CIVIL AIVIATION AUTHORITY

CIVIL AVIATION PUBLICATION
SMS-02
FOR
SAFETY MANAGEMENT SYSTEMS

Non-Technical Skills Training and Assessment

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CIVIL AVIATION PUBLICATION (CAP)

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CIVIL AVIATION PUBLICATION (CAP)

GENERAL

Civil Aviation Publications (CAPs) are issued by the Civil Aviation Authority of Oman (DGCAR) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. CAPs contain information about standards, practices and procedures acceptable to the CAA. A CAP may be used, in accordance with the Civil Aviation Law (Royal Decree 76/2019) Article 7, and CAR-11 to demonstrate compliance with a statutory requirement.

PURPOSE

The human contribution to accidents in high-risk operations such as aviation is readily apparent. Safety investigations have repeatedly confirmed that human factors contribute in some way to at least 80 per cent of aviation incidents and accidents. It has become self-evident that managers and operators within aviation must better understand and enhance the human dimension of their operations.

To support this goal, the International Civil Aviation Organization (ICAO) has specified in Annex 1 (Personnel Licensing) and Annex 6 (Operations of Aircraft) to the Convention on International Civil Aviation (Chicago Convention) that training in the human performance aspects underpinning work performance shall be undertaken by crew members and an operator's maintenance personnel. This CAP provides advice and guidance for operators to develop non-technical skills training and, where necessary, its assessment.

APPLICABILITY

This CAP applies to all holders of an Oman Air Operator Certificate (AOC), plus occupations mandated by ICAO to be covered under this CAP include:

(a) flight crew;
(b) cabin crew; and
(c) flight operation officers/ flight dispatchers.

Other occupations performing safety-related work (e.g. safety management personnel, flight operations senior management, ramp staff) may benefit from tailored non-technical skills training programs. An existing safety management system should identify any unacceptable risks that are attributed to deficiencies in nontechnical skills (e.g. fatigue awareness, stress management, communication, decision making), and it may be necessary to develop non-technical skills training programs for other occupations as further controls to manage this risk.

CANCELLATION

This CAP is current from the date of issue until otherwise cancelled or reviewed by the CAA.

EFFECTIVE DATE

This CAP is effective from 28th June 2021.

REFERENCES

➢ ICAO Annex 19.

➢ ICAO Safety Management Manual (Doc 9859).

➢ ICAO Line Operations Safety Audit (Doc 9803)

➢ Oman CAP SMS-01 – Safety Management Systems

➢ Oman CAP SMS-01 – Safety Management Systems (Appendix B, Integrating Human factors into an SMS)

➢ Flin, R., O'Connor, P., & Crichton, M. (2008). Safety at the sharp end: A guide to non-technical skills. Aldershot, Hampshire: Ashgate.

➢ Helmreich, R. L., Kanki, B. G., & Anca, J. M. (Eds.). (2010). Crew Resource Management (2nd ed.). Maryland Heights: Academic Press.

➢ CAR OPS-1 – Commercial Air Transport.

DEFINITIONS AND TERMS

Assessment: The process of observing, recording, and interpreting individual knowledge and performance against a required standard.

Behavioural marker: A single non-technical skill or competency within a work environment that contributes to effective or ineffective performance.

Behavioural marker system: An organised set of competency descriptors, collectively representing the domain of non-technical skills required for successful performance in a specified role.

Cabin crew member: A crew member who performs, in the interest of safety of passengers, duties assigned by the operator or the pilot-in-command of the aircraft, but who shall not act as a flight crew member.

Cognitive task analysis: An analysis applied to modern work environments such as supervisory control where the work is characterised more by mental tasks such as situation assessment, decision making, and response planning and execution.

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

Competency-based training: Develops the skills, knowledge and behaviour required to meet competency standards.

Crew resource management (CRM): A team training and operational philosophy with the objective of ensuring the effective use of all available resources to achieve safe and efficient flight operations.

Facilitator: A person who enables learning in a student-centred environment by guiding participants through discussions, interactions, structured exercises and experiences.

Flight crew member: A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Flight operations officer/flight dispatcher: A person designated by the operator to engage in the control and supervision of flight operations.

Inter-rater reliability: The extent to which two or more individuals (coders or raters) agree. Inter-rater reliability addresses the consistency of the implementation of a rating system.

Human Factors (HF): The minimisation of human error and its consequences by optimising the relationships within systems between people, activities and equipment.

Learning outcome: A concrete action that a student demonstrates as a result of learning. A learning outcome can be a demonstration of knowledge, a skill, or an attitude. Generally, learning outcomes are assessed at the course and/or program levels.

Line-Oriented Flight Training (LOFT): Refers to aircrew training which involves a full mission simulation of situations which are representative of line operations, with special emphasis on situations which involve communications, management and leadership.

Line Operational Safety Audit (LOSA): A behavioural observation data gathering technique, which aims to capture data on the performance of flight crews during normal operations.

Non-technical skills: the mental, social, and personal-management abilities that complement the technical skills of workers and contribute to safe and effective performance in complex work systems. They include competencies such as decision-making, workload management, team communication, situation awareness, and stress management.

NOTECHS: A framework, designed under the Joint Aviation Authorities (Europe), for the structured assessment of nontechnical skills, based on a behavioural marker system.

Occupational Analysis: A process of identifying the purposes, skills, knowledge, aptitudes, responsibilities, task characteristics, duties, technical requirements and environmental factors of an occupation or employment category through observation, interview and study. Analysis outcomes are used to create formal job descriptions and job specifications.

Operational safety-critical personnel: Persons performing or responsible for safety-related work, including those personnel performing roles that have direct contact with the physical operation of the aircraft or with those that have operational contact with personnel who operate the aircraft.

Safety Culture: An enduring set of beliefs, norms, attitudes, and practices within an organisation concerned with minimising exposure of the workforce and the general public to dangerous or hazardous conditions. In a positive safety culture, a shared concern for, commitment to, and accountability for safety is promoted.

