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AN/472

Quality Assurance Manual for Flight Procedure Design

Volume 2
Flight Procedure Designer Training
(Development of a Flight Procedure Designer Training Programme)

Approved by the Secretary General
and published under his authority

First Edition — 2009

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AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
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PREFACE

The *Quality Assurance Manual for Flight Procedure Design* (Doc 9906) consists of four volumes:

Volume 1 — *Flight Procedure Design Quality Assurance System*;

Volume 2 — *Flight Procedure Designer Training*;

Volume 3 — *Flight Procedure Design Software Validation*; and

Volume 4 — *Flight Procedures Design Construction.*

Instrument flight procedures based on conventional ground-based navigational aids have always demanded a high level of quality control. The implementation of area navigation and associated airborne database navigation systems, however, means that even small errors in data can lead to catastrophic results. This significant change in data quality requirements (accuracy, resolution and integrity) has led to the need for a systemic quality assurance process (often part of a State Safety Management System). The *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168) Volume II, Part I, Section 2, Chapter 4, *Quality Assurance,* refers to this manual and requires that a State take measures to "control" the quality of the processes associated with the construction of instrument flight procedures. To this end, this manual has been assembled to provide guidance in attaining these stringent requirements for quality assurance in the procedure design process. All four volumes address crucial areas related to the attainment, maintenance and continual improvement of procedure design quality. Data quality management, procedure designer training, and validation of software are all integral elements of a quality assurance programme.

Volume 1 — *Flight Procedure Design Quality Assurance System* provides guidance for quality assurance in the elements of procedure design, such as procedure design documentation, verification and validation methods, and guidelines about the acquisition/processing of source information/data. It also provides a generic process flow diagram for the design and implementation of flight procedures.

Volume 2 — *Flight Procedure Designer Training* provides guidance for the establishment of flight procedure designer training. Training is the starting point for any quality assurance programme. This volume provides guidance for the establishment of a training programme.

Volume 3 — *Flight Procedure Design Software Validation* provides guidance for the validation (not certification) of procedure design tools, notably with regard to criteria.

Volume 4 — *Flight Procedures Design Construction* (to be incorporated later).

Note.— In the independent volumes, when a reference is made to the term "manual" in the context of this document, without any further specification, it is presumed to refer to this volume of the Quality Assurance Manual for Flight Procedure Design*.*

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ABBREVIATIONS

ABAS	Aircraft-based augmentation system
AIP	Aeronautical Information Publication
AIRAC	Aeronautical information regulation and control
AIS	Aeronautical Information Service
ANSP	Air Navigation Service Provider
APV	Approach procedure with vertical guidance
ARP	Aerodrome reference point
ATC	Air traffic control
ATM	Air traffic management
ATS	Air traffic services
Baro-VNAV	Barometric vertical navigation
CAA	Civil Aviation Authority
CAT I/II/III	Category of approach
CDA	Continuous descent approach
CRM	Collision risk model
DEM	Digital elevation model
DF	Direction finding
DME	Distance measuring equipment
DTM	Digital terrain model
EUROCAE	European Organization for Civil Aviation Equipment
FAF	Final approach fix
FAS	Final approach segment
FMS	Flight management system
FPD	Flight procedure design
GBAS	Ground-based augmentation system
GNSS	Global navigation satellite system
GP	Glide path
HRP	Heliport reference point
IAC	Instrument approach chart
ICAO	International Civil Aviation Organization
IELTS	International English language testing system
IF	Intermediate fix
IFR	Instrument flight rules
ILS	Instrument landing system
IR	Instrument rating
ISD	Instructional system design
LOC	Localizer
MLS	Microwave landing system
MOC	Minimum obstacle clearance
MSA	Minimum sector altitude
NDB	Non-directional radio beacon
NM	Nautical mile
NOTAM	Notice to airmen

NPA	Non-precision approach
OAS	Obstacle assessment surface
OCA(H)	Obstacle clearance altitude/height
OJT	On-the-job training
PA	Precision approach
PAR	Precision approach radar
PDSP	Procedure design service provider
RASS	Remote altimeter setting source
RNAV	Area navigation (also, random area navigation)
RNP	Required navigation performance
RNP AR	Required navigation performance authorization required
RTCA	RTCA (formerly Radio Technical Commission for Aeronautics)
SBAS	Satellite-based augmentation system
SID	Standard instrument departure
SKA	Skills, knowledge, attitudes
SMS	Safety management system
SRE	Surveillance radar equipment
STAR	Standard terminal arrival
TAA	Terminal arrival altitude
TOEFL	Test of English as a foreign language
VNAV	Vertical navigation
VOR	Very high frequency omnidirectional radio range
VORTAC	Combination VOR and TACAN
VSS	Visual segment surface
WGS-84	World Geodetic System 1984

DEFINITIONS

When the following terms are used in this document, they have the following meanings.

***Accuracy*.** The degree of conformance between the estimated or measured value and its true value.

Aerodrome. A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Aerodrome data. Data relating to an aerodrome including the dimensions, co-ordinates, elevations and other pertinent details of runways, taxiways, buildings, installations, equipment, facilities and local procedures.

Aeronautical data. Data relating to aeronautical facts, such as, *inter alia*, airspace structure, airspace classifications (controlled, uncontrolled, Class A, B, C... F, G), name of controlling agency, communication frequencies, airways/air routes, altimeter transition altitudes/flight levels, colocated instrument procedure (and its airspace as assessed by design criteria), area of magnetic unreliability, magnetic variation.

***AIRAC*.** An acronym for aeronautical information regulation and control, signifying a system aimed at advance notification based on common effective dates of circumstances that necessitate significant changes in operating practices.

Air traffic management (ATM). A generic term relating to the management of air traffic services (ATS).

Air traffic services (ATS). A generic term meaning, variously, flight information service, alerting service, air traffic advisory service and air traffic control service (area control service, approach control service or aerodrome control service).

***Cartographic map*.** A representation of a portion of the Earth, its culture and relief, with properly referenced terrain, hydrographic, hypsometric and cultural data depicted on a sheet of paper.

Civil Aviation Authority (CAA). The relevant aviation authority designated by the State responsible for providing air traffic services in the airspace concerned; sometimes referred to as the “State Authority”.

Competency. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

***Competency-based training and assessment*.** Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards.

Competency element. An action that constitutes a task that has a triggering event and a terminating event that clearly defines its limits, and has an observable outcome.

Competency framework. A competency framework consists of *competency units*, *competency elements*, *performance criteria*, *evidence and assessment guide* and *range of variables.* Competency units, competency elements and performance criteria are derived from job and tasks analyses of procedure designers and describe observable outcomes.

Competency unit. A discrete function consisting of a number of competency elements.

***Datum*.** Any quantity or set of quantities that may serve as a reference or basis for the calculation of other quantities (ISO 19104).

Digital elevation model (DEM). The representation of a portion of the Earth's surface by continuous elevation values at all intersections of a defined grid, referenced to common datum.

Note.— Digital terrain model (DTM) is sometimes referred to as DEM.

Enabling objective. A training objective derived from performance criteria in the competency framework. In order to achieve enabling objectives, a trainee requires skills, knowledge and attitudes.

Error. An action or inaction by the designer that leads to deviations from criteria.

Error management. The process of detecting and responding to errors with countermeasures that reduce or eliminate the errors or the consequence of errors.

Evidence and assessment guide. A guide that provides detailed information (e.g. tolerances) in the form of evidence that an instructor or an evaluator can use to determine if a candidate meets the requirements of the competency standard.

***Integrity*.** A degree of assurance that an aeronautical data and its value has not been lost or altered since the data origination or authorized amendment.

Maintenance (continuous). The continuous maintenance of an instrument procedure is an ongoing process triggered by the State aeronautical information services (AIS) through notification of any critical changes to the instrument procedure environment that would necessitate timely revision of the instrument procedure design. Examples of critical changes would be the erection of an obstacle within a determined radius of an Aerodrome Reference Point (ARP); the planned decommissioning of an associated secondary navigation aid; or the planned extension/ reduction of a runway. It is assumed that the State AIS would respond by NOTAM to any unplanned critical change to the instrument procedure environment. The State AIS would notify the procedure designer of the NOTAM action and would then expect the procedure designer to take maintenance/corrective action as required.

Maintenance (cyclical). The cyclical maintenance of an instrument procedure is a planned systemic review at a predetermined interval of the procedure design.

Mastery test. A test that evaluates a trainee's ability to perform a terminal objective. A mastery test should match as closely as possible the conditions, behaviours and standards of terminal objectives.

Material-dependent training. A well-documented and repeatable training package that has been tested and proven to be effective.

Navaid data. Data relating to both ground-based and space-based navigational aids including service volume, frequency, identification, transmission power and limitations of operation.

Obstacle data. Any man-made fixed or temporary object which has vertical significance in relation to adjacent and surrounding features and which is considered as a potential hazard to the safe passage of aircraft, or man-made fixed or temporary objects that extend above a defined surface intended to protect aircraft in flight.

Obstacle/terrain data collection surface. A defined surface intended for the purpose of collecting obstacle/terrain data.

Performance criteria. A simple, evaluative statement on a required outcome of the competency element and a description of the criteria used to judge if the required level of performance has been achieved. Several performance criteria can be associated to a competency element.

Procedure design service provider (PDSP). A body that provides procedure design services. It may also be a training provider providing procedure designer training.

Progress test. A test that measures a trainee's ability to meet key enabling objectives.

Range of variables (conditions). The conditions under which the competency units must be performed.

***Raster map*.** An electronic representation of a cartographic map with properly referenced terrain, hydrographic, hypsometric and cultural data.

Recognized source. A source of data that is either recognized by the State or a source that has professional credentials to provide a specific type of data.

***Reference geodetic datum*.** The numerical or geometrical quantity or set of such quantities (mathematical model) which serves as a reference for computing other quantities in a specific geographic region such as the latitude and longitude of a point. A minimum set of parameters required to define location and orientation of the local reference system with respect to the global reference system/frame.

***Resolution*.** The number of units or digits to which a measured or calculated value is expressed and used. The smallest difference between two adjacent values that can be represented in a data storage, display or transfer system.

Skills, knowledge, attitudes (SKA). The skills/knowledge/attitudes are what an individual requires to perform an enabling objective derived from performance criteria. A skill is the ability to perform an activity that contributes to the effective completion of a task. Knowledge is specific information required for the trainee to develop the skills and attitudes for the effective accomplishment of tasks. Attitude is the mental state of a person that influences behaviour, choices and expressed opinions.

Stakeholder. An individual or party with vested interests in an instrument procedure design.

Standard instrument departure (SID). A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of flight can be commenced.

Standard terminal arrival (STAR). A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

Terminal arrival altitude (TAA). The lowest altitude that will provide a minimum clearance of 300 m (1 000 ft) above all objects located in an arc of a circle defined by a 46 km (25 NM) radius centred on the initial approach fix (IAF), or where there is no IAF on the intermediate approach fix (IF), delimited by straight lines joining the extremity of the arc to the IF. The combined TAAs associated with an approach procedure shall account for an area of 360 degrees around the IF.

Terminal objective. A training objective derived from a competency element in the competency framework which a trainee will achieve when successfully completing instruction.

***Terminating event*.** A cue or indicator that a task has been completed.

***Terrain data*.** Data pertaining to the natural surface of the Earth excluding man-made obstacles, and can be represented as a cartographic map, an electronic raster map, an electronic vector data map or an electronic Digital Elevation Model (DEM).

***Traceability*.** The degree that a system or a data product can provide a record of the changes made to that product and thereby enable an audit trail to be followed from the end-user to the data originator.

***Training objective*.** A clear statement that is comprised of three parts, i.e. the *desired performance* or what the trainee is expected to be able to do at the end of particular stages of training, the *performance standard* that must be attained to confirm the trainee's level of competence and the *conditions* under which the trainee will demonstrate competence.

***Training provider*.** In the context of this manual, a body that provides procedure designer training.

***Triggering event*.** A cue or indicator that a task should be initiated.

***Validation*.** Confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled (see Annex 15 — *Aeronautical Information Services*).The activity whereby a data element is checked as having a value that is fully applicable to the identity given to the data element, or a set of data elements that is checked as being acceptable for their purpose.

***Vector data*.** The digitized version of graphic or rasterized data, usually having three-dimensional attributes.

***Verification*.** Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (see Annex 15).The activity whereby the current value of a data element is checked against the value originally supplied.

FOREWORD

1. OVERVIEW

The flight procedure development process involves input from a variety of personnel. Surveyors, AIS personnel, ground validation personnel, flight validation pilots and designers all play a key role in the development of a quality flight procedure. To ensure quality it is essential to provide competency-based training and assessment to all contributors to the flight procedure development process, as indicated in the *Procedures for Air Navigation Services* (PANS-OPS, Doc 8168), Volume II, Part I, Section 2, Chapter 4, 4.7, *Procedure designer qualifications and training*. While this training manual focuses on the competency requirements that a flight procedure designer should achieve, it should be understood that the designer's work depends on other personnel also meeting competency standards.

The activities of flight procedure designers are considered critical to the safety of aviation. The provision of erroneous, incomplete or badly designed flight procedures and associated minima has direct consequences for the users.

Recently, procedure design work has become more critical due to:

– increasing complexity;

– increased importance of data integrity, especially for modern area navigation (RNAV) and satellite-based navigation; and

– introduction of new avionics.

2. COMPETENCY-BASED APPROACH TO PROCEDURE DESIGNER TRAINING

It was decided to adopt a "competency-based approach" for training and assessment. The development of competency-based training and assessment is based on a systematic approach whereby competencies and their standards are defined; training is based on the competencies identified; and assessment tools for these competencies are developed to determine whether these competencies have been achieved. This method had already been introduced in other fields of aviation activities such as flight crew training and licensing.

A "job and task analysis" for flight procedure designers was conducted. The outcome of this analysis was a "competency framework" for flight procedure designers, on which this manual is based.

While this manual provides guidance on how to develop a competency-based training curriculum specifically for flight procedure designers, it should not be used or considered as a textbook on course development. It is assumed that experienced and qualified course developers will participate in the development of flight procedure designer training.

3. FEEDBACK

Comments on this manual, particularly with respect to its application, usefulness and scope of coverage, would be appreciated from States and ICAO Technical Cooperation field missions. These will be taken into consideration in the preparation of subsequent editions. Comments concerning this manual should be addressed to:

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Montréal, Quebec, Canada
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Chapter 1

INTRODUCTION

1.1 GENERAL

1.1.1 The State is responsible for the safety of all instrument flight procedures in its airspace. Safety is accomplished by application of the technical criteria in PANS-OPS and associated ICAO provisions and requires measures that control the quality of the process used to apply the criteria, which may include regulation, air traffic monitoring, ground validation and flight validation.

1.1.2 PANS-OPS, Volume II, Part I, Section 2, Chapter 4, *Quality Assurance*, provides procedures which each State must comply with for quality assurance in flight procedure design. Guidance material for quality assurance supplementing provisions in PANS-OPS is provided in each volume of the *Quality Assurance Manual for Flight Procedure Design* (Doc 9906).

1.1.3 Training is one of the most important elements of quality assurance. Each State must establish standards for the required competency level for flight procedure design. Each State must ensure that flight procedure designers have acquired and maintain this competency level through training, supervised on-the-job training (OJT), recurrent and refresher training.

1.1.4 This manual is a guideline for States and other stakeholders who are to meet these requirements.

1.2 TARGET AUDIENCE OF THE MANUAL

1.2.1 This manual will be useful to:

– State authorities that approve training courses/programmes conducted by procedure design service providers (PDSP), training providers, etc., where applicable (see *Note 1*);

– PDSPs that design flight procedures and/or promulgate them as appropriate (see *Note 2*); and

– organizations/institutes that provide a training course/programme for flight procedure design (training providers).

Note 1.— This statement in the manual does not imply that the State authority must approve/certify the training course/programme.

Note 2.— A PDSP may be a State authority, an air navigation service provider (ANSP) or an independent third party.

Figure 1-1 indicates the relationship among these parties.

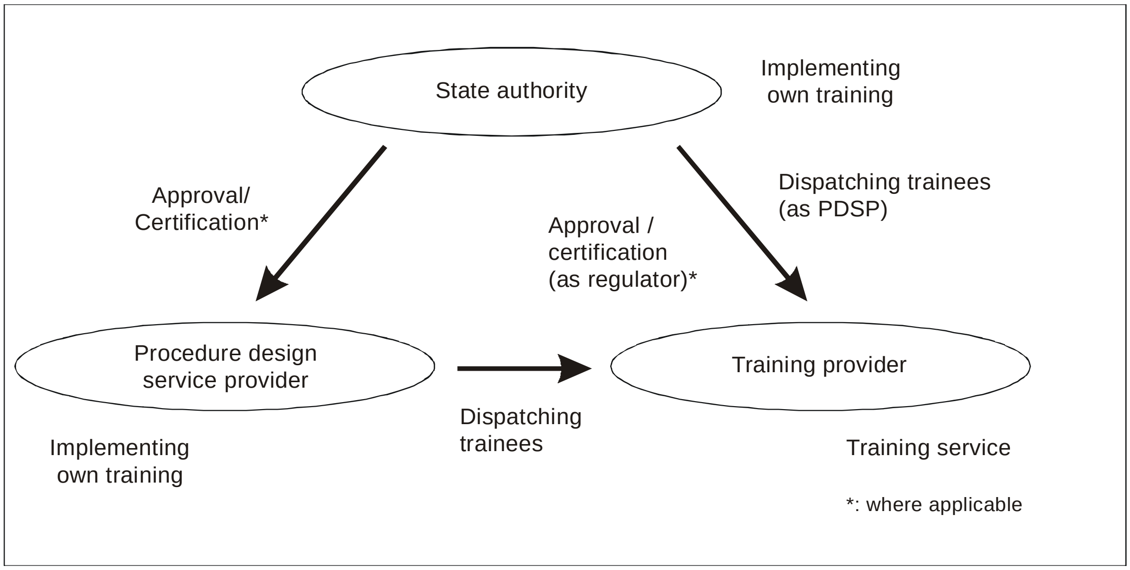

Figure 1-1. Relationships among State authority, procedure design service provider (PDSP) and training provider

1.2.2 State authority

1.2.2.1 As a regulator, a State authority can utilize the manual as a guideline to establish approval/certification criteria of a training course/programme conducted by PDSPs and training providers, where such systems are implemented.

1.2.2.2 The authority, if it designs procedures by itself, can use this manual as a guideline to establish its own training course/programme. Furthermore, if it dispatches its flight procedure designers to a training provider, it can use the manual as a guideline to evaluate potential courses. Refer to 1.3.2 and/or 1.3.3, as appropriate.

1.2.2.3 The authority can use the manual as a guideline to develop its own training course/programme if it provides training by itself. Refer to 1.5.

1.2.2.4 The manual can provide useful information for approval/certification/licensing criteria of flight procedure designers where such systems are implemented. However, ICAO regulations do not include provisions for such systems at present. Therefore it is beyond the scope of this manual to provide guidance for these systems.

1.2.3 Procedure Design Service Providers (PDSPs)

1.2.3.1 PDSPs who dispatch personnel to a training provider can utilize the manual as a guideline to evaluate potential courses.

1.2.3.2 PDSPs can also use the manual as a guideline to develop their own training courses/programmes. Refer to 1.5.

1.2.3.3 Note that any organization that designs flight procedures is considered a PDSP. For example, an airport operator that designs flight procedures for its own airport is a PDSP.

1.2.4 Training providers

Flight procedure design training providers can use the manual as a guideline to develop their training courses and programmes.

1.3 GOALS OF THE MANUAL

1.3.1 The primary and main goal of the manual is to provide guidance to organizations that are providing flight procedure designers training, particularly on developing, implementing and validating training.

1.3.2 A secondary goal of the manual is to provide guidance to regulators who certify and/or approve training courses and programmes, as well as organizations that dispatch trainees to training providers and who have to evaluate training courses and programmes.

1.3.3 Section 1.5 describes how to use the manual based on the goals described above.

1.4 STRUCTURE OF THE MANUAL

1.4.1 The manual consists of five chapters as described below:

1.4.1.1 Chapter 1, *Introduction,* provides introductory information on the manual: target audiences, goals, structure, and how to use the manual. It also includes a note on the use of automated tools in flight procedure design and its relation to training.

1.4.1.2 Chapter 2*, General Provisions for Competency-based Training and Assessment,* describes general concepts of a competency-based approach including how to conduct a job and task analysis so as to derive a competency framework, which is used as a basis to design a curriculum as described in Chapter 3. Chapter 2 also includes the competency framework for flight procedure designers. Also included is a sample evidence and assessment guide for one selected competency element.

1.4.1.3 Chapter 3*, Designing Curriculum*, describes how to derive a curriculum from the competency framework. It should be noted that this method is applicable to all phases of training: ab initio training, initial training, recurrent training, refresher training, OJT advanced training, etc. This chapter also includes information on:

– how to determine prerequisites;

– how to develop tests applicable to the interim and/or final stage of training; and

– other considerations in designing modules and course materials.

1.4.1.4 Chapter 4*, Instructor Competencies,* describes competencies required for instructors of flight procedure designer training.

1.4.1.5 Chapter 5, *Validating and Post-Training Evaluation of Flight Procedure Designer Training,* describes how to implement training and how to evaluate training at the following levels:

– Level 1: evaluation of trainee reaction

– Level 2: evaluation of trainee mastery learning

– Level 3: evaluation of on-the-job performance

– Level 4: evaluation of results/impact on the organization.

