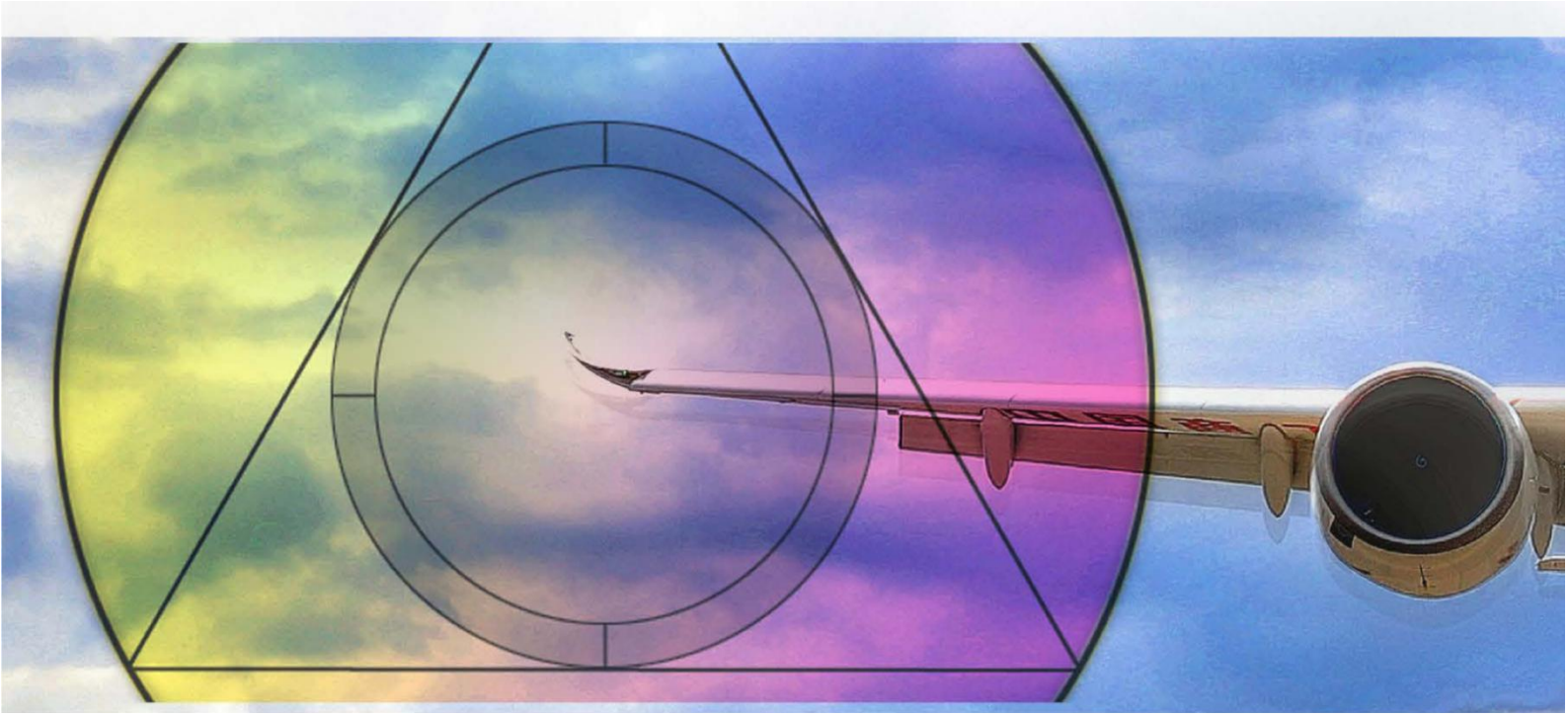
PLM

Development and Implementation Roadmap



Civil Aviation Administration of China

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Foreword

CAAC PLM Development and Implementation Roadmap

Pilot Professionalism Lifecycle Management System (PLM) is a qualification management system developed by Civil Aviation Administration of China (CAAC), comprising theories, personnel, equipment, procedures, supporting systems and other related elements, which is centered on job competency, driven by evidence-based training, led by conduct improvement, based upon the evidence-based input into core competencies and the psychological assessment of occupational aptitude, characterized as the inclusion of all elements during pilot training and full professional lifecycle, and aimed at continuous enhancement of the pilot's ability to manage the risks of "gray rhinos" and "black swans".

PLM is developed under the guidance of a series of instructions and written comments given by General Secretary Xi Jinping on safe, steady and controllable civil aviation operations, in accordance with the requirements of "strengthening the frontline units, consolidating the basic works and improving the fundamental skills" proposed by the Party Leadership Group of CAAC, and revolving around the program to promote the conduct of "holding reverence for life, responsibility and regulations". Based upon the development phases and practices of civil aviation in China, and with a thorough study of new problems emerging from both international and domestic training systems, PLM uncovers its new features and patterns. With the focus on the management of airline transport pilot training, PLM develops an integrated indicator system consisting of three dimensions, (i.e., conduct competencies, core competencies, and psychological competencies), and adopts the basic method of performance indicators by unifying multiple input sources, by which the dynamic "profile" of the pilot job competencies will be accomplished step by step, and the flight training mode has improved in terms of quality and efficiency.

PLM development is a transformation in China's flight training and an important strategic support in building a nation with strong civil aviation industry. It can lay a solid foundation for the conduct improvement in a regular, systematic and scientific manner; make full use of the institutional advantages in integrating the industry-wide flight training resources; enhance the high correlation between training input and the substantial improvement of safety performance; provide basic theoretical research findings of flight training as well as training solutions, establish a sustainable supply mechanism of the training resources in line with the operation scale; improve the regulatory paradigm and organizational structure fulfilling the requirements of highly

standardized training; produce globally competitive and high-quality instructors and designated pilot examiners; enhance the capability of big data interaction and application that supports the evolution of flight training systems; raise the voice of China in terms of formulating the international civil aviation flight training rules and standards; and improve the innovative capabilities that lead the development of international civil aviation training. CAAC has decided to fully implement the PLM in accordance with the requirements of ICAO and the CAAC comprehensive strategies of deepening airline transport flight training reform.

