Transport Canada | Transports Canada

Advisory Circular

Subject:	**Crew Resources Management (CRM)**		

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1.0 INTRODUCTION

(1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

(2) This AC may use mandatory terms such as "must", "shall" and "is/are required" so as to convey the intent of the regulatory requirements where applicable. The term "should" is to be understood, unless an alternative method of safety protection is implemented that would meet or exceed the intent of the recommendation. For further clarification of terms used please refer to "Appendix H" of this document (commonly undefined terms) for their regulatory meaning.

1.1 Purpose

(1) The purpose of this AC is in response to the Transportation Safety Board of Canada (TSB) recommendation (A09-02) that Transport Canada Civil Aviation (TCCA) require commercial air operators to provide Contemporary Crew Resource Management (CRM) for Subpart 703 *Air Taxi Operations* and Subpart 704 *Commuter Operations* of the *Canadian Aviation Regulations* (CARs).

(2) The goal is to improve the CRM knowledge and skills of commercial crew members engaged in a commercial air service, in order to reduce the frequency and severity of errors that are crew based. The expected reduction of the frequency of accidents and incidents within the scope of commercial flight operations will provide an enhanced level of aviation safety.

1.2 Applicability

(1) This document applies to all TCCA employees and to individuals and organizations, when they are exercising privileges granted to them under an External Ministerial Delegation of Authority. This information is also available to the aviation industry for information purposes.

1.3 Description of Changes

(1) Not applicable.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

(1) It is intended that the following reference materials be used in conjunction with this document:

   (a) *Aeronautics Act* (R.S., 1985, c. A-2);

   (b) Part VII, Subpart 2 of the *Canadian Aviation Regulations* (CARs) — *Aerial Work*;

   (c) Part VII, Subpart 3 of the CARs — *Air Taxi Operations*;

   (d) Part VII, Subpart 4 of the CARs — *Commuter Operations*;

   (e) Part VII, Subpart 5 of the CARs — *Airline Operations*;

   (f) Standard 722 of the *Commercial Air Service Standards* (CASS) — *Aerial Work*;

   (g) Standard 723 of the CASS — *Air Taxi*;

(h)   Standard 724 of the CASS — *Commuter Operations*;

(i)   Standard 725 of the CASS — *Airline Operations* – Aeroplanes;

(j)   Transport Canada Publication, TP 185E, Aviation Safety Letter Issue 04/2012 — *Single-Pilot Resource Management (SRM) Competencies*;

(k)   TP 6533, 10th Edition, 2017-06-01 — *Approved Check Pilot Manual*;

(l)   TP 14727, 1st Edition, 2017-06-01 — *Pilot Proficiency Check and Aircraft Type Rating (Aeroplane)*;

(m)   TP 14728, 1st Edition, 2007-11-01 — *Pilot Proficiency Check and Aircraft Type Rating (Helicopter)*;

(n)   Approved Check Pilot Program — Course Training Standard (Second Edition);

(o)   Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Part-ORO Initial Issue 25 October 2012;

(p)   Air Carrier Advisory Circular (ACAC) No. 0117, 1997-04-15 — *Crew Resource Management Training*;

(q)   Boeing Statistical Summary of Commercial Jet Aircraft — *Airplane Accidents Worldwide Operations 1959-2014*;

(r)   Captain Dan Maurino Coordinator, Flight Safety and Human Factors Program — International Civil Aviation Organization (ICAO);

(s)   Defensive Flying for Pilots: An Introduction to Threat and Error Management, The University of Texas Human Factors Research Project: The LOSA Collaborative, Austin, Texas, 2006;

(t)   Development of NOTECHS (non-technical skills) system for assessing pilots' CRM skills position paper. Human Factors and Aerospace Safety 3(2), 95-1H 2003, Ashgate Publishing;

(u)   E-Learning: The future of Pilot Safety Training Dr. Suzanne K. Kearns University of Western Ontario;

(v)   European Aviation Safety Agency (EASA) — *Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Annex III* — Part-ORO;

(w)   European Helicopter Safety Team (EHEST) / European Aviation Safety Agency (EASA);

(x)   EHEST The Principles of Threat and Error Management (TEM) for Helicopter Pilots, Instructors and Training Organizations;

(y)   Federal Aviation Administration Advisory Circular (FAA AC) 120-51E, 2004-04-01 — *Crew Resource Management Training*;

(z)   FAA Aviation Safety;

(aa)   FAA Crew Resource Management Training in Part 135 Training Programs and Ops Spec A037 and A038 for Basic Part 135 Operators; Flight Safety Foundation — Helicopter Safety, Crew Resource Management Applies to Single-Pilot Flight Operations;

(bb)   Flin, R., Martin, L., Goeters, K.-M., Hoermann, H.-J., Amalberti, R., Valot, C. and Nijhuis, H.: 'Development of the NOTECHS (non-technical skills) system for assessing pilots' CRM skills', Human factors and aerospace safety 3(2), 2003, pp. 95-117;

(cc)   Hawkins,F.H., & Orlady H.W. (1993). Human Factors in flight (2nd Edition). England: Avebury Technical, 1993;

(dd)   Human factors digest no 1. Fundamental human factors concepts. Circular 216-AN/131. ICAO (Montreal, Canada), 1989;

(ee)   ICAO — International Standards and Recommended Practices Annex 6 to the Convention on International Civil Aviation — Part I International Commercial Air Transportation Aeroplanes;

(ff)   ICAO — Human Factors Training Manual (Doc 9683);

(gg)   ICAO — UNITING AVIATION — AFI Region Seminar on transition to AIM: Phase 1 to 3;

(hh)   International Federation Airline Pilots Association (IFALPA) Pilot Training Standards — *Guide for Best Practices*;

(ii)   International Journal of Advanced Research (2013), Volume 1, Issue 8, 797-810;

(jj)   Kolleg Group Interaction in High Risk Environment (GIHRE);

(kk)   SHEL Model;

(ll)   Skybrary — *The single point reference for Aviation Safety Knowledge*;

(mm)   The Evolution of Crew Resource Management Training in Commercial Aviation – Robert L. Helmreich, Ashleigh C. Merrit, John A. Wilhelm;

(nn)   Transportation Safety Board (TSB) — Statistical Summary — *Aviation Occurrences 2015 — Data tables*.

2.2   Cancelled Documents

(1)   Not applicable.

(2)   By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

2.3   Definitions and Abbreviations

(1)   The following **definitions** are used in this document:

(a)   **Behavioural Markers:** A prescribed set of behaviors indicative of some aspect of performance.

(b)   **Contemporary Crew Resource Management:** Contemporary CRM integrates technical skill development with communications and crew coordination training and operational risk management by applying threat and error management (TEM) concepts.

(c)   **Crew Member:** Means a person assigned to duty in an aircraft during flight time.

(d)   **Crew Resource Management (CRM):** As defined in part by EASA: "CRM is the effective utilization of all resources including crew members, aircraft systems, supporting facilities and persons to achieve safe and efficient operations. The objective of CRM is to enhance communication, interaction, human factors and management skills of the crew members concerned. Emphasis is also on the non-technical aspects of crew performance".

(e)   **Computer-Based Training (CBT):** Classroom instruction that is performed individually by trainees at a computer station.

(f)   **Curriculum Design:** The activities involved in organizing, clustering, sequencing and otherwise structuring the elements of instruction (objectives, lessons, evaluations, etc.) into an orderly flow of learning experiences to facilitate student performance.

(g)   **Courseware:** All instructional material that a candidate requires to complete a curriculum, in whatever media required, including manuals, visual aids, lesson plans,

flight event descriptions, computer software programs, audio-visual programs, workbooks, handouts, etc.

(h) **Element:** A component of training analysis or design. In the case of task analysis, the element may be used as a level of analysis: phase of flight, task, sub-task, element, sub-element, etc.

(i) **E-Learning:** The delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device (e.g. a mobile phone) in some way to provide training, educational or learning material. (Derek Stockley 2003).

(j) **Flight Attendant:** Means a crew member, other than a flight crew member, who has been assigned duties to be performed in the interest of the passengers in a passenger-carrying aircraft.

(k) **Flight Crew Member:** Means a crew member assigned to act as pilot or flight engineer of an aircraft during flight time.

(l) **Flight check**: Means a Pilot Proficiency Check (PPC) or a Line Check.

(m) **Human Factors:** Is about people interacting with technology; about people in their working and living environments, and about their relationship with equipment, procedures and living environments. Just as importantly, it is about their relationship with other people. Its twin objectives can be seen as safety and efficiency (ICAO Circular 227).

(n) **Modular Course:** A modular course is defined as a part of the main course that can stand alone. The topics are related and when combined with all other parts, become the entire course. Modular courses may not exist without the main course. Some modules may be self-paced.

(o) **Non-Technical Skills (NOTECHS):** Non-technical competencies are behaviours that are not directly related to the control of equipment and technical proficiency. They encompass aspects of behaviour such as cognitive skills, and interpersonal skills.

(p) **Observable Behaviours:** Are actions performed by a person that can be seen and measured.

(q) **Principal Operations Inspector (POI):** A TCCA employee having principal responsibilities associated with a particular Air Operator for operational issues.

(2) The following **abbreviations** are used in this document:

(a) **AC:** Advisory Circular;
(b) **CARAC:** Canadian Aviation Regulations Advisory Council;
(c) **CARs:** Canadian Aviation Regulations;
(d) **CASS:** Commercial Air Service Standards;
(e) **CBT:** Computer Based Training;
(f) **CRM:** Crew Resource Management;
(g) **EASA:** European Aviation Safety Agency;
(h) **FAA:** Federal Aviation Administration;
(i) **FSTD:** Flight Simulation Training Device;
(j) **HEMS:** Helicopter Emergency Medical Service;
(k) **ICAO:** International Civil Aviation Organization;
(l) **LOFT:** Line Oriented Flight Training;
(m) **POI:** Principal Operations Inspector;
(n) **PPC:** Pilot Proficiency Check;
(o) **SOP:** Standard Operating Procedures;
(p) **TCCA:** Transport Canada Civil Aviation;
(q) **TEM:** Threat and Error Management;

(r)   **TSB:** Transportation Safety Board;
(s)   **TP:** Transport Canada Publication;
(t)   **705:** Subpart 705 of the CARs – Airline;
(u)   **704:** Subpart 704 of the CARs - Commuter;
(v)   **703:** Subpart 703 of the CARs - Air Taxi;
(w)   **702:** Subpart 702 of the CARs - Aerial Work.