1.4.2 Throughout the manual, examples are provided based on the VOR/NDB with a final approach fix (FAF) procedure. This particular procedure was selected as an example because it is commonly used and stable.

1.5 HOW TO USE THE MANUAL

1.5.1 This section outlines how different target audiences can use the manual depending on whether their purpose is in line with the primary or secondary goal outlined in 1.3.

1.5.2 Organizations providing flight procedure designer training (training providers)

1.5.2.1 Organizations providing flight procedure designer training, such as independent training providers and State authorities/PDSPs that provide training for their own procedure designers, can use the manual to:

– complete the job and task analysis with the competency framework as a starting point;

– develop training courses/programmes; and

– evaluate training courses/programmes.

1.5.2.2 Once job and task analysis is completed, training providers can apply the method described in Chapter 2. It should be noted that competency requirements for flight procedure designers can vary among States.

1.5.2.3 Developing a training course/programme includes several steps such as:

– determining prerequisites;

– determining training objectives (terminal objectives, enabling objectives, OJT objectives);

– organizing modules; and

– developing tests.

1.5.3 Regulators

1.5.3.1 Regulators that intend to approve/certify a training course or programme can use this manual as a part of their approval/certification of the training process. For instance, they can establish standards which state that: "The proposed training shall be developed, implemented and evaluated in accordance with a competency-based approach. Application of such an approach is described in the *Flight Procedure Designer Training Manual* (Doc 9906)".

1.5.3.2 However, it should be noted that this use of the manual is not its primary goal.

1.5.4 Organizations that dispatch procedure designers to training providers

1.5.4.1 Organizations that dispatch procedure designers to training providers can evaluate the training course or programme by checking if the course/training has been developed using a competency-based approach as described in this manual. The curriculum and material of well-developed training must adequately cover the competency elements in the procedure designer competency framework.

1.5.4.2 However, it should be noted that this use of the manual is not its primary goal.

1.6 USE OF AUTOMATION

1.6.1 Procedure design automated tools have the potential to greatly reduce errors, save time and provide for standardized application of criteria. For this reason, States are encouraged to use software packages to design instrument flight procedures.

1.6.2 It should be emphasized, however, that the use of automated tools (whether a hand calculator, a spreadsheet or fully automated software) does not waive the requirement for the designer to meet the competency standards as set out in the competency framework. Procedure design tools can sometimes have spurious results, especially after revisions in code, database updates or simply the proverbial “garbage in – garbage out” scenario. It must be emphasized that automated design tools provide assistance to the designer but that the designer must at all times be vigilant of the automated results. It is the designer who is ultimately responsible for the validity of the procedure design regardless whether it is produced manually or by software. Moreover, it is the designer’s responsibility to ensure that all stakeholder requirements are met within the design. For these reasons, procedure designers must maintain high competency in criteria application and an awareness of the “big picture” results of any design.

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Chapter 2

GENERAL PROVISIONS FOR COMPETENCY-BASED TRAINING AND ASSESSMENT

2.1 INTRODUCTION

This chapter outlines, in a general manner, the principles and procedures to be followed in the design and implementation of a competency-based approach to training and assessment. It outlines its key features and briefly describes how the competency-based approach is to be used by course developers, instructors and examiners, where applicable. This chapter provides the requirements with which training providers and licensing authorities should comply in order to implement competency-based training and assessment.

2.2 COMPETENCY-BASED APPROACH TO TRAINING AND ASSESSMENT

2.2.1 The development of competency-based training and assessment must be based on a systematic approach whereby competencies and their standards are defined; training is based on the competencies identified and assessments are developed to determine whether these competencies have been achieved. Competency-based approaches include mastery learning, performance-based training, criterion-referenced training and instructional systems design.

2.2.2 Competency-based approaches to training and assessment must include at least the following features:

a) the justification of a training need through a systematic analysis and the identification of indicators for evaluation;

b) the use of a job and task analysis to determine performance standards, the conditions under which the job is carried out, the criticality of tasks, and the inventory of skills, knowledge and attitudes;

c) the identification of the characteristics of the trainee population;

d) the derivation of training objectives from the task analysis and their formulation in an observable and measurable fashion;

e) the development of criterion-referenced, valid, reliable and performance-oriented tests;

f) the development of a curriculum based on adult learning principles, with a view to achieving an optimal path to the attainment of competencies;

g) the development of material-dependent training; and

h) the use of a continuous evaluation process to ensure the effectiveness of training and its relevance to line operations.

Note.— A detailed description of the ICAO course development methodology, a competency-based approach to training and assessment, and an example of an instructional system design (ISD) methodology can be found in the Procedures for Air Navigation — Training *(PANS-TRG, Doc 9868), Attachment to Chapter 2.*

According to PANS-TRG, the course development methodology comprises nine phases which can be subdivided in three broad categories of analysis, design and production, and evaluation.

Analysis is covered through:
Phase 1 – Preliminary study
Phase 2 – Job analysis
Phase 3 – Population analysis

Design and Production is covered in:
Phase 4 – Design of curriculum
Phase 5 – Design of modules
Phase 6 – Production

Evaluation is covered by:
Phase 7 – Validation and revision
Phase 8 – Implementation
Phase 9 – Post-training evaluation.

A brief description of the specific outputs of the nine phases is summarized in the following table.

Category	Phases	Outputs
Analysis	Phase 1 – Preliminary study	Training proposals, their justification and proposed course of action.
	Phase 2 – Job analysis	Task description and performance standards.
	Phase 3 – Population analysis	Trainees' characteristics and their existing skills and knowledge.
Design and Production	Phase 4 – Design of curriculum	Training objectives, mastery tests and sequence of modules.
	Phase 5 – Design of modules	Mode of delivery, training techniques and media, draft training material.
	Phase 6 – Production	Production of all trainee materials.
Evaluation	Phase 7 – Validation and revision	Try-out of course and revision as required.
	Phase 8 – Implementation	Human resources trained.
	Phase 9 – Post-training evaluation	Evaluation of training effectiveness; plans for remedial action.

2.2.3 Aviation authorities should develop general requirements concerning the management of their examiners and provide guidance on:

a) the selection of examiners and description of competency-based assessment training;

b) the performance criteria to be considered by the examiner when assessing each competency; and

c) the tolerances applicable to all competency-based tests.

2.3 THE COMPETENCY FRAMEWORK

2.3.1 The competency framework consists of competency units, competency elements, performance criteria, evidence and assessment guide, and range of variables. The competency framework for procedure designers must be based on the following competency units:

1. Design departure procedure
2. Design en-route procedure
3. Design arrival route procedure
4. Design approach procedure
5. Design reversal and holding procedures
6. Review instrument flight procedures.

2.3.2 Competency units, competency elements and performance criteria must be derived from job and task analyses of procedure designers and describe observable outcomes.

Note.— Definitions of competency units, competency elements and performance criteria are provided in the Definitions *section.*

2.3.3 The competency framework is as indicated in Table 2-1. A Sample Evidence and Assessment Guide for Competency Element 4.1 "Design a VOR or NDB FAF Procedure" is also indicated in Attachment A to this chapter.

2.3.4 The procedure design process flow diagram indicating work flow and items by the procedure designer is also provided in Attachment B to this chapter. In general, work items in the diagram correspond to some competency elements in the competency framework. However, they are not identical. For instance, one single competency element is applicable to multiple work steps.

2.3.5 The performance criteria make use of action verbs. Below are additional explanations concerning these:

Apply criteria. Applying criteria is the action of defining and assessing areas of airspace intended for use as an aircraft flight path, length of segment, angle of turn, etc., in accordance with State-approved instrument procedure design criteria.

Collect. The action of bringing together, collating, assembling, editing and formatting from recognized sources data required for the development of an instrument procedure design.

Incorporate. As in to incorporate electronic and/or paper data into a procedure design file, to create congruency with other design data.

Plot. The action of determining, positioning and drawing over top of terrain, aeronautical, aerodrome and obstacle data the optimal flight path of a procedure design, its associated fixes, assessment airspace, assessment surfaces and minimum safe altitudes.

Promulgate. The action of submitting to a State authority, an instrument procedure design package for distribution to the international aviation community via the State-published Aeronautical Information Regulation and Control (AIRAC) document.

Originate. The process of creating a data element or amending the value of an existing data element.

Table 2-1. Competency framework of flight procedure designer

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes Annex 4, 10th Edition, Amendment 53 Annex 14, Volume I, 4th Edition, Amendment 6 Annex 15, 12th Edition, Amendment 33***
1	**Design departure procedure**				
	1.1	Design straight departure non-RNAV procedure			
		1.1.1	Collect, validate and incorporate electronic/paper data for straight departure non-RNAV procedure	I-3-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		1.1.2	Apply criteria for straight departure non-RNAV procedure	I-3-1	
		1.1.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		1.1.4	Document and store straight departure non-RNAV procedure	I-3-1	AN 15, Ch. 3
		1.1.5	Ground verify and validate straight departure non-RNAV procedure	I-2-4, I-3-1	AN 15, Ch. 3
		1.1.6	Flight verify and validate straight departure non-RNAV procedure	I-2-4, I-3-1	AN 15, Ch. 3
		1.1.7	Promulgate straight departure non-RNAV procedure	I-3-5	AN 4, Ch. 2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
		1.1.8	Maintain straight departure non-RNAV procedure	I-3-1	AN 15, Ch. 3, Ch. 5
	1.2	Design turn departure non-RNAV procedure			
		1.2.1	Collect, validate and incorporate electronic/paper data for turn departure non-RNAV procedure	I-3-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		1.2.2	Apply criteria for turn departure non-RNAV procedure	I-3-1	
		1.2.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		1.2.4	Document and store turn departure non-RNAV procedure	I-3-1	AN 15, Ch. 3
		1.2.5	Ground verify and validate turn departure non-RNAV procedure	I-2-4, I-3-1	AN 15, Ch. 3
		1.2.6	Flight verify and validate turn departure non-RNAV procedure	I-2-4, I-3-1	AN 15, Ch. 3
		1.2.7	Promulgate turn departure non-RNAV procedure	I-3-5	AN 4, Ch .2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
		1.2.8	Maintain turn departure non-RNAV procedure	I-3-1	AN 15, Ch. 3, Ch. 5

X	***Competency Unit***			
	X.X	***Competency Element***		
		X.X.X ***Performance Criteria***		
			In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes Annex 4, 10th Edition, Amendment 53*** ***Annex 14, Volume I, 4th Edition, Amendment 6*** ***Annex 15, 12th Edition, Amendment 33***
1.3	Design omnidirectional departure non-RNAV procedure			
	1.3.1	Collect, validate and incorporate electronic/paper data for omnidirectional departure non-RNAV procedure	I-3-4	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
	1.3.2	Apply criteria for omnidirectional departure non-RNAV procedure	I-3-4	
	1.3.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
	1.3.4	Document and store omnidirectional departure non-RNAV procedure	I-3-4	AN 15, Ch. 3
	1.3.5	Ground verify and validate omnidirectional departure non-RNAV procedure	I-2-4, I-3-4	AN 15, Ch. 3
	1.3.6	Flight verify and validate omnidirectional departure non-RNAV procedure	I-2-4, I-3-4	AN 15, Ch. 3
	1.3.7	Promulgate omnidirectional departure non-RNAV procedure	I-3-5	AN 4, Ch .2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
	1.3.8	Maintain omnidirectional departure non-RNAV procedure	I-3-4	AN 15, Ch. 3, Ch. 5
1.4	Design straight departure RNAV/RNP procedure			
	1.4.1	Collect, validate and incorporate electronic/paper data for straight departure RNAV/RNP procedure	III-3-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
	1.4.2	Apply criteria for straight departure RNAV/RNP procedure	III-3-1	
	1.4.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
	1.4.4	Document and store straight departure RNAV/RNP procedure	III-3-1	AN 15, Ch. 3
	1.4.5	Ground verify and validate straight departure RNAV/RNP procedure	I-2-4, III-3-1	AN 15, Ch. 3
	1.4.6	Flight verify and validate straight departure RNAV/RNP procedure	I-2-4, III-3-1	AN 15, Ch. 3
	1.4.7	Promulgate straight departure RNAV/RNP procedure	I-3-5, III-5-1	AN 4, Ch .2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
	1.4.8	Maintain straight departure RNAV/RNP procedure	III-3-1	AN 15, Ch. 3, Ch. 5
1.5	Design turn departure RNAV/RNP procedure			
	1.5.1	Collect, validate and incorporate electronic/paper data for turn departure RNAV/RNP procedure	III-3-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
	1.5.2	Apply criteria for turn departure RNAV/RNP procedure	III-3-1	
	1.5.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
	1.5.4	Document and store turn departure RNAV/RNP procedure	III-3-1	AN 15, Ch. 3
	1.5.5	Ground verify and validate turn departure RNAV/RNP procedure	I-2-4, III-3-1	AN 15, Ch. 3
	1.5.6	Flight verify and validate turn departure RNAV/RNP procedure	I-2-4, III-3-1	AN 15, Ch. 3
	1.5.7	Promulgate turn departure RNAV/RNP procedure	III-3-5, III-5-1	AN 4, Ch .2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes Annex 4, 10th Edition, Amendment 53 Annex 14, Volume I, 4th Edition, Amendment 6 Annex 15, 12th Edition, Amendment 33***
		1.5.8	Maintain turn departure RNAV/RNP procedure	III-3-1	AN 15, Ch. 3, Ch. 5
	1.6	Design omnidirectional departure RNAV procedure			
		1.6.1	Collect, validate and incorporate electronic/paper data for omnidirectional departure RNAV procedure	I-3-4	AN 15, Ch. 2, App.7 App.8 AN 14, Ch. 2, Ch. 4
		1.6.2	Apply criteria for omnidirectional departure RNAV procedure	I-3-4	
		1.6.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		1.6.4	Document and store omnidirectional departure RNAV procedure	I-3-4	AN 15, Ch. 3
		1.6.5	Ground verify and validate omnidirectional departure RNAV procedure	I-2-4, I-3-4	AN 15, Ch. 3
		1.6.6	Flight verify and validate omnidirectional departure RNAV procedure	I-2-4, I-3-4	AN 15, Ch. 3
		1.6.7	Promulgate omnidirectional departure RNAV procedure	I-3-4, III-5-1	AN 4, Ch. 2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
		1.6.8	Maintain omnidirectional departure RNAV procedure	I-3-4	AN 15, Ch. 3, Ch. 5
	1.7	Design simultaneous operations on parallel instrument runways departure procedure			
		1.7.1	Collect, validate and incorporate electronic/paper data for simultaneous operations on parallel instrument runways departure procedure	I-3-3,6	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		1.7.2	Apply criteria for simultaneous operations on parallel instrument runways departure procedure	I-3-3,6	
		1.7.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		1.7.4	Document and store simultaneous operations on parallel instrument runways departure procedure	I-3-3,6	AN 15, Ch. 3
		1.7.5	Ground verify and validate simultaneous operations on parallel instrument runways departure procedure	I-2-4 I-3-3,6	AN 15, Ch. 3
		1.7.6	Flight verify and validate simultaneous operations on parallel instrument runways departure procedure	I-2-4 I-3-3,6	AN 15, Ch. 3
		1.7.7	Promulgate simultaneous operations on parallel instrument runways departure procedure	I-3-5	AN 4, Ch. 2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
		1.7.8	Maintain simultaneous operations on parallel instrument runways departure procedure	I-3-3,6	AN 15, Ch. 3, Ch. 5
	1.8	Design simultaneous operations on near parallel instrument runways departure procedure			
		1.8.1	Collect, validate and incorporate electronic/paper data for simultaneous operations on near parallel instrument runways departure procedure	I-3-3,6	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		1.8.2	Apply criteria for simultaneous operations on near parallel instrument runways departure procedure	I-3-3,6	
		1.8.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes Annex 4, 10th Edition, Amendment 53 Annex 14, Volume I, 4th Edition, Amendment 6 Annex 15, 12th Edition, Amendment 33***
		1.8.4	Document and store simultaneous operations on near parallel instrument runways departure procedure	I-3-3,6	AN 15, Ch. 3
		1.8.5	Ground verify and validate simultaneous operations on near parallel instrument runways departure procedure	I-2-4 I-3-3,6	AN 15, Ch. 3
		1.8.6	Flight verify and validate simultaneous operations on near parallel instrument runways departure procedure	I-2-4 I-3-3,6	AN 15, Ch. 3
		1.8.7	Promulgate simultaneous operations on near parallel instrument runways departure procedure	I-3-5	AN 4, Ch. 2, Ch. 9, App. 6 AN 15, Ch. 6, App. 4
		1.8.8	Maintain simultaneous operations on near parallel instrument runways departure procedure	I-3-3,6	AN 15, Ch. 3, Ch. 5
2	**Design en route procedure**				
	2.1	Design en route RNAV/RNP procedure			
		2.1.1	Collect, validate and incorporate electronic/paper data for en route RNAV/RNP procedure	II-3-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		2.1.2	Apply criteria for en route RNAV/RNP procedure	II-3-1	
		2.1.3	Document and store en route RNAV/RNP procedure	II-3-1	AN 15, Ch. 3
		2.1.4	Ground verify and validate en route RNAV/RNP procedure	I-2-4, II-3-1	AN 15, Ch. 3
		2.1.5	Flight verify and validate en route RNAV/RNP procedure	I-2-4, II-3-1	AN 15, Ch. 3
		2.1.6	Promulgate en route RNAV/RNP procedure	II-3-1	AN 4, Ch. 2, Ch. 7, App. 6 AN 15, Ch. 6, App.4
		2.1.7	Conduct continuous maintenance of en route RNAV/RNP procedure	II-3-1	AN 15, Ch. 3, Ch. 5
	2.2	Design en route non-RNAV/RNP procedure			
		2.2.1	Collect, validate and incorporate electronic/paper data for en route non-RNAV/RNP procedure	III-3-8	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		2.2.2	Apply criteria for en route non-RNAV/RNP procedure	III-3-8	
		2.2.3	Document and store en route non-RNAV/RNP procedure	III-3-8	AN 15, Ch. 3
		2.2.4	Ground verify and validate en route non-RNAV/RNP procedure	I-2-4, III-3-8	AN 15, Ch. 3
		2.2.5	Flight verify and validate en route non-RNAV/RNP procedure	I-2-4, III-3-8	AN 15, Ch. 3
		2.2.6	Promulgate en route non-RNAV/RNP procedure	III-3-8	AN 4, Ch. 2, Ch. 7, App. 6
		2.2.7	Maintain en route non-RNAV/RNP procedure	III-3-8	AN 15, Ch. 3, Ch. 5

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes Annex 4, 10th Edition, Amendment 53 Annex 14, Volume I, 4th Edition, Amendment 6 Annex 15, 12th Edition, Amendment 33***
3	**Design arrival route**				
	3.1	Design non-RNAV standard instrument arrival procedure			
		3.1.1	Collect, validate and incorporate electronic/paper data for non-RNAV standard instrument arrival procedure	I-4-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		3.1.2	Apply criteria for non-RNAV standard instrument arrival procedure	I-4-1	
		3.1.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		3.1.4	Document and store non-RNAV standard instrument arrival procedure	I-4-1	AN 15, Ch. 3
		3.1.5	Ground verify and validate non-RNAV standard instrument arrival procedure	I-2-4, I-4-1	AN 15, Ch. 3
		3.1.6	Flight verify and validate non-RNAV standard instrument arrival procedure	I-2-4, I-4-1	AN 15, Ch. 3
		3.1.7	Promulgate non-RNAV standard instrument arrival procedure	I-4-9	AN 4, Ch. 2, Ch. 10, App. 6 AN 15, Ch. 6, App. 4
		3.1.8	Maintain non-RNAV standard instrument arrival procedure	I-4-1	AN 15, Ch. 3, Ch. 5
	3.2	Design RNAV/RNP standard instrument arrival procedure			
		3.2.1	Collect, validate and incorporate electronic/paper data for RNAV/RNP standard instrument arrival procedure	III-3-2	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		3.2.2	Apply criteria for RNAV/RNP standard instrument arrival procedure	III-3-2	
		3.2.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		3.2.4	Document and store RNAV/RNP standard instrument arrival procedure	III-3-2	AN 15, Ch. 3
		3.2.5	Ground verify and validate RNAV/RNP standard instrument arrival procedure	I-2-4, III-3-2	AN 15, Ch. 3
		3.2.6	Flight verify and validate RNAV/RNP standard instrument arrival procedure	I-2-4, III-3-2	AN 15, Ch. 3
		3.2.7	Promulgate RNAV/RNP standard instrument arrival procedure	I-4-9, III-2-4, III-5-1	AN 4, Ch. 2, Ch. 10, App. 6 AN 15, Ch. 6, App. 4
		3.2.8	Maintain RNAV/RNP standard instrument arrival procedure	III-3-2	AN 15, Ch. 3, Ch. 5
	3.3	Design non-RNAV omnidirectional arrival procedure			
		3.3.1	Collect, validate and incorporate electronic/paper data for non-RNAV omnidirectional arrival procedure	I-4-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		3.3.2	Apply criteria for non-RNAV omnidirectional arrival procedure	I-4-3	
		3.3.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		3.3.4	Document and store non-RNAV omnidirectional arrival procedure	I-4-3	AN 15, Ch. 3
		3.3.5	Ground verify and validate non-RNAV omnidirectional arrival procedure	I-2-4, I-4-3	AN 15, Ch. 3
		3.3.6	Flight verify and validate non-RNAV omnidirectional arrival procedure	I-2-4, I-4-3	AN 15, Ch. 3