This Roadmap, in line with the concrete conditions of China, provides the policies and overall planning for CAAC's implementation of PLM from present to 2030, and serves as an "ignitor" for the further development of civil aviation flight training system. The Roadmap also provides guidelines for stakeholders to find the right position, identify the tasks, and collaborate with each other; furthermore, it will accelerate the integration of global training standards and international cooperation. It is hoped that all stakeholders will make suggestions for revision to get the Roadmap steadily improved during its implementation so as to ensure that it is in line with the safety oversight strategic planning of the civil aviation sector in China. Then the strategic synergy is to be created. The Roadmap is expected to become a landmark in the planning of flight training systems in China's civil aviation sector, and serves as a blueprint for the implementation of regional safety plan in the global civil aviation industry.

Hu Zhenjiang

Deputy Administrator of Civil Aviation Administration of China

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Chapter 2 Key Concepts

2.1 Competency-based training and assessment (CBTA)

(1) Concept

- Training and assessment characterized by a performance orientation emphasis on standards of performance and their measurement and initiate the training by the defined standards of performance.

(2) Key words

- Competency: an individual's fundamental characteristics based upon target performance, including knowledge, skills, self-concept (personal attitudes, values, or self-image), traits and motivation.
- Core competencies: a group of related behaviors, based on job requirements, which describe how to effectively perform a job and what proficient performance looks like. They include the name of competencies, descriptions, and a list of behavioral indicators. Core competencies encompass technical and non-technical knowledge, skills, and attitudes.
- Core competencies mainly include the framework of pilot's core competencies defined by ICAO.
- The goal of CBTA is to provide a competent workforce for the provision of a safe and efficient airline transportation system. In order to focus training and assessment on how an aviation professional is expected to competently perform on the job, a description of this performance in the particular operational and environmental context is needed. The adapted competency model, with its associated performance criteria, provides a means of assessing whether trainees achieve the desired performance.

(3) CBTA principles

- Relevant competencies are clearly defined for a particular job within an aviation discipline.
- There is an explicit link between competencies and training, and between required job performance and assessment.

- Competencies are formulated in a way that ensures they can be trained for, observed and assessed consistently in a wide variety of work contexts for a given aviation profession or job.
- Trainees successfully demonstrate competency by meeting the associated competency standards.
- Each stakeholder in the process including the trainee, instructor, training organization, operator, service provider and regulator has a common understanding of the competency standards.
- Clear performance criteria are established for assessment of competence.
- Evidence of competent performance is valid and reliable.
- The assessment for the instructors and designated pilot examiners is calibrated to achieve a high degree of inter-rater reliability.
- Assessment of competencies is based on multiple observations across multiple contexts.
- To be considered competent, an individual shall demonstrate an integrated performance of all the required competencies to a specified standard.

2.2 Evidence-based training (EBT)

(1) Concept

- The generalized Evidence-based Training (EBT) refers to the training and assessment based on operational data that is characterized by developing and assessing the overall capability of a trainee across a range of core competencies rather than by measuring the performance in individual events or maneuvers.
- Broadly speaking, Evidence-based Training (EBT) refers to the training and assessment based on multiple data sources including operations, conduct evaluations and psychological tests that is characterized by adopting diversified training methods to cover all elements of the competencies in the job.
- Elementary Level (EL) EBT: traditional check methods are combined with EBT based on elementary evidence database in the airline transport pilot

recurrent training and proficiency check. The elementary evidence database mainly comprises flight data (QAR), aviation safety reports, investigation and analysis of events, and investigation reports of accidents or incidents.

- Medium Level (ML) EBT: the evidence databases are extended on the basis of EL EBT. The extended database mainly includes Line Operations Safety Audit (LOSA), simulator training data, scientific research on maintenance and decline in pilot competency and critical analysis of the training, etc.
- Advanced Level (AL) EBT: EBT is completely integrated based on the extended evidence database and applicable data of conduct competencies/ psychological competencies in the airline transport pilot recurrent training.
- Advanced Level+ (AL+) EBT: EBT is extended to the license and rating training based on the extended evidence database and the input of conduct competency and psychological competency data.

(2) Background

- In 2013, ICAO applied the evidence-based concept in pilot recurrent training and officially released *Manual of Evidence-based Training* (Doc 9995) to conduct periodic pilot assessment and training, provide guidance to CAAs, operators and training organizations. Traditional flight training incorporates safety events into training requirements, which leads to inventory or “check box” style training methods filled with various events in recurrent training programs. However, in today’s aviation system, its complexity and high reliability mean that the next accident may be something completely unexpected. EBT addresses this by moving from pure scenario-based training, to prioritizing the development and assessment of key competencies, leading to a better training outcome. Mastering a finite number of competencies should allow a pilot to manage situations in flight that are unforeseen by the aviation industry and for which the pilot has not been specifically trained (black swan events).
- The aim of EBT training program is to develop and evaluate the identified competencies required to operate safely, effectively and efficiently in a

commercial air transport environment whilst addressing the most relevant threats according to evidence collected in accidents, incidents, flight operations and training.

2.3 Crew Resource Management (CRM)

(1) Concept

- CRM refers to, for the purpose of realizing safe and efficient flight, the process where the crew effectively makes use of all available resources (information, equipment, human resources, etc.) to identify, and address threats, prevent, identify, and correct errors, and recognize and manage undesired aircraft states.
- CRM training: it refers to the process of using classroom teaching, simulated flight training, team activities, case analysis, role-playing and other means to promote the crew's mastering of the knowledge conducive to safe and efficient flight as well as to form corresponding attitudes and behavior patterns.

2.4 Psychological competencies

(1) Concept

- Psychological competencies refer to the conformity of the pilot's mental health and occupational aptitude developed by the pilot's practical training based on the genetic basis and under the influence of education and environment with the job competency requirements.
- Broadly speaking, mental health means that all aspects of the mind and the process of activities are in a good or normal state. Strictly speaking, mental health refers to a person's basic mental activities that are complete and coordinated. In other words, it is a kind of mental state reflecting correct cognition, appropriate emotion, reasonable will, positive attitudes, appropriate behaviors, and good adaptability in work and life.
- Occupational aptitude means that a person must possess certain psychological characteristics when working as a professional pilot. It is formed and developed based on the interaction between innate factors and

acquired environment.

