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नागर विमानन विभाग  
महानिदेशक नागर विमानन का कार्यालय  
सफदरजंग एयरपोर्ट के सामने  
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## **Operations Circular 03 of 2004**

**SUBJECT: HUMAN PERFORMANCE TRAINING PROGRAMMES FOR OPERATIONAL PERSONNEL.**

### **1 PURPOSE**

1.1 It is, intended that this circular becomes a source of information and practical measure to be used in the effort to improve education, training and remedial measures in Human Factors. This advisory circular presents guidelines for developing, implementing, reinforcing, and assessing Human Factors Training and Crew Resource Management (CRM) training programs for flight crew members and other personnel essential to flight safety. These programs are designed to become an integral part of training and operations. All air operators are required by regulations to provide Human Factors and CRM training for cockpit crew, cabin crew, maintenance personnel and flight dispatchers. AOC holders and other individuals operating apart from commercial air transport operations should find these guidelines useful in addressing human performance issues.

### **2. BACKGROUND**

2.1 Human error is, by far, the most pervasive cause of accidents and incidents in technologically complex systems such as air transportation, with studies indicating that between 80 and 90 per cent of all aviation accidents are attributable to human error in one form or another. Sources of human error, including Flight Crew, maintenance, dispatch and, importantly, air traffic control, account for another significant proportion of accidents. Lately, the study of human error has broadened to include the influence of senior, high-level management performance on aviation safety.

- 2.2 Human performance is the critical and enduring issue facing those who have responsibility for the design, operation and supervision of our aviation system. The solution of these long-standing and perplexing Human Factors problems is, therefore, essential.
- 2.3 No person, whether designer, engineer, manager, controller or pilot, can perform perfectly at all times. Also, what could be considered perfect performance in one set of circumstances might well be unacceptable in another.
- 2.4 Long-term research has demonstrated that air operator incidents and accidents share common characteristics. Many problems encountered by flight crews have very little to do with the technical aspects of operating in a multi-person cockpit. Instead, problems are associated with poor group decision-making, ineffective communication, inadequate leadership, and poor task or resource management. Pilot training programs historically focused almost exclusively on the technical aspects of flying and on an individual pilot's performance; they did not effectively address crew management issues that are also fundamental to safe flight.
- 2.5 The application of team management concepts in the flight deck environment was initially known as Cockpit Resource Management. As CRM training programs evolved to include cabin crews, maintenance personnel and others, the phrase Crew Resource Management has been adopted. Briefly defined, **Crew Resource Management is the effective use of all available resources, i.e. equipment, procedures and people, to achieve safe and efficient flight operations.** CRM training is one way of addressing the challenge of optimizing the human/ machine interface and accompanying interpersonal activities. These activities include team building and maintenance, information transfer, problem solving, decision making, maintaining situation awareness, and dealing with automated systems.
- 2.6 Industry and government have come to consensus that training programs should place emphasis on the factors that influence crew coordination and the management of crew resources. The need for additional training in communication between cockpit crew members and cabin crews have been specifically identified.
- 2.7 CRM training is based on awareness that a high degree of technical proficiency is essential for safe and efficient operations. However, high technical proficiency cannot guarantee safe operations in the absence of effective crew coordination. The Human Factors research community has a fundamental contribution to the implementation of Human Factors training for flight crews. The effectiveness of CRM/LOFT as a vehicle for Human Factors training is beyond question. Line-Oriented Flight Training (LOFT) is a group performance training exercise. LOFT can have a

significant impact on aviation safety through improved training and validation of operational procedures.

There is sufficient evidence supporting the effectiveness of CRM to warrant its use in the training environment. This conclusion is based upon several types of evidence. The programmes have a high degree of validity. That is, they reflect sound operating principles and are focused on areas of known weaknesses as supported by accident/incident data. The skills that are targeted for improvement in these programmes and the means to achieve that improvement have been incorporated into effective programmes already in use in other areas, such as business management.

- 2.8 SOP's have been identified as a persistent element in problems, which sometimes have led to accidents. SOP's define the shared mental model upon which good crew performance depends. Too often well-established SOP's have been unconsciously ignored by pilots and others; in other cases they have been consciously ignored. In still other cases SOP's have been inadequately developed by the operator for use by its pilots or cabin crews, or a significant SOP has been omitted altogether from an operator's training program. Initiatives to improve SOP's and adherence to those SOP's are among the top priority safety initiatives now being implemented by ICAO.
- 2.9 Continuing ICAO NASA and FAA measurements of the impact of CRM training show that after initial indoctrination, significant improvements in behaviour occur regarding crew coordination and flight deck management. In programs that also provide recurrent training and practice in CRM concepts, significant changes have been recorded in flight crew performance during Line Oriented Flight Training (LOFT) and during actual flight. CRM- trained crews operate more effectively as teams and cope more effectively with non-routine situations.

Research also shows that when there is no effective reinforcement of CRM concepts by way of **recurrent training**, improvements in behaviours observed after initial indoctrination tend to disappear, and individuals' behaviours tend to revert to former levels.

### 3. HUMAN FACTORS TRAINING

- 3.1 The multidisciplinary field of human factors is devoted to optimizing human performance and reducing human error. It incorporates the methods and principles of the behavioral and social sciences, engineering, and physiology. It is the applied science that studies people working together in concert with machines. It embraces variables that influence individual performance and variables that influence team or crew performance. It is recognized that inadequate system design or inadequate operator training can contribute to individual human error that leads to system performance degradation. Further, it is recognized that inadequate design and management of crew tasks can contribute to group errors that lead to system performance degradation.

- 3.2 **The knowledge requirement of Human Factors has the same status as knowledge required in respect of Meteorology, Navigation, Principles of Flight, or any other part of the traditional training syllabus.** The training curriculum for Human Factors (for flight crew, maintenance and air traffic controllers) is as per Appendix – 1, which can be adapted for cabin crew and flight despatchers as well.
- 3.3 As long as human beings are the part of the aviation system, human capabilities and limitations will influence safety. Human Factors is about people : it is about people in their working and living environments, and it is about their relationship with equipment procedures and the environment. Just as importantly, it is about their relation with other people. Human Factors involves with overall performance of human beings within the aviation system; it seeks to optimise people’s performance through the systematic application of the Human Sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.
- 3.4 Human Factors is essentially a multi-disciplinary field, including but not limited to psychology, engineering, physiology, sociology and anthropometry. Human Factors has come to be concerned with diversified elements in the aviation system, these include Human Behaviour and performance; the design of controls and displays; flight deck and cabin layout; communication and software aspects of computers; maps, charts and documentation; and the refinement of training. Each of these aspects demands skilled and effective human performance.
- 3.5 Given the contemporary emphasis upon the social sciences within Human Factors, it should be remembered that physiology is one among the many important sources of human factors knowledge. Thus, for eg. Anthropometry and biomechanics – involving measurements and movements of human body – are relevant to the design of the workplace and to the equipment therein; similarly, biology and its sub discipline, chronobiology, are necessary for an understanding of those **bodily rhythms** which influence human performance.
- 3.6 ICAO introduced the ‘SHEL’ model which provides a conceptual framework to help understand human factors. It illustrates the various constituents and interfaces – or points of interaction – which comprise the subject. Human Factors elements can be divided into four basic conceptual categories :

Software : documentation, procedures, symbols, etc.