3.0   BACKGROUND

3.1   General

(1)   The Transportation Safety Board of Canada (TSB) recommendation A09-02 (2009) which states in part: "CRM training has developed over the years as an effective tool. Modern, well-designed CRM training now includes such things as the concept of threat and error management. In light of the risks associated with the absence of recent CRM training for Air Taxi and Commuter crew members, the Board recommends that: The Department of Transport require commercial air operators to provide contemporary crew resource management (CRM) for *Canadian Aviation Regulations* (CARs) Subpart 703 *Air Taxi Operations* and CARs Subpart 704 *Commuter Operations*".

(2)   Below are TSB statistical data of reportable occurrences in Canada, 2006-2015.

Table 1 - Accidents by Operators Type – Commercial

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Airliner	**(705)**	7	4	6	2	6	6	5	7	4	8
Commuter	**(704)**	4	4	5	6	7	6	5	3	2	3
Air taxi	**(703)**	63	53	63	43	44	37	33	32	34	24
Aerial work	**(702)**	30	34	19	20	28	27	26	21	17	18

Note: The statistics presented here reflect the TSB database at 17 February 2016. Since the occurrence data are constantly being updated in the live database, the statistics may change slightly over time. (TSB)

(3)   Transport Canada Civil Aviation (TCCA) conducted a detailed Risk Assessment (RA) in August 2010. The RA team recommended that a balanced approach between the four areas of regulatory action, oversight, training and guidance be implemented in regards to CRM.

(4)   In September 2010, TCCA accepted the recommended regulatory action, and at the September 2011 meeting of the Civil Aviation Rulemaking Committee a CRM team comprised of Canadian aviation industry representatives, human factors experts and TCCA representative was commissioned and tasked to develop a set of recommendations with respect to CRM Training Standards.

(5)   Based on recommendations from the TSB, the joint TCCA-industry focus group recommended that the 10 items (Table 2) replace the current CRM Standard found in subsection 725.124(39) of the *Commercial Air Service Standards* (CASS); that the same Standard would apply to subsections 702 for Aerial Work, 703 for Air Taxi and 704 for Commuter Operations; and that these air operators add a CRM program to their current training curriculum.
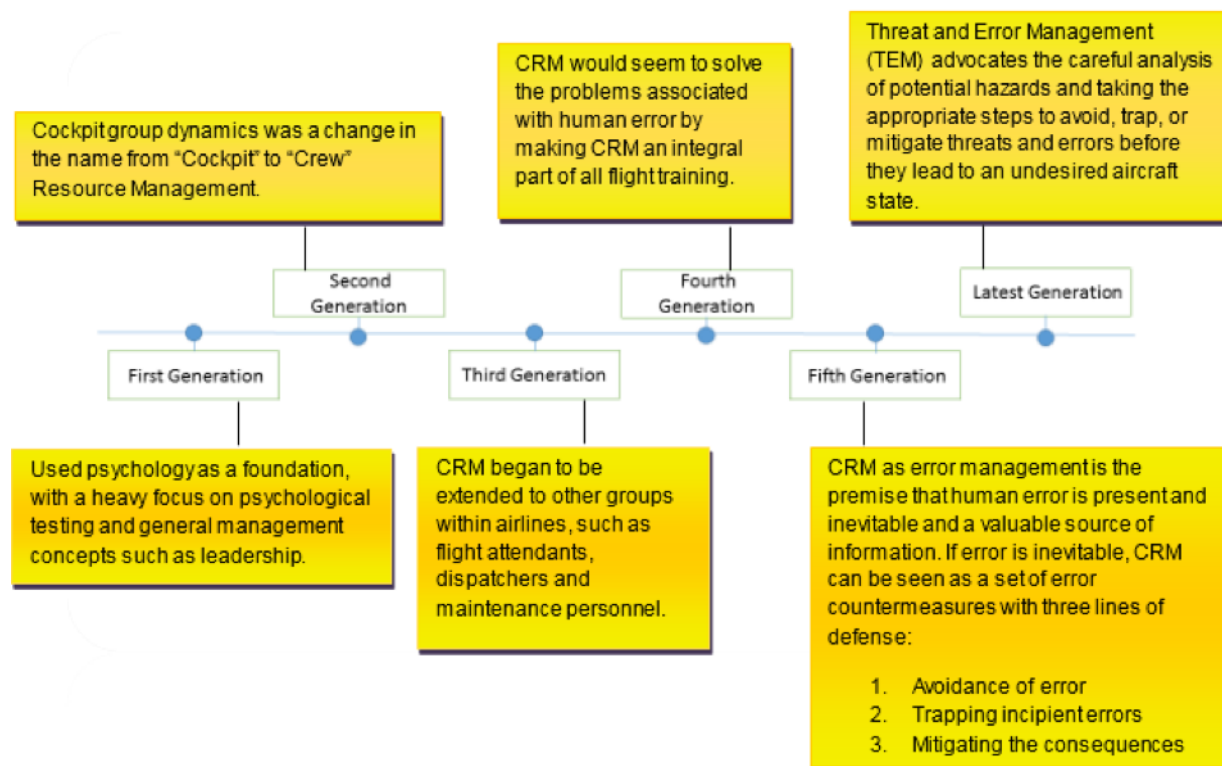
Table 2 - New CRM Training Standard

Initial	
1.	Threat and Error Management
2.	Communications
3.	Situational Awareness
4.	Pressure and Stress
5.	Fatigue
6.	Workload Management
7.	Decision Making
8.	Leadership and Team Building
9.	Automation and Technology Management
10.	Relevant Case Study
Annual training in safety and emergency procedures shall comprise of a joint participation of flight crew, flight attendant, dispatchers/flight followers, ground crew and maintenance personnel, as applicable, and shall cover the following items:	
1.	Threat and Error Management
2.	In-depth Review of a Minimum of three Additional Core Elements as found in Items 2 - 9 above
3.	Relevant Case Study
4.	Review and Discussion of Current Safety Trends within the Operator's Specific Operations and Industry
5.	Crew Member Evacuation Drills including Debriefing

4.0   HISTORY

4.1   General

(1)   The origins of CRM can be traced back to 1979, following the National Aeronautics and Space Administration (NASA) - sponsored Resource Management on the Flight deck workshop which identified human error as the main cause of several high-profile accidents.

(2)   Over 70% of aviation incidents and accidents are caused, at least in part, by a failure of the flight crew to make use of readily available resources.

(3)   Historically the Canadian regulatory framework only addressed CRM training requirements for Subpart 705 - Airline Operations of the *Canadian Aviation Regulations* (CARs). The CRM standard was published in 1996, which involved a basic approach to CRM training that did not reflect many of the contemporary CRM training concepts that leads to an improved level of aviation safety.

(4)   Section 705.124 of the CARs requires Airline Operations to establish and maintain a training program that was designed to ensure that each person who receives training acquires the competence to perform the person's assigned duties; and that the training program be approved by the Minister in accordance with the CASS.

(5)   CRM is not a static concept but rather an evolving science – as research into the field of human factors is ongoing, new initiatives continue to emerge (Figure 1).

Figure 1 - Crew Resource Management Initiatives

Cockpit group dynamics was a change in the name from "Cockpit" to "Crew" Resource Management.

CRM would seem to solve the problems associated with human error by making CRM an integral part of all flight training.

Threat and Error Management (TEM) advocates the careful analysis of potential hazards and taking the appropriate steps to avoid, trap, or mitigate threats and errors before they lead to an undesired aircraft state.

Second Generation

Fourth Generation

Latest Generation

First Generation

Third Generation

Fifth Generation

Used psychology as a foundation, with a heavy focus on psychological testing and general management concepts such as leadership.

CRM began to be extended to other groups within airlines, such as flight attendants, dispatchers and maintenance personnel.

CRM as error management is the premise that human error is present and inevitable and a valuable source of information. If error is inevitable, CRM can be seen as a set of error countermeasures with three lines of defense:

1. Avoidance of error
2. Trapping incipient errors
3. Mitigating the consequences

(6) CRM is concerned not so much with the technical knowledge and skills required to fly and operate an aircraft, but rather with the cognitive and interpersonal skills needed to manage the flight within an organized aviation system.

(7) Furthermore, CRM is not confined to multi-crew aircraft, but also relates to single pilot operations, that invariably need to interface with other aircraft and with various ground support agencies in order to complete their missions successfully (Table 3).

Table 3 - Ground Support Agencies

Subpart 702	Subpart 703	Subpart 704
• Aerial Spraying • Parachute Jumping Operations • Firefighting/Forest Fire Management • NVIS Operations (*)	• Seaplane Operations • HEMS • Air Ambulance • NVIS Operations (*)	• Seaplane Operations • HEMS • Air Ambulance • NVIS Operations (*)

(*) NVIS: Night Vision Imaging Systems

(8) A recent adaption of CRM is single-pilot resource management (SRM) training. SRM adapts concepts from CRM to the single-pilot environment. Topics in SRM include: situational awareness, workload management, aeronautical decision making and automation management.

(9) Current CRM training concepts include Threat and Error Management (TEM), which speaks to the identification and analysis of potential hazards; the implementation of appropriate strategies

to handle threats; and the implementation of steps to avoid, trap, or mitigate errors before they lead to undesired consequences such as an undesired aircraft state. There are three basic components in the TEM model, for the perspective of flight crews:

(a)   Threats;

(b)   Errors;

(c)   Undesired Aircraft State.

(10)   As aircraft became more and more reliable, the incidence of mechanical failure decreased rapidly, but the human component still played a part in the accident rate over the years. The steep decline is shown graphically in Boeing's 'Accident Rates and Onboard Fatalities by Year. Please refer to Boeing Website at the following link.

https://www.skybrary.aero/bookshelf/books/3198.pdf

(11)   In accordance with the European Aviation Safety Agency (EASA) requirements to strengthen CRM performance, the flight crew, flight attendants and technical crew shall complete CRM training at various stages of their careers, including initial and annual training. Contemporary CRM is the training tool required to achieve the objective of TEM Concepts (Figure2).