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes*** ***Annex 4, 10th Edition, Amendment 53*** ***Annex 14, Volume I, 4th Edition, Amendment 6*** ***Annex 15, 12th Edition, Amendment 33***
		3.3.7	Promulgate non-RNAV omnidirectional arrival procedure	I-4-9	AN 4, Ch. 2, Ch. 10, App. 6 AN 15, Ch. 6, App. 4
		3.3.8	Maintain non-RNAV omnidirectional arrival procedure	I-4-3	AN 15, Ch. 3, Ch. 5
	3.4	Design RNAV/RNP omnidirectional arrival procedure			
		3.4.1	Collect, validate and incorporate electronic/paper data for RNAV/RNP omnidirectional arrival procedure	I-4-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		3.4.2	Apply criteria for RNAV/RNP omnidirectional arrival procedure	I-4-3	
		3.4.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		3.4.4	Document and store RNAV/RNP omnidirectional arrival procedure	I-4-3	AN 15, Ch. 3
		3.4.5	Ground verify and validate RNAV/RNP omnidirectional arrival procedure	I-2-4, I-4-3	AN 15, Ch. 3
		3.4.6	Flight verify and validate RNAV/RNP omnidirectional arrival procedure	I-2-4, I-4-3	AN 15, Ch. 3
		3.4.7	Promulgate RNAV/RNP omnidirectional arrival procedure	I-4-9 III-2-4 III-5-1	AN 4, Ch. 2, Ch. 10, App. 6 AN 15, Ch. 6, App. 4
		3.4.8	Maintain RNAV/RNP omnidirectional arrival procedure	I-4-3	AN 15, Ch. 3, Ch. 5
4	**Design approach procedure**				
	4.1	Design VOR or NDB FAF procedure			
		4.1.1	Collect, validate and incorporate electronic/paper data for VOR or NDB FAF procedure	II-2-4	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.1.2	Apply criteria for VOR or NDB FAF procedure	II-2-4	
		4.1.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.1.4	Document and store VOR or NDB FAF procedure	II-2-4	AN 15, Ch. 3
		4.1.5	Ground verify and validate VOR or NDB FAF procedure	I-2-4, II-2-4	AN 15, Ch. 3
		4.1.6	Flight verify and validate VOR or NDB FAF procedure	I-2-4, II-2-4	AN 15, Ch. 3
		4.1.7	Promulgate VOR or NDB FAF procedure	II-2-4	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.1.8	Maintain VOR or NDB FAF procedure	II-2-4	AN 15, Ch. 3, Ch. 5
	4.2	Design VOR/NDB no-FAF procedure			
		4.2.1	Collect, validate and incorporate electronic/paper data for VOR/NDB no-FAF procedure	II-2-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.2.2	Apply criteria for VOR/NDB no-FAF procedure	II-2-3	
		4.2.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes Annex 4, 10th Edition, Amendment 53 Annex 14, Volume I, 4th Edition, Amendment 6 Annex 15, 12th Edition, Amendment 33***
		4.2.4	Document and store VOR/NDB no-FAF procedure	II-2-3	AN 15, Ch. 3
		4.2.5	Ground verify and validate VOR/NDB no-FAF procedure	I-2-4, II-2-3	AN 15, Ch. 3
		4.2.6	Flight verify and validate VOR/NDB no-FAF procedure	I-2-4, II-2-3	AN 15, Ch. 3
		4.2.7	Promulgate VOR/NDB no-FAF procedure	II-2-3	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.2.8	Maintain VOR/NDB no-FAF procedure	II-2-3	AN 15, Ch. 3, Ch. 5
	4.3	Design SRE procedure			
		4.3.1	Collect, validate and incorporate electronic/paper data SRE procedure	II-2-6	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.3.2	Apply criteria for SRE procedure	II-2-6	
		4.3.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.3.4	Document and store SRE procedure	II-2-6	AN 15, Ch. 3
		4.3.5	Ground verify and validate SRE procedure	I-2-4, II-2-6	AN 15, Ch. 3
		4.3.6	Flight verify and validate SRE procedure	I-2-4, II-2-6	AN 15, Ch. 3
		4.3.7	Promulgate SRE procedure		AN 4, Ch. 2, Ch. 11, App. 6
		4.3.8	Maintain SRE procedure	II-2-6	AN 15, Ch. 3, Ch. 5
	4.4	Design DF procedure			
		4.4.1	Collect, validate and incorporate electronic/paper data DF procedure	II-2-5	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.4.2	Apply criteria for DF procedure	II-2-5	
		4.4.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.4.4	Document and store DF procedure	II-2-5	AN 15, Ch. 3
		4.4.5	Ground verify and validate DF procedure	I-2-4, II-2-5	AN 15, Ch. 3
		4.4.6	Flight verify and validate DF procedure	I-2-4, II-2-5	AN 15, Ch. 3
		4.4.7	Promulgate DF procedure	II-2-5	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.4.8	Maintain DF procedure	II-2-5	AN 15, Ch. 3, Ch. 5
	4.5	Design visual manoeuvring			
		4.5.1	Collect and validate electronic/paper data visual manoeuvring	I-4-7	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.5.2	Apply criteria for visual manoeuvring	I-4-7	
		4.5.3	Document and store visual manoeuvring	I-4-7	AN 15, Ch. 3

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes*** ***Annex 4, 10th Edition, Amendment 53*** ***Annex 14, Volume I, 4th Edition, Amendment 6*** ***Annex 15, 12th Edition, Amendment 33***
		4.5.4	Ground verify and validate visual manoeuvring	I-2-4, I-4-7	AN 15, Ch. 3
		4.5.5	Flight verify and validate visual manoeuvring	I-2-4, I-4-7	AN 15, Ch. 3
		4.5.6	Promulgate visual manoeuvring	I-4-7 Appendix	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.5.7	Maintain visual manoeuvring	I-4-7	AN 15, Ch. 3, Ch. 5
	4.6	Design visual manoeuvring with prescribed track			
		4.6.1	Collect and validate electronic/paper data for visual manoeuvring with prescribed track	I-4-7 Appendix	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.6.2	Apply criteria for visual manoeuvring with prescribed track	I-4-7 Appendix	
		4.6.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.6.4	Document and store visual manoeuvring with prescribed track	I-4-7 Appendix	AN 15, Ch. 3
		4.6.5	Ground verify and validate visual manoeuvring with prescribed track	I-2-4 I-4-7 Appendix	AN 15, Ch. 3
		4.6.6	Flight verify and validate visual manoeuvring with prescribed track	I-2-4 I-4-7 Appendix	AN 15, Ch. 3
		4.6.7	Promulgate visual manoeuvring with prescribed track	I-4-7 Appendix	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.6.8	Maintain visual manoeuvring with prescribed track	I-4-7 Appendix	AN 15, Ch. 3, Ch. 5
	4.7	Design RNAV DME/DME procedure (stations prior 1 January 1989)			
		4.7.1	Collect and validate electronic/paper data for RNAV DME/DME procedure	III-1-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.7.2	Apply criteria for RNAV DME/DME procedure	III-1-3 III-3-2 and 3	
		4.7.3	Establish Minimum Sector Altitudes (MSA, if applicable)	I-4-8	
		4.7.4	Apply the T/Y-Bar concept (if applicable)	III-2-3	
		4.7.5	Establish Terminal Arrival Altitudes (TAA, if applicable)	III-2-4	
		4.7.6	Document and store RNAV DME/DME procedure	III-1-3 III-3-2 and 3	AN 15, Ch. 3
		4.7.7	Ground verify and validate RNAV DME/DME procedure	I-2-4 III-1-3 III-3-2 and 3	AN 15, Ch. 3
		4.7.8	Flight verify and validate RNAV DME/DME procedure	I-2-4 III-1-3 III-3-2 and 3	AN 15, Ch. 3

X	***Competency Unit***				
	X.X	***Competency Element***			
		X.X.X	***Performance Criteria***		
				In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes*** ***Annex 4, 10th Edition, Amendment 53*** ***Annex 14, Volume I, 4th Edition, Amendment 6*** ***Annex 15, 12th Edition, Amendment 33***
		4.7.9	Promulgate RNAV DME/DME procedure	III-1-3 III-5-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.7.10	Maintain RNAV DME/DME procedure (stations prior 1 January 1989)	III-1-3 III-3-2 and 4	AN 15, Ch. 3, Ch. 5
	4.8	Design RNAV DME/DME procedure (stations post 1 January 1989)			
		4.8.1	Collect and validate electronic/paper data for RNAV DME/DME procedure	III-1-3	AN 15, Ch. 2, App.7 App.8 AN 14, Ch. 2, Ch. 4
		4.8.2	Apply criteria for RNAV DME/DME procedure	III-1-3 III-3-2 and 3	
		4.8.3	Establish Minimum Sector Altitudes (MSA, if applicable)	I-4-8	
		4.8.4	Apply the T/Y-Bar concept (if applicable)	III-2-3	
		4.8.5	Establish Terminal Arrival Altitudes (TAA, if applicable)	III-2-4	
		4.8.6	Document and store RNAV DME/DME procedure	III-1-3 III-3-2 and 3	AN 15, Ch. 3
		4.8.7	Ground verify and validate RNAV DME/DME procedure	I-2-4 III-1-3 III-3-2 and 3	AN 15, Ch. 3
		4.8.8	Flight verify and validate RNAV DME/DME procedure	I-2-4 III-1-3 III-3-2 and 3	AN 15, Ch. 3
		4.8.9	Promulgate RNAV DME/DME procedure	III-1-3 III-5-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.8.10	Maintain RNAV DME/DME procedure (stations post 1 January 1989)	III-1-3 III-3-2 and 4	AN 15, Ch. 3, Ch. 5
	4.9	Design RNP approach (RNP APCH) procedure			
		4.9.1	Collect and validate electronic/paper data for RNP approach (RNP APCH) procedure	III-1-2	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.9.2	Apply criteria for RNP approach (RNP APCH) procedure	III-1-2 III-3-2 and 3	
		4.9.3	Establish Minimum Sector Altitudes (MSA, if applicable)	I-4-8	
		4.9.4	Apply the T/Y-Bar concept (if applicable)	III-2-3	
		4.9.5	Establish Terminal Arrival Altitudes (TAA, if applicable)	III-2-4	
		4.9.6	Document and store RNP approach (RNP APCH) procedure	III-1-2 III-3-2 and 3	AN 15, Ch. 3

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		4.9.7	Ground verify and validate RNP approach (RNP APCH) procedure	I-2-4 III-1-2 III-3-2 and 3	AN 15, Ch. 3
		4.9.8	Flight verify and validate RNP approach (RNP APCH) procedure	I-2-4 III-1-2 III-3-2 and 3	AN 15, Ch. 3
		4.9.9	Promulgate RNP approach (RNP APCH) procedure	III-1-2 III-5-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.9.10	Maintain RNP approach (RNP APCH) procedure	III-1-2 III-3-2 and 4	AN 15, Ch. 3, Ch. 5
	4.10	Design RNP procedure			
		4.10.1	Collect and validate electronic/paper data for RNP procedure	III-1-7	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.10.2	Apply criteria for RNP procedure	III-1-7 III-3-2 and 3	
		4.10.3	Establish Minimum Sector Altitudes (MSA, if applicable)	I-4-8	
		4.10.4	Apply the T/Y-Bar concept (if applicable)	III-2-3	
		4.10.5	Establish Terminal Arrival Altitudes (TAA, if applicable)	III-2-4	
		4.10.6	Document and store RNP procedure	III-1-7 III-3-2 and 3	AN 15, Ch. 3
		4.10.7	Ground verify and validate RNP procedure	I-2-4 III-1-7 III-3-2 and 3	AN 15, Ch. 3
		4.10.8	Flight verify and validate RNP procedure	I-2-4 III-1-7 III-3-2 and 3	AN 15, Ch. 3
		4.10.9	Promulgate RNP procedure	III-1-7 III-3-2 and 3	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.10.10	Maintain RNP procedure	III-1-7 III-3-2 and 3	AN 15, Ch. 3,Ch. 5
	4.11	Design ILS approach			
		4.11.1	Collect and validate electronic/paper data for ILS approach	II-1-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.11.2	Apply criteria for ILS approach	II-1-1	
		4.11.3	Apply criteria for steep approach angle (if applicable)		
		4.11.4	Establish Minimum Sector Altitudes (MSA)	I-4-8	

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		4.11.5	Document and store ILS approach	II-1-1	AN 15, Ch. 3
		4.11.6	Ground verify and validate ILS approach	I-2-4, II-1-1	AN 15, Ch. 3
		4.11.7	Flight verify and validate ILS approach	I-2-4, II-1-1	AN 15, Ch. 3
		4.11.8	Promulgate ILS approach	II-1-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.11.9	Maintain ILS approach	II-1-1	AN 15, Ch.3, Ch. 5
	4.12	Design ILS localizer only approach			
		4.12.1	Collect and validate electronic/paper data for ILS localizer only approach	II-2-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.12.2	Apply criteria for ILS localizer only approach	II-2-1	
		4.12.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.12.4	Document and store ILS localizer only approach	II-2-1	AN 15, Ch. 3
		4.12.5	Ground verify and validate ILS localizer only approach	I-2-4, II-2-1	AN 15, Ch. 3
		4.12.6	Flight verify and validate ILS localizer only approach	I-2-4, II-2-1	AN 15, Ch. 3
		4.12.7	Promulgate ILS localizer only approach	II-2-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.12.8	Maintain ILS localizer only approach	II-2-1	AN 15, Ch. 3, Ch. 5
	4.13	Design ILS approach with offset localizer			
		4.13.1	Collect and validate electronic/paper data for ILS approach with offset localizer	II-1-2	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.13.2	Apply criteria for ILS approach with offset localizer	II-1-2	
		4.13.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.13.4	Document and store ILS approach with offset localizer	II-1-2	AN 15, Ch. 3
		4.13.5	Ground verify and validate ILS approach with offset localizer	I-2-4, II-1-2	AN 15, Ch. 3
		4.13.6	Flight verify and validate ILS approach with offset localizer	I-2-4, II-1-2	AN 15, Ch. 3
		4.13.7	Promulgate ILS approach with offset localizer	II-1-2	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.13.8	Maintain ILS approach with offset localizer	II-1-2	AN 15, Ch. 3, Ch. 5
	4.14	Design MLS approach			
		4.14.1	Collect and validate electronic/paper data for MLS approach	II-1-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.14.2	Apply criteria for MLS approach	II-1-3	

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		4.14.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.14.4	Document and store MLS approach	II-1-3	AN 15, Ch. 3
		4.14.5	Ground verify and validate MLS approach	I-2-4, II-1-3	AN 15, Ch. 3
		4.14.6	Flight verify and validate MLS approach	I-2-4, II-1-3	AN 15, Ch. 3
		4.14.7	Promulgate MLS approach	II-1-3	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.14.8	Maintain MLS approach	II-1-3	AN 15, Ch. 3, Ch. 5
	4.15	Design MLS azimuth only approach			
		4.15.1	Collect and validate electronic/paper data for MLS azimuth only approach	II-2-2	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.15.2	Apply criteria for MLS azimuth only approach	II-2-2	
		4.15.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.15.4	Document and store MLS azimuth only approach	II-2-2	AN 15, Ch. 3
		4.15.5	Ground verify and validate MLS azimuth only approach	I-2-4, II-2-2	AN 15, Ch. 3
		4.15.6	Flight verify and validate MLS azimuth only approach	I-2-4, II-2-2	AN 15, Ch. 3
		4.15.7	Promulgate MLS azimuth only approach	II-2-2	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.15.8	Maintain MLS azimuth only approach	II-2-2	AN 15, Ch. 3, Ch. 5
	4.16	Design MLS approach with offset azimuth alignment			
		4.16.1	Collect and validate electronic/paper data for MLS approach with offset azimuth alignment	II-1-4	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.16.2	Apply criteria for MLS approach with offset azimuth alignment	II-1-4	
		4.16.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.16.4	Document and store MLS approach with offset azimuth alignment	II-1-4	AN 15, Ch. 3
		4.16.5	Ground verify and validate MLS approach with offset azimuth alignment	I-2-4, II-1-4	AN 15, Ch. 3
		4.16.6	Flight verify and validate MLS approach with offset azimuth alignment	I-2-4, II-1-4	AN 15, Ch. 3
		4.16.7	Promulgate MLS approach with offset azimuth alignment	II-1-4	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.16.8	Maintain MLS approach with offset azimuth alignment	II-1-4	AN 15, Ch. 3, Ch. 5
	4.17	Design PAR approach			
		4.17.1	Collect and validate electronic/paper data for PAR approach	II-1-5	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4

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		4.17.2	Apply criteria for PAR approach	II-1-5	
		4.17.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.17.4	Document and store PAR approach	II-1-5	AN 15, Ch. 3
		4.17.5	Ground verify and validate PAR approach	I-2-4, II-1-5	AN 15, Ch. 3
		4.17.6	Flight verify and validate PAR approach	I-2-4, II-1-5	AN 15, Ch. 3
		4.17.7	Promulgate PAR approach	II-1-5	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.17.8	Maintain PAR approach	II-1-5	AN 15, Ch. 3, Ch. 5
	4.18	Design APV/Baro VNAV approach procedure			
		4.18.1	Collect and validate electronic/paper data for APV/Baro VNAV approach procedure	III-3-4	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.18.2	Apply criteria for APV/Baro VNAV approach procedure	III-3-4	
		4.18.3	Document and store APV/Baro VNAV approach procedure	III-3-4	AN 15, Ch. 3
		4.18.4	Ground verify and validate APV/Baro VNAV approach procedure	I-2-4, III-3-4	AN 15, Ch. 3
		4.18.5	Flight verify and validate APV/Baro VNAV approach procedure	I-2-4, III-3-4	AN 15, Ch. 3
		4.18.6	Promulgate APV/Baro VNAV approach procedure	III-3-4	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.18.7	Maintain APV/Baro VNAV approach procedure	III-3-4	AN 15, Ch. 3, Ch. 5
	4.19	Design RNP AR approach procedure			
		4.19.1	Collect and validate electronic/paper data for RNP AR approach procedure	To be determined	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.19.2	Apply criteria for RNP AR approach procedure	TBD	
		4.19.3	Establish Minimum Sector Altitudes (MSA)	TBD	
		4.19.4	Document and store RNP AR approach procedure	TBD	AN 15, Ch. 3
		4.19.5	Ground verify and validate RNP AR approach procedure	TBD	AN 15, Ch. 3
		4.19.6	Flight verify and validate RNP AR approach procedure	TBD	AN 15, Ch. 3
		4.19.7	Promulgate RNP AR approach procedure	TBD	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.19.8	Maintain RNP AR approach procedure	TBD	AN 15, Ch. 3, Ch. 5
	4.20	Design SBAS APV approach procedure			
		4.20.1	Collect and validate electronic/paper data for SBAS APV approach procedure	III-3-5	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4

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		4.20.2	Apply criteria for SBAS APV approach procedure	III-3-5	
		4.20.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.20.4	Document and store SBAS APV approach procedure	III-3-5	AN 15, Ch. 3
		4.20.5	Ground verify and validate SBAS APV approach procedure	I-2-4, III-3-5	AN 15, Ch. 3
		4.20.6	Flight verify and validate SBAS APV approach procedure	I-2-4, III-3-5	AN 15, Ch. 3
		4.20.7	Promulgate SBAS APV approach procedure	III-3-5 III-5-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.20.8	Maintain SBAS APV approach procedure	III-3-5	AN 15, Ch. 3, Ch. 5
	4.21	Design GBAS cat I approach			
		4.21.1	Collect and validate electronic/paper data for GBAS cat I approach	III-3-6	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.21.2	Apply criteria for GBAS cat I approach	III-3-6	
		4.21.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.21.4	Document and store GBAS cat I approach	III-3-6	AN 15, Ch. 3
		4.21.5	Ground verify and validate GBAS cat I approach	I-2-4, III-3-6	AN 15, Ch. 3
		4.21.6	Flight verify and validate GBAS cat I approach	I-2-4, III-3-6	AN 15, Ch. 3
		4.21.7	Promulgate GBAS cat I approach	III-3-6 III-5-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.21.8	Maintain GBAS cat I approach	III-3-6	AN 15, Ch. 3, Ch. 5
	4.22	Design GBAS off set approach			
		4.22.1	Collect and validate electronic/paper data for GBAS off set approach	III-3-6	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		4.22.2	Apply criteria for GBAS off set approach	III-3-6	
		4.22.3	Establish Minimum Sector Altitudes (MSA)	I-4-8	
		4.22.4	Document and store GBAS off set approach	III-3-6	AN 15, Ch. 3
		4.22.5	Ground verify and validate GBAS off set approach	I-2-4, III-3-6	AN 15, Ch. 3
		4.22.6	Flight verify and validate GBAS off set approach	I-2-4, III-3-6	AN 15, Ch. 3
		4.22.7	Promulgate GBAS off set approach	III-3-6, III-5-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		4.22.8	Maintain GBAS off set approach	III-3-6	AN 15, Ch. 3, Ch. 5

