2.1 Application of Procedures and Knowledge and Compliance with Regulation

ICAO's Procedures for Air Navigation Services – Training [i] (Doc 9868) lays out material for the implementation of all training required for Flight Crew Licensing. It also includes direction on the use of Competency Based Training and Assessment (CBTA). Alongside this, ICAO Doc 9995, the Manual for Evidence Based Training gives further guidance to civil aviation authorities for pilot training and recurrent assessment. Together these documents lay out the Pilot Competency Framework.

There is a minor difference in the way these two documents handle the first, underpinning competency, listed as:

- *Application of Procedures and Compliance with Regulation* in ICAO 9868.[ii]
- *Application of Procedures* in ICAO 9995[iii]

The CAE Pilot Competency Model, uses the competency definition below.

Application of Procedures and Compliance with Regulations (PRO): Identifies and applies appropriate procedures in accordance with published operating instructions and applicable regulations.

Application of Knowledge (KNO)

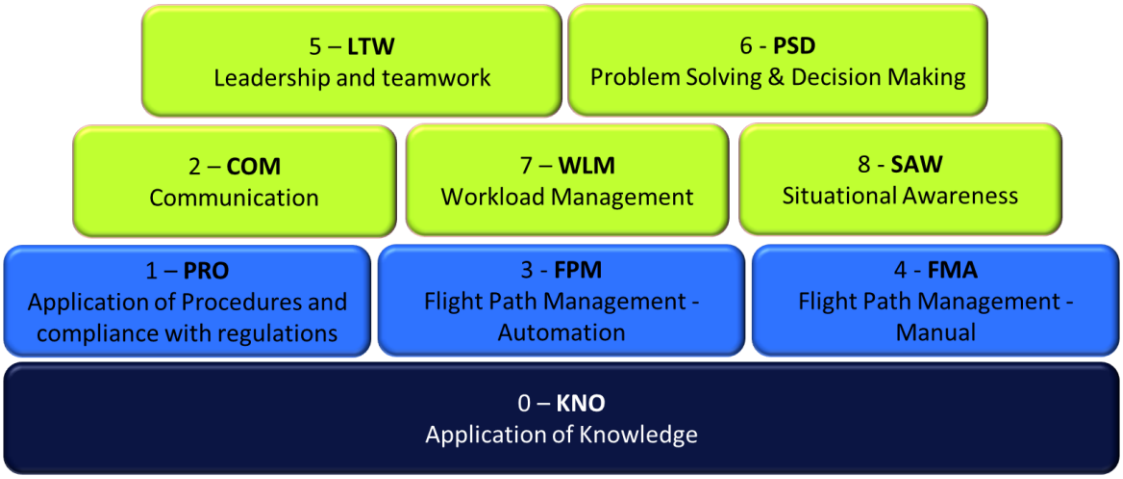
Knowledge is the foundation upon which all other competencies are built. In nearly every profession, education will start with a period of instructive learning, building from basics and advancing through an educational structure, to the operational skills and applications.

Knowledge is different from *Application of Knowledge*. The latter includes the ability to select what relevant knowledge needs to be applied in different situations, to appropriately blend knowledge from different areas to develop solutions where needed. The CAE Pilot Competency Model, uses the following competency definition. [iv]

Application of Knowledge (KNO):
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.

Application of Knowledge underpins the application of procedures and the technical skills of flight path management, which then support the human skills above.



To discuss how the Application of Knowledge can be observed in a pilot's performance, let us consider the Observable Behaviors (OBs) from the CAE Competency model:

KNO **Observable Behaviors** v	**KNO.1**	Demonstrates practical and applicable knowledge of limitations and systems and their interaction
	KNO 2	Demonstrates required knowledge of published operating instructions
	KNO 3	Demonstrates knowledge of the physical environment, the air traffic environment including routings, weather, airports, and the operational infrastructure
	KNO 4	Demonstrates appropriate knowledge of applicable legislation
	KNO 5	Knows where to source required information
	KNO 6	Demonstrates a positive interest in acquiring knowledge
	KNO 7	Is able to apply knowledge effectively

Simply put, the KNO 1-5 cover the ability to find and apply knowledge of:

- Systems and their limitations
- Operating procedures
- Physical environment
- Legislation

The level of knowledge in these areas can be objectively tested by asking examination style questions or by observing their application in practical training and line operations. For example, "What is the general outline of contents in regulation X?" Or

the pilot correctly interpreting a METAR or TAF. These are observable, measurable, and can be easily translated into performance criteria, listed as the SOPs and regulations that must be readily recalled.