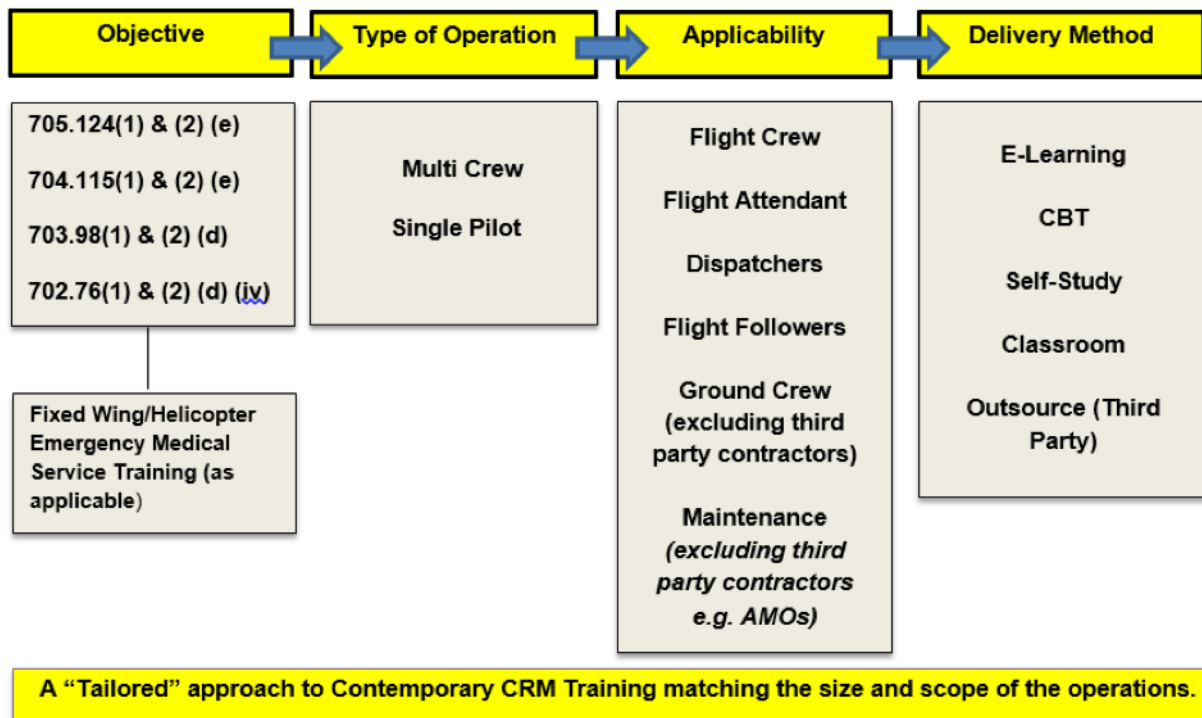**Figure 2 - Objective of Threat and Error Management (TEM)**
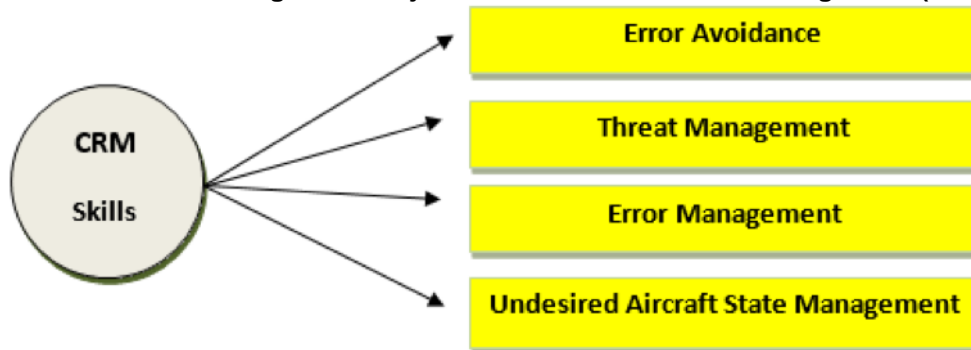
4.2 Crew Resource Management International Perspective

(1) Crew Resource Management (CRM) training is a mandated International Civil Aviation Organization (ICAO) requirement for commercial crews working under most regulatory bodies worldwide including the United States Federal Aviation Administration (FAA) and EASA, amongst others.

(2) The FAA requires that each certificate holder must have an approved CRM training program that includes initial and annual training.

(3) The FAA, on January 21, 2011, published a final rule requiring CRM training for crew members in Part 135 operations with an effective date of March 22, 2011. This final rule requires all certificated holders conducting operations under Part 135, that are required to have a training program under 135.341, include initial and annual CRM training in their crew member training programs. The FAA determined that CRM issues are not limited to dual-pilot operations, therefore CRM training is required for all crew members conducting either dual or single pilot operations. After March 22, 2013, no certificate holder may use a person as a flight crew member or Flight Attendant (F/A) unless that person has completed approved CRM initial training with that certificate holder.

(4) EASA – ORO.AOC 135 in part states: all personnel assigned to, or directly involved in ground and flight operations, shall be properly trained, demonstrate their capabilities in the performance of their assigned duties and be aware of their responsibilities and the relationship of their duties to the operation as a whole.

(5) ICAO considers CRM to be part of "human performance" and requires an operator to establish and maintain a ground and flight training program approved by the State of the Operator, which ensures that all flight crew members are adequately trained to perform the assigned duties.

(6) Additionally, ICAO acknowledges that the contemporary CRM concept is about people in their living and working situations, their relationship with machines, with operational procedures and environment; and also about their relationship with other people at work (colleagues).

(7) In order to achieve harmonization with future proposed changes to the CARs, contemporary CRM training will contain material mirroring the latest ICAO, EASA, and FAA guidance and Regulatory material applicable to the Canadian aviation industry.

5.0   CREW RESOURCE MANAGEMENT TRAINING PROGRAM TEMPLATE

5.1   General

Figure 3 - Crew Resource Management Training Program Template

Objective	Type of Operation	Applicability	Delivery Method
705.124(1) & (2) (e) 704.115(1) & (2) (e) 703.98(1) & (2) (d) 702.76(1) & (2) (d) (iv) Fixed Wing/Helicopter Emergency Medical Service Training (as applicable)	Multi Crew Single Pilot	Flight Crew Flight Attendant Dispatchers Flight Followers Ground Crew (excluding third party contractors) Maintenance *(excluding third party contractors e.g. AMOs)*	E-Learning CBT Self-Study Classroom Outsource (Third Party)

A "Tailored" approach to Contemporary CRM Training matching the size and scope of the operations.

(1)   CRM training as stipulated by the regulations need not be repeated as part of the revised 725 Standard, provided the air operator's initial and annual CRM training program completed at that time met the requirements of subparagraph 725.124(39).

(2)   Operators (702, 703 and 704) have **18 months** from the date of publication of the official Standard to implement CRM training.

6.0 CREW RESOURCE MANAGEMENT TRAINING REQUIREMENTS CHECKLIST

6.1 General

Table 4 -

DESCRIPTION	ELEMENTS
1. Operator Responsibilities	CRM Training Program
	Culture
2. Trainer/Facilitator	Qualifications
	Assessment
3. Training Facility	Location
	Flight Simulation Training Device (FSTD)
4. Course Development	Specific Tailored Program
	Flexible Curriculum
5. Delivery Method	Synchronous
	Asynchronous
6. Third-Party Providers (Outsourcing)	Contract Training
	Quality Assurance
7. Program (Crew) Assessment	Non-Technical Skills (NOTECHS)
	CRM Skills

6.2 Operator Responsibilities

(1) Ultimately, the effectiveness of a contemporary CRM training program depends upon the extent to which an air operator treats CRM as an integral part of its culture. Company safety culture should support CRM throughout the organization, as well as among aircraft crew members.

(2) CRM training should also address hazards and risks identified by the operator's safety management system (as applicable).

(3) CRM embraces all operational personnel and should include initial indoctrination, annual practice, feedback and continuing reinforcement.

(4) The operator is solely responsible for all activities related to the training of personnel both for in-house or any outsourced training program.

6.3 Trainer/Facilitator

(1) The air operator must demonstrate to TCCA that their trainer/facilitator meets the qualification requirements to function in that position under the following subsections (as applicable):

(a) 722.76 (3);

(b)   723.98 (3);

(c)   724.115 (4);

(d)   725.124 (4).

(2)   TCCA does not mandate instructor qualifications for CRM trainers/facilitators within the regulations, other than the general qualification of all training personnel as described in the CASS - *Training Program - Qualifications of Training Personnel – General* in each Subpart.

(3)   In addition to those items listed in the CASS, the following would be considered a valuable asset for the CRM trainer/facilitator:

(a)   adequate knowledge of CRM;

(b)   adequate knowledge of Human Performance and Limitations (HPL);

(c)   have completed CRM training themselves.

(4)   The Principal Operations Inspector (POI) or other authorized TCCA inspector will assess the CRM trainer/facilitator to confirm competency to deliver the CRM course through an acceptable combination of skills, education and expertise.

(5)   It is expected that those responsible for the development and facilitation of a contemporary CRM training program will update their skills as required to ensure they remain current with the latest CRM concepts and best practices.

(6)   A CRM Trainer/Facilitator and Program Monitoring form in TCCA's CRM Guidance Material has been provided to TCCA inspectors as part of either a surveillance program, stand-alone or using a sampling technique to ensure compliance. This is to be completed annually.

6.4   Training Facility

(1)   Whenever possible, classroom training should be conducted away from the pressure of the usual working environment so that the opportunity is provided for crew members to interact and communicate in an environment conducive to learning.

(2)   Tools such as group discussion, team task analysis, team task simulation and feedback should also be used and encouraged if applicable.

(3)   Aerial Work and Air Taxi Operators should make every effort possible to emulate the training facilities standard as listed under subsections 724.115 (3) and 725.124 (3) of the CASS.

(4)   Training may also be conducted in an operational environment such as a Flight Simulation Training Device (FSTD) or the aircraft. This includes but is not limited to Line Oriented Flight Training (LOFT) scenarios as part of a blended approach to a Contemporary CRM training program. Operators using approved LOFT scenarios shall ensure the facilitator meets the requirement as per paragraph 725.124 (4)(e) — Qualifications of a LOFT Facilitator.

(5)   Operators may be faced with geographical/technological barriers which may prove difficult to provide the ideal training facility. Should operators decide to have a "work around" solution, they shall contact TCCA to ensure an alternate means of compliance is possible.

6.5   Course Development

(1)   It is important for any CRM training program to provide the following:

(a)   a standard training syllabus for every student; and,

(b)   a tailored training program that is operator specific.

(2) Operators must develop a contemporary CRM training program tailored to the size and scope of their operations and pay particular attention to the current state of human factors and technology interface in the operational environment.

(3) CRM training should be integrated in every stage of training, and should be stressed in line operations including checklist, briefings, abnormal and emergency procedures.

(4) The curriculum should be flexible enough to allow a continuous evaluation of the training process while enabling students and trainers/facilitators to adapt the content to ensure high quality results. The trainer/facilitator must have the ability and authority to personalize the training to meet each student's needs.

(5) No two operators are the same and an effective tailored approach to CRM training will provide the required flexibility to ensure each student's skill set meets or exceeds the applicable standard.

(6) Training courseware shall contain lesson plans, instructor guides, computer software programs, audiovisual programs, workbooks and handouts (as applicable). Courseware must also accurately reflect curriculum requirements and must be revised as regulations, policies, procedures and aircraft systems/procedures change.

(7) To be effective, CRM should be embedded in every stage of training, and CRM concepts should also be stressed in line operations.

