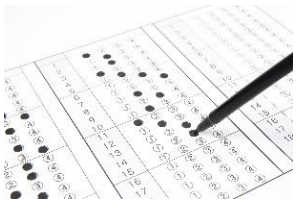
1.3 Competency Based Training and Assessment

Competence

All individuals in the pilot community come from diverse backgrounds in terms of culture, education, life experience and more. So, it is unreasonable to assume that two pilots with the same number of flight hours will be matched in piloting ability. A pilot's ability can be judged depending on how many hours they have flown, how many approaches they have performed, and how recently they were last airborne. This system can show varying degrees of 'experience levels' and may account for skill erosion. However, there are many reasons (individual ability, personal life, distractions, or time spent on the ground) hours flown may not necessarily equate to how good a pilot is at their job. In fact, previous assumptions were that accident rates decrease with increased total flight hours (TFH), however, FAA research[i] has shown this is not the case.

	***Training:*** structured delivery of knowledge and skills with learning as its desired outcome. Teaching, imparting knowledge and skills, and modifying behavior
	***Assessment:*** the systematic process of gathering and documenting evidence of knowledge, skills, and attitudes. Gathering evidence via written or oral exams, investigations, simulations, and observations
	***Evaluation:*** the attribution of value to the performance to the assessment made. Determining whether the minimum criteria, grade, or level has been met.

There was a need for more effective and efficient training to:

- accommodate varying levels of student knowledge, skills, and attitudes (KSA);
- allow for different acquisition/ learning rates throughout a course;
- maintain a minimum pass standard;

To achieve this goal, aviation looked to the education sector for a solution, and found Competency Based Training and Assessment, (CBTA).

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

Competency Based Training and Assessment: 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[ii].

The defining feature of CBTA is the focus on individual *competence*. In a CBTA framework, progression is only achieved through mastery of knowledge and skills as opposed to the accrual of hours. Students must continue to study and practice each element until they meet the required level of competence.

Competence: Ability to demonstrate the necessary skills, knowledge and behaviors that are required to perform a task to a prescribed standard.

There are several differences between traditional hours based and CBTA frameworks:

Traditional Hours-Based	CBTA
▪ Students advance based on final or overall course *grades*. ▪ If mastery is not achieved, the student receives a *low grade* but continues. ▪ Students may fail to meet the *minimum grade* and repeat a section. ▪ If a student does not meet the minimum standard in a set time, there is *little flexibility*.	▪ Students advance based on *mastery*. ▪ Each student may progress at a *different pace*. ▪ A student will have *multiple opportunities* to demonstrate mastery. ▪ Learning time is *flexible* to allow student growth and attainment of *superior performance*.

While CBTA allows for a personalized training experience for students, it does require flexibility from the organization, training design teams and instructors. The reward for implementing a competency framework lies in the ability to clearly define high standards and guarantee students meet these in all areas before graduation.

Competency

Within CBTA, the words competency (a collection of knowledge, skills, and attitudes) and competence (a level of mastery) are often confused. To explain this distinction, let us look further into the meaning of competency.

Competencies are often used to create a list of demonstrable characteristics and skills that are required to participate fully in a particular role. These lists are often referred to as '*competency frameworks.*'

Technical and Non-Technical competencies, are defined as:

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

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

Development of CBTA Regulation

Aviation safety has incrementally progressed, over time, by focusing on specific areas of activity. From its origins until the end of the 1960s, safety performance was primarily enhanced through technical developments which reduced the rate of aircraft system failures or malfunctions. Lessons learned from accident and incident investigations were integrated into the ICAO Standards and Recommended Practices (SARPs).

SARPs are adopted by the Council under the provisions of the Convention.

