Competency-Based Training and Assessment (CBTA) Expansion within the Aviation System

White Paper

(March 2024)

Contents

Abbreviations and Acronyms

AOC	Operator holding an Air Operator Certificate
ATO	Approved Training Organization
ATPL	Airline Transport Pilot License
OEM	Original Equipment Manufacturer
CAA	Civil Aviation Authority
CCQ	Cross Crew Qualification (an Airbus term)
CPL	Commercial Pilot License
ICAP	Interagency Committee for Aviation Policy
MPL	Multi-Crew Pilot License
OCC	Operational Control Centre
PPL	Private Pilot License

Note: “Organization” refers to an ATO, an AOC or an OEM

1. Introduction

The civil aviation industry has been the fastest growing means of transportation in the last few decades. The technical advances and considerable efforts to improve flight safety have led our industry to be widely recognized as one of the safest means of transportation in terms of number of passengers/kilometres.

These good results illustrate the safety commitment of our industry, which has been able to continuously adapt, develop and implement consolidated standards related to personnel training and licensing, to operational procedures and to the airworthiness of the airplanes.

Additionally, since the early stages of aviation, the accidents and incidents investigations protocols were formalized to produce safety recommendations, to implement corrective action plans, and more recently, to establish and maintain accident and incident databases. These databases facilitate the effective analysis of information on actual or potential safety deficiencies and to determine any preventive actions required.

Today, the aviation system safety performance has achieved an increased level of maturity as States, airlines, training organizations, manufacturers and other service providers have begun implementing State Safety Programs (SSPs) or Safety Management Systems (SMSs) that permit to have a harmonized safety management approach among stakeholders, which consequently generates safety benefits.

As a matter of fact, this modern global safety management is significantly sustained by safety data as both SSP and SMS mandate the establishment and maintenance of a formal process to collect, capture and enable the analysis of hazards based on a combination of reactive and proactive safety data collection methods.

However, today, the safety data integrates a very limited amount of training data or training records from Civil Aviation Authority Licensing departments, Approved Training Organizations (ATOs), Air Operators (AOCs) and other service providers.

In the context of the expansion of new training methodologies such as Competency-Based Training and Assessment (CBTA) for several categories of personnel, and Evidence-Based Training (EBT) for pilots, the aviation system is gaining access to a significant volume of training data that relates directly to human performance.

Therefore, the purpose of this white paper is to inform about CBTA and its associated benefits, while describing the nature and the value of the upcoming CBTA training data. The paper identifies the opportunities and challenges related to the CBTA expansion and proposes recommendations for its implementation by States and the industry.

In particular, this paper proposes solutions to integrate training data into the safety management system to enhance operational safety, with the goal to cope with the increased complexity of the aviation system due to the advent of different models of operations, the introduction of advanced technologies, the design of new procedures and the enforcement of environmental constraints.

The role of training data, in regard to license recognition and training efficiency enhancements, is also covered as there is, in the long-term, a global need for licensing harmonization under CBTA programs, and, in the short and medium-term, for optimization of the training capacities in the context of the post COVID restart of operations.

2. Aviation System and Safety Management System

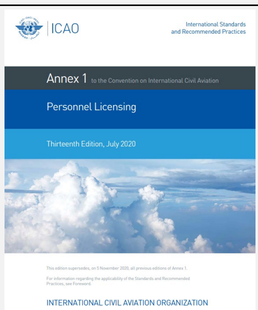
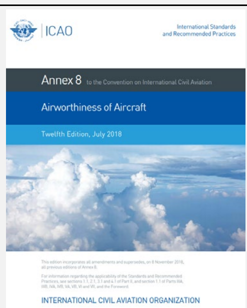
2.1 Aviation system components

As this white paper relates to CBTA in the pilot and pilot instructor domain, the aviation system and safety management are described from the pilot training and licensing, and operational perspective. As any other system, the aviation system is constituted of three essential components where the pilots (and the pilot instructors) represent the people, the operational procedures represent the processes, and the aircraft represents the technology.

From an international perspective, since 1948, the States have agreed to adopt common standards for pilot qualification, ICAO Annex 1 (Personnel Licensing), for operational procedures, Annex 6 (Operation of Aircraft), and for aircraft design and certification, Annex 8 (Airworthiness of Aircraft). These standards also describe the role and the requirements that are applicable to the organizations delivering pilot training (ATOs), conducting operations (AOCs) and producing the aircraft (Original equipment manufacturer [OEM]). The standards also define the obligation of the States in terms of certification of personnel and organizations.

Since 1951, Annex 13 defines the standards that are applicable to the States in terms of accidents and incidents investigations. The safety recommendations arising from accidents and incidents investigations, combined with the continuous consolidation of the different annexes' standards, have been a key enabler to flight safety enhancements

Summary:

Aviation System components		
People	**Processes**	**Technology**
Pilots and Instructors 	Operational Procedures 	Aircraft 
ICAO Standards		
		
Service providers		
Approved Training Organizations (ATO) Deliver training	Air Operators (AOC) Conduct operations	Original Equipment Manufacturers (OEM) Design and produce aircraft

2.2 Safety performance enhancements

The aviation safety performance system has incrementally progressed in time by focusing on specific areas of activity. From its origins until the end of the 1960s, safety performance was mainly enhanced by technical developments that permitted to reduce the rate of aircraft system failures or malfunctions, and with the integration of safety recommendations arising from accidents and incidents investigations, and the continuous consolidation of the different annexes' standards.

By the early 1970s, the frequency of aviation accidents had significantly declined due to major technological advances and enhancements in safety regulations. Aviation became a safer mode of transportation. The focus of safety endeavors was extended to include human factors. Those years saw the promotion of Human Factors through the introduction of Crew Resources Management (CRM) training programs as well as Line Oriented Flight Training (LOFT), which focused on the application of CRM in in-flight scenarios.

During the mid-1990s, safety began to encompass organizational factors as well as human and technical factors. Additionally, routine safety data collection and analysis, using reactive and proactive methodologies, enabled organizations to monitor known safety risks and to detect emerging safety trends. These enhancements provided the knowledge and foundation that have led to the current safety management approach.

By the beginning of the 21st century, many States, airlines, training organizations and manufacturers had embraced the safety approaches of the past and evolved to a higher level of safety maturity. They are implementing State Safety Programs (SSP) or Safety Management System (SMS) and are reaping the safety benefits.

ICAO Annex 19 (Safety Management), and related documents, describe the requirements related to the SSP and SMS that sustain this global proactive approach to safety. In particular, the Safety Management Manual (ICAO Doc 9859) provides guidance on interface management between organizations, which can make a significant contribution to safety.

It is to be noted that States shall establish a process to investigate accidents and incidents in accordance with Annex 13, in support to the State's safety management.

Summary:

2.3 Safety Risk Management

The safety management framework described in Annex 19, which is applicable to both States and organizations, is composed of the following four elements:

- Safety policy, objectives, and resources,
- Safety risk management,
- Safety assurance, and
- Safety promotion.

Although differences exist in terms of scope and responsibilities, there are a lot of similarities between the States and the organizations in the application of a safety management framework. In particular, the Safety Risk Management process follows similar steps. First, the identification of hazards based on a combination of a reactive and proactive methodology. Second, the assessment and management of the risks associated with the identified hazards.