Hardware : machinery, equipment, etc.

Environment : both internal and external to the workplace

Liveware : the human element

Interactions between human beings and the other elements of the SHELL model are at the heart of Human Factors, which involves the interfaces between :

- humans and machines - “Liveware – Hardware”
- humans and materials – “Liveware – Software”
- humans and their colleagues - “Liveware – Liveware”
- humans and the operating environment - “Liveware – Environment”.

#### **4. CREW RESOURCE MANAGEMENT (CRM) TRAINING :**

4.1 CRM training focuses on situation awareness, communication skills, teamwork, task allocation, and decision making within a comprehensive framework of standard operating procedures (SOP's).

4.2 As used in this Operations Circular, CRM refers to the effective use of all available resources: human resources, hardware, and information. Other groups routinely working with the cockpit crew, who are involved in decisions required to operate a flight safely, are also essential participants in an effective CRM process. These groups include but are not limited to :

- a) Aircraft dispatchers
- b) Cabin crews.
- c) Maintenance personnel
- d) Air Traffic Controllers.

4.3 CRM training is one way of addressing the challenge of optimizing the human/ machine interface and accompanying interpersonal activities. These activities include team building and maintenance, information transfer, problem solving, decision making, maintaining situation awareness, and dealing with automated systems. CRM training is comprised of three components : initial indoctrination/ awareness, recurrent practice and feedback, and continual reinforcement.

#### **4.4 COMPONENTS OF CRM TRAINING**

The topics outlined below have been identified as critical components of effective CRM training. They do not represent a fixed sequence of phases, each with a beginning and an end. Ideally, each component is continually renewed at every stage of training.

##### **4.4.1 Initial Indoctrination / Awareness.**

- (a) Indoctrination /awareness typically consists of classroom presentations and focuses on communications and decision making, interpersonal relations, crew coordination, leadership, and

adherence to SOP's, among others. In this component of CRM training, the concepts are developed, defined, and related to the safety of line operations. This component also provides a common conceptual framework and a common vocabulary for identifying crew coordination problems.

- (b) Indoctrination/ awareness can be accomplished by a combination of training methods. Lectures, audiovisual presentations, discussion groups, role-playing exercises, and videotaped examples of good and poor team behaviour are commonly used methods.
- (c) Initiating indoctrination/ awareness training requires the development of a curriculum that addresses CRM skills that have been demonstrated to influence crew performance. To be most effective, the curriculum should define the concepts involved and relate them directly to operational issues that crews encounter. Many organizations have found it useful to survey crewmembers. Survey data have helped identify embedded attitudes regarding crew coordination and cockpit management. The data have also helped to identify operational problems and to prioritize training issues.
- (d) Effective indoctrination/ awareness training increases understanding of CRM concepts. That understanding, in turn, often influences individual behaviour favorably regarding human factors issues. Often the training also suggests more effective communication practices.
- (e) It is important to recognize that classroom instruction alone does not fundamentally alter crewmember attitudes over the long term. The indoctrination/ awareness training should be regarded as a necessary first step towards effective crew performance training.

#### **4.4.2 Recurrent Practice and Feedback.**

- (a) CRM training must be included as a regular part of the recurrent training requirement once a year. Recurrent CRM training should include classroom or briefing room refresher training to review and amplify CRM components, followed by practice and feedback exercises such as LOFT, preferably with taped feedback; or a suitable substitute such as role-playing in a flight training device and taped feedback. It is recommended that these recurrent CRM exercises take place with a full crew, each member operating in his or her normal crew position. A complete crew should always be scheduled, and every attempt should be made to maintain crew integrity. Recurrent training LOFT which includes CRM should be conducted with current line crews, and preferably not with instructors or check pilot as stand-ins.
- (b) Recurrent training with performance feedback allows participants to practice newly improved CRM skills and to receive feedback on

their effectiveness. Feedback has its greatest impact when it comes from self-critique and from peers, together with guidance from a facilitator with special training in assessment debriefing techniques.

- (c) The most effective feedback refers to the coordination concepts identified in Indoctrination/ Awareness training or in recurrent training. Effective feedback relates to specific behaviours. Practice and feedback are best accomplished through the use of simulators or training devices and videotape. Taped feedback, with the guidance of a facilitator, is particularly effective because it allows participants to view themselves from third person perspective. This view is especially compelling in that strengths and weaknesses are captured on tape and vividly displayed. Stop action, replay, and slow motion are some of the playback features available during debriefing. Behavioral patterns and individual work styles are easily seen, and appropriate adjustments are often self-evident.

#### 4.4.3 Continuing Reinforcement.

- (a) No matter how effective each curriculum segment is ( the classroom, the role-playing exercises, the LOFT, or the feedback), one-time exposures are simply not sufficient. The attitudes and norms that contribute to ineffective crew coordination may have developed over a crewmember's lifetime. It is unrealistic to expect a short training program to reverse years of habits. To be maximally effective, CRM should be embedded in every stage of training, and CRM concepts should be stressed in line operations as well.
- (b) **CRM should become an inseparable part of the organization's culture.**
- (c) There is a common tendency to think of CRM as training only for captains. This notion misses the essence of the CRM training mission, the prevention of crew-related accidents. **CRM training works best in the context of the entire crew.** Training exercises are most effective if all crewmembers work together and learn together. In the past, much of the flight crew training has been segmented by crew position. This segmentation has been effective for meeting certain training needs such as seat dependent technical training and upgrade training, but segmentation is not appropriate for most CRM training.
- (d) **Reinforcement can be accomplished in many areas Training such as joint cabin and cockpit crew training in security can deal with many human factors issues.**

#### 4.5 BASIC CONCEPTS OF CRM :

CRM training is based on an awareness that a high degree of technical proficiency is essential for safe and efficient operations. Demonstrated mastery of CRM concepts cannot overcome a lack of proficiency. Similarly, high technical proficiency cannot guarantee safe operations in the absence of effective crew coordination.

- a. Experience has shown that lasting behavior changes in any environment cannot be achieved in a short time, even if the training is well designed. Trainees need awareness, practice and feedback, and continuing reinforcement: in brief, time to learn attitudes and behaviors that will endure. To be effective, CRM concepts must be permanently integrated into all aspects of training and operations.
- b. While there are various useful methods in use in CRM training today, certain essentials are universal:
  - (1) CRM training is most effective within a training program centered on clear, comprehensive SOPs.
  - (2) CRM training should focus on the functioning of crewmembers as teams, not as a collection of technically competent individuals.
  - (3) CRM training should instruct crewmembers how to behave in ways that foster crew effectiveness.
  - (4) CRM training should provide opportunities for crewmembers to practice the skills necessary to be effective team leaders and team members.
  - (5) CRM training exercises should include all crewmembers functioning in the same roles (e.g., captain, first officer, and/or flight engineer, flight attendants) that they normally perform in flight.
  - (6) CRM training should include effective team behaviors during normal, routine operations.
- c. Good training for routine operations can have a strong positive effect on how well individuals function during times of high workload or high stress.
- d. Effective CRM has the following characteristics:
  - (1) CRM is a comprehensive system of applying human factors concepts to improve crew performance.