Standard: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as **necessary** for the safety or regularity of international air navigation and to which Contracting States **will conform** in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.[iv]

Recommended Practice: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as **desirable in the interest of safety,** regularity, or efficiency of international air navigation, and to which Contracting States **will endeavor to conform** in accordance with the Convention.[v]

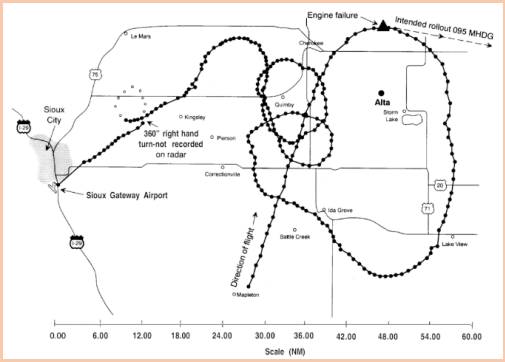
In simple terms:

- Standards are mandatory
- Recommend Practices are encouraged but not mandatory

By the early 1970s, the frequency of aviation accidents had significantly declined due to major technological advances and enhancements in safety regulations. However, the 1980s saw significant growth in passenger air traffic which required innovation in technology and operations to sustain the expansion of air travel. Nevertheless, safer operations had an unexpected side effect; crews were no longer accustomed to increasingly rare technical failures.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

United Airlines Flight 232, Sioux City, 19 July 1989.[vi]



- DC10 suffered catastrophic failure in the tail mounted engine.
- Shrapnel from the engine cut lines of all three hydraulic systems leaving the aircraft with no control via the flight controls.
- The cockpit voice recording showed the crew demonstrated excellent non-technical skills in discussions which enabled them to problem solve and control the aircraft by use of asymmetric thrust of the two remaining wing-mounted engines.
- Despite exceptional handling, the engine response rate was not sufficient to stop the last-minute roll encountered during the high-speed landing. The DC10 lost its right wing, rolled over and caught fire.
- Sadly 112 died, but 184 survived due to the skills of the crew.

The Sioux City accident is an excellent example of the importance of non-technical skills. The crew had never encountered an emergency of this nature, nor heard of any previous accidents like this. Amongst several findings, the NTSB praised the crew for their CRM[vii], which they had been trained for in the early CRM programs after Tenerife and Portland.

1989: NTSB quoted United 232 as evidence of the success of CRM training and the FAA made CRM training mandatory. At the same time, ICAO published Digest Number 2 (now CAP 720), discussing the benefits of Cockpit Resource Management and Line Orientated Flight Training (LOFT).

Despite the emergence of CRM, training and assessment were still in a traditional method. Crews would complete a specified number of hours of training and would be assessed within a well-defined technical framework such as the FAA Practical Test Standards (now superseded by the Airman Certification Standards). Training was only focused on technical competencies, but data continued to illustrate that a large number of accidents had root causes linked to poor non-technical skills (NTS).

2002: The aviation training community came to realize the need to evolve training away from a tick-box approach, and to focus more on creating resilient pilots. The Flight Crew Licensing and Training Panel (FCLTP) identified a clear need for a new licensing and training document, called the Procedures for Air Navigation Services -Training (PANS-TRG). Whilst it was too detailed to take the form of 'standards,' it was of sufficient importance to provide universal benefit to member States.

2006: ICAO supported a performance-based approach to training with the publication of standards for the multicrew pilot license (MPL). This was the first ICAO licensed

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

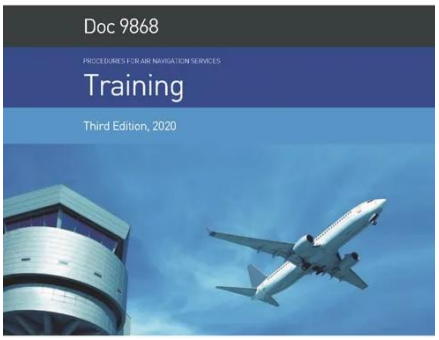
Competency-based Training and Assessment (CBTA) framework and was adopted in Europe as a common standard by the Joint Aviation Regulations (JARs).

2007: The IATA Training and Qualification Initiative (ITQI) set up a working group comprised of representatives from airlines, civil aviation authorities, academic institutions, aircraft original equipment manufacturers, international organizations, pilot representative bodies and training organizations. Their goal was to establish a new method for the development and conduct of recurrent training and assessment, today known as *Evidence-Based Training (EBT)*.