Before elaborating on hazard identification, it is important to remember that the States also have specific obligations in terms of safety risk management. Among others, the States have obligations in regard to licensing, certification, authorization, and approval (CE-6) and resolution of safety issues (CE-8), which correspond, respectively, to the State's safety oversight critical elements number 6 and 8.

The role of CBTA in the support of CE-6 and CE-8 is described in Chapter 4. CBTA Opportunities, in this document.

Actual hazard identification methods

The reactive hazard identification methodology involves the analysis of past outcomes or events. Hazards are identified through the investigation of safety occurrences. Incidents and accidents are an indication of system deficiencies and should, therefore, be analyzed to determine which hazard(s) contributed to the event.

The proactive hazard identification methodology involves collecting safety data of lower consequence events, or process performance, and analyzing the safety information or frequency of occurrence to determine if a hazard could lead to an accident or incident. The safety information for proactive hazard identification comes primarily from flight data analysis (FDA) programs and the safety reporting systems.

A safety reporting system includes a mandatory occurrence reporting that tends to collect more technical information and operational deviations (e.g., hardware failures, level bust, etc.), than human performance aspects. A voluntary safety reporting system will permit to address the need for a greater range of safety reporting to acquire more information on human factors related aspects, and to enhance aviation safety.

Summary:

Example of hazard identification methodology		
Reactive	Reactive/Proactive	Proactive
E.g., Analysis Accident-Incidents	E.g., Analysis of event including Undesired Aircraft States	E.g., Analysis of Threat and Error Management
	Flight Data Analysis (FDA) Mandatory Occurrence reporting	Line Oriented Safety Audits (LOSA) Voluntary Safety reporting

Safety Data

ICAO Annex 19 defines Safety Data as "*A defined set of facts or set of safety values collected from various aviation-related sources, which is used to maintain or improve safety. Note.— Such safety data is collected from proactive or reactive safety-related activities, including but not limited to: a) accident or incident investigations; b) safety reporting; c) continuing airworthiness reporting; d) operational performance monitoring; e) inspections, audits, surveys; or f) safety studies and reviews.*

The effective management of safety is highly dependent on the effectiveness of safety data collection, analysis, and overall management capabilities. Reliable safety data and safety information is needed to identify trends, make decisions, evaluate safety performance in relation to safety targets and safety objectives, and to assess risk.

Many ATOs and AOCs have collected a wealth of safety data and safety information, from mandatory and voluntary safety reporting systems, as well as from automated data capture systems. This safety data and safety information allows organizations to identify hazards and supports safety performance management activities at the organization's level.

ICAO Annex 19 requires States to establish a Safety data collection and processing system (SDCPS) to capture, store, aggregate and enable the analysis of safety data and safety information to support the identification of hazards that cut across the aviation system.

The safety data, safety information and their related sources are also subject to protection protocols in order to ensure their continued availability, with a view to using them to maintain or improve aviation safety, while encouraging individuals and organizations to report safety data and safety information. The protection protocols are not intended to relieve sources of their safety related obligations or interfere with the proper administration of justice.

Actual Training Data

Today, the safety data integrates a very limited amount of training data or training records from the CAA's Licensing Department (via certification records), ATOs (training data) and AOCs (training records). Additionally, under traditional task-based training the quality of the training data and records does not provide sufficient visibility on the pilot's and instructor's abilities to contribute efficiently to safe operations. This limitation exists because traditional training focusses on a few technical skills, while human performance encompasses a broader set of non-technical skills and attitudes.

Summary:

Example of typical safety data and safety information sources

States [• Accident/incident database • State audits • National aviation reviews • State safety programme • SPIs and SPTs • ICAO USOAP • In-flight medical incapacity database • Other state partner]

Civil aviation authority [• Mandatory occurrence reports • Voluntary reports • Risk assessments • Risk profiles • Industry SPIs/trend analysis • Service provider surveillance • External and internal audits • Enforcement records • Incident/accident reports **• Certification records** • Aircrew in-flight medical incapacity reports • Trends in medical assessment findings]

Approved training organizations (ATOs)
- Mandatory occurrence reports
- Voluntary reports
- Risk assessment register
- SPIs trend analysis
- Quality assurance reports
- **Training data**

Air operators (AOCs)
- Mandatory occurrence reports • Voluntary reports
- Flight data analysis (FDA) • Recorded data (flight data recorder, cockpit voice recorder, video...)
- Fatigue risk management system
- Risk assessment register • SPIs/trend analysis
- Maintenance records • Internal audits
- Reliability programme reports
- **Training records**

3. Competency-Based Training and Assessment (CBTA) including Evidence-Based Training (EBT)

3.1 Definitions

CBTA is defined by ICAO 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 sake 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 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.

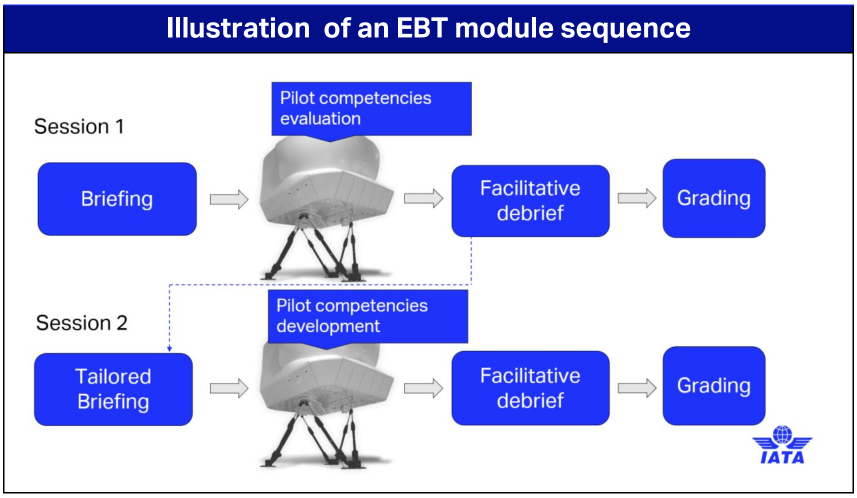
CBTA is applicable to all spectrum of pilot training from pilot aptitude testing, pilot initial licensing training, Instructor/Evaluator training and operator training.

EBT is defined by EASA as assessment and training based on operational data that is characterized by the development and assessment of 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, through the analysis of 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 perform their job in operations.



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

3.2 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 that is CBTA compliant.

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

In 2016, ICAO published Amendment 5 to 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.

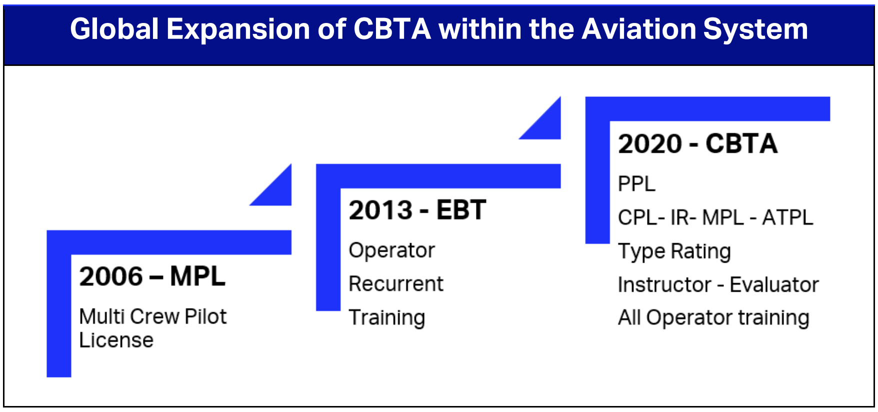
In 2020, ICAO published Amendment 7 to PANS-TRG. This formalized the global expansion and applicability of CBTA principles to all licensing training (ICAO Annex 1) and operator training (ICAO Annex 6).