(8) CRM training may be developed as a distinct modular course or incorporated into other technical or non-technical training components. The benefits of a distinct modular training program are as follows:

    (a) can be tailored to the scope of the operation, e.g. single-pilot operations;

    (b) encourages baseline knowledge and highlights areas that will require particular emphasis during formal in class training as applicable;

    (c) allows for industry best practices updates increasing safety and awareness; and

    (d) any practical aid training and reference material can be delivered electronically.

(9) Those responsible in the development of a CRM program should provide key stakeholders with a preview of what the focus of the training will entail and all aspects of its implementation.

(10) Provision should be made for the transfer of relevant knowledge of CRM skills between flight crew, flight attendants and technical training departments.

6.6 Delivery Method - Training Model

(1) Operators may decide to combine their CRM training program using one or a combination of methods.

(2) However, there are some components of training that should be facilitated using a specific training method to produce the most optimal outcome as part of the regulatory requirement (as applicable).

    (a) E-Learning*

    (b) CBT*

    (c) Self-Study*

    (d) Classroom

    (e) Outsourced (third party)

***Note (*):** May be used only as a pre-requisite to classroom trainer/facilitation as applicable.*

(3)   The two primary models of web-based instruction methods are synchronous and asynchronous.

    (a)   Synchronous:

        (i)   Instructor facilitated interaction of trainer and trainee at the same time over the internet.

        (ii)   Technologies that allow people to interact with peers and subject matter experts (SMEs).

    (b)   Trainers can choose from a variety of synchronous technologies including:

        (i)   Slide presentation;

        (ii)   Audio and video conferencing;

        (iii)   Shared whiteboard.

    (c)   Asynchronous:

        (i)   Self-Directed/Self-Paced allows the student to complete the Web based training on his/her own time and schedule, without live interaction with the trainer.

        (ii)   There is flexibility with asynchronous training such as a Self-Paced course and can be delivered in many ways including:

            (A)   Internet;

            (B)   Intranet or Local Area Networks;

            (C)   CD-ROM or DVD.

(4)   E-learning can offer several advantages for seasonal and sole pilot operators, including supporting tactile learners, geographic flexibility, and cost savings. (Strait, 2006).

(5)   The course however must still place value on student participation; therefore a classroom setting for all Subparts is considered essential, where applicable.

(6)   Where CRM core training elements, "Appendix A" of this document, are integrated into the training program i.e. ground, simulator, and aircraft, they should be clearly identified and documented in the student(s)' ground training record.

(7)   Operators shall be prepared to demonstrate to TCCA the training methods utilized (e.g. self-study), and that the CRM training elements of the applicable Standard are relevant to the size and scope of the operation.

6.7   Third-Party Providers (Outsourcing)

(1)   TCCA recognizes that as CRM training design becomes more sophisticated, operators may find it advantageous to outsource the development of the courseware.

(2)   In the case of contracted CRM training, it is the responsibility of the operator to ensure the content of the CRM program covers the specific operator's culture, the type of operations and associated procedures.

(3)   It should be noted that it is up to the operator to demonstrate to TCCA the means of compliance in accordance with the following subsections as applicable:

    (a)   722.76 (2);

    (b)   723.98 (2);

    (c)   724.115 (2);

    (d)   725.124 (2).

(4) When crew members from diverse operations attend the same CRM training course, the CRM training elements should be specific and relevant to the flight operations of those attending.

(5) Any outsourced CRM training program performed by the third-party provider must be subjected to the same quality assurance (QA) practices that the operator is expected to apply to its own work. All CRM courses either from an external training provider or developed internally, shall be approved by the appropriate TCCA authority.

6.8 Program (Crew) Assessment – Non-Technical (NOTECHS) Skill Elements

(1) Assessment of CRM skills is the process of observing, recording, interpreting and debriefing flight crews and individual performance and knowledge using an acceptable methodology in the context of overall performance.

(2) The flight crew member's CRM skills should be assessed in the operational environment, but not during CRM training.

(3) Feedback on individual and crew performance may be given during training to the crew members concerned. This can be conducted during training or following a flight check. The NOTECHS framework consist of four main categories:

    (a) Cooperation;

    (b) Leadership and managerial skills;

    (c) Situational awareness;

    (d) Decision making.

(4) Each of the four categories is subdivided into elements and behavioural markers as detailed in "Appendix F" of this document.

(5) The behavioural markers are assessed by a rating scale in accordance with the Approved Check Pilot (ACP) Manual — TP 6533. The assessment shall be based on the following:

    (a) observable behaviour;

    (b) CRM skills that enhance safety; and

    (c) behaviour that contributed to a significant reduction in safety margins.

(6) Flight Checks conducted under Part VII of the CARs consist of PPCs and Line Checks. Line Checks are applicable only to Subpart 705 of Part VII of the CARs.

(7) Furthermore, the assessment will assist operators in the improvement of their CRM training system by evaluating summaries of all flight crew CRM assessments.

(8) Below are a few examples of behaviours that can be directly observed or inferred by crew interaction:

    (a) active monitoring of weather, aircraft systems, instruments and Air Traffic Services (ATS) communications;

    (b) proper communication and acknowledgement with respect to workload distribution;

    (c) proper planning of time and space with respect to aircraft maneuvering or the completion of procedures; and

    (d) use of recommended terminology as per Standard Operating Procedures (SOPs) with no or limited chatter.

Table 5 - Examples of behaviours

BEHAVIOUR
Helps other crew members in demanding situations (+)
Competes with others (-)

7.0 CREW RESOURCE MANAGEMENT TRAINING COURSE METHODOLOGY

7.1 General

Table 6 – CRM Training Course Methodology

Training Matrix	Curriculum	Training Syllabus
		Emergency Medical Services (HEMS) Syllabus

7.2 Philosophy

(1) Initial operators' training should include: human factors in aviation; CRM principles and objectives; human performance and limitations; threat and error management.

(2) In addition, training should be broken down into three areas:

    (a)   individual crew members;

    (b)   entire flight crew;

    (c)   operator and the organization.

(3) CRM training should also include areas of operations that may lead to particular difficulties or involve unusual hazards.

7.3 Training Matrix

(1) A CRM training Matrix specifies the topics and frequency, allowing operators to cover core elements as specified in the applicable Standard during a three (3) year training cycle.

(2) Operators may elect to change the order of the elements as required. Below is a sample of a CRM Training Matrix.

CRM Training Matrix	**Year One**	**Year Two**	**Year Three**
702, 703, 704 and 705			
Elements	**Initial**	**Annual**	**Annual**	**Initial**

1.	Threat and Error Management	✓	✓	✓	✓
2.	Communications	✓		✓	✓
3.	Situational Awareness	✓	✓		✓
4.	Pressure and Stress	✓		✓	✓
5.	Fatigue	✓	✓		✓
6.	Workload Management	✓		✓	✓
7.	Decision Making	✓	✓		✓
8.	Leadership and Team Building	✓		✓	✓
9.	Automation and Technology Management	✓	✓		✓
10.	Relevant Case Study	✓	✓	✓	✓
11.	Joint Annual training (all applicable crews) - see note three	N/A	✓	✓	N/A

Notes:

(1)   Initial and annual CRM training shall include Threat and Error Management (TEM) and a relevant case study matching the size and scope of the operations (refer to "Appendix B" of this document). The operator's case study shall be updated annually.

(2)   CRM training content shall be updated every three (3) years to reflect current industry best practices. The content update shall also take into account information from the operator's syllabus including the results of crew CRM skills assessments and any other updates through the use of the following methods:

   (a)   self-analysis (operator);

   (b)   Safety Management System (SMS) – where applicable.

(3)   Annual training in safety and emergency procedures shall comprise of a joint participation of flight crew, flight attendant, dispatchers/flight followers, ground crew and maintenance personnel, as applicable, and shall cover the following items:

   (a)   Threat and Error Management;

   (b)   In-depth Review of a Minimum of three Additional Core Elements as found in Items 2 - 9 above;

   (c)   Relevant Case Study;

   (d)   Review and Discussion of Current Safety Trends within the Operator's Specific Operations and Industry;

   (e)   Crew Member Evacuation Drills including Debriefing.

7.4   Operator's Initial Crew Resource Management Course Curriculum

(1)   The following shall form part of the operators CRM training curriculum and will be tailored to the size and scope of the organization:

     (a)   General;

     (b)   Relevant to the individual flight crew member;

     (c)   Relevant to the flight crew;

     (d)   Relevant to the entire aircraft crew;

     (e)   Relevant to the operator and the organization.

7.5   Crew Resource Management Training Syllabus Logic

(1)   General

Figure 4 - CRM Training Syllabus Logic
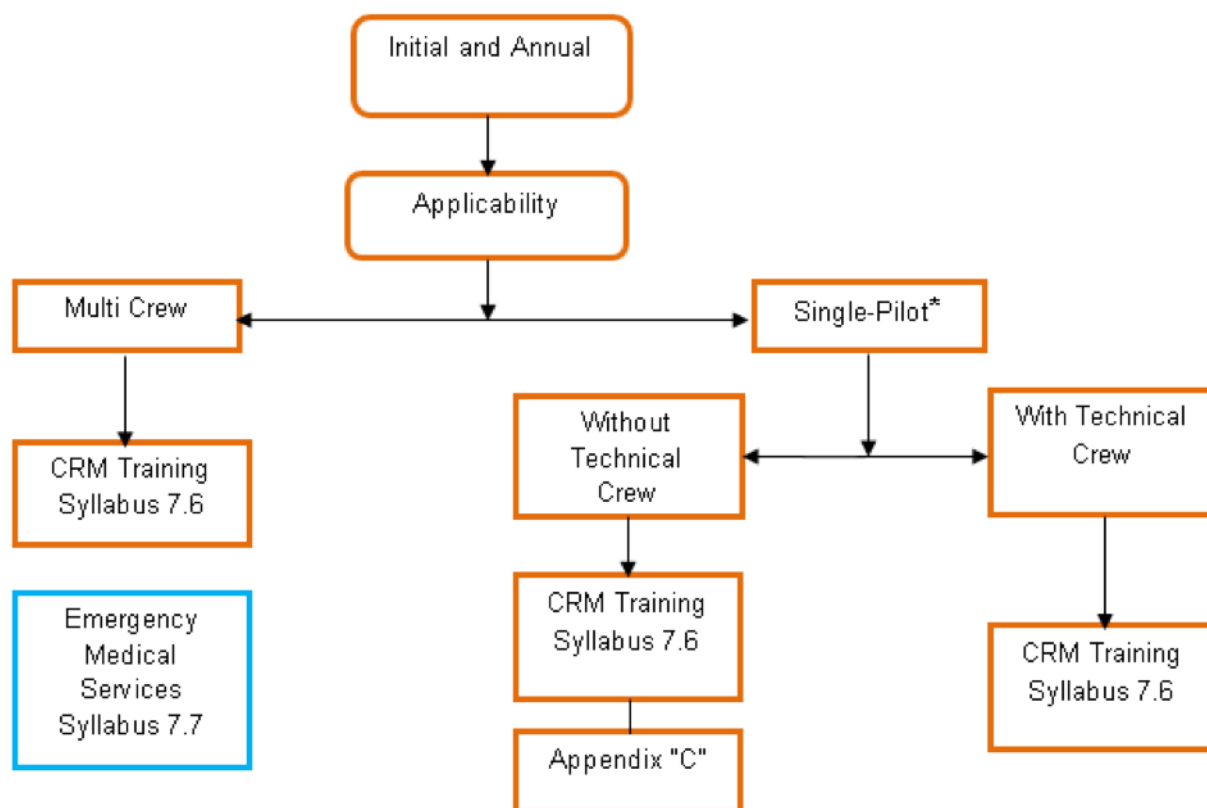
***Note:** Single-Pilot CRM training should focus on the elements that are relevant to the single-pilot and tailored to the operations, and should include:*

     (a)   situational awareness;

     (b)   workload management;

     (c)   decision-making;

(d)   resilience development;

(e)   surprise and startle effect; and

(f)   effective communication and coordination with other operational personnel and ground services.

