Flight supervision and pilot training standards: a study of international aviation regulations

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ABSTRACT

This paper analyzes variations in pilot training and licensing policies across four major organizations: the International Civil Aviation Organization (ICAO), the Federal Aviation Administration (FAA), the European Union Aviation Safety Agency (EASA), and the Directorate General of Civil Aviation (DGCA) of Indonesia. The main issue here is the impact of contradictory training pathway requirements, flight hours, simulator requirements, language proficiency requirements, and instructor qualification requirements on aviation safety, license transferability, and the construction of the pilot training system in Indonesia. This study employs a qualitative research design, combining a systematic literature review with regulatory comparative analysis. The findings demonstrate that the prescriptive and competency-based model is most prevalent in EASA, where simulation and multi-crew requirements are widely applied; whereas in the FAA, the emphasis is more on total flight experience and rules related to 1,500 hours; and in the Civil Aviation Safety Regulations (CASR), there is minimal implementation but overall consistent with ICAO minimum. The paper finds that the country must progressively harmonize with modern ICAO, EASA, and FAA standards of good practice, prioritizing competency-based training (CBT), fatigue risk management, simulator capacity, and instructor professionalization to enhance safety performance and international recognition.

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1. INTRODUCTION

Transportation is a critical sector of the economy that enables people by enhancing human mobility [1]. Air travel is one of the existing transportation industries, and nowadays it is a primary mode of transportation worldwide [2]. The aviation industry has positive impacts on people's mobility at both domestic and international levels. The aviation industry is also significant in enhancing the speed of goods and services transfer via air mobility [3]. But there is also a significant risk of accidents in the aviation industry that are not professionally managed. Thus, it is significant to apply aviation regulations to pilots, as they are the core of aircraft operations [4]. Pilots not only manage the aircraft but also the flight path, as long as it conforms to the standards. The conditions to fly as a pilot require formal training and education. Regarding the regulations governing the education and training of future pilots in the civil aviation sector, collective safety should be ensured [5]. These laws set the minimum requirements for gaining a country's authorities' attention. The quality-based research standards encompass all areas, including engineering processes, manufacturing, and aircraft operations [6]. Moreover, flight safety should be prioritized based on the competency of the prospective pilots. Thus, countries should also lay down their own standards for the curriculum, the minimum number of flight hours, and competency assessment, in accordance with international standards [7].

Aviation laws worldwide are established by various international bodies that serve as benchmarks. This is the basic requirement for annex 1 personnel licensing under International Civil Aviation Organization (ICAO) [8]. The part-flight crew licensing (FCL) regulations were issued by the European Union Aviation Safety Agency (EASA) and the Joint Aviation Authorities (JAA) in Europe [9]. Meanwhile, in the United States, pilot licensing is governed by the Federal Aviation Regulations (FAR) parts 61 and 141, which are administered by the Federal Aviation Administration (FAA) [10]. These guidelines control the existence of particular aircraft standards.

The Indonesian system of national legal norms for air traffic safety control is known as the Civil Aviation Safety Regulations (CASR), which follow the provisions of annex 1 to the ICAO [11]. However, they are modified to suit the context and requirements of the Indonesian national law. ICAO, as a member state of Indonesia, has an obligation to ensure that its standards comply with ICAO's minimum standards. But Indonesia is free to modify the rules in accordance with its domestic policy. This adjustment was made so that national aviation regulations are not only compliant with international standards but also tailored to the conditions and requirements of the Indonesian aviation industry. It is against this backdrop that one needs to understand the differences in pilot training and certification systems worldwide. The goal of this understanding is to facilitate the harmonization of international civil aviation standards. Thus, the proposed study will compare and contrast pilot licensing standards in ICAO, FAA, EASA, and Directorate General of Civil Aviation (DGCA) Indonesia, with the aim of providing a holistic discussion of the similarities and differences among these systems and their implications for the pilot training system in Indonesia.