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5	**Design reversal and holding procedures**				
	5.1	Design base-turn			
		5.1.1	Collect and validate electronic/paper data for base-turn	I-4-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.1.2	Apply criteria for base-turn	I-4-3	
		5.1.3	Document and store base-turn	I-4-3	AN 15, Ch. 3
		5.1.4	Ground verify and validate base-turn	I-2-4, I-4-3	AN 15, Ch. 3
		5.1.5	Flight verify and validate base-turn	I-2-4, I-4-3	AN 15, Ch. 3
		5.1.6	Promulgate base-turn	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		5.1.7	Maintain base-turn	I-4-3	AN 15, Ch. 3, Ch. 5
	5.2	Design 45/180 procedure-turn			
		5.2.1	Collect and validate electronic/paper data for 45/180 procedure-turn	I-4-3	AN 15, Ch. 2, App.7 App.8 AN 14, Ch. 2, Ch. 4
		5.2.2	Apply criteria for 45/180 procedure-turn	I-4-3	
		5.2.3	Document and store 45/180 procedure-turn	I-4-3	AN 15, Ch. 3
		5.2.4	Ground verify and validate 45/180 procedure-turn	I-2-4, I-4-3	AN 15, Ch. 3
		5.2.5	Flight verify and validate 45/180 procedure-turn	I-2-4, I-4-3	AN 15, Ch. 3
		5.2.6	Promulgate 45/180 procedure-turn	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		5.2.7	Conduct continuous maintenance of 45/180 procedure-turn	I-4-3	AN 15, Ch. 3, Ch. 5
	5.3	Design 80/260 procedure-turn			
		5.3.1	Collect and validate electronic/paper data for 80/260 procedure-turn	I-4-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.3.2	Apply criteria for 80/260 procedure-turn	I-4-3	
		5.3.3	Document and store 80/260 procedure-turn	I-4-3	AN 15, Ch. 3
		5.3.4	Ground verify and validate 80/260 procedure-turn	I-2-4, I-4-3	AN 15, Ch. 3
		5.3.5	Flight verify and validate 80/260 procedure-turn	I-2-4, I-4-3	AN 15, Ch. 3
		5.3.6	Promulgate 80/260 procedure-turn	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		5.3.7	Maintain 80/260 procedure-turn	I-4-3	AN 15, Ch. 3, Ch. 5

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	5.4	Design racetrack reversal procedure			
		5.4.1	Collect and validate electronic/paper data for racetrack reversal procedure	I-4-3	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.4.2	Apply criteria for racetrack reversal procedure	I-4-3	
		5.4.3	Document and store racetrack reversal procedure	I-4-3	AN 15, Ch. 3
		5.4.4	Ground verify and validate racetrack reversal procedure	I-2-4, I-4-3	AN 15, Ch. 3
		5.4.5	Flight verify and validate racetrack reversal procedure	I-2-4, I-4-3	AN 15, Ch. 3
		5.4.6	Promulgate racetrack reversal procedure	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 11, App. 6 AN 15, Ch. 6, App. 4
		5.4.7	Maintain racetrack reversal procedure	I-4-3	AN 15, Ch. 3, Ch. 5
	5.5	Design conventional overhead holding procedure			
		5.5.1	Collect and validate electronic/paper data for conventional overhead holding procedure	II-4-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.5.2	Apply criteria for conventional overhead holding procedure	II-4-1	
		5.5.3	Document and store conventional overhead holding procedure	II-4-1	AN 15, Ch. 3
		5.5.4	Ground verify and validate conventional overhead holding procedure	I-2-4, II-4-1	AN 15, Ch. 3
		5.5.5	Flight verify and validate conventional overhead holding procedure	I-2-4, II-4-1	AN 15, Ch. 3
		5.5.6	Promulgate conventional overhead holding procedure	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 7/10/11, App. 6 AN 15, Ch. 6, App. 4
		5.5.7	Maintain conventional overhead holding procedure	II-4-1	AN 15, Ch. 3, Ch. 5
	5.6	Design conventional VOR/DME fix holding procedure			
		5.6.1	Collect and validate electronic/paper data for conventional VOR/DME fix holding procedure	II-4-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.6.2	Apply criteria for conventional VOR/DME fix holding procedure	II-4-1	
		5.6.3	Document and store conventional VOR/DME fix holding procedure	II-4-1	AN 15, Ch. 3
		5.6.4	Ground verify and validate conventional VOR/DME fix holding procedure	I-2-4, II-4-1	AN 15, Ch. 3
		5.6.5	Flight verify and validate conventional VOR/DME fix holding procedure	I-2-4, II-4-1	AN 15, Ch. 3
		5.6.6	Promulgate conventional VOR/DME fix holding procedure	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 7/10/11, App. 6 AN 15, Ch. 6, App. 4
		5.6.7	Maintain conventional VOR/DME fix holding procedure	II-4-1	AN 15, Ch. 3, Ch. 5

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	5.7	Design RNAV holding procedure (VOR/DME, DME/DME, GNSS)			
		5.7.1	Collect and validate electronic/paper data for RNAV holding procedure	III-4-7	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.7.2	Apply criteria for RNAV holding procedure	III-4-7	
		5.7.3	Document and store RNAV holding procedure	III-4-7	AN 15, Ch. 3
		5.7.4	Ground verify and validate RNAV holding procedure	I-2-4, III-4-7	AN 15, Ch. 3
		5.7.5	Flight verify and validate RNAV holding procedure	I-2-4, III-4-7	AN 15, Ch. 3
		5.7.6	Promulgate RNAV holding procedure	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 7/10/11, App. 6 AN 15, Ch. 6, App. 4
		5.7.7	Maintain RNAV holding procedure (VOR/DME, DME/DME, GNSS)	III-4-7	AN 15, Ch. 3, Ch. 5
	5.8	Design RNP holding procedure			
		5.8.1	Collect and validate electronic/paper data for RNP holding procedure	III-7-1	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		5.8.2	Apply criteria for RNP holding procedure	III-7-1	
		5.8.3	Document and store RNP holding procedure	III-7-1	AN 15, Ch. 3
		5.8.4	Ground verify and validate RNP holding procedure	I-2-4, III-7-1	AN 15, Ch. 3
		5.8.5	Flight verify and validate RNP holding procedure	I-2-4, III-7-1	AN 15, Ch. 3
		5.8.6	Promulgate RNP holding procedure	I-4-1, II-4-1	AN 4, Ch. 2, Ch. 7/10/11, App. 6 AN 15, Ch. 6, App. 4
		5.8.7	Maintain RNP holding procedure	III-7-1	AN 15, Ch. 3, Ch. 5
6	**Review Instrument Flight Procedures (periodic checks, stakeholder request)**				
	6.1	Review procedure on a periodic basis			
		6.1.1	(Re-)collect and validate and integrate electronic/paper data for the maintenance of the procedure	(Appropriate Chapter for the type of procedure in question)	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
		6.1.2	Apply latest criteria to procedure	“	
		6.1.3	Document and store maintained procedure	“	AN 15, Ch. 3
		6.1.4	Ground verify and validate maintained procedure	“	AN 15, Ch. 3
		6.1.5	Flight verify and validate maintained procedure	“	AN 15, Ch. 3

X	***Competency Unit***			
	X.X	***Competency Element***		
		X.X.X ***Performance Criteria***		
			In accordance with: PANS-OPS, Doc 8168, Volume II (5th edition) Part-Section-Chapter	***Annexes*** ***Annex 4, 10th Edition, Amendment 53*** ***Annex 14, Volume I, 4th Edition, Amendment 6*** ***Annex 15, 12th Edition, Amendment 33***
	6.1.6	Promulgate maintained procedure (if necessary)	“	AN 4, Ch. 2, Ch. 7/9/10/11, App. 6 AN 15, Ch. 6, App. 4
6.2	Review procedure based on a stakeholder’s request			
	6.2.1	Collect, validate and incorporate latest electronic/paper data for the maintenance of the procedure	(Appropriate Chapter for the type of procedure in question)	AN 15, Ch. 2, App. 7, App. 8 AN 14, Ch. 2, Ch. 4
	6.2.2	Apply latest criteria to procedures		
	6.2.3	Assure integration into ATM system (procedural separation, capacity)	“	
	6.2.4	Document and store maintained procedure	“	AN 15, Ch. 3
	6.2.5	Ground verify and validate maintained procedure	“	AN 15, Ch. 3
	6.2.6	Flight verify and validate maintained procedure	“	AN 15, Ch. 3
	6.2.7	Promulgate maintained procedure (if necessary)	“	AN 4, Ch. 2, Ch. 7/9/10/11, App. 6 AN 15, Ch. 6, App. 4

2.4 SKILLS, KNOWLEDGE AND ATTITUDES

2.4.1 General

In order to perform tasks, a combination of adequate skills, knowledge and attitudes (SKAs) is required. A skill is the ability to perform an activity that contributes to the effective completion of a task. Knowledge is specific information required for the trainee to develop the skills and attitudes for the effective accomplishment of tasks. Attitude is the person’s mental state that influences behaviour, choices and expressed opinions.

For example, for performance criteria 4.1.1 “collect, validate and incorporate electronic/paper data for VOR or NDB FAF procedure”, there would be a need to have knowledge about different types of terrain data. In turn, this knowledge would be required to apply the skill of interpreting a cartographic map. The procedure designer, applying this skill, would need to be thorough and accurate. This attitude would be reflected throughout the collection and validation process as well as in the outcome of the performance.

The SKAs necessary to achieve performance criteria and competency elements are inventoried during job and task analysis. During the curriculum design phase, the specific SKAs identified during job and task analysis can be categorized according to the learning associated with them. Different taxonomies can be used to achieve this categorization (see Bloom; Anderson and Krathwohl; Gagné, Briggs and Wagner). However, it is beyond the scope of this manual to describe in detail these different taxonomies and their interpretation.

As an example, Gagné, Briggs and Wagner's taxonomy breaks down intellectual skills into four categories: classifying, rule-using, discriminating and problem-solving. Using this taxonomy, knowledge about different types of terrain data could be categorized as the intellectual skill of classifying. When developing training materials for this skill, course developers would require trainees to define, itemize, rank or catalogue different types of terrain. Different media could be used to accomplish this. For example, a computer programme could be devised where trainees are asked to classify types of terrain data. The skill of interpreting a cartographic map could be categorized as the intellectual skill of rule-using. Course developers could require trainees to check, explain and correct a cartographic map. As regards thoroughness and accuracy (attitudes), course developers would ensure that instructors demonstrate these attitudes and that they are elicited from trainees through practical exercises.

2.4.2 Attitudes

An attitude is the mental state of a person that influences behaviour, choices and expressed opinion. Our beliefs and values are combined with our cognitive skills; thus, two components (affective and cognitive) give us our long-range or persistent measurements for dealing with the world (Bootzin, 1983). While a person may have the competency to perform a task, that does not mean he or she will have the desire (attitude) to do so correctly. In other words, competencies give us the ability to perform, while attitudes give us the desire to perform. Attitudes change with various events in a person's life.

2.4.3 Procedure-design-specific skills, knowledge and attitudes

Some SKAs are particularly useful for flight procedure designers and are a great aid to those seeking to become an "expert performer". These SKAs are not necessarily a prerequisite to start training as a flight procedure designer, nor does the absence of those SKAs make it impossible to perform on the job. It is possible that such SKAs develop during the process of training or later during job performance.

2.4.3.1 Demonstrate three-dimensional visualization (skill)

It is of great advantage to flight procedure designer trainees to have three-dimensional visualization skills in order to transfer the geographical data provided (maps, charts, obstacle databases) into a three-dimensional mental picture.

2.4.3.2 Demonstrate ability to work as part of a team (attitude)

Flight procedure designers function as one element of the air traffic safety system. Often procedure design is where all the requirements in the system coincide, and a great deal of coordination is required. For a process to be efficient, it is desirable that flight procedure designers are adaptable and open-minded to requests and requirements from other stakeholders. This means they need to demonstrate their ability to work as part of a team, including demonstrating communication, negotiation and group-work facilitation skills.

2.4.3.3 Criticism (attitude)

Flight procedure designers should be both open to constructive criticism that is given regarding their work and, in turn, they should be able to critique another designer's work in an unbiased and results-oriented way. Flight procedure design is not an exact science, and therefore it is possible that several solutions serve the same purpose and sometimes do not exactly fit the expectations of stakeholders. Being open to criticism and being able to communicate criticism will serve the safety and efficiency of the air traffic system.

Attachment A to Chapter 2

Sample Evidence and Assessment Guide

Edition/Amendment of ICAO Documents referred to:

PANS-OPS Doc 6168 Vol. II, 5th Edition
Annex 4, 10th Edition, Amendment 53
Annex 15, 12th Edition, Amendment 33

X	***Competency Unit***					
	X.X	***Competency Element***				
		X.X.X	***Performance Criteria***			
				X.X.X.X	***Evidence and Assessment Guide***	***Reference***
4	**Design Approach Procedure**					
	4.1	**Design a VOR or NDB FAF Procedure**				
			Performance Criteria		**Evidence and Assessment Guide**	**Reference**
						PANS-OPS, Vol. II, Doc 8168: **Part-Section-Chap**, Para or **Annex**, Para
		4.1.1	**Collect, validate and incorporate electronic/paper data for VOR or NDB FAF procedure**	**4.1.1.1**	Collect from recognized sources, validate for resolution, accuracy, integrity, reference geodetic datum and effective dates, and incorporate data into design file. **Terrain data:** electronic raster and/or vector data or paper cartographic maps.	**Annex 15,** 10.1 to 10.6 and APP 8
				4.1.1.2	Collect from recognized sources, validate for resolution, accuracy, integrity, reference geodetic datum and effective dates, and incorporate data into design file. **Obstacle data**: man-made and natural (tree/vegetation height).	**Annex 15,** 10.1 to 10.6 and APP 8
				4.1.1.3	Collect from recognized sources, validate for resolution, accuracy, integrity, reference geodetic datum and effective dates, and incorporate data into design file. **Aerodrome data**: ARP, runway, lighting, magnetic variation and rate of change, weather statistics, altimetry.	**Annex 15**, APP 7**,** APP 8 and 10.1 to 10.6
				4.1.1.4	Collect from recognized sources, validate for resolution, accuracy, integrity, reference geodetic datum and effective dates, and incorporate data into design file. **Aeronautical data:** airspace structure, classifications (controlled, uncontrolled, Class A, B, C... F, G, name of controlling agency), airways/air routes, altimeter transition altitudes/flight levels, other instrument procedure assessed airspace, area of magnetic unreliability.	**Annex 15**, APP 7 and APP 8

X	***Competency Unit***					
	X.X	***Competency Element***				
		X.X.X	***Performance Criteria***			
				X.X.X.X	***Evidence and Assessment Guide***	***Reference***
				4.1.1.5	Collect from recognized sources, validate for resolution, reference datum and effective dates, and incorporate data into design file. **Navaid data:** coordinates, elevation, service volume, frequency, identifier, magnetic variation, as well as existent waypoints significant to local navigation.	**Annex 15**, APP 7 and APP 8
				4.1.1.6	Collect, validate and incorporate **ATS requirements:** local traffic patterns (altitude, direction, airspeed), feeder/transitions, arrival/departures, preferred routes, ATS routes, communication facilities, and any ATS needs, restrictions or problems.	
				4.1.1.7	Collect, validate and incorporate aviation issues: Stakeholder requirements: State aviation authorities**,** air operators, airport authorities, aviation associations, municipal/civil authorities, environmental authorities.	
		4.1.2	**Apply criteria for VOR or NDB FAF procedure**	**4.1.2.1**	Plot track for final approach segment and check alignment criteria.	**II-2-4,** 4.4 **II-2-4**, 4.4.2 **I-4-5**, 5.2, 5.2.2
				4.1.2.2	Plot final approach fix.	**II-2-4,** 4.4
				4.1.2.3	Plot missed approach point.	**II-2-4**, 4.5.1
				4.1.2.4	Plot primary/secondary areas for final approach segment.	**II-2-4**, 4.4.4.1 **II-2-4**, 4.4.4.2 **II-2-4**, 4.4.4.3 **II-2-4**, 4.4.4.4 **I-4-5** ,5.4.6.2b
				4.1.2.5	Determine and label controlling obstacle for final approach segment.	**I-4-5**, 5.4
				4.1.2.6	For final approach segment apply appropriate MOC and descent gradient parameters and then determine obstacle clearance altitude OCA (H) in conjunction with missed approach segment obstacle clearance surface.	**II-2-4**, 4.4.3 **II-2-4**, 4.4.6.1 **I-4-5**, 5.3, 5.4
				4.1.2.7	Determine procedure altitude and descent gradient.	**II-2-4**,4.4.3.1 **II-2-4**,4.4.3.2
				4.1.2.8	Plot track for missed approach segment.	**II-2-4**,4.5.1
				4.1.2.9	Plot primary/secondary areas for missed approach segment.	**I-4-6**
				4.1.2.10	Determine and label controlling obstacle for missed approach segment.	**I-4-6**
				4.1.2.11	Determine missed approach obstacle clearance surface and respective climb gradient and define the obstacle clearance	**1-4-6**

X	*Competency Unit*					
	X.X	***Competency Element***				
		X.X.X	***Performance Criteria***			
				X.X.X.X	***Evidence and Assessment Guide***	***Reference***
					altitude OCA (H) in conjunction with final approach segment minimum altitude.	
				4.1.2.12	Determine missed approach instructions.	
				4.1.2.13	Determine and plot intermediate fix, if necessary.	**I-4-4**
				4.1.2.14	Plot track for intermediate approach segment.	**I-4-4,** 4.3
				4.1.2.15	Plot primary/secondary areas for intermediate approach segment.	**I-4-4,** 4.3.1
				4.1.2.16	Determine and label controlling obstacle for intermediate approach segment.	**I-4-4,** 4.3.2
				4.1.2.17	Apply appropriate MOC and descent gradient parameters and then determine minimum segment altitude.	**I-4-1,** 1.9 **I-4-4,** 4.3.3
				4.1.2.18	Determine procedure altitude and if necessary check descent to ensure a flat level.	**I-4-1,** 1.5.1, 1.5.2 **I-4-4,** 4.3.3
				4.1.2.19	Determine and plot initial approach fix.	**I-4-3**, 3.1
				4.1.2.20	Plot track for initial approach segment (or procedure turn).	**I-4-3**, 3.4, 3.5, 3.6, 3.7
				4.1.2.21	Plot primary/secondary areas for initial approach segment.	**I-4-3**, 3.3.3
				4.1.2.22	Determine and label controlling obstacle for initial approach segment.	**I-4-3**, 3.3.4
				4.1.2.23	Apply appropriate MOC and descent gradient parameters and then determine minimum segment altitude.	**I-4-1,** 1.9 **I-4-3**, 3.2, 3.3.5
				4.1.2.24	As required apply RASS calculations to all altitudes.	
				4.1.2.25	As required increase altitudes/heights for mountainous areas.	**I-2-1**, 1.7
		4.1.3	**Establish Minimum Sector Altitudes (MSA)**	**4.1.3.1**	Plot 25 NM minimum safe altitude(s).	**I-4-8**, 8.1 to 8.5
		4.1.4	**Document and store VOR or NDB FAF procedure**	**4.1.4.1**	For traceability, complete necessary submission forms in paper and/or electronic formats.	**Annex 15**, 3.2.4
				4.1.4.2	Create a sample instrument procedure graphical depiction.	**I-2-1**, 1.8, 1.9, 1.10
				4.1.4.3	Provide a summary of the logic and decisions used in the step-by-step design of the procedure.	