- (2) CRM embraces all operational personnel.
- (3) CRM can be blended into all forms of aircrew training.
- (4) CRM concentrates on crewmembers' attitudes and behaviors and their impact on safety.
- (5) CRM uses the crew as the unit of training.
- (6) CRM is training that requires the active participation of all crewmembers. It provides an opportunity for individuals and crews to examine their own behavior, and to make decisions on how to improve cockpit teamwork.
  - (a) LOFT sessions provide an extremely effective means of practicing CRM skills and receiving reinforcement.
  - (b) Audiovisual (taped) feedback during debriefing of LOFT and other training is an excellent way for flight crewmembers to assess their skills as individuals and as team members. Bulk erasure of taped sessions is suggested to encourage candor among participants while assuring their privacy.
  - (c) In cases where simulators are not available, crewmembers can participate in group problem-solving activities designed to exercise CRM skills. Through taped feedback during debriefing, they can then assess the positive and negative behaviors of all crewmembers.
  - (d) Crewmembers may also participate in role-playing exercises. Such exercises permit practice in developing strategies for dealing with events or event sets, and enable analysis of behaviors shown while dealing with them. Again, taping the role-playing exercises is useful for assessment and feedback during debriefing. Crewmembers' abilities can be clearly observed in such areas as adherence to SOPs, decision making, teamwork, and leadership.
  - (e) Attitude and/or personality measures can also be used to provide feedback to participants, allowing them to assess their own strengths and weaknesses.
- (7) Success of CRM training depends upon CRM facilitators, check airmen, instructors, and examiners who are highly qualified in the operator's SOPs and specially trained in CRM.

#### 4.6 **FUNDAMENTALS OF CRM TRAINING IMPLEMENTATION.**

Research programs and airline operational experience suggest that the greatest benefits are achieved by adhering to the following practices:

- a. **Assess the Status of the Organization Before Implementation.** It is important to know how widely CRM concepts are understood and practiced before designing specific training. Surveys of crewmembers, management, training, and standards personnel, observation of crews in line observations, and analysis of incident/accident reports can provide essential data for program designers.
- b. **Get Commitment from All Managers, Starting with Senior Managers.** CRM programs are received much more positively by operations personnel when senior managers, flight operations managers, and flight standards officers conspicuously support CRM concepts and provide the necessary resources for training. Flight operations manuals and training manuals should embrace CRM concepts by providing crews with necessary policy and procedures guidance centered on clear, comprehensive SOPs. A central CRM concept is communication. It is essential that every level of management support a safety culture in which communication is promoted by encouraging appropriate questioning. It should be made perfectly clear in pilots' manuals, and in every phase of pilot training, that appropriate questioning is encouraged and that there will be no negative repercussions for appropriate questioning of one pilot's decision or action by another pilot.
- c. **Customize the Training to Reflect the Nature and Needs of the Organization.** Using knowledge of the state of the organization, priorities should be established for topics to be covered, including special issues, such as the effects of mergers or the introduction of advanced technology aircraft. Other special issues might include topics specific to the particular type of operation, such as the specific characteristics that exist in commuter operations, in long-haul international operations or night operations. This approach increases the relevance of training for crewmembers.
- d. **Define the Scope of the Program and an Implementation Plan.** Institute special CRM training for key personnel, including CRM facilitators and Training Captains. It is highly beneficial to provide training for these groups before beginning training for crewmembers. CRM training may be expanded to combine pilots, flight attendants, and aircraft dispatchers. It may also be expanded to include maintenance personnel and other company team members, as appropriate. It is also helpful to develop a long-term strategy for program implementation. *Eventually, the operator should progressively plan to evolve from Crew Resource Management to*

***Company Resource Management***, wherein, all the departments can adopt an integrated approach to enhance safety and efficiency.

- e. **Communicate the Nature and Scope of the Program Before Startup.** Training departments should provide crews, managers, training, and standards personnel with a preview of what the training will involve together with plans for initial and continuing training. These steps can prevent misunderstandings about the focus of the training or any aspect of its implementation.
  - f. **Institute Quality Control Procedures.** It has proved helpful to monitor the delivery of training and to determine areas where training can be strengthened. Monitoring can be initiated by providing special training to program instructors (often called facilitators) in using surveys to collect systematic feedback from participants in the training.
- 4.7 **SPECIALIZED TRAINING IN CRM CONCEPTS.**  
(CRM Training curriculum is outlined in Appendix 2 and Appendix3.)
- a. After all current crewmembers have completed the Initial Indoctrination! Awareness component of CRM training, arrangements are needed to provide newly hired crewmembers with the same material. A number of organizations have modified their CRM initial courses for inclusion as part of the initial training and qualification for new hire crewmembers.
  - b. Training for upgrading to captain provides an opportunity for specialized training that deals with the human factors aspects of command. Such training can be incorporated in the upgrade process.
  - c. Training involving communications and the use of automation can be developed for crews operating aircraft with advanced technology cockpits, or for crews transitioning into them.
- 4.8 **ASSESSMENT OF CRM TRAINING.**

It is vital that each training program be assessed to determine if CRM training is achieving its goals. Each organization should have a systematic assessment process. Assessment should track the effects of the training program so that critical topics for recurrent training may be identified and continuous improvements may be made in all other respects. Assessment of the training program should include observation and feedback by program administrators and self-reports by participants using standard survey methods.

- a. The emphasis in this assessment process should be on crew performance. The essential areas of CRM -related assessment include communications, decision making, team building and maintenance,

workload management, and situation awareness, always in balance with traditional technical proficiency. An additional function of such assessment is to determine the impact of CRM training and organization-wide trends in crew performance.

- b. For optimal assessment, data on crewmembers' attitudes and behavior should be collected before CRM indoctrination and again at intervals after the last component of CRM training, to determine both initial and enduring effects of the program. The goal should be to obtain an accurate picture of the organization's significant corporate personality traits before formal adoption of CRM training, and to continue to monitor those traits after implementation.
- c. Reinforcement and feedback are essential to effective CRM training. Crewmembers must receive continual reinforcement to sustain CRM concepts. Effective reinforcement depends upon usable feedback to crewmembers on their CRM practices and on their technical performance.
- d. Usable feedback requires consistent assessment. Crewmembers and those involved in training and evaluation should be able to recognize effective and ineffective CRM behaviors. CRM concepts should be critiqued during briefing/debriefing phases of all training and checking events.
- e. To summarize, the assessment process should:
  - (1) Measure and track the organization's corporate culture as it is reflected in attitudes and norms.
  - (2) Identify topics needing emphasis within the CRM program.
  - (3) Ensure that all CRM facilitators and Training captains, and instructors are well prepared and standardized.