2013: CBTA principles were extended to operator recurrent training with the publication of ICAO, Doc 9995, Manual for Evidence-based Training (EBT), where it has been accepted as an alternative means of compliance for recurrent training and checking by several Civil Aviation Authorities.

2014: The Australian Civil Aviation Safety Authority (CASA) introduced competency-based training standards for all CASA flight crew qualifications.

Australian Government
Civil Aviation Safety Authority



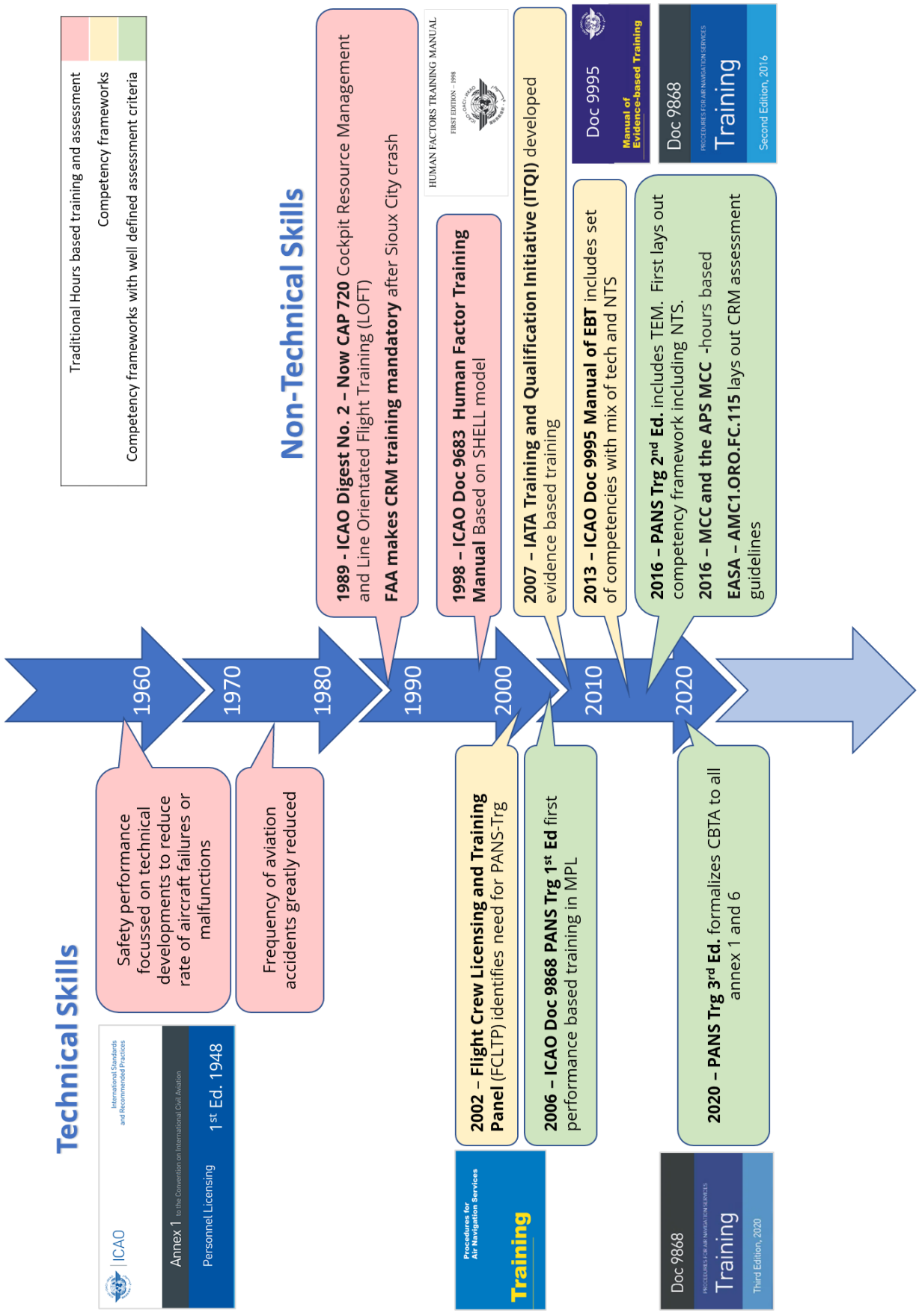
2016: ICAO published the second edition (Amendment 5) to PANS-TRG, General provisions for competency-based training and assessment. This defined the role of the pilot competencies in the context of Threat and Error Management (TEM) and provided a basis for further development of CBTA.