(2) Background

- An IATA survey shows that between 80% and 90% of the flight accidents are caused by human factors. Human factors have been widely recognized as the key elements to ensure aviation safety and efficiency. Being in a safety-critical position, the mental health of pilots has become one of the key factors to ensure aviation safety.
- Through psychological assessment, personnel suitable for commercial transport flights are selected for training to cultivate qualified pilots, which can effectively save training fees while laying the foundation for ensuring flight safety. The psychological assessment, including basic cognitive ability, psychomotor ability, and personality (mental health) test, has been regarded as an essential step in enrolling ab initio worldwide.

2.5 Conduct competencies

(1) Concept

- It refers to the conformity of pilots' stable attitudes and behaviors in the process of safe production operations, especially the recognition of and response to various behavioral norms restricting and instructing safe production operation with job competency requirements. It is characterized by observable, quantifiable, and trainable indicator system.

(2) Key words

- Bearing hardships, standing hard work, working steadily, and showing integrity, strict self-discipline, and strict self-examination shall be demonstrated.
- The pursuit of excellence and professionalism are demonstrated in behaviors, appearance, and temperament.

2.6 Job competencies

It refers to objectively measured individual features that are essential to performing pilots' duties, and closely related behavior features that are predictable and performance-oriented, including three dimensions: core competencies,

psychological competencies as well as conduct competencies.

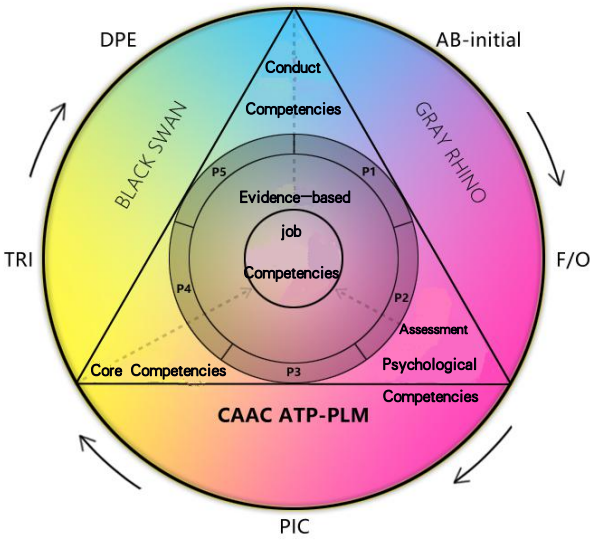
2.7 Lifecycle

It means the whole process of professional pilots' flying career, including the stage of engaging in commercial transport flights and the stage of preparation for the qualification of the corresponding basic competencies before participation in commercial transport flights. The typical lifecycle incorporates ab initio, first officer, pilot-in-command (airline transport), type rating instructor, and designated pilot examiner.

2.8 Pilot Professionalism Lifecycle Management System (PLM)

2.8.1 Concept

(1) Pilot Professionalism Lifecycle Management System (abbreviated as PLM) integrates such three dimensions as core competencies, psychological competencies and conduct competencies. Based on the same underlying methodology of building the indicator system, PLM establishes a three-pronged evaluation model characterized by multi dimension, lifecycle, big data, which enriches the connotation of job competencies according to the management practice of civil aviation in China. The structure diagram is as follows:



Note: The structure diagram, called the "Sky Eye", incorporates the key elements of PLM, and shows insight into pilot operational risks. The diagram integrates and

plans the two risks, three assessment dimensions, five implementation phases, and five lifecycle phases that pilots need to deal with.

(2) The three basic components of PLM require continued improvement. As illustrated in the diagram above, four phases (P1-P4) will be followed to steadily advance the integration of EBT. For Phase 1 (P1), the pilot EL EBT will be launched in which the proficiency checks will be retained, and sequence will be adjusted from "training before checking" to "checking before training" to avoid the "survival mode". For Phase 2 (P2), EL EBT will be fully implemented. For Phase 3 (P3), ML EBT (extended evidence database) will be fully implemented to improve the indicator system of conduct competencies. For Phase 4 (P4), AL EBT will be fully implemented to enter the final phase in which the checks will be replaced with training and instruction assessment, the indicator system for psychological competencies will be improved, and the reform of license and rating policies based on CBTA will be basically completed.

(3) The five stages as a pilot (e.g., ab initio, first officer, pilot in command, type rating instructor, and designated pilot examiner) are a general process from zero to professional pilot, in which training is essential to continuously strengthen the core competencies, psychological competencies and conduct competencies required to cope with the risks of "gray rhinoceros" and "black swans". The CBTA has established nine core competencies and behavioral indicators for pilots to identify the basic behavioral characteristics of professionalism. The psychological competencies assessment is an effective tool for incremental control and screening of training reserve, and its primary purpose is to determine that the individual psychological characteristics of pilots meet the requirements of psychological competencies. The conduct competencies impose requirements in terms of personal conduct, individual's guarantee of safety and self-improvement.

(4) In PLM, the three-dimensional competencies all point to job competencies, and evidence-based training lays the foundation for the training methodology.

The pilot's core competencies level is assessed according to training operational data, the pilot's mental health and occupational aptitude capability are obtained from psychological competencies assessment, and the pilot's ideological state is obtained from conduct competencies assessment. Evidence input from the three-dimensional competencies further expands the connotation of E into broad evidence-based training, and finally completes the building of AL+ EBT theories, namely Phase 5 (P5) of the "Sky Eye".

2.8.2 Roles and advantages

(1) Strategy as driving force

- The proposed PLM is a top-level institutional design in the field of flight training to fulfill the requirement of the high-quality development of civil aviation. With the gradual implementation of the system, PLM will play a fundamental and key role in promoting the pilot qualifications governance system and capacity to keep pace with the times and enhance the safety development of the industry, which is showing a milestone significance.
- The quality of pilot training is the cornerstone of flight safety. PLM is a systematic and comprehensive strategic plan of flight training in the history of civil aviation in China. It represents the core objectives in the field of flight training, the inherent requirement for China's civil aviation to enter a high-quality development stage, and the only way to become a strong civil aviation country.
- By creating a unified and scientific flight training system and indicators that cover the pilot professionalism lifecycle and development for the whole civil aviation, PLM strives to tackle the challenges of improving the capability of pilots and solve the problem of unbalanced development of flight training levels among airlines in different regions. Led by the development of training system, the institutional advantages should be given full play to mobilize resources from all parties with coordinate efforts, to point out the direction and provide support for the development of flight training, straighten out relationships and solve problems.