#### 4.9 **EVOLVING CONCEPTS OF CRM.**

- a. **Crew Monitoring and Cross-Checking.** Several studies of crew performance, incidents, and accidents have identified inadequate flight crew monitoring and crosschecking as a problem for aviation safety. Therefore, to ensure the highest levels of safety, each flight crewmember must carefully monitor the aircraft's flight path and systems and actively crosscheck the actions of other crewmembers. Effective monitoring and cross-checking can be the last line of defense that prevents an accident because detecting an error or unsafe situation may break the chain of events leading to an accident.

- b. Joint CRM Training.** More carriers are discovering the value of expanding CRM training to reach various employee groups beyond flight crew and flight attendants. Dissimilar groups are being brought together in CRM training and in other activities. The objective is to improve the effectiveness and safety of the entire operations team as a working system.
- (1) Even broader cross-pollination of CRM concepts has been considered, using other groups such as passenger service agents, mid- and upper-level managers, and special crisis teams like hijack and bomb-threat teams.
  - (2) Flight attendants are probably the most obvious of the groups other than pilots who may profit from CRM training. Joint CRM training for pilots and should be encouraged and has been practiced effectively at some air carriers for years. One fruitful activity in joint training has been that each group learns of the other group's training in shared issues. The joint training has revealed inconsistencies between training for one group and training on the same topic for another group. Examples of shared issues include delays, the use of personal electronic devices in the cabin, evacuation and ditching, and hijack response: When inconsistencies are identified between the contents of pilots' manuals and flight attendants' manuals, for instance, or between widely-held ideas or attitudes in those two populations, those inconsistencies are brought out into the open and often resolved. Other specific topics for joint training include:
    - (a) Pre-flight briefings;
    - (b) Post incident/accident procedures;
    - (c) Sterile cockpit procedures;
    - (d) Notification procedures (pre-takeoff and pre-landing);
    - (e) Procedures for turbulence and other weather;
    - (f) Security procedures;
    - (g) Passenger-handling procedures;
    - (h) In-flight medical problems;
    - (i) Smoke/fire procedures;
    - (j) Passenger-related regulations such as those relating to smoking, exit row seating, and carry-on baggage; and
    - (k) Authority of the pilot in command.

- (3) CRM principles are made more relevant for pilots, flight attendants, and other groups by treating those principles in a familiar job-related context. Furthermore, each group should benefit from concurrent training in CRM that is complemented by usable knowledge of the other's job.
- (4) Communication and coordination problems between cockpit crewmembers and flight attendants continue to challenge air carriers. Other measures with positive CRM training value for flight crews are being considered, such as providing experienced flight crewmembers to teach new-hire flight attendant orientation classes.

**c. Error Management.** It is now understood that pilot errors cannot be entirely eliminated. It is important, therefore, that pilots develop appropriate error management skills and procedures. It is certainly desirable to prevent as many errors as possible, but since they cannot all be prevented, detection and recovery from errors should be addressed in training. Evaluation of pilots should also consider error management (error prevention, detection, and recovery). Evaluation should recognize that since not all errors can be prevented, it is important that errors be managed properly.

**d. Advanced CRM.** CRM performance requirements or procedures are being integrated into the SOPs of certain air carriers. Specific callouts, checks, and guidance have been included in normal checklists, the quick-reference handbook (QRH), abnormal/emergency procedures, manuals, and job aids. This integration captures CRM principles into explicit procedures used by flight crews.

**e. Culture issues.** While individuals and even teams of individuals may perform well under many conditions, they are subject to the influence of at least three cultures - the professional cultures of the individuals themselves, the cultures of their organizations, and the national cultures surrounding the individuals and their organizations. If not recognized and addressed, factors related to culture may degrade crew performance. Hence, effective CRM training must address culture issues, as appropriate in each training population.

#### **4.10 Dispatcher/Flight Operations Officer Resource Management (DRM) :**

4.10.1 Accident histories have established that inadequate operational control and inadequate collaborative decision-making have been contributing factors in air carrier accidents. Effective management of available resources by aircraft dispatcher/flight operations officers is one essential deterrent to such accidents. In exercising operational control, the dispatcher/flight operations officer coordinates with flight crewmembers, air traffic controllers (ATC), and other members of a vast team in

order to meet the requirements of daily flight operations. This Operations Circular encourages the dispatcher/flight operations officer's knowledge of the functions of the other participants throughout the operating environment. Two expected benefits to the dispatcher/flight operations officer are (1) better handling of information that bears on safe flight operations and (2) a better interface with each pilot in command, consistent with the joint responsibility concept outlined in States CAR's.

4.10.2 The communication center with respect to positive operational control is the dispatcher/flight operations officer who coordinates a wide array of resources for the flight crew. DRM addresses the challenge of optimizing the person/machine interface and related interpersonal issues. These issues include effective teambuilding and maintenance, information transfer, problem solving, decision making, maintaining situational awareness, and dealing with automated systems. DRM training, like CRM training, is comprised of three components: Initial Indoctrination/Awareness, Recurrent Practice and Feedback, and Continuing Reinforcement. DRM differs in the effective use of all resources: human resources, hardware, and information.

#### 4.10.3 BASIC CONCEPTS OF DRM

**a. Operating Environment.** The operating environment comprises interactions of the aircraft dispatcher/flight operations officer with:

- (1) Pilots.
- (2) Air traffic controllers.
- (3) Other dispatcher/flight operations officers.
- (4) Managers.
- (5) Station personnel.
- (6) Meteorology resources.
- (7) Aircraft maintenance staff.
- (8) Load planners.
- (9) Crew schedulers.
- (10) Aircraft routers.
- (11) Communication systems and related personnel.
- (12) Flight planning systems and related personnel.

**b. Situational Awareness (Dispatcher/Flight Operations Officer).** The ability to absorb information in a dynamic environment, to evaluate and refine that information, to anticipate contingencies, and to initiate appropriate actions as necessary.

**c. Communications.** Chief among many functions, the dispatcher/flight operations officer is a center for communications, continually receiving and disseminating information. He/she interfaces with the flight crew, with ATC, and with many others in the operational environment. Communication skills are at the heart of this work. Communication should be in standardized language that is easily understood by individuals in various departments and organizations. Communication among departments and training should be encouraged. Special emphasis should be given to.

(1) Inquiry /advocacy /assertion.

(2) Conflict resolution.

(3) Radio communication (phraseology and technique).

**d. Handling Information.** One of the aircraft dispatcher/flight operations officer's main responsibilities is to keep the flight crew updated on any information that affects flight safety. Dispatcher/flight operations officers are required to review large quantities of real-time information and to decide what information is pertinent for each flight under their operational control. Dispatcher/flight operations officers pass on information relevant to each flight, sometimes obtaining missing information as part of the process. This linkage provides timely information to the flight crewmembers and relieves workload.

**e. Interpersonal Skills.** DRM concentrates on dispatcher/flight operations officers' attitudes and behaviours and the effects that they have on others.

**f. Workload Management.** DRM should help dispatcher/flight operations officers see that how they react during normal routine circumstances can have a powerful influence on how well they function during high workload and stressful situations. Prioritizing tasks is one key element in consistent, effective operational control.

