degradation of the pilot's ability to quickly recover the aircraft from an undesired state.

Poor manual techniques are flagged by a number of accident analysis that cite inappropriate or erroneous control inputs by the flight crew in response to abnormal events. Although the overall Loss of Control In flight (LOC-I) accident rate has decreased, this accident category continues to outpace other factors as the leading cause of fatal accidents. A number of these accidents may have had a different outcome if the pilots have shown a higher level of monitoring and flying manual skills. Poor manual techniques may also lead to other events such as hard landing, unstable approaches, runway excursions and others. Amongst other techniques and enhancements for manual flight operations, keeping pilots engaged, maintaining and improving the knowledge and skills needed are essential for a safe flight operation.

An analysis of the accident data conducted by IATA identified an increase in manual handling errors. To better understand the issues and why many pilots are reluctant or unable to practice manual flight, a survey was conducted by IATA on Aircraft Handling and Manual Flying Skills to capture the pilots' subjective feedback about their airline automation policies, manual flying practices during everyday line operations and during operator training.

The survey, which included 42 questions, was circulated to over 8,000 people in the aviation industry with the objective to assess:

- if increased automation contributes to pilots' over-reliance and manual flying deficiencies or shortcomings
- how critical manual handling skills are for pilots' confidence and competence, and are needed to take control of the aircraft when automated systems fail to function as intended
- the effect that training techniques and automation policies and guidance have on the ability of pilots to obtain and maintain manual flying skills
- whether there is a need to adjust standards/guidance, so pilots have better opportunities to practice manual flying skills without compromising flight safety, efficient flight operations and/or passenger comfort
- the degree to which dependency on automation may be occurring globally and review the procedures currently employed to ensure pilots maintain the necessary skills.

Survey Results in Brief

The overall results of the survey from 5,650 respondents:

- Good manual flying skills remain essential to achieve safe line operations
- Manual flying skills need to be trained and maintained, irrespective of the aircraft generation
- Manual flying skills can be lost if they are not practiced on a regular basis
- Pilots should have the possibility to revert to basic hand flying when situation permit
- Pilots should be trained to revert to manual flying when automation fails or during an emergency
- Pilots need to maintain manual flying skills to a high degree of proficiency and must develop confidence in their ability to do so

But:

- Many pilots are facing very limited manual flying opportunities, due to regulatory restrictions or airline policies.
- At some airlines, culture and policy discourage pilots from practicing manual flying, since deviations are being managed in a strict way. Consequently, pilots keep away from hand flying, to avoid any potential disciplinary measure.
- Some AOCs have established automation policies that specify the appropriate use of automation; these policies may also include provisions related to manual flying.
- Automation policies vary among AOCs. These range from always mandating the use of full automation, except for take-off and landing, to encouraging the disconnection of automation whenever possible, under certain conditions.
- Although some of the respondents have indicated that they have no clear policies with regards to the use of automation versus manual handling, many have indicated that their policies recommend the highest level of automation to maintain a high level of situation awareness.
- The use of automation above a certain flight level being mandatory means that regulations prevent pilots from acquiring practical manual flying experience at high altitude and high speed.
- The high altitude and speed cruising phase are trained infrequently in the simulator.
- Airline policies recommend the use of automation unless the pilot sees a situation that endangers the safe conduct of the flight.

Recommendations

Operators

- As manual flying competency is essential for flight safety, operators should:
  - Consider whether their automation policies allow sufficient manual operation during line operations.
  - Monitor, in a non-punitive way, using Flight Operational Quality Assurance (FOQA) data, pilots' manual flying performance.
  - Analyze FOQA data to identify and correct deficiencies.

  - Give guidelines to their pilots regarding the minimum level of automation that must be used (considering manufacturers' requirements and operational context).
  - Encourage regular practice of manual flying skills, when appropriate, in order to reinforce the pilots' confidence in their manual flying capabilities.
  - Develop an integrated approach to manual handling into both line operations and simulator training (to include more time allocated to manual flying in the simulator sessions).
  - Ensure that the training objectives include the pilot's ability to manually control the aircraft using the relationship between aeroplane attitude, speed and thrust while monitoring and assessing the aircraft's energy state, and its anticipated flight path.
  - Ensure that flight crew maintain their ability to manage the flight path through manual control of pitch, bank, yaw and/or thrust. This may be conducted with or without the use of a flight directors. but demands pilot competency, ability, knowledge, and skills in the cognitive and motor areas.
  - Consult for further information with the different regulatory publications on promoting manual flight operations when appropriate. Examples of such documentations are the Safety Alert for Operators (SAFO 17007 issued on 5/4/17), EASA Safety Information Bulletin (SIB No.: 2013-05, Issued: 23 April 2013), and Transport Canada Advisory Circular (AC-600-06, Issued: 26 May 2015).
- The operator's training policies should include statements about the importance of maintaining situation awareness and, in particular, mode and energy awareness.
- Automation versus manual flying guidance rules should be based on a mature TEM approach (taking into consideration the four major threats identified in the survey: adverse weather, poor visibility, fatigue and traffic).

Conclusion

The report concludes that, generally speaking, in modern aviation, automation has contributed to the improvement of systems accuracy, reliability and greater operational efficiency. The EBT SG added that it has also contributed to improve safety.

However, the results of the survey confirm that a significant number of pilots have experienced a degradation of their manual handling skills, and a subsequent over-reliance and dependence on automation.

The report states that operators must provide all their pilots, even the highly experienced ones, with opportunities, as appropriate, to hand-fly the aircraft. They must also monitor in a non-punitive way, using FOQA data, pilots' performance with the view of improving safety. This data should be continuously used to guide future pilot assessment and training.

The general sense of lack of confidence in the pilots' manual flying skills can be reversed by encouraging pilots to fly manually whenever the situation permits.

To access the full report, click here.

Loss of Control In-Flight Accident Analysis Report (IATA 2019)

Executive Summary

Loss of Control – Inflight (LOC-I) is the most significant cause of fatal accidents in commercial aviation. LOC-I occurs when an aircraft deviates from the intended flight path or an adverse flight condition places an aircraft outside the normal flight envelope, with the pilot unable to maintain control of the aircraft. A study of LOC-I accidents has been conducted to provide an overview of the subject.

A search was conducted of the IATA Global Aviation Data Management (GADM) accident database to identify accidents that were classified as LOC-I. The study focused on worldwide commercial jet and turboprop aircraft over the last 10 years (2009 through 2018) and found that:

- There were 64 LOC-I accidents identified over the 10-year reporting period.
- 94% of LOC-I accidents involved fatalities to passengers and/or flight crew.
- LOC-I resulted in more fatalities than any other accident category (2,462 of 4,075). It surpassed Controlled flight into Terrain (CFIT), Runway Excursions as the leading cause of fatalities in commercial aviation accidents.
- LOC-I accidents ranked the second highest in terms of hull losses after Runway Excursion accidents.
- LOC-I is one of the accident categories with the lowest survivability ratio.
- The LOC-I all accident and LOC-I fatal accident rates over the 10-year period are 0.17 and 0.16 per million sectors, respectively.
- LOC-I could occur during any phase of flight, but it is most common during Initial Climb (ICL).
- IATA Operational Safety Audit (IOSA)-registered airlines have a lower LOC-I accident rate than non-IOSA- registered airlines.
- LOC-I accidents happen more often on Generation Two turboprops operated by non-IOSA-registered carriers.
- LOC-I is a complex accident category in that the accidents can result from numerous contributing factors, either acting individually or (more often) in combination. Very often, the trigger that initiates a LOC-I accident sequence is an external environmental factor, predominantly meteorological.
- LOC-I accidents do not occur because of an inability to fly the aircraft manually but are rather due to a late or non-decision to take over control manually.
- The following factors which frequently constitute the LOC-I and may preclude an effective recovery are:
  - Human performance deficiencies
  - Automation and flight mode confusion
  - Distraction
  - Startle effect
  - Loss of situational awareness

LOC-I accidents often result from failure to prevent or recover from a stall and/or an upset. Pilots should not only be able to avoid stall and/or upset but should also be able to recover from such situation should they occur. Pilots can prevent and overcome LOC-I accidents through but not limited to:

- Increased awareness of the precursors leading to an upset or a stall
- Development of skills to recognize an upset early in its development
- Taking definitive action to recover from an upset
- Increased awareness for flight crews on the phases of flight and conditions where they are most vulnerable to a LOC-I
- Enhancing monitoring of aircraft and of flight path
- Increased awareness of the flight phases where poor monitoring can be most problematic
- Strategically plan workload to maximize monitoring during those areas of vulnerability (AOV)
- Briefing emphasis on pre-flight and in certain phases/impending night or IMC entries that complicate SA and recovery
- Increased awareness and understanding of certain controls and displays, such as the Flight modes annunciator (FMA) on the primary flight display (PFD)/ Electronic attitude director indicator (EADI)
- Develop a predictive cognitive picture (ahead of the aircraft) and predict on what the aircraft should be doing at certain points
- Constant awareness of stall margin throughout all phases of flight

Proper and adequate training with an emphasis on awareness and prevention provides pilots with the skills to recognize conditions that could lead to a LOC-I event, if not effectively managed.

Moreover, LOC-I is often linked to operation of an aircraft below stall speed. Even with fully protected aircraft, stall awareness, prevention and recovery training, as well as approach-to-stall recovery training, need to be addressed on a regular basis. Training must also be inclusive of the Crew Resource Management (CRM) techniques for the most effective threat prevention and mitigation strategies. The CRM training should focus on situation awareness, communication skills, monitoring, teamwork, task allocation, decision-making and error management within a comprehensive context of standard operating procedures (SOPs).

With LOC-I accidents resulting in more fatalities in commercial operations than any other accident category over the last decade, reducing LOC-I accidents is a priority for IATA and the aviation industry across the globe.

To access the full report, click here.

IATA Safety Reports 2010-2019

The IATA Safety Report is published once a year. The 2019 Safety Report was the 56th Edition of the report.

The Safety Report provides essential insight into global and regional accident rates and contributing factors.

The 2019 edition stated that over the last decade the industry continued its 10-year trend of declining accident rates and fatality risks. All indicators show a 10-year downward trend.

Here is an overview of the data from the IATA Safety Reports that were analyzed for this Amendment.

Between 2013 and 2017:

- The most common accident was Runway/Taxiway Excursion, followed by Gear Up Landing/Gear Collapse and Hard Landings, in that order.
- The top three latent conditions contributing to accidents were Regulatory Oversight, Safety Management and Flight Operations.
- The top three threats were Weather, Aircraft Malfunction and Wind/Wind Shear/Gusts.
- The top three errors were Manual Handling/Flight Controls, Standard Operating Procedure (SOP) Adherence/Cross-verification, Callouts, and Pilot-to-Pilot Communication.
- The most common undesired aircraft state, from which a recovery is still possible, was Long/Floated/Bounced/Firm/Off-center/Crabbed landing, followed by Vertical, Lateral or Speed Deviation and Unstable Approaches.
- The most common counter measures absent in the accidents were Overall Crew Performance, followed by Monitor/Cross- Check and Leadership.

Between 2014 and 2018:

- The most common accident category was Runway/Taxiway Excursion, followed by Gear-up Landing/Gear Collapse, with Hard Landings the third most common category.
- The top three latent conditions contributing to accidents were Regulatory Oversight, Safety Management and Flight Operations.
- The top three threats were adverse weather conditions, Aircraft Malfunction and Wind/Wind Shear/Gusts.
- The top three errors were Manual Handling/Flight Controls, Standard Operating Procedures (SOPs) Adherence/Cross-Verification and Callouts.
- The most common undesired aircraft state, from which a recovery was still possible, was Long/Floated/Bounced/Firm/Off-Center/Crabbed Landing, followed by Vertical, Lateral or Speed Deviation, with Unstable Approaches the third most common state.
- The most common counter measures absent in the accidents were Overall Crew Performance, followed by Monitor/Cross-Check and In-flight Decision-Making/Contingency Management.

Between 2015 and 2019:

- The most common accident category was Runway/Taxiway Excursion (74), followed by In-flight Damage (39), Hard Landings (38) and Gear-up Landing/Gear Collapse (38).
- LOC-I was the most common fatal accident. This single accident category had 19 fatal accidents over the reporting period and was responsible for 780 deaths.
- The top three latent conditions contributing to accidents were Regulatory Oversight, Safety Management and Flight Operations.
- The top environmental and airline threats were Adverse Weather Conditions, Wind/Wind Shear/Gusts, Airport Facilities, and Aircraft Malfunction.
- The top three errors were Manual Handling/Flight Controls, Standard Operating Procedures (SOPs) Adherence/Cross-verification and Callouts.
- The most common undesired aircraft state, from which a recovery was still possible, was Long/Floated/Bounced/Firm/Off-Center/Crabbed Landing, followed by Vertical, Lateral or Speed Deviation, with Unstable Approaches the third most common state.
- The most common countermeasures absent in the accidents were Overall Crew Performance, followed by Monitor/Cross-Check and In-flight Decision-Making/Contingency Management.

Loss of Control – In-flight

Although the LOC-I category represented only 8% of all accidents during the last five years (2015-2019), it resulted in the highest percentage of fatal accidents (51%). Therefore, LOC-I remains one of the most significant contributors to fatal accidents worldwide.

LOC-I refers to accidents in which the flight crew was unable to maintain control of the aircraft in flight, resulting in an unrecoverable deviation from the intended flight path. LOC-I can result from a range of interferences, including engine failures, icing or stalls. It is one of the most complex accident categories, involving numerous contributing factors that act individually or, more often, in combination. Reducing this accident category, through understanding of causes and possible intervention strategies, is an industry priority.

IATA has developed an accident analysis report using data from LOC-I accidents. By definition, LOC-I can be avoided, and it is hoped that the content of the interactive LOC-I Accident Analysis Report will help achieve that goal. This report presents data from 64 LOC-I accidents that occurred over 10 years, spanning 2009 through 2018. Some of the recommendations for operators to consider are:

- Conduct training on energy management in a variety of scenarios and flight phases, including, but not limited to, engine failure, thrust loss, and abnormal engine configurations.
- Provide classroom and simulator training to flight crew on a regular basis.
- Include and emphasize training for pilot monitoring of the aircraft flight path and system, and encourage manual intervention, as appropriate.
- Reinforce workload management as well as task allocation and prioritization.
- Ensure operations are conducted in accordance with SOPs. • Ensure training is completed within the validated training envelop of the Flight Simulation Training Devices (FSTD).

- Refer to IATA Guidance Material and Best Practices for the Implementation of Upset Prevention and Recovery Training (REV 2).
- Consult the 3rd edition of the Airplane Upset Prevention and Recovery Training Aid (AUPRTA), which emphasizes both recognition and prevention.
- Incorporate, where applicable, the Commercial Aviation Safety Team (CAST) safety enhancements (SEs). All SEs, including 192-211 on Airplane State Awareness, are available on Skybrary.

Pilots can prevent and overcome LOC-I accidents through, but not limited to:

- Increased awareness of the precursors leading to an upset or a stall.
- Taking definitive action to recover from an upset.
- Enhanced monitoring of aircraft and flight path.
- Increased awareness of the flight phases where poor monitoring can be most problematic.
- Strategically plan workload to maximize monitoring during those Areas of Vulnerability (AOV).
- Emphasize the briefing on pre-flight and, in certain phases, impending night or Instrument Meteorological Conditions (IMC) entries that complicate situational awareness and recovery.
- Increased awareness and understanding of certain controls and displays, such as the Flight Modes Annunciator (FMA) on the Primary Flight Display (PFD)/Electronic Attitude Director Indicator (EADI).
- Constant awareness of stall margin throughout all phases of flight.