Safety Management System (SMS): A systematic approach to managing safety, including the necessary organisational structures, accountabilities, policies and procedures.

Safety-related work: Any task or role that has the potential to influence the safe conduct of aviation operations, through error identification, error mitigation, and/or responses to emergency situations. Aviation occupations engaged in safety-related work would include flight crew, cabin crew, aircraft and crew dispatchers, load control staff, and planning and management roles, such as safety management and flight operations.

Task analysis: The analysis of how a task is accomplished, including a detailed description of both manual and mental activities, task duration, frequency, allocation, complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task. Information from a task analysis is used for purposes such as personnel selection and training, the design of tools, equipment and automated systems, and the refinement of procedures such as checklists and decision support processes.

Training: The process of bringing a person to an agreed standard of proficiency by practice and instruction.

Training Needs Analysis: The identification of training needs at employee, departmental, or organisational level, in order for the organisation to perform effectively.

Non-Technical Skills Training and Assessment

1.   INTRODUCTION

1.1.   For individuals and teams to perform effectively in safety critical environments, they must be proficient in both technical skills (such as manipulation of aircraft controls, arming aircraft doors, marshalling, loading baggage, refuelling) and non-technical skills (such as communication, making decisions, maintaining situation awareness and managing stress).

1.2.   Non-technical skills are sometimes referred to as 'human factors'. However, the label 'human factors' can be confusing because it also refers to a scientific discipline that encompasses a range of subjects (e.g., crew station design, automation, nutrition) that are much broader than the scope of this advisory publication. This publication uses the term 'non-technical skills' to denote the mental, social and personal management abilities that contribute to safe and efficient operations.

1.3.   Non-technical skills complement the technical skills of workers and contribute to reliable and effective performance in the complex work systems typical of the aviation industry. Well-developed technical expertise without non-technical skills such as good judgement, interpersonal competence, and adequate self-control is likely to result in less than optimal performance.

1.4.   Numerous case studies1[1] across a variety of high-reliability industries have shown that deficiencies in non-technical skills increase the chance of error and, in turn, increase the chance of an adverse event in the work environment. According to this perspective, non-technical skills are as essential as technical occupational competencies in safeguarding operations from the various latent errors that exist in safety-critical industries.

1.5.   Therefore, non-technical skills should be included as a core component of any competency-based training system. It is expected that effective integration of non-technical skills training into the broad training system will provide improved training system efficiencies and performance outcomes.[2]

1.6.   This CAP provides guidance on particular non-technical skills which should be included in training and related assessment programs in AOC aviation settings. Information about identifying and developing training content and training techniques for non-technical skills is provided.

1.7.   Techniques to assess the degree of transference of non-technical skills training to operational performance are also reviewed. It is recognised that organisations may be limited in terms of the time and resources that can be devoted to training. Fortunately, the training of non-technical skills in the aviation industry is well developed and much

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[1] Overviews of high profile safety case studies are widely available, for example: James Reason (2008), The human contribution (Ashgate) and Charles Perrow (1999), Normal accidents: Living with high-risk technologies (2nd ed.) (Princeton University Press).

[2] A recent publication that examines the many demonstrated benefits of non-technical skills is Crew resource management (2010; 2nd ed.) edited by Robert Helmreich and colleagues (Academic Press).

of this knowledge can be utilised by operators irrespective of their size and business focus.

1.8.   It is also acknowledged that operators have well developed training programs that meet many of the recommendations of this CAP, however, implementing the recommendations of this CAP may involve an expansion of existing programs to include other safety-related occupations and additional non-technical skills topics within their training program. For operators with less developed training programs, this publication includes guidance and practical tools to support implementation.

1.9.   A definition of terms used in this CAP may be found in **Definitions and Terms** (page 6).

2.   APPLICATIONS

2.1.   **ICAO requirements**

2.1.1.   In order to ensure international harmonisation, CAA ensures that ICAO standards are implemented within the Sultanate of Oman aviation system. Annex 6 Parts I, II & III of ICAO's Standards and Recommended Practices to the Convention on International Civil Aviation stipulate human performance training requirements for flight crew, flight operations officer/flight dispatcher, and cabin crew.

2.1.2.   For example, Chapter 9 of Annex 6 Part I (International Commercial Air Transport) entitled Aeroplane Flight Crew states that with respect to flight crew member training programs:

"An operator shall establish and maintain a ground and flight training programme, approved by the State of the Operator, which ensures that all flight crew members are adequately trained to perform their assigned duties. The training programme shall ... include training in knowledge and skills related to ... human performance, including threat and error management" (paragraph 9.3.1).

Annex 6 Part II (International General Aviation – Aeroplanes) entitled: Flight Crew member training programmes (paragraph 3.9.3.1):

"An operator shall establish and maintain a training programme that is designed to ensure that a person who receives training acquires and maintains the competency to perform assigned duties, including skills related to human performance. Ground and flight training programmes shall be established, either through internal programmes or through a training services provider, and shall include or make reference to a syllabus for those training programmes in the company operations manual. The training programme shall include training to competency for all equipment installed".

Annex 6 Part III (International Operations – Helicopters): Flight Crew member training programmes (paragraph 7.3.1):

"An operator shall establish and maintain a ground and flight training programme, approved by the State of the Operator, which ensures that all flight crew members are adequately trained to perform their assigned duties. The training programme shall:

> *a) include ground and flight training facilities and properly qualified instructors as determined by the State of the Operator;*

> *b) consist of ground and flight training for the type(s) of helicopter on which the flight crew member serves;*
>
> *c) include proper flight crew coordination and training for all types of emergency and abnormal situations or procedures caused by engine, transmission, rotor, airframe or systems malfunctions, fire or other abnormalities;*
>
> *d) include training in knowledge and skills related to the visual and instrument flight procedures for the intended area of operation, human performance and threat and error management, the transport of dangerous goods and, where applicable, procedures specific to the environment in which the helicopter is to be operated;*
>
> *e) ensure that all flight crew members know the functions for which they are responsible and the relation of these functions to the functions of other crew members, particularly in regard to abnormal or emergency procedures;*
>
> *f) shall include knowledge and skills related to the operational use of head-up display and/or enhanced vision systems for those helicopters so equipped; and*
>
> *g) be given on a recurrent basis, as determined by the State of the Operator and shall include an examination to determine competence".*

2.1.3.   Paragraph 9.3.1 of Annex 6 Part I further specifies that flight crew training "be given on a recurrent basis, as determined by the State of the Operator, and shall include an assessment of competence."