However, KNO 6 is different! It is difficult to assess a *positive interest in acquiring knowledge* in an examination style question. This is a desirable characteristic that is difficult to capture as a set of performance criteria. Assessment would need to be based upon observable behaviors that may show evidence of this characteristic trait.

For example, the individual might:

- question instructors to gain a deeper understanding of their specialty,
- request feedback for continual improvement,
- choose to dedicate personal time to professional development, or
- explain recent advancements and evolving ideas in science, techniques and/or procedures.

Lastly, let us look at KNO 7: *able to apply knowledge effectively*. To examine the meaning of this OB, the word 'effectively' needs to be defined.

Effectively: producing a desired or intended result.[vi]

This may be slightly problematic to observe, as without knowing the **student's** intended result, the success of this OB cannot be ascertained. The pilot's cognitive processes must be elicited in discussion with the instructor to correctly find the origin of a mistake in their application of the knowledge, so that a constructive feedback element can be given. Instructors will need to discuss the students thought process to correctly identify where their actions diverged from the ideal. This may be easily objectively assessed, or the instructor may have to give a subjective assessment, based on their many years of experience, to decide if this OB has been observed or not. See section 4 of this human performance guide for more information on assessment and the instructor evaluator competencies.

Application of Procedures and Compliance with Regulations (PRO)

It can be harder to observe PRO in an operational environment, where examination style questioning may not be appropriate. In this case, the OBs will be more directed towards the intended result of the performance. The *Application of Procedures* (PRO) do have an overlap with KNO but are more focussed on the operational context rather than a classroom base of knowledge.

PRO **Observable Behaviors** [vii]	**PRO 1**	Identifies where to find procedures and regulations
	PRO 2	Applies relevant operating instructions, procedures, and techniques in a timely manner
	PRO 3	Follows SOPs unless a higher degree of safety dictates an appropriate deviation
	PRO 4	Operates aeroplane systems and associated equipment correctly
	PRO 5	Monitors aircraft systems status
	PRO 6	Complies with applicable regulations.
	PRO 7	Applies relevant procedural knowledge

In a Timely Manner

The OBs also use wording such as: timely manner, higher degree of safety, and appropriate deviation, with the aim of focussing the behaviours to more of an application, than a simple knowledge recall. Again, this is potentially bringing subjectivity into assessment of the competency. For example, how do we define a *timely manner* in an objective way?

Time is very easily measurable. Let us assume we set a definition for timely manner to mean 'within 5 minutes'. You would probably be pleased if a long-haul flight arrived in a timely manner, but not so pleased if an engine failure on take-off was actioned at the limit of this definition. PRO 2 will be subjective unless the SOPs, regulations, and/or legislation of a set time limit for specific actions. This discussion is often the focus of standardisation workshops.

One practical method to help pilots meet the 'timely' requirement is to use the prioritizing order of actions: 'Aviate, Navigate, Communicate, Manage.'