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 in 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 a common standard by the Joint Aviation Regulations (JARs) in 2006
- EBT, since the publication of 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 has launched a Rulemaking Task (RMT 0194) to introduce CBTA principles in the Aircrew regulation (results expected in 2022)

Summary:



3.3 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]

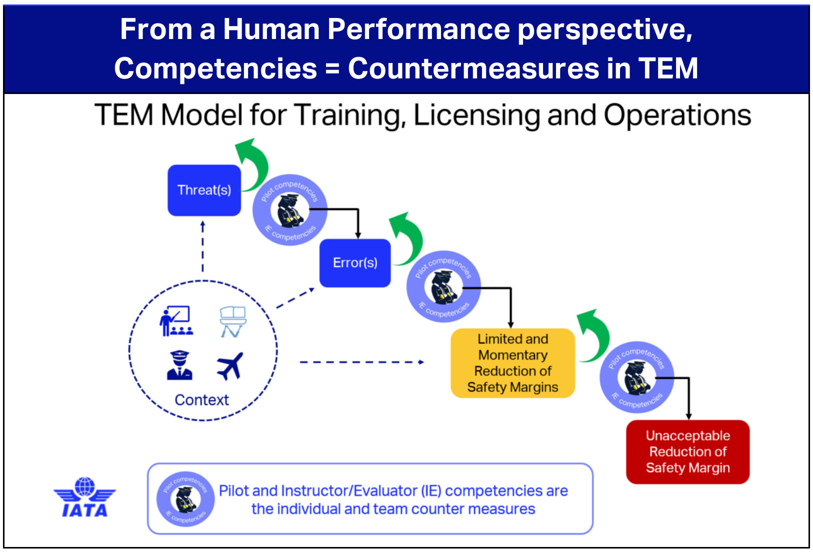
The pilot competencies were officially introduced as a new standard to measure the pilot's performance between 2008- 2013 when the design of EBT took place. The detailed pilot competency set is provided in Annex 1.

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 the detailed instructor/evaluator competency set in Annex 2**.**

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

Summary:



3.4 Training system performance

CBTA is a performance-based training program that integrates, by design (Instructional System Design), 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, and
- 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 an 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 the level of performance within the range of competencies and outcomes
- instructor inter-rater reliability data

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.

4. CBTA opportunities

4.1 Safety enhancement

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

Traditional training, which is hours-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 exercises where the measurement of pilot performance is mainly based on a set of fixed, predetermined criteria represented by numeric flight path deviation tolerances.

In contrast, CBTA aims at assessing, developing, and enhancing the pilot competencies (see Annex 1) and the Instructor/Evaluator competencies (see Annex 2). CBTA also uses more scenario-based training for more 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, required under CBTA programs, were originally developed under modern training programs such as Advanced Qualification Programs (AQP) regulated by the FAA, and Alternative Training and Qualification Programs (ATQP) regulated by EASA.

To illustrate the specific value of the training data generated by 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 to avoid a reduction of safety margins.

Therefore:

- The more competencies' Observable Behaviors 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 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 and the recognition and recovery of the potential reductions of safety margins that may have happened during training or evaluation.

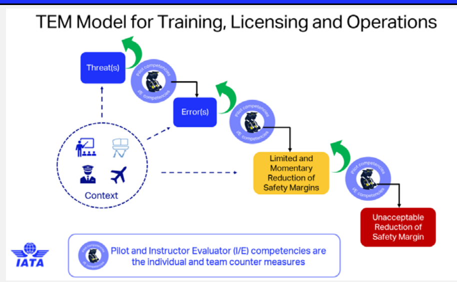
As an example, the following grading metrics (comprising four categories of metrics) had been introduced within the European regulatory framework in the context of baseline EBT implementation.

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 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.

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 Accident-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
			

From a State perspective, CBTA should also support the efforts to enhance safety by providing a more robust licensing system. In particular, the critical element "CE-6. Licensing, certification, authorization, and approval obligations", which is part of the State's safety oversight system, is reinforced by the integration of the CBTA training metrics. These metrics should permit enhancement in the accuracy and the reliability of the pilot's or instructor's performance assessment requirements for the license, qualification or certificate issuance, revalidation, and renewal. At the organizational level, the global collection and analysis of the CBTA metrics should positively complement the actual safety performance indicators with the goal to achieve better safety records.

Note: CE-6 mandates that States implement documented processes and procedures to ensure that individuals and organizations performing an aviation activity meet the established requirements before they are allowed to exercise the privileges of a license, certificate, authorization or approval to conduct the relevant aviation activity.

CBTA should also facilitate the resolution of safety issues [another critical element of the State Safety oversight system (CE-8.)] by providing more detailed and reliable trends from different organizations about pilot and instructor/evaluator performance, in order to manage threats and errors in both training and operational context. The States could interact proactively with the organizations under their oversight by documenting and sharing all interface safety issues, safety reports and lessons learned, as well as safety risks between interfaces. Sharing enables transfer of knowledge and working practices that could improve the safety effectiveness of each organization.

Summary:

Enhanced State safety risk management via CE-6 and CE-8	
States-CAAs State Safety Program (SSP)	**Service Providers' Safety Management System (SMS)**
❑ Safety policy, objectives (and resources) ❑ Safety risk management ▪ Licensing, certification, authorization and approval obligations (CE-6) ▪ Ensure S.Ps have implemented an SMS ▪ Accident Incident investigation (Annex 13) ▪ Hazard identification (from data collection) and risk management ▪ Resolution of safety issues (CE-8) ❑ Safety assurance ❑ Safety promotion	❑ Safety policy, objectives (and resources) ❑ Safety risk management ▪ Hazard identification ▪ Safety risk assessment and mitigation ❑ Safety assurance ❑ Safety promotion

4.2 Training effectiveness and efficiency

CBTA implicitly provides dynamic, effective, and efficient programs because it respects the instructional system design concept. In particular, the ADDIE principles (Analyze, Design, Develop, Implement and Evaluate) ensure that the training program is adapted to the organization and the pilot needs while making best usage of training media and devices.

In practicality, using the defined pilot and Instructor/Evaluator competencies allows course designers to get a clear idea of the scope of the training required to qualify pilots and instructors. This will enable them to:

- Create consistent training programs
- Define training objectives effectively
- Allocate instructor resources and training media effectively
- Train pilots and Instructors/Evaluators specifically for their assignments; additionally, when changing assignment or adding new assignments, the training needs can easily be identified

CBTA's effectiveness and efficiency is also based on the consistent use of the same set of competencies during the entire career path of the pilot, from aptitude testing, to PPL, CPL, MPL, ATPL, through operator training, as well as for pilot Instructor/Evaluator.

This consistent use of pilot and instructor competencies facilitates training data exchange, the benchmark of training metrics and training data analysis, in order to enhance individual courses, a company's training pathway and the performance of the global training system.