2. METHOD

The systematic literature review is used in this study as the regulatory comparative analysis design to achieve an understanding of the equality, gaps, and trend of pilot training and certification policy harmonization in four central aviation regulators, including ICAO, FAA, EASA, and DGCA Indonesia [12]. The systematic literature review approach was selected because it offers systematic, open, and replicable method for appraising cross-jurisdictional policies. The regulatory corpus included ICAO annex 1 as global personnel-licensing baseline [13]. The EASA comparison used the easy access rules for aircrew under regulation (EU) no 1178/2011 [14]. The Indonesian comparison used CASR part 61 on licensing of pilots and flight instructors (FIs) [15]. The phases of the systematic literature review used in this research paper are as follows:

i) Literature identification: academic databases and the official websites of aviation agencies and organizations, such as ICAO, FAA, EASA, DGCA Indonesia, and other relevant international journals, were searched. Keywords are included as follows: pilot licensing standards, comparison of aviation regulations, annex 1 ICAO, FAR parts 61 and 141, part-FCL EASA, and CASR Indonesia.
ii) Source selection and screening: selection of the sources obtained was followed by inclusion criteria (relevance to the topic and year of publication 2015-2025) and exclusion criteria (non-official materials, literature without peer review, and literature that did not cover aspects of pilot licensing).
iii) Data extraction and content analysis: it employed a thematic content analysis of the documents, and each was coded under the major themes of licensing requirements, training standards, minimum flight hours, competency-based training (CBT), and recognition of cross-border licensing.
iv) Synthesis of findings: the coded information was further synthesized comparatively to determine which factors are similar, which are different, and the policy implications of each of the four regulatory systems. The reporting was done in a descriptive and critical format to highlight the impact of regulatory differences on harmonizing safety and pilot training standards worldwide.

3. RESULTS AND DISCUSSION

3.1. Main differences in the training system for prospective aviators

Flight training organizations (FTOs) commonly use two primary training pathways for ab-initio pilots: modular and integrated systems. In the modular system, trainees progress stepwise from a private pilot license (PPL) to additional ratings and licenses such as the instrument rating (IR), multi-engine piston (MEP) rating, commercial pilot license (CPL), and ultimately the airline transport pilot license (ATPL). In the United States, modular training is typically conducted under FAA FAR part 61, which defines the aeronautical knowledge, experience, and proficiency requirements for individual licenses and ratings, while allowing considerable flexibility in how FTOs structure their curricula.

In Europe, modular training is permissible only at schools approved under EASA part-FCL (formerly joint aviation requirements (JAR)-FCL) and overseen by the relevant national competent authority. This requirement reflects a stronger emphasis on standardization of training pathways and learning outcomes across member states, including detailed provisions on minimum flight hours, simulator credit, and multi-crew training. The comparison presented in Figure 1 shows that, even within modular frameworks, European systems embed more prescriptive competency checkpoints and structured use of flight simulation training devices (FSTDs). An integrated system designs the entire curriculum as a single, continuous program approved by the authority, from zero flight experience up to CPL/IR or ATPL level. Integrated courses both in EASA and FAA part 141 environments use a reduced minimum flight-hour requirement compared to modular part 61 routes, on the assumption that a carefully structured curriculum with high simulator usage and close supervision can produce competence equivalent to or superior to that achieved through modular part 61 routes. However, trainees must still meet strict aeronautical experience and performance benchmarks as specified by the authority. Evidence from elementary pilot training also shows that simulator-based instruction can support the rehearsal and acquisition of flight tasks as a complement to aircraft-based training [16].

Recent developments since 2020 have shown convergence between modular and integrated systems through the broader adoption of competency-based training and assessment (CBTA) and evidence-based training (EBT). ICAO has progressively embedded CBTA principles into annex 1 and associated guidance material. At the same time, EBT for recurrent training has been formalized through manuals such as ICAO Doc 9995 and amendments to procedures for air navigation services - training (PANS-TRG). EASA has updated the aircrew framework under regulation (EU) no 1178/2011 to support competency-oriented training provisions and the structured use of FSTDs. Several states now require FTOs to evidence CBTA alignment in their manuals and syllabi. Recent CBTA research likewise emphasizes that training quality should be organized around demonstrable competencies rather than flight-hour accumulation alone [17]. A scoping review of extended-reality flight simulators further shows growing evidence for simulation as an adjunct to conventional flight training, while stressing that transfer to operational performance must remain evidence-based [18].