2.1.4.   Chapter 10 of Annex 6 Part I, entitled Flight Operations Officer/Flight Dispatcher, stipulates that "a flight operations officer/flight dispatcher shall not be assigned to duty unless that person has ... demonstrated to the operator, knowledge and skills related to human performance relevant to dispatch duties" (paragraph 10.3).

2.1.5.   Similarly, in Chapter 12 of Annex 6 Part I on Cabin Crew, guidance with respect to training is that:

"An operator shall establish and maintain a training programme, approved by the State of the Operator, to be completed by all persons before being assigned as a cabin crew member. Cabin crew members shall complete a recurrent training programme annually. These training programmes shall ensure that each person is ... knowledgeable about human performance as related to passenger cabin safety duties including flight crew-cabin crew coordination" (paragraph 12.4).

2.1.6.   In light of developments in human performance training in the aviation workplace since the release of the *ICAO Human Factors Training Manual (1998), the* CAA has endorsed the term 'non-technical skills' when referring to the host of practical human performance awareness, knowledge and skills training programs that currently exist. Operators may continue to use current titles and terms for human performance training (e.g., crew resource management, team resource management, human factors awareness training). The term 'non-technical skills training' is meant to be generic and to include the wide-ranging human performance training activities that currently occur.

2.1.7.   This document addresses a diverse range of operators, and therefore it is not feasible to provide overly prescriptive guidance. The CAA is encouraging operators to tailor their non-technical skills training to their specific needs and available resources. For operators with a preference for more prescriptive guidance, the UK CAA provides detailed information that is readily available (see reference section).

2.1.8.   There are three distinct developmental phases of effective non-technical skills training. These phases are:

      (a)   ***Awareness.*** This phase provides team members with a common language and frame of reference for discussing and thinking about non-technical skills. The focus of the awareness phase is the development of basic knowledge and the formation or consolidation of attitudes likely to promote appropriate safety behaviours in the workplace. Awareness training typically includes basic information about human performance limitations, modern approaches to understanding how incidents and accidents occur in complex organisational settings; and case studies that powerfully demonstrate the importance of non-technical skills in aviation and other high-reliability industries.

      (b)   ***Knowledge.*** This phase provides more advanced understanding of important concepts. The focus of the knowledge phase is the development of practical knowledge relevant to skilled performance. Teaching methods commonly used to impart knowledge include pre-course readings, presentations, practical exercises, detailed case studies and documentaries.

      (c)   ***Skills.*** The skills phase has two distinct components. The first is called practice and feedback. In aviation, this phase generally consists of supervised simulator training or systematic observation of on-the-job performance by specialist trainers with the goal of developing skills. Though the use of high fidelity simulation is common with larger operators, there is compelling evidence to suggest that the use of low fidelity simulation, affords inexpensive and effective approaches to skills-based training. For example, the use of inexpensive personal computers or classroom-based practical exercises allows opportunities for operators with limited resources to develop specific skills within their personnel. The second component of the skills development phase is called reinforcement. To be retained, concepts and skills covered in previous training phases must be regularly reinforced, typically via refresher training.

2.1.9.   The CAA recognises that this CAP will apply to operators with widely differing capabilities for delivering and assessing non-technical skills training. A goal of this publication is to promote flexible options with respect to how its advice is applied, providing adequate standards are achieved and maintained. Smaller CAT operators may wish to consider the following options in relation to maximising training efficiencies:

      (a)   using a 'mixed' employee group in training to reduce disruption and to encourage the exchange of ideas and concepts between different work groups;

      (b)   conducting training with other operators to share costs and resources;

      (c)   negotiating the use of a larger operator's training programs and resources;

      (d)   conducting modular training over an extended period to minimise employee downtime and disruption to operations (taking into consideration issues of knowledge erosion over time);

      (e)   utilising an external service provider if internal expertise in training delivery is limited; and/or

      (f)   implementing an 'off-the-shelf' training product if expertise in course development is lacking.

2.1.10.   Each of the preceding strategies may present challenges as well as opportunities. For example, conducting training with other operators may overlook specific cultural or procedural differences between organisations. Therefore, operators should consider the relative merits of each strategy and decide on the most appropriate training delivery methods to meet their particular needs.

2.1.11.   For smaller operators, it is common for staff to have multiple safety-related roles (for example, a check and training pilot may also have a formal safety management role). For staff with more than one safety-related role, the appropriate level of nontechnical skills training needs to be determined. Normally, the role with the greatest inherent risk of adverse safety outcomes should be used to determine non-technical skills training requirements. This determination should not be onerous because this CAP essentially advocates that non-flight crew occupations undertake non-technical skills training up to the knowledge phase (with the option of skills development); while flight crew and dispatch are required, under ICAO guidelines, to undertake training and assessment to the skills level (see paragraphs 2.1.1 to 2.1.4 above).

3.   OVERVIEW OF NON-TECHNICAL SKILLS TRAINING AND ASSESSMENT

3.1.   Non-technical skills training

3.1.1.   For decades, aviation has been at the forefront of the development of specialised training courses to raise awareness of the importance of non-technical skills and to provide the necessary underpinning knowledge and practice for skill development. The most widely used strategy to train non-technical skills in aviation is known as crew resource management (CRM) training. Because many safety-related occupations within aviation do not work as 'crews', the label 'non-technical skills training' has been introduced as a more general and inclusive term for this form of training.