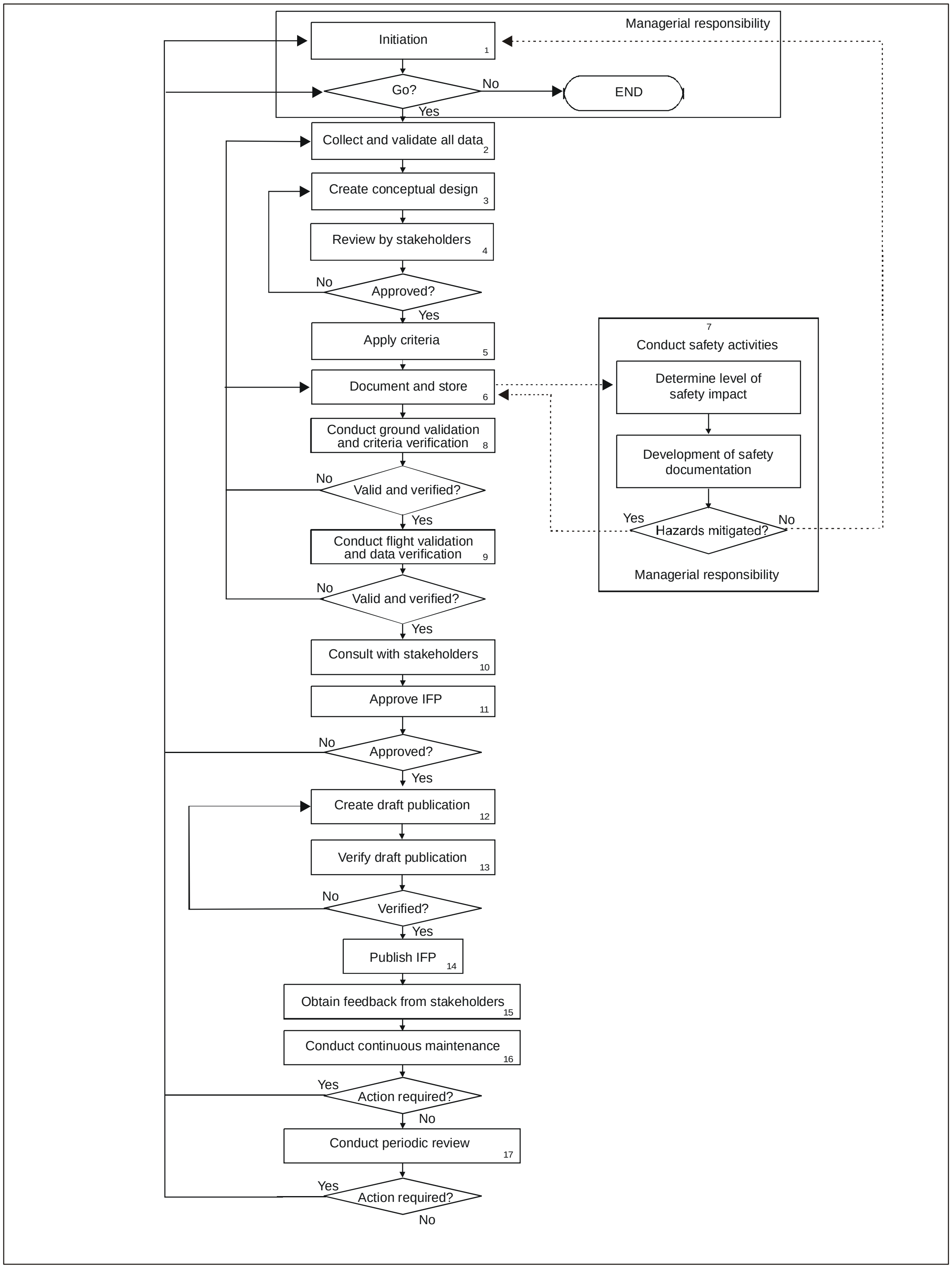
X	***Competency Unit***					
	X.X	***Competency Element***				
		X.X.X	***Performance Criteria***			
				X.X.X.X	***Evidence and Assessment Guide***	***Reference***
				4.1.4.4	Gather all information used and created in the design of the procedure, and assemble into an intuitive submission package.	
				4.1.4.5	Obtain traceability of consensus from stakeholders via signatures.	**Annex 15**, 3.2.4
				4.1.4.6	For traceability, store submission package in a secure format and area, easily accessible for future considerations.	**Annex 15**, 3.2.4
		4.1.5	**Ground verify and validate VOR or NDB FAF procedure**	**4.1.5.1**	Validate for resolution, integrity, reference geodetic datum and effective dates of all terrain data used in the procedure design.	**Annex 15**, 3.1.1.2, 3.1.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8
				4.1.5.2	Validate for resolution, integrity, reference geodetic datum and effective dates of all obstacle data used in the procedure design.	**Annex 15**, 3.1.1.2, 3.1.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8
				4.1.5.3	Validate for resolution, integrity, reference geodetic datum and effective dates of all aerodrome data used in the procedure design.	**Annex 15**, 3.1.1.2, 3.1.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8
				4.1.5.4	Validate for resolution, integrity, reference geodetic datum and effective dates of all aeronautical data used in the procedure design.	**Annex 15**, 3.1.1.2, 3.1.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8
				4.1.5.5	Validate for resolution, integrity, reference geodetic datum and effective dates of navaid data used in the procedure design.	**Annex 15**, 3.1.1.2, 3.1.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8
				4.1.5.6	Validate for intended use that identified ATS requirements have been incorporated into the procedure design.	
				4.1.5.7	Validate for intended use that identified stakeholder requirements have been incorporated into the procedure design.	
				4.1.5.8	Verify criteria application for track for final approach segment and check alignment.	**II-2-4,**4.4 **II-2-4**,4.4.2 **I-4-5**,5.2
				4.1.5.9	Verify criteria application for final approach fix.	**II-2-4,**4.4
				4.1.5.10	Verify criteria application for missed approach point.	**II-2-4**,4.5.1
				4.1.5.11	Verify criteria application for primary/ secondary areas for final approach segment.	**II-2-4**,4.4.4.1 **II-2-4**,4.4.4.2 **II-2-4**,4.4.4.3 **II-2-4**,4.4.4.4 **I-4-5**,5.4.6.2b
				4.1.5.12	Verify criteria application for controlling obstacle for final approach segment.	**I-4-5**, 5.4

X	***Competency Unit***					
	X.X	***Competency Element***				
		X.X.X	***Performance Criteria***			
				X.X.X.X	***Evidence and Assessment Guide***	***Reference***
				4.1.5.13	Verify criteria application for MOC and descent gradient parameters and obstacle clearance altitude OCA (H) in conjunction with missed approach segment obstacle clearance surface.	**II-2-4**,4.4.3 **II-2-4**,4.4.6.1
				4.1.5.14	Verify criteria application for procedure altitude and descent gradient.	**II-2-4**,4.4.3.1 **II-2-4**,4.4.3.2
				4.1.5.15	Verify criteria application for track for missed approach segment.	**II-2-4**,4.5.1
				4.1.5.16	Verify criteria application for primary/ secondary areas for missed approach segment.	**I-4-6**
				4.1.5.17	Verify criteria application for controlling obstacle for missed approach segment.	**I-4-6**
				4.1.5.18	Verify criteria application for missed approach obstacle clearance surface and respective climb gradient and the obstacle clearance altitude OCA (H) in conjunction with final approach segment minimum altitude.	**I-4-6**
				4.1.5.19	Verify criteria application for missed approach instructions.	
				4.1.5.20	Verify criteria application for intermediate fix, if necessary.	**I-4-4**
				4.1.5.21	Verify criteria application for track for intermediate approach segment.	**I-4-4**, 4.3
				4.1.5.22	Verify criteria application for primary/secondary areas for intermediate approach segment.	**I-4-4**, 4.3.1
				4.1.5.23	Verify criteria application for controlling obstacle for intermediate approach segment.	**I-4-4**, 4.3.2
				4.1.5.24	Verify criteria application for MOC and descent gradient parameters and minimum segment altitude.	**I-4-4**, 4.3.3
				4.1.5.25	Verify criteria application for procedure altitude and if necessary validate descent to ensure a flat level.	**I-4-4**, 4.3.3
				4.1.5.26	Verify criteria application for initial approach fix.	**I-4-3**, 3.1
				4.1.5.27	Verify criteria application for track for initial approach segment (or procedure turn).	**1-4-3**, 3.4, 3.5, 3.6, 3.7
				4.1.5.28	Verify criteria application for primary/secondary areas for initial approach segment.	**1-4-3**, 3.3.3

X	***Competency Unit***					
	X.X	***Competency Element***				
		X.X.X	***Performance Criteria***			
				X.X.X.X	***Evidence and Assessment Guide***	***Reference***
				4.1.5.29	Verify criteria application for controlling obstacle for initial approach segment.	**1-4-3**, 3.3.4
				4.1.5.30	Verify criteria application for MOC and descent gradient parameters and minimum segment altitude.	**I-4-3**, 3.2
				4.1.5.31	Verify criteria application for RASS calculations to all altitudes, as required.	
				4.1.5.32	Verify criteria application for altitudes/heights for mountainous areas, as required.	**I-2-1**,1.7
				4.1.5.33	Verify criteria application for all fix coordinates.	
		4.1.6	**Flight verify and validate VOR or NDB FAF procedure**	**4.1.6.1**	Verify for accuracy terrain data, obstacle data, aerodrome data, aeronautical data, and navaid data via flight.	**Annex 15**, 3.1.1.2, 3.1.4, 3.2.5, 3.2.6, 3.2.7, 3.2.8, 3.6.7
				4.1.6.2	Validate for intended use and flyability (human factors).	**Annex 15**, 3.6.7
		4.1.7	**Promulgate VOR or NDB FAF procedure**	**4.1.7.1**	Provide submission design package including a graphical depiction to the State aviation authority for promulgation via the Aeronautical Information Regulation and Control (AIRAC) document.	**I-4-1,** 1.5.1, 1.5.2, 1.7 **I-4-9** **I-4-5,** 5.5 **I-4-6,** 6.5.1, 6.5.2 **II-2-4**, 4.4-4.6 **Annex 4**, 11.1-11.10.9 **Annex 4**, APP 6 **Annex 4**, 2.1-2.1.6, 2.17.3, 2.2-2.18
				4.1.7.2	Distribute to stakeholders.	**Annex 15**, 6.1 to 6.3 and APP 4
		4.1.8	**Maintain VOR or NDB FAF Procedure**	**4.1.8.1**	On a continuous basis (as determined and notified by AIS) ensure that significant changes to obstacles, aerodrome, aeronautical and navaid data are assessed. Criteria and depiction changes are assessed only if required.	**Annex 15**, 3.1.1.2 and 5.1
				4.1.8.2	On a continuous basis ensure that significant changes to provisions that affect procedure design (stakeholder data and tombstone data) are assessed.	**Annex 15**, 3.1.1.2 and 5.1

Attachment B to Chapter 2

Procedure design process flow diagram



Note.— For details of each step, see textual description in the following pages.

Figure 2-1. IFP process flow diagram.

PROCEDURE DESIGN PROCESS FLOW TEXTUAL DESCRIPTION					
Step	*Description*	*Input*	*Output*	*Parties Involved*	*References*
1	INITIATION At the starting point a "pre-design" request is made for a new flight procedure design (FPD) or a "modification" request to an existing FPD resulting from feedback, continuous maintenance or periodic review (see steps Nos. 12 to 14). Justification for the FPD must be clearly stated and must be in accordance with the airspace concept and the State navigation strategy. It is a managerial responsibility to make a decision at this point to "go" or "no go".	• Request from a stakeholder for a new or a modified procedure. • Review of an existing procedure. • Navigation strategy considerations. • Resource planning. • Feedback on existing procedure.	• Managerial decision to set up the procedure design process or to discontinue the activity.	• Stakeholders	• ISO 9001:2000: section 7.2.1 "Determination of requirements related to the product"; section 7.2.2 "Review of requirements related to the product"; section 7.3.1 "Design and development planning"; and section 7.3.2 "Design and development inputs".
2	COLLECT AND VALIDATE ALL DATA • Specific ATS stakeholders' requirements: local traffic patterns (altitude, direction, airspeed), feeder/transitions, arrival/departures, preferred routes, ATS routes, communication facilities, time, restrictions and any ATS needs, restrictions or problems. • The designer is to collect from recognized sources, validate for resolution, integrity, reference geodetic datum and effective dates, and incorporate the following data into a design file: – Terrain data: electronic raster and/or vector data or paper cartographic maps. – Obstacle data: man-made and natural (tower/tree/vegetation height). – Aerodrome/heliport data: ARP/HRP, runway, lighting, magnetic variation and rate of change, weather statistics, altimetry source. – Aeronautical data: airspace structure, classifications (controlled, uncontrolled, Class A, B, C, D, E, F, G, name of controlling agency), airways/air routes, altimeter transition altitudes/flight levels, other instrument procedure assessed airspace, area of magnetic unreliability. – Navaid data: coordinates, elevation, service volume, frequency, identifier, magnetic variation. • Existent waypoints significant to the planned navigation.	• All stakeholder requirements. • Previous designs. • Data from State-recognized sources. • All other data.	• Preliminary work file containing summary of stakeholder requirements, summary of all data.	• Designer • ATM, AIS • Stakeholders • Data sources (e.g. surveyors, charting agencies, MET Offices, etc.)	• *Safety Management Manual* (Doc 9859). • *Quality Assurance Manual for Flight Procedure Design* (Doc 9906). • ISO 9001:2000. • Annexes 11, 14, 15. • *World Geodetic System-1984 (WGS-84) Manual* (Doc 9674). • ED 76/RTCA DO 200. • ED 77/RTCA DO 201. • ED 98/RTCA DO 276. • Eurocontrol Doc P357/DO 002-2. • ISO 9001:2000. • *Guidelines for electronic terrain, obstacle and aerodrome mapping information* (Doc 9881).

PROCEDURE DESIGN PROCESS FLOW TEXTUAL DESCRIPTION					
Step	*Description*	*Input*	*Output*	*Parties Involved*	*References*
3	CREATE CONCEPTUAL DESIGN A conceptual design is drafted with the key elements considering the overall strategy.	• Preliminary work file.	• Conceptual design.	• Designer.	• Doc 8168 (or applicable criteria) • *Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual* (Doc 9905) (or applicable criteria) • ISO 9001:2000: section 7.3.1 “Design and development planning”.
4	REVIEW BY STAKEHOLDERS Formal agreement and approval of the conceptual design is sought at this stage. If agreement and approval are not possible then either the designer must redesign the conceptual design or the stakeholders must reconsider their requirements.	• Work programme to serve as basis for decision, including the scope of the activity to be performed. • Conceptual design.	• Formally approved conceptual design or formal decision to discontinue, updated with any consequential changes, if applicable. • Planned implementation AIRAC date, based on available resources and any other technical/ operational/training constraints.	• All concerned stakeholders. • Designer and management.	• ISO 9001:2000: section 7.3.1 "Design and development planning"; and section 7.3.4 "Design and development review".
5	APPLY CRITERIA Using the stakeholder-approved conceptual design, apply criteria.	• Preliminary work file. • Formally approved conceptual design. • Planned implementation AIRAC date. • Resource allocation for the design and planning for publication.	• FPD. • Draft procedure layout. • Report. • Calculation outputs. • Coordinates. • Textual description of the procedure.	• Designer.	• Doc 8168 (or applicable criteria) • Doc 9905 (or applicable criteria) • ISO 9001:2000: section 7.3 “Design and development”

PROCEDURE DESIGN PROCESS FLOW TEXTUAL DESCRIPTION					
Step	*Description*	*Input*	*Output*	*Parties Involved*	*References*
6	DOCUMENT AND STORE • For traceability, complete necessary submission/calculation forms in paper and/or electronic formats. • Create a draft instrument procedure graphical depiction. • Provide a summary of the logic and decisions used in the step-by-step design of the procedure. • Gather all information used and created in the design of the procedure and assemble into a submission package. • Obtain traceability of consensus from stakeholders via signatures. • Store submission package in a secure format and area, easily accessible for future considerations.	• FPD. • Draft procedure layout. • Report. • Calculation outputs. • Coordinates. • Textual description of the procedure.	• Data store FPD containing: all calculations; all forms and reports, including consensus from stakeholders; all charts/maps AIRAC textual description; path terminators (if applicable); and procedure plate (draft graphical depiction).	• Designer.	• Doc 8168 (or applicable criteria). • Doc 9905 (or applicable criteria). • Annexes 4 and 15. • Doc 9906. • State depiction standards. • State forms.
7	CONDUCT SAFETY ACTIVITIES Determine level of safety impact Perform an assessment of the magnitude of change to determine the amplitude needed for the safety case. Develop Safety documentation Safety documentation to be provided for the implementation of a new procedure should be agreed at this stage. Normally the Safety Management System to be used is defined for the ANSP affected by the change or by the regulator responsible for the area where the procedure will be implemented.	• FPD containing draft procedure layout, report, calculation outputs, coordinates, textual description of the procedure.	• Formal statement on the significance of change, allowing to determine the amplitude of the safety case that needs to be performed.	• Quality and safety officer, affected stakeholders, supported by designers.	• EUROCONTROL Safety Regulatory Requirement (ESARR 4, Section 5) • Doc 9859. • ISO 9001:2000. • European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) Safety Assessment Method • State Safety Management System documentation (e.g. UK CAA Doc 675)
8.	CONDUCT GROUND VALIDATION AND CRITERIA VERIFICATION • Validate all data used in the procedure design (i.e. data resolution and format). • Validate the "intended use" of FPD as defined by stakeholders and described in the conceptual design. • Verify that the criteria have been properly and accurately applied.	• FPD package. • Safety case.	• Ground validated IFP.	• Designer. • Validation team.	• Doc 8168 (or applicable criteria). • Doc 9905 (or applicable criteria) • Annexes 4 and 15.
9.	CONDUCT FLIGHT VALIDATION AND DATA VERIFICATION • Verify for accuracy of terrain data, obstacle data, aerodrome data, aeronautical data, navaid data. • Validate the "intended use" of FPD as defined by stakeholders and described in the conceptual design. • Validate flyability and/or human factors. • Validate safety case.	• Ground validated IFP. • Safety documentation.	• Validated IFP.	• Designer. • All concerned stakeholders. • Flight validation organization. • Flight inspection organization.	• Doc 8168 (or applicable criteria). • *Manual for Testing of Radio Navigation Aids* (Doc 8071) • Doc 9906, Vol. 1.

PROCEDURE DESIGN PROCESS FLOW TEXTUAL DESCRIPTION					
Step	*Description*	*Input*	*Output*	*Parties Involved*	*References*
10.	CONSULT WITH STAKEHOLDERS • Submit all pertinent information to all relevant stakeholders for consultation.	• Validated IFP.	• Stakeholder endorsement.	• Designer. • Relevant stakeholders.	• National regulations as appropriate.
11.	APPROVE IFP • Provide IFP documentation to the designated authority for approval.	• Validated IFP. • Stakeholder endorsement.	• Approved IFP.	• Designer. • Designated authority.	• National regulations as appropriate.
12.	CREATE DRAFT PUBLICATION • Provide FPD package, including a graphical depiction, to the AIS to create a draft publication.	• Approved IFP.	• Draft publication.	• Designer. • AIS.	• Annexes 4 and 15 • ISO 9001:2000 section 4.2 “Documentation requirements”; section 7.3.5 “Design and development verification”
13.	VERIFY DRAFT PUBLICATION • Verify the draft publication for completeness and consistency.	• Draft publication. • Validated FPD.	• Cross-checked draft publication. • Decision for publication release.	• Designer. • AIS/aviation authority.	• Regional/national regulation • Doc 8168, Vols. I and II (or applicable criteria) • All applicable Annexes and Docs • ISO 9001:2000 section 7.3.5 “Design and development verification”; and section 7.3.6 “Design and development validation”
14	PUBLISH IFP • AIS initiates the AIRAC process.	• Cross-checked draft publication. • Decision for publication release.	• AIP chart, documentation.	• AIS.	• Annexes 4 and 15
15	OBTAIN FEEDBACK FROM STAKEHOLDERS • Request and analyse feedback from stakeholders on the acceptability of the work performed. • Cross-check the AIP chart, documentation.	• AIP chart, documentation • Reports from stakeholders.	• Decision for ongoing activities.	• Manager of the design office. • Stakeholders.	• Standards for processing aeronautical data (EUROCAE ED-76/ RTCA DO-200)
16	CONDUCT CONTINUOUS MAINTENANCE • On a continuous basis ensure that: – significant changes to obstacles, aerodrome, aeronautical and navaid data are assessed; and – significant changes to criteria and design specification that affect procedure design are assessed to determine if action is required prior to the periodic review. • If action is required, return to Step No. 1 to re-initiate process.	• Significant changes in the FPD environment or design criteria changes that are safety related.	• Revision as required.	• Designer. • Regulator. • Procedure owner. • Pilots (when applicable and possible).	• Doc 8168 (or applicable criteria) • Doc 9905 (or applicable criteria) • Annexes 4 and 15 • Doc 9859 • Doc 9906

PROCEDURE DESIGN PROCESS FLOW TEXTUAL DESCRIPTION					
Step	*Description*	*Input*	*Output*	*Parties Involved*	*References*
17	CONDUCT PERIODIC REVIEW • On a periodic basis (periodicity determined by State, but no greater than five years) ensure: – that all changes to obstacles, aerodrome, aeronautical and navaid data are assessed; and – that all changes to criteria, user requirements and depiction standards are assessed. • If action is required, return to Step No. 1 to re-initiate process.	• All changes in the FPD environment, design criteria or depiction standards.	• Revisions as required.	• Designer. • AIS/aviation authority.	• Doc 8168 (or applicable criteria) • Doc 9905 (or applicable criteria) • Annexes 4 and 15 • Doc 9859 • Doc 9906

Chapter 3

DESIGNING CURRICULUM

3.1 INTRODUCTION

3.1.1 The following paragraphs describe different types of flight procedure design training. All types are interdependent. Therefore, when planning the most effective and efficient training path, training providers and other stakeholders need to bear in mind the interdependence of these different types of training. Each organization will achieve training effectiveness and efficiency in different ways.

3.1.2 The duration of a course should not be determined a priori but derived from a course plan that is competency-based. It is recognized, however, that the duration of a course impacts cost-effectiveness for both training providers and their clients. As the duration of a course is lengthened, the client organization faces a human resource planning challenge. As the duration of a course is shortened, the training provider faces a training quality and training effectiveness challenge. For longer training phases (e.g. four weeks or longer) consideration should be given to breaking the long period into multiple shorter training periods.

3.1.3 Training providers can address these challenges by determining more or less stringent prerequisite skills, knowledge and attitudes for ab initio and initial training. This will impact the time required to achieve training objectives. The course duration can then be adjusted accordingly.

3.1.4 The final goal of training is to ensure flight procedure designers perform to the requirements specified in the competency framework. This cannot be achieved solely through initial training; on-the-job training is critical. The interdependence of initial and on-the-job training also impacts course duration. More or less time will be needed for on-the-job training depending on the stringency of performance standards to be achieved during initial training.