7.6   Training Syllabus

(1)   The CRM training syllabus below specifies training elements that should be covered during an initial or annual training phase.

(2)   A description of the Level of Training is as follows:

(a)   "In-depth": Training that should be interactive in style taking full advantage of group discussions, team task analysis, team task simulation, etc., for the consolidated knowledge, skills and attitudes acquired. The CRM training elements should be tailored to the specific needs of the training phase being undertaken.

(b)   "Required": Training that should be instructional or interactive in style to meet the objectives specified in the CRM training program or to refresh knowledge gained in a previous training.

(3)   The syllabus suggests a logical grouping of topics, but should not be interpreted as a sequential order in which topics should be introduced. It is up to the operator's trainer/facilitator to organize the syllabus in a logical manner to accomplish the CRM training to ensure retention of material covered.

(4)   The table below does not stipulate a minimum time frame in order to accomplish CRM training as per the applicable Subpart. It is up to the operator to allocate adequate time in order to guarantee meeting the requirements of the applicable Standard.

Subject Area	Topics	Initial	Annual	Reference Appendices
General	• Human Factors in Aviation • General Instructions on CRM Principles and Objectives • Human Performance and limitations • Threat and Error Management	In-Depth	Required	A & E
Relevant to the individual flight crew member	• Personality awareness, human error and reliability, attitudes and behaviours, self-assessment and self-critique • Stress and stress management • Fatigue and vigilance • Assertiveness, situational awareness, information acquisition and processing	In-Depth	Required	A & E
Relevant to the flight crew	• Automation and philosophy on the use of automation • Specific type-related differences • Monitoring and intervention	In-Depth	Required	A & E

Relevant to the entire aircraft crew	• Shared situational awareness, shared information acquisition and processing • Workload management • Effective communication and coordination inside and outside the flight crew compartment • Leadership, cooperation, synergy, delegation, decision-making, actions	In-Depth	Required	A & E
	• Resilience development • Surprise and startle effect • Cultural differences	In-Depth	Required	C & D
Relevant to the operator and the organization	• Operator's safety culture and company culture, standard operating procedures (SOPs), organizational factors, factors linked to the type of operations • Effective communication and coordination with other operational personnel and ground services	In-Depth	In-Depth	A & D and E

7.7 Helicopter Emergency Medical Services (HEMS) and Fixed Wing Syllabus

Subject Area	Topics	Initial	Annual
Fixed wing/Helicopter Emergency Medical Services Training For Medical Personnel	• Familiarization with the type(s) operated • Entry and exit under normal and emergency conditions both self and patients • Use of the relevant on-board specialist medical equipment • The need for the commander's approval prior to use of specialized equipment • Method of supervision of other medical staff • The use of inter-communications systems • Location and use of on board fire extinguishers • The operator's crew coordination concept including relevant elements of crew resource management (CRM)	In-Depth	Required

7.8 Annual Training Program

(1)   Effective CRM begins with initial training; it is strengthened by annual practice and feedback and it is sustained by continuing reinforcement that is part of the corporate culture.

(2)   Annual CRM training should be provided in such a way that all CRM training elements, as listed in the training Matrix, are discussed over a period not exceeding three (3) years.

(3)   Ground training programs should also include an interactive training session involving flight crew, flight attendants and technical crew where applicable.

8.0 SUMMARY

8.1 General

(1)   The material presented has been provided to assist operators in the development and delivery of their CRM training program, and for the use of the POI in the review and approval process.

(2)   Due to the evolving nature of CRM, it should also remain current and allow for integration of future developments of CRM concepts.

9.0 INFORMATION MANAGEMENT

(1)   Not applicable.

10.0 DOCUMENT HISTORY

(1)   Not applicable.

11.0   CONTACT OFFICE

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Original signed by

Robert Sincennes
Director, Standards
Civil Aviation, Transport Canada

APPENDIX A — CREW RESOURCE MANAGEMENT CORE ELEMENT (including, but not limited to)

Elements	Topics	Sub-Topics
Threat and Error Management	• Theory and Applications • Relationship of Skill & Error	For crews to recognize threats and errors within their environment and to interpret cues, then discuss and select the appropriate action as appropriate. • **Types of Error**: Procedural/Communication/Proficiency/Operational/ Intentional Non-Compliance • **Areas of Risk**: Aircrew/Maintenance/Air Traffic Control • **Threat and Error Management Strategies**: Avoid – Trap – Mitigate • **Error Avoidance Strategies**: Planning/Procedures/SOPs/Automation Proficiency • **Trapping Strategies**: Standard Operating Procedures/Checklist • **Mitigating Strategies**: Awareness/Implications/Plan/ Act
Communication	• Process • Information Transfer • Interpersonal and Team	The importance of clear and unambiguous communication must be stressed in all training activities for all crew members involved. • **Modes of Communication:** Verbal/Tone/Volume/Body Language • **Process and Feedback**: Sender/Receiver • **Barriers**:

		Internal /External
		• **Communication Skills**:
		Inquiry/Assertion/Listening/Critique/Feedback
		• **Communication Strategy (P.A.C.E):** P **–** Probe for a better understanding A – Alert to any problems C – Challenge suitability of present situation E – Emergency action to reduce danger
Situational Awareness (SA)	• Theory • Challenges • Countermeasures	One's ability to accurately perceive what is in the cockpit and outside the aircraft' (ICAO, 1989b, p13); or simply as 'knowing what is going on'; or more precisely as, 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (Endsley, 1995, p36).
		• **Total SA**:
		Geographical/System/Environmental/Tactical
		• **Three levels of SA**:
		Perception, Comprehension, and Projection
		• **Factors Affecting SA:**
		Human Attention/Working Memory/Automation
		• **Loss of SA – Causes**:
		Time Pressure/Workload (low or high)/Distraction
		• **Recognizing a Loss of SA:**
		Departure from SOP/Ambiguity/Unresolved Discrepancies
		• **Recovering from a Loss of SA:**
		Obtain feedback/Prioritize
		• **Building and Maintaining SA**:

		Manage Workload/Communicate Clearly and Effectively
Pressure and Stress	• Identification • Managing Pressure and Stress	How to respond to pressure (real or perceived) and the ability to distinguish between pressure and stress. • **Causes**: External/Internal • **Type**: • Acute/Chronic • **Symptoms**: Chronic/Unmanaged Stress • **Stress Countermeasures**: Goal Setting/Visualization/Self Talk/Tactical Breathing
Fatigue	• Recognition • Effects • Countermeasures	Causes may include time zones, crew rest and possible sleep barriers. • **Causes:** Circadian Rhythms/Time Awake/Time Working • **Normal Sleep Pattern**: Rapid Eye Movement (REM) • **Signs and Effect of Fatigue**: Judgment/Decision/Making/Performance/ Communication • **Barriers to Sleep**: Age/Stress/Alcohol/Caffeine/Medication/Environment/ Sleep Disorders • **Countermeasures:** Napping/Physical Activity/Eating appropriately/Review of Procedures • **Addressing Fatigue**: Awareness/Implications/Plan/Act

Workload Management	• Prioritizing • Delegating • Planning	Understanding workloads, efficiency and time management.
		• **Workload**: Demands and Capacity • **Factors**: Time Pressure/Experience and Proficiency/Task Duration • **Task**: Low/High/Optimal • **Task Management**: Time/Attention & Vigilance/Distractions/Memory
Decision Making	• Theory • Application • Challenges	Identification of threats and errors; identifying what makes a decision difficult, if the cues are ambiguous.
		• **Resources**: Knowledge/Attention/Time • **Process**: Awareness/Implications/Plan/Act • **Errors**: Goal/Awareness/Implications/Planning/Planning/Resource • **Effective**: SOPs/Proactive/Time/Attention/Feedback
Leadership and Team Building	• Professional Discipline • Group Dynamic	Understanding the chain of command and group dynamics between flight crew and others.

		• **Authority and Assertiveness**: Assertiveness/Crew Member participation • **Maintaining Standards:** Compliance with Standards (i.e. SOPs)/Communication • **Planning and Coordination**: Completion of Task/Goals and boundaries/Changing plans • **Workload Management**: Prioritizing/Time/Communication/Sign of stress and fatigue
Automation and Technology Management	• Philosophy • Use of Technology • Data Interface	Automation Dependency has commonly been described as a situation in which pilots who routinely fly aircraft with automated systems are only fully confident in their ability to control the trajectory of their aircraft when using the full functionality of such systems. Such a lack of confidence usually stems from a combination of inadequate knowledge of the automated systems themselves unless all are employed and a lack of manual flying and aircraft management competence. • **Communication**: SOPs/Feedback/Standard Phraseology • **Workload**: SOPs/Verification/Monitoring/Standard call-outs • **Level (1):** Manual Flight without Flight Direct Guidance • **Level (2):**

		Manual Flight with Flight Director Guidance
		• **Level (3):**
		Auto-pilot Coupled to Heading/Course Guidance
		• **Level (4):**
		Auto-pilot Coupled to LNAV and VNAV Guidance

APPENDIX B — CASE STUDY

Subject Area	Topics	Initial	Annual
Case Study	• The operator is responsible to create a case study which forms part of the CRM training (initial and annual). A relevant case study should cover an operator's aircraft type. • Accident and serious incident reviews to analyze and identify any associated non-technical – NOTECHS, causal and contributory factors, and instances or examples of lack of CRM. • Analysis of occurrences that were well managed. • If relevant aircraft type-specific or operator-specific case studies are not available, the operator should consider other case studies relevant to the scale and scope of its operations. The Transportation Safety Board (TSB) should be utilized for relevant type-specific case studies using the following link provided below: ***http://www.tsb.gc.ca/eng/rapports-reports/aviation/2007/a07c0001/a07c0001.asp***	In-Depth	In-Depth