**g. Effective Decision Making.** Through inquiry, advocacy, and assertion, the dispatcher/flight operations officer assumes a leadership role within the operational environment. This leadership role in workload management and situational awareness supports the captain. It requires the dispatcher/flight operations officer, together with the pilot in command, to apply problem-solving skills, which include the following:

- (1) Weighing the competing needs that must be considered in choosing among alternatives.
- (2) Being aware of the resources available to the various parties involved in the decision making;
- (3) Applying effective problem solving strategies to help in decision making; and
- (4) Avoiding situations and behaviours that contribute to errors.

## 5. CRITICAL ROLE OF CRM FACILITATORS & TRAINING CAPTAINS

- 5.1 The success of any CRM training program ultimately depends on the skills of the people who administer the training and measure its effects. CRM instructors, check pilots, supervisors, and course designers must be skilled in all areas related to the practice and assessment of CRM. These skills comprise an additional level to those associated with traditional flight instruction and checking.
- 5.2 Gaining proficiency and confidence in CRM instruction, observation, and measurement requires special training for CRM Facilitators and Training Captains in many CRM training processes. Among those processes are role-playing simulations, systematic crew-centered observation, administering LOFT programs, and providing usable feedback to crews.
- 5.3 Pilots, Training Captains and personnel with aviation background in the cockpit who are specially trained in Human Factors and CRM may be used as CRM facilitators.
- 5.4 Instructors, examiners, and check pilots also require special training in order to calibrate and standardize their own skills.
- 5.5 Instructors, examiners, and check pilots should use every available opportunity to emphasize the importance of crew coordination skills. The best results occur when the crews examine their own behaviour with the assistance of a trained instructor who can point out both positive and negative CRM performance. Whenever highly effective examples of crew coordination are observed, it is vital that these positive behaviors be discussed and reinforced. Debriefing and critiquing skills are important tools for CRM facilitators and Training Captains. (Behavioral markers of effective LOFT debriefings are shown in Appendix 3.)
- 5.6 Feedback from instructors, supervisors, and check pilot is most effective when it refers to the concepts that are covered in the initial indoctrination/awareness training. The best feedback refers to instances of specific behavior, rather than behavior in general.

## 6. LOFT (LINE ORIENTED FLIGHT TRAINING)

- 6.1. LOFT refers to aircrew training which involves a full flight simulation of situations, which are representative of line operations, ***with special emphasis on situations, which involve communications,***

**management and leadership.** In short, LOFT means realistic, “real-time”, full flight training.

LOFT presents to aircrews scenarios of typical daily operations in their airline with reasonable and realistic difficulties and emergencies introduced to provide training and evaluation of proper flight deck management techniques. The result is an appreciation by the air carrier of operational shortcomings on the part of line crews and an evaluation of the adequacy of flight deck procedures and instrumentation, as well as over-all crew training effectiveness.

LOFT scenarios may be developed from many sources, but accident reports provide a realistic and appropriate starting point. A properly conducted LOFT programme can provide great insight into the internal workings of an airline’s operations and training programme for the following reasons :

- a) If similar mistakes seem to be recurring among pilots, it may indicate a potentially serious problem as a result of incorrect procedures, conflicting or incorrect manuals, or other operational aspects.
- b) Air carriers can use it to test and verify flight deck operational procedures.

A LOFT session should not be interrupted except in extreme and unusual circumstances. Repositioning the simulator and repeating problems is inconsistent with the principles of LOFT. Part of the benefit of LOFT is derived from an individual or crew being able to quickly appreciate the results, either positive or negative, of operational decisions. After completion of such a session, a thorough debriefing should be made of all aspects. This may be accomplished by an initial self-briefing by the crew, followed by the Instructor’s / Examiner’s / LOFT coordinator’s debriefing.

## **6.2. Development of scenario designs**

The origin, routing and destination of a particular scenario should be dictated by the specific objectives for that scenario or leg. Other factors to be considered are the weather, operational and equipment problems, etc. Simulator visual systems, as well as other capabilities and limitations must be considered at a very early stage of scenario design. The simulator navigation area must be appropriate and must coincide with current charts. Similarly, current manuals and other operational documentation must be available to preserve realism.

Other factors to be considered are alternate airports, fuel, and air traffic control. The specifics of location choice will depend on the operator’s needs. For example, if a simulation is to be constructed around an air traffic control problem, one must choose a route where that problem is likely to occur.

Problems and anomalies should be chosen in terms of the specific objectives. Both, simple problems (those that have no impact on the flight once they have been diagnosed and corrected) and complex problems (those that exert an influence on the remainder of the flight) may be used. Problems should not be compounded. The simultaneous presentation of multiple problems should not result from scenario design, although it may occur as a result of inappropriate crew action. LOFT scenarios should not be designed to “bury” or overload the crew.

Designers should avoid totally filling a flight period. They should leave some time for lulls and periods of relative inactivity. The pacing of anomalies and other events must not detract either from the realism of the scenario or from the training potential of the situation.

In the area of scenario revision and quality control after development, the scenario must be tested. Revisions will almost always be required. Even after further testing, use of a scenario may reveal details that require further revision based on input from Instructors / Examiners / LOFT coordinator's and line flight crews.

Procedures and practices in the flight operations manuals or flight crew operating manuals that are known to be frequently misunderstood should be considered for inclusion in a LOFT scenario. For this purpose, also consider accident and maintenance reports, as well as incidents taken from information exchanges and confidential reporting systems.

Under operational problems, include pre-flight, dispatch release, hazardous cargo, fueling options, NOTAMs, etc.

Minimum equipment list (MEL) items, as well as cabin/passenger problems, ATC problems and mass and balance problems are all good sources for LOFT scenarios.

Under environmental problems include weather, wind, temperature, runways that are wet, icy or closed and runway and touchdown zone lighting problems, as appropriate.

In the equipment problems category include, as appropriate, airborne equipment problems and ground equipment problems such as support equipment and ground-based radio aids.

Under crew problems include cabin crew problems, flight crew problems including incapacitation, either obvious or subtle.

### **6.3. Performance evaluation and assessment**

It should be emphasized during CRM – LOFT that :

- a) it is a purely a learning experience;

- b) it is a training concept designed to emphasize crew command, coordination, communication, and full management of the available resources;
- c) the Instructor / Examiner and LOFT coordinator will not interfere regardless of developments;
- d) apparent mistakes may be made, but the crew should carry on since there is no one book solution to a LOFT exercise;
- e) there will be an opportunity for a full self-analysis during the debriefing; and
- f) the Instructor / Examiner and LOFT coordinator will take notes during the exercise and will assist in the debriefing.

The role of Instructor / Examiner and LOFT coordinator is not that of an instructor in the traditional sense. For example, realism considerations dictate that the Instructor / Examiner and LOFT coordinator will not intervene or intrude in any way into the LOFT scenario. Thus, for purposes of the debriefing, it is crucial that the Instructor / Examiner and LOFT coordinator serve primarily as a moderator.