Additionally, CBTA drives and enables pilots and instructors to reach their highest level of performance during all their training, and potentially beyond the training, and during their operational duties.

Practically, adopting a competency-based training approach for both pilots and IEs offers AOCs/ATOs the opportunity to optimize training.

Efficiency can be improved by:

- Increasing effectiveness of instruction and evaluation
- Reducing the number of failures
- Identifying and avoiding duplications and overlaps in existing courses
- Merging content of different fleets courses
- Cooperating with other AOC/ATOs
- Introducing position/type optimized courses, e.g., for OCC, CCQ, requalification and bridge courses
- Standardizing the formats of the courses
- Optimizing scheduling and training time
- Using consistent data-driven feedback from students, instructors, and evaluators for course evaluation

Regulators generally recognize the potential benefits of CBTA-EBT by supporting its expansion and by providing training credits after a successful implementation by an organization.

4.3 Adapted to the individual pilot and instructor needs

CBTA follows a training plan with some inbuilt flexibility, and all pilot and instructor competency in all stages and phases of training. As such pilots and instructors:

- Benefit from a training tailored to their individual needs
- Gain greater confidence in their ability to manage the unexpected and build resilience
- Are more motivated through the individualization of training and use of applied and relevant scenarios
- Are supported and mentored to continuously improve in all areas, and, where feasible, the training plan and time allocation is shifted toward the areas of the trainee's weakness or concerns, maximizing the effectiveness of the instructional contact time

Summary: CBTA is more trainee centered.

4.4 EBT Data Report update

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. 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.

The whole concept behind 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.

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

The IATA EBT Data Report ,1st Edition, 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 IATA EBT Subgroup, constituted of representatives from operators and Approved Training Organizations (ATOs) that have implemented EBT, was created.

During the review of the data sources and the methodology, the EBT Accident-Incident Study was identified as one of the cornerstones of the EBT Data Report to ensure the relevance of the EBT curriculum.

The EBT Accident-Incident Study is a two-stage 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 have been weak as countermeasures) that have been identified as contributive factors to the accident or incident. IATA Training and Licensing developed and provided a specific standardization (a 2-hour computer-based training) to the analysts and designed an electronic tool to collect the results of the analysts. The standardization of the analysts ensured the global consistency of the analysis, while the tool supported the accuracy of the reporting/recording of the analysis results.

The standardization ensures accuracy and correctness of the data collected, while the tool supports the global consistency of the analysis.

Stage 2 of the study is based on the results of Stage 1 and involves a statistical analysis 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. In particular, Stage 2 of the study process applies the principles of risk management (risk probability vs risk severity) by using an algorithm to prioritize training topics and determining training criticality.

Hence, the EBT Accident-Incident Study provides objectivity (qualification of the analysts) and reliability during the analysis (algorithmic process) that consequently induces a strong relevance to the EBT curriculum, in terms of training topic definition.

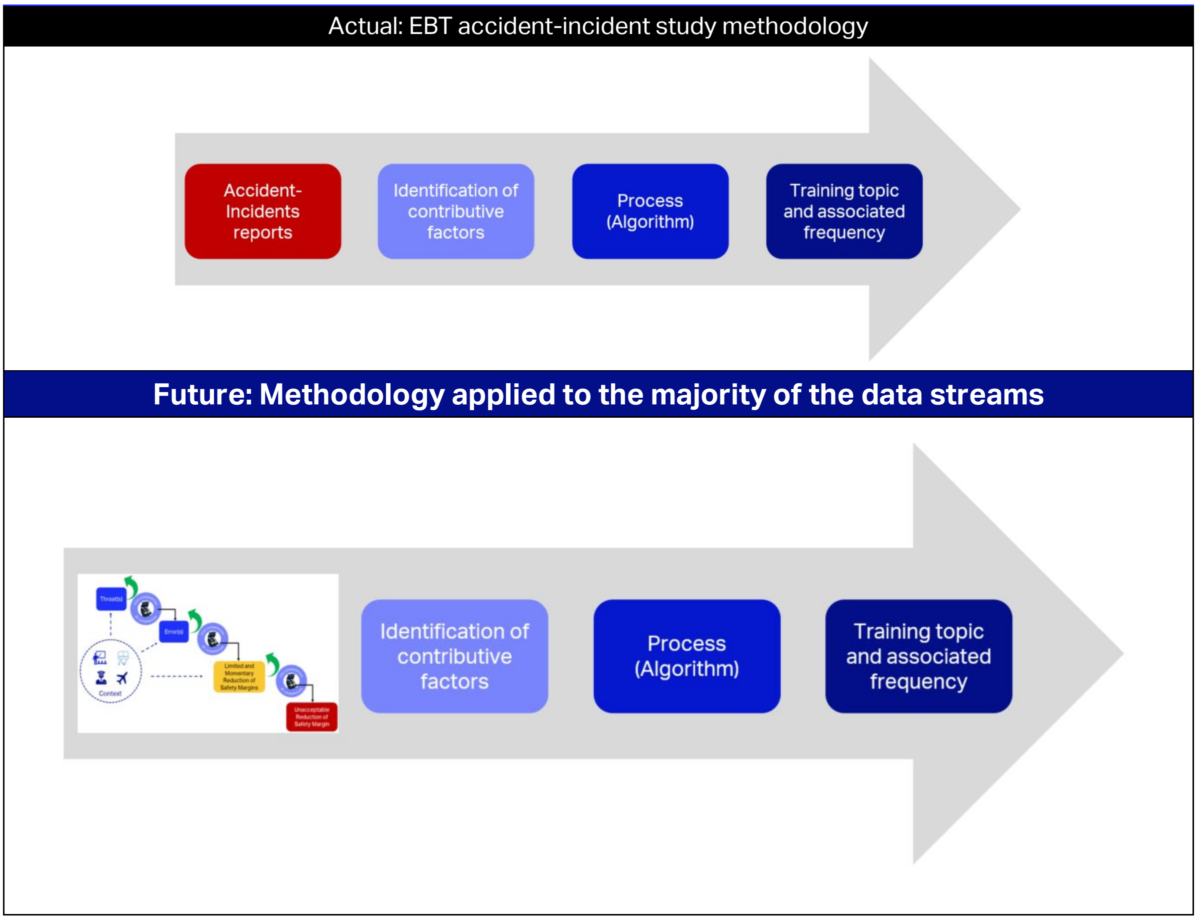
Therefore, one of the recommendations of the IATA EBT Subgroup has been to extend the analysis methodology of the EBT Accident-Incident Study to lower consequence events such as, for example, the reduction of safety margins events captured via mandatory occurrence reporting. This methodology could also be applied to LOSA observations data and to Simulator Operations Quality Assurance (SOQA) data.

In the context of the expansion of CBTA, there is an additional opportunity for the EBT Accident-Incident analysis methodology to be applied to the CBTA training data collected in the training context and in operations. This would permit to continuously evaluate the relevance of the EBT training program in light of both safety data and training data collected at the organizational and State levels.

However, the opportunity to continuously update the EBT Data Report also represents an important challenge in regard to storage, access, and protection of this sensitive and intimate training data, which will need to be addressed by the industry.

Summary:

The extension of the EBT Accident-Incident Study methodology to the majority of the safety and training data streams should permit a continuous and more robust update of the EBT curriculum.