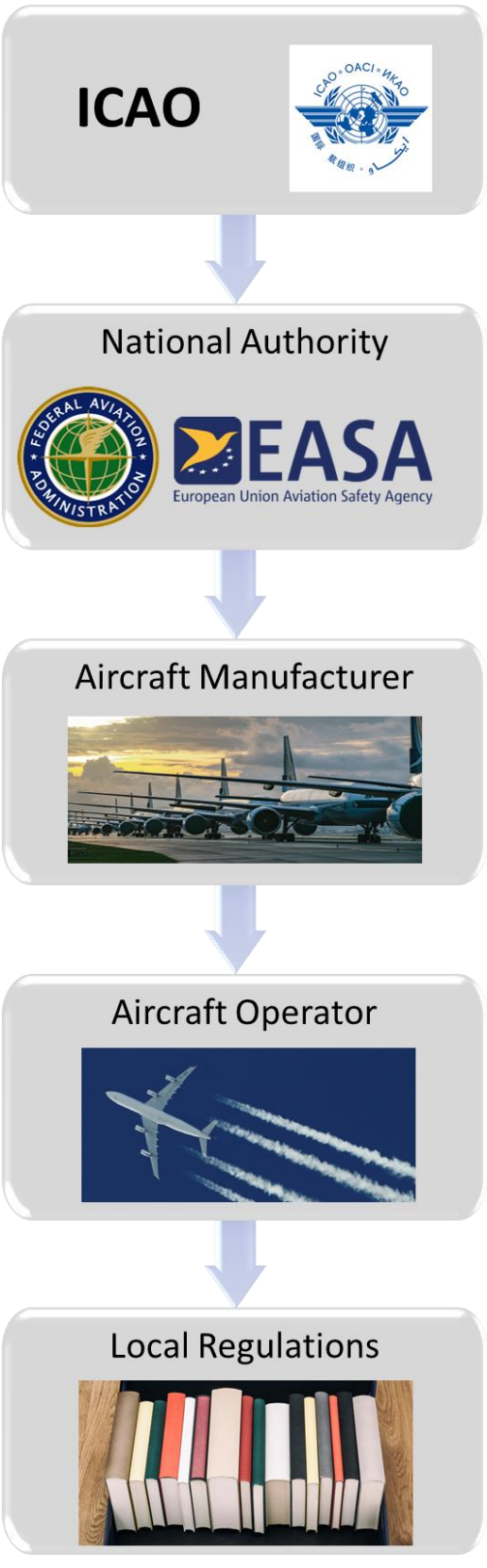
A Higher Degree of Safety

PRO 3 uses the term a *higher degree of safety* to express when deviations from SOPs are permitted. Before discussions about those deviations, and where/when they are appropriate, first there must be an understanding of how regulations are formulated to achieve enhanced safety.

There are many places that aviation regulations come from, and they form a basic hierarchy as shown in figure 4. At the top is the International Civil Aviation Organization (ICAO). Funded and directed by 193 national governments, ICAO sets out Standards and Recommended Practices (SARPs), as well as Procedures for Air Navigation (PANS).

Below ICAO are several levels, from national, through the aircraft manufactures and operators, and down to individual fleets and local regulations. At each level, the rules can be made tighter, or safer, but they cannot be relaxed.

Any individual performing tasks within such a framework will require a depth of knowledge about how the regulation hierarchy is interrelated, to be able to appropriately decide when a deviation for safety is required. For example, imagine an approach with a mountainous area in the overshoot. While conducting the MAP, the pilot elects to maintain wings level for a few seconds after the SOP demanded a turn. In this high-pressure situation, discussion on the topic would de delayed till debrief, where it then is realised that the pilot suspected windshear and therefore maintained wings level for performance considerations, in opposition to the SOP. There is no definitive correct answer in this scenario, and therefore pilots must be able to decide when appropriate deviation from regulations is suitable. [viii]



Appropriate Deviations

High performance teams in safety critical industries will always be bound by many rules. Years of experience will have created these rules in the interest of enhanced safety. However, should we *ALWAYS* follow the rules? Are they complete? Could they be improved? Or is there a rule that is outdated and now wrong?

It is possible that a dynamic performance environment may quickly develop into a no-win situation. There are two feasible options for the absence of a solution:

- either no solution exists, or
- regulation and legislation do not cover the parameters in question.

In these instances, a deviation from the published regulation or SOP will be required, but if not fully discussed, this could appear as missing element of a KNO or PRO criteria. Our rules need to include a rule for when to break the rules.

Assessing KNO and PRO

Based on pure observations, root cause is sometimes incorrectly categorized as KNO or PRO. There may be explanations beyond the KNO or PRO competencies. This must be investigated before an accurate assessment can be made. Discussion with the pilot could reveal a more appropriate competency to assign to the situation. Remember that the point of assessment is to give next steps for improved performance, not just to identify what went wrong.

For example, consider an experienced captain flying an ILS, but gets high on the glideslope. This could be labelled as omission of PRO 4, 5, and 6. However, was PRO really the root cause?

Or would a debrief discussion uncover that the pilot may have:

- lost SAW;
- been distracted due to poor WLM;
- missed vital COM with the PM; or,
- been unable to manually fly the aircraft - FPM?

It is vital that the instructor determines root cause and assigned it to the most relevant competency, so the pilot receives the most relevant feedback for improvement.