- PLM outlines the full professional lifecycle for pilots for the first time. It is a refined and innovative way of thinking on pilot training and conduct improvement of CAAC in the past, and it straightens out the relationships among three dimensions in pilot training. Based on adopting CBTA and EBT promoted by ICAO, and combined with Chinese pilot management philosophies, it puts forward a pilot professionalism management system with Chinese characteristics.
- During the transition from rough management to refined governance, from reactive response to root-cause regulation, and from regulatory management to systematic management, PLM has been scientifically planned and actively integrated, providing a blueprint and planning for training professional pilots in a new era.

(2) Concept transformation

- "Six transformations" of flight training concept will be achieved. The connotation of "fundamental skills" will be transformed from emphasis of manual maneuvering capability into compatibility with core competencies, ensuring that pilots have the ability to prevent both "gray rhinoceroses" and "black swans"; the practical examination assessment will be transformed from the early "check box" style evaluation based on list of typical aircraft subjects into the evaluation by score range corresponding to core competencies; the recurrent training will be transformed from the subjects based on accumulated typical events in which checks are given the priority into the "tailored" scenarios based on EBT data in which trainings are given priority; the focus will be transformed from the standardization of results into the standardization of processes; the way of learning will be transformed from drawing lessons from typical events into learning the experience of successfully handling "black swan" events; and the governance will be transformed from frequent blitz and campaign style management into development of long-term mechanism.

(3) Scientific "profiling"

- The pilot skills are categorized into different dimensions of competencies. From an ab initio at flight school to the end of the career as a professional pilot, the data of pilot's training, examination and commercial flight qualities at each stage are transformed into quantifiable competency indicators according to a unified scale, so as to realize a long-term, all-round and traceable profiling of pilot's professionalism. A curve of job competencies development will be formed to finally realize an accurate multidimensional dynamic profiling of pilot's competencies, so as to identify obvious competency deficiencies.
- A scientific coordinate system will be provided to take multidimensional capability indicators analysis as the standard to distinguish and manage pilots of different levels and classifications. There will be a transition from "group-based policy" to "individual-based policy".

(4) Leading role in standard setting

- PLM aims to increase China's influence in formulating flight training rules and standards for international civil aviation and promotes China's civil aviation among the world's forefront in terms of the capability in flight training research, implementation, innovation, sustainable development and international influence.
- It provides mature experience that can be used for reference and replicated for the development of training systems for other professionals in the civil aviation system.

2.9 Relationships among CBTA/EBT/CRM/PLM

(1) CBTA is the basic theory and shows the direction for the training objectives. From the strategic level, it stipulates that the training system construction should be based on the internalized competencies of pilots rather than the externalized technical performance.

(2) On the basis of CBTA, EBT represents as a kind of training methodology developed by integrating the concept of evidence-based practice. It stipulates from the tactical level that the formation of a virtuous cycle of training must

be based on "practical data" and establishes the mapping relationship between data and capability to form closed-loop management.

(3) PLM is the further development of CBTA/EBT under the specific practice in China. It describes much more comprehensively the three dimensions of core competencies, psychological competencies and conduct competencies, and it is far more complete in system and methodology, meeting the requirements of three levels of individual's learning and development, namely cognition, practice, and cultural identity. Its main features are as follows:

- Adhering to the basic theory of CBTA and being supported by job competencies.
- Clarifying the overlap of the three dimensions of PLM and developing an indicator system by classification to avoid cross-dimensional attribution of the same observable behavior.
- Enriching the source of evidence and the means of training and taking EBT as a methodology to guide training after expanding its connotation and denotation.
- According to the management practice with Chinese characteristics, the connotation of "attitude" in traditional KSA is expanded, in which self-concept, traits and motivation are introduced to extend to psychological competencies and conduct competencies.

(4) PLM covers the training based on core competencies, and CRM is one of the foundations of the training based on core competencies which thus overlaps many elements of PLM and serves as the strategic point in developing PLM. PLM can be improved based on CRM training, while CRM training can be widely promoted under the guidance of PLM strategy. The promotion of CRM training prepares the necessary conditions for advancing PLM by stages. Some of the core competencies which are categorized as non-technical competencies have been elevated as important as technical competencies. Behavioral indicators of non-technical competencies can be used to evaluate

pilots' CRM competencies and the effectiveness of CRM training.

Chapter 3 Purposes of PLM Implementation Roadmap

ICAO has reached a consensus with the Contracting States and relevant international organizations that CBTA/EBT will serve as the main development direction for global pilot training in the future. The roadmap for PLM implementation including CBTA/EBT has been developed in China by combining the general requirements of ICAO with the specific practices of China's airline pilots training on the basis of mature international experience so as to develop and improve a training system suitable for China's national conditions and the current situation of pilots, to lay the foundation for training development planning and policy formulation for all stakeholders, to meet the new requirements for the transition and advancement into a strong civil aviation country, and to explore the integration and innovation of international training standards.

PLM development is a profound change in the basic development of pilot training. It is a long-term strategy for which the in-depth inheritance and development of all accumulated experiences, the continuous mobilization of all training resources and the full stimulation of the endogenous momentum for all stakeholders to embrace reform are required in China's civil aviation.

3.1 Clarifying decisions and plans

In the Roadmap, the decisions and plans for CAAC PLM implementation are expounded, the overall strategic objectives and time frame are provided, the development phases and refinement requirements for the implementation are specified, a three-dimensional assessment system for pilot professionalization and a full life-cycle time span are proposed, and the CBTA/EBT methodology is regarded applicable to three basic phases of training system in China's civil aviation (i.e., application, integration, and development).

The future flight training system shall be based on evidence (data), guided by principles (programs and subjects), inclusive of training (personnel training) and supported by a system (closed loop capability) to facilitate CAAC oversight and the

development of airlines and training organizations. A management mechanism for core personnel such as pilot instructors/designated pilot examiners with high standard, strict assessment and elimination system will be further established to keep a smooth connection between operations and training in data exchange, scenario matching and management process.

(1) In terms of being based on evidence, data mining and trend predication will be strengthened, a data analysis framework be established, and multidimensional analysis of human, machine and the environment be conducted so as to form a positive input to support training; a reverse feedback on the assessment of training subjects by increasing the application of data will be established to assess the effectiveness of training; and data mining will be conducted, decisions be made upon evidence, and constant improvement be achieved.