Self-criticism and self-examination are normally much more effective than a critique led by the Instructor / Examiner and LOFT coordinator. In fact, crews are often much harder on themselves than the Instructor / Examiner and LOFT coordinator would ever consider being. The Instructor / Examiner and LOFT coordinator should do everything possible to foster such self-analysis.

When serving as moderator, the Instructor / Examiner and LOFT coordinator can guide the discussion to points that need attention. Questions about certain procedures, mistakes, and so forth, should be asked whenever possible. A suggested format for the debriefing should include :

- a) a positive general statement opening the discussion;
- b) a short review of the scenario, including the human factors and training objectives;
- c) a discussion by crew members of the operation as a whole or in part;
- d) coverage of all aspects of the flight, not permitting any one feature to dominate the debriefing;
- e) reference to possible alternatives and better ways of accomplishing the objectives; and

- f) further development of the discussion through the use of questions to each crewmember, such as “what if you had done.....”.

With respect to evaluation and assessment, everything should be done to assure crews participating in LOFT that their jobs are not in jeopardy every time they enter the simulator for a LOFT session. While “satisfactory completion” is an inescapable aspect of LOFT. In some cases, LOFT may underscore areas, which need extra attention.

During debriefing, both total crew performance and individual performances should be openly discussed and assessed by the Instructor / Examiner and LOFT coordinator. Critical assessment of an individual must be mentioned in the presence of the full crew, but remedial details may be handled separately. Tact is required to maintain the proper training atmosphere.

Additional training for crewmember, when indicated, must be handled in a low-key, non-threatening manner. If these factors are carefully handled, the evaluation/assessment chore will not necessarily detract from the pure training atmosphere, and will result in full acceptance.

## **7. LINE OPERATIONS SAFETY AUDIT (LOSA) :**

- 7.1 Line Operations Safety Audit (LOSA) or LOAS (Line Operations Assessment System) is a critical organizational strategy aimed at developing countermeasures to operational errors. It is an organizational tool used to identify threats to aviation safety, minimize the risks such threats may generate and implement measures to manage human error in operational contexts. LOSA will enable us to assess our level of resilience to systemic threats, operational risks and front-line personal errors, thus providing a principled, data-driven approach to prioritize and implement actions to enhance safety.
- 7.2 **LOSA is closely linked with Crew Resource Management (CRM) training.** Since CRM is essentially error management for operational personnel, data from LOSA form the basis for contemporary CRM training refocus and/or design known as Threat and Error Management (TEM) training. Data from LOSA also provide a real-time picture of system operations that can guide organizational strategies in regard to safety, training and operations.
- 7.3 DFDR/QAR readouts provide information on the frequency of exceedances and the locations where they occur, but the **DFDR readouts do not provide information on the human behaviours that were precursors of the events.** When DFDR/QAR data track potential systemic problems, pilot reports are still necessary to provide the context within which the problems can be fully diagnosed. LOSA helps in doing so.

- 7.4 The line observations are conducted under strict no-jeopardy conditions; therefore, **flight crews are not held accountable for their actions and errors that are observed.** During flights that are being audited, observers record and code potential threats to safety; how the threats are addressed; the errors such threats generate; how flight crews manage these errors; and specific behaviours that have been known to be associated with accidents and incidents.
- 7.5 LOSA observations are **Jump-seat observations during normal flight operations** limited to regularly scheduled flights.
- 7.6 **Pilots/ CRM facilitators should be trained for carrying out the LOSA observations, and should be objective, trustworthy and non-controversial.** Observation teams will typically include line pilots, instructor pilots, safety pilots, management pilots, members of Human Factors groups and CRM facilitators.
- 7.7 **LOSA data should be De-identified and confidential.** LOSA observers should not record names, flight numbers, dates or any other information that can identify a crew. This allows for a level of protection against disciplinary actions. The purpose of LOSA is to collect safety data, not to punish crewmembers. In order to maintain confidentiality, there must be a **trusted data collection site.**
- 7.8 The final product of a LOSA is the data-derived LOSA **targets for enhancements.** As the data are collected and analyzed, patterns emerge. Certain errors occur more frequently than others, certain airports or events emerge as more problematic than others, certain SOPs are routinely ignored or modified and certain maneuvers pose greater difficulty in adherence than others. These patterns can be identified as LOSA targets for enhancement. Action plans based on these targets, to analyze the targets and implement appropriate change strategies, can be adopted.

## **8. APPLICABILITY :**

- 8.1 *All air operators are required to provide Human Factors and CRM training for cockpit crew, cabin crew, maintenance personnel and flight dispatchers.*
- 8.2 *A detailed initial Human Factors course and initial CRM course should be imparted to all ab-initio cockpit crew, ab-initio cabin crew, ab-initio maintenance personnel and ab-initio flight dispatchers. The Human Factors Training curriculum is as per Appendix-1 and the CRM Training curriculum is as per Appendix-2 and Appendix-3.*
- 8.3 *A recurrent Human Factors and CRM course should be imparted once a year for cockpit crew, cabin crew, maintenance personnel and flight dispatchers.*

- 8.4 *Cockpit crew will undergo Human Factors and CRM Training, when converting to another aircraft and when they upgrade to initial command and subsequent command conversion.*
- 8.5 *Cockpit Crew will undergo a special Command Course on Human Factors & Crew Resource Management, when they upgrade as Pilot-in-Command.*
- 8.6 *All Training Captains should undergo Human Factors and CRM Training before exercising the privileges of a Training Captain.*
- 8.7 *LOFT should be carried out during ab-initio training, conversion training as well as command training for all pilots.*
- 8.8 *LOSA observations should be carried out on a regular basis, covering all areas of operation by all scheduled airlines.*

All Operators are required to formulate Training Programme on Human Factors and Crew Resource Management for their Cockpit Crew, Cabin Crew, Flight Dispatchers, Maintenance Personnel and Training Captains based on the contents of this Circular.

**(Capt Dilip Kharkar)**

Chief Flight Operations Inspector  
for Director General of Civil Aviation)

To

1. All Scheduled/Non-scheduled Operators (Fixed Wing and Helicopter)
2. All General Aviation Operators including State Governments
3. Directorate of Training, Air Headquarters, Vayu Bhawan, New Delhi  
**(Attn : Assistant Chief of Air Staff)** for compliance by all your Flying Training Institutes.
4. Airports Authority of India **(Attn: Member (Operations))**, Rajiv Gandhi Bhawan, New Delhi. This Circular (Ref. Para 1.1 to Appendix-I) is for information and guidance on training of ATCOs on Human Factors/CRM.

Copy for Internal Distribution to:

1. PS to DG / PS to JDGs
2. DDG(PKC). You are requested to ensure that this Circular is complied by all Maintenance Organizations and Maintenance Personnel of all Operators.
3. DDG(B). You are requested to ensure that contents of this Circular are brought to the notice of all Flying Training Institutes for guidance of their Chief Flight Instructor / Flight Instructor Incharge..