Download the LOC-I Accident Analysis Report (pdf) to get an evaluation of the risk factors from LOC-I accidents and information designed to aid the industry in the implementation of mitigation strategies.

To access the IATA Safety Report, click here.

Unstable Approaches, Risk Mitigation Policies, Procedures and Best Practices, 3rd Edition (IATA / IFALPA / IFATCA / CANSO)

The purpose of this document is to reiterate the importance of a stable approach and encourage pilots to make the proper go-around decision if the approach exhibits any element of an unstable approach. It also enhances the overall awareness of the contributing factors and outcomes of unstable approaches, together with some proven prevention strategies. This manual provides a reference, based upon the guidance of major aircraft manufacturers and identified industry best practice, against which to review operational policy, procedures and training.

The document states that the industry– manufacturers, regulators, professional associations, air navigation service providers (ANSPs), operators, air traffic controllers and pilots – share an unequivocal position that the only acceptable approach is a stable one.

An important part of a stable approach training program is that pilots have the ability to recognize an unstable approach, when it occurs, and initiate a go-around. Pilots must be trained to go-around from any point on the approach where the approach may need to be discontinued because it is unstable or has become unstable.

The most effective unstable approach countermeasures are the Threat and Error Management (TEM) and Crew Resource Management (CRM) skills. Leadership, monitoring, cross checking, communication and sharing mental models, if used correctly, can all prevent an Undesired Aircraft State from developing into a more serious End State.

The document concludes that:

An unstable approach is an undesired aircraft state which is recoverable only with the execution of a missed approach or go around. Fifteen percent of the landing accidents in the five-year period reviewed (2012-2016) would have been prevented by such action.

Failure to go around from an unstable approach or an approach which becomes unstable is an intentional violation of standard operating procedures. Understanding why procedures are violated is a complex human factors equation. There is often little reward for complying with SOPs and violations, which do not always generate adverse outcomes, can reinforce non-compliant behavior. It is therefore important for pilots to understand what it is that an unstable approach is compromising. The accidents show that the stable approach gate is a safe height to review the aircraft energy state. If the gate is not achieved the flight crew are carrying the energy management problem to an unsafe height. In accident scenarios, when other unexpected conditions are encountered, a decision to go around below the gate is too late to recover the undesired aircraft state. Conversely, in some accidents studied the option to go around was still available to the flight crew from, for example, a baulked or bounced landing as a result of the unstable approach.

Flight crews must be completely comfortable and confident with execution of a go around from any position on the approach and landing right down to a bounced landing. This requires training and practice, so far as it is possible, in the simulator, because the maneuver is seldom encountered in routine line operations. It also requires a company culture where go arounds are encouraged and not the catalyst for sanctions.

A culture of compliance with all SOPs must also prevail. Compliance with stable approach procedures can easily be monitored with an FDM/FOQA program and protocols must be in place to allow flight crews to be debriefed and retrained as appropriate. Some operators also have a system to monitor for repeated non- compliance by using pseudo codes and a method for approaching this under agreements with pilot representative bodies.

Challenging operating environments, a can-do culture and operational pressure must all be balanced and assessed by operators to ensure that this accident precursor is eliminated from their operation. An active SMS, and positive safety culture, is a benefit in this regard and is encouraged.

The contributory factor to accidents of a failure to go around will continue to be monitored between the ACTF and reported in the IATA safety report. Operators are commended to apply the guidance in this document.

To access the Unstable Approaches, Risk Mitigation Policies, Procedures and Best Practices, 3rd Edition, click here.

ICAO Safety Report – 2020

ICAO promulgates Standards and Recommended Practices (SARPs) to facilitate harmonized regulations in aviation safety, security, efficiency and environmental protection on a global basis.

Improving the safety of the global air transport system is ICAO's guiding and most fundamental strategic objective. The Organization works constantly to address and enhance global aviation safety through the following coordinated activities:

- Policy and Standardization;
- Monitoring of key safety trends and indicators;
- Safety Analysis; and
- Implementing programmes to address safety issues.

The ICAO Global Aviation Safety Plan (GASP) presents the strategy in support of the prioritization and continuous improvement of aviation safety. The GASP sets the goals and targets and outlines key safety enhancement initiatives (SEIs) aimed at improving safety at the international, regional and national levels. This edition of the Safety Report is structured in alignment with the 2020–2022 edition of GASP and the new edition of the Global Air Navigation Plan (GANP), which provides global strategic guidelines to drive the evolution of the air navigation system. This report provides a summary of initiatives to improve aviation safety and provides updates on some safety performance indicators (SPIs), including accidents that occurred in 2019, and related risk factors.

High-risk Categories of Occurrence

Based on actual fatalities, high fatality risk per accident or the number of accidents and incidents, as well as results from the analysis of safety data collected from proactive and reactive sources of information from ICAO and other non-governmental organizations, ICAO has identified five high-risk categories of occurrence (HRCs) as global safety priorities in the 2020–2022 edition of the GASP:

a) controlled flight into terrain (CFIT);

b) loss of control in-flight (LOC-I);

c) mid-air collision (MAC);

d) runway excursion (RE); and

e) runway incursion (RI).

ICAO uses these high-risk categories of occurrence (HRCs) as a baseline in its safety analysis to achieve a continuous reduction of operational safety risks (Goal 1) and its linked targets and indicators, as presented in the GASP.

Chart 13 below shows that in 2019, the five HRCs for scheduled commercial air transport operations represented 29 per cent of all fatalities, 67 per cent of fatal accidents, 16 per cent of the total number of accidents and 24 per cent of the accidents that destroyed or caused substantial damage to aircraft

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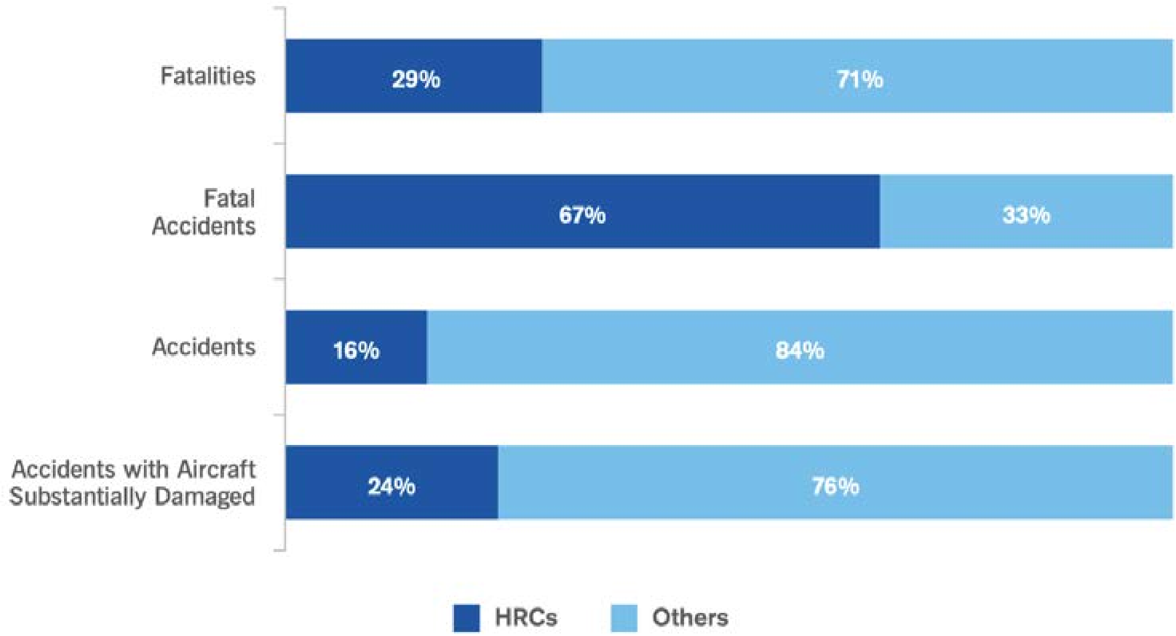

Chart 13. HRC accident distribution

To access the ICAO Safety Report, click here.

ICAO Runway Safety Programme – Global Runway Safety Action Plan 2017

Global Priorities for Runway Safety

The current edition of the Global Aviation Safety Plan (GASP) identifies runway safety as a global safety priority. Runway safety-related events as defined in the GASP and ICAO Annual Safety Report, include the following ICAO accident occurrence categories:

- Abnormal Runway Contact
- Bird Strike Ground Collision
- Ground Handling
- Runway Excursion
- Runway Incursion
- Loss of Control on the Ground
- Collision with Obstacle(s) Undershoot / Overshoot
- Aerodrome

In line with safety management principles the RSAP-WG conducted an analysis of available runway safety accident and serious incident data and conducted a risk assessment to identify the runway safety high risk categories, in order to prioritize the efforts of the Runway Safety Programme.

The result of the analysis identified runway excursions as the highest risk category with a total risk weight significantly higher than all other categories.

ICAO and Runway Safety Partners have also identified runway incursions as a high risk category. Although the number of runway incursion accidents reported between the period of 2008 to 2016 is very low, the number of runway incursion incidents remains high (at a rate of 1 report per day according to IATA STEADES data). There is a very high fatality risk associated with runway incursion accidents. The collision between two B747s at Los Rodeos Airport, Tenerife, in 1977, was the result of a runway incursion and remains the worst accident in aviation history, with the highest number of fatalities.

Although the Runway Safety Programme will focus efforts on the runway safety high risk categories, runway excursions and runway incursions, the other runway safety categories should not be forgotten. Aerodrome runway safety teams and safety management systems should continue to focus on all the runway safety accident categories.

This action plan provides recommended actions for runway stakeholders, including ICAO, the runway safety programme partners, State Civil Aviation Authorities, Regional Safety Oversight Organisations (RSOOs), Regional Aviation Safety Groups (RASGs), aircraft operators, aerodrome operators, air navigation service providers and Aerospace Industry. The actions detailed in this document are aimed at reducing the global rate of runway excursions and runway incursions. However, regions, States and industry may have their own unique challenges, therefore the actions are not all encompassing. States, regions and industry should conduct their own regular risk analyses to identify their own operational safety risks and appropriate mitigations.

To access the ICAO Runway Safety Programme – Global Runway Safety Action Plan 2017, click here.

IATA Runway Safety Accident Analysis Report (2010–2014)

Runway safety has become a significant area of interest for the industry due to the frequency of accidents in the runway environment; these include runway excursions, runway collisions, undershoot/overshoots, tail strikes and hard landing events.

Runway/taxiway excursion is the most frequent category of accidents, representing 22 percent of all accidents over the period of 2010–2014. There is an average of 18 runway/taxiway excursions to commercial air transport aircraft worldwide per year. Excursions can lead to loss of life and/or injury to persons either on board the aircraft or on the ground and can result in damage to aircraft, airfield or off airfield equipment including other aircraft, buildings or other items struck by the aircraft.

In total, there were 90 runway/taxiway excursions accidents identified over the five (5)-year period emphasizing a need to prioritize preventive measures.

Analysis in this report evaluates the risk factors from runway safety accidents and presents information designed to aid industry in the implementation of mitigation strategies. The data set includes aircraft over 5,700 kg maximum take-off weight engaged in commercial operations according to the IATA definition.

Scope (Section 4)

The report is designed to inform the aviation industry and provide detailed information and understanding of global accidents, runway safety and runway excursion accident statistics during the five (5) years (2010–2014) to support the industry with safety improvement initiatives. The report also identifies causal and contributory factors that may lead to a runway safety event and from which preventive measures can be formulated.

Mitigations (Section 9)

The most robust operational mitigation against runway excursions, which constitute the majority of runway safety accidents, is effective recognition and decision making in respect to unstable approaches. If an aircraft arrives at touchdown too fast or with too little runway remaining the chances of completing the landing safely are much reduced. If the approach cannot be stabilized a go around must be flown, followed by a second stable approach or diversion to a more suitable runway. A fundamental understanding of the exponential effect of additional speed on total aircraft energy at landing, whether due to excess airspeed or to tailwind, is vital to this process and training programs must ensure pilots are well aware of this relationship (momentum = ½ mass x velocity 2). Operators should ensure that they promulgate, monitor (using flight data programs – see below) and enforce a rigorous stabilized approach policy, supported by clear procedures and effective training. There are an increasing number of technological solutions available to assist pilots in the decision-making process and these are discussed in a separate IATA guidance document. Air traffic service providers can facilitate stabilized approaches by ensuring that the approach paths offered are 'compliant' in terms of final approach interception angle and altitude.

Pilots must also recognize the importance of the timely deployment of retardation devices to the aircraft's runway stopping performance. Many accidents have been exacerbated by the absence of ground spoiler deployment, late selection of reverse thrust or late/inadequate application of braking.

Contaminated runways frequently contribute to runway safety accidents and pilots must ensure that the landing performance has been calculated correctly in respect to the runway condition. Air traffic service providers and airport managements can greatly assist in this by ensuring accurate and timely runway condition reports are provided to pilots, both for arrivals and departures.

Airports and their regulators can also help mitigate the severity of runway excursions by requiring and providing runway end safety areas (RESA) in accordance with ICAO standards and recommended practices (Annex 14). Where local topography does not permit the standard RESA, consideration may be given to the installation of engineered materials arresting systems, which use frangible concrete paving to absorb aircraft energy in the runway overrun area. Neither of these measures will prevent runway excursions but they may reduce damage, fatalities and injuries by ensuring aircraft do not impact obstacles prior to stopping.

FDM Guidance for Monitoring Runway Safety Indicators

The European Action Plan for the Prevention of Runway Excursions – Released Edition 1.0 – January 2013 states that European regulation requires aircraft operators to establish and maintain an accident and flight safety program which includes a flight data monitoring (FDM) program for aircraft in excess of 27.000kg.

The flight path parameters monitored by this system should include parameters closely related to the risk of runway excursion such as:

Landing:

- Deep landing
- Short landing
- Long flare
- Spoiler deployment during landing
- Late landing flaps selection
- Late landing gear selection
- Tail and/or crosswind
- Stabilized approach criteria met at the specified gates
- Threshold crossing height
- Excess speed over the threshold
- Use of reverse thrust
- Use of brakes
- High speed exits from runways
- Landing performance analysis

Takeoff:

- Use of reverse on rejected takeoff
- Use of brakes on rejected takeoff
- Nose wheel steering used at high speeds
- Runway distance remaining after rejected takeoff
- Crosswind and/or tailwind

The European Authorities Coordination Group on Flight Data Monitoring developed standardized FDM based indicators for Runway Excursion as follows:

- RE1 – High speed rejected take-off
- RE2 – Take-off with abnormal configuration
- RE3 – Insufficient take-off performance
- RE4 – Unstable shortly before landing
- RE5 – Abnormal altitude or bounce at landing

- RE6 – Hard or heavy landing
- RE7 – Aircraft lateral deviations at high speed on the landing

To access the full report, click here.