3.1.5 In addition, training needs vary among States. This is partially due to the emergence or obsolescence of technologies for which a flight procedure design is required within that State. Therefore, training providers may include or exclude parts of training depending on the training needs. This again will impact course duration and prerequisite skills, knowledge and attitudes. For example, some States may require the inclusion of RNAV competency elements within initial training, while others may require it as recurrent or advanced training.

3.1.6 It will be up to each training provider to establish a balance between the factors described above while ensuring the quality and effectiveness of training.

3.1.7 Course developers, course instructors and trainees are all stakeholders in the instructional process.

- Course developers are responsible for the development and production of all course materials. Their goal is to produce training packages that can stand alone, are material-dependent and performance-oriented.

- Course instructors are responsible for delivery of all course content and instructional events. They are responsible for completing all activities involved in the instructional process as well as guiding and counselling trainees.

– Trainees are responsible for actively engaging in the training and the successful completion of all course module activities and assessment materials.

3.1.8 In order for a trainee to achieve full competency on the job, he or she will go through a training programme consisting of several phases of training. These phases of training are described in 3.2. Depending on the trainee's entry level of skill and knowledge, he or she may forego parts of some phases of training. Each phase of training will involve a curriculum development process. The steps to carry out curriculum development are to:

– state the aim of the training;

– derive terminal and enabling objectives from the competency framework identified in Chapter 2;

– design a competency-based mastery test for each terminal objective;

– ensure that all skills, knowledge and attitude required for each enabling objective are covered;

– sequence terminal and enabling objectives; and

– group objectives into modules.

3.2 TRAINING PHASES

3.2.1 Ab initio training

Before conducting initial training, the skills and knowledge of the trainees are assessed. Procedure designers can be recruited from different domains (ATM, AIS, engineer, technician, pilots, just to name a few) therefore their skills and knowledge vary, and ab initio training may be necessary to meet the entry level required in the different domains to be able to successfully complete initial training (see 3.2.2). Ab initio training will not cover any procedure design technique or criteria, but basic skills and knowledge that need to be mastered prior to commencing initial training. The purpose of ab initio training is to harmonize trainees' entry skills and knowledge before they start initial training. The programme for this phase of training should not be developed from the competency framework.

3.2.2 Initial training

3.2.2.1 Initial training is the first phase of training where actual procedure design topics and criteria are covered. The purpose of initial training is to provide basic skills and knowledge to procedure designers who have been recently recruited or transferred from another job. The curriculum of initial training is derived from the competency framework. The associated duration and mastery test are relevant to the programme.

3.2.2.2 Initial training should be followed by on-the-job training in order to ensure that the acquired skills and knowledge from initial training are consolidated.

3.2.3 On-the-job training (OJT)

While on-the-job training cannot be considered a specific training course in the formal sense, it is an essential phase in a training programme. Its purpose is to reinforce formal training and support the achievement of competency standards.

Similar to initial training, the on-the-job training curriculum will be derived from the competency framework and driven by training objectives. If appropriate, OJT phases can also follow advanced or refresher training.

3.2.4 Advanced training

The purpose of advanced training is to augment the skills and knowledge of active procedure designers in dealing with more complex procedure design problems. The curriculum of advanced training should be derived from the competency framework.

3.2.5 Recurrent training

The purpose of recurrent training is to address changes in the available criteria and regulations. It is essential that the procedure designer updates his or her knowledge and skills in accordance with the latest criteria and technologies and benchmarks his or her usual design process against identified best practices. Regular recurrent training should therefore be planned accordingly.

3.2.6 Refresher training

The purpose of refresher training is to strengthen skills and knowledge that have weakened through disuse and the passage of time. Given the safety-critical nature of the flight procedure design function, it is strongly recommended that designers identify skills and knowledge that have weakened with time and that refresher training be planned accordingly. The refresher training curriculum should be derived from the competency framework.

3.3 DETERMINING THE PREREQUISITE SKILLS, KNOWLEDGE AND ATTITUDE

3.3.1 General

3.3.1.1 Personnel intending to attend initial training need to meet the requirements stated in 3.3.2 to 3.3.4. Training providers are encouraged to deliver ab initio training to ensure that trainees meet the entry prerequisites. Entry prerequisites are established mainly to assure that the training objectives set for the training can be met within the duration established for the training. Failure to comply with the prerequisites established by the training provider will not necessarily lead to exclusion from the training but may impact a trainee’s ability to meet training objectives within the duration of the training.

3.3.1.2 It should be noted that it is the responsibility of the training provider to establish and assess prerequisites for initial training. The prerequisite skills listed in 3.3.1 to 3.3.3 refer to knowledge and skills which will be used during the initial training.

3.3.1.3 Training providers of advanced, recurrent or refresher training for experienced designers must be responsible for establishing entry prerequisites according to the training objectives and duration of the respective training.

3.3.1.4 Such prerequisites can vary depending on whether training providers offer advanced, recurrent or refresher training as “open” courses where participants come from a variety of States and backgrounds or as “tailored” courses aimed at a specific client where personnel have similar homogeneous expertise.

3.3.2 Mathematics

3.3.2.1 Algebra

Trainees should be competent in algebra to at least the level of resolving equations with two unknowns and handling operations of the third level (exponentiation, radical, logarithms and angular functions). This requirement will assure the understanding of formulas given in the relative criteria documents as well as the ability to follow rationales on which certain criteria are based.

3.3.2.2 Geometry

Trainees should be familiar with the classical Euclidian geometry (plane geometry, solid geometry) as well as Thales and Pythagoras constructions.

3.3.2.3 Trigonometry

Trainees should be competent in all trigonometry functions such as sine, cosine, tangent, cotangent, secant and cosecant. Furthermore they should be familiar with trigonometry theorems such as the theorem of sines and the theorem of cosines.

3.3.2.4 Probability and statistics

Trainees should have basic knowledge of statistical and probability mathematics, particularly an understanding of the Gaussian (normal) distribution.

3.3.3 Aviation or aviation-related prerequisites

3.3.3.1 The job profile of an instrument flight procedure designer requires knowledge in various fields of activity in aviation. Training providers are encouraged to offer ab initio training covering the following prerequisites that should be met by the trainee so as to ensure that the length of the procedure design training can be optimized.

3.3.3.2 Air traffic management

Trainees should demonstrate fundamental knowledge of air traffic management (ATM) as in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) as well as understanding the broad concept of ATM which consists of ATS including air traffic control, air traffic flow management, airspace management and other fields related to ATM such as route spacing, ATC separation and aviation weather.

3.3.3.3 Navigation, navigation systems and geography

Trainees should demonstrate knowledge of navigation, navigation systems and geography to the level of any pilot's licence with instrument rating (IR). It is not, however, a requirement to hold such a license.

3.3.3.4 Aircraft operations

Trainees should demonstrate knowledge of the basics of flying and aerodynamics. It is not, however, a requirement to hold a pilot's license.

3.3.3.5 Aircraft performance

Trainees should demonstrate knowledge of aircraft performance to the level of any pilot's license with instrument rating (IR). It is not, however, a requirement to hold such a license.

3.3.3.6 Aeronautical information services

Trainees should demonstrate fundamental knowledge of Annex 15 — *Aeronautical Information Services*.

3.3.3.7 Aerodrome safeguarding

Trainees must be familiar with the basic requirements for aerodrome safeguarding (Annex 14, Obstacle limitation surfaces, Aerodrome reference codes).

3.3.3.8 Geodesy

3.3.3.8.1 Geodesy, also called geodetics, is the scientific discipline that deals with the measurement and representation of the Earth, its gravitational field and geodynamic phenomena (polar motion, earth tides and crustal motion) in three-dimensional, time-varying space. Geodesy is primarily concerned with positioning and the gravity field and geometrical aspects of their temporal variations, although it can also include the study of the Earth's magnetic field.

3.3.3.8.2 Trainees should demonstrate fundamental knowledge in the following areas of geodesy:

- geoid and reference ellipsoid;
- coordinate systems in space;
- coordinate systems in the plane;
- heights;
- geodetic datums and datum conversion;
- point positioning;
- units and measures on the ellipsoid;
- geodetic principal problem; and
- geodetic inverse problem.

3.3.4 Language

3.3.4.1 In order to progress through the competency-based training outlined above, trainees need to demonstrate their ability to achieve the terminal objective related to the competency elements. As training will be delivered within a certain timeframe, it is important that trainees learn the material within the time allocated. For this reason, proficiency in the language in which training will be delivered (instruction and training materials) is essential.

3.3.4.2 As an example for courses in English, training providers could require a score of 550 in the written TOEFL (Test of English as a Foreign Language), 213 in the TOEFL Computer-Based Test, 79 in the TOEFL Internet-Based Test and 750 in TOEIC (Test of English for International Communication) for trainees whose native language is not English. Alternatively, a score of 6.5 in the IELTS Academic Module (International English Language Testing System) can be accepted. Trainees having studied at an English-speaking institution for one year or longer can be exempted from providing a TOEFL or IELTS score.

3.3.4.3 Training providers offering courses in languages other than English should establish similar prerequisites.

3.4 PROCESS TO DERIVE TRAINING OBJECTIVES FROM THE COMPETENCY FRAMEWORK

3.4.1 Training providers must establish training objectives for all courses offered. Training objectives must be established using the competency framework in Chapter 2. The training provider must define which competency elements must be mastered at the end of course modules and establish training objectives for each module accordingly.

It should be noted that training providers can use different courses and different methods to support trainees in achieving similar objectives. Course durations, course titles and course content will vary depending on the training provider. It is emphasized that establishing the training objectives for a course with a given duration will always have an impact on entry requirements (prerequisite skills) for the course.

3.4.2 Example for establishing training objectives for instrument flight procedure designer training

3.4.2.1 Training objectives are comprised of three parts: conditions of performance, expected behaviour and a standard. There are two types of training objectives: terminal objectives and enabling objectives.

Terminal objectives are derived from competency elements. For example: Within Competency Unit 4, we find Competency Element 4.1, Designing a VOR or NDB FAF procedure. A terminal objective can then be formulated as follows:

Conditions of performance	Given maps and other documents containing validated data,
Expected behaviour	the trainee will design a VOR or NDB FAF procedure
Standard	in accordance with Doc 8168.

3.4.2.2 A trainee will then undergo a module of training, and at the end of it, the trainee will be required to perform the terminal objective as formulated in a mastery test.

3.4.2.3 In order to achieve the terminal objective, there are several enabling objectives the trainee needs to master. Enabling objectives may be derived from performance criteria. For example: for competency element 4.1, Performance Criterion 4.1.1 states “Collect, validate and incorporate electronic/paper data”. One enabling objective of the module on the “design of a VOR or NDB FAF procedure” would be:

Conditions of performance	Using standard forms and/or software,
Expected behaviour	the trainee will collect, validate and incorporate electronic/paper data
Standard	with accuracy upon prescribed confidence level, within an acceptable time period.

3.4.2.4 To be able to achieve this enabling objective, the trainee will require specific knowledge and skills. For example the trainee is required to:

Skills	– apply methods to identify corrupt data; and – verify that the latest edition of such data is received and used.
Knowledge	Identify all sources of necessary data such as maps, charts, obstacles, navigation aids, digital terrain, obstacle database extracts, etc., as well as the format in which the data are to be collected.
Attitude	Ensure accuracy of data.

Refer to 2.4 for general information on skills, knowledge and attitudes.

3.4.3 Establishing on-the-job training objectives

3.4.3.1 Establishing on-the-job training objectives from the competency framework in Chapter 2

The purpose of the OJT phases is to consolidate the knowledge and skills acquired during initial training. Training objectives for OJT phases must be established from the competency framework. In fact, the difference between the training objectives and the OJT objectives is the standard which trainees should achieve to demonstrate that they have mastered the competency. Often it is not possible to achieve full mastery of a competency through training alone. Experience and practice on the job are required to meet the full performance standard stated in the competency framework. When deriving training objectives, especially for initial training, the course development team should determine the performance standard they expect trainees to achieve. For example, it may not be possible to expect a trainee to design a VOR or NDB FAF procedure without errors. There may be a minimum number of errors that are acceptable in the achievement of this objective. The acceptable number and type of errors should be discussed by the course development team with input from subject matter experts. Some errors, even during training, may not be acceptable because they indicate a lack of skill, knowledge or positive attitude that may impact safety. Other types of errors are less critical and may be acceptable in initial training. OJT objectives, however, need to be as close or equivalent to the expected job performance. Therefore the standards for OJT objectives are more demanding.

3.4.3.2 Example for establishing OJT training objectives

3.4.3.2.1 The following example is based on the same one used in 3.4.2. The terminal objective for the OJT phase following a training course is derived from the competency elements. In this example, “Competency Element 4.1, Designing a VOR or NDB FAF procedure” is used as the OJT terminal objective. In order to achieve the OJT terminal objective, there are several enabling objectives the trainee needs to master. Enabling objectives can be derived from the performance criteria. See the following explanations:

3.4.3.2.2 Performance Criterion 4.1.1: Collect, validate and incorporate electronic/paper data for VOR or DME FAF procedure (enabling objective)

The student must be able to get all necessary data such as maps, charts, obstacles, navigation aids, digital terrain and obstacle database extracts. He or she can identify all the sources from where data can be received and in what format the data should be delivered (collection phase).

The trainee must be able to validate the received data using methods for identification of corrupt data. Furthermore the student must be able to assure that the latest edition of such data is received and used (validation phase).

The student must incorporate the data into his or her work using recognized methods. He or she will verify the impact of transformations of existing procedures and ensure that the data are processed in the procedure design work in a correct manner (incorporation phase).

Example: Obstacles are extracted from a database and are delivered in WGS-84 format. The procedure design work is done overlaying a map using a different geodetic reference datum such as a Bessel Ellipsoid, and the map projection is an Oblique Mercator Projection. The trainee must be able to convert the data into the correct frame of reference for further use.

3.4.3.2.3 Performance Criterion 4.1.2: Apply criteria for VOR or DME FAF procedure (enabling objective)

The student must demonstrate knowledge of the required criteria for the procedure. He or she must be able to apply them in a realistic procedure design and ATM environment.

3.4.3.2.4 Performance Criterion 4.1.3: Establish Minimum Sector Altitude (MSA) (enabling objective)

The student must demonstrate knowledge of the required criteria for establishing an MSA. He or she must be able to apply them in a realistic procedure design and ATM environment.

3.4.3.2.5 Performance Criterion 4.1.4: Document and store VOR or NDB FAF procedure (enabling objective)

The student must identify the necessary format and required content of information given in the documentation of his or her procedure design work. He or she must identify where such reports are stored and who has the rights for access as well as editing rights.

3.4.4 Skills, knowledge and attitudes required to achieve training objective

(See also sections 2.4 and 3.3.)

3.4.4.1 Example for establishing prerequisite skills, knowledge and attitudes to achieve training objectives

When a training provider has established training objectives for a course, it will be necessary to establish entry requirements for that course in order to assure that the objectives can be achieved in the time given. Training objectives, course length and prerequisite skills, knowledge and attitudes are always directly related. Course content, scope and course length in the following example are not meant to be prescriptive.

Course goal	At the end of this course, the participant will be able to design RNAV procedures in accordance with PANS-OPS (Doc 8168) and the competency framework specified in Chapter 2, Table 2-1, of this manual.
Target population	Active procedure designers who wish to refresh and/or improve their skills and knowledge in RNAV procedure design. Note.— Active procedure designers who never were trained in RNAV criteria may benefit from this course also.
Course duration	Two weeks/ten working days.
Prerequisites skills, knowledge and attitudes	Demonstrate sound knowledge and experience in the design of procedures for conventional navigation. Demonstrate SKAs outlined in 3.2.

Training providers are invited to state the prerequisites of the respective courses referring to the mastery of competency elements and performance criteria in Chapter 2 of this manual.

3.5 PROCESS OF SEQUENCING OBJECTIVES AND ORGANIZING MODULES OF TRAINING

3.5.1 The different training courses can be divided into modules. The flexibility of a modular approach allows training providers to cope with a variety of entry levels, to establish the most effective duration for the course, to address individual learning styles and characteristics, and to measure results on job performance.

3.5.2 The grouping of the objectives into modules and the sequencing of the modules define the training strategy. The objectives will describe what the trainees must be able to do after training. Objectives should be expressed in terms of measurable performance, i.e., elements derived from the competency unit or competency element of the framework provided in Chapter 2, 2.3.

3.5.3 A given module can have several terminal objectives, and each terminal objective will have several enabling objectives which describe the desired performance derived from performance criteria. Finally, OJT objectives describe what the trainee should be able to do after a defined period of practice on the job.

3.5.4 Each module should be designed to ensure that trainees are capable of performing the objectives to the standard required at the end of the module. This will normally require that the module follow the sequence described as:

a) defining what the trainee will be able to accomplish after learning (the objective);

b) explaining how the accomplishment will be tested (methodology);

c) stimulating the recall of prerequisite learning;

d) presenting the subject-matter content to be learnt, piece by piece (based on competency unit and performance criteria);

e) providing opportunities for the trainee to practice (laboratory exercises, projects, etc.);

f) reinforcing learning by providing feedback on the trainees' practice (enabling objective test, presentation);

g) assessing the performance of the trainee (mastery test); and

h) enhancing retention of what has been learnt so that it can be transferred to other situations (example of the trainee's strategy, presentation and listening to different projects by other trainees).

A variety of instructional techniques can be used to achieve training objectives including lectures, guided group discussions, case studies/projects, laboratory exercises, supervised practice, leaderless groups, field visits, e-learning, tutorials and on-the-job practice. For each training technique there are usually several alternative media for presenting information to the trainees, and these should be selected to suit the training objectives.

3.5.5 Examples of training

3.5.5.1 Below are examples of different module structures for an initial training course. The modules are sequenced differently depending on the terminal objectives the employing organizations expect the trainees to achieve.

Example 1:

The trainees have undergone ab initio training and are newly recruited. The employing organization expects trainees to be able to design non-RNAV non precision approach procedures. The course consists of six modules. Module 1 addresses the terminal objective derived from competency element 4.1, Module 2 competency element 4.2, Module 3 competency element 4.3, etc.

Example 2:

The trainees have undergone ab initio training and are newly recruited. The employing organization expects trainees to be able to design approach procedures based on conventional means and area navigation. The course consists of four modules as follows :

– **Module 1:** design non-RNAV non precision approach
  Six terminal objectives: 4.1 to 4.6 in the competency framework

– **Module 2:** design RNAV/RNP procedure
  Five terminal objectives: 4.7 to 4.11 in the competency framework

– **Module 3:** design an ILS procedure with and without glide path
  Three terminal objectives: 4.12 to 4.14 of the competency framework

– **Module 4:** design APV Baro VNAV
  One terminal objective: 4.19 in the competency framework

In this example, the trainee's employer expects that the procedure designer will be able to design approach procedures based on conventional means or area navigation.

As the example above illustrates, the duration of initial training courses will vary.

3.5.5.2 An example of a flight procedure designer training programme is provided in Attachment A to this chapter.

3.6 DEVELOPING MASTERY TESTS

3.6.1 Purpose of mastery tests

3.6.1.1 A mastery test evaluates a trainee’s ability to perform on the job. All trainees must be tested on their level of mastery of terminal objectives identified throughout the course. Training programmes must provide an appropriate level of assessment. As much as possible, mastery tests should match conditions, behaviours and standards of terminal objectives. While in certain types of training, for example flight crew training, this may not always be advisable, feasible or safe; in other types of training, such as flight procedure design training, it may be possible to closely approximate actual job performance conditions in classroom conditions.

3.6.1.2 Wherever possible the mastery test should require trainees to demonstrate the necessary ability to perform on the actual equipment. Test items should require trainees to demonstrate desired performance based on the terminal objective(s) being covered. Testing items must match the performance standard and conditions under which trainees are being evaluated as closely as possible.

3.6.1.3 Design of the mastery test should not take place until all terminal objectives have been clearly defined. Mastery tests can then be developed or outlined before putting together the training curriculum. Outlining the mastery test before producing a course structure allows for greater alignment between training and on-the-job performance. It is important to remember that trainees are being tested on their ability to perform specific tasks on the job. By designing tests before the curriculum is designed, tests can focus on the “need to know” rather than the “nice to know” thereby ensuring an efficient and effective use of training time.

3.6.2 Validity and reliability

3.6.2.1 The most important requirements of the mastery test are that it must be valid and reliable. A mastery test is considered valid if it measures what it is intended to measure. A valid test must therefore reproduce faithfully the conditions, behaviour and standards identified by the objectives and cover all skills, knowledge and attitudes required to achieve these.

3.6.2.2 A reliable test refers to the capability of yielding the same scores with different people scoring the test. The test should also yield comparatively similar results when administered at different points in time to equally competent trainees. The reliability of a mastery test is dependent on the quality of instructions provided to the trainee. It is important that test instructions are always complete, clear and unambiguous.

3.6.3 Mastery test format

3.6.3.1 Ideally, mastery tests would reproduce the conditions of a job performance. Simulations and case scenarios are a good example of a test format that reproduces these conditions. However, it may not always be possible to design mastery tests in these formats. Multiple choice or short-answer tests can be designed in such a way as to present a case in which the test-taker should demonstrate his or her ability to perform given terminal objectives. There are several advantages as well as disadvantages to the various types of test a training provider chooses to provide. Refer to Attachment B to this chapter for an outline of test selection criteria.