**1.1 HUMAN PERFORMANCE TRAINING CURRICULUM FOR FLIGHT CREW**

**Module 1 ( Introduction to Human Factors in Aviation - SHEL MODEL)**

**Module 2 : The Human Element (aviation physiology )**

Breathing ; recognizing and coping with:

- hypoxia
- hyperventilation

Pressure effects; effects on ears, sinuses and closed cavities of:

- trapped or evolved gases
- decompression
- underwater diving

Limitations of the senses

- visual
- aural
- vestibular
- proprioceptive
- tactile

Acceleration effects; positive and negative “G’s”

- aggravating conditions

Disorientation

- visual illusions
- vestibular illusions
- coping mechanisms

Fatigue/alertness

- acute
- chronic
- the effects on skill and performance

Sleep disturbances and deficits

Circadian dysrhythmia/jet lag

Personal health

Effects of:

- diet/ nutrition
- alcohol
- drugs (including nicotine/ caffeine)
- medications (prescribed; over-the –counter)
- blood donations
- aging

Psychological fitness/ stress management

Pregnancy

### **Module 3 : The Human Element (aviation psychology)**

Human error and human reliability

Workload (attention and information processing)

- perceptual
- cognitive

Information processing

- mind set and habit patterns
- attention and vigilance
- perceptual limitations
- memory

Attitudinal factors

- personality
- motivation
- boredom and complacency
- culture

Perceptual and situational awareness

Judgement and decision –making

Stress

- symptoms and effects
- coping mechanisms

Skills/ experience/ currency vs. proficiency.

### **Module 4 : Liveware- Hardware : Pilot-equipment Relationship**

Controls and displays

- design (Movement, size, scales, colour, illumination, etc.)

- common errors in interpretation and control
- “glass” cockpits; information selection
- habit patterns interference/ design standardization

#### Alerting and warning systems

- appropriate selection and set-up
- false indications
- distractions and response

#### Personal comfort

- temperature, illumination, etc.
- adjustment of seat position and controls

#### Cockpit visibility and eye-reference position

#### Motor workload.

### **Module 5 : Liveware-Software : Pilot-software Relationship**

#### Standard operating procedures

- rationale
- benefits
- derivation from human limitations and the accident/ incident record

#### Written materials/ software

- errors in the interpretation and use of maps/ charts
- design principles and correct use of checklists and manuals
- the four Ps

#### Operational aspects of automation

- overload/ under load and phase of flight ; complacency and boredom
- staying in the loops/ situational awareness
- automated in-flight equipment; appropriate use, effective task allocation, maintenance of basic flying skills.

### **Module 6 : Liveware –Liveware : Interpersonal Relations**

Note :- Liveware-Liveware deals with interpersonal contacts happening at the present time (here and now), as opposed to the interpersonal contacts involving people outside of the current operating situation.

Factors influencing verbal and non-verbal communication between and with :

- flight deck crew
- cabin crew
- maintenance personnel
- company management/ flight operations control
- air traffic services
- passengers

How verbal and non-verbal communication affects information transfer and thus safety and efficiency of flight.

Crew problem solving and decision-making.

Introduction to small group dynamics/ crew management

## **Module 7 : Liveware – Environment : The Organizational Environment**

- A systemic view of safety
- The aviation system : components
- General models of organizational safety
- Organizational structures and safety
- Culture and safety
- Procedures and safety
- Safe and unsafe organizations.

## **1.2 HUMAN PERFORMANCE TRAINING CURRICULUM FOR AIR TRAFFIC CONTROLLERS**

### **Module 1 : Introduction to Human Factors in Aviation**

### **Module 2 : The Human Element ( aviation physiology)**

The module may be divided into two sections. The first consists of physiological aspects affecting pilots, and thus possibly also affecting the interaction between pilot and controller. The second consists of physiological aspects of shift work.

Part one : Pilots

- Hypoxia
- Pressure effects
- Limitations of the senses
- Acceleration effects (positive / negative “G”s).(N.B. This could be especially relevant for air traffic controllers handling military traffic.)
- Disorientation
- Fatigue/ alertness
- Sleep disturbances and deficits
- Circadian dysrhythmia/ jet lag

## Part two : Air Traffic Controllers

Fatigue/ alertness :

- Sleep disturbances and deficits
- Circadian dysrhythmia
- Nightshift paralysis
- Handling traffic peaks at the end of a long shift/ use of rest breaks
- Social aspects of shift work.

### **Module 3 : The Human Element (aviation psychology)**

Human error and human reliability :

Workload (attention and information processing )

- perceptual
- cognitive

Information processing :

- mindset and habit patterns
- attention and vigilance
- perceptual limitations
- memory
- 

Attitudinal factors:

- personality
- motivation
- boredom and complacency
- culture
- individual versus team

Perception and situational awareness

Judgement decision-making

Stress:

- possible causes
- symptoms and effects
- coping mechanisms

Skills/ experience /currency versus proficiency:

- possible loss of rating after not having worked operationally for a specified time.

## Personal health

### Effects of :

- diet/ nutrition
- alcohol
- drugs (including nicotine / caffeine)
- medications (prescribed; over-the-counter)
- blood donations
- aging /burn-out

## Psychological fitness/ stress management

- Critical Incident Stress Management (CISM)

Note :- Much work on developing a CISM programme for ATC has been done in Canada.

## Pregnancy

Retirement from operational ATC.

## **Module 4 : Liveware-Hardware: Controller- Equipment Relationship**

### Displays

- flight progress strips
- VDUs
- Use of colours
- Radar / ADS

Alerting and warning systems (Both airborne and ground-based).

(Examples : GPWS, TCAS (airborne), STCA (ground-based):

- false indications ( nuisance warnings)
- distractions and response

### Personal comfort :

- temperature, illumination, humidity etc.
- seat adjustment
- noise
- use of headset versus speaker

### Console design :

- height /angle(ergometric design)
- colour of paintwork
- eye-reference position

## **Module 5 : Controller – Software Relationship**

Standard operating procedures :

- rationale
- benefits
- derivation from human limitations and the accident/ incident record.

Written materials / software :

- errors in the interpretation and use of maps/ charts
- design principles and correct use of manuals and checklists

Operational aspects of automation :

- overload/ underload ; complacency and boredom
- staying in the loops/ situational awareness
- automated equipment : appropriate use; maintenance of “manual” skills; staffing consequences.

## **Module 6 : Liveware –Liveware : Interpersonal Relations**

Note: Liveware-Liveware deals with interpersonal contacts happening at the present time, as opposed to the interpersonal contacts involving people outside of the current operating situation.

Factors influencing verbal and non-verbal communication between and with :

- Other Air Traffic Controllers in the team (shift ) and/or Ops-room
- Co-ordination partners (other ATC units)
- Pilots (R/T)
- Maintenance personnel
- Supervisors/management
- Coach/trainee – On-the –Job Training (OJT)

How verbal and non-verbal communication affects information transfer and thus safety and efficiency.

Special emphasis on problems with native and non-native English speakers (both in R/T and inter-unit coordination).

Cultural differences:

- crews from foreign operators may have different expectations, or be trained to react differently from what ATC would expect in certain situations. An example could be the case study by

Professor Robert Helmreich on the crash of Avianca 052, New York, 1990 ( " Anatomy of a system accident : Avianca Flight 052"; The International Journal of Aviation Psychology, 4 (3), 265-284.)