Performance Assessment of Pilot Compliance with Traffic Collision Avoidance System Advisories Using Flight Data Monitoring Guidance Material – 2nd Edition (IATA / EUROCONTROL)

Conclusions (pilot compliance with TCAS RAs)

The study has shown that a significant proportion of RAs are not flown correctly. These results are in line with anecdotal evidence from various sources. The study is not well placed to determine directly whether safety is degraded when pilots do not follow RAs correctly. However, it can be assumed that any incorrect responses to RAs may fail to resolve a collision (as indicated by simulations of TCAS in safety studies).

The study found a number of cases where, in the absence of correct pilot response, vertical separation at the Closest Point of Approach was significantly reduced. However, the relative infrequency of these cases meant they could not be used to draw statistically significant conclusions. Moreover, the achieved vertical separation was affected by additional factors, including: pilot responses to modified RAs; manoeuvres of the other aircraft in the encounter; and, in the case of Level Off RAs (which are typically issued when the aircraft are still separated) any degradation of separation is difficult to detect.

For Climb and Descend RAs, regardless of whether the assessment was at 8, 12 or 16 seconds after the RA, the compliance never exceeded 30%, with opposite reactions reaching 22%. Approximately half of the pilots did not achieve the required vertical rate, so their response was classified as “not followed”. It should be noted here that the required vertical rate was “generously” applied, classifying an RA as followed if the vertical speed was within 300 ft/min. of the required vertical rate (as indicated by the lowest value of the green arc).

Prompt and correct responses are particularly important for reversal and strengthening RAs. Unfortunately, in over half of the cases pilots did not react correctly to these RAs. Although the assessment using radar data comes with some limitations (which could be overcome with the use of recorded airborne data, but this is not generally available due to logistic, commercial, and legal reasons), it clearly indicates that the level of pilot compliance with TCAS resolution advisories is low. That, again, emphasizes the need for aircraft operators to monitor carefully performance of their crews and to take corrective measures as necessary.

Based on the VMDs conducted examination it can be confirmed that pilot compliance with Resolution Advisories brings safety benefits by increasing the relative vertical distance between the two-conflicting aircraft

To access the full report, click here.

IATA – Guidance Material for Improving Flight Crew Monitoring, 1st Edition

This manual serves as guidance material for operators to better understand the concept of monitoring, the flight crew monitoring functions and roles, and current practices for integrating monitoring knowledge and skills into flight training programs, such as ab-initio, conversion, upgrading, type rating and recurrent training. It provides practical guidance for defining pilot roles and responsibilities for monitoring during line operations, for training monitoring tasks and skills, and for instructors to properly teach monitoring.

Most flight crew tasks include some form of monitoring or the tasks themselves are monitored as part of the overall task management of the flight. Monitoring is performed during all phases of flight, from aircraft ground and pre-flight operations to take-off until landing, to after landing and post flight operations, and should be adapted to each phase of the flight.

The primary job of the flight crew is the flight path management, including managing the energy state of the aircraft at all times. This requires effective monitoring, whether operating in manual or automated flight. Monitoring of the flight path is done through the observation of essential instruments including primary flight displays, navigation displays, mode control panel, flight mode annunciations, configuration status, etc.

The document stresses the importance that operators define in their operation manual an overarching policy providing guidance on the monitoring process, monitoring tasks, assigned flight crew monitoring duties, crew communications, and SOPs related to monitoring.

Section 9 of this manual provides strategies for evaluating monitoring.

Strategies for Evaluating Monitoring

Evaluating monitoring is challenging because some of the monitoring processes reside in the mind; they cannot be observed and are difficult to measure. Additionally, monitoring is not a stand-alone task; it is integrated in all the pilot competencies.

Currently there is no specific cognitive task analysis tool available to evaluate monitoring in aviation training. However, effortful, and carefully designed training scenarios, allow for structured observation of the flight crew's monitoring skills. When measuring their monitoring performance, instructors and evaluators should stick to the operator's defined observable behaviors and monitoring policy. Evaluation and grading of monitoring can then be achieved by comparing the observed level of performance with the targeted values of the operator.

Deficiencies in monitoring may be observed by the operational outcome. The TEM model serves for instructors and evaluators to capture and analyze such deficiencies. Threats that remain unidentified, errors that are not detected and undesired aircraft states that are not recognized may be tracked back to insufficient monitoring.

To add training value for the flight crew, instructors and evaluators should properly identify the root causes of monitoring failures. Helping to identify the barriers that hampered monitoring will enable the flight crew to understand "why" the failure occurred and facilitate learning.

To help learning, an operator should provide a safety culture that includes self-debriefing and crew-debriefing tools for each flight and training session. These debriefing tools should include discussing observed behaviors and the cognitive process of the flight crew.

Based on the desired training outcomes, an operator can include specific monitoring events in the training and evaluation and use a debriefing strategy to reinforce and evaluate monitoring. The syllabus should integrate the operator's SOPs for monitoring with the SOPs for flight path management and CRM and TEM, with focus on predictive and reactive monitoring, anticipation and identification of threats, detection and correction of errors and recognition and recovery of undesired aircraft states.

Evaluation Using Observable Behaviors

Observed behavior followed up by facilitated discussion to bring out the contributing factors of the behavior is critical for success. Observable behaviors serve as a debriefing tool for monitoring performance. It is important that the operator identifies among the behaviors the ones that are related to monitoring. This makes it easier for the crew member and instructor/evaluator to evaluate and facilitate the debriefing of the monitoring abilities of the PF, PM, and flight crew. This is particularly true for line oriented evaluation and scenario-based training when monitoring activities are targeted with surprise effect, high workload management, etc.

Evaluating Monitoring

The evaluation should focus on the monitoring process and pilot performance based on observable behaviors. Remember that observable behaviors are defined to address monitoring as a primary focus for some elements/competencies and may also be embedded in other observable behaviors as secondary elements, e.g., the observable behavior "Maintains the desired flight path" also requires that the pilot monitors the flight path. As one can only evaluate what is observed, to better understand what a crew member was thinking and why he reacted in a certain way, a facilitated debrief is a good way to understand why the crew member acted in a certain way.

This document can be found on the IATA on-line store: https://www.iata.org/en/publications/

Flight Safety Foundation, Global Action Plan for the Prevention of Runway Excursions (2021)

Below is an extraction of the recommendations made within this report to aircraft operators.

RECOMMENDATIONS TO AIRCRAFT OPERATORS			
REF	**Recommendation**	**Action by**	**Implementation Date**
OPS1	Aircraft operators should participate in safety information sharing networks with all relevant stakeholders. This should facilitate the free exchange of relevant runway safety information including identified risks, safety trends and good practices.	Aircraft Operator	Ongoing
OPS2	Aircraft operators should include and monitor aircraft parameters related to potential runway excursions in their Flight Data Monitoring (FDM) programme. Whenever standardised FDM markers are provided by the industry, aircraft operators should use them with priority to ensure the effectiveness of risk mitigation and safety assurance associated with runway excursion barriers and to allow comparability on an industry level.	Aircraft Operator	End of 2023
OPS3	Aircraft operators and training providers should include realistic, evidence- and competency-based scenarios into their training programmes requiring threat and error management for runway excursion prevention during both takeoff and landing. This should include evidence- and competency-based recurrent simulator training programmes which are representative in terms of environmental conditions, including crosswind, landing on contaminated/slippery runways and poor visibility adapted with simulator representativeness. Representativeness of simulators should be assessed and their limitations communicated (in order to avoid negative training)	Aircraft Operator	End of 2023
OPS4	Aircraft operators should incorporate appropriate technical solutions to reduce runway excursion risks, where available (including Runway Overrun Awareness and Alerting System (ROAAS), and runway veer off awareness and alerting systems, when and if available). If technical solutions are not available, operators should implement appropriate SOPs and TEM strategies which support flight crews in effectively preventing run- way excursions.	Aircraft Operator	End of 2027
OPS5	If technically feasible, aircraft operators should equip their air- craft fleet with data-link systems (e.g., ACARS) enabling them to digitally obtain the latest weather information (e.g., D-ATIS or METAR). The use of this technical means has to be supported by adequate SOPs enabling all pilots on the flight deck to familiarise themselves with the latest weather conditions without impeding aircraft and flight path monitoring.	Aircraft Operator	End of 2025
OPS6	Aircraft operators should implement policies for flight crews not to accept ATC procedures and clearances which have the potential to	Aircraft Operator	End of 2027

RECOMMENDATIONS TO AIRCRAFT OPERATORS			
REF	**Recommendation**	**Action by**	**Implementation Date**
	decrease safety margins to an unacceptable level for the flight crew thereby increasing the risk of runway excursions. This includes such procedures and clearances which increase the likelihood of having an unsafe approach path management with consequences for safe landing, e.g., which bear the risk of being unstabilised at the landing gate or high-energy approaches.		
	These policies should be further supplemented by the implementation of effective SOPs and flight crew training. Flight Crews should be required to report such risks within their operators SMS and the aircraft operator should further report such risks to the ANSPs via established reporting systems. (see OPS1)		
OPS7	Aircraft operators should implement policies for safe descent and approach planning, stabilised approach, safe landing and go-around and should ensure that these are implemented in their training. Aircraft operators should define which elements of these policies have to be included and highlighted during the approach briefings by flight crews.	Aircraft Operator	End of 2023
OPS8	Aircraft operators should implement policies or SOPs for flight crews not to conduct takeoff or approach following any runway change until the appropriate set-up, planning, performance calculations (for multi-pilot operations this includes independent calculations and cross-checks by at least two pilots) and re-briefings are completed. When a takeoff runway change is received whilst taxiing, the above should be performed by flight crew without rushing and when the aircraft is stationary. Runway-excursion related TEM should be addressed in the briefing every time a runway change is expected, probable or actually occurs.	Aircraft Operator	End of 2023
OPS9	Aircraft operators should implement policies or SOPs for flight crews to request a more favourable runway for takeoff or landing for any reason, which may affect the safety of the flight and to advise the safety reasons to ATC.	Aircraft Operator	End of 2023
OPS10	Aircraft operators should implement policies or SOPs requiring flight crews to confirm prior to commencing the takeoff or landing phase that the actual conditions (weather and aircraft configuration) are better or at least correspond to the values used for performance calculations. When conditions are predicted to approach operational limitations, flight crews should be required to identify the limiting parameters and incorporate this into their TEM briefing.	Aircraft Operator	End of 2023
OPS11	Aircraft operators should define company cross- and tailwind limits which are specific to each type of aircraft operated. Moreover, specific guidance on the runway conditions and the gust components should be clarified. Aircraft operators should establish clear policies to allow their flight crews to reduce the established limits whenever deemed necessary for safety reasons in actual flight operation.	Aircraft Operator	End of 2023

RECOMMENDATIONS TO AIRCRAFT OPERATORS			
REF	**Recommendation**	**Action by**	**Implementation Date**
OPS12	Aircraft operators should publish specific guidance and training for their flight crews on crosswind takeoff and landing techniques, especially in wet, slippery or contaminated runway conditions. This should include the correct touchdown and stopping techniques, which incorporate all available control and deceleration devices as well as TEM topics and methods for effective monitoring and intervention by the PM. Aircraft manufacturers advice should be incorporated, if available.	Aircraft Operator	End of 2023
OPS13	OPS13 a. Aircraft operators should ensure their policies or SOPs require flight crews to perform independent performance calculations. This should also include independent cross-checks of the load and trim sheet and the actual TORA/TODA from the AIS (e.g., if reduced by NOTAM) with TORA/TODA used to calculate the takeoff performance. This independent calculation should also be applied following a runway change. OPS13 b. Aircraft operators should ensure their policies or SOPs include flight crew gross-error checks and crew cross-checks prior to any data input and prior to executing any data input in the FMS.	Aircraft Operator	End of 2023
OPS14	Aircraft operators should publish SOPs and guidance which in- corporate runway excursion mitigation associated with rejected takeoff decision making and rejected takeoff manoeuvres. Appropriate training should be provided.	Aircraft Operator	End of 2023
OPS15	Aircraft operators should develop SOPs which include an assessment, possibly prior to the top of descent, of landing performance based upon latest and best-available weather information. This calculation should not be performed using dispatch weather information. Flight crews should be informed of the type of landing distance data available (factored or unfactored) and of which correlating safety factors are used. When possible, the crew should complete descent, approach, landing planning, set-up and briefings prior to the top-of-descent.	Aircraft Operator	End of 2023
OPS16	Aircraft operators should develop a clear go-around policy which should be further supplemented by a set of SOPs and guidance materials to put this policy into action. This go-around policy should enable every flight crew member on the flight deck to call for a go-around at any time unless an emergency situation dictates otherwise. In all cases, the SOPs should require both pilots to have and retain the required visual reference below DA/MDA with a go around call mandatory if either pilot loses it. A go-around should also be mandatory if the approach becomes unstabilised below the specified approach/landing gate. Recurrent simulator training should be provided on the competencies of safe go-around in various stages during the approach and landing, including shortly prior or during touchdown (before activation of thrust reversers).	Aircraft Operator	End of 2023

RECOMMENDATIONS TO AIRCRAFT OPERATORS			
REF	**Recommendation**	**Action by**	**Implementation Date**
OPS17	Aircraft operators should require the flight crew to carefully evaluate operational safety before selecting/accepting an approach and landing runway including the following: weather conditions (in particular cross and tailwind), runway condition (dry, wet or contaminated/slippery), inoperable equipment and aircraft and flight crew performance in order to reduce runway excursion risks.	Aircraft Operator	End of 2023
OPS18	Aircraft operators should clearly define stabilised approach, landing and go-around polices in their operations manual. These polices have to be aligned with regulations requirements and manufacturers guidance. Supplementing SOPs should include the requirement for completion of the landing checklist and flying with the final approach speed latest at the defined approach/landing gate. These SOPs should include appropriate means for the pilot monitoring (PM) to effectively monitor and, if needed, intervene. To properly implement the defined policies and SOPs, aircraft operators have to deliver appropriate training.	Aircraft Operator	End of 2023
OPS19	Aircraft operators should publish SOPs and guidance and provide training highlighting the importance of active monitoring and effective intervention by the pilot monitoring (PM) during descent, approach, approach path management and landing. Actions to be taken by the PM and required reactions by the PF should be clearly documented in the official publication (e.g., SOPs or Operations Manual, FCOM, etc). These publications should include guidance how to achieve effective PM performance, independent of rank and experience.	Aircraft Operator	End of 2023
OPS20	Aircraft operators should publish SOPs and guidance for their pilots not to conduct auto-land approach manoeuvres at airports when low visibility procedures (LVP) are not in force, unless: • the ILS critical and sensitive areas are protected, • ATC had been informed and reassurance of ILS sensitive area protection had been received or • specific precautions have been taken and risk analysis has been performed. More information is available in the guidance material. or • the aircraft is demonstrated as robust to non-protection of ILS sensitive area.	Aircraft Operator	End of 2023
OPS21	Aircraft operators should clearly define their policy for a safe landing and publish it in their SOPs and Operations Manuals. This policy should clearly define acceptable touchdown limits and prohibit intentional long and short landings, e.g., to minimise runway occupancy or minimise taxi time to the gate. The supplementing SOPs and guidance should include means, methods and responsibilities with regard to how a crew will identify and act on such limits. Appropriate classroom and simulator training should be provided.	Aircraft Operator	End of 2023