(2) In terms of being guided by principles, the scenes will be designed resembling closely to the operation and mapped to relevant competencies to form a standardized training scenario database, and the effect perturbation caused by differences in individual instructor's decision preferences will be mitigated. Instructors can easily select applicable scenes to determine the competency deficiencies of trainees.

(3) In terms of being inclusive of training, the effectiveness of training will be improved, and mechanization, blindness and the campaign-style will be prohibited. The research on training purpose, training content and training means will be strengthened, corresponding guarantee mechanisms be established, and the consistency of the cognition of relevant personnel be improved. Training policies at three levels of core competencies, psychological competencies and conduct competencies will be formulated, combined with job requirements at different levels, in different stages and with different objectives.

(4) In terms of being supported by a system, training managerial personnel will adhere to a systematic professionalism in training management, following the ADDIE instructional development model recommended by ICAO in Doc

9868, *Training*, throughout the whole process of analysis, design, development, implementation, and evaluation.

3.2 Building institutions and systems

A key role of long-term mechanism for reform is depicted in the PLM Implementation Roadmap, ensuring a stable, progressive and consistent development of PLM by implementing '4+N' ('4' refers to the *Guidance*, the Roadmap, the supporting framework of regulatory documents, and the leading group mechanism; 'N' refers to a number of supporting facilities), and achieving "four unifications", which refer to unification of theory (CBTA/EBT basic theory), path (steady progress in phases), system (PLM), and standard (framework of regulatory documents).

The PLM Implementation Roadmap is supportive in making explicit development of pilot training and evaluation and enabling all stakeholders to understand the steps and phases of the tasks including the study of basic theories, development of supporting documents, and investment of human resources; and it also facilitates the communication between China and national and regional organizations around the world.

3.3 Deciding responsibilities and division of labor

The implementation of PLM will bring a significant impact and transformation to pilot training system in China's civil aviation. In the supporting documents of the Roadmap, the responsibilities and requirements of participants in PLM implementation are defined, and the likely training outcomes are described, which are assistive in analyzing and identifying the difficulties and challenges in PLM implementation and thus supportive in important strategic decisions in civil aviation. CAAC will specify specific implementation efforts in the annual PLM work plan.

With the Roadmap, all stakeholders will take their due positions and responsibilities, and all pilot units can understand their key tasks. Thus, the advantage of the system in pooling efforts to accomplish big tasks can be demonstrated and a vibrant ecosystem of PLM can be developed.

In the promotion of the Roadmap, the Administration should be capable of using data and cases to guide the management of airlines and training organizations to

invest resources in implementing flight training reforms on their initiatives, rather than enforce the implementation only by means of administrative orders while ignoring their awareness.

Chapter 4 Implementation

4.1 Overall objectives

The overall objectives are to establish a Transport Airlines Pilot Professionalism Lifecycle Management System (PLM) in an all-around way to improve flight training quality and efficiency, to promote aviation operational safety and to achieve unity with global standards; and to provide new thoughts and methods for international civil aviation in flight training management, to build a flight training system with Chinese characteristics for the new era that is strongly supported, coordinated and efficient, open and innovative, and to modernize the pilot qualification management system and governance capability.

4.2 Key tasks

In order to achieve the above goals, the key tasks include:

- Establishing the working mechanism of leading group for the PLM implementation;
- Developing specifications for the CCAR-121 operator training program;
- Completing the *PLM Data* Analysis *Report*;
- Establishing an all-around computer-based recording system for operators;
- Developing pilot EL EBT guidelines;
- Developing specifications for EL EBT implementation;
- Establishing PLM research bases (laboratories);
- Reconstructing the adaptability of the flight personnel qualification management system in airlines and training organizations;
- Establishing the long term mechanism of training resources guarantee mechanism for PLM development;
- Deploying FSOP supporting system;
- Releasing the specifications for developing the overall training programs for airline transport pilots;
- Reforming the designated pilot examiners management system;
- Revising the type rating instructors standards;

- Developing an indicator system for conduct competencies;
- Developing an indicator system for psychological competencies;
- Developing specifications for ML EBT implementation;
- Developing specifications for AL EBT implementation;
- And releasing the overall indicators of job competencies for airline pilots.

4.3 Implementation timetable

The PLM will be implemented in five phases: Phase 1 (2020-2022), Phase 2 (2023), Phase 3 (2024), Phase 4 (2025-2026) and Phase 5 (2027-2030). See the attachment for the specific timetable.

4.3.1 Phase 1 (2020-2022)

- Establishing the working mechanism of leading group for the PLM development

The leading group is set up in the Flight Standard Department of CAAC and carries out basic work such as development and study of policies and theories, development and revision of technical specifications, development of systematic support, training and publicity, and international cooperation through the established secretariat, working group and expert groups under the working group.

- Developing specifications for the CCAR-121 operator training program

Through the promotion of the ADDIE model, (i.e., analysis - design - production - implementation - evaluation), the development of training program curriculum in airlines and training organizations can be standardized, including regular training program (initial/transition/upgrade/recurrent training, etc.), CRM training program, and instructor/designated pilot examiner training program. Some indicators for core competencies will be introduced to improve the application of ADDIE methodology by airlines and training organizations, which can lay a foundation for the subsequent gradual introduction of CBTA.

- Carrying out Elementary Level EBT Pilot program

The guidelines for EL EBT pilot program will be developed to provide guidance for the pilot airlines and CAAC units, and realize two steps of transformation, “check-training” arrangement and “check-training-evaluation”

(introduction of the concept of core competencies and the evaluation - comment - specific training based on core competencies performance).

✓ Guideline for LOSA Implementation

LOSA, a tool to obtain the actual performance of the operation, has the advantage of on-the-spot observation and in-depth front-line investigation, and is also an important source of evidence in EBT. Through the implementation of the guideline, airlines are guided to expand data collection channels and open up pre-security management channels.

✓ 'Green' QAR

As a data source of EBT, QAR needs to be analyzed more systematically and objectively. In order to enhance the effectiveness of its output, the 'green' QAR specification is adopted to determine the usage specification of QAR and the competencies requirements of relevant managerial personnel, so as to realize the smooth transformation from QAR analysis to training requirements.