APPENDIX C — RESILIENCE DEVELOPMENT/SURPRISE AND STARTLE EFFECT

Subject Area	Topics
Resilience Development	Training in resilience development enables crew members to draw the right conclusions from both positive and negative experiences. Based on those experiences crew members are better prepared to maintain or create safety margins by adapting to dynamic complex situations. **The main aspects of resilience development can be described as the ability to:** • Learn (knowing what has happened) • Monitor (knowing what to look for) • Anticipate (finding out and knowing what to expect) • Respond (knowing what to do and being capable of doing it) Operational safety is a continuous process of evaluation of and adjustment to existing and future conditions. **Resilience development involves an ongoing and adaptable process including:** • Situation assessment • Self-review • Decision • Action
Surprise and Startle Effect	CRM Training should address unexpected, unusual and stressful situations. **Management of abnormal and emergency situations, including:** • The development and maintenance of the capacity to manage crew resources • The acquisition and maintenance of adequate automatic behavioural responses • Recognizing the loss and re-building situational awareness and control

APPENDIX D — SAFETY AND COMPANY CULTURE/CULTURAL DIFFERENCES

Subject Area	Topics
Safety and Company Culture	• CRM training should cover the operator's safety culture, its company culture, and the type of operations and the associated procedures of the operator. • Should include areas of operations that may lead to particular difficulties or unusual hazards.
Cultural Differences	• Different cultures may have different communications specifics, ways of understanding and approaches to the same situation or problem. • Difficulties may arise when crew members of different mother tongues communicate in a common language which is not their mother tongue. • Cultural differences may lead to different methods for identifying a situation and solving a problem.

APPENDIX E — CREW RESOURCE MANAGEMENT TRAINING MATERIAL

Threat and Error Management

(1) Introduction

> **Threat and Error Management (TEM) is a general safety concept regarding aviation operations. The three basic components are 'threats', 'errors' and 'undesired (aircraft) states'.**

(a) The TEM framework proposes that threat and errors are part of everyday aviation operations that must be managed by flight crew, since both, threats and errors, have the potential to generate undesired aircraft states, which represents the last opportunity to avoid an unsafe outcome.

(b) CRM is described as the effective use of available resources, emphasizing the non-technical aspects of crew performance. In relation to TEM, CRM behaviours are an effective tool for managing threats and errors. In this context, TEM encompasses CRM with respect to crew performance.

(c) TEM learning objectives:

(i) Ability to describe and identify threats;

(ii) Ability to describe and identify errors;

(iii) Ability to describe the threats and error management process.

(d) What is a threat?

(i) A threat refers to any condition that increases the complexity of the operation;

(ii) Threats can decrease safety margins and lead to errors;

(iii) There are two types of threats:

    (A) External Threats – Outside of your control (weather, system errors, inadequate lighting).

    (B) Internal (Human) Threats – Those within your control (fatigue, stress).

(e) What is an error?

(i) An error refers to the mistake that is made when a threat is mismanaged.

(f) Threat & Error Management Model;

(i) What is threat management?

    (A) Recognizing that a threat exists.

    (B) Developing a strategy to deal with the threat, so as not to reduce safety margins.

(ii) What is error management?

    (A) The process of correcting an error before it becomes consequential to safety.

    (B) To prevent future, similar errors by improving the resistance to errors in the system-depending on the threat, this can be done in two ways:

        (I) By improving strategies to deal with threats that you cannot control,

        (II) By fixing threats that you can control.

(g) Error outcome:

    (i) Inconsequential - The error has no immediate effect on safety.

    (ii) Undesired state - Risk or unsafe operational conditions are increased.

    (iii) Additional errors - The error triggers another error.

(h) Error Management: Resist & Resolve:

    (i) Resist things that already exist within the system to protect against errors (i.e. speeding on the ramp).

    (ii) Resolve: The human corrects the error before it leads to an unwanted consequence.

    (iii) Despite the above, there are things in the environment that increase the compliance of the work we are doing, but if we recognize the threats and come up with strategies to manage them, they won't contribute to error.

        (A) If an error occurs, there may be things already built into the system, such as inspections and operational checks, which resist the error to avoid a harmful outcome, or the person doing the work could recognize that he/she made an error and resolve the error quickly.

(i) Analyze the Failures:

    (i) Apply the 'TEM Management Model' in reverse:

        (A) Consequence(s)>Resist & Resolve>Errors>Strategies>Threats.

    (ii) Requirements for a Successful Analysis:

        (A) Be specific,

        (B) Use TEM language in reporting,

        (C) Identify threats, errors and error outcomes,

        (D) Identify 'Resolve & Resist' strategies,

        (E) Recognize human factors affecting behaviour choices,

        (F) Recommend solutions for changes.

Table 7 – Examples of Threat and Errors

Threats for Flight Crew (Fixed & Rotary wing)	Weather Call signs Wires/obstacles Mountainous Terrain	Laser attacks Language Drones Ground congestion
Threats for Flight Attendant	Lighting Airplane Design Communication Distraction/interruption	Time Pressure Hazardous Materials Noise Resource
Threats for Maintenance Staff	Passengers Catering Weather Equipment	Delays Clothing Culture Scheduling
Threats for Ramp Staff	Distractions Late Aircraft Arrival Time Pressure Flight diversion Heavy traffic	Fatigue System Malfunction Unfamiliar Gate Weather
There are five types of errors	Intentional Non-Compliance Errors Communications Errors Operational Decision Errors	Procedural Proficiency

Communications

(1)   Introduction

> **The importance of clear and unambiguous communication must be stressed in all training activities involving all operational crew members (i.e. pilots, flight attendants and aircraft dispatchers/flight followers).**

(2)   This topic includes internal and external influences on interpersonal communication:

    (a)   External factors include communication barriers, such as:

        (i)   Rank;

        (ii)   Age;

        (iii)   Gender;

        (iv)   Organizational culture;

        (v)   Identification of inadequate SOPs.

    (b)   Internal factors include:

        (i)   Speaking skills;

        (ii)   Listening skills;

        (iii)   Decision-making skills;

        (iv)   Conflict resolution techniques;

        (v)   Appropriate assertiveness;

        (vi)   Advocacy.

    (c)   The more one is concerned with flight related matters, the greater the need for clear communication.

(3)   Advocacy/Assertion:

    (a)   Training in the potential benefits of crew members advocating the course of action that they feel is best, even though it might involve conflict with others.

(4)   Crew Self Critique:

    (a)   Illustrating the value of review, feedback and critique focusing on the process and the people involved. One of the best techniques for recognizing effective human factors practices is careful debriefing of activities, highlighting the process that was followed.

    (b)   It is also useful for crew members to have the ability to recognize good and bad communication while dealing with conflict.

(5)   Conflict Resolution:

    (a)   Demonstrating effective techniques of resolving disagreements among crew members.

    (b)   Demonstrating effective techniques for maintaining open communication while dealing with conflict.

(6)   Decision Making:

    (a)   Demonstrating effective techniques of seeking and evaluating information.

    (b)   Showing the influence of biases and other cognitive factors on decision quality.

Situational Awareness

(1)   Introduction

> **Situational awareness stresses the importance of maintaining awareness of the operational environment. The instructions address practices and attitudes that result in higher levels of situational awareness.**

    (a)   Preparation/Planning: includes methods to improve monitoring and accomplish required tasks by asking for and responding to new information.

    (b)   Situational awareness relates to one's ability to accurately perceive what is in the flight crew compartment and outside the aircraft.

    (c)   It also relates to one's ability to comprehend the meaning of different elements in the environment and the projection of their status in the near future.

    (d)   CRM training should address unexpected, unusual and stressful situations, including interruptions and distraction.

Pressure and Stress

(1)   Introduction

> **Training in this area should describe and demonstrate individual characteristics that can influence crew effectiveness.**

     (a)   Research shows that crew members are often unfamiliar with the negative effects of stress and fatigue on individual cognitive functions and team performance. Training should include a review of scientific evidence on fatigue and stress and their effects on performance, including:

          (i)   the effects of pressure and stress in potential emergency situations;

          (ii)   the effects of personal and interpersonal problems and the increased importance of effective interpersonal communications under stressful conditions;

          (iii)   familiarization with various countermeasures for coping with stressors;

          (iv)   examination of personality and motivation characteristics;

          (v)   self-assessment of personal style;

          (vi)   identifying cognitive factors that influence perception and decision-making.

     (b)   Good training for routine operations can have a strong positive effect on how well individuals function during times of high workload or high stress.

     (c)   During emergency situations, it is highly unlikely (and probably undesirable) that any crew member would take the time to reflect upon his or her CRM training in order to choose the appropriate behaviour, but practice of desirable behaviours during times of low stress increases the likelihood that emergencies will be handled effectively.

Fatigue

(1)   Introduction

> **It is important to recognize symptoms of fatigue and stress and taking appropriate action.**

     (a)   Risk factors/indicators of fatigue:

          (i)   Time of Day;

          (ii)   Shift irregularities;

          (iii)   Length of duty day;

          (iv)   Schedule, consecutive duty days;

          (v)   Poor communication;

          (vi)   Performance;

          (vii)   Variability and unpredictability;

          (viii)   Impaired judgment and decision making;

          (ix)   Limited situational awareness;

          (x)   Undiagnosed or untreated medical condition that affect fatigue;

(xi)   Differences in ability to sleep and respond to conditions;

(xii)   Quality of sleep.

(b)   It is important that training include a review of scientific evidence on fatigue and stress and their effects on performance.

Workload Management

(1)   Introduction

> **These behaviours relate to crews anticipating contingencies and the various actions that may be required.**

(a)   Excellent crews are always "ahead of the curve" and generally seem relaxed. They devote appropriate attention to required tasks and respond without undue delay to new developments.

(b)   These behaviours relate to time and workload management. They reflect how well the crew manages to prioritize tasks, share the workload and avoid being distracted from essential activities.

(c)   Issues involve proper allocation of task to individuals, avoidance of work overloads in self and others, prioritization of task during periods of high workloads and preventing nonessential factors from distracting attention from adherence to SOPs particularly in the case of critical tasks.

Decision Making

(1)   Introduction:

> **Instruction on decision making serves to demonstrate effective techniques of seeking and evaluating information.**

(a)   It is important to show the influence of biases and other cognitive factors on decision quality.

(b)   There are benefits in providing crew with operational models of this group decision process. An example would be the following:

(i)   Crews may refer to these models to make good choices in situations when information is incomplete or contradictory.