5. CBTA challenges

5.1 Alignment of Safety Data and Training Data taxonomies

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, improving the quality of information and communication. The aviation community's capacity to identify and focus on safety issues is greatly enhanced by sharing a common language. Taxonomies enable analysis and facilitate information sharing and exchange.

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 explained in Chapter 4, the training metrics relate directly to threat and error management and the recognition and recovery of any reduction in 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, the safety data taxonomy should be aligned with the training data taxonomy, as it relates 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 taxonomy should be aligned with the safety data taxonomy as it relates to the threats, errors, undesired aircraft states and end states codification, while safety taxonomy should be aligned with the training data taxonomy as it relates to the flight crew countermeasures codification, represented by the observable behaviors (OBs) of the pilot and instructor competencies. **The States should provide high level guidance about the safety and training data taxonomies alignment.**

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. **The ATO and AOC should be able 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 1 and Annex 2)

5.2 Training data quality

The alignment of the safety and training data taxonomies significantly facilitates the processing of data to produce meaningful safety information in useful forms such as diagrams, reports, or tables. However, there are a number of important considerations related to data processing, including: data quality, aggregation, fusion, and filtering.

As training data relates to human performance, this chapter elaborates on the data quality aspects that should be implemented to ensure a proper analysis. For the training data quality to be clean and fit for purpose, it is important that this data collection happens in a very controlled environment.

ICAO doc 9859 (Safety Management System) indicates that data quality involves the following aspects:
a) cleanliness: data cleansing is the process of detecting and correcting (or removing) corrupt or inaccurate records from a record set, table, or database and refers to identifying incomplete, incorrect, inaccurate or irrelevant parts of the data and then replacing, modifying, or deleting the dirty or coarse data. *b) relevance: relevant data is data which meets the organization's needs and represents their most important issues. An organization should assess the relevance of data based on its needs and activities.*

c) timeliness: Safety data and safety information timeliness is a function of its currency. Data used for decisions should reflect what is happening as close to real time as possible. Judgement is often required based on the volatility of the situation. For example, data collected two years ago on an aircraft type still operating the same route, with no significant changes, may provide a timely reflection of the situation. Whereas data collected one week ago on an aircraft type no longer in service may not provide a meaningful, timely reflection of the current reality.

d) accuracy and correctness: data accuracy refers to values that are correct and reflect the given scenario as described. Data inaccuracy commonly occurs when users enter the wrong value or make a typographical error. This problem can be overcome by having skilled and trained data entry personnel or by having components in the application such as spell check. Data values can become inaccurate over time, also known as "data decay". Movement is another cause of inaccurate data. As data is extracted, transformed and moved from one database to another, it may be altered to some extent, especially if the software is not robust.

The cleanliness aspects should be facilitated by allocating indicators to the different training or evaluation events that the ATO or AOC are conducting. This filtering should permit to attach meaningful information to each training or evaluation event. This would be the case when a different subset of data could be identified for the training data collected during a line evaluation in operations (e.g., subset Alpha), during a line evaluation in a flight simulator (e.g., subset Bravo), during an Upset Prevention and Recovery training (e.g., subset Charlie), etc. This example illustrates the fact that each subset has its own value but processing subset Charlie with subsets Alpha and Bravo could corrupt the quality of the results.

The relevance of the training data, the need for alignment for the safety and training data taxonomies and the timeliness aspects, already elaborated in Section 5.1 above, are also fully applicable to the training data.

The accuracy and correctness of the training data are fundamental aspects, as today the training data is mainly collected by an Instructor/Evaluator (IE). This explains the reinforcement of the IEs' initial and recurrent standardization content of the CBTA programs. Additionally, training data collection is also applicable to the IE population to ensure their performance level and the continuous enhancement of the IE training programs. The regulators moving to CBTA-EBT also mandate to the organizations that are implementing CBTA to put in place an Instructor Concordance Assurance Program (ICAP), which is a critical element to obtain and maintain the CBTA approval.

The industry has also developed tools to provide the IEs with the recording of technical parameters related to the flight crew performance. These tools support the IEs' competency assessment by giving access to objective training data and consequently increasing the accuracy and the correctness of the training data quality.

Summary:

Solution to the training data quality challenge
- CBTA Instructor standardization and related Instructor Concordance Assurance Program (ICAP) =>Refer to Annex 4 - Introduction of advance technology to support instructor competency assessment

5.3 License recognition

The introduction of CBTA is an important shift in training, which has a significant impact on the issuing, the revalidation, and the renewal of licenses and certificates.

Under traditional task-based and hour-based training, an applicant (pilot or instructor) seeking the privilege of a license or certificate must follow a training course composed of different elements that combine theoretical knowledge, ground and flight training. These elements prescribe minimum training time and experience that assume that the training objectives can be achieved within that timeframe at a normal pace. The training objectives focus on the completion of a tasks list that does not permit to reliably predict successful performance on the job.

Once the training course is completed, the applicant is generally recommended for testing by the organization or person responsible for the training. The content of the traditional skill test or proficiency check is based on the restitution of exercises or maneuvers where the measurement of pilot performance is mainly based on a set of fixed predetermined criteria represented by the flight path deviation numeric tolerances. The skill test and proficiency check contents are harmonized across the different regulations and are generally composed of a list of specific maneuvers that must be satisfactorily performed to obtain a "pass" mark. See example below.

Example of a skill test or proficiency check content under traditional training	
Maneuver/Procedure	**Limits for flight deviation** Heading with all engines operating ± 5° Speed with simulated engine failure + 10 knots/– 5 knots…
-Take-offs with simulated engine failure between V1 and V2	Pass or Fail
-Windshear at take-off/ landing	Pass or Fail
…	…
-Landing with simulated jammed horizontal stabilizer	Pass or Fail
Skill Test or Proficiency check global result	**Pass or Fail**

Under CBTA, the aim of the training is to develop the nine pilot competencies and the four Instructor/Evaluator competencies. The training course is also generally composed of theoretical knowledge, ground, and flight training elements. Nevertheless, the training objectives are considered satisfactorily completed when there is sufficient evidence to ensure that the trainee has achieved competency, without any reference to prescribed training time, and that he meets the interim and/or final competency standards. Under CBTA, the competency standards are the goals to be achieved, while the tasks and the maneuvers are the vehicles to develop the competencies.

In the CBTA context, the evaluation of the applicant corresponds to a skill test or a proficiency check for the issuing, revalidation and renewal of licenses and certificates. The evaluation of the applicant is a summative assessment that is carried out at defined points during the training and/or at the end of the training. During summative assessments, the decision is either "competent" or "not competent" with respect to the interim or final competency standard(s).

Practically speaking, during the evaluation, the Instructor/Evaluator collects evidence on the presence, the robustness and the effectiveness of the competencies by observing, recording and classifying the Observable Behaviors demonstrated or not demonstrated by the applicant during the evaluation session. This data collection and analysis is necessary for the Instructor/Evaluator to assess the applicant's performance in regard to the competency standards. See example below.