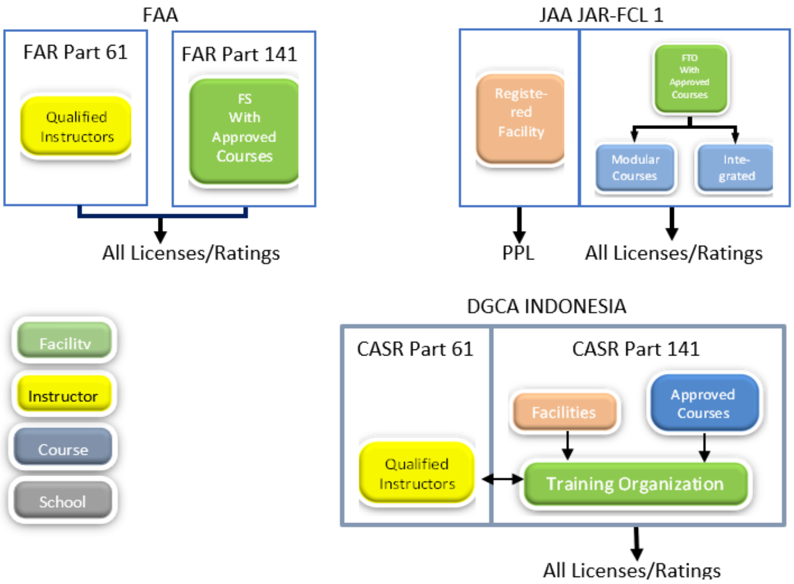

Figure 1. Pilot training system (FAA, JAA, and DGCA)

3.2. Differences in first officer requirements

The requirements for first officer (FO) or second-in-command (SIC) positions in commercial air transport show marked divergence between FAA and EASA regimes, especially following regulatory changes adopted after 2010–2013. In the United States, the FAA previously allowed entry into airline operations under part 121 with a commercial pilot certificate and approximately 250 hours of flight time. In response to the Colgan Air Flight 3407 accident and subsequent public law mandates, the “1500-hour rule” was introduced: all FOs in part 121 operations must now hold an airline transport pilot (ATP) certificate, be at least 23 years old, pass the ATP knowledge and practical tests, and have at least 1,500 hours of total flight time, subject to limited reductions via the restricted airline transport pilot (R-ATP) pathway for specific accredited university or military training program. This shift explicitly links FO eligibility to a "time-in-air" threshold, even though later analyses have noted that both Colgan pilots already exceeded 1,500 hours and that qualitative aspects of training and supervision were also critical. A recent evaluation of U.S. post-Colgan legislation shows that tighter pilot qualification and duty requirements also affect airline operational capacity, illustrating the policy trade-off between higher entry standards and workforce constraints [19].

In the EASA system, prospective FOs on multi-pilot aircraft are generally required to hold a CPL/IR, complete multi-crew cooperation (MCC) training, and obtain a type rating on the relevant aircraft. JAR-FCL and EASA part-FCL regulations have progressively moved toward competency-based multi-crew cooperation (CB-MCC) and integration of EBT concepts, with emphasis on scenario-based training, crew resource management (CRM), and management of automation rather than mere accumulation of hours. The importance of CRM as a structured component of crew performance and training is well established in the aviation human-factors literature [20]. During type rating training, candidates must demonstrate competence in both pilot-in-command (PIC) and co-pilot roles. However, some pathways may be limited to "co-pilot only" privileges at the initial stage. The FAA does not require a type rating for SICs on all domestic operations, as EASA mandates type-specific training under part-FCL. However, ICAO annex 1 stipulates that both the PIC and the SIC on international operations must meet type-rating and proficiency standards, creating a degree of misalignment between domestic FAA rules and international expectations. The legal regulation of aviation personnel also shows how national employment and qualification rules interact with sector-specific safety requirements [21]. This regulatory divergence complicates license conversion and recognition for FOs working in global alliances or transferring between EASA-regulated and FAA-regulated operators.