(c)   Training should demonstrate effective techniques of seeking and evaluating information. It may also be useful to illustrate the influence of biases and other cognitive factors on decision quality.

(d)   Training should also include a review of Dr. Klein's "recognition primed decision making model" which illustrates how people actually make decisions.

Leadership and Team Building

(1)   Introduction:

> **CRM training should show the benefits of the practice of effective leadership.**

        (a)   Coordinating activities and maintaining proper balance between respecting authority;

        (b)   Practicing assertiveness;

        (c)   Staying centered on the goals of safe and efficient operations.

(2)   These behaviours relate to appropriate leadership and followership. They reflect the extent to which the crew is concerned with the effective accomplishment of tasks.

(3)   Resilience Development:

        (a)   Learn ('knowing what has happened');

        (b)   Monitor ('knowing what to look for');

        (c)   Anticipate ('finding out and knowing what to expect');

        (d)   Respond ('knowing what to do and being capable of doing it').

Automation and Technology Management

(1)   Introduction:

> **The CRM training should include training in the use and knowledge of automation, and in the recognition of systems and human limitations associated with the use of automation.**

        (a)   Therefore, the operator should ensure that the flight crew member receives training on:

                (i)   The application of the operations policy concerning the use of automation as stated in the operations manual;

                (ii)   System and human limitations associated with the use of automation, giving special attention to issues of mode awareness, automation surprises and over reliance including false sense of security and complacency.

        (b)   The objective of this training should be to provide appropriate knowledge, skills and attitudes for managing and operating automated systems.

        (c)   Special attention should be given to how automation increases the need for crews to have a common understanding of the way in which the system performs, and any features of automation that make this understanding difficult.

        (d)   The training should include practical training with automation surprises of different origin (system and pilot induced) to be provided, whenever practicable, in Flight Simulation Training Devices (FSTDs).

Building Scenarios

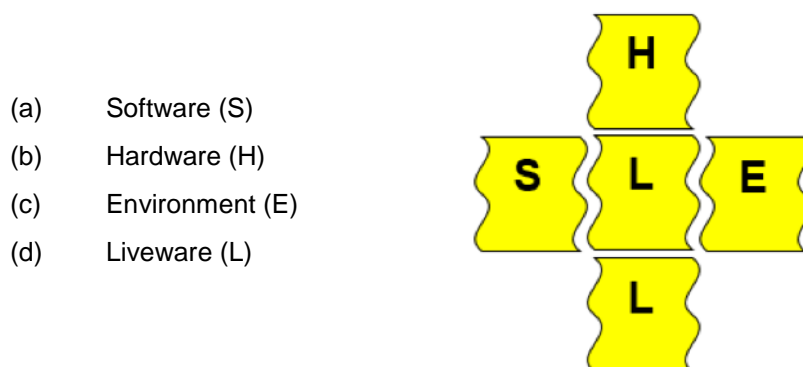(1)   Introduction

> **Scenario-based training is a highly structured script of real world experiences to meet training objectives in an operational environment.**

(a)   Training scenarios are only effective and powerful if they deal with real world challenges or situations that people might encounter outside of the virtual classroom. This is why it is essential that you do your research to figure out what problems or obstacles pilots face and analyze their training needs.

(b)   You need to know what key pieces of knowledge must be acquired in order to cope with problems or difficult situations. It may be tempting to simply make a generic online training scenario that pertains to the subject matter, however, if you take the time to determine exactly what your pilots need to gain from their training, you can create training scenarios that are engaging, entertaining, and offer them the best possible experience imaginable.

(c)   Determine what they need based upon their regular job responsibilities, aircraft, terrain, weather, clients, and mission.

SHEL MODEL

(1)   The SHEL Model was originally developed by Edwards (1972) and modified by Hawkins (1987).

(2)   There are four components to the SHEL model which interface:

(3)   The SHEL Model is commonly depicted graphically to display, not only the four components, but also the relationships, or interfaces, between the Liveware and all the other components. The above figure attempts to portray the fact that the match or mismatch of the interfaces is just as important as the characteristics of the blocks themselves. A mismatch can be a source of human error and identification of a mismatch may be the identification of a safety deficiency in the system. Each of the components is described below.

Figure 5 - SHEL Model

(a)   Software (S)

(b)   Hardware (H)

(c)   Environment (E)

(d)   Liveware (L)

Liveware (Central Component) ***Knowledge, Attitude and Skill***	• The most valuable and flexible component in the system is the human element, the Liveware, placed at the center of the model. • Each person brings his or her own capabilities and limitations, be they physical, physiological, psychological or psychosocial. • This component can apply to any person involved with the operation or in support of the operation. • The person under consideration interacts directly with each one of the four other elements. • The person and each interaction, or interface, constitute potential areas of human performance investigation.
Liveware (peripheral) ***Communication, ATC and Technology***	• The peripheral Liveware refers to the system's human-human interaction, including such factors as management, supervision, crew interactions and communications.
Hardware ***Aircraft, Equipment and Technology***	• Hardware refers to the equipment part of a transportation system. • It includes the design of workstations, displays, controls, seats, etc.
Software ***SOPs, Manual, Rules etc.***	• Software is the non-physical part of the system including organizational policies, procedures, manuals, checklist layout, charts, maps, advisories, and computer programs.
Environment ***Physical, Organization and Weather***	• Environment includes the internal and external climate, temperature, visibility, vibration, noise and other factors which constitute the conditions within which people are working. • Sometimes the broad political and economic constraints under which the aviation system operates are included in this element. • The regulatory climate is part of the environment in as much as its climate affects communications, decision making, control, and coordination.

APPENDIX F — NON-TECHNICAL SKILLS (NOTECHS)

(1)   The NOTECHS framework consists of four main categories: *Co-operation, Leadership and Managerial Skills, Situational Awareness, Decision Making*, each of them being subdivided into elements and behavioural markers (below). The latter are examples of effective and ineffective behaviours.

Category	Elements	Good Practice	Poor Practice
Cooperation	Team building and maintaining	• Establishes atmosphere for open communications and participation	• Blocks open communication
	Considering others	• Takes condition of other crew members into account	• Does not take account of the condition of other crew members
	Supporting others	• Helps other crew members in demanding situations	• Hesitates to help other crew members in demanding situations
	Conflict solving	• **Concentrates on what is right rather than who is right**	• **Accuses other crew members of making errors**
Leadership and managerial skills	Use of authority and assertiveness	• Takes initiative to ensure crew involvement and task completion	• Passive, does not show initiative for decisions, own position not recognizable
	Maintaining standards	• Intervenes if task completion deviates from standards	• Does not intervene in case of deviation
	Planning and coordination	• Clearly states intentions and goals	• Intentions not stated or confirmed
	Workload management	• **Being aware of signs of stress and fatigue**	• **Inadequate workload planning**
Situational awareness	Awareness of aircraft systems	• Monitors and reports changes in system states	• Does not ask for updates
	Awareness of external environment	• Contacts outside resources when necessary	• Does not enquire about environmental changes
	Awareness of time	• Discusses contingency strategies	• Does not set priorities with respect to time limits

Decision-making	Problem definition and diagnosis	• Reviews causal factors with other crew members	• No discussion of probable causes
	Option generation	• States alternative courses of action	• Does not search for information
	Risk assessment and option selection	• Considers and shares estimated risk of alternative courses of action	• Inadequate discussion of limiting factors with crew
	Outcome review	• Checks outcome against plan	• Fails to check selected outcome against goal

*NOTE: The category '**Communication**' is featured in a number of systems but is not shown in NOTECHS as a separate category. This is because communication skills are inherent in all four categories and the listed behaviours all involve communication.*

(2) Description of the four categories:

(a) **Co-operation**: Defined as 'the ability to work effectively in a team/crew'. Co-operation requires team building and maintaining, so that co-operative actions are based on mutual agreement by crew members in a positive group climate. Such a climate is also created by factors like consideration / support of other crew members and conflict solving skills. Co-operation deals with the question of how people function as a working group. It does not refer to the work itself, such as the quality/quantity of output.

(b) **Leadership and managerial Skills**: Defined as: 'effective leadership and managerial skills achieve joint task completion within a motivated, fully functioning team through coordination and persuasion'. The core of effective leadership is to set the highest priority on the joint completion of a given task. Leadership responsibilities include the active and goal-directed coordination of the working activities within the crew. This is always a reciprocal process. Without complementary behaviour of the crew, leadership behaviour is less effective. All crew members are expected to dedicate their efforts and initiative to the safe and efficient achievement of the flight goals.

(c) **Situational awareness**: Defined as 'one's ability to accurately perceive what is in the cockpit and outside the aircraft' (ICAO, 1989b, p13); or simply as 'knowing what is going on'; or more precisely as, 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (Endsley, 1995, p36). Shrestha, et al (1995, p.52) suggest an alternative version as a result of their review of ten definitions of situational awareness: 'situational awareness is a dynamic, multifaceted construct that involves the maintenance and anticipation of critical task performance events. Crew members must also have temporal awareness, anticipating future events based on knowledge of both the past and the present. It is crucial that individuals monitor the environment so that potential problems can be corrected before they escalate.

(d)   **Decision Making**: Defined as 'The process of reaching a judgement or choosing an option'. This definition of decision making is not generally disputed in the aviation literature although it may be labelled aeronautical decision making (Kaempf and Klein, 1995) or pilot judgement. Pilot decision making does not just involve one strategy - different types of decisions are made at different times. Decision events differ enormously in what they demand of the crew, what options and supports exist in standard procedures and policies for making decisions and in features that may make the situation complex. Orasanu (1993), a NASA research psychologist, has studied the styles of decision making used by pilots in different situations. *'…crew decision making is not one thing. Crews make many different kinds of decisions, but all involve situation assessment, choice among alternatives, and assessment of risk.'* (p.138). Hence, pilots' decisions differ in the degrees to which they call on various cognitive processes depending on the decision structure and task conditions.

APPENDIX G — CRM TRAINER/FACILITATOR AND PROGRAM MONITORING FORM

NAME: **OPERATOR:**	**Date:**
OBSERVATION	✓
1. Did the company culture support CRM throughout the organization?	
2. Did the trainer/facilitator demonstrate effective instructional and facilitation skills?	
3. Was the training facility appropriate for the number of student(s) and free of distractions?	
4. Was the CRM training tailored to the operation and did it respond to the student(s) needs, relative to expertise and experience?	
5. Was the courseware (ground, flight simulation training device (FSTD)) appropriately employed?	
6. Was the CRM training delivery method acceptable for the type of operation being conducted? Identify training delivery option(s) utilized. ☐ **E-Learning** ☐ **CBT** ☐ **Self-Study** ☐ **Classroom** ☐ **Third-Party Provider (Outsourcing)**	
7. Did the training incorporate company CRM standards (SOPs, Checklist, etc.) where appropriate?	
8. Was pre-course reading and study material useful in conjunction with the actual CRM training during the classroom setting and was it effective?	
9. Was a third party provider utilized in developing and delivering the CRM training program in accordance with the applicable standard? If so was it effective in its content and relevant to the operations?	
10. Were all the CRM training objectives identified and completed using a blended approach to CRM training?	
11. Was a case study used to identify and discuss the non-technical (NOTECHS) reasons involved in accidents, incidents and events?	
12. Was the time allocated for CRM training adequate as per the applicable standard?	
13. Was feedback collected from participants?	
14. Did the CRM content support contemporary CRM training concepts?	