3.1.2.   As noted above, there is no compulsion for operators to change the titles and terms in any current human performance training (e.g., crew resource management, team resource management, human factors awareness training). The term 'non-technical skills training' provides an umbrella label for all these sorts of training programs that fundamentally are designed to enhance knowledge and performance related to the human dimension of work.

3.1.3.   Non-technical skills are defined as the cognitive, social and self-management skills that complement the technical skills of workers, and contribute to safe and effective task performance (see Flin, O'Connor & Crichton, 2008). Non-technical skills are not just important for managing critical situations or emergencies; they are useful for optimising safety and performance during routine work conditions as well.

3.1.4.   Examples of cognitive skills are situation awareness (attending to changes in the work environment) and decision-making. Social or interpersonal skills include communication, teamwork, and leadership. Skills in self-management (personal adaptation) include the management of stress and fatigue – being able to marshal and sustain one's motivational levels and other emotional reactions and resources to prevent performance decline.

3.1.5.   Five broad steps are essential to develop effective non-technical skills training. These steps are:

(a) identify training needs within your organisation, using accepted techniques to determine the knowledge and skills that enhance safety and performance in your workplace;

(b) determine and develop training content that addresses your identified training needs;

(c) implement non-technical skills training, using approved training techniques;

(d) assess individual non-technical skills, where necessary; and

(e) evaluate the effectiveness of non-technical skills training.

3.1.6.   The following Sections (4 – 8) of this advisory are devoted to examining each of these steps.

4.   IDENTIFYING TRAINING NEEDS

4.1.   Designing training for non-technical skills

4.1.1.   The identification of the specific aptitudes and abilities inherent in an occupation or task set is the first step in designing training for non-technical skills. It is fortunate that a lot of information related to identifying non-technical skills training needs already exists in most workplaces within the aviation industry. Routine sources such as job assessments, audit reports, competency frameworks, technical training program evaluations, appraisal systems and safety management system outputs (e.g., hazards with unacceptable levels of risk, line oriented safety audits (LOSA), flight operations quality assurance (FOQA)) can provide useful information for identifying non-technical training needs. Current training assessments and evaluations and individual training records should also be useful. Other less frequent but potentially valuable sources of information include task analysis, occupation analysis, and accident and incident investigation reports in your own or similar organisations. This quantity of information allows the training needs analysis for some operators to be based on a review of existing information sources.

4.1.2.   A variety of diagnostic tools exist to examine existing information or to generate new information to assist in the identification of training needs. These tools vary in their sophistication from basic to quite complex. Broadly, these tools can be categorised into three types: analysis of existing procedures/information, questioning, and observation (see Table 1).

Table 1 – Popular types of tools and techniques used to identify important non-technical skills

Type	Tools/Techniques
Event-based analyses (examining safety reports to identify patterns)	➢ accident/incident analysis in one's own or similar operations ➢ analysis of confidential reporting systems
Questioning techniques (seeking information directly from workers)	➢ interviews: structured, unstructured and semi-structured ➢ focus groups ➢ questionnaires and surveys
Observational techniques (watching individuals and teams at work)	➢ direct: observation by trainer/researcher not engaged in the work at hand ➢ participant: observation by a co-worker ➢ remote (e.g., video and audio recordings)

4.1.3. It is recommended that multiple sources of information and multiple tools/techniques be used in efforts to identify training needs. Observational techniques have the added benefit of being useful in developing assessment measures. Larger and specialist operators may benefit from the use of more complex analytical tools, such as occupation analysis and cognitive task analysis. Normally, specialists would be engaged to undertake these sorts of analyses.

4.1.4. The use of training needs analysis for the development of refresher training is strongly recommended. By identifying issues of special importance (using techniques discussed above) to a particular workplace or work role, using 'in-house' sources of information, the currency, credibility and value of refresher training are likely to be strengthened.

5. DEVELOPING TRAINING CONTENT

5.1. Selection design of a training program

5.1.1. The outputs from the training needs analysis will guide the organisation in the selection of the training programmes required. Again, it is noted that there are substantial, good quality training resources available that have been tailored for the aviation industry. These readily accessible resources can assist in keeping the development costs of an effective non-technical skills training programmes at a reasonable level.

5.1.2. Traditionally, non-technical skills have tended to be taught informally and inconsistently from one work generation to the next. Fortunately, in aviation, a core set of non-technical skills is now well-established. In response to a series of high-fatality aircraft accidents in the 1970s, the aviation industry and the human sciences began to collaborate on programs to better understand the human dimension of performance in the aviation system.

5.1.3. By the 1980s, the major airlines, military aviation organisations, and air transportation regulators had developed training courses to raise awareness of the importance of non-technical skills and to provide the necessary foundation knowledge and practice for skill development. The names given to courses focussed on the training of non-

technical skills in aviation have included: cockpit resource management, crew resource management, aviation team training, and safety leadership.

5.1.4.   ***Gap analysis.*** An important consideration in developing the training content is to determine the difference between what your current training delivers and what your training needs analysis recommends that your training deliver. More simply, two questions need to be addressed with respect to non-technical skills training:

(a)   "Where are we at present?" and

(b)   "Where do we want to be?"

5.1.5.   A phased implementation plan can be developed to define the clear milestones to support the identified training needs. These milestones, once approved by the CAA, form the basis of a phased implementation against which the operator can be held accountable.