3.3. License validation

The global-level control of license validation is primarily based on ICAO annex 1, which describes the circumstances under which a license issued in one State can be validated in another state. The ICAO intentionally grants contracting states significant discretion, leading to various forms of validation worldwide. Under JAA/EASA, JAR-FCL 1.015, and more recently, under EASA aircrew regulation (EU) 1178/2011, the conditions for recognizing and converting licenses outside and inside the EASA member states are detailed. Intra-EASA licenses are usually mutually recognized, whereas owners of licenses issued by non-EASA jurisdictions must present strict evidence of experience and may be subjected to further theoretical and practical examinations. The experience thresholds based on the license validation table reveal that validation is not confined to total flight hours, but also extends to the nature of operation (single-pilot and multi-pilot), the pilot's position (PIC or co-pilot), and the aircraft category. As an example, an ATPL(A) holder who is in excess of 1,500 hours PIC on multi-pilot aircraft can be qualified to become PIC on multi-pilot aircraft, whereas CPL(A)/IR holders may become PIC on operations at commercial air transport at most, on single-pilot aircraft. Co-pilots with extensive experience in single-pilot flights can qualify to work as FOs but may not qualify to be commanders. These differences demonstrate that European validation regimes, based on JAR-FCL and transposed into EASA part-FCL, entrench a granular matrix of hour credits and role-specific thresholds. This pattern is consistent with the broader role of EU agencies in shaping and implementing technical rulemaking. This result also reflects the role of ICAO standards as a baseline for regulatory convergence [22]. Research on EU agency rulemaking similarly shows that harmonization depends on how supranational technical rules are implemented across member jurisdictions [23].

Holders of ATPL(A) are required to have over 1,500 hours as PIC on multi-pilot aircraft to be validated as PIC in multi-crew commercial air operations. For ATPL(A) or CPL(A)/IR holders, a total experience of over 1,500 hours as PIC or co-pilot on multi-pilot aircraft in accordance with regulations allows them to be validated as co-pilot in multi-pilot commercial flights. Meanwhile, CPL(A)/IR holders can be validated as PIC of single-pilot aircraft if they have over 1,000 hours as PIC in commercial air transport since obtaining their IR. Alternatively, pilots with a CPL(A)/IR who have logged over 1,000 hours as PIC or co-pilot on single-pilot aircraft can be validated as co-pilot in accordance with JAR-operations regulations. For a CPL(A) without an IR, validation is only applicable for non-commercial activities on aircraft other than commercial transport aircraft, with a requirement of over 700 flight hours, including a minimum of 200 hours in the activity to be validated and 50 hours in the last 12 months.

3.4. Language provisioning

Language proficiency is a critical component of safe international operations. ICAO annex 1, chapter 1.2.9.6 requires that, since 5 March 2008, pilots, air traffic controllers (ATCs), and other relevant personnel using radiotelephony must demonstrate a minimum ICAO level 4 (operational) in aviation English, with mandatory re-evaluation intervals: at least every three years for level 4 and every six years for level 5, while level 6 (expert) holders are not subject to periodic re-testing. The JAA/EASA framework, through provisions like JAR-FCL 1.200(a) and EASA part-FCL language requirements, implements the ICAO scale within the European licensing system. Applicants for IR(A), multi-crew pilot license or MPL(A), and ATPL(A), as well as license validations, must demonstrate language proficiency at or above ICAO level 4, and the assessment must be documented and traceable. FAA FAR part 61 requires that applicants be able to read, speak, write, and understand English, but does not formally adopt the ICAO level 1-6 scale nor specify re-evaluation intervals. This divergence creates challenges for license conversion from FAA to EASA or other ICAO-levelled jurisdictions, where formal language test results at a specified level are required. Disparities in language provisions have repeatedly been identified as a risk factor in safety analyses and universal safety oversight audit program (USOAP) assessments, particularly regarding radiotelephony clarity and cross-border ATCs-pilot communication. Empirical work on aviation English shows that simulation-based instruction can improve domain-specific vocabulary and readback performance among aspiring pilots [24]. A recent needs analysis also indicates that student-pilot language training should be closely aligned with the communicative events encountered during practical flight training [25].