RECOMMENDATIONS TO AIRCRAFT OPERATORS			
REF	**Recommendation**	**Action by**	**Implementation Date**
OPS22	Aircraft operators should publish SOPs and guidance for landing techniques that are aligned with ICAO Global Reporting Format and manufacturer's guidance for all runway states and environmental conditions. Aircraft operators should require their flight crew to always favour a go-around or diversion rather than to attempt a landing when approaching wet, slippery/contaminated runways without appropriate stopping margin and/or in limiting wind situations. Appropriate training should be provided including training in the ICAO Global Reporting Format.	Aircraft Operator	End of 2021
OPS23	Aircraft operators should publish SOPs for their flight crews when runway conditions are uncertain or actual or anticipated slippery wet, slippery or contaminated, to fully use all deceleration means, including speed brakes, wheel braking and reverse thrust irrespective of noise-related restrictions, until a safe stop is assured, unless this causes controllability issues.	Aircraft Operator	End of 2021
OPS24	Aircraft operators should publish SOPs and guidance and provide training highlighting the importance of active monitoring, including monitoring of the activation of the stopping devices on landing, and effective intervention during landing associated with pilot monitoring duties and performance. Appropriate training should be provided.	Aircraft Operator	End of 2023
OPS25	Aircraft operators should define policies and procedures to address bounced landings. Whenever available, aircraft operators should take into account and include manufacturers' guidance. Moreover, aircraft specific and appropriate training, including simulator training, should be provided for flight crews.	Aircraft Operator	End of 2023
OPS26	Aircraft operators should develop guidance on whether a change of control during landing roll out has to take place and require their flight crews to brief and agree on the planned runway exit, taking into account the friction status of both runway and runway exit, whenever available. When a change of control is necessary during roll-out, this should be performed below taxi speed and when the aircraft trajectory is stable.	Aircraft Operator	End of 2023
OPS27	Aircraft operators should implement policy, technical solutions or SOPs which confirm that the aircraft is lining up on the planned runway, its centreline and via the correct intersection.	Aircraft Operator	End of 2023
OPS28	Aircraft operators should publish SOPs and guidance for their flight crew not to accept line-up, backtrack or takeoff clearances until pre-takeoff preparation (including cabin secure), procedures and checklists are completed to the appropriate point which permits the accomplishment of the associated manoeuvre without delay and until they have reported "ready for departure" to ATC. Aircraft operators should publish an explicit SOP for "rolling takeoffs".	Aircraft Operator	End of 2023

RECOMMENDATIONS TO AIRCRAFT OPERATORS			
REF	**Recommendation**	**Action by**	**Implementation Date**
OPS29	Aircraft operators should foster a culture that stimulates safe behaviour, which encourages risk-averse decision-making by flight crews.	Aircraft Operator	Ongoing
OPS30	Aircraft operators should, when determining their TEM strategies and SOPs, identify runways with a remaining safety margin of less than 400m/1200ft after application of all required safety factors as safety critical.	Aircraft Operator	End of 2023
OPS31	Aircraft operators should monitor go-around policy compliance through their FDM programmes and establish go-around safety performance indicators (SPIs) for monitoring through their SMS. In addition to monitoring go-arounds, aircraft operators should also monitor discontinued approaches.	Aircraft Operator	End of 2023
OPS32	Aircraft operators should: 1) Define an unstable approach followed by landing as a mandatory reporting event by the flight crew and; 2) Minimise the need to report a go-around due to an unstable approach unless there is another significant event in relation to the go-around, e.g. flap overspeed.	Aircraft Operator	End of 2023
OPS33	Aircraft operators, for aircraft equipped with EFBs and when technically feasible, should systematically compare the EFB takeoff performance loggings with the relative FDM data to identify the takeoff runway excursion risks.	Aircraft Operator	End of 2023
OPS34	Aircraft operators, for aircraft equipped with EFBs and when technically feasible, should visualise on the EFB the FULL RWY with its planned TO RWY holding position to increase the situational awareness of the crew for the intended T/O position.	Aircraft Operator	End of 2023
OPS35	Aircraft operators should consider observational procedures (e.g. Line Operations Safety Audits) to identify runway excursion safety risks precursors and best practices which cannot be captured by the traditional reporting or FDM.	Aircraft Operator	End of 2023

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Appendix 7 – ICAO Doc 9995 Extractions

Topic		Freq	Description	Outcome
Evaluation and scenario-based training phases	Competencies non-technical (CRM)	A	This encapsulates communication; leadership and teamwork; problem solving and decision making; situation awareness; workload management. Emphasis should be placed on the development of leadership, shown by EBT data sources to be a highly effective competency in mitigating risk and improving safety through pilot performance	Communication: Demonstrate effective use of language, responsiveness to feedback and that plans are stated and ambiguities resolved. Leadership and teamwork: Use appropriate authority to ensure focus on the task. Support others in completing tasks. Problem solving and decision making: Detect deviations from the desired state, evaluate problems, identify risk, consider alternatives and select the best course of action. Continuously review progress and adjust plans. Situation awareness: Have an awareness of the aircraft state in its environment; project and anticipate changes. Workload management: Prioritize, delegate and receive assistance to maximize focus on the task. Continuously monitor the flight progress

Topic		Freq	Description	Outcome
Evaluation and scenario-based training phases	Compliance	A	We agree with the current ICAO and EASA view on this training topic: "it is not intended to list example scenario elements, but instructors should ensure that observed non compliances are taken as learning opportunities"	

Topic		Freq	Description	Outcome
Evaluation and scenario-based training phases	Workload, distraction, pressure	B	This is not considered a topic for specific attention on its own, but more as a reminder to programme developers to ensure that pilots are exposed to immersive training scenarios which expose them to manageable high workload and distractions during the course of the EBT programme, at the defined frequency	Manage available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances

Topic		Freq	Description	Outcome
Evaluation and scenario-based training phases	Surprise	B	The data analysed during the development of this manual and of the EBT concept indicated substantial difficulties encountered by crews when faced with a threat or error, which was a surprise, or an unexpected event. The element of surprise should be distinguished from what is sometimes referred to as the "startle factor", the latter being a physiological reaction. Wherever possible, consideration should be given towards variations in the types of scenario, times of occurrences and types of occurrence, so that pilots do not become overly familiar with repetitions of the same scenarios. Variations should be the focus of EBT programme design, and not left to the discretion of individual instructors, in order to preserve programme integrity and fairness	Exposure to an unexpected event or sequence of events at the defined frequency

Topic		Freq	Description	Outcome	Example Scenario elements
Evaluation and scenario-based training phases	Aircraft system management	B	Normal system operation according to defined instructions	This is not considered as a stand-alone topic. It links with the topic "compliance" Where a system is not managed according to normal or defined procedures, this is determined as a non-compliance	See "compliance" topic above. There are no defined scenarios, but the instructor should focus on learning opportunities when system management non-compliances manifest themselves during other scenarios. Underpinning knowledge of systems and their interactions should be developed and challenged, and not merely the application of normal procedures

Topic		Freq	Description	Outcome
Evaluation and scenario-based training phases	Operations or type specific	C	Intentionally blank	Intentionally blank

Appendix 8 – Threat and Error and Mapping Results

ERRORS (flight crew deviation)	Code	**SME Mapping to EBT Training Topic**
H – Aircraft Handling Errors		H – Aircraft Handling Errors
H01 Manual handling / Flight Controls	H01	Manual Aircraft Control
H02 Ground Navigation (Surface nav)	H02	Navigation
H03 Automation (settings/selections)	H03	Automation management
H04 Systems/Radio/Instruments (settings/selections)	H04	Aircraft System management
H99 Other	H99	N/A
P – Procedural Errors	Code	**SME Mapping to EBT Training Topic**
P01 SOP adherence/ cross-verification (see breakdown)		SOP Adherence / SOP Cross-verification
P01.01 Intentional	P01.01	Compliance
P01.02 Unintentional	P01.02	Compliance
P01.03 Unknown	P01.03	Compliance
P02 Checklist (see breakdown)		P02 Checklist (see breakdown)
P02.01 Normal checklist (error)	P02.01	Compliance
P02.02 Abnormal checklist (error)	P02.02	Error management
P03 Callouts	P03	Compliance
P04 Briefings	P04	Competencies non-technical (CRM)
P05 Documentation (see breakdown)		
P05.01 Incorrect weight and balance/ fuel information	P05.01	Managing loading, fuel, performance errors
P05.02 Incorrect ATIS/ clearance	P05.02	Error management
P05.03 Misinterpreted items on paperwork	P05.03	FSTD limited value
P05.04 Incorrect or missing log book entries	P05.04	FSTD limited value
P06 Failure to Go-Around	P06	Unstable Approach

P06.01 Failure to go-around after destabilization on approach	P06.01	Go-Around management
P06.02 Failure to go-around after a bounced landing	P06.02	Go-Around management
P99 Other	P99	N/A
C – Communication Errors	Code	**SME Mapping to EBT Training Topic**
C01 Crew to External communication		C01 Crew to External communication
C01.01 With ATC	C01.01	Competencies non-technical (CRM)
C01.02 With cabin crew	C01.02	Competencies non-technical (CRM)
C01.03 With ground crew	C01.03	Competencies non-technical (CRM)
C01.04 With Dispatch	C01.04	Competencies non-technical (CRM)
C01.05 With Maintenance	C01.05	Competencies non-technical (CRM)
C02 Pilot-to-Pilot Communication	C02	Competencies non-technical (CRM)
C03 Communication Errors CPDLC	C03	Competencies non-technical (CRM)

THREATS (occurs outside the influence of the flight crew)	Code	
E – Environmental Threats		**SME Mapping to EBT Training Topic**
E01 Meteorology (see breakdown)		E01 Meteorology (see breakdown)
E01.01 Thunderstorm	E01.01	Adverse weather
E01.02 Poor Visibility/IMC	E01.02	Approach, visibility close to minimum
E01.03 Gusty wind/ windshear	E01.03	Windshear recovery
E01.04 Icing conditions	E01.04	Adverse weather
E01.05 Hail		Adverse weather
E02 Lack of Visual Reference	E02	Adverse weather
E03 Air Traffic Services	E03	ATC
E04 Birds/foreign objects	E04	E04 Birds/foreign objects
E04.01 Birds	E04.01	Surprise
E04.02 Wildlife	E04.02	Cannot be trained in an FSTD
E04.03 Foreign objects	E04.03	Cannot be trained in an FSTD

E05 Airport Facilities (see breakdown)		E05 Airport Facilities (see breakdown)
E05.01 Poor signage/lighting, faint markings, rwy/txy closures	E05.01	Cannot be trained in an FSTD
E05.02 Contaminated runways, taxiways, poor braking action	E05.02	runway or taxiway conditions
E05.03 Trenches, ditches, intruding structures	E05.03	Cannot be trained in an FSTD
E05.04 Airport perimeter control/fencing / Wildlife control	E05.04	Cannot be trained in an FSTD
E06 Ground-based nav aid malfunction or not available	E06	
E06.01 Malfunction, lack, or unavailable	E06.01	Navigation
E06.02 Uncalibrated	E06.02	Navigation
E07 Terrain/Obstacles	E07	Terrain
E08 Traffic	E08	Traffic
E08.01 Aircraft	E08.01	Traffic
E08.02 Vehicle	E08.02	Traffic
E09 RWY Surface Incursion		E09 RWY Surface Incursion
E09.01 Aircraft	E09.01	Traffic
E09.02 Vehicle	E09.02	Surprise
E09.03 Wildlife	E09.03	Cannot be trained in an FSTD
E09.04 Other	E09.04	Cannot be trained in an FSTD
E99 Other	E99	N/A
A – Airline Threats A01 Aircraft Malfunction (see breakdown)	Code	**SME Mapping to EBT Training Topic**
A01.01 Uncontained Engine failure	A01.01	Engine failure
A01.02 Contained Engine failure (incl overheat and prop fail)	A01.02	Engine failure
A01.03 Landing gear/ tires	A01.03	Aircraft system malfunction
A01.04 Brakes	A01.04	Aircraft system malfunction
A01.05 Flight Controls (see breakdown)		A01.05 Flight Controls (see breakdown)
A01.05.01 Primary flight controls	A01.05.01	Aircraft system malfunction
A01.05.02 Secondary flight controls (flaps, spoilers) (flaps, spoilers)	A01.05.02	Aircraft system malfunction
A01.06 Structural Failure	A01.06	Aircraft system malfunction
A01.07 Fire/Smoke	A01.07	Fire and smoke management
A01.08 Avionics, flight instruments	A01.08	Aircraft system malfunction
A01.09 Autopilot/ FMS	A01.09	Automation management
A01.10 Hydraulic system failure	A01.10	Aircraft system malfunction
A01.11 Electrical power/ generation failure	A01.11	Aircraft system malfunction
A01.12 Fuel System malfunction (including fuel leak)	A01.12	Aircraft system malfunction

A01.13 Air Conditioning/Pressurization Failures	A01.13	Aircraft system malfunction
A01.99 Other	A01.99	N/A
A02 MEL item	A02	Aircraft System management
A03 Operation pressure	A03	Workload, distraction, pressure
A04 Cabin events	A04	Competencies non-technical (CRM)
A05 Ground events	A05	Workload, distraction, pressure
A06 Dispatch/paperwork	A06	Managing loading, fuel, performance errors
A07 Maintenance events	A07	Cannot be trained in an FSTD
A08 Dangerous goods	A08	Managing loading, fuel, performance errors
A09 Manual/charts/checklists	A09	Compliance
A99Other	A99	N/A
B – Psychological/Physiological Threats		**SME Mapping to EBT Training Topic**
B01 – Fatigue	B01	Cannot be trained in an FSTD
B02 – Optical illusion/visual mis-perception	B02	Upset recovery
B03 – Spatial disorientation & spatial/somatogravic illusion	B03	Upset recovery
B04 – Crew Incapacitation	B04	Pilot incapacitation
U – Undesired Aircraft States (flight crew induced, recoverable)		**SME Mapping to EBT Training Topic**
U01 Abrupt Aircraft Control	U01	Manual Aircraft Control
U02 Vertical, Lateral or Speed Deviations	U02	Automation management
U03 Unnecessary Weather Penetration	U03	Adverse weather
U04 Unauthorized Airspace Penetration	U04	Navigation
U05 Operation Outside Aircraft Limitations	U05	Upset recovery
U06 Unstable Approach	U06	Unstable Approach
U07 Continued Landing after Unstable Approach	U07	Unstable Approach
U08 Long, Floated, Bounced, Firm, Off centerline, Canted, Porpoised Landing	U08	Manual Aircraft Control
U09 Rejected Take-off after V1	U09	Compliance
U10 Controlled Flight Toward Terrain	U010	Terrain

Appendix 9 – Training Topic RRR mapped and grouped total results

The tables below present the RRR grouped total of the mapping and grouping exercise performed by the EBT SG (See Section 4.4.3), for all the threats and errors. The third column indicates whether the RRR grouped total results are aligned with the current EBT training topics frequency as per ICAO Doc 9995. If they are not aligned, the letter in this third column indicates the current frequency of the EBT training topics.

As explained in Section 4.4.3, the mapping exercise contained some challenges, as the safety taxonomy of threats and errors and the EBT training topics are not completely aligned. For example, the EBT SG did not map any threat or error against 'Monitoring and cross-checking' as this training topic was not considered as a 'standalone' topic for this revision, as it is embedded within multiple competencies, in their observable behaviors (OBs). The same with 'surprise', which was not considered as a standalone topic, but as something that should be interwoven throughout the EBT training modules.

The EBT Subgroup's comments and recommendations included in the last two columns in the tables below are based on the consolidated analysis of all the data sources used in this Amendment, based on the analyses detailed in Section 4 of this Amendment.