- Developing specifications for EL EBT implementation

The specifications for EL EBT implementation will be issued after the pilot projects are completed and the experience is summarized to specifically guide airlines to establish an elementary-level EBT training system.

- Establishing PLM research bases (laboratories)
- Revising the Advisory Circular "Professional Conduct in Flight Operations"
- Compiling *PLM Data Analysis Report*

According to the principle of "progressive and step-by-step development", the compilation of *PLM Data Analysis Report*, an on-going task through phases 1 to 3, will be initiated. In the Report, besides the traditional EBT data report, reliable data will be provided to support the two theoretical innovation parts of PLM, namely "psychological competencies" and "conduct competencies".

- Developing an indicator system for conduct competencies (basic KPI)

Some sections of the basic indicator system will be completed based on the preliminary research on the theories of conduct competencies, which is characterized

as scientific and quantifiable, and premised on appropriate input of administrative resources.

4.3.2 Phase 2 (2023)

- Establishing an all-round computer-based recording system for operators
- Implementing the EL EBT in an all-around way

The reform of the management system for proficiency pilot examiners and the revision of the standards for instructor rating will be completed.

- Carrying out pilot ML EBT
- Developing an indicator system for conduct competencies (expanded KPI)

A relatively complete indicator system will be formed based on the in-depth study of the theories of conduct competencies based on basic KPI, which is characterized as easy in collection, systematic, scientific and quantifiable.

- Developing an indicator system for psychological competencies (basic KPI)

A preliminary indicator system for psychological competencies will be developed by profiling the required match between the pilot psychological health and occupational aptitude based on the occupational characteristics of pilots.

- Developing the specifications for ML EBT implementation

The specifications for ML EBT implementation will be issued after the pilot projects are completed and the experience is summarized to specifically guide airlines to establish a ML EBT training system.

- Developing the specifications for PLM validation data collection (V1.0) to realize basic skill profiling (based on recurrent training)

The granularity and interface standards for exchange between FSOP and airlines/training organizations of data concerning core competencies, conduct competencies and psychological competencies will be standardized.

- Deploying the supporting FSOP subsystems

The supporting functions of cloud licenses, cloud desktops, designated representative and designated pilot examiners system and Lifecycle Management System for PLM will be deployed.

- Releasing the specifications for implementing the overall curricula in training

program for airline transport pilots

All training organizations, especially flight colleges and universities, should complete transform their current overall curricula in training program for airline transport pilots based on CBTA and establish a one-stop and integrated CBTA training system that meets the operational requirements of airlines.

4.3.3 Phase 3 (2024)

- Implementing the ML EBT in an all-around way

The reform of the management system for designated representatives will be completed, and the formal review will be replaced by substantive review.

- Carrying out pilot AL EBT
- CCAR-121/142 CBTA integration (initial + upgrade)

The initial/upgrade training courses will be developed and implemented based on CBTA theories and the corresponding practice examination standards and worksheets will be revised.

- Releasing the specifications for AL EBT implementation

The specifications for the AL EBT implementation will be issued after the pilot projects are completed and the experience is summarized to specifically guide airlines to establish an AL EBT training system.

- Optimizing the supporting FSOP subsystems (for diversified evidence-based practice)
- Completing the reform of the management system for airline transport instructors
- Completing the *PLM Data Analysis Report*
- Developing the specification for PLM validation data collection (V2.0), and optimizing the skill profiling (based on practice examination standards)

4.3.4 Phase 4 (2025-2026)

- Implementing the AL EBT in an all-around way
- CBTA Integration
  - ✓ CCAR-121/142 (full coverage)

- ✓ CCAR-141 Overall courses (full coverage)
- ✓ CCAR-141 High Performance Courses
- ✓ ACPC
- ✓ Record and track the whole process of job competencies defect

- Developing an indicator system for the psychological competencies (expanded KPI)
- Developing the specifications for PLM validation data collection (V3.0), and optimizing skill profiling (based on multiple data source including airline/training organizations internal training and inspection)

4.3.5 Phase 5 (2027-2030)

- Promoting AL+ EBT continuous evolution
- Releasing the overall indicators of job competencies for airline pilots

Based on the full AL EBT implementation, PLM concept is widely understood by the airline management and pilots. In the light of the characteristics of the personnel composition, fleet composition and operation qualification, the airlines output the integral job competencies composite indicators of airline pilots. The indicators are dynamic, which can be adjusted according to the variation of associated elements.

- Initially establishing the training theory/system with Chinese characteristics
  - ✓ Theoretical innovation and transcendence
  - ✓ The output of system standards
  - ✓ The output of commercialization of training services
  - ✓ OEM course development

Chapter 5 Integration with Conduct Improvement

5.1 Positioning of conduct competencies

Conduct refers to the stable attitude and behavior people demonstrate in work, study and life, including way of thinking, working style, life style. The conduct mentioned in this Roadmap mainly refers to the working style (i.e., the improvement of professional conduct).

Professional conduct is the attitude, action and working method as well as the behavior style and working pattern shown by pilots in performing their job duties, which is the concrete embodiment of pilots' worldview and professionalism in their working behavior and practical actions and the consistent style throughout the working process. Good professional conduct is the fundamental guarantee of flight safety under the management system of CAAC, and an important guarantee for achieving high-quality development of civil aviation.

Professional conduct is closely related to a pilot's state of mind which includes elements that are more difficult to measure quantitatively at the level of worldview, values and outlook on life, as well as at the measurable level of conduct competencies.

The key to the improvement of conduct competencies lies in building a scientific and quantifiable management indicator system, ensuring that it can be defined, screened, observed, trained, and educated, and continuously providing core data for evidence-based training, to realize that the three endpoints of the PLM triangle are able to support each other and be integrated as one.

5.2 The connotation of conduct improvement

Airlines and training organizations should establish assessment mechanism for conduct improvement and integrate the assessment mechanism with PLM development. The data can be extracted, and the indicators can be improved in the assessment, and the key channels that link the assessment and evaluation, defects transformation, and targeted training should be established. Strict regulation and generous support should be equally emphasized, and the practices of regulation

merely by means of punishment should be avoided. The enthusiasm shared by most pilots for conduct improvement should be treasured and encouraged, while the individuals who play a negative role should be seriously punished. Airlines and training organizations are encouraged to appropriately raise the requirements for the theoretical development of pilots at specific technical levels.