3.5. Private pilot license for fixed wing aircraft

Regulations governing the PPL for aeroplanes are set by ICAO annex 1, chapter 2.3, JAR-FCL 1.100-1.135 (and their EASA successors), and U.S. regulations in FAR part 61 (notably §61.103-61.109) and part 141 appendix B. ICAO annex 1 provides the global baseline for personnel licensing requirements. While all three frameworks aim to define minimum requirements for entry-level pilots, they differ in training structure, recognition of flight time across categories, and medical certification requirements. ICAO annex 1 provides a global minimum baseline: minimum age 17, class 2 medical, and at least 40 hours of flight time, including a specified amount of solo and cross-country flight. JAR-FCL 1 and EASA part-FCL build on this by requiring at least 45 hours, with more detailed prescriptions for dual instruction, solo cross-country requirements, and night training options. The FAA under part 61 requires at least 40 hours total, but allows substantial flexibility in how those hours are accrued. In contrast, part 141 program may reduce the required total to 35 hours under more tightly controlled syllabi. Recent evidence from pre-private-pilot training suggests that guided simulator pre-training can reduce the flight and ground training required before pre-solo milestones, supporting simulation as a complement to aircraft experience [26]. Survey evidence from general-aviation pilots also reports strong acceptance of FSTDs for routine and emergency training, while identifying regulatory and perceptual barriers to wider adoption [27].

One notable difference concern human performance and limitations. ICAO annex 1 explicitly lists human performance as a mandatory component of knowledge for PPL holders. In contrast, FAR part 61.105 does not single it out with the same level of detail, leaving the integration of human factors content largely to discretion of FTOs and examiners. Likewise, JAR-FCL provides more specific provisions on cross-category crediting of hours, for example, recognizing up to 10% of total PIC hours on other aircraft categories. At the same time, ICAO allows such recognition only to the extent that the national authority approves it.

3.6. Airline transport pilot license

For the ATPL, ICAO annex 1 chapter 2.6, JAR-FCL 1.265, EASA part-FCL, and FAR part 61 subpart G plus part 141 appendix E provide the main regulatory framework. ICAO annex 1 establishes the international baseline for ATPL licensing. EASA applies the corresponding requirements through its aircrew and part-FCL framework. All three major regulatory bodies (ICAO, EASA, and FAA) require a minimum of 1,500 total flight hours and a class 1 medical certificate for ATPL issuance. However, they diverge in age requirements, PIC experience composition, multi-pilot time, and cross-country thresholds. ICAO and JAR-FCL/EASA set the minimum age at 21 years, while the FAA requires 23 years for a standard ATP certificate (subject to reduced thresholds for specific R-ATP categories). JAR-FCL and EASA additionally require 500 hours in multi-pilot operations, reflecting a deliberate emphasis on multi-crew readiness. The FAA does not explicitly impose such multi-pilot-hour requirements; instead, it prioritizes totals, such as 100 hours of night flying and 500 hours of cross-country flying.

In terms of PIC and cross-country experience, ICAO and JAR-FCL allow the required 500 hours PIC to be constructed as a combination of PIC and pilot in command under supervision (PICUS), with specified minima. The FAA requires 250 hours as PIC or PICUS, including at least 100 hours cross-country and 25 hours at night, but raises the total cross-country requirement to 500 hours. FSTD credit is generally capped at 100 hours across the three regimes, with the FAA permitting additional flexibility through part 142 training centers. These structural differences have direct implications for license portability and mutual recognition. For example, FAA ATPL holders with strong general aviation backgrounds but limited multi-crew jet time may not automatically meet EASA's multi-pilot experience thresholds. In contrast, EASA ATPL holders may need to revalidate or undergo additional checks to exercise their privileges in FAA environments. USOAP personnel licensing findings repeatedly highlight such mismatches as a barrier to full cross-border equivalency.

ICAO annex 1, JAR-FCL 1, and FAA FAR part 61 all require 1,500 hours of flight experience and a class 1 medical certificate, there are significant differences regarding minimum age, PIC experience, and multi-pilot requirements. ICAO and JAR-FCL set the minimum age at 21 years, while the FAA sets it at 23 years. JAR-FCL is much stricter, mandating 500 hours of multi-pilot operational experience, reflecting the European focus on multi-crew readiness from the outset. In contrast, the FAA does not explicitly require multi-pilot hours, providing flexibility for pilots to build PIC hours through general aviation routes. ICAO remains a more flexible global baseline, while the other two systems set higher standards based on their operational context. Evidence from a large commercial-pilot sample also shows that flight exposure and safety performance are related in complex, age-dependent ways, which supports evaluating experience together with competency rather than treating total hours as a complete proxy for proficiency [28].