Example of a CBTA evaluation	
Line Oriented	**The instructor collects evidence**
- Departure Airport - Introduction of relevant threats during the flight profile - Destination Airport (or Alternate Airport)	▪ Observe performance (behaviors) during the evaluation. ▪ Record details of effective and ineffective performance (behaviors) observed during the evaluation ('record' in this context refers to instructors taking notes).
End of the Evaluation session	▪ Classify observations against the Observable Behaviors (OBs) and allocate the OBs to each competency (or competencies). ▪ Assess the performance by determining the root cause(s) according to the competency framework. Low performance would normally indicate the area of performance to be remediated in subsequent training.
Evaluation result	**Competent or not competent**

This transition from traditional training to CBTA is a challenge for the personnel conducting the evaluation as they must adopt the CBTA philosophy and apply a new methodology to assess the applicant's performance. This aspect is covered in Annex 4, which provides details for CBTA instructor standardization and related Instructor Concordance Assurance Program (ICAP).

The transition from traditional training to CBTA also represents several challenges for the States that integrate CBTA within their regulatory framework as the CAAs must define the competency standards to be applied for the issuing, revalidation and renewal of the licenses and certificates. This implies that the national competency standards related to each license or certificate delivered under CBTA are:

1) Acceptable from an international standard perspective, to ensure license recognition
2) Adapted to the different licenses: for private pilots, commercial pilots, multi-crew pilot, airline transport pilots and related flight instructors
3) Comprehensive for the licensing personnel in charge of the evaluation of the individuals and the organizations

The Chicago Convention Article 32 a) states that *"the pilot of every aircraft and the other members of the operating crew of every aircraft engaged in international navigation shall be provided with certificates of competency and licenses issued or rendered valid by the State in which the aircraft is registered".*

Therefore, it is of upmost importance that an international competency standard be defined for the licenses or certificates issued under CBTA. The newly reconstituted ICAO Personnel Training and Licensing Panel should address this challenge and propose harmonized international solutions for points 1) and 2) mentioned above.

The challenge of the CBTA international license recognition represents an opportunity as well to have a fresh start for a revisited common international competency standard for all licensed personnel.

It is to be noted that the methodology to assess the pilot and instructor competency has been implemented for more than a decade now in the context of EBT implementation.

The competency assessment methodology aims at ensuring the maximum level of consistency and objectivity to assessments performed in a CBTA program.

ICAO should endorse the competency assessment methodology and should also define the competency standards and the conditions of competency demonstration for the issue of any license.

Competency assessment methodology
To assess how well the trainee demonstrated the competency during training or evaluation, the trainer should assess the associated OBs of each competency against the following dimensions by determining: • How many OBs the trainee demonstrated when they were required; • How often the trainee demonstrated the OB(s) when they were required; and • What was the outcome of the threat management and error management relating specifically to the competency being assessed? The competency assessment (**HOW WELL**) is the combination of the number of OBs demonstrated and their frequency of demonstration and the consequential outcome of the Threat and Error Management relating specifically to the competency being assessed. The "**HOW MANY**" dimension provides evidence related to the acquisition of the competency. The "**HOW OFTEN**" dimension provides evidence related to the robustness of the competency. The "**Outcome of TEM"** dimension provides evidence related to the effectiveness of the competency as individual and team countermeasures against the threats and errors.
Detailed IATA competency assessment guidance: https://www.iata.org/contentassets/c0f61fc821dc4f62bb6441d7abedb076/competency-assessment-and-evaluation-for-pilots-instructors-and-evaluators-gm.pdf

Concerning point 3) above, another critical element of the State Safety Program is related to the qualification of the State personnel (licensing personnel, pilot inspectors, etc.) and the technical guidance, the tools and the information that should be provided to the personnel to perform their duties.

When introducing CBTA into the licensing system, the States should provide awareness and training to ensure that licensing and operation personnel are able to evaluate an individual's competency or an organization's ability to deliver CBTA programs, or, more generally, to interpret the role of the training data within the global safety management. The content of this training is generally very similar to the CBTA instructor initial standardization, while addressing specifically the oversight aspects of the CBTA programs.

Annex 5 provides an example of pilot inspector training and qualification in the context of the introduction of EBT into the European regulatory framework.

Summary:

Solution to the license recognition challenge
ICAO Personnel Training and Licensing: - Defines a minimum competency standard for licenses issues under CBTA - Endorses the competency assessment methodology - Adopts a suitable training and qualification for CAAs' personnel in charge of CBTA

5.4 Training data protection

As training data is part of the safety data within the safety management system, the protection requirements that apply to safety should logically be 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, be 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 should be noted that the EBT program permits compliance with the 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 maneuvers training phase, comprising training to proficiency in certain defined maneuvers
- 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 pilot's 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 the individual pilot training data:

- From a pilot's perspective: to get access to a training tailored to his needs
- From an instructor's perspective: to deliver adapted training to the individual pilots' needs
- From an operator perspective: to adapt the training sessions to the individuals' needs when necessary and to implement the instructor concordance assurance program (ICAP refer to Annex 4)
- 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

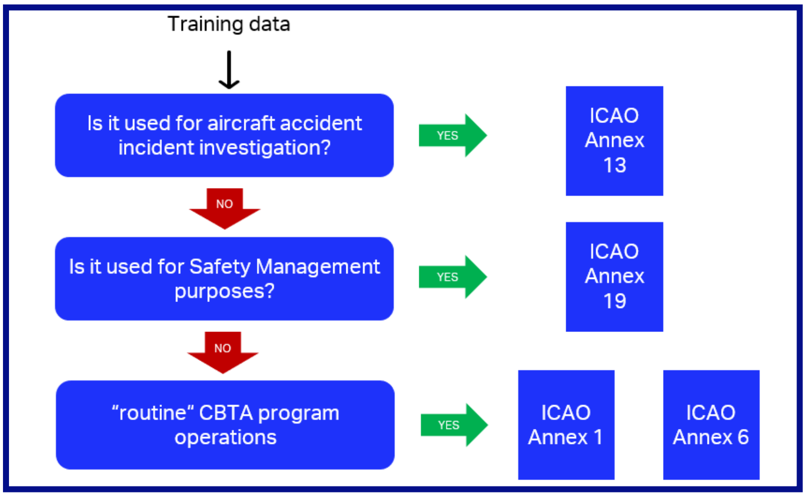
Beyond EBT, which is an operator CBTA recurrent training example, CBTA expansion for all licensing and operator training implies the use of individual training data from the early stages of the pilot's career path: during the selection process (Pilot Aptitude Testing), during the initial and advanced 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-identified format for global safety management, while some protocols should permit the use of individual pilot data in the interest of "routine" CBTA program operations. Routine CBTA program operations refers 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.



Summary:

Solution to the CBTA training data protection
ICAO Personnel Training and Licensing Panel to define the training data protection protocols

6. Conclusion and recommendations

CBTA has been supported by IATA and the industry for more than 15 years now and its actual expansion within the aviation system should continue to be supported by proper awareness and implementation efforts by States and industry. CBTA is sustained by specific training data that brings additional value for the global enhancement of safety management.

This paper has identified several challenges related to the introduction of CBTA within the aviation system and proposes several solutions regarding the essential components of our aviation system, which are the people, the process, and the technology.

People

The introduction of CBTA implies that the State and the organizations provide suitable awareness to the personnel. In particular, the pilots need to clearly understand the impact of CBTA in regard to their own training and evaluation. This paper proposes already existing instructor CBTA standardization to achieve performance on the job and to ensure the quality of the training data collected. The instructor's CBTA standardization should be a guideline for the training and qualification of both the States' CAA personnel and the organizations' SMS staff.