Airlines and training organizations should improve the guarantee system for conduct improvement. Institutional measures should be introduced to take the investment in conduct improvement as an integral part of safety investment, to ensure that the conduct improvement from the aspects of human, financial and material are strongly guaranteed, to stimulate pilots' enthusiasm for work, to encourage them to innovate, to promote the management of conduct improvement to continuously go deep, so as to form a mutually reinforcing pattern with core competencies and psychological competencies enhancing each other.

CCAR Part 141 training organizations that implement the overall course training for airline transport pilots should play their key role in the initial formation stage of pilots by combining conduct education, academic education, and license training to build a firm foundation for pilot conduct competencies.

Chapter 6 Integration with Pilot Psychological Assessment

Based upon the indicator system for psychological competencies, psychological assessment includes basic cognitive ability, psychomotor ability, personality (mental health) and occupational aptitude psychology. Occupational aptitude testing refers to the employment of a series of scientific measuring tools to assess the physical and psychological qualities of an individual to match people to occupations in a more scientific way, reduce accidents and improve work efficiency.

The risk of certain inherent occupational aptitude mental defects cannot be controlled or mitigated through flight training, or the cost of training is unacceptable. The ability to deal with “black swans” is closely related to both the inborn occupational aptitude mental defects and training. Pilot psychological assessment is not only the first line of defense for the professional pilots, but also the tool in the selection of potential pilots. The scientific pilot psychological assessment tools can play the role of incremental control and screening control at critical points such as the recruitment of student pilots by the transport airlines and the promotion regarding key technical levels. They can also identify occupational aptitude mental defects of the airline transport reserve pilots.

The pilot psychological competencies indicator system shall be developed along with the core competencies and conduct competencies. To continuously improve the assessment model, long term follow-up studies shall be conducted by relying on operations data. Meanwhile, the psychological competencies indicator system shall not be used indiscriminately.

Chapter 7 Principles of Safe Transition

It is a transformation of pilot qualification management to develop a PLM with the integration of core competencies, conduct competencies and psychological competencies by the gradual transition from traditional model to EBT model, the gradual incorporation of CBTA into the licensing/rating training and examination and the integration of the quantitative management of both the psychological competencies and conduct competencies. Due to the adequate consideration of the influence of flight training reform on operations, the following principles of smooth transition shall be observed:

- Some pilot projects and different batches, specific implementation approaches, and approved restrictive measures shall be determined based upon the comprehensive study of the safety levels and management capabilities of airlines and training organizations.
- Each key phase shall advance gradually in due order, from pilot projects to assessment and finally to the full-scale application, and the minimum time required for implementation during each phase shall be specified.
- Pilot projects shall be launched according to the airlines' training system foundation and safety levels and the following sequential order shall be observed: single fleet, mixed fleet, single subsidiary (base), and then the whole company.
- The whole process of the system transition shall be monitored. The variation trend of important safety indicators during different phases shall be closely followed up by comparing the FSOP and airlines/training organizations' SMS data sources and corrective measures against significant deviations shall be formulated.
- The training system of the pilot units and develop contingency plans shall be checked on a regular basis so as to ensure the smooth transition of the system.
- Hierarchical training programs for inspectors, instructors and examiners shall

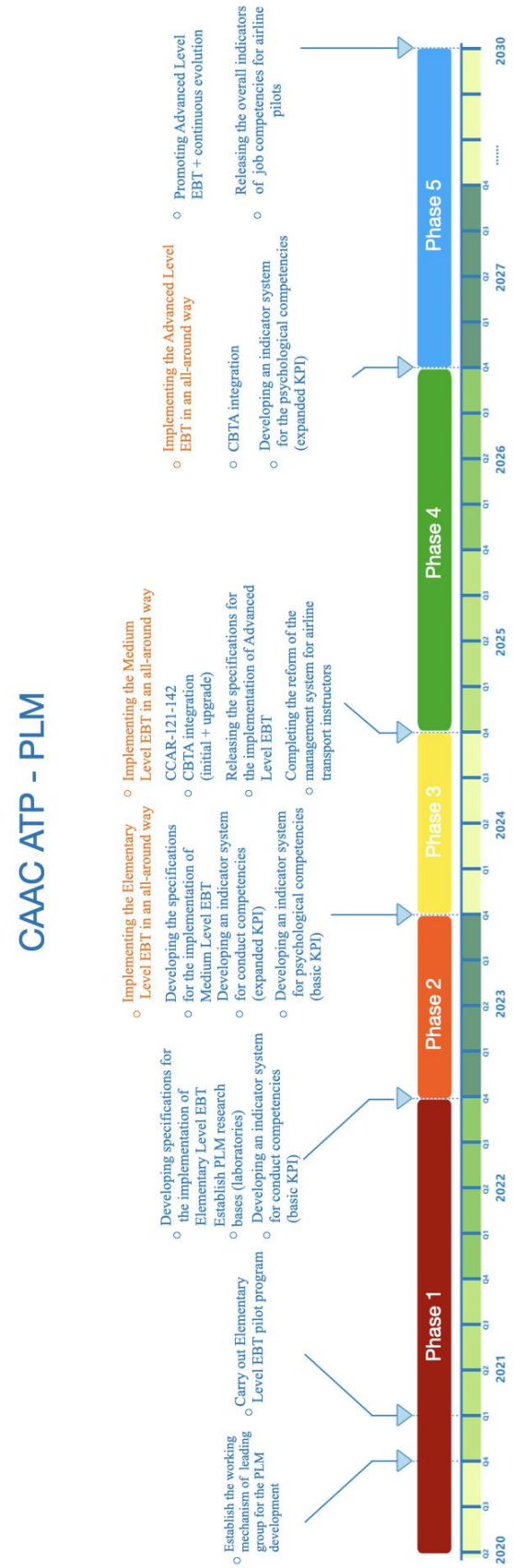
be developed and the mechanism of employment and dismissal for instructors and designated pilot examiners shall be improved.