5.1.6.   Non-technical skills topic areas included in some established training programs are listed in Table 2.

Table 2 – Recommended non-technical skills training topics for three aviation agencies

Oman Aviation Operator	FAA (2004)	UK CAA (2006)
- human behaviour - human performance limitations - communication - threat and error management - leadership/followership - team coordination - situation awareness - judgement and decision making - stress management and fatigue management - workload management and automation - mission analysis and planning - mission briefing and debriefing, organisational and safety culture	- communications processes and decision behaviour - briefings - safety, security - inquiry/advocacy/assertion - crew self-critique (decisions and actions) - conflict resolution - communication and decision-making - team-building and maintenance: - leadership/followership/ concern for task - interpersonal relationships/ group climate - workload management and situation awareness - individual factors/stress reduction	- human error and reliability, error chain, error prevention and detection - company safety culture, standard operating procedures, organisational factors - stress, stress management, fatigue and vigilance - information acquisition and processing, situation awareness, workload management - decision-making - communication and coordination inside and outside the cockpit - leadership and team behaviour synergy - automation (for type of aircraft) - case-based studies

5.1.7.   In the book, *Safety at the Sharp End: A Guide to Non-Technical Skills* (Flin, O'Connor & Crichton, 2008), the authors present chapters on seven non-technical skills that they consider fundamental to any training program in safety-critical industries. The chapter's address situational awareness, decision-making, communication, team working, leadership, stress management, and coping with fatigue.

The book is recommended as a practical and informative training development resource. Another recommended report titled *Enhancing performance in high risk environments: Recommendations for the use of behavioural markers* is available via: http://www.abdn.ac.uk/iprc/papers/

5.1.8.   Models of aviation training usually include stages or phases of training. For example, common stages of training include orientation training, initial or awareness training, conversion training, upgrade training and recurrent or refresher training. With respect to non-technical skills training, different instructional elements are likely to be covered during the different stages of training. Furthermore, the depth of training (awareness, knowledge, skills) will also vary across stages.

6.   IMPLEMENTING NONTECHNICAL SKILLS TRAINING

6.1.   Training strategy

6.1.1.   The implementation of training should be underpinned by a training strategy that defines the training methods, objectives, and resources. It is recommended that the training strategy incorporates theory and proven evidence. Established instructional techniques should be adopted. Other pertinent issues for training staff to consider in the implementation phase are discussed in this section.

6.1.2.   ***Choice of instructors.*** The skills and credibility of instructor(s) are paramount to effective training. For some operators, familiarity with the context of their operations is considered the most important attribute of instructors. This normally leads to a preference to train their own staff to be nontechnical skills instructors. Other operators that emphasise technical knowledge of human factors may seek subject matter experts from outside the organisation. Either approach is valid.

6.1.3.   ***Style of instruction.*** The aim of non-technical skills training is to reinforce the desirable cognitive, social and self-regulation skills of personnel who are technically proficient. A facilitative style of training is recommended when attempting to impart knowledge, influence attitudes and change behaviour. This style is often referred to as the *'adult education'* approach where the experience of students is recognised and made use of during training.

6.1.4.   ***Instructional techniques.*** Common techniques for training non-technical skills are listed below. Experience suggests that effective training programs utilise a range of instructional techniques rather than relying on a single mode (such as computer-based training, which is often over-used).

These instructional modes and techniques can include:

(a)   Self-paced learning, for example, pre-course readings and computer-based training.

(b)   Individual instructional feedback, for example, proficiency flight debriefs.

(c)   Team facilitation (encouraging team discussion and learning during training experiences), for example, directed classroom discussion and after-activity debriefs.

(d)   Team coordination (enhancing skills such as shared awareness, group decision-making and supervision to improve team performance), for example, elements of crew resource management training.

(e) Team self-correction (promoting team behaviours that lead to improved identification and remediation of errors, such as event review, error correction, planning and risk assessment), for example, Line Oriented Flight Training debriefs.

(f) Event-based training (where learning objectives are tightly linked and related exercises, performance measurement and feedback are combined into a minimum number of training sessions), for example, scenario simulator exercises.

(g) Cross-training (where team members are trained to some level in the duties of his or her team members; level of training may vary from basic awareness to well-skilled, depending on a range of factors and constraints), for example, mixed group crew resource management training and dedicated cross-training courses.

6.1.5. ***Management support.*** Experience suggests that the engagement of staff in non-technical skills training is more likely when senior management openly supports the training and champion its potential value to the organisation's safety and effectiveness.

6.1.6. ***Reinforcement of training.*** Training should be assessed during or shortly after instruction and also after a period of time has elapsed in order to encourage consolidation or retention of both knowledge and skills. Such reinforcement training should be scheduled with an awareness of the evidence about how skills and knowledge erode over time.

7.   ASSESSMENT OF NONTECHNICAL SKILLS TRAINING

7.1.   Assessment of training

7.1.1. Any training must be assessed and the level of training (awareness, knowledge or skill-based) determines the level of assessment required. Just as safety management systems require safety assurance measures to confirm that tangible improvements within the system are occurring, some form of measurement is required within any training program to determine the impact of training. The measurement of training outcomes is normally called assessment.

7.1.2. A primary goal of assessment is to determine to what extent those participating in the training program are learning. Different phases of training – awareness, knowledge, and skills – will entail different forms of assessment. Assessment techniques for awareness and knowledge phases of training programs are well founded. All readers will be familiar with directed classroom discussion, role-plays, homework, tests, and participant feedback. With respect to the skills phase of learning, specific assessment techniques for non-technical skills have been developed for several aviation occupations, and they continue to evolve. A good example is the use of simulators in training, which can range from desktop computer programs to Line Oriented Flight Training (LOFT) involving simulated flight situations that require decision making.

7.1.3. Another goal of assessment is to act as a feedback mechanism to permit adaptive changes to training content and methods of instruction. The diagnostic use of assessment to provide feedback to instructors and students during a program of instruction is known as formative assessment. The other main form of appraisal – called summative assessment - traditionally uses a behavioural test or written paper after a specified period of training to enable judgements about what level of learning has occurred. Both formative and summative assessment can be used to make adjustments

to the practise and design of training, such as re-teaching, implementing alternative instructional approaches, and adding extra opportunities for practice.