Process

This paper proposes robust procedures for competency assessment and evaluation. These procedures and methodology, which have been positively implemented by the industry and adopted by regulators, should be endorsed by ICAO as well as the associated instructor concordance assurance program.

The ICAO Personnel training and licensing panel should also formalize an acceptable competency standard for the issuance, the revalidation and the renewal of a license delivered under a CBTA program and define the protection protocols applicable to the training data.

The alignment of the safety and training data taxonomies should be conducted as a global safety initiative and therefore could be part of the ICAO Global Aviation Safety Plan (GASP) to ensure proper implementation across the states and industry.

Technology

Today, training data collection relies heavily on the instructors/evaluators, the efforts to develop new tools that take advantage of advanced technology should be maintained to increase the volume of objective training data collection. This effort should enhance the quality of the data collected and should also increase the training system efficiency.

The volume, the value, and the sensitivity of the upcoming CBTA training data will necessitate the creation of a new and safe data repository that should permit access to the data for the benefit of global safety. As an example, the continuous updating of the EBT Data Report will only be possible if there is a common repository for several operators to record their safety and training data. Other international cooperation to collect training data would be beneficial to ensure license recognition and global safety levels.

Summary:

Recommendations
People
– Instructors standardized according to industry best practices (e.g., IATA guidance for instructors) – CAAs' licensing and operation personnel trained for CBTA – ATOs' and AOCs' SMS staff trained for CBTA
Process
– ICAO to endorse industry best practices for competency assessment and associated ICAP – ICAO to define a minimum competency standard for licenses issues under CBTA – ICAO Personnel Training and Licensing Panel to define the training data protection protocols – Alignment of the safety and training data taxonomies
Technology
– Develop innovative tools to increase the collection of objective training data – Consider options for international training data repository setup and access

Annex 1. Pilot competencies

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
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
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
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
Workload Management Maintain 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

Annex 2. Instructor/Evaluator competencies

Competency Description	**Observable behaviors**
Pilot Competencies Refer to the description in the Pilot Competencies in Annex 1 above	Refer to observable behaviors in the Pilot Competencies in Annex 1 above
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 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 and Demonstrates exemplary behavior (role model)	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 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 and Contributes to continuous training system improvement	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 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

Annex 3. IATA ACTF TEM-based Accident Classification Taxonomy

END STATES (unrecoverable)

S01 CFIT
S02 Loss of Control in-flight
S03 Runway Collision
S04 Mid-air Collision
S05 Runway/Taxiway Excursion
S05.01 RWY Excursion Overrun
S05.02 RWY Excursion Lateral
S05.03 TXY Excursion
S06 In-flight Damage
S07 Ground Damage
S08 Undershoot
S09 Hard Landing
S10 Gear Up Landing/ Gear Collapse
S11 Tail Strike
S12 Off Airport Landing/Ditching
S98.01 Deliberate Act – Security
S98.02 Deliberate Act – Suicide
S99 OTHER

UNDESIRED AIRCRAFT STATES (flight crew induced, recoverable)

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
U08 Long, Floated, Bounced, Firm, Off centerline, Canted, Porpoised Landing
U09 Rejected Take-off after V1
U10 Controlled Flight Toward Terrain
U99 Other

V – Ground Navigation (Surface Nav)

V01 Proceeding towards wrong taxiway/ runway
V02 Wrong taxiway, ramp, gate or hold spot
V03 Runway/ taxiway incursion
V04 Ramp movements, including when under marshalling
V05 Loss of aircraft control while on the ground
V99 Other

W – Incorrect Aircraft Configurations

W01 Brakes, Thrust Reversers, Ground spoilers

W02 Systems (Fuel, Elec, Hydraulic, Pnem, A/C, Press, Inst)
W03 Landing Gear
W04 Flight Controls/ Automation
W05 Engine
W06 Weight & Balance
W99 Other

ERRORS (flight crew deviation)

H - Aircraft Handling Errors

H01 Manual handling/Flight Controls
H02 Ground Navigation (Surface nav)
H03 Automation (settings/selections)
H04 Systems/Radio/Instruments (settings/selections)
H99 Other

P – Procedural Errors

P01 SOP adherence/ cross-verification (see breakdown)

P01.01 Intentional
P01.02 Unintentional
P01.03 Unknown

P02 Checklist (see breakdown)

P02.01 Normal checklist (error)
P02.02 Abnormal checklist (error)
P03 Callouts
P04 Briefings

P05 Documentation (see breakdown)

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

P06.1 Failure to go-around after destabilization on approach
P06.2 Failure to go-around after a bounced landing
P99 Other

C – Communication Errors

C01 Crew to External communication

C01.01 With ATC
C01.02 With cabin crew
C01.03 With ground crew
C01.04 With Dispatch
C01.05 With Maintenance

C02 Pilot to Pilot

THREATS (occurs outside the influence of the flight crew)

E - Environmental Threats

E01 Meteorology (see breakdown)

E01.01 Thunderstorm

E01.02 Poor Visibility/IMC

E01.03 Gusty wind/ windshear

E01.04 Icing conditions

E01.05 Hail

E02 Lack of Visual Reference

E03 Air Traffic Services

E04 Birds/foreign objects

E04.01 Birds

E04.02 Wildlife

E04.03 Foreign objects

E05 Airport Facilities (see breakdown)

E05.01 Poor signage/lighting, faint markings, rwy/txy closures

E05.02 Contaminated runways, taxiways, poor braking action

E05.03 Trenches, ditches, intruding structures

E05.04 Airport perimeter control/fencing / Wildlife control

E06 Navaids (see breakdown)

E06.01 Malfunction, lack, or unavailable

E06.02 Uncalibrated

E07 Terrain/Obstacles

E08 Traffic

E08.01 Aircraft

E08.02 Vehicle

E09 RWY Surface Incursion

E09.01 Aircraft

E09.02 Vehicle

E09.03 Wildlife

E09.04 Other

E99 Other

A - Airline Threats

A01 Aircraft Malfunction (see breakdown)

A01.01 Uncontained engine failure

A01.02 Contained engine failure (incl overheat and prop fail)

A01.03 Landing gear/ tires

A01.04 Brakes

A01.05 Flight Controls (see breakdown)

A01.05.01 Primary flight controls

A01.05.02 Secondary flight controls (flaps, spoilers)

A01.06 Structural Failure

A01.07 Fire/Smoke

A01.08 Avionics, flight instruments

A01.09 Autopilot/ FMS

A01.10 Hydraulic system failure
A01.11 Electrical power/ generation failure
A01.99 Other
A02 MEL item
A03 Operation pressure
A04 Cabin events
A05 Ground events
A06 Dispatch/paperwork
A07 Maintenance events
A08 Dangerous goods
A09 Manual/charts/checklists
A99 Other

B - Psychological/Physiological Threats
B01 – Fatigue
B02 – Optical illusion/visual mis-perception
B03 – Spatial disorientation & spatial/somatogravic illusion
B04 – Crew Incapacitation