3.7. Flight instructor rating

The FI rating plays a pivotal role in ensuring the quality and safety of pilot training. Here, ICAO annex 1, JAR-FCL/EASA, and FAA FAR parts 61 and 141 again adopt different levels of detail in Table 1. ICAO annex 1 sets general requirements for instructors but does not prescribe explicit minimum flight hours, instructional time, or structured restricted periods. It functions as a normative guidance document, leaving specific implementation to each state's civil aviation authority. JAR-FCL 1 and EASA part-FCL are more prescriptive. They require FIs to hold at least a CPL(A) or, under certain conditions, a PPL(A) with substantial PIC time (e.g., 200 hours total, 150 hours as PIC), plus specified instrument and cross-country experience. They also codify a restricted period for new FIs, during which instructors may provide training only under the supervision of a senior FI(A) and are limited to specific tasks, such as PPL training on single-engine aircraft. Additional requirements apply to night-rating, CPL, and MPL instruction, including minimum instrument flight rules (IFR) hours and multi-crew operational experience.

Under FAA regulations, FIs must hold at least a commercial pilot certificate with appropriate ratings (often CPL/IR or ATPL) and complete dedicated instructor training and testing for the certified flight instructor (CFI) certificate. The FAA does not impose a formal restricted period analogous to EASA's, but relies on rigorous initial testing and periodic proficiency checks for renewal. Compared to ICAO's generic provisions, both EASA and FAA set higher and more detailed standards. However, EASA places greater emphasis on structured competency frameworks (especially for MPL instructors) and supervisory phases, while FAA prioritizes experience and recurrent testing. Research on evidence-based flight-instructor learning further supports structured instructor development for the assessment of pilots' non-technical competencies [29].

3.8. Basic competency education for prospective aviators (pilot)

The MPL, introduced with the 10th edition of ICAO annex 1 (2006), represents the first license designed from the outset around the CBTA paradigm. MPL program are intended to prepare pilots directly for co-pilot roles in multi-crew commercial jet operations through an integrated curriculum with a dominant share of training conducted in high-fidelity FSTDs. MPL training is usually divided into several stages: basic single-engine flying (typically including at least 10 hours solo), multi-engine (ME) training, instrument-flight training in multi-crew conditions where two students operate as pilot flying and pilot monitoring, and a type rating phase comprising extensive full flight simulator (FFS) sessions plus a limited number of landings in the actual aircraft. Total training time must be at least 240 hours under ICAO minimums, but many Asian regulators require 325-355 hours to strengthen safety margins. Evidence from Indonesian aviation cadets also shows that structured simulator-based instruction can improve safety awareness, decision-making, and flight-performance competencies [30].

The key differentiator between MPL and traditional integrated ATPL or modular CPL routes is the high proportion of simulator-based training, often exceeding 50% of total hours. Properly implemented, MPL can accelerate learning in modern glass-cockpit, multi-crew environments, with documented benefits in CRM, automation management, and threat-and-error management. CRM research supports the importance of coordinated crew competencies in multi-crew settings. However, implementation has been uneven: EASA and several Asian states have adopted MPL and CBTA frameworks extensively, while the FAA has not fully embraced MPL, and some CASR systems have yet to incorporate MPL. This uneven adoption contributes to competency gaps for pilots transitioning into jet operations in non-MPL jurisdictions and remains a recurring topic in USOAP personnel licensing and operations evaluations [31]. Related research on automatic flight-control operation also reinforces the need for training that addresses modern cockpit automation [32]. A recent systematic review with meta-analysis similarly concludes that extended-reality technologies can support pilot simulator training, particularly through immersive and spatially rich practice, although implementation quality remains important [33].