7.1.4.   Assessment criteria for non-technical skills should be drawn from the initial training needs analysis. Training personnel are encouraged to use their experience to develop non-technical skills assessment criteria tailored to their particular operation.

7.1.5.   ***Behaviour rating systems.*** Often referred to as 'behavioural markers' in aviation, these systems are commonly used in training and assessing non-technical skills. Behavioural markers were initially developed as a by-product of crew resource management training. Behavioural markers are observable, non-technical behaviours that are present in teams or individuals, which contribute to superior or substandard performance within the work environment. The markers are usually structured into a set of categories with various sub-components.

7.1.6.   A ***behavioural marker*** describes a specific, observable behaviour, not an attitude or personality trait, with a demonstrated, causal relationship to performance. Markers do not have to be present in all situations. Well known behavioural maker systems include NOTECHS (Non-Technical Skills)[3] and LOSA.[4] Behavioural marker systems are not essential for the assessment of non-technical skills but they have won significant acceptance in aviation and other safety-critical industries and their efficacy is generally well-regarded.[5] Smaller operators may be able to modify existing marker systems for their own use.

7.1.7.   ***Competency-based training (CBT).*** This is an approach to vocational education and training that places emphasis on what a person can do in the workplace as a result of completing a program of training. Competency standards are industry-determined specifications of performance that set out the skills, knowledge and attitudes required to operate effectively in a specific industry or profession. Competency standards are made up of units of competency, which are themselves made up of elements of competency, together with performance criteria, a range of variables, and an evidence guide. Competency standards are an endorsed component of a training package. For a person to be assessed competent they need to demonstrate the ability to perform tasks and duties to the standard expected in employment. CBT focuses on the development of the skills, knowledge, and attitudes required to achieve those competency standards.

7.1.8.   One of the primary features of CBT is that each learner's achievement is measured against the competency standards rather than against the achievement of other learners. Under the CBT approach, each learner is assessed to find the gap between the skills they need (as described in the Training Package) and the skills they already have. The difference between the two is called the skills gap. A training program is then developed to help the learner acquire the missing skills.

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[3] van Avermaete, J. A. G. (1998). NOTECHS: Non-technical skill evaluation in JAR-FCL (NLR-TP-98518). Hoofddorp: National Aerospace Laboratory, Netherlands.

[4] International Civil Aviation Organization. (2002). Line Operations Safety Audit (LOSA) (Doc 9803 AN/761). Montreal: ICAO.

[5] A useful review of behavioural markers was provided in a report on a workshop devoted to this methodology, edited by Barbara Klampfer and her colleagues in 2001, entitled: Enhancing performance in high risk environments: Recommendations for the use of behavioural markers (internet link provided in the references).

7.1.9.   Additional considerations when developing and implementing assessment criteria are:

(a) When first introduced, an assessed deficiency in a nontechnical skill was required to be linked with a technical deficiency for an overall assessment fail. This linkage to technical performance was intended as a safeguard until such time as the assessment of non-technical skills was carried out reliably and proficiently. As training and assessment systems have matured, including improved standardisation among instructors, some operators are now moving towards accepting non-technical skills deficiencies as justification for an assessed failure. Only where organisations have developed good levels of standardisation and inter-rater reliability does the CAA support a move towards jeopardy based non-technical skills training. This aligns with CBT during which a trainee can fail when any core competency does not meet a required standard.

(b) The CAA encourages the use of CBT for non-technical skills. These skills are considered core competencies for safety related occupations.

(c) Instructors will determine how assessed deficiencies in non-technical skills are to be remedied.

(d) As noted above, it is not mandatory to use behavioural markers in assessing non-technical skills. Smaller operators may prefer to adopt systems incorporating measurement techniques such as word pictures and basic rating scales for the assessment of training.

(e) A system for storage and access to assessment information must be implemented.

(f) Any behavioural rating system must be underpinned by adequately trained assessors. The training of raters is a complex undertaking. Instruction should develop thorough understanding of the science of rating scales, the characteristics of the actual rating system used, sources of rater bias, the concept of inter-rater reliability, debriefing skills, and procedures to calibrate and optimise the accuracy of observations and ratings.

8.   EVALUATION OF NONTECHNICAL SKILLS TRAINING PROGRAMS

8.1.   Evaluating training courses

8.1.1.   It is important that any training course is evaluated to determine whether its objectives have been achieved. AOC holders will be required to provide evidence to demonstrate to the CAA the effectiveness of their non-technical skills training activities. Evaluation measures range from individual to organisational indicators; although individual performance measures are by far the most common. One useful framework for assessing the effects of a training program was developed by Kirkpatrick (1998).[6] The framework includes four components:

(a) the *reaction* of students - what they thought and felt about the training;

(b) degree of *learning* - the resulting increase in knowledge or capability;

(c) *behaviour* change – the extent learning is being applied back on the job; and

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[6] Donald Kirkpatrick (1998) Evaluating Training Programs (Berrett-Koehleer)

(d) ***organisational results*** - the effects on the business or the operating environment due to the trainee's performance.

8.1.2. All four components should be measured to determine the true extent of learning outcomes. The challenge of such an evaluation is that complexity and cost of measurement tends to increase as more components are adopted. Brief guidance on how to measure each of the components follows:

(a) ***Reactions.*** Feedback on participants' reactions to the training can be gauged via a simple questionnaire. Normally a five-point response scale is used (e.g., very low, low, satisfactory, high, very high) to respond to simple questions about interest in the training, its relevance, quality of presentation and materials, and so on. It is normally very useful to allow participants to make general written comments about any aspect of the course.

(b) ***Learning.*** This refers to how well the training concepts were understood and retained. Have the participants acquired knowledge and modified their attitudes or beliefs as a result of attending the training? Pre- and post-course administration of a knowledge quiz is one useful technique for determining learning. Alternatively, presenting accident case studies for course participants to identify strengths and weaknesses in relevant non-technical skills can be used to assess knowledge in a less formal way.[7]

(c) ***Behaviour.*** Evaluations at this level assess whether knowledge and skills learned in training actually transfer to on-the-job behaviour. A widely used technique for assessing non-technical skills in flight crew is the use of observational rating scales (refer to paragraph 7.1.5 on behaviour rating systems).