3.6.3.2 A mastery test should be based on the training objectives covered throughout the course. Developers of the course must describe the context in which observable and measurable outcomes will be identified. For each desired level of mastery, training programmes must structure testing materials on the basis of the competency framework outlined in Chapter 2. Refer to 2.3.1, as appropriate.

3.6.3.3 Mastery tests should:

– be balanced so that the distribution of items reflects the relative importance of the objectives being covered;

– be efficient so delivery of the exam is not too time-consuming; it should allow for quick but efficient scoring and the processing of results; and

– include a scoring key and a model answer (if appropriate) so that a minimum amount of interpretation is needed when scoring the trainee’s responses.

3.6.4 Mastery test design

3.6.4.1 For a given terminal objective, trainees will undergo a corresponding module or modules of training, and they will go through a mastery test at the end. During the mastery test the trainee will be required to perform the terminal objective as formulated by the training provider. Each terminal objective should be developed in accordance with the competency framework.

3.6.4.2 Based on the context of each training environment, it is up to the training provider to establish appropriate test items for the mastery test. Based on the example provided in 3.4.1, the following example is provided as an outline of a sample test:

a) Terminal objective:

Given valid sets of electronic/paper data, the trainee will be able to design a VOR or NDB FAF approach procedure using the following criteria: a) using standard forms and/or software, b) establish the minimum sector of altitudes, c) document and store VOR or NDB FAF procedures d) within an acceptable time period identified by the course instructor. All criteria are in accordance with the competency framework as derived from Doc 8168, Volume II.

b) Before writing a test item for this objective, the following questions should be answered:

– In what context is the terminal objective being carried out?

– What conditions are being stated for the trainee to complete the objective?

– What is the expected behaviour for this objective?

– To what standards should the behaviour be carried out?

Conditions. *Given maps and other documents containing validated data*
Behaviour. *Design a VOR or NDB FAF procedure*
Training standard. *In accordance with Doc 8168, Volume II.*

c) Sample test item based on the above terminal objective:

Given a valid set of electronic/paper data design for a VOR or NDB FAF approach procedure, design a procedure using the appropriate standard forms and/or the use of electronic software, with the minimum sector altitudes established. Be sure to document and store designated procedures as appropriate within the time allotted by the test instructions.

Note.— Differences in avionics systems need to be considered during the processing of aeronautical data. As a result, records from different automated systems may not always be consistent.

Figure 3-1 identifies the mastery test design process.

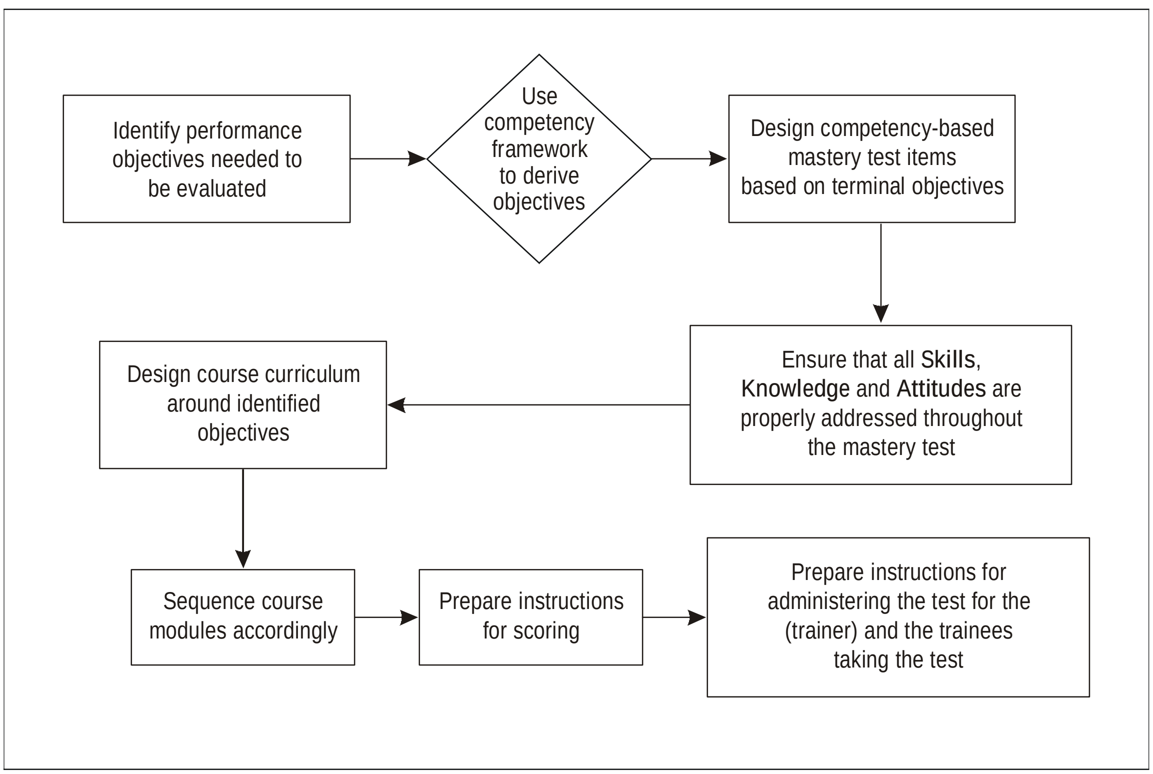


Figure 3-1. Mastery test design process

3.6.5 Progress test

3.6.5.1 The purpose of a progress test is to measure a trainee's ability to meet key enabling objectives. It provides immediate feedback to trainees regarding their success or failure to meet enabling objectives. During this part of the module, and through the feedback they obtain from trainees, instructors should consult with them on areas of difficulty or where additional clarification is necessary. Instructors use the feedback to assess the effectiveness of their instruction.

3.6.5.2 It is not feasible or advisable to administer progress tests for every enabling objective. However, the administration of a progress test should be considered for enabling objectives that are difficult or critical to the successful achievement of terminal objectives. The number of progress tests should therefore be based on a criticality analysis of enabling objectives.

3.6.5.3 Progress tests should be designed to address specific skills, knowledge and attitudes required to support enabling objectives. SKAs can be assessed in the following manner:

- skills are best measured when a performance test is utilized (the task must be assigned to match the outlined objective);
- knowledge may be tested through written or oral tests; and
- attitudes are measured through observations of specific performance or questionnaires.

3.6.5.4 Testing can be administered orally, in a written format or a combination of both modes. Each test item, irrespective of the form, should fulfil the following requirements:

- test appropriate level of skills, knowledge and attitude required by the objective;
- not be identifiable from similar or related questioning;
- clearly stated and unambiguous;
- arranged in an encouraging sequence to motivate trainees; and
- arranged by the type of testing item.

3.7 CONSIDERATIONS IN DESIGNING MODULES AND COURSE MATERIALS

3.7.1 The structure of each module must take into consideration the SKAs necessary to perform the desired objective(s). Module design should address any prerequisites necessary for trainees to reach the optimum level of performance or desired objective(s). Course modules and all learning materials should be developed using a systematic step-by-step approach.

3.7.2 Module design

3.7.2.1 The following instructional steps should be used throughout the course module for each enabling objective:

a) presentation of the objective and the mastery test;

b) indication of the relevance of the module content;

c) presentation of content;

d) clarification of main points;

e) provision of a practice opportunity or reinforcement;

f) provision of feedback for participants (progress test, etc.); and

g) performance of the objective and assessment of the achievement.

3.7.2.2 Course objective(s) and a description of the mastery test should be introduced at the beginning of the course module. This allows trainees to know exactly what is expected of them and how they will be evaluated at the end of the course. This will also reduce the level of anxiety for trainees but also help to keep instruction focused on the desired level of performance. At a minimum, the introduction should include:

a) the presentation of terminal or end-of-module objectives and the mastery test;

b) intermediate objectives;

c) activities provided in the module; and

d) any reference material on the subject matter and intended length of time of the module.

3.7.2.3 During the presentation of the module, it may be useful to provide a brief demonstration or sample of the desired performance. This may help motivate participants and provide relevant context for expected levels of proficiency. The relevance of the content being presented could be identified several different ways. One way is to ask participants: "What will happen if this is done?"

3.7.2.4 Presentation of content should be divided into manageable pieces of information. Course modules should be sequenced in a logical and interesting manner. The main points of module content should be clarified immediately after the elements of content have been presented.

3.7.2.5 Activities and practice items should be provided to support the successful achievement of training objectives(s). Trainees must be provided with several opportunities to review and practice the skills and knowledge being covered before taking a mastery or progress test. This will help to ensure trainees have mastered all enabling objectives leading to the desired performance of a terminal objective.

3.7.2.6 Once critical enabling objective(s) are completed a progress test may be necessary. Not in every situation will a course instructor need to test for the trainee's progress. For further description of when to test a trainee's progress, refer to 3.6.5.1 and 3.6.5.2.

3.7.3 Instructional events

3.7.3.1 Instructional events are identified as "any action, which moves the trainee towards the accomplishment of any instructional objective". When designing instructional events, course developers should ensure that they address any of the following functions:

a) gain attention and motivate trainee;

b) demonstrate what the trainee will be able to accomplish after learning;

c) demonstrate how accomplishments will be tested;

d) stimulate the recall of prerequisite learning;

e) present subject-matter content;

f) provide opportunity for trainees to make appropriate responses (activities to be performed by the trainee, partial practice, global practice);

g) reinforce learning by providing feedback (progress test etc.);

h) assess performance of trainees (mastery test, progress test etc.); and

i) enhance what has been learnt and transfer it to other situations (case studies, scenarios, simulations, etc.).

3.7.3.2 Instructional events may combine two or three of these functions at a time. As an example, if a course instructor wishes to gain attention and motivate trainees (a), he or she can simultaneously demonstrate what the trainee will be able to do after learning has occurred (b).

3.7.3.3 Presenting instructional events can vary depending on the content, materials or the trainees themselves. In any case, instructional events should be described and documented. For example, specific instructions should be provided on how instructors summarize discussions, how to organize a role-playing situation, or how to administer a mastery or progress test. When designing course modules, materials can be instructor-dependent or material-dependent. To help ensure a more consistent delivery of course content, course developers should design content that is material-dependent. Material-dependent courses are courses where the instructor requires minimum interpretation of course content. In this situation, instruction is dictated by the materials. This focuses the instructor's work on course facilitation. Instructor-dependent courses are courses where the instructional process is not documented. In this case, an inexperienced or new instructor will need to interpret and adapt the course materials. Material-dependent courses ensure that training is delivered in a consistent and reliable manner.

3.7.4 Production and development of material

3.7.4.1 In order to validate the complete training process, the technical accuracy of all training materials should be verified by subject matter experts; this helps to assure that all information presented is not only accurate but also current. This subject matter review will provide further assurance that the training materials actually meet the standards of task(s) trainees will eventually perform on the job.

3.7.4.2 A sample of individuals from the target population should be trained using a draft version of the instructional materials. The feedback from this validation delivery will be used to address any major flaws in course design and correct materials. All instruction and module terminology should be clearly defined and closely matched with the learning styles of trainees.

Attachment A to Chapter 3

EXAMPLE OF A FLIGHT PROCEDURE DESIGNER TRAINING PROGRAMME

1. BACKGROUND

1.1 General presentation of the training programme

1.1.1 This programme comprises training courses delivered by a training provider for initial, advanced, recurrent and refresher training and on-the-job training tutored by a qualified procedure design team. Ongoing competency-based assessments are conducted throughout the training programme.

1.1.2 It is strongly recommended that the trainee puts into practice what has been learnt as soon as possible after completion of the training courses. It can be useless to attend a training programme in procedure design if no application is planned in the short or medium term.

Note. — It is essential that procedure design be carried out by a team rather than a single person. A team approach is critical in ensuring that all points of view and assumptions are taken into consideration as well as to ensure quality.

Training flight procedure designers is a resource-intensive and lengthy exercise. Therefore, given the average expected duration of training, turnover should be limited as much as possible, as it will affect the efficiency and productivity of the flight procedure design team. It is suggested that a qualified procedure designer should work at least three years to balance the training cost. To limit this effect, it is recommended that the employing organization develop a recruitment plan, a training policy and a career development plan for procedure designers.

1.2 Training programme goal

Once the trainee has completed the training programme, he or she will be able to design IFR procedures, more specifically, non-precision approach procedures, precision approach procedures, standard instrument arrival (STAR), standard instrument departures (SID), using conventional means of navigation and RNAV information (VOR/DME, DME/DME, GNSS), RNP procedures and APV procedures, in accordance with standards specified in PANS-OPS (Doc 8168), Doc 9905 for RNP AR procedures, or any other applicable criteria.

1.3 Training programme duration

The training programme outlined in the example has a duration of approximately fifteen months, starting from ab initio training.

Note. — According to the employing organization's expectations, the training steps proposed here can be programmed in different ways, for instance, beginning with RNAV/RNP procedures.

2. TRAINING PROGRAMME STEPS

Step 0 – AB INITIO

- **Location:** Training provider, PDSPs.
- **Duration:** One week. This duration depends on the entry level required.
- **Goal:** Review basic knowledge and skills required for entry in initial training course.
- **Means:** Pre-test at the beginning of the course to identify the level of skill and knowledge of each trainee and post ab initio training test to ensure trainees meet initial training entry levels. Lectures and practical exercises.
- **Course Topics:**
  - Mathematics
  - System units
  - Basics of navigation
  - Basics of avionics
  - Altimetry
  - Cartography, scale, WGS-84 system, projection
  - Computer science

Step 1 – INITIAL TRAINING

- **Location:** Training provider, PDSPs.
- **Duration:** Six weeks.
- **Goal:** Design non-RNAV PA and NPA approach procedures and non-RNAV arrival and departure procedures.
- **Description:**
  A six-week course is provided in procedure design criteria NPA, PA, departure and arrival procedures for conventional means of navigation, finishing with a two-week practical work training period very close to "on-the-job" work. During the first four weeks of initial training in PANS-OPS, lectures and practical exercises are programmed to enable the trainees to acquire the knowledge and skills necessary to apply criteria for the design of the IFR non-RNAV procedures. During the last two weeks, the trainees will work in groups of two to perform the connection between STAR and approaches, then to design one NPA and one PA and one SID procedure. Then they will have to write the associated report and produce the corresponding instrument approach charts, SID and STAR charts. Part of the training should emphasize the attitude of the procedure designers as team players and their skill at communicating and presenting their work.
- **Module (from Competency elements):**
  - Module 1: Design Non RNAV NPA *(Competency Element 4.1-4.6, 5.1-5.6)*
  - Module 2: Design Non RNAV Arrival *(Competency Element 3.1, 3.3)*
  - Module 3: Design Non RNAV PA *(Competency Element 4.12, 4.13, 4.15, 4.16)*
  - Module 4: Design Non RNAV Departure *(Competency Element 1.1-1.3)*

- **Teaching points *(from the evidence and assessment guide in competency framework)*:**

  Module 1
  - Fix and tolerance calculation
  - Segment and protection area, MOC
  - Initial segment (racetrack, reversal procedure…)
  - Intermediate segment
  - Connection between segment and turn protection
  - Minimum altitude/procedure altitude computation
  - Holding pattern
  - NPA Straight in approach - final segment
  - NPA missed approach
  - OCH computation
  - Circling
  - Charting NPA – Annex 4

  Module 2
  - MSA
  - En-route and arrival criteria
  - Charting – Annex 4

  Module 3
  - Precision approach segment
  - OAS, Basic ILS Surface, CRM
  - Connection with intermediate segment
  - PA missed approach
  - OCH computation
  - ILS GP inoperative
  - Charting – Annex 4

  Module 4
  - Straight departure criteria
  - Turning departure criteria
  - Guided or dead reckoning track
  - Omnidirectional departure
  - Charting – Annex 4

  Additional units:
  - Annex 14 surfaces
  - Pilot point of view: flight simulation

- **Assessment:** Progress test and mastery tests administered as planned in the course module plan.

- **Expected level:** In accordance with the competency standards set in the terminal objectives for initial training.

Step 2 – ON-THE-JOB TRAINING – Initial

- **Location:** On site, tutored by a qualified procedure designer or instructor in procedure design designated by the appropriate authority.

- **Duration:** Fifteen weeks.

- **Goal:** Within the workplace, using the means available, improve the knowledge and skill on design of non-RNAV PA and NPA approach procedures and non-RNAV arrival and departure procedures in accordance with standards established in competency framework.

- **Description:** Under a tutorial frame.
  - Under the supervision of an OJT instructor, the trainee will design one NPA and PA procedure taking into account constraints such as noise abatement, airspace management and the airline's request.
  - The trainee should collect the data, design the selected procedures with the tools/means available at the local procedure design unit, and acquire the employing organization's method to integrate his/her work in the quality process, validation process and archiving process specific to the company/organization.
  - As part of his/her OJT, the trainee can technically handle some issues related to continuous maintenance of SID and STAR.

- **Competency elements:**
  - Design non-RNAV SID, STAR, NPA, and PA.

- **Additional units:**
  - Use of the specific tools such as excel sheet, software, geodetic calculator.
  - Use of the regulation documents, official websites dedicated to the activities.

- **Assessment:** Ongoing assessment against performance criteria for each competency element as work is carried out.

- **Expected level:** Non-RNAV NPA and PA can be designed for selected procedures in accordance with the terminal objective.

Step 3 – ADVANCED TRAINING I

- **Location:** Training provider, PDSPs.

- **Duration:** Three weeks.

- **Goal:** Given a more constrained environment such as ….., design procedures involving advanced criteria for departures and approach procedures in accordance with competency standards.

- **Description:** During the first week of training, instructional events such as lectures and practical exercises will provide skill and knowledge. During the last two weeks, the trainees will work in teams of two to design procedures on an airport with an obstacle-rich environment and/or operational constraints. Sharing of experience with other procedure designers will be encouraged in order to facilitate learning.

- **Module *(from Competency elements)*:**
  - Module 1: Departure for parallel runway *(Competency Element 1.7)*
  - Module 2: NPA in obstacle-rich environment *(Competency Element 4.1-4.6)*
  - Module 3: Non-standard ILS approaches *(Competency Element 4.14, 4.17)*

- **Teaching points *(from the evidence and assessment guide in competency framework)*:**
  - For SID: Departure for parallel runways
  - For NPA:
    - Use of step-down fixes in NPA
    - Turn at the missed approach point

- For PA:
    - Missed approach procedure as soon as possible
    - ILS with steep angle
    - Offset LOC

- **Additional unit:**
  - Noise abatement
  - Airspace management
  - Aeronautical study

- **Assessment:** Progress test and mastery tests administered as planned in course module plan.

- **Expected level:** Advanced criteria and design process for non-RNAV SID NPA and PA must be acquired in accordance with the standard specified in terminal objectives for this course.

Step 4 – ON-THE-JOB TRAINING – Advanced I

- **Location:** On site, tutored by a qualified procedure designer or instructor in procedure design designated by the appropriate authority.

- **Duration:** Twelve weeks.

- **Goal:** Non-RNAV SID and STAR can be designed for selected procedures in accordance with competency standards.

- **Description:**
  - Under the supervision of an OJT instructor, the trainee will design a selected STAR and SID omnidirectional departure and arrival among the procedures to be reviewed.
  - The trainee will participate with the OJT instructor in meetings and studies to be aware of and to take into account the constraints related to noise abatement, airspace management and airlines' requests.
  - The trainee should collect the data and design the selected procedures taking into account the constraints expressed.
  - Comply with the quality process, validation process and archiving process specific to the company/organization.
  - In the meantime, the trainee can technically deal with issues related to continuous maintenance of PA and NPA even in an obstacle-rich environment or constraining airspace.

- **Units of competency:**
  - Design non-RNAV SID/STAR omnidirectional departure and arrival.

- **Additional units:**
  - Noise abatement
  - Airspace management
  - Aeronautical study

- **Assessment:** Ongoing assessment against performance criteria for each competency element as work is carried out.

Step 5 – ADVANCED TRAINING II

- **Location:** Training provider.

- **Duration:** Three weeks.

- **Goal:** The trainee will be able to design RNAV and RNP SID STAR NPA and Design RNAV (VOR/DME, DME/DME and GNSS) and RNP NPA SID and STAR.

- **Description:** This course will be three weeks long and will consist of instructional events such as lectures, practical exercises and practical work conducted in teams of two. The flyability and efficiency of the RNAV/RNP procedure will be highlighted.

- **Module *(from competency element)*:**
  Module 1: Design RNAV NPA based on sensor VOR/DME, DME/DME, GNSS
  (Competency elements 4.7-4.10, 5.7)
  Module 2: Design RNAV terminal procedures (based on sensor)
  (Competency elements 1.4-1.6, 3.2, 3.4)
  Module 3: Design RNP procedures
  (Competency elements 4.11, 5.8)

- **Teaching points *(from the evidence and assessment guide in competency framework)*:**
  - Nominal track: strategy, minimum length, path terminator, flyability of a procedure, constraint, procedure altitude, minimum altitude
  - T and Y concept
  - Tolerance of the waypoint according to the different sensors
  - Fly by turn followed by TF
  - Fly-over turn followed by TF, DF
  - Connection between segment for wide and small turn
  - Protection area for each segment according to each sensor, e.g. initial, intermediate, final approach and missed approach
  - Critical navaid assessment for DME/DME sensor
  - Departure procedure
  - Departure with a turning altitude followed by a DF path terminator
  - Arrival criteria
  - Terminal arrival altitude
  - RNP criteria
  - Charting criteria
  - Waypoint coordinate calculation, resolution
  - Data encoding information

- **Additional units:**
  - GNSS concept (ABAS, SBAS, GBAS)
  - Information about the existing or ongoing system, time schedule
  - Airworthiness information
  - Pilot point of view: Flight simulation of the designed procedure in a flight simulator
  - CDA (Continuous Descent Approach)

- **Assessment:** Progress test and mastery tests administered as planned in course module plan.