2018: ICAO endorsed the IATA definitions of a pilot instructor-evaluator competency set.

2020: ICAO published the third edition (amendment 7) to PANS-TRG, which formalized the global expansion and applicability of CBTA principles to all licensing training (ICAO Annex 1) and operator training (ICAO Annex 6).

The timeline of regulation development can be split into technical and non-technical skills and demonstrates the move from traditional training to competency-based training and assessment. This graphic shows, in red, where traditional hours-based training and assessment were used, and in yellow, where the competency frameworks are being developed. Finally, green shows when the frameworks include a detailed list of assessment criteria, performance indicators or observable behaviors.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.



Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

IATA and ICAO Competency Frameworks

The IATA Training and Qualifications Initiative (ITQI) was implemented in 2007 to modernize maintenance training, align regulations to provide a more flexible aviation workforce, and to attract younger generations to the aviation industry. In conjunction with ICAO and the International Federation of Air Line Pilots' Associations (IFALPA), the following 8 Core Competencies were agreed upon:[viii]

Application of Procedures Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge.	**Communication** Demonstrates effective oral, non-verbal, and written communications, in normal and non-normal situations.
Leadership & Teamwork Demonstrates effective leadership and team working.	**Problem Solving & Decision Making** Accurately identifies risks and resolves problems. Uses the appropriate decision-making processes.
Situation Awareness Perceives and comprehends all the relevant information available and anticipates what could happen that may affect the operation.	**Workload Management** Manages available resources efficiently to prioritize and perform tasks in a timely manner, under all circumstances.
Flight Path Management: Automation Controls the aircraft flight path through automation, including appropriate use of flight management system(s) and guidance	**Flight Path Management: Manual** Controls the aircraft flight path through manual flight, including appropriate use of flight management system(s) and flight guidance systems.

Despite 'Knowledge' being mentioned in the ICAO descriptor of Application of Procedures, it was felt this competency needed highlighting further. In the most recent edition of ICAO Doc 9868, PANS – Training, there was the addition of the underpinning competency, 'Application of Knowledge', bringing the total of PCs to nine[ix].

Application of Knowledge

Underpinning the pilot competencies is the 'application of knowledge' which collectively refers to the ability of the pilot to:

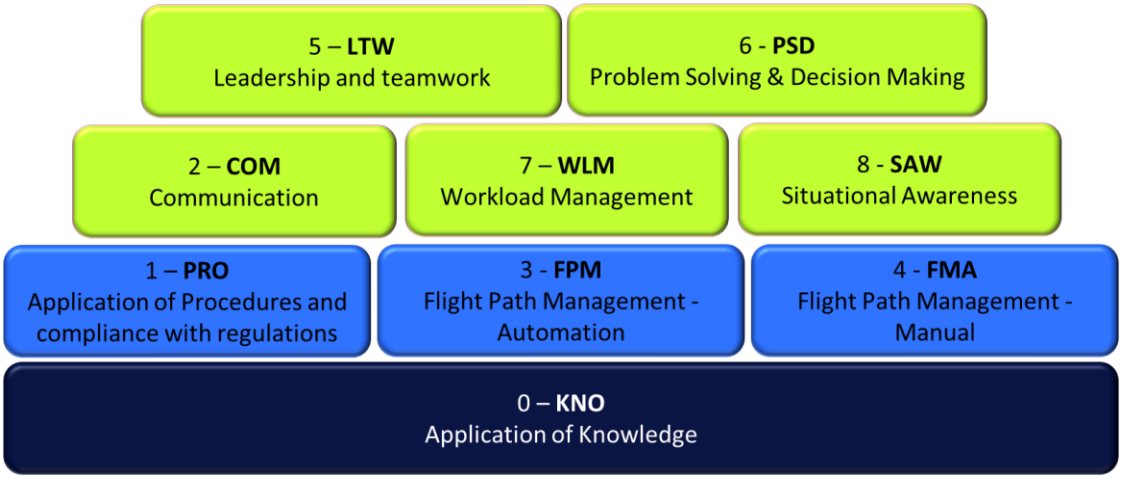
- recall and proactively update relevant knowledge; and
- apply acquired knowledge to the operational environment, including TEM.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