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
RRR Grouped Total	Training Topics	Alignment of results with current EBT training topics Yes/No	EBT Subgroup's Comments	EBT Subgroup's Recommendation(s)
7.820	Compliance	Yes	The results of the EBT A&I Study RRR mapped and grouped total are consistent with the current EBT training curriculum, placing compliance as an A frequency topic. However, as explained in Section 4, 'Compliance' is embedded throughout EBT training via the development of several competencies and should not be treated as a separate training topic.	Move 'Compliance' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section (See 4.4.1.1) and maintain the A frequency of this training topic.
3.939	Competencies non-technical (CRM)	Yes	Under a CBTA program, the 'Competencies non-technical' form part of the pilots' competencies. They are the team and individual countermeasures against the threats and errors	Move 'Competencies non-technical (CRM)' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
			encountered in operations in the TEM model. They encapsulate: Problem Solving and Decision Making (PSD), Workload Management (WLM), Leadership and Teamwork (LTW), Situation Awareness and Management of Information (SAW), Communication (COM). Therefore, they should not be treated as a standalone training topic.	Rename it 'Pilot Competencies' which will therefore include all nine pilot competencies and maintain the frequency A for this training topic. (See 4.4.1.1)
2.694	Manual Aircraft Control	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
1.912	Adverse weather	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
1.767	Aircraft system malfunction	No – B Topic	Although the RRR mapped and grouped total of the EBT A&I Study placed this training topic at a potential A frequency, after a review and analysis of all the data sources, the EBT SG concluded that the current B frequency is sufficient. There are five elements of 'Malfunction Equivalency' which must be trained over two modules. This requires elements of this topic to be integrated into each training module. If it were to be increased to an A frequency topic, it would require all five elements to be trained in each module. The EBT SG considered this unnecessary	Maintain this training topic at a B frequency.
1.477	Automation management	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
1.274	Unstable Approach	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
1.188	ATC	No – C Topic	The data from the EBT A&I Study and the GADM ADX analysis show that many of the events include ATC; explaining the high-risk ranking result of this training topic (see Section 4.4.3.1). Moreover, the EBT SG pointed out to the difficulty of training this topic in an FSTD. Further research would be needed to identify or develop more effective training solutions, e.g., AR, CBT etc. (See Section 4.4.1.3).	Maintain this training topic at a C frequency.
1.014	Approach, visibility close to minimum	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a B frequency.
0.927	Error management	No – A Topic	Although the results of the EBT A&I Study RRR mapped and grouped total placed this training topic at a potential B frequency (see Section 4.4.3.1), the EBT SG concluded that 'Error management' is a fundamental component of 'Threat and Error Management' and should, therefore, be maintained at an A frequency within the topic 'Error management, mismanaged aircraft state.	Maintain this training topic at an A frequency, within the topic 'Error management, mismanaged aircraft state'.
0.695	Windshear recovery	No – C Topic	The results of the EBT A&I Study RRR mapped and grouped total indicated that this training topic may require a higher frequency than the current C frequency in the Recurrent Assessment and Training Matrix. After further analysis, the EBT SG concluded that a B frequency for 'Windshear recovery' would be more appropriate for generation 4 Jet aircraft, bringing it in line with generation 3 Jet. This was supported by their internal training and safety data and by the results of the EBT A&I Study. (See Section 4.4.5.2)	Increase the frequency of this training topic from C to B for generation 4 Jet aircraft.

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
0.521	Aircraft system management	Yes	As explained in Section 4, aircraft system management is not a training topic on its own but can be clearly observed in the operation of the aircraft's systems during normal and abnormal operations. Crew would demonstrate compliance with procedures in accordance with published operating instructions using the appropriate system knowledge during the EBT training event (see Section 4.4.1.1.).	Move 'Aircraft system management 'from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles, consequently increasing its frequency from B to A.
0.492	Upset recovery	No – C Topic	The results of the EBT A&I Study RRR mapped and grouped total placed 'Upset recovery' as a potential B frequency topic. This is supported by EASA, IATA studies and also by the EBT SG data. In addition, the EBT SG indicated that it is not necessary to have separate topics related to 'upset recovery' and 'upset prevention'. It should be one training topic, 'UPRT'. (See Section 4.4.2.1).	Increase the frequency of this training topic from C to a B for generation 4 Jet. Rename this training topic as UPRT.
0.434	Workload, distraction, pressure	Yes	The pilot competency 'Workload management' (WLM) clearly sets out the Observable Behaviors (OBs) that are required to demonstrate competency in this area. The EBT course developers are responsible for designing a program that exposes pilots to scenarios in which they can develop and learn, by applying all the competencies, with a particular emphasis on 'Workload management' (WLM). (See Section 4.4.1.1)	Move 'Workload, distraction, pressure' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles, consequently increasing its frequency from B to A.
0.203	Fire and smoke management	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.203	Engine failure	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
0.174	Terrain	No – B Topic	Although the EBT A&I Study RRR mapped and grouped total placed this topic as a potential C frequency (see Section 4.4.3.1), after a review and analysis by the EBT SG of their own data and the results of the other data sources analyzed in this amendment, and related studies and reports, the EBT SG concluded that the frequency by which 'Terrain' is trained should remain as a B frequency. (See Section 4.4.5.1)	Maintain this training topic at a B frequency.
0.087	Managing loading, fuel, performance errors	Yes	Nothing in the data sources analysis and results indicated a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.058	Traffic	Yes	The analysis and discussions by the EBT SG on 'Traffic' confirmed that there is no need to change the frequency of this training topic. (See Section 4.4.2.2)	Maintain this training topic at a C frequency.
0.029	Runway or taxiway conditions	No – B Topic	Although the RRR mapped and grouped total of the EBT A&I Study placed this topic as a potential C topic (see Section 4.4.3.1), after revision and analysis of their own data and the results of the other data sources analyzed in this amendment, and related studies and reports, the EBT SG concluded that it should remain at a B frequency. (See Section 4.4.5.3)	Maintain this training topic at a B frequency.
0.029	Navigation	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.000	Go-Around management	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the importance of training this topic to an A frequency.	Maintain this training topic at an A frequency

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
0.000	Operations or type specific	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. As ICAO Doc 9995 provides no guidance about this topic, the EBT SG's understanding is that the 'Operations or type specific' training topic should be developed by the EBT course designer considering the OEM operational and training guidance and operator data. For this reason, this training topic is maintained at a C frequency. The evidence will guide the operator as to whether an element requires frequent inclusion (B frequency), infrequent inclusion (C frequency) or is a one-off point of emphasis. (See sections 4.4.1.2 and 5.1)	Maintain 'Operations or type specific' at a C frequency with the caveat that the operator will ensure proper inclusion of the training elements within the tri annual EBT program.
0.000	Mismanaged aircraft state	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic.	Maintain it as part of the training topic 'Error management and mismanaged aircraft state', at an A frequency.
0.000	Monitoring & cross-checking	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as 'monitoring and cross-checking' are embedded in the pilot competencies and was, therefore, not considered as a standalone topic in this Amendment. (See Section 4.4.1.1)	Move 'Monitoring & cross-checking' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, maintaining an A frequency.
0.000	Adverse wind	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic due to the differences between the IATA safety taxonomy and the EBT training topics. However, because 'adverse wind' is closely related to the threat 'Gusty wind / Windshear / Wake turbulence', the EBT SG reviewed the results of the data sources analyzed and concluded that it should be maintained as a B frequency.	Maintain this training topic at a B frequency.
0.000	Landing	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the	Maintain this training topic at a B frequency.

EBT A&I Study RRR mapped and grouped total – Generation 4 Jet				
			importance of maintaining this training topic at a B frequency. This topic is often connected with 'Adverse wind'.	
0.000	Surprise	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as it was not considered a standalone topic in this Amendment. Surprise should not be seen as a standalone training topic in any specific module of an EBT program but rather as an aspect of scenarios to be integrated in as many modules as possible throughout the program. (See Section 4.4.1.1)	Move 'Surprise' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles, consequently increasing its frequency from B to A.
0.000	Loss of communications	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. The EBT SG stated that this is no longer a threat with the advent of far more robust methods of air-ground communication. It was also noted that training this topic in an FFS is neither effective nor a good use of resources and that the method for dealing with any loss of communications may be better taught by other means, e.g., flight crew notices, computer-based training (CBT), etc. (See Section 4.4.1.4) Therefore, the EBT SG concluded that it should form part of the training topic 'ATC', rather than being a standalone training topic. (See Section 4.4.1.4)	Integrate 'Loss of communications' into the training topic 'ATC'.
0.000	Pilot incapacitation		'Pilot incapacitation' was not a contributing factor to any of the accidents and incidents analyzed in the EBT A&I Study.	Maintain this training topic at a C frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
RRR Grouped Total	Training Topics	Alignment of results with current EBT training topics Yes/No	EBT Subgroup's Comments	EBT Subgroup's Recommendation(s)
3.041	Compliance	Yes	The results of the GADM ADX analysis RRR mapped and grouped total are consistent with the current EBT training curriculum, placing compliance as an A frequency topic. However, as explained in Section 4, 'Compliance' is embedded throughout EBT training via the development of several competencies and should not be treated as a separate training topic. (See 4.4.1.1)	Move 'Compliance' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section and maintain the A frequency.
2.201	Manual Aircraft Control	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain at an A frequency.
1.274	Adverse weather	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain it at an A frequency.
1.188	Competencies non-technical (CRM)	Yes	Under a CBTA program, the 'Competencies non-technical' form part of the pilots' competencies. They are the team and individual countermeasures against the threats and errors encountered in operations in the TEM model. They encapsulate: Problem Solving and Decision Making (PSD), Workload Management (WLM), Leadership and Teamwork (LTW), Situation Awareness and Management of Information (SAW), Communication (COM). Therefore, they should not be treated as a standalone training topic. (See 4.4.1.1)	Move 'Competencies non-technical (CRM)' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section Rename it 'Pilot Competencies' which will therefore include all nine pilot competencies and maintain the frequency A for this training topic. (See 4.4.1.1)

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
1.159	Windshear recovery	No – C Topic	The results of the GADM ADX analysis RRR mapped and grouped total placed this training topic at a higher frequency than the current C frequency in the Recurrent Assessment and Training Matrix. After further analysis, the EBT SG concluded that a B frequency for 'Windshear recovery' would be more appropriate for generation 4 Jet aircraft. This was supported by their internal training and safety data and by the results of the EBT A&I Study. (See Section 4.4.5.2)	Increase the frequency of this training topic from C to B.
0.840	Unstable Approach	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
0.753	Approach, visibility close to minimum	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a B frequency.
0.434	Aircraft system malfunction	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a B frequency.
0.463	ATC	No – C Topic	The data from the EBT A&I Study and the GADM ADX analysis shows that many of the events include ATC, explaining the high-risk ranking result of this training topic (see Section 4.4.3.1). Therefore, the EBT SG concluded that there is no need to increase its frequency. They pointed out to the difficulty of training this topic in an FSTD and suggested that further research is needed to identify or develop more effective training solutions, e.g., AR, CBT etc.	Maintain this training topic at a C frequency.
0.377	Automation management	No – A Topic	Although the GADM ADX analysis RRR mapped and grouped total for generation 4, placed this topic as a potential B frequency (see Section 4.4.3.1), the EBT SG supported maintaining	Maintain this training topic at an A frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
			‘Automation management’ as an A topic. This is also supported by the results of the EBT A&I Study and the results of the IATA ‘Aircraft Handling and Manual Flying Skills’ survey report.	
0.319	Workload, distraction, pressure	Yes	The pilot competency ‘Workload management’ (WLM) clearly sets out the Observable Behaviors (OBs) that are required to demonstrate competency in this area. The EBT course developers are responsible for designing a program that exposes pilots to scenarios in which they can develop and learn, by applying all the competencies, with a particular emphasis on ‘Workload management’ (WLM). (See Section 4.4.1.1).	Move ‘Workload, distraction, pressure’ from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency from B to A.
0.261	Fire and smoke management	No – C Topic	Although the GADM ADX analysis RRR mapped and grouped total of the GADM ADX analysis placed this topic as a potential B frequency (see Section 4.4.3.1), the EBT SG determined that there was no other supporting evidence to recommend increasing its training frequency.	Maintain this training topic at a C frequency.
0.232	Runway or taxiway conditions	Yes	The analysis and discussions by the EBT SG on ‘Runway or taxiway conditions’ concur with the results of the GADM ADX analysis RRR mapped and grouped total and confirmed that there is no need to change the frequency of this training topic for generation 4 Jet aircraft. (See Section 4.4.2.2)	Maintain this training topic at a B frequency.
0.232	Engine failure	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.203	Terrain	No – B Topic	Although the GADM ADX analysis RRR mapped and grouped total placed this topic as a potential C frequency (see Section 4.4.3.1), after a review	Maintain this training topic at a B frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
			and analysis of their own data and the results of the other data sources analyzed in this amendment, and related studies and reports, the EBT SG concluded that it should be maintained at a B frequency. (See Section 4.4.4.1)	
0.203	Upset recovery	Yes	Although the GADM ADX analysis RRR mapped and grouped results placed this topic at a potential C frequency, same frequency as in the current EBT Recurrent Assessment and Training Matrix, considering the significant risks linked to LOC-I and the extent of UPRT training required under ICAO Doc 10011, which needs to be covered over a number of different modules during the recurrent program, the EBT SG agreed that it would be appropriate to increase its frequency from a C to a B. This is supported by EASA and IATA studies. (See Section 4.4.2.1). In addition, the EBT SG indicated that it is not necessary to have separate topics related to 'upset recovery' and 'upset prevention'. It should be one training topic, 'UPRT'. (See Section 4.4.2.1).	Rename this training topic 'UPRT' Increase the frequency of this training topic from C to B.
0.145	Traffic	Yes	The analysis and discussions by the EBT SG on 'Traffic' confirmed that there is no need to change the frequency of this training topic. (See Section 4.4.2.2)	Maintain this training topic at a C frequency.
0.116	Navigation	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.116	Aircraft system management	No – B Topic	The results of the GADM ADX analysis RRR mapped and grouped total place this training topic at a potential C frequency. However, as explained in Section 4, aircraft system	Move 'Aircraft system management ' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
			management is not a training topic on its own but can be clearly observed in the operation of the aircraft's systems during normal and abnormal operations. Crew would demonstrate compliance with procedures in accordance with published operating instructions using the appropriate system knowledge during the EBT training event. (See section 4.4.1.1.).	Principles, consequently increasing its frequency from B to A.
0.087	Managing loading, fuel, performance errors	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.058	Error management	No – A Topic	Although the results of the GADM ADX analysis RRR mapped and grouped total placed this training topic at a potential C frequency (see Section 4.4.3.1), the EBT SG concluded that 'Error management' is a fundamental component of 'Threat and Error Management' and should, therefore, be maintained at an A frequency within the topic 'Error management, mismanaged aircraft state.	Maintain this training topic at an A frequency, within the topic 'Error management, mismanaged aircraft state'
0.000	Go-Around management	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the importance of training this topic to an A frequency.	Maintain this training topic at an A frequency.
0.000	Operations or type specific	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. As ICAO Doc 9995 provides no guidance about this topic, the EBT SG's understanding is that the 'Operations or Type Specific' training topic should be developed by the EBT course designer considering the OEM operational and training guidance and operator data. For this reason, this training topic is maintained as a C frequency. The evidence will guide the operator as to whether an element requires frequent inclusion (B frequency),	Maintain 'Operations or type specific' at a C frequency, with the caveat that the operator will ensure proper inclusion of the training elements within the tri annual EBT program.