Step 6 – ON-THE-JOB TRAINING – Advanced II

- **Location:** On site, tutored by a qualified procedure designer or an instructor in procedure design designated by an appropriate authority.

- **Duration:** Twenty weeks with a period of one week at the mid-point to attend the GBAS and APV Baro-VNAV, SBAS training course.

- **Goal:** The trainees will be able to design different types of RNAV/RNP approaches and arrivals/ departures. Through this training, they will improve, practice and gain confidence in the application of RNAV procedure criteria.

- **Description:**
  - Under the supervision of an OJT instructor, the trainee will design a selected RNAV NPA, PA and APV approaches, SID and STAR among the procedures to be reviewed, or propose the study of the improvement of the airspace management by implementation of an RNAV/RNP procedure.
  - The trainee should collect all the information by contacting and meeting with the ATC, airlines and airport authorities to define the present difficulties, analyse the issues and propose assumptions for enhancement of efficiency in the airspace management.
  - The trainee should collect the data, design the selected procedures with the tools/means available at the local procedure design unit, present the solutions, and amendments if necessary, and integrate the work in the quality process, validation process and archiving process specific to the company/organization.
  - In the meantime, the trainee can technically deal with issues related to continuous maintenance of NPA SID and STAR.

- **Units of competency:**
  - Design RNAV SID STAR NPA.

- **Additional units:**
  - Airspace management.

- **Assessment:** Ongoing assessment against performance criteria for each competency element as work is carried out.

Step 7 – ADVANCED TRAINING III

- **Location:** Training provider.

- **Duration:** One week in the middle of the previous on-the-job training.

- **Goal:** Design GBAS, APV Baro-VNAV, APV SBAS procedure.

- **Description:** This course will be one week long and will consist of instructional events such as lectures, practical exercises and practical work conducted in teams of two.

- **Module (from units of competency in competency framework):**
  - Design APV SBAS final and missed approach segment
  - Design APV Baro-VNAV final and missed approach segment
  - Design GBAS final and missed approach segment

- **Teaching points *(from the evidence and assessment guide in competency framework)*:**
  - GBAS OAS, basic surface, CRM
  - SBAS OAS
  - Extension of OAS
  - VSS
  - Baro VNAV surfaces
  - Intermediate and final segment connection
  - Straight-in missed approach
  - FAS data block
  - Data encoding
  - Waypoint coordinate calculation, resolution
  - Earth curvature impact

- **Additional units:**
  - Airworthiness information
  - VNAV avionic information
  - Pilot point of view: Flight simulation in a flight simulator of the designed procedure

- **Assessment:** Progress test and mastery tests administered as planned in course module plan.

Step 8 – RECURRENT TRAINING

- **Goal:** Maintain competency standards for newly developed procedure design features.

- **Description:** Update knowledge according to each PANS-OPS (Doc 8168) amendment by following a seminar/course/workshop and by meeting procedure designers and sharing experiences.

Step 9 – REFRESHER TRAINING

- **Goal:** Maintain and upgrade skills and knowledge in accordance with competency framework.

- **Description:** Update knowledge and strengthen skill after a long period of non-application of specific criteria.

Attachment B to Chapter 3

Test Selection Criteria

TYPE OF TEST	ADVANTAGE(S)	DISADVANTAGE(S)	SKAs TESTED	EXAMPLES
Simulation (a) Real performance in simulated situation	– Reduces consequence(s) of mistakes – Can create realistic dangerous situations – Reduces stress on trainees	– Scoring may be subjective (biased) if the scoring key is not explicit enough	All SKAs (application and transfer of learnt skills to novel situations)	– Design straight departure non-RNAV procedure – Design omnidirectional departure RNAV procedure
(b) Simulated performance in simulated situation	– Can create realistic portable and dangerous situation – No risk attendant on mistake – Little stress on trainees	– Further removed from real conditions (raises issue of validity)	All SKAs (Except physical skills)	– Case studies (varying degrees of complexity) – Identify best practices for an en-route procedure design – Recognize appropriate instruments for the design of VOR or NDB FAF procedure
Objective-Type (a) Alternate response (binary choice)	– Easy to construct – Permits coverage of many points (wide coverage) – Efficient (easy to take and score)	– Possibility of guessing the answer (reliability?) – Memorization of unrelated facts is encouraged – Cannot tell whether trainee has learnt or not	Knowledge Discrimination Classifying	True/False Test – Sequence of design preparation – Meaning of technical terms
(b) Multiple choice	– Can measure trainee's ability to make judgements of predetermined exactness – Easy to score and comparatively free from guessing	– Susceptible to clues (within construction of item, item choices) – Time-consuming and somewhat difficult to construct	Problem solving Classifying Discrimination Knowledge	– Choosing a particular procedure design based on a given problem situation among several alternatives – Recognize the proper criteria for RNAV/RNP standard instrument arrival procedure among a list provided.
(c) Matching	– Measures ability to recognize relationships and make associations – Economical – Requires less construction time than multiple choice items of equal quality	– Inferior to multiple choice in measuring fine discrimination understanding and judgement – Can provide clues, especially if the choice is limited to the number of items to be matched	Knowledge Discrimination Classifying	– Diagrams and specific measurements – Technical terms and their meanings – Sequencing order of specific design procedures – Sample design procedures requesting appropriate labels and terminology
Open Question	– Sharp and accurate evaluation – No introduction of erroneous items that can be then reminded by the trainees (as in, for example, multiple choice) – Easy to implement	– Scoring may be subjective – Time-consuming for correction	Comprehension versus memorization	– Modeling sophisticated obstacles as Hangar or Hill or railroad for CRM OCH calculation (in that case a figure is often provided)
Open question with short answer	– Sharp evaluation – Easy scoring – Particularly adapted when numerical answers are expected	– Not all items can be tested in this way	Knowledge Discrimination	– On an IAC indicate the item corresponding to the identification of procedures

TYPE OF TEST	ADVANTAGE(S)	DISADVANTAGE(S)	SKAs TESTED	EXAMPLES
Oral question	– Evaluation by « saying » versus « writing » – Direct contact with the assessor who can reword the question to really test the knowledge	– Often stressful – Scoring may be subjective	Knowledge Rapidity Ability to express, to present	– Using an IAC displayed, the trainee is questioned on the feasibility of the procedure if aircraft are coming from specific directions and why. Or application of specific criteria and why.
Project/thesis redaction and presentation (often in a team)	– Evaluation by saying and writing – Simulate real case – Develop team-player mindset	– Time-consuming for the realization by the trainee – Time-consuming for the assessor(s) – Scoring may be subjective – When it is a team project, sometimes difficult to score the trainee individually	Comprehension Process Link between all the different types of knowledge taught. Ability to take decisions and make choices regarding the hypothesis and to discuss and promote them. Synthesis ability Oral expression	– Design an RNP 0.3 procedure on a specific environment.

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Chapter 4

INSTRUCTOR COMPETENCIES

4.1 FLIGHT PROCEDURE DESIGN INSTRUCTOR COMPETENCIES

4.1.1 Flight procedure design competencies

4.1.1.1 In competency-based programmes, instructor competencies are made explicit, and instructors have to demonstrate their instructional skills and their knowledge in subject matter expertise and training course content.

4.1.1.2 Instructors must also meet all competency standards listed in the competency framework developed for flight procedure designers. The instructor must be able to provide rationales for the criteria provided in ICAO manuals. Furthermore, an appropriate level of experience in the practical field of flight procedure design is desirable.

4.1.1.3 The instructor must demonstrate mastery of all mathematical and geometrical problems associated with flight procedure design.

4.1.2 Instructional competencies

The instructor must have appropriate knowledge of the following fields:

a) techniques of applied instruction;

b) assessment of trainee performance;

c) the learning process;

d) elements of effective teaching;

e) trainee evaluation and testing, training and learning theories;

f) training programme development;

g) lesson planning;

h) classroom instructional techniques;

i) use of training aids; and

j) analysis and correction of trainee errors.

4.1.3 Maintaining instructional competency standards

It is considered essential that the instructors be given the opportunity to maintain their competency standards. This should be the responsibility of the training provider, and the instructors should be given adequate means to maintain both their flight procedure design and instructional competencies.

Chapter 5

VALIDATION AND POST-TRAINING EVALUATION OF FLIGHT PROCEDURE DESIGNER TRAINING

5.1 INTRODUCTION

This chapter describes the process concerning validation and post-training evaluation of flight procedure designer training. The purpose of this process is to ensure a harmonized level of effective training. Four levels of evaluation have been identified; each of the four levels will discuss the role and responsibilities of the following organizations:

– State authorities that approve training conducted by procedure design service providers (PDSPs), training providers, etc. (see *Note*);

– PDSPs that conduct design (and/or promulgation, as appropriate) of flight procedures; and

– training providers for flight procedure design.

Note.— Any statement in this manual does not imply that the State authority must approve and/or certify the training course/programme.

Stakeholders in flight procedure training should be involved at different levels of the evaluation process as appropriate.

5.2 PURPOSE OF EVALUATION

5.2.1 Each training objective has a meaningful goal or performance output identified in the competency framework. Consequently, evaluations focus on how well terminal objectives are met and how their achievement will impact performance on the job. The evaluation structure should be aligned with a competency-based approach as discussed in Chapter 2, 2.2. Refer to 2.2.1 and/or 2.2.2, as appropriate.

5.2.2 The principal goal of evaluation is to ensure a level of consistency between all organizations involved in implementation of flight procedure designer training. Figure 1-1 displays the relationships between three key organizations that plan, develop and conduct flight procedure training. It is critical that all organizations that design flight procedures comply with the same competency standards to ensure safety. To properly monitor the effects of training, evaluation must be considered before, during and after training. This will provide organizations with a comprehensive look at the results of evaluation.

5.3 EVALUATION APPROACH

In order to properly evaluate how flight procedure designer training impacts PDSPs, State authorities and training providers, a four-level evaluation model is used (Kirkpatrick's Model of Evaluation). This model considers trainee reaction, mastery learning, job performance and organizational impact. Each level is assessed in sequential order, providing essential feedback on specific aspects linking training and performance outcomes. The evaluations in Levels 1 and 2 provide immediate feedback on the design, development and administration of all courses. Level 3 provides critical feedback to training providers regarding on-the-job performance of trainees who have successfully completed an approved course. Level 4 is the highest level of evaluation; it requires a direct line of communication between all parties involved with flight procedure training. Figure 5-1 describes the four levels of evaluation.

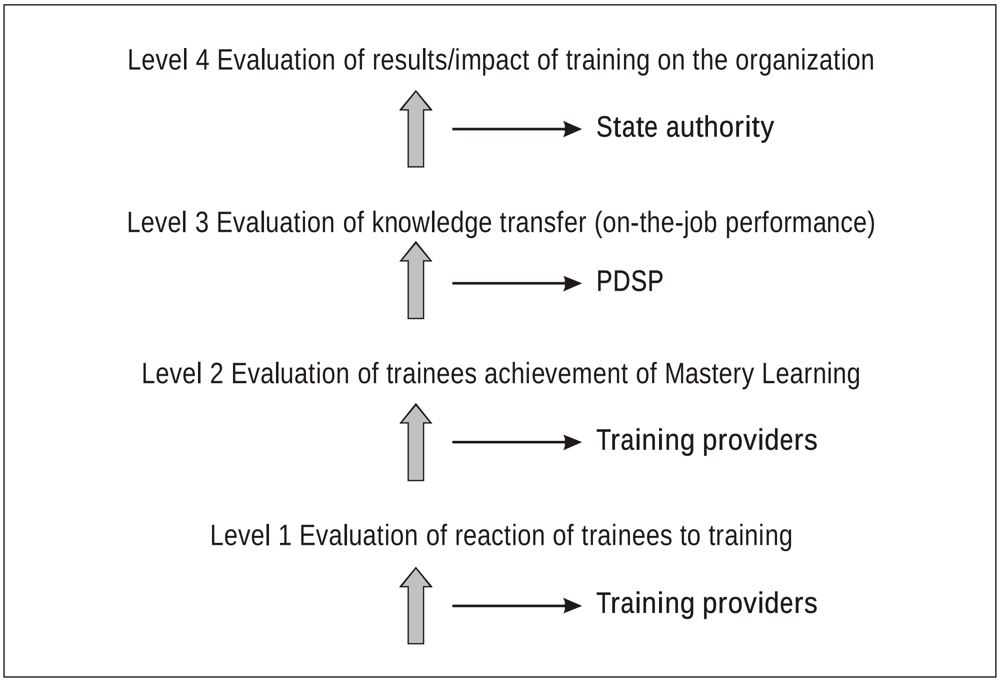

Figure 5-1. Description of four levels of evaluation

5.4 LEVEL 1: EVALUATION OF TRAINEE REACTION

5.4.1 Level 1 identifies the trainee's reactions to and opinions of the training course. At this level of the evaluation, training providers are able to obtain feedback on the learning environment. Level 1 surveys are an easy and effective tool for assessing how to improve trainee motivation and provide the best possible learning environment. Training providers are responsible for the design and administering of a Level 1 survey. This level of evaluation must be used for all newly designed training courses. Below are some guidelines to consider in developing a Level 1 survey:

a) identify what information is needed and the goals of the evaluation;

b) design a form that captures needed information while minimizing the time required to complete and evaluate forms;

c) encourage written comments or suggestions. Even excellent "check the box" surveys are limited in information provided. Comments can point to issues that could otherwise be missed;

d) allow enough time for trainees to respond. Once training is complete, trainees are ready to leave. Therefore surveying participants at the very end of the session might promote a hurried response;

e) allow for an anonymous survey or optional signature as this will provide more reliable data collection;

f) objectives of the survey should be closely aligned with the objectives of the course; and

g) results of the evaluation are used to revise course materials as necessary. A clearly established distribution process must be in place for the dissemination of information to anyone who needs it. A suitable level of confidentiality should also be in place for all parties involved in the handling of such documentation.

5.4.2 Where the course is delivered for the first time (validation delivery), feedback should be collected from trainees after completion of each training module. At the end of the course, overall feedback should be obtained from trainees. Level 1 evaluation forms for the collection of end-of-module and end-of course information (a trainee sample survey) are provided in Attachment A and Attachment B to this chapter.

5.5 LEVEL 2: EVALUATION OF TRAINEE MASTERY LEARNING

Level 2 determines to what extent training has changed attitudes, increased knowledge and improved skills. Training providers use Level 2 evaluations to ensure that trainees have gained the desired skills, knowledge and attitudes to achieve terminal objectives. Level 2 evaluations should be based on mastery test results and apply the following principles:

a) measure trainees' performance before and after training. Comparing data on trainees' pre-course to post-course knowledge, skill and attitude helps shape course content and structure. For example, if a significant number of trainees already had the required skills and knowledge prior to the course, then the terminal objectives may need to revised;

b) mastery tests should be criterion-referenced. A criterion-referenced test helps determine if trainees meet the standard of performance as established by the terminal objectives;

c) ensure that terminal objectives are used to design mastery tests that call trainees to demonstrate successful performance on the job as well as provide valid and reliable measures of performance; and

d) ensure statistics are collected on mastery test results for each module of a course. Analysis of these statistics can be used to determine whether course materials should be modified or not.

5.6 LEVEL 3: EVALUATION OF ON-THE-JOB PERFORMANCE

5.6.1 Level 3 evaluation instruments help to analyse whether trainees have transferred the skills, knowledge and attitudes they acquired through training to actual job performance.

5.6.2 A Level 3 instrument collects data on the following questions:

a) Is the task for which training was provided performed on the job?

b) How confident are trainees in their ability to perform the task once training has been completed?

c) How often do the trainees perform the trained task?

d) Will on-the-job training reinforce the needs of the trainee or is formal training required again?

e) Additional comments (should be open-ended questions).

5.6.3 While a Level 2 evaluation is carried out by training providers, a Level 3 evaluation requires some coordination between training providers and on-the-job instructors and supervisors. A Level 3 evaluation identifies limitations and barriers to a trainee's performance following the delivery of training. Feedback from a Level 3 evaluation is used to revise training courses and programmes to ensure a better fit between training and job performance.

A. Training providers must:

a) ensure that all newly designed or revised terminal objectives are based on current job performance. Without appropriate alignment of course materials with terminal objectives and competencies, a Level 3 evaluation cannot effectively identify gaps between a trainee's performance on the job and the performance required by terminal objectives;

b) complete the appropriate steps to ensure training quality; and

c) review and analyse programme reports and modify training materials accordingly.

B. Procedure design service providers must:

a) ensure that all newly designed or revised training materials are based on required job performance and safety standards; and

b) review and analyse programme reports and recommend modifications to training programmes, as necessary.

5.7 LEVEL 4: EVALUATION OF RESULTS/IMPACT

5.7.1 Level 4 seeks to measure how training has benefited the organization affected. Level 4 evaluation is not always applicable because of the organizational differences in States worldwide (ANSP and State authority can be the same organization, or ANSP can be a State-authorized/recognized privatized company, or PDSP can be a third party). In some cases there is no direct interaction between the PDSP (subcontracted work) and the State authority.

5.7.2 However, when applicable, statistics and reports are summarized to evaluate the overall impact of training on the organization especially as it relates to safety management. A steering committee including those responsible for safety management should be established to carry out this level of evaluation. Based on performance and safety goals set by the organization, this level of evaluation measures how training supports achievement of these goals. In this context, training is one component of a Safety Management System (SMS) that must be balanced with other organizational components.

5.7.3 Level 4 evaluation identifies the impact of training on the organization's overall performance. Implementation of flight procedure training should be monitored through results-based evaluations. PDSPs, regulators and training providers should partner in constructing and analysing Level 4 evaluations. This partnership will help link validation and post-training evaluations of flight procedures with organizational goals and business objectives.

A. State authorities must:

a) ensure PDSPs are utilizing a current competency framework that can be reflected in terminal objectives :

b) review data provided by PDSP;

c) analyse statistical data based on performance goals and eventual outcome;

d) review and establish performance indicators of the flight procedure design system indicating job performance of flight procedure designers; and

e) oversee the flight procedure design system.

Attachment A to Chapter 5

COURSE MODULE OPINION SAMPLE SURVEY

Course instructor: ________________ **Module Title/Number:** _______________
Participant name (optional): __________________________
Date: ____________________________

Instructions: Below you will find a series of questions related to the course module you have just participated in. Please take the time to complete each set of questions and answer them as accurately as possible.

Overall View of Course
Please mark the response that most closely expresses your opinion.
Strongly Disagree | Disagree | Somewhat Disagree | Agree | Strongly Agree

Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
1. The instructor for this module was easy to follow.					
2. Course content met my expectations.					
3. Materials used were easy to read and understand.					
4. Pace of the module was appropriate.					

Mastery Test

Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
5. Information on the test was difficult to understand.					
6. Mastery test did **not** match terminal objectives.					
7. Mastery test did **not** increase my capabilities of performing the job-related task.					

Additional Comments

8. Do you feel anything should be added to make this course more effective? Yes:____ No:_____
   Please explain.

   ____
   ____
   ____

9. Should anything be removed from this module? Yes:____ No:____
   Please explain.

   ____
   ____
   ____

10. What do you plan to take away from this module?
    Please explain.

    ____
    ____
    ____

    Additional Comments

    ____
    ____
    ____

Attachment B to Chapter 5

COURSE VALIDATION SAMPLE SURVEY

Course Instructor: __________________ Course Title/Number: ________________
Participant Name (Optional): ___________________________
Date: _____________________________

Instructions: Below you will find a series of questions related to the training course. Please take your time to complete all sections of the survey.

Overall View of Training
Please mark the response that most closely expresses your opinion.
Strongly Disagree | Disagree | Somewhat Disagree | Agree | Strongly Agree

Scale: 1 = Strongly Disagree; 5 = Strongly Agree	1	2	3	4	5
1. The information presented was well organized.					
2. Training activities were very engaging.					
3. Information presented was applicable to my performance on the job.					
4. The objectives for this course were met.					
5. The instructor for this course was easy to understand.					

Technical Components

Scale: 1 = Strongly Disagree; 5 = Strongly Agree	1	2	3	4	5
6. Information for this course was easy to understand.					
7. Terminology used was comprehensible.					
8. Visual materials were understandable.					
9. The practical work and written exercises were appropriate for the course.					
10. Mastery test reflected content covered throughout the course.					

Practical Issues

Scale: 1 = Strongly Disagree; 5 = Strongly Agree	1	2	3	4	5
11. During this course I needed help from the instructor.					
12. I required help from other trainees.					

Additional Feedback

13. Did you find participating in this course difficult? Yes:____ No:_____
Please explain why.

____
____
____

14. Did you enjoy participating in this course? Yes:____ No:____
Please explain why or why not.

____
____
____

15. Was any part of the course not useful or not valuable? Yes:____ No:____
    Please explain why or why not.

    ____
    ____
    ____

16. What did you find most valuable in this course?

    ____
    ____
    ____

17. What additional suggestions or comments do you have for improvements?

    ____
    ____
    ____

— END —

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