(d) ***Organisational results.*** The ultimate aim of non-technical skills training in aviation is to produce measurable evidence of improvement in safety and productivity at the organisational level. Of course, it can be difficult to develop suitable indicators and to attribute any changes in these indicators to a single training course. A common approach in aviation is to undertake a measure of safety climate across the organisation before and after major training programs are implemented. Information regarding safety surveys is provided in CAP SMS-01.

8.1.3. With respect to the three developmental phases of effective non-technical skills training discussed in Section 2, the assessment associated with each phase becomes increasingly resource intensive as outlined below:

(a) aware: requires a measure of awareness; for example, a test of basic information and perhaps an attitudinal survey across sub-sections of the organisation;

(b) knowledgeable: requires assessment of specific knowledge transfer to trainee; for example, multiple choice questions following training; and

(c) skilled: requires assessment of skill transfer to the trainee; for example, a combination of assessments, including observed behaviours, as part of line checks, emergency procedure tests, etc.

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[7] With respect to measuring the effects of non-technical skills training in flight crew, including attitudes, several established instruments are available, for example, the Flight Management Attitudes Questionnaire (FMAQ) developed by NASA and the University of Texas. The FMAQ has generated a range of similar tools across different occupations and industries (see Chapter 10 of Flin, O'Connor & Crichton, 2008).

9.   PROGRAM IMPLEMENTATION: GENERAL CONSIDERATIONS

9.1.   **Implementing a training program**

9.1.1.   This section provides general guidance on implementing a non-technical skills training program. It discusses factors that are necessary for the training to succeed. It lists the formal requirements that the regulator expects will occur.

9.1.2.   The following actions are recommended to enable effective implementation of a non-technical skills training program:

(a) *Integrate training with existing systems of safety management:*

- Embed non-technical skills training within the organisation's SMS, whose key principles include the acceptance of human performance limitations, the promotion of a just safety culture and the establishment of a learning organisation.

- The content of non-technical skills training should be seen to have direct relevance to the operational safety issues encountered by participants.

- Existing SMS processes should be used to provide a risk-based approach to non-technical skills training. For example, the SMS processes would determine, from a risk-based perspective, those personnel considered to perform safety-related work. Any known risks (e.g., incidents involving a break down in flight crew communication) would inform the training needs analysis. In simple terms, a mature SMS can provide valuable input into shaping non-technical skills training to meet operational needs and improve performance.

(b) *Foster a supportive organisational culture:*

- Actively demonstrate management's commitment to the training program, including behaviours consistent with principles of non-technical skills training (e.g., just culture, continuous learning, and error prevention).

- Promote mutual trust and respect across all levels and departments of the organisation.

(c) *Allocate resources:*

- Allocate adequate resources, including trainers, materials, and time.

- Accept that the benefits of non-technical skills training will not be realised without ongoing investment and effort.

(d) *Keep records:*

- Records of all non-technical training courses documented by facilitators and examiners should be kept for a period of three years.

- Records should show the instructional course dates, the type of course or assessment, trainee names and the type of simulator or aircraft (if any) used.

(e) *Identify training needs:*

- Undertake and document some form of training needs appraisal.

- Ideally, training needs analyses should be conducted by personnel familiar with the nature and goals of nontechnical skills training and knowledgeable about the roles, job requirements, operational context, and recent safety incidents in the organisation being assessed.

- A training needs analysis should not only determine particular training needs, it should identify and prioritise target groups for non-technical skills training.

- Those responsible for managing safety and conducting incident and accident investigations should also participate in non-technical skills training. Such personnel might include senior managers and line managers, safety managers, safety investigators and auditors, training managers and training instructors, examiners and competency assessors, load controllers, and operations control staff.

- The same non-technical skills training will not be required by all personnel.

- The training needs analysis should identify training gaps where relevant training is not currently provided.

- The training needs analysis should also evaluate the possibilities for joint training with other operators.

(f) *Develop training content:*

- The training needs analysis should lay the foundations for the design of a non-technical skills training syllabus.

- Safety investigations should consider matters related to non-technical skills and, where possible, be used as a basis for in-house case studies to ensure the organisational relevance of training.

- The concepts presented in non-technical skills training should have direct relevance to the operational safety issues encountered by participants.

- Table 2 in Section 5 provides the topics of three major non-technical skills training programs in the aviation industry.

- Initial non-technical skills training should include at least the following topics: situation awareness, decision making, communication, teamwork, leadership, stress management, and coping with fatigue. Additional topics are provided in Table 2. These topics should not be considered exhaustive. Training needs analysis and SMS outputs may identify other issues that warrant inclusion in a tailored non-technical skills training program.

- Training content will vary across different phases of training. Phases of training in the aviation industry typically include initial non-technical skills training, conversion training, command/upgrade training and recurrent or refresher training.

- Training modules should include learning outcomes against which operational personnel should confirm the learning outcome is appropriate and whether the training has adequately addressed the learning outcome.

(g) **Implement non-technical skills training:**

- Ensure program facilitators and instructors are trained and/or qualified.

- Other than self-management competencies, training should be focused on enhancing the performance of staff as members of a team rather than as individuals.

- Where appropriate, members of extended or dispersed teams may be involved in combined training, reinforcing the 'one team/crew concept' and increasing mutual understanding and respect.

- Initial non-technical skills training topics ideally should be delivered in a single consolidated training event, rather than dispersed over many months.

- Initial training courses are usually between one and three (3) days duration.

- It is recognised that some organisations will find it impractical to conduct an extended non-technical skills training course due to resource limitations or limited access to employees. For these operators, an acceptable alternative is to split the syllabus into smaller modules to be delivered over a longer period of time.