CAE's Pilot Competencies

The PCs were numbered and given short abbreviations. These are CAE's 9 Pilot Competencies:

0. Application of Knowledge (KNO)
1. Application of Procedures & Compliance with Regulations (PRO)
2. Communication (COM)
3. Aircraft Flight Path Management - Manual Control (FPM)
4. Aircraft Flight Path Management – Automation (FPA)
5. Leadership and Teamwork (LTW)
6. Problem Solving and Decision Making (PSD)
7. Workload Management (WLM)
8. Situational Awareness and Management of information (SAW)



So how do we define 'Application of Procedures,' compared to 'Application of Knowledge.' Is it possible to have one without the other? Can they be taught separately?

Definitions from the field of learning science can give some answers.

	Knowledge: Facts, information, and skills gained through education or experience. The theoretical or practical understanding of a subject.
	Procedure: A sequence of actions that is the established or official way of doing something.

By using these definitions, it becomes evident that knowledge is a forerunner to a procedure. In some frameworks, KNO and PRO are combined to Application of Procedures and Knowledge (APK). Throughout this hp guide, we will continue to concentrate on the CAE 9 Pilot Competencies.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

Observable Behaviors

Each competency listed in a framework needs further definition so they can be taught and assessed. To achieve this, lists of behaviors which may indicate the presence of each competency were created, to assist both students and instructors to understand what is meant by the competencies; these are called observable behaviors.

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

Observable behaviors can cause a lot of discussion, but very simply, there are either seen (observed), or not. A full list of OBs can be found in ICAO Doc 9868 PANS Training, and in each chapter of section 2 of this human performance guide.

It is often easier to think of this in terms of technical skills; for example, did the pilot fly the approach within limits? The answer is simply yes or no for this single event. In technical terms we can imagine a case where the student flies a single approach and was within most of the limits. They may also fly several approaches, but only fly it 'acceptably' less than half the time. There would therefore be a lower grade given as this student lacks the reliability in this skill.

This table describes the similarities between technical and non-technical observed behaviors.

	Technical Skill – Approach path	**Non-technical skill - Communication**
How many	Does the student fly a single maneuver within most of the deviation limits?	Does the student demonstrate many aspects of communication as required?
How often	Can the student reliably repeat this exercise to the same standard?	Does the student reliably demonstrate these behaviors throughout the learning event?
How well	Did this result in a safe or unsafe outcome?	

Importantly here, we note that non-technical skills cannot be assessed in a single task – they have to be considered over a period of time for that learning activity.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