Table 1. Flight instructor rating

Requirement	ICAO annex 1	JAR-FCL 1	FAR part 61
Minimum age	N/A	18	18
Medical class	N/A	N/A	2
Validity	N/A	3	N/A
Experience (hours)	As for CPL (2.8.1.3)	At least a CPL(A) or 200 hours of flight time, of which 150 hours as PIC if holding a PPL(A). Of these 30 single-engine piston or SEP (5 during 6 months before pre-entry flight test)	A CPL/IR or ATPL with the appropriate ratings for the instructor rating sought
Instrument experience	N/A	10 (Max. 5 flight and navigation procedures trainer (FNPT) or a flight simulator)	Must have IR
Cross-country experience	N/A	20 PIC including a flight totaling not less than 300 nm in the course of which full stop landings at two different aerodromes	N/A
Training for obtaining FI(A)	N/A	30 (25 dual of which 5 can be flight simulator or FNPT) The remaining 5 may be two applicants flying together	25 (Max. 10% flight simulator and max. 5% flight training device, 10% max. together)
Training for the MPL(A) instructor	N/A	14	N/A
Experience on type/class	N/A	15	15
Restricted period	N/A	100hours and 25 solo flight supervisions	N/A
Experience for CPL training	N/A	500, including 200 hours of flight instruction	N/A
Experience for night flying	N/A	200 hours IFR (50 can be FNPT II or flight simulator)	N/A
Experience for training of FI(A)	N/A	500 hours of flight instruction	N/A
Experience for MPL(A) training	N/A	For the core flying phase, 500 hours from which 200 is flight instruction, for the basic phase of training (requiring IR(ME)), 1500 hours of flight time in multi-crew operations	N/A

3.9. Policy reform and future directions

In the medium run, the harmonization of pilot training and licensing requirements will be essential in supporting cross-border pilot placement, airline operations, and regional safety oversight. Greater consistency of CASR-type systems with ICAO annex 1 and 6, EASA CBTA/EBT, and current fatigue risk management system (FRMS) practices should be treated as an investment in human-capital quality and international interoperability. FAA fatigue research shows why fatigue-related evidence remains important to training and operational safety policy [34]. The Indonesian licensing framework provides the domestic regulatory basis that must be aligned with these broader international requirements. Aviation policy research also shows that regulatory transitions depend on institutional coordination and implementation capacity [35]. Governance studies in aviation similarly emphasize the difficulty of translating broad policy objectives into workable sectoral rules [36]. Changes in international aviation regulation can also create tensions between domestic implementation and wider regulatory trends [37]. Future reforms could include:

i) ICAO, regional authorities, who established common templates to CBTA syllabi, MPL implementation, and FI qualification models, with support of new USOAP protocol questions and performance indicators, helped to create regulatory convergence platforms.
ii) Adoption of advanced training technologies, such as artificial intelligence (AI)-assisted training analytics, virtual-reality or mixed-reality simulators, and adaptive CBT platforms that personalize learning trajectories while ensuring compliance with annex 1 competency frameworks. Machine-learning research in commercial aviation illustrates the growing role of data-driven analysis in identifying safety-relevant parameters [38]. Recent aviation research also shows that AI can be integrated with competency-based assessment to support risk analysis and decision support in emerging operational settings [39].
iii) Organized stakeholder consultation with airlines, FTOs, pilot unions, and regulators in order to design transition pathways between a system based on hours and one based on competency, particularly in developing states where there are acute resource pressures.

4. CONCLUSION

The current researcher's finding is that the global pilot training and licensing systems are determined by different philosophical approaches, in the sense that ICAO offers a good loose minimum situation, the EASA/JAR-FCL offers a highly structured and competency-driven format, the FAA offers accumulating flight experience, and 1,500-hour ATP rule, and CASR offers a more relaxed approach and less even-handed in application. The results that have been obtained in the comparison are always in line with the presented claims: the differences in the training pathways (modular, integrated, and MPL), the mechanism of license validation, the level of language proficiency, and the extensive provisions to PPL, CPL, ATPL, and flight inspector rating generate their objective differences in the safety assurance level, portability of these licenses and the quality of instructors. Such results are generally consistent with previous studies indicating the safety advantages of CBTA/EBT, multi-crew-based training, and the use of a systematic simulator, as well as validating the continuity of implementation gaps in most developing states. Simultaneously, the analysis is nuanced because it already includes post-COVID dynamics, USOAP audit indicators, and the particular role of Indonesia in this regulatory environment. In sum, the article contributes to the knowledge base by going beyond the level of cross-sectional comparison and offering policy-oriented synthesis: it defines specific harmonization priorities including the implementation of CBTA and FRMS in CASR, simulator infrastructure empowerment and the professionalization of the FIs, and a clearer outlay of the license validation procedures that can help the regulators and training organizations adjust national systems to the new international best practices.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [HP], upon reasonable request.

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