(h) **Assess non-technical skills training:**

- Utilise or develop assessors with recent or current operational knowledge who understand the professional and safety cultures of your organisation.

- Ideally, assessment of non-technical skills should be integrated into routine performance assessment processes.

- Where feasible, at least one element of assessment should occur within the operational environment.

(i) **Evaluate non-technical skills training:**

- The evaluation of the training program effectiveness should be conducted as part of the operator's SMS assurance processes.

- Program evaluation should be based on recognised and systematic sources of information, such as pre- and post-training surveys examining the safety-related attitudes and behaviours of employees, and operational or simulator performance data.

- Observational information from behavioural auditing methods, such as the Line Operations Safety Audit process, is becoming industry best practice for evaluation.

- Non-technical skills training courses can provide an additional avenue for organisational feedback and learning through course evaluations and feedback to managers.

- Non-technical skills training and assessment documentation, including course syllabi, should be incorporated within the organisation's suite of manuals, along with details of any external providers. This information could form a separate volume of the Operations Manual.

- The operator must be able to demonstrate to the CAA that the quality of training programs, including course content, delivery and assessment, meets the intent of the regulations.

10. FREQUENTLY ASKED QUESTIONS (FAQ)

This section lists some frequently asked questions that have arisen during the development of non-technical skills training programs.

FAQ 1. What is the difference between non-technical skills training and CRM?

Non-technical skills training and CRM training can be considered synonymous. The term 'non-technical skills training' is meant to be generic and to include the wide-ranging human performance training activities that currently occur in high reliability industries. For many operators, CRM training to date has been largely knowledge-based; the next phase is to transition to skills-based training and assessment.

Operators may wish to continue to use current titles and terms for human performance training (e.g., crew resource management, team resource management, maintenance error management, human factors awareness training).

FAQ 2. How much time should be spent on non-technical skills training?

Duration of training should be determined largely by the training needs analysis (TNA), although it may be influenced by other factors such as hazards and risks identified through the SMS. It is recommended that non-technical skills training topics be delivered in a single consolidated training event, rather than dispersed over weeks or months. First-time non-technical skills training courses are usually between one and three days and, typically, have been supplemented by an annual recurrent/refresher training event. A concentrated approach provides a substantial one-off exposure to non-technical skills and safety concepts.

It is recognised, however, that some organisations will find it impractical to conduct an extended non-technical skills training course because of resource limitations or limited employee availability. An acceptable alternative may be to split the training syllabus into modules to be delivered over a longer period of time.

One aim of a mature non-technical skills training program, particularly where training is required to reach the 'skilled' level, is to integrate non-technical skills into existing simulator and/or line proficiency checks. Such integration would involve redevelopment of the existing training program and the training manual, with the advantage that the need for stand-alone non-technical skills training will be reduced.

The basic non-technical skills requirement is a three-year cyclic program that covers, at a minimum, situation awareness, decision making, communication, teamwork, leadership, stress management, and coping with fatigue. Topics identified as important to safety by the training needs analysis should also be incorporated into the program.

FAQ 3. What non-technical skills training is required for contract staff employed to perform safety-related duties?

Contract staff performing safety-related functions will need to comply with the same requirements as permanent staff in safety-related roles; in accordance with the guidance in this advisory.

FAQ 4. What qualifications or experience do in-house instructors need to conduct non-technical skills training?

Instructors need to have specific training or have undertaken formal studies in the non-technical skills training topics delivered. When qualified, an instructor in non-technical skills training should be supervised by an experienced instructor. Non-technical skills training instructors should maintain currency by delivering at least two topics/courses in any rolling 12-month period.

FAQ 5. What if we outsource non-technical skills training to an external provider?

External providers will need to provide evidence that they have relevant expert knowledge (specialist training, tertiary qualifications), and experience in instructional and facilitation roles. If they are required to conduct assessment, they will need to demonstrate techniques consistent with accepted best practice for the assessment of non-technical skills.

For training that is intended to build skills development, external training providers will need to have training and experience in the provision of constructive debriefs. External providers should be thoroughly briefed prior to the commencement of training in order to promote an understanding of the unique aspects of the operational environment and organisational culture of the operator.

FAQ 6. What if I'm already qualified in accordance with overseas standards?

Any person qualified in accordance with the more prescriptive UK CAA standards and advisory publications is considered to meet the CAA requirements. Qualifications from other regulatory organisations will be considered on a case by case basis.

FAQ 7. Should non-technical skills training be delivered separately to different occupational groups?

Non-technical skills training courses and presentations provide valuable opportunities to bring together participants with different experience, backgrounds, knowledge, beliefs and opinions. Such diversity is generally considered to have many advantages, including increased mutual understanding and expanded social networks.

FAQ 8. How long does non-technical skills training remain current?

The currency of training would be dependent upon the schedule of reinforcement of non-technical skills in the operational context. From a cyclical training perspective, it is a requirement to cover the elements of non-technical skills training at least every three years. For some operators, such a cycle may necessitate a one-day refresher every 12 months to allow sufficient time to address each of the elements to an appropriate depth. The aim is not to repeat the same material, rather to tailor recurrent training based on participant feedback and identified operational risk(s).

As a general rule, where non-technical skills are regularly exercised in operations (e.g., the flight crew environment), longer periods between training may be appropriate, particularly if the non-technical skills are integrated within existing training systems. Where the schedule of reinforcement in the operational context is less frequent, shorter periods (every 12 months) between training would be appropriate. Aligning the schedule of non-technical skills training with technical skills training is appropriate, wherever possible.

11. Conclusion

The development of non-technical skills is an important component of an effective SMS. Non-technical skills complement technical skills and thereby contribute to safe and effective task performance in high reliability industries like civil aviation.

This advisory publication provides a framework to enable the development, implementation, assessment and evaluation of a customised non-technical skills training program. The annexes provide detailed guidance and illustrative examples related to the core components of the framework.