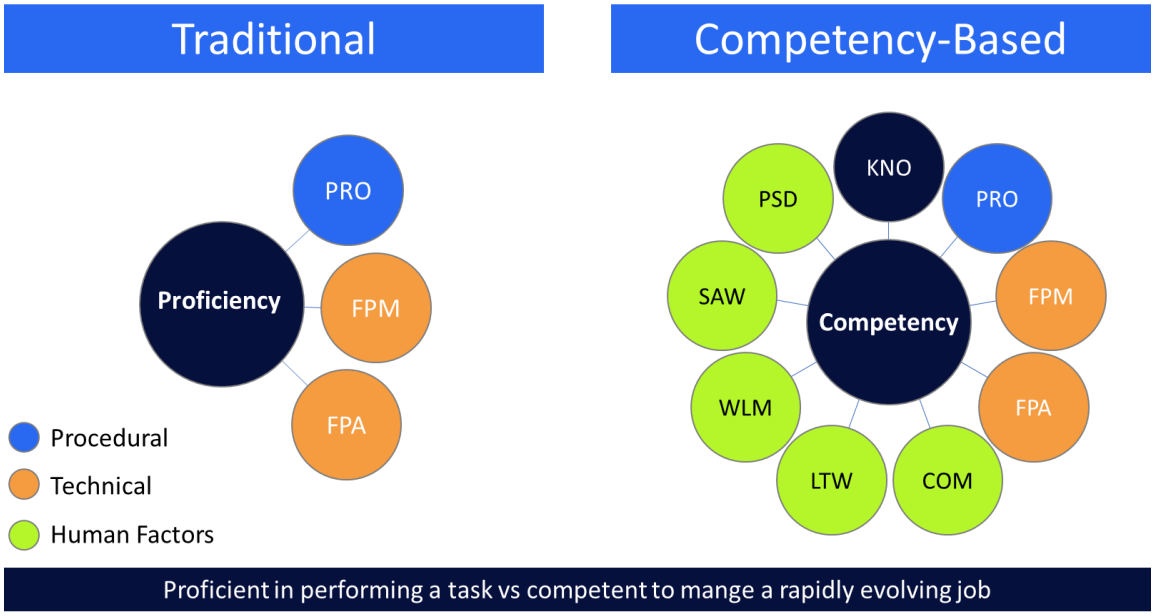
Traditional training versus CBTA

Each of the CAE pilot competencies and associated OBs are discussed further in their own chapter, but a good point to address now is a common question from instructors:

"How does CBTA change what I already do?"

The answer to this question lies in two halves:

- ***Technical Skills:*** Good instructors have always coached and mentored their students through difficult elements, ensuring competence is achieved before moving on. For the technical skills, CBTA simply gives more guidance material on how these elements can be taught and assessed.
- ***Non-technical Skills***: CBTA now treats non-technical skills with the same regard as technical skills. CBTA includes a shift towards ensuring non-technical skills courses are not simply attendance courses, but that mastery of each competence area is achieved. This creates a need for new methods of training and assessment, so an instructor knows how to teach them and how to judge when students meet required standards.



Irrespective of whether we are training and assessing technical or non-technical skills, in CBTA, the assessment of competence performed by an instructor or evaluator, during and at the end of a course of training, is equally focused on both, the process and the outcome.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

Other Regulatory CBTA Frameworks

EASA Knowledge, Skills, and Attitudes

EASA uses the 9 competencies, referenced by the numbers previously described[xi]. Then at FTO level, and in a purely theoretical knowledge instruction environment, the competencies are again adapted slightly. Here, FPA and FPM are irrelevant (until the flying phase) and therefore are replaced with Threat and Error Management (including resilience and UPRT), and Mental Mathematics.

FAA Training and Assessment

Training and assessment of non-technical Skills are reflected in the FAA slightly differently to those found in ICAO and EASA documentation. Human skills concepts are addressed in the CRM Advisory Circulars[xii], in the following categories:

a. Communications Processes and Decision Behavior.
   (1) Briefings
   (2) Inquiry/Advocacy/Assertion
   (3) Crew Self-Critique (Decisions and Actions)
   (4) Conflict Resolution
   (5) Communications and Decision making
b. Team Building and Maintenance
   (1) Leadership/Followership/Concern for Task
   (2) Interpersonal Relationships/Group Climate
   (3) Workload Management and Situation Awareness
   (4) Individual Factors/Stress Reduction

While this list has obvious overlap to the EASA competency framework, there is no mandate to follow a competency-based approach. If a training organization wishes, they may follow the Advanced Qualification Program (AQP). [xiii]

> *"It (AQP) replaces programmed hours with proficiency-based training and evaluation derived from a detailed job task analysis that includes Crew Resource Management (CRM)."*