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
			infrequent inclusion (C frequency) or is a one-off point of emphasis. (See sections 4.4.1.2 and 5.1)	
0.000	Mismanaged aircraft state	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic.	Maintain it as part of the training topic 'Error management and mismanaged aircraft state', at an A frequency.
0.000	Monitoring & cross-checking	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as 'monitoring and cross-checking' are embedded in the pilot competencies and was, therefore, not considered as a standalone topic in this Amendment. (See Section 4.4.1.1)	Move 'Monitoring & cross-checking' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, maintaining an A frequency.
0.000	Adverse wind	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic due to the differences between the IATA safety taxonomy and the EBT training topics. However, because 'Adverse wind' is closely related to the threat 'Gusty wind / Windshear / Wake turbulence', the EBT SG reviewed the results of the data sources analyzed and recommended that it be maintained as a B frequency.	Maintain this training topic at a B frequency.
0.000	Landing	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirmed the importance of training this topic to a B frequency as this is often connected with 'Adverse wind'.	Maintain this training topic at a B frequency.
0.000	Surprise	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as it was not considered as a standalone topic in this Amendment. Surprise should not be seen as a standalone training topic in any specific module of an EBT program but rather as an aspect of scenarios to be integrated in as many modules as possible throughout the program. (See Section 4.4.1.1)	Move 'Surprise' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency from B to A.

GADM ADX analysis RRR mapped and grouped total – Generation 4 Jet				
0.000	Loss of communications	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. The EBT SG stated that this is no longer a threat with the advent of far more robust methods of air-ground communication. It was also noted that training this topic in an FFS is neither effective nor a good use of resources and that the method for dealing with any loss of communications may be better taught by other means, e.g., flight crew notices, computer-based training (CBT), etc. (See Section 4.4.1.4) Therefore, the EBT SG concluded that it should form part of the training topic 'ATC', rather than being a standalone training topic. (See Section 4.4.1.4)	Integrate 'Loss of communications' into the training topic 'ATC'.
0.000	Pilot incapacitation		'Pilot incapacitation' was not a contributing factor to any of the generation 4 aircraft accidents and incidents analyzed in the GADM ADX analysis.	Maintain this training topic at a C frequency.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
RRR Grouped Total	Training Topics	Alignment of results with current EBT training topics Yes/No	EBT Subgroup's Comments	EBT Subgroup's Recommendation(s)
12.466	Compliance	Yes	The results of the EBT A&I Study RRR mapped and grouped total are consistent with the current EBT training curriculum, placing compliance as an A frequency topic. However, as explained in Section 4, 'Compliance' is embedded throughout EBT training via the development of several competencies and should not be treated as a separate training topic. (See 4.4.1.1)	Move 'Compliance' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section and maintain the A frequency.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
6.552	Competencies non-technical (CRM)	Yes	Under a CBTA program, the 'Competencies non-technical' form part of the pilots' competencies. They are the team and individual countermeasures against the threats and errors encountered in operations in the TEM model. They encapsulate: Problem Solving and Decision Making (PSD), Workload Management (WLM), Leadership and Teamwork (LTW), Situation Awareness and Management of Information (SAW), Communication (COM). Therefore, they should not be treated as a standalone training topic. (See 4.4.1.1)	Move 'Competencies non-technical (CRM)' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section Rename it 'Pilot Competencies' which will therefore include all nine pilot competencies and maintain the frequency A for this training topic. (See 4.4.1.1)
4.993	Manual Aircraft Control	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
4.321	Adverse weather	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
2.267	Unstable Approach	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
1.487	Windshear recovery	No – B Topic	Although the results of the EBT A&I Study RRR mapped and grouped total placed this training topic at a potentially higher frequency than the current B frequency (see Section 4.4.3.1) in the Recurrent Assessment and Training Matrix, after review and analysis of all the data sources, the EBT SG concluded that the current frequency of this training topic is still appropriate. (See Section 4.4.5.2)	Maintain this training topic at a B frequency.
1.346	Aircraft system malfunction	No – B Topic	Although the EBT A&I Study RRR mapped and grouped total of the EBT A&I Study placed this training topic at a potentially higher frequency, after review and analysis of all the data sources, the EBT SG concluded that the current B frequency is sufficient. There are five elements of 'Malfunction Equivalency' which must be	Maintain this training topic at a B frequency.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
			trained over two modules. This requires elements of this topic to be integrated into each training module. If it were to be increased to an A frequency topic, it would require all five elements to be trained in each module. The EBT SG considered this unnecessary.	
1.275	ATC	No – C Topic	The results from the RRR mapped and grouped total for the EBT A&I Study and the GADM ADX analysis show that many of the events include ATC, which explains the high risk ranking of this topic in the EBT A&I Study and the GADM ADX analysis (see Section 4.4.3.1). Therefore, the EBT SG concluded that there is no need to increase its frequency. The EBT SG pointed out to the difficulty of training this topic in an FSTD and suggested that further research is needed to identify or develop more effective training solutions, e.g., AR, CBT, etc.	Maintain this training topic at a C frequency.
1.204	Upset recovery	No – C Topic	The RRR mapped and grouped total of the EBT A&I Analysis placed 'Upset recovery' as a potential B frequency topic. This is supported by EASA and IATA studies. Considering the significant risks linked to LOC-I and the extent of UPRT training required under ICAO Doc 10011, which needs to be covered over a number of different modules during the recurrent program, the EBT SG agreed that it would be appropriate to increase its frequency from a C to a B. (See Section 4.4.2.1) In addition, the EBT SG indicated that it is not necessary to have separate topics related to 'upset recovery' and 'upset prevention'. It should be one training topic, 'UPRT'.	Rename this training topic 'UPRT' Increase the frequency of this training topic from C to B
1.133	Approach, visibility close to minimum	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a B frequency.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
1.133	Error management	No – A Topic	Although the results of the EBT A&I Study RRR mapped and grouped total placed this training topic at a potential B frequency (see Section 4.4.3.1), the EBT SG concluded that 'Error management' is a fundamental component of 'Threat and Error Management' and should, therefore, be maintained at an A frequency within the topic 'Error management, mismanaged aircraft state.	Maintain this training topic at an A frequency, within the topic 'Error management, mismanaged aircraft state'.
1.098	Automation management	No – A Topic	Although the RRR mapped and grouped total of the EBTA&I Study for generation 3 placed this topic as a potential B frequency (see Section 4.4.3.1), the EBT SG supported maintaining 'Automation management' as an A topic. This is also supported by the results of the IATA 'Aircraft Handling and Manual Flying Skills' survey report.	Maintain this training topic at an A frequency.
0.921	Aircraft system management	Yes	As explained in Section 4, aircraft system management is not a training topic on its own but can be clearly observed in the operation of the aircraft's systems during normal and abnormal operations. Crew would demonstrate compliance with procedures in accordance with published operating instructions using the appropriate system knowledge during the EBT training event (see Section 4.4.1.1.). Therefore, the EBT SG concluded that 'Aircraft systemin management' should be moved to the EBT/CBTA Overarching Principles section.	Move 'Aircraft system management' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching principles sections, consequently increasing its frequency from B to A.
0.708	Traffic	Yes	The data analysis and discussions by the EBT SG on 'Traffic' confirmed that there is no need to change the frequency of this training topic. (See Section 4.4.2.2)	Maintain this training topic at a C frequency.
0.673	Runway or taxiway conditions	Yes	Although the results of the EBT A&I Study RRR mapped and grouped total placed this topic as a C, same frequency as in the EBT Recurrent Assessment and Training Matrix, a review of the evidence indicates that there is no clear difference between generations 4 and 3 Jet aircraft in respect to this training topic. Therefore, the EBT SG recommended that the frequency by which	Increase the frequency of this training topic from C to B.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
			'Runway and taxiway conditions' is trained be increased from a frequency C to a frequency B for generation 3 Jet, which brings it in line with generation 4 Jet (see Section 4.4.5.3).	
0.637	Terrain	No – C Topic	Although the EBT A&I Study RRR mapped and grouped total placed 'Terrain' as a potential C frequency (see Section 4.4.3.1), a review of the evidence by the EBT SG indicates that there is no clear difference between aircraft generations. Therefore, the EBT SG recommended that the frequency by which 'Terrain' is trained be increased from a frequency C to a frequency B for generation 3 Jet, bringing it in line with generation 4 Jet. This was further supported by data provided by Airbus (see Section 4.4.5.1)	Increase the frequency of this training topic from C to B.
0.637	Managing loading, fuel, performance errors	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.567	Fire and smoke management	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.390	Workload, distraction, pressure	No – B Topic	The pilot competency 'Workload management' (WLM) clearly sets out the Observable Behaviors (OBs) that are required to demonstrate competency in this area. The EBT course developers are responsible for designing a program that exposes pilots to scenarios in which they can develop and learn, by applying all the competencies, with a particular emphasis on 'Workload management' (WLM). (See 4.4.1.1).	Move this training topic from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency from B to A.
0.354	Navigation	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
0.319	Pilot incapacitation	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.106	Engine failure	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.000	Go-Around management	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the importance of training this topic to an A frequency.	Maintain this training topic at an A frequency.
0.000	Operations or type specific	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. As ICAO Doc 9995 provides no guidance about this topic, the EBT SG's understanding is that the 'Operations or Type Specific' training topic should be developed by the EBT course designer considering the OEM operational and training guidance and operator data. For this reason, this training topic is maintained as a C frequency. The evidence will guide the operator as to whether an element requires frequent inclusion (B frequency), infrequent inclusion (C frequency) or is a one-off point of emphasis. (See sections 4.4.1.4 and 5.1)	Maintain 'Operations or type specific' at a C frequency, with the caveat that the operator will ensure proper inclusion of the training elements within the tri annual EBT program.
0.000	Mismanaged aircraft state	Not mapped	This topic was not directly mapped from a threat or error, but the EBT SG recommends that it still be part of the training topic 'Error management and Mismanaged aircraft state'.	Maintain 'Mismanaged aircraft state' as part of the training topic 'Error management and mismanaged aircraft state', at an A frequency.
0.000	Monitoring & cross-checking	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as 'monitoring and cross-checking' are embedded in the pilot competencies and was not considered a standalone topic in this Amendment. (See Section 4.4.1.1)	Move 'monitoring and cross-checking' from the EBT Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, maintaining it at an A frequency.
0.000	Adverse wind	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic due to the differences	Maintain this training topic at a B frequency.

EBT A&I Study RRR mapped and grouped total – Generation 3 Jet				
			between the IATA safety taxonomy and the EBT training topics. However, because 'Adverse wind' is closely related to the threat 'Gusty wind / Windshear / Wake turbulence', the EBT SG reviewed the results of the data sources analyzed and concluded that it should be maintained as a B frequency.	
0.000	Landing	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the importance of training this topic to a B frequency. This is often connected with Adverse Wind.	Maintain this training topic at a B frequency.
0.000	Surprise	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as it was not considered a standalone topic in this Amendment. Surprise should not be seen as a standalone training topic in any specific module of an EBT program but rather as an aspect of scenarios to be integrated in as many modules as possible throughout the program. (See Section 4.4.1.1)	Move 'Surprise' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency from B to A.
0.000	Loss of communications	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. The EBT SG stated that this is no longer a threat with the advent of far more robust methods of air-ground communication. It was also noted that training this topic in an FFS is neither effective nor a good use of resources and that the method for dealing with any loss of communications may be better taught by other means, e.g., flight crew notices, computer-based training (CBT), etc. (See Section 4.4.1.4) Therefore, the EBT SG concluded that it should form part of the training topic 'ATC', rather than being a standalone training topic. (See Section 4.4.1.4)	Integrate 'Loss of communications' into the training topic 'ATC'.

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
RRR Grouped Total	Training Topics	Alignment of results with current EBT training topics Yes/No	EBT Subgroup's Comments	EBT Subgroup's Recommendation(s)
5.631	Compliance	Yes	The results of the GADM ADX analysis RRR mapped and grouped total are consistent with the current EBT training curriculum, placing compliance at an A frequency topic. However, as explained in Section 4, 'Compliance' is embedded throughout EBT training via the development of several competencies and should not be treated as a separate training topic. (See 4.4.1.1)	Move 'Compliance' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, maintaining it at an A frequency.
4.250	Manual Aircraft Control	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
3.223	Adverse weather	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic it at an A frequency.
2.656	Competencies non-technical (CRM)	Yes	Under a CBTA program, the 'Competencies non-technical' form part of the pilots' competencies. They are the team and individual countermeasures against the threats and errors encountered in operations in the TEM model. They encapsulate: Problem Solving and Decision Making (PSD), Workload Management (WLM), Leadership and Teamwork (LTW), Situation Awareness and Management of Information (SAW), Communication (COM). Therefore, they should not be treated as a standalone training topic. (See 4.4.1.1)	Move 'Competencies non-technical (CRM)' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section Rename it 'Pilot Competencies' which will therefore include all nine pilot competencies and maintain the frequency A for this training topic. (See 4.4.1.1)
2.585	Aircraft system malfunction	No – B Topic	Although the GADM ADX analysis RRR mapped and grouped total placed this training topic at a	Maintain this training topic at a B frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
			potential A frequency, after review and analysis of all the data sources, the EBT SG concluded that the current B frequency is sufficient. There are five elements of 'Malfunction Equivalency' which must be trained over two modules. This requires elements of this topic to be integrated into each training module. If it were to be increased to an A frequency topic, it would require all five elements to be trained in each module. The EBT SG considered this unnecessary.	
2.019	Workload, distraction, pressure	No – B Topic	The pilot competency 'Workload management' (WLM) clearly sets out the Observable Behaviors (OBs) that are required to demonstrate competency in this area. The EBT course developers are responsible for designing a program that exposes pilots to scenarios in which they can develop and learn, by applying all the competencies, with a particular emphasis on workload management (WLM). (See Section 4.4.1.1).	Move' Workload, distraction, pressure' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency to A.
1.948	Approach, visibility close to minimum	No – B Topic	Although the results of the GADM ADX RRR mapped and grouped total placed this topic at a potential A frequency, the EBT SG supported maintaining 'Approach, visibility close to minimum' at a B frequency. They noted the importance of this topic but had no additional supporting evidence to recommend increasing its training frequency.	Maintain this training topic at a B frequency.
1.948	Unstable Approach	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at an A frequency.
1.842	Windshear recovery	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a B frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
1.133	Runway or taxiway conditions	No – C Topic	The results of the GADM ADX analysis RRR mapped and grouped total placed this topic at a potential B frequency, which was supported by a significant number of studies and reports. Additionally, a review of the evidence indicated that there was no clear difference between aircraft generations. Therefore, the EBT SG recommended that the frequency by which 'Runway and taxiway conditions' is trained be increased from a frequency C to a frequency B for generation 3 Jet, which brings it in line with generation 4 Jet (see Stion 4.4.5.3).	Increase the frequency of this training topic from C to a B.
1.098	ATC	No – C Topic	The results from the EBT A&I Study and the GADM ADX analysis show that many of the events include ATC, explaining the high risk ranking of this topic (see Section 4.4.3.1). Therefore, the EBT SG concluded that there is no need to increase its frequency and recommended maintaining it as a C frequency. They pointed out to the difficulty of training this topic in an FSTD and suggested that further research is needed to identify or develop more effective training solutions, e.g., AR, CBT, etc.	Maintain this training topic at a C frequency.
0.885	Managing loading, fuel, performance errors	No – C Topic	Although the results of the GADM ADX analysis RRR mapped and grouped total placed this topic at a potential B frequency, the EBT SG supported maintaining 'Managing loading, fuel, performance errors' at a C frequency topic. They noted the importance of this topic but had no other supporting evidence to recommend increasing its training frequency.	Maintain this training topic at a C frequency.
0.815	Error management	No – A Topic	Although the results of the GADM ADX analysis RRR mapped and grouped total placed this training topic at a potential B frequency (see Section 4.4.3.1), the EBT SG concluded that 'Error management' is a fundamental component of	Maintain this training topic at an A frequency, within the topic 'Error management, mismanaged aircraft state'