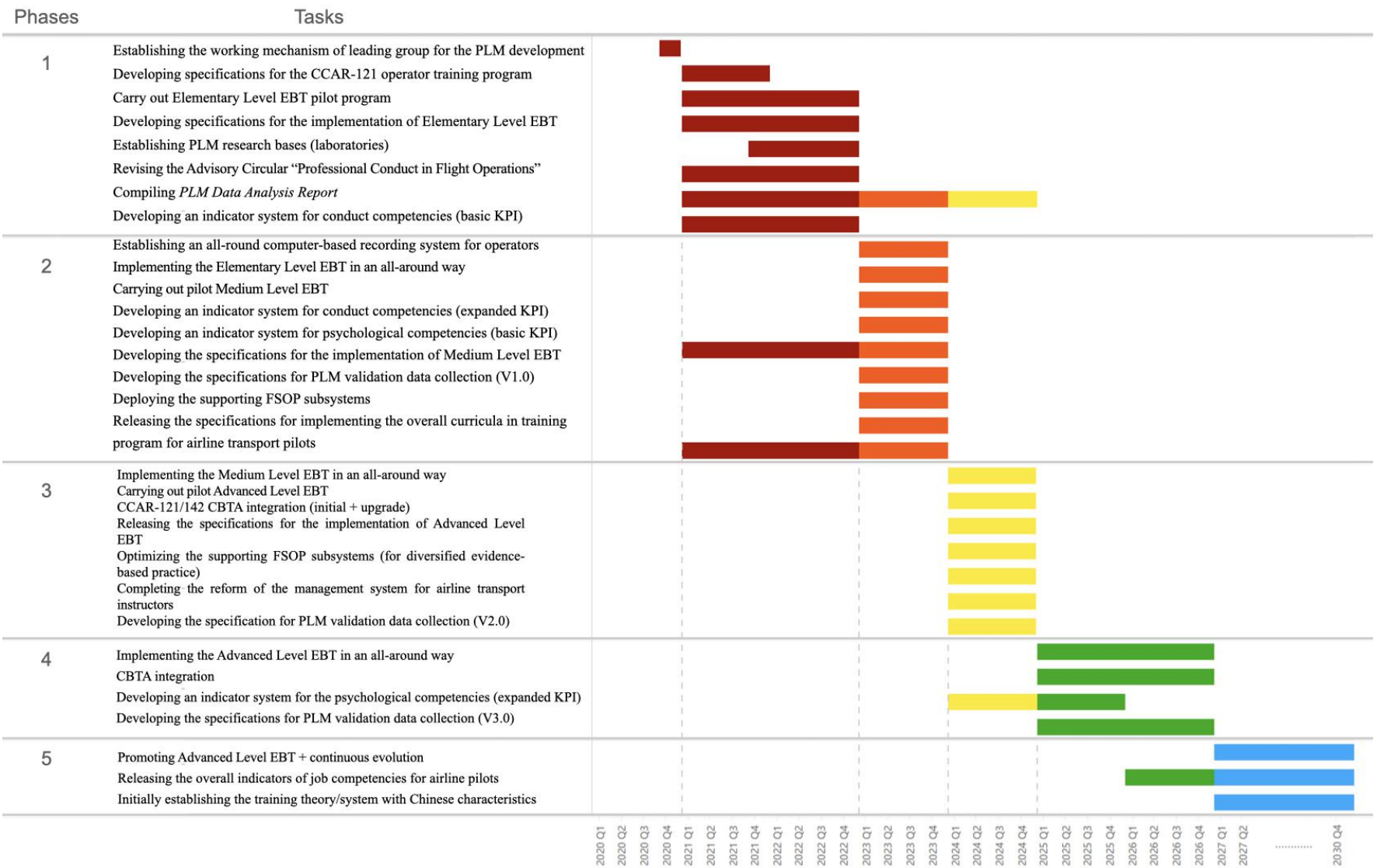
- Airlines and training organizations shall communicate with the CAAC in advance regarding the implementation of the reform of training system to set aside enough time for approval.
- It is important to actively communicate and coordinate with ICAO and other civil aviation authorities to obtain support and ensure the validity of licenses and ratings.
- It is important to establish long term mechanism for the exchange of training experiences with the regional representative offices of ICAO, IATA and other international agencies.

Chapter 8 Revision of the Roadmap

This is the first edition of CAAC PLM Implementation Roadmap. CAAC will continuously update and issue new editions as needed, and any suggestions and comments regarding this Roadmap will be greatly appreciated.

Annex: PLM implementation timetable for specific tasks




Phases
Tasks
1
Establishing the working mechanism of leading group for the PLM development
Developing specifications for the CCAR-121 operator training program
Carry out Elementary Level EBT pilot program
Developing specifications for the implementation of Elementary Level EBT
Establishing PLM research bases (laboratories)
Revising the Advisory Circular "Professional Conduct in Flight Operations"
Compiling PLM Data Analysis Report
Developing an indicator system for conduct competencies (basic KPI)
2
Establishing an all-round computer-based recording system for operators
Implementing the Elementary Level EBT in an all-around way
Carrying out pilot Medium Level EBT
Developing an indicator system for conduct competencies (expanded KPI)
Developing an indicator system for psychological competencies (basic KPI)
Developing the specifications for the implementation of Medium Level EBT
Developing the specifications for PLM validation data collection (V1.0)
Deploying the supporting FSOP subsystems
Releasing the specifications for implementing the overall curricula in training program for airline transport pilots
3
Implementing the Medium Level EBT in an all-around way
Carrying out pilot Advanced Level EBT
CCAR-121/142 CBTA integration (initial + upgrade)
Releasing the specifications for the implementation of Advanced Level EBT
Optimizing the supporting FSOP subsystems (for diversified evidence-based practice)
Completing the reform of the management system for airline transport instructors
Developing the specification for PLM validation data collection (V2.0)
4
Implementing the Advanced Level EBT in an all-around way
CBTA integration
Developing an indicator system for the psychological competencies (expanded KPI)
Developing the specifications for PLM validation data collection (V3.0)
5
Promoting Advanced Level EBT + continuous evolution
Releasing the overall indicators of job competencies for airline pilots
Initially establishing the training theory/system with Chinese characteristics
2020 Q1
2020 Q2
2020 Q3
2020 Q4
2021 Q1
2021 Q2
2021 Q3
2021 Q4
2022 Q1
2022 Q2
2022 Q3
2022 Q4
2023 Q1
2023 Q2
2023 Q3
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2024 Q1
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2024 Q4
2025 Q1
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2026 Q1
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2026 Q3
2026 Q4
2027 Q1
2027 Q2
2030 Q4