Within AQP, there is less guidance for assessment than seen in the EASA AMC[xiv]. It is the ATO's responsibility to align their training with the Aircrew Certification Standards (ACS). Therefore, there are no shared competencies, behavioral indicators, or criteria that are common throughout the FAA.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

Instructor and Evaluator Competencies

Further to the pilot competencies, IATA set out the following Instructor and Evaluator Competencies (IECs)[xv]:

1. **Pilot Competencies:** The 9 Pilot competencies
2. **Management of the learning environment:** Ensures that the instruction, assessment, and evaluation are conducted in a suitable and safe environment.
3. **Instruction:** Conducts training to develop the trainee's competencies.
4. **Interaction with the trainees:** Supports the trainees' learning and development and demonstrates exemplary behavior (role model)
5. **Assessment and Evaluation:** Assesses the competencies of the trainee and contributes to continuous training system improvement.

Future chapters to this guide will include each of the IECs.

Summary

- Traditional training is based on duration only and will have a grade based on a summative assessment. Whereas CBTA is based on acquisition of knowledge and skills and is paced by the student's mastery (competence) before progression.
- Competency frameworks identify the knowledge and skills required to do a job; they include technical and non-technical skills.
- There are several competency frameworks, most commonly used is the ICAO 9 Pilot Competency Model, numbered 0-8, where zero is the underpinning Application of Knowledge
- Advanced Qualification Program (AQP) in the FAA is closest in scope to the ICAO CBTA program.
- Further competencies are listed for instructors and evaluators; the 5 IECs.
- While good aviation instructors have used elements of CBTA for many years, it has only been a regulated method of training since the first edition of PANS Trg in 2006 for MPL.
- Competencies that include the non-technical skills were included in CBTA in the Manual of evidence-based training in 2013.
- In CBTA, the assessment of competence, is equally focused on both the process and the outcome.

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.

Further Reading

- IATA CBTA Centre at: www.iata.org/en/training/training-certifications/cbta-center/cbta-exellence/
- ICAO Doc 7300: Convention on International Civil Aviation
- Joint ICAO, IATA and IFALPA publication: Evidence-based Training Implementation Guide
- Kearns, et al. *Competency-Based Education in Aviation: Exploring Alternate Training Pathways.* United Kingdom, Ashgate Publishing Limited, 2016.

References

---

i Knecht, W. R. Predicting Accident Rates from General Aviation Pilot Total Flight Hours. Civil Aerospace Medical Institute, Federal Aviation Administration. 2015.
ii ICAO. Doc 9995 AN/497 'Manual of Evidence-based Training'. First edition. 2013.
iii IATA GM. Competency Assessment and Evaluation for Pilots, Instructors and Evaluators. 2021.
iv ICAO Annex 1- Personal Licensing
v ICAO Annex 1- Personal Licensing
vi National Transportation Safety Board. November 1, 1990. NTSB/AAR-90/06. Archived from the original on October 24, 2018. Retrieved March 15, 2011.
vii "How Swift Starting Action Teams Get off the Ground: What United Flight 232 and Airline Flight Crews Can Tell Us About Team Communication" (PDF). Management Communication Quarterly. Vol. 19, no. 2. November 2005. Archived from the original on July 5, 2007.
viii ICAO. Doc 9995 AN/497 'Manual of Evidence-based Training'. First edition. 2013.
ix ICAO. Doc 9868 Procedures for Air Navigation Services, Training. Third edition. 2020.
x ICAO. Doc 9868 Procedures for Air Navigation Services, Training. Third edition. 2020.
xi EASA Easy Access Rules. AMC1 ORO.FC.231(b) Evidence-based training
xii FAA Advisory Circulars: 120-51E: Crew Resource Management Training & 121-42/43 for Leadership Command and Mentoring
xiii FAA Advisory Circular 120-54A: Advanced Qualification Program
xiv EASA Easy Access Rules for Air Operations. AMC1 ORO.FC.231(b) Evidence-based training
xv IATA GM. Competency Assessment and Evaluation for Pilots, Instructors and Evaluators. 2021

Confidential and/or Proprietary to CAE Inc.
© CAE Inc. 2023.