In each case, it is crucial to fully discuss and debrief after an event to understand the behaviors observed and to delve into why they were seen. Without full discussion, instructors cannot give relevant advice and guidance to facilitate student progression and give the correct 'next steps' for each student.

For example, a pilot negates to act and does not discuss the 'why' with the crew. At this point in time, it may appear that a student does not have sufficient knowledge and is accordingly marked down for KNO or PRO.

Instead ask, is it possible that:

- the student lacks confidence to act and/or explain?
- conflicting or excessive information led to a prolonged thinking time?
- workload management and delegation could help with capacity?
- this event was a Black Swan to the student?
- leadership and teamwork could be improved to develop trust?
- doing nothing was the correct action?
- a new SOP might be necessary?

Case Studies

Alitalia Flight 112 [ix] [x]

- On 5 May 1972
- Scheduled flight from Rome to Palermo International Airport
- Crashed into Mount Longa, 4.8 km southwest of Palermo while on approach to the airport
- Investigators believe that the crew had 3 miles visibility and did not adhere to the established vectors issued by air traffic control
- The incident is the worst in Alitalia's history with 115 on board killed

What could have saved them:

- PRO 2 – need to follow set procedures.
- PRO 5 – must monitor aircraft to know your position, especially in relation to high ground.
- PRO 6 – safety altitude regulations must be followed.

United Airlines Flight 232[xi]

- On July 19, 1989, DC-10
- Scheduled flight Denver - Chicago O'Hare - Philadelphia
- Suffered a catastrophic failure of its tail-mounted engine due to an unnoticed manufacturing defect in the engine's fan disk, which led to the loss of many flight controls
- Of the 296 passengers and crew on board, 112 died during the accident, while 184 people survived
- Despite the deaths, the accident is considered a prime example of successful crew resource management because of the large number of survivors and the manner in which the flight crew handled the emergency and landed the airplane without conventional control

OBs that went well:

- KNO 1,2,5, PRO 7: The crew knew the operating limits and where to find more information from ground sources. They then applied this with expert knowledge of the plane, its systems, and the surrounding airspace.
- KNO 7, PRO 4,5: The crew used exceptional team work to apply their knowledge, operate the aircraft and monitor the effects of their actions.
- PRO 3: despite being prohibited in normal flight, the aircraft was controlled by asymmetric thrust, as this gave the only way of ensuring the continuation of flight.

Summary

- KNO underpins all the ICAO core pilot competencies and includes a basic understanding of all technical and non-technical skills.
- PRO covers the appropriate application of the rules and regulations needed.
- Keep the focus on the constructive feedback and the students 'next steps' for their development in that competency and/or observed behavior. Which competency it comes under it widely irrelevant other than to help instructors gather thoughts.

Further Reading

- Moriarty, David. Practical Human Factors for Pilots. Netherlands, Elsevier Science, 2014.
- Kearns, Suzanne K., et al. Competency-Based Education in Aviation: Exploring Alternate Training Pathways. United Kingdom, Taylor & Francis, 2017.
- Assessment and Learning. United Kingdom, SAGE Publications, 2012.

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[i] ICAO. Doc 9868 Pans Training. 3rd Ed. 2020.

[ii] ICAO. Doc 9868 Pans Training. 3rd Ed. 2020.

[iii] ICAO. Doc 9995 AN/497. Manual of Evidence-based Training.' First edition. 2013.

[iv] ICAO. Doc 9868 Pans Training. 3rd Ed. 2020.

[v] IATA GM: Competency Assessment and Evaluation for Pilots Instructors and Evaluators

[vi] Oxford English Dictionary

[vii] IATA GM: Competency Assessment and Evaluation for Pilots Instructors and Evaluators

[viii] Further advice on handling windshear can be found here: FSF ALAR Briefing Note 5.4 Wind Shear.

[ix] Moretta, R,A. Unconventional Aeronautical Investigatory Methods: The Case of Alitalia Flight AZ 112. Nov 2021.

[x] https://www.italyonthisday.com/2019/05/montagna-longa-air-disaster.html

[xi] Aircraft Accident Report, United Airlines Flight 232, McDonnell Douglas DC-10-10, Sioux Gateway Airport, Sioux City, Iowa, July 19, 1989 (PDF). NTSB/AAR-90/06.