LATENT CONDITIONS (present in system before accident)
O01 Design (design shortcomings and defects)
O02 Regulatory Oversight
O03 Management Decisions (cost cutting)
O04 Safety Management (absent or deficient)
O05 Change Management (deficiencies in monitoring change)
O06 Selection Systems (deficient selection standards)
O07 Ops Planning & Scheduling (deficiencies in crew rostering, flight time limits)
O08 Technology & Equipment (available safety equip not installed)
O09 Flight Operations (see breakdown)
O09.01 SOPs & Checking
O09.02 Training Systems
O10 Cabin Operations (see breakdown)
O10.01 SOPs & Checking
O10.02 Training Systems
O13 Ground Operations (see breakdown)
O13.01 SOPs & Checking
O13.02 Training Systems
O14 Maintenance Operations (see breakdown)
O14.01 SOPs & Checking
O14.02 Training Systems
O15 Dispatch (see breakdown)
O15.01 SOPs & Checking
O15.02 Training Systems
O16 Flight watch/following/support

O99 Other

FLIGHT CREW COUNTERMEASURES

L – Team Climate

L01 Communication Environment

L02 Leadership (see breakdown)

L02.01 Captain shows leadership and coordinates flight deck activities

L02.02 FO is assertive and able to take over as leader

L03 Overall crew performance

L99 Other

M – Planning

M01 SOP Planning

M02 Plans stated

M03 In flight decision making/contingency management

M03.01 - Pro-active: Inflight Decision Making

M03.02 – Re-active: Contingency Management

M99 Other

N – Execution

N01 Monitor/ Cross-check

N02 Workload management

N03 Automation Management

N04 Taxiway/ Runway management

N99 Other

R – Review/Modify

R01 Evaluation of Plans

R02 Inquiry

R99 Other

ADDITIONAL CLASSIFICATION

I Insufficient Data

Y Incapacitation

Annex 4. CBTA Instructor/Evaluator initial standardization

The CBTA IE initial standardization program comprises

- CBTA IE training, and
- CBTA assessment of competence.

CBTA IE training

The CBTA IE training course should be delivered by a qualified CBTA IE.

The CBTA IE training course should comprise both theoretical and practical training.

At the completion of CBTA IE training, the applicant CBTA IE should:

(1) have knowledge of CBTA, including the following underlying principles:

- threat and error management
- CBTA
- learning from positive performance
- building resilience, and
- data-driven training

(2) demonstrate knowledge of Instructional System Design, the structure and the method of training delivery for each phase of the AOC/ATO CBTA program;

(3) demonstrate knowledge of the principles of adult learning and how they relate to CBTA;

(4) conduct objective observations based on a competency framework, and document evidence of observed performance;

(5) relate specific performance observations of competencies;

(6) analyze trainee performance to determine competency-based training needs and recognize strengths;

(7) evaluate performance using the competency-based grading system;

(8) apply appropriate teaching styles during training to accommodate trainee learning needs;

(9) facilitate trainee learning, focusing on specific competency-based training needs; and

(10) conduct a debrief using facilitation techniques.

An IE may be given credit for parts of the above if the IE has previously demonstrated competence in those topics.

CBTA assessment of competence

Prior to delivering CBTA, the IE should undergo an assessment of competence, conducted during a practical CBTA session by a person nominated by the AOC/ATO and acceptable to the Licensing Authority.

CBTA Instructor/Evaluator – Recurrent standardization

The CBTA IE should complete annual (or at a specific interval approved by the authority) recurrent standardization comprising

- Refresher CBTA training to develop the IE's competence to conduct CBTA; and
- Concordance training

Note: "Concordance" means inter-rater-reliability. It is the consistency or stability of scores between different CBTA IE; it gives a score (or scores) of how much homogeneity, or consensus, there is in the ratings given by IEs (raters).

Recurrent standardization should incorporate de-identified grading data to show where grading is consistent or where there is inconsistency. Use of example scenarios that demonstrate appropriate grading have proven to be helpful in calibrating the IE workforce. Providing individual IE grading data in comparison to the entire population of IE can also be a useful tool to help individual instructors see how they perform compared to their peers.

The standardization could also incorporate feedback received from pilots that received CBTA and a review of relevant inter-rater reliability data.

At regular intervals not to exceed three years, the IE should undergo a CBTA assessment of competence, conducted during the delivery of a practical CBTA session.

Instructor Concordance Assurance Program (ICAP)

STANDARDISATION OF CBTA INSTRUCTORS — ACCEPTABLE INSTRUCTOR CONCORDANCE

The authority may require a minimum acceptable level of concordance. This may be a non-exhaustive list:

- Set a minimum acceptable level of concordance per aircraft fleet or by group of instructors.
- Set a minimum acceptable level of concordance per competency.
- Set a minimum acceptable level of concordance for all operators under its oversight, or a minimum acceptable level of concordance per operator (or type of operator) based on the risk of the operator.

Annex 5. Authority CBTA Inspectors training and qualification example from EASA EBT regulation

QUALIFICATION AND TRAINING — INSPECTORS

(a) For the initial approval and oversight of an operator's EBT programme, the inspector of the competent authority should undertake EBT training as part of their required technical training. At the conclusion of the inspector training, the inspector should:

(1) know the principles of EBT, including the following underlying principles:

(i) competency-based training;

(ii) learning from positive performance;

(iii) building resilience; and;

(iv) data-driven training;

(2) know the structure of an EBT module;

(3) know the method of training delivery for each phase of an EBT module;

(4) know the principles of adult learning and how they relate to EBT;

(5) recognise effective observations based on a competency framework, and document evidence of observed performance;

(6) recognise and relate specific performance observations of competencies;

(7) recognise trainee performance to determine competency-based training needs and recognise strengths;

(8) understand methods for the evaluation of performance using a competency-based grading system;

(9) recognise appropriate teaching styles during simulator training to accommodate trainee learning needs;

(10) recognise facilitated trainee learning, focusing on specific competency-based training needs; and

(11) understand how to conduct a debrief using facilitation techniques.

(b) The objective of such training is to ensure that the inspector:

(1) attains the adequate level of knowledge in the principles of approval and oversight of the EBT programmes; and

(2) acquires the ability to recognise the EBT programme suitability.

Annex 6. Data protection example from EASA EBT regulation

DATA PROTECTION 1

a) The objective of protecting the EBT data is to avoid inappropriate use of it in order to ensure the continued availability of such data, to maintain and improve pilot competencies.

b) The data access and security policy should restrict information access to authorised persons.

c) The data access and security policy should include the measures to ensure the security of the data (e.g., information security standard).

d) The data access and security policy (including the procedure to prevent disclosure of crew identity) should be agreed by all parties involved (airline management and flight crew member representatives nominated either by the union or the flight crew themselves).

e) The data access and security policy should be in line with the organisation safety policy in order to not make available or to not make use of the EBT data to attribute blame or liability.

f) The operator may integrate the security policy within other management systems already in place (e.g., information security management).

DATA PROTECTION 2

(a) The data access and security policy may, as a minimum, define:

(1) a policy for access to information only to specifically authorised persons identified by their position in order to perform their duties. The required authorised person(s) does (do) not need to be the EBT manager; it could be the EBT programme manager or a third party mutually acceptable to unions or staff and management. The third party may also be in charge of ensuring the correct application of the data access and security policy (e.g., the third party is the one activating the system to allow access to the authorised persons);

(2) the identified data retention policy and accountability;

(3) the measures to ensure that the security of the data includes the information security standard (e.g., information security management systems standard e.g., ISO 2700x-ISO 27001, NIST SP 800-53, etc.);

(4) the method to obtain de-identified crew feedback on those occasions that require specific follow-up; and

(b) When there is a need for data protection, it is preferable to de-identify the data rather than anonymise it.