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
			‘Threat and Error Management’ and should, therefore, be maintained at an A frequency within the topic ‘Error management, mismanaged aircraft state.	
0.815	Upset recovery	No – C Topic	The RRR mapped and grouped total of the GADM ADX analysis placed ‘Upset recovery’ as a potential B frequency topic. This is supported by EASA and IATA studies. Considering the significant risks linked to LOC-I and the extent of UPRT training required under ICAO Doc 10011, which needs to be covered over a number of different modules during the recurrent program, the EBT SG agreed that it would be appropriate to increase its frequency from a C to a B. (See Section 4.4.2.1) In addition, the EBT SG indicated that it is not necessary to have separate topics related to ‘upset recovery’ and ‘upset prevention’. It should be one training topic, ‘UPRT’.	Rename this training topic ‘UPRT’ Increase the frequency of this training topic from C to B.
0.673	Fire and smoke management	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.637	Automation management	No – A Topic	Although the RRR mapped and grouped total of the GADM ADX analysis for generation 3 placed this topic as a C frequency (see Section 4.4.3.1), the EBT SG supported maintaining ‘Automation management’ as an A topic. This is also supported by the results of IATA ‘Aircraft Handling and Manual Flying Skills’ survey report.	Maintain this training topic at an A frequency.
0.354	Engine failure	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at C frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
0.319	Aircraft system management	No – B Topic	As explained in Section 4, aircraft system management is not a training topic on its own but can be clearly observed in the operation of the aircraft's systems during normal and abnormal operations. Crew would demonstrate compliance with procedures in accordance with published operating instructions using the appropriate system knowledge during the EBT training event (see Section 4.4.1.1.).	Move 'Aircraft system management' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency from B to A.
0.283	Terrain	No – B Topic	Although the RRR mapped and grouped total of the GADM ADX analysis for generation 3 Jet, placed this topic as a potential C frequency (see Section 4.4.3.1), after a review and analysis of their own data and the results of the other data sources analyzed in this amendment, and related studies and reports, the EBT SG recommended increasing it to a B frequency for generation 3 Jet. A review of the evidence indicated that there is no clear difference between generations 3 and 4 Jet aircraft, hence the recommendation to align generation 3 Jet with generation 4 Jet. This was further supported by data provided by Airbus (See Section 4.4.5.1)	Increase the frequency of this training topic from C to B.
0.248	Traffic	Yes	The results of the GADM ADX analysis RRR mapped and grouped total placed 'Traffic' at a potential C frequency, as in the current EBT curriculum. The data analysis and discussions by the EBT SG on 'Traffic' confirmed that there is no need to change the frequency of this training topic. (See Section 4.4.2.2)	Maintain this training topic at a C frequency.
0.177	Navigation	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
0.071	Pilot incapacitation	Yes	The analysis and results from the data sources did not indicate a need to recommend a change to this training topic.	Maintain this training topic at a C frequency.
0.000	Go-Around management	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the importance of training this topic to an A frequency.	Maintain this training topic at an A frequency.
0.000	Operations or type specific	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. As ICAO Doc 9995 provides no guidance about this topic, the EBT SG's understanding is that the 'Operations or type specific' training topic should be developed by the EBT course designer considering the OEM operational and training guidance and operator data. For this reason, this training topic is maintained as a C frequency. The evidence will guide the operator as to whether an element requires frequent inclusion (B frequency), infrequent inclusion (C frequency) or is a one-off point of emphasis. (See sections 4.4.1.4 and 5.1)	Maintain 'Operations or type specific' at a C frequency with the caveat that the operator will ensure proper inclusion of the training elements within the tri annual EBT program.
0.000	Mismanaged aircraft state	Not mapped	This topic was not directly mapped from a threat or error, but the EBT SG recommends that it still be part of the training topic 'Error management and Mismanaged aircraft state'.	Maintain it as part of the training topic 'Error management and mismanaged aircraft state', at an A frequency.
0.000	Monitoring & cross-checking	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as 'monitoring and cross-checking' are embedded in the pilot competencies and was not considered as a standalone topic in this Amendment. (See Section 4.4.1.1)	Move 'monitoring and cross-checking' from the EBT Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, maintaining it at an A frequency.
0.000	Adverse wind	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic due to the differences between the IATA safety taxonomy	Maintain this training topic at a B frequency.

GADM ADX analysis RRR mapped and grouped total – Generation 3 Jet				
			and the EBT training topics. However, because 'Adverse wind' is closely related to the threat 'Gusty wind / Windshear / Wake turbulence', the EBT SG reviewed the results of the data sources analyzed and concluded that it should be maintained as a B frequency.	
0.000	Landing	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic, but the EBT SG and the training studies all confirm the importance of training this topic to a B frequency. This is often connected to 'Adverse wind'.	Maintain this training topic at a B frequency.
0.000	Surprise	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic as it was not considered a standalone topic in this Amendment. Surprise should not be seen as a standalone training topic in any specific module of an EBT program but rather as an aspect of scenarios to be integrated in as many modules as possible throughout the program. (See Section 4.4.1.1)	Move 'Surprise' from the Recurrent Assessment and Training Matrix to the EBT/CBTA Overarching Principles section, consequently increasing its frequency from B to A.
0.000	Loss of communications	Not mapped	This topic was not directly mapped from a threat or error to an EBT training topic. The EBT SG stated that this is no longer a threat with the advent of far more robust methods of air-ground communication. It was also noted that training this topic in an FFS is neither effective nor a good use of resources and that the method for dealing with any loss of communications may be better taught by other means, e.g., flight crew notices, computer-based training (CBT), etc. (See Section 4.4.1.4) Therefore, the EBT SG concluded that it should form part of the training topic 'ATC', rather than being a standalone training topic.	Integrate 'Loss of communications' into the training topic 'ATC'.

Appendix 10 – New example scenario elements

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	PRO	COM	FPA	FPM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	Managing loading, fuel, performance errors	C	GND		This should make specific reference to the avoidance of errors and the effective management of change	ATC advise crew that there is a change in environmental conditions or runway state during taxi out that requires take-off performance to be re-calculated	X							X	
			CRZ DES			ATIS report of degraded braking action or contaminated conditions (un-forecast) at destination onto a performance limited runway	X					X		X	
			GND			Fuel supply shortage such that fuel quantity available to uplift is slightly below flight plan fuel	X				X	X			
			GND			Informed of loadsheet error during taxi out		X			X	X		X	
			GND			Fuelling figures passed which leads to discrepancy that requires resolving	X					X	X	X	
			GND			Performance calculation error, for example incorrect runway or incorrect runway starting point	X					X	X		
			GND			Stabiliser/trim out of take-off limitation	X					X	X	X	

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	PRO	COM	FPA	FPM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	Navigation	C	CLB CRZ DES APP			GPS jamming resulting in loss of GPS signal and navigation accuracy downgrade below minimum required for flight in current airspace or to fly SID/STAR/approach	X	X	X			X	X		
			CLB CRZ DES APP			Aircraft navigation equipment failure below minimum required for flight in current airspace or to fly SID/STAR/approach/oceanic airspace	X	X	X			X	X	X	
			CRZ			SCATANA rules activated that require aircraft to comply with ATC instructions to change course, altitude or land.	X	X			X		X	X	

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	AOP	COM	FPMA	FPMM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	ISI		APP	As commented above: ISI is a training method and not a training topic, so should not be included in this table. For info, the Data Report for		Demo of a runway switch followed by at least one further switch with each crew member as PM. Introduce some scripted errors during the second approach that requires effective monitoring and intervention.		X			X			X	
			TO CLB			Scripted errors made by instructor during take-off and departure that requires effective monitoring and intervention by trainee in the PM role.		X			X				
			APP			Demo of a mishandled glideslope intercept from above; further demo to highlight appropriate prevention and recovery technique.	X		X						

			CRZ	Evidence-Based Training does not make any reference to in seat instruction.		Upset prevention: Instructor led exercise to practise high altitude manual flight, including in a degraded flight control law.				X					
			TO CLB APP LDG			Subtle incapacitation: e.g. instructor is PM and doesn't respond to flap retraction call during climb; instructor is PF and doesn't initiate final deceleration to VAPP on approach.	X	X			X			X	
			CRZ			Scripted errors or omissions made by the instructor during malfunctions during the cruise, for example engine failure		X	X	X	X			X	

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	AOP	COM	FPMA	FPMM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	Windshear	C	GND APP			Windshear conditions reported by ATC during taxi out or during intermediate approach that require the crew to avoid or prepare for a possible windshear encounter.	X	X				X	X		
			TO CLB APP			Predictive windshear alert during take-off roll, initial climb or approach.	X		X	X	X	X			
			TO CLB APP			Reactive windshear alert during take-off roll, initial climb or approach.	X		X	X	X				

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	AOP	COM	FPMA	FPMM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	Terrain	B	APP	Alert, warning, or conflict	Anticipate terrain threats Prepare for terrain threats Recognise unsafe terrain clearance Take appropriate action Apply appropriate procedure correctly Maintain aircraft control Restore safe flight path Manage consequences	Incorrect baro setting on 3D RNAV approach leading to EGPWS warning in IMC.	x		x	x	x	x	x		x
			APP			'Soft' go around into 'glass mountain' requiring change to TOGA for escape manoeuvre.	x		x	x		x			
			APP			Curved approach/RNPAR radius to fix 'glass mountain' causing EGPWS.	x		x	x		x	x		
			APP			Spurious EGPWS in VMC.	x	x	x	x	x		x	x	x

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	AOP	COM	FPMA	FPMM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	Pilot Incapacitation	C	TO	Consequences for the non-incapacitated pilot.	Recognise incapacitation Take appropriate action including correct stop/go decision Apply appropriate procedure correctly Maintain aircraft control Manage consequences	Incapacitation during rejected take off requiring role change for evacuation management.	x	x			x	x	x	x	x
			TO			Incapacitation of Pilot Flying at rotation.	x	x			x	x	x		
			APP			Incapacitation of PF during LVO approach.	x	x	x			x			
			APP			Somatogavic illusion on go around, Pilot Flying pitches nose down. (ISI)		x		x		x	x		x
			APP/TO/CRZ			Subtle incapacitation sensed by errors in automation.		x	x		x		x		

Topic		Freq	Phase	Description	Outcome	Example Scenario elements	AOP	COM	FPMA	FPMM	LTW	PSD	SAW	WLM	KNO
Evaluation and scenario-based training phases	Adverse wind	B		Adverse wind/cross wind. This includes tailwind but not ATC miss-reporting of the actual wind	Recognise adverse wind conditions Observe limitations Apply appropriate procedures Maintain directional control and safe flight path	Approach and landing with FMC generated winds exceeding tailwind limit with tower reported winds within tail wind limit.	x			x	x		x		x
						Increasing turbulence with increasing wind gusts.				x			x		

Appendix 11 – Pilot Competencies and Observable Behaviors

Competency Description	Observable behaviors
Application of knowledge Demonstrates knowledge and understanding of relevant information, operating instructions, aircraft systems and the operating environment	OB 0.1 Demonstrates practical and applicable knowledge of limitations and systems and their interaction OB 0.2 Demonstrates required knowledge of published operating instructions OB 0.3 Demonstrates knowledge of the physical environment, the air traffic environment including routings, weather, airports and the operational infrastructure OB 0.4 Demonstrates appropriate knowledge of applicable legislation OB 0.5 Knows where to source required information OB 0.6 Demonstrates a positive interest in acquiring knowledge OB 0.7 Is able to apply knowledge effectively
Application of procedures and compliance with regulations Identifies and applies appropriate procedures in accordance with published operating instructions and applicable regulations	OB 1.1 Identifies where to find procedures and regulations 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 1.4 Operates aeroplane systems and associated equipment correctly OB 1.5 Monitors aircraft systems status OB 1.6 Complies with applicable regulations. OB 1.7 Applies relevant procedural knowledge

Competency Description	Observable behaviors
Communication Communicates through appropriate means in the operational environment, in both normal and non normal situations	OB 2.1 Determines that the recipient is ready and able to receive information OB 2.2 Selects appropriately what, when, how and with whom to communicate OB 2.3 Conveys messages clearly, accurately and concisely OB 2.4 Confirms that the recipient demonstrates understanding of important information OB 2.5 Listens actively and demonstrates understanding when receiving information OB 2.6 Asks relevant and effective questions OB 2.7 Uses appropriate escalation in communication to resolve identified deviations OB 2.8 Uses and interprets non-verbal communication in a manner appropriate to the organizational and social culture OB 2.9 Adheres to standard radiotelephone phraseology and procedures OB 2.10 Accurately reads, interprets, constructs and responds to datalink messages in English
Aeroplane Flight Path Management, automation Controls the flight path through automation	OB 3.1 Uses appropriate flight management, guidance systems and automation, as installed and applicable to the conditions OB 3.2 Monitors and detects deviations from the intended flight path and takes appropriate action OB 3.3 Manages the flight path safely to achieve optimum operational performance OB 3.4 Maintains the intended flight path during flight using automation while managing other tasks and distractions OB 3.5 Selects appropriate level and mode of automation in a timely manner considering phase of flight and workload OB 3.6 Effectively monitors automation, including engagement and automatic mode transitions

Competency Description	**Observable behaviors**
Aeroplane Flight Path Management, manual control Controls the flight path through manual control	OB 4.1 Controls the aircraft manually with accuracy and smoothness as appropriate to the situation OB 4.2 Monitors and detects deviations from the intended flight path and takes appropriate action OB 4.3 Manually controls the aeroplane using the relationship between aeroplane attitude, speed and thrust, and navigation signals or visual information OB 4.4 Manages the flight path safely to achieve optimum operational performance OB 4.5 Maintains the intended flight path during manual flight while managing other tasks and distractions OB 4.6 Uses appropriate flight management and guidance systems, as installed and applicable to the conditions OB 4.7 Effectively monitors flight guidance systems including engagement and automatic mode transitions
Leadership and Teamwork Influences others to contribute to a shared purpose. Collaborates to accomplish the goals of the team	OB 5.1 Encourages team participation and open communication OB 5.2 Demonstrates initiative and provides direction when required OB 5.3 Engages others in planning OB 5.4 Considers inputs from others OB 5.5 Gives and receives feedback constructively OB 5.6 Addresses and resolves conflicts and disagreements in a constructive manner OB 5.7 Exercises decisive leadership when required OB 5.8 Accepts responsibility for decisions and actions OB 5.9 Carries out instructions when directed OB 5.10 Applies effective intervention strategies to resolve identified deviations OB 5.11 Manages cultural and language challenges, as applicable