COMMENTS/OBSERVATIONS	
RESULT: ☐ **Satisfactory** ☐ **Satisfactory with Briefing**	
Signature	
TCCA Inspector: **Date:**	

APPENDIX H — COMMONLY USED UNDEFINED TERMS

Term	Meaning
may	• permissive • usually no legal obligation to carry out the act in question
shall/must	• mandatory • no choice but to carry out the required act
should	• suggestion • no legal obligation to carry out the act in question, but compliance is desirable
and	• conjunction • all conditions to be satisfied
or	• disjunction or separation • at least one condition to be satisfied
means	• indicates an exhaustive definition
includes	• indicates a qualifier or an example
on	• spatial: e.g., on the surface of... • relational: e.g., based on... • temporal: e.g., on a given date...
between	• spatial: e.g., between the seats... • relational: e.g., communication between people... • temporal: e.g., the time between events...
within	• spatial: e.g., within the fence... • relational: e.g., within the guidelines... • temporal: e.g., within the allotted time...
deemed	• treating as true for the law what may not be true in fact
subject to	• subordinate provision
in accordance with	• in conformity with • as per
adequate	• sufficient, suitable to the occasion

APPENDIX I — FURTHER READING REFERENCE – WEB LINKS

TOPICS	WEB ADDRESS	ORGANIZATION
Aerial Work	www.tc.gc.ca/eng/civilaviation/regserv/cars/part7-standards-standard722-2167.htm	TC CASS – 722
Air Taxi – Aeroplanes Air Taxi - Helicopters	http://www.tc.gc.ca/eng/civilaviation/regserv/cars/part7-standards-standard723-aero-2168.htm http://www.tc.gc.ca/eng/civilaviation/regserv/cars/part7-standards-standard723-heli-418.htm	TC CASS – 723 (aero) TC CASS – 723 (heli)
Commuter Operations - Aeroplanes Commuter Operations - Helicopters	http://www.tc.gc.ca/eng/civilaviation/regserv/cars/part7-standards-standard724-aero-2169.htm http://www.tc.gc.ca/eng/civilaviation/regserv/cars/part7-standards-standard724-heli-2170.htm	TC CASS – 724 (aero) TC CASS – 724 (heli)
Airline Operations - Aeroplanes	http://www.tc.gc.ca/eng/civilaviation/regserv/cars/part7-standards-standard725-419.htm	TC CASS – 725
Assessment of PPC Performance - Aeroplane	http://www.tc.gc.ca/eng/civilaviation/publications/tp14727-menu-2709.htm	TP14727 - Pilot Proficiency Check and Aircraft Type Rating Flight Test Guide (Aeroplane)
Assessment of PPC Performance - Helicopter	http://www.tc.gc.ca/eng/civilaviation/publications/tp14728-menu-516.htm	TP14728 - Pilot Proficiency Check and Aircraft Type Rating (Helicopter)
Cognitive and Organizational Processes	https://human-factors.arc.nasa.gov/ihs/flightcognition/	NASA Ames Research Centre Human Factors
Crew Resource Management (CRM) Training	https://www.tc.gc.ca/eng/civilaviation/publications/tp13689-menu-2415.htm	TP 13689-2 - Crew Resource Management (CRM)
Data Base/Current Releases (CAN)	http://www.tsb.gc.ca/eng/aviation/index.asp	Transport Safety Board (TSB) of Canada
Data Base/Current Releases (US)	www.ntsb.gov	National Transportation Safety Board (NTSB)
European Aviation Safety Agency (EASA)	https://www.easa.europa.eu/	European Aviation Safety Agency (EASA)
Federal Aviation Administration (FAA)	www.faa.gov	Federal Aviation Administration (FAA)
Fatigue Countermeasures Program	https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20020042348.pdf	National Aeronautics and Space Administration (NASA)
Flight Safety Foundation (FSF)	www.flightsafety.org	Flight Safety Foundation (FSF)
Human Factors	www.hf.faa.gov	Federal Aviation Administration Human Factors (FAA)

International Civil Aviation Organization (ICAO)	www.icao.int	International Civil Aviation Organization (ICAO)
Pilot Assessment	www.tc.gc.ca/eng/civilaviation/standards/commerce-operationalstandards-acp-menu-380.htm	TP-6533 TC Approved Check Pilot Manual/Advanced Qualification Programs
Research Material on CRM by Professor Robert Helmreich	www.raes-hfg.com/reports/18oct00-RAWG-1/culture.pdf	University of Texas CRM Research
Single-Pilot Resource Management (SRM) Competencies	https://www.tc.gc.ca/eng/civilaviation/publications/tp185-4-2012-6448.htm	TC Flight Operations Focus on CRM

APPENDIX J — CREW RESOURCE MANAGEMENT (CRM) - FREQUENTLY ASKED QUESTIONS (FAQS)

Q1. Does the new Contemporary CRM Standard apply to Subparts 702, 703 and 704 operators?

A1. Yes. The new Standard (below) will apply to all Subparts 702, 703 and 704 of the *Canadian Aviation Regulations* (CARs) and replaces the existing standard under subsection 725.124(39) of the *Commercial Air Service Standards* (CASS).
Reference: Section 3.1 of this AC, table 2.

Q2. Does the new Contemporary CRM Standard and Guidance Material have any input from other regulatory bodies worldwide and why?

A2. Yes. In order to achieve harmonization of contemporary CRM, training standards mirror the International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA), and the Federal Aviation Administration (FAA).
Reference: Section 4.2 of this AC

Q3. What time frame is required to implement a CRM training program in accordance with the applicable standard?

A3. The applicability date of *18 months* is the requirement for all operators to implement CRM training as stipulated by regulation.
Reference: Section 5.1 of this AC

Q4. Are 705 operators required to repeat CRM training if previously completed?

A4. 705 operators need not repeat CRM training as part of the revised Standard provided the initial and annual CRM training program completed at that time met the requirements of subsection 725.124(39) of the CASS.
Reference: Section 5.1 of this AC

Q5. As an operator will I be required to outsource or employ the services of a qualified contracted CRM trainer/facilitator in order to remain compliant?

A5. No. Transport Canada Civil Aviation (TCCA) will not mandate instructor qualifications for CRM trainer/facilitator within the regulations, other than the general qualification of all training personnel as described in the applicable subpart of the CASS - Training Program.
Reference: Section 6.7 of this AC

Q6. **Will CRM training requirements also be extended to third party crews?**

A6. No. It does not apply to third party contractors e.g. Approved Maintenance Organizations (AMOs) providing services to the operator. It applies only to operational personnel employed by the operator.
Reference: Section 5.1 of this AC

Q7. Can a seasonal owner/pilot operator under Subpart 702 or 703 of the CARs be able to administer a self-study standalone Computer Based Training (CBT)?

A7. Yes. CBT may be conducted for either the initial or annual CRM training using CBT method in lieu of a classroom setting as this may not be feasible nor practical.
Reference: Section 6.5 of this AC

Q8. Will Fixed Wing/Helicopter Emergency Medical Services Personnel require relevant CRM training relating to the type of operation being conducted?

A8. Yes. Medical personnel will be required to have relevant CRM training appropriate to the operation.
Reference: Section 7.7 *of this AC*

Q9. Who will determine the appropriate time allocated for CRM training?

A9. It is up to the operator to allocate adequate time in order to meet the requirement of the applicable standard.
Reference: Section 7.6 of this AC

Q10. TCCA CRM Guidance material specifies that initial CRM training shall be administered every three (3) years is this correct?

A10. Yes. The initial CRM training course shall be administered every three (3) years and its training content shall be updated every three (3) years to reflect current industry best practices and any other operator updates.
Reference: Section 7.3 of this AC

Q11. TCCA CRM Guidance Material makes reference to the following term: *'Tailored CRM Training Program'*, what is inferred by the word "*Tailored"*?

A11. The term *"Tailored CRM Training Program"* allows operators to integrate CRM training into their existing training footprint. TCCA recognizes that a "one size fits all approach" to CRM training would not apply i.e. subpart 702 versus 705 of the CARs.
Reference: Section 6.5 of this AC

Q12. When developing a CRM training program does TCCA favor one method over another in regards to the approval process?

A12. Operators may decide to combine their CRM training footprint using one or a combination of methods such as the following:

o   E-Learning*
o   CBT*
o   Self-Study*
o   Classroom
o   Outsourced (third party)
      (*): May be used only as a pre-requisite to classroom trainer/facilitation as applicable.
Reference: Section 6.6 of this AC

Q13. How will flight crew CRM skills be assessed?

A13. The assessment will be in operational environment and shall be in accordance with Transport Canada Publication, TP 6533 - *Approved Check Pilot Manual* and TPs 14727/14728 - *Pilot Proficiency Check and Aircraft Type Rating Flight Test Guide.*
Reference: Section 6.8 of this AC

Q14. What benchmark will TCCA use to establish competency of an operators CRM training program including the trainer/facilitator?

A14. A CRM trainer/facilitator and Program Monitoring form in TCCA's CRM Guidance Material has been provided to TCCA inspectors as part of either a surveillance program, standalone or using a sampling technique to ensure compliance, this is to be completed annually.
Reference: Appendix "G" of this AC

Q15. Can the required CRM training elements be developed utilizing a distinct modular approach?

A15. Yes. TCCA encourages CRM training elements to be integrated into the training program (ground, simulator, and aircraft) matching the size and scope of the operation.
Reference: Section 6.5 of this AC

Q16. May an operator use a self-study component as part of the curriculum?

A16. Yes. Operators may utilize self-study material as a component of their curriculum and shall be prepared to demonstrate to TCCA that the content is relevant and appropriate to the size and scope of the operation.
Reference: Section 6.5 of this AC

Q17. Is there going to be a regulation implemented for pilots of Subparts 702, 703 of the CARs single-pilot operations which requires initial and annual line checks (for rotary and fixed-wing)?

A17. No. There will be no regulatory changes to Subparts 702 and 703 of the CARs operations requiring an initial or annual line check to be administered.
Reference: Section 6.8 of this AC