Competency Description	Observable behaviors
Problem Solving and Decision Making Identifies precursors, mitigates problems; and makes decisions	OB 6.1 Identifies, assesses and manages threats and errors in a timely manner OB 6.2 Seeks accurate and adequate information from appropriate sources OB 6.3 Identifies and verifies what and why things have gone wrong, if appropriate OB 6.4 Perseveres in working through problems while prioritizing safety OB 6.5 Identifies and considers appropriate options OB 6.6 Applies appropriate and timely decision-making techniques OB 6.7 Monitors, reviews and adapts decisions as required OB 6.8 Adapts when faced with situations where no guidance or procedure exists OB 6.9 Demonstrates resilience when encountering an unexpected event
Situation awareness and management of information Perceives, comprehends and manages information and anticipates its effect on the operation.	OB 7.1 Monitors and assesses the state of the aeroplane and its systems OB 7.2 Monitors and assesses the aeroplane's energy state, and its anticipated flight path. OB 7.3 Monitors and assesses the general environment as it may affect the operation 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 OB 7.6 Develops effective contingency plans based upon potential risks associated with threats and errors OB 7.7 Responds to indications of reduced situation awareness

Competency Description	**Observable behaviors**
Workload Management Maintains available workload capacity by prioritizing and distributing tasks using appropriate resources	OB 8.1 Exercises self-control in all situations OB 8.2 Plans, prioritizes and schedules appropriate tasks effectively OB 8.3 Manages time efficiently when carrying out tasks OB 8.4 Offers and gives assistance OB 8.5 Delegates tasks OB 8.6 Seeks and accepts assistance, when appropriate OB 8.7 Monitors, reviews and cross-checks actions conscientiously OB 8.8 Verifies that tasks are completed to the expected outcome OB 8.9 Manages and recovers from interruptions, distractions, variations and failures effectively while performing tasks

Appendix 12 – Instructor/Evaluator Competencies

Competency Description	Observable behaviors
Pilot Competencies Refer to the description in the Pilot Competencies in Annex 1	Refer to observable behaviors in the Pilot Competencies in Annex 1.
Management of the learning environment Ensures that the instruction, assessment and evaluation are conducted in a suitable and safe environment.	IOB 2.1 Applies TEM in the context of instruction/evaluation IOB 2.2 Briefs on safety procedures for situations that are likely to develop during instruction/evaluation IOB 2.3 Intervenes appropriately, at the correct time and level (e.g., progresses from verbal assistance to taking over control) IOB 2.4 Resumes instruction/evaluation as practicable after any intervention IOB 2.5 Plans and prepares training media, equipment and resources IOB 2.6 Briefs on training devices or aircraft limitations that may influence training, when applicable IOB 2.7 Creates and manages conditions (e.g., airspace, ATC, weather, time, etc.) to be suitable for the training objectives IOB 2.8 Adapts to changes in the environment whilst minimizing training disruptions IOB 2.9 Manages time, training media and equipment to ensure that training objectives are met
Instruction Conducts training to develop the trainee's competencies.	IOB 3.1 References approved sources (operations, technical, and training manuals, standards and regulations) IOB 3.2 States clearly the objectives and clarifies roles for the training IOB 3.3 Follows the approved training program IOB 3.4 Applies instructional methods as appropriate (e.g., explanation, demonstration, facilitation, discover with assistance, discover without assistance) IOB 3.5 Sustains operational relevance and realism IOB 3.6 Adapts the amount of instructor inputs to ensure that the training objectives are met IOB 3.7 Adapts to situations that might disrupt a planned sequence of events IOB 3.8 Continuously assesses trainee's competencies IOB 3.9 Encourages the trainee to self-assess

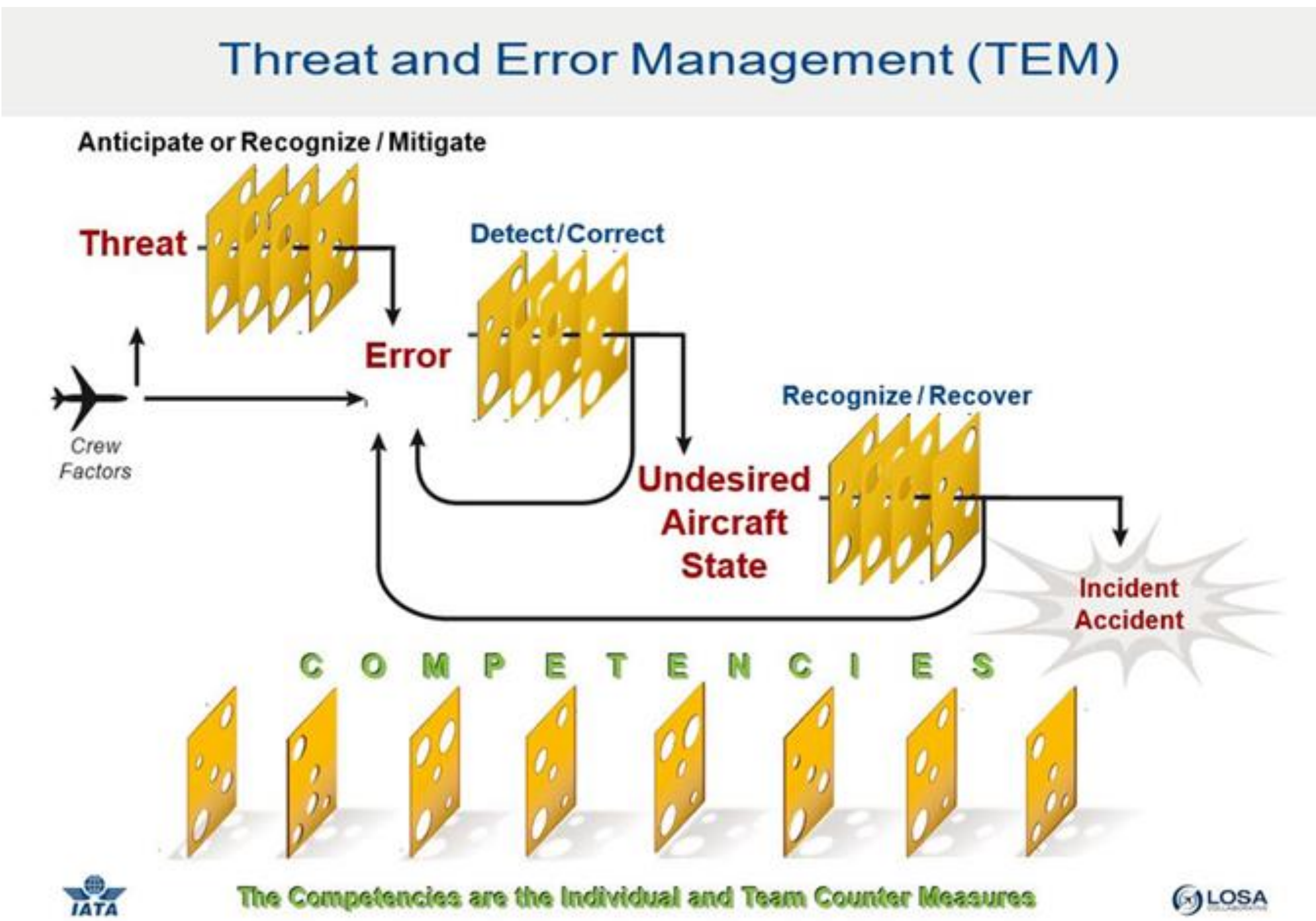
Competency Description	**Observable behaviors**
	IOB 3.10 Allows trainee to self-correct in a timely manner IOB 3.11 Applies trainee-centered feedback techniques (e.g., facilitation, etc.) IOB 3.12 Provides positive reinforcement
Interaction with the trainees Supports the trainees' learning and development	IOB 4.1 Shows respect for the trainees (e.g., for culture, language, experience) IOB 4.2 Shows patience and empathy (e.g., by actively listening, reading non-verbal messages and encouraging dialogue) IOB 4.3 Manages trainees' barriers to learning IOB 4.4 Encourages engagement and mutual support IOB 4.5 Coaches the trainees
and Demonstrates exemplary behavior (role model)	IOB 4.6 Supports the goal and training policies of the operator/ATO and Authority IOB 4.7 Shows integrity (e.g., honesty and professional principles) IOB 4.8 Demonstrates acceptable personal conduct, acceptable social practices, content expertise, a model for professional and interpersonal behavior IOB 4.9 Actively seeks and accepts feedback to improve own performance
Assessment and Evaluation Assesses the competencies of the trainee	IOB 5.1 Complies with Operator/ATOs and Authority requirements IOB 5.2 Ensures that the trainee understands the assessment process IOB 5.3 Applies the competency standards and conditions IOB 5.4 Assesses trainee's competencies IOB 5.5 Performs grading IOB 5.6 Provides recommendations based on the outcome of the assessment IOB 5.7 Makes decisions based on the outcome of the summative assessment IOB 5.8 Provides clear feedback to the trainee
and Contributes to continuous training system improvement	IOB 5.9 Reports strengths and weaknesses of the training system (e.g., training environment, curriculum, assessment/evaluation) including feedback from trainees IOB 5.10 Suggests improvements for the training system IOB 5.11 Produces reports using appropriate forms and media

Appendix 13 – Competencies and Threat and Error Management (TEM)

The role of the competencies within the Threat and Error Management model has been formalized at the international level.

First, ICAO Doc 9868 (PANS-TRG) Amendment 7 states that: *"From a competency-based training and assessment perspective, the competencies of the approved adapted competency model provide individual and team countermeasures to threats and errors and undesired aircraft states. CRM skills are embedded in the approved adapted competency model. Therefore, the CRM training supports the development of the competencies as countermeasures in the TEM concept."*

The schematic below is used as a pedagogical tool to illustrate the above-mentioned concept



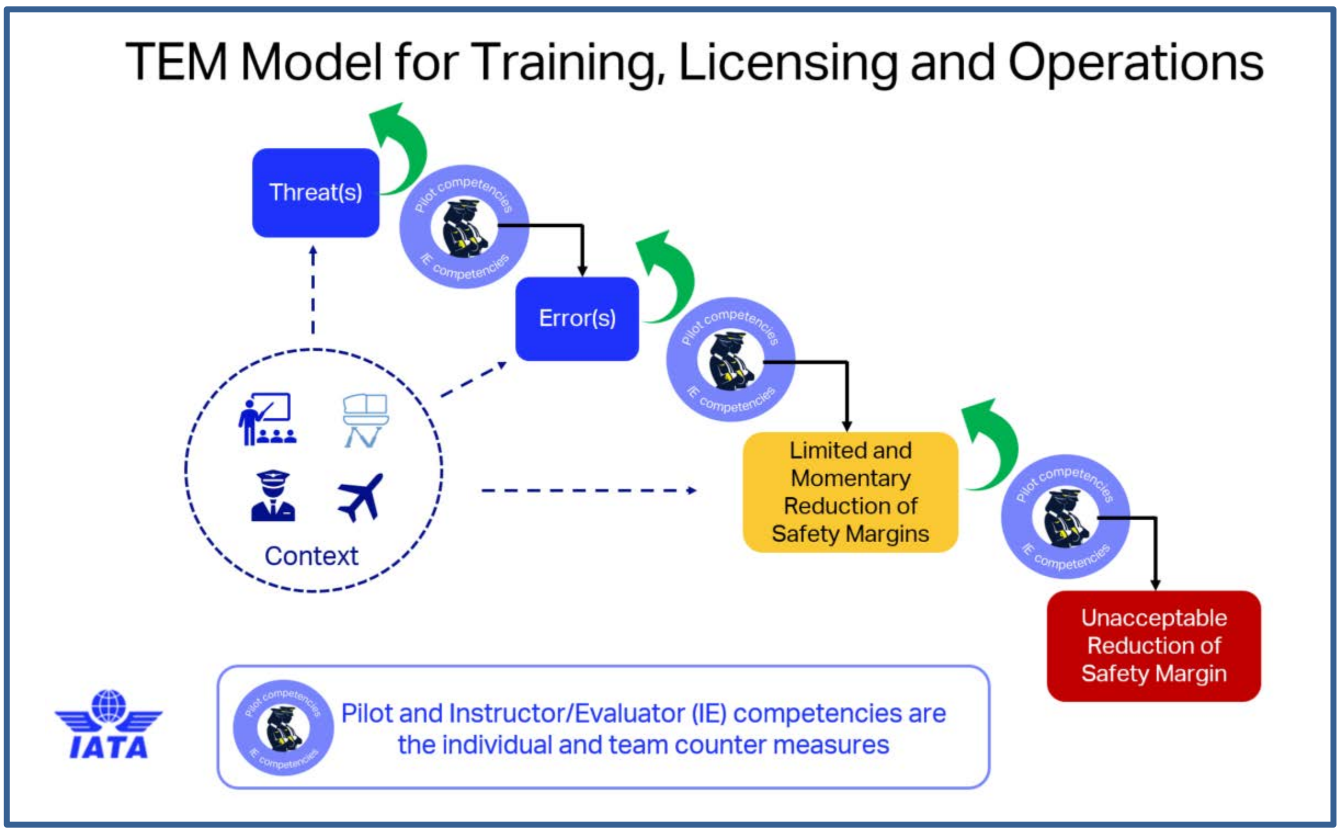
From a practical perspective, the competencies being the countermeasures in the TEM model:

- The more Observable Behaviors are timely demonstrated, the better the threat and error management should be. This should lead to the maintenance of the safety margins.
- Per opposition, the Observable Behaviors that have not been demonstrated when they were required could result in the mismanagement of the threats and errors. This could lead to a reduction of the safety margins.

Second, ICAO Doc 9868 (PANS-TRG) Amendment 7 also states that: *"Originally developed for flight deck operations, the TEM model can nonetheless be used at different levels and in different sectors within an organization, and across different organizations and activities within the aviation industry. It is therefore important, when applying TEM, to keep the user's perspective in the forefront. Depending on "who" is using TEM (front-line personnel, intermediate management, senior management; flight operations, maintenance, air traffic control), slight adjustments to related definitions may be required."*

The above statement illustrates the fact that the TEM model usage has historically expanded from the pure area of operations and safety to the training and licensing domain. This development has been synchronous with the expansion of the CBTA principles and is fully consistent, as the competencies permit (per definition) to reliably predict successful performance on the job as they represent the individual and team countermeasures in the TEM model.

The schematic below is an example of a more holistic TEM model that can be used as a tool in operations (e.g., LOSA), but also in training and licensing (e.g., assessment of competence).



Note the wording adjustments:

'Limited and Momentary Reduction of Safety Margin' describes an outcome of TEM where the pilot or the instructor/evaluator did not demonstrate, on a few occasions, the Observable Behaviors that would have allowed a timely management of the threats or errors. This led to a limited and momentary reduction of the safety margin.

'Unacceptable Reduction of Safety Margin' describes an outcome of TEM where the pilot or the instructor/evaluator demonstrated Observable Behaviors that did not allow a timely management of the threats or errors. This led to an unacceptable reduction of the safety margin. For example, involuntary Undesired Aircraft State (UAS) during flight training, due to mismanagement of a stall exercise, that is recognized late or recovered late by the instructor.

The above is an extraction from the IATA Guidance Material and Best Practices for Instructor and Evaluator Training, Edition 2.

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