Pros and cons of data link communications :

- loss of non-verbal component of R/T
- input errors versus readback/heartback errors
- partyline effect

Team problem-solving and decision –making:

- principles of CRM (pilot training)
- application of CRM techniques in ATC.

## **Module 7 : Liveware – Environment : The Organizational Environment**

- A systemic view of safety
- The aviation system : components
- General models of organizational safety
- Organizational structures and safety
- Culture and safety
- Procedures and safety
- Safe and unsafe organizations.

### **1.3 HUMAN PERFORMANCE TRAINING FOR MAINTENANCE PERSONNEL**

The knowledge requirement

- 1.3.1 A general survey within the industry indicates that approximately 16 hours is the time required to properly present Human Factors training similar to that in the proposed syllabus..

Module title

- Human Factors defined
- Costs of maintenance errors
- Classification of maintenance errors
- Prevention of maintenance errors
- Human/ machine systems
- Communications : verbal and written
- Workplace environment and safety
- Shiftwork, fatigue and scheduling
- Training /OJT (On-the-Job Training)
- Maintenance Resource Management

**CRM TRAINING CURRICULUM**

The topics outlined below have been included in many current CRM programs. Specific content of training and organization of topics should reflect an organization's unique culture and specific needs. Appendix - III offers a set of behavioral markers fitting subtopics with each topic cluster. Sometimes overlapping, these markers may be helpful in curriculum development and in LOFT design.

**A. Communications Processes and Decision Behaviour :** This topic includes internal and external influences on interpersonal communications. External factors include communication barriers such as rank, age, gender, and organizational culture, including the identification of inadequate SOP's. Internal factors include speaking skills, listening skills and decision-making skills, conflict resolution techniques, and the use of appropriate assertiveness and advocacy. The importance of clear and unambiguous communication must be stressed in all training activities involving pilots and cabin crews. The greater one's concern in flight-related matters, the greater is the need for clear communication. More specific subtopics include the following:

- (1) **Briefings** : Training in addressing both operational and interpersonal issues, and training in establishing and maintaining open communications. Briefings should reaffirm established SOP's.
  - (a) **Safety.** A captain's briefing should address emergencies that might require an airplane evacuation (e.g., cabin fire or engine fire) and should highlight the functions of flight crew and flight attendants during an evacuation. A captain's briefing should stress to flight attendants the importance of identifying able-bodied passengers and briefing them, in turn. Passengers in exit rows are particularly important resources, and flight attendants should brief them on what to do during an evacuation.
  - (b) **Security.** A captain's briefing should address general security topics, especially hijack, and any known or suspected specific threat pertaining to the flight. Flight attendants should identify able-bodied passengers, including exit row seat occupants, and may enroll them as resources who might be called upon to help contain a disruption caused by a passenger(s).
- (2) **Inquiry/Advocacy/Assertion.** Training in the potential benefits of crewmembers advocating the course of action that they feel is best, even though it may involve conflict with others.

- (3) **Crew Self-Critique (Decisions and Actions).** Illustrating the value of review, feedback, and critique focusing on the process and the people involved. One of the best techniques for reinforcing effective human factors practices is careful debriefing of activities, highlighting the processes that were followed. Additionally, it is essential that each crewmember be able to recognize good and bad communications, and effective and ineffective team behaviour.
- (4) **Conflict Resolution.** Demonstrating effective techniques of resolving disagreements among crewmembers in interpreting information or in proposing courses of action. Demonstrating effective techniques for maintaining open communication while dealing with conflict.
- (5) **Communications and Decision-making :** Demonstrating effective techniques of seeking and evaluating information. Showing the influence of biases and other cognitive factors on decision quality. There are benefits in providing crews with operational models of this group decision process. Crews may refer to these models to make good choices in situations when information is incomplete or contradictory.

**B. Team Building and Maintenance.** This topic includes interpersonal relationships and practices. Effective leadership/ follower-ship and interpersonal relationships are key concepts to be stressed. Curricula can also include recognizing and dealing with diverse personalities and operating styles. Subtopics include:

- (1) **Leadership/ Follower-ship/ Concern for Task.** Showing the benefits of the practice of effective leadership through coordinating activities and maintaining proper balance between respecting authority and practicing assertiveness. Staying centered on the goals of safe and efficient operations.
- (2) **Interpersonal Relationships/ Group Climate.** Demonstrating the usefulness of showing sensitivity to other crewmembers' personalities and styles. Emphasizing the value of maintaining a friendly, relaxed and supportive yet task oriented tone in the cockpit and aircraft cabin. The importance of recognizing symptoms of fatigue and stress, and taking appropriate action.
- (3) **Workload Management and Situation Awareness.** Stressing the importance of maintaining awareness of the operational environment and anticipating contingencies. Instruction may address practices (for example, vigilance, planning and time management, prioritizing tasks, and avoiding distractions) that result in higher levels of situation awareness. The following operational practices may be included.
  - (a) Preparation/ Planning/ Vigilance. Issues include methods to improve monitoring and accomplishing required tasks, asking for and responding to new information, and preparing in advance for required activities.

- (b) Workload Distribution/Distracted Avoidance. Issues involve proper allocation of tasks to individuals, avoidance of work overloads in self and in others, prioritization of tasks during periods of high workload and preventing nonessential factors from distracting attention from adherence to SOP's, particularly those relating to critical tasks.
- (4) **Individual Factors/ Stress Reduction**. Training in this area may include describing and demonstrating individual characteristics that can influence crew effectiveness. Research has shown that many crewmembers are unfamiliar with the negative effects of stress and fatigue on individual cognitive functions and team performance. Training may include a review of scientific evidence on fatigue and stress and their effects on performance. The content may include specific effects of fatigue and stress in potential emergency situations. The effects of personal and interpersonal problems and the increased importance of effective interpersonal communications under stressful conditions may also be addressed. Training may also include familiarization with various countermeasures for coping with stressors. Additional curriculum topics may include examination of personality and motivation characteristics, self-assessment of personal style, and identifying cognitive factors that influence perception and decision-making.

**CREW PERFORMANCE MARKER CLUSTERS – (CRM/LOFT /LOSA)**

These behavioural markers are provided to assist organizations in program and curriculum development and to serve as guidelines for feedback. They are not presented as a checklist for evaluating individual crewmembers.

**1. COMMUNICATIONS PROCESSES AND DECISION BEHAVIOUR CLUSTER**

**A. Briefings** . An effective briefing is interesting and thorough. It addresses coordination, planning, and problems. Although, briefings are primarily a captain’s responsibility, other crewmembers may add significantly to planning and should be encouraged to do so.

**Behavioural Markers.**

- (1) The briefing establishes an environment for open/ interactive communications ( for example, the captain calls for questions or comments, answers questions directly, listens with patience, does not interrupt or talk over, does not rush through the briefing, and makes eye contact as appropriate)
- (2) The briefing is interactive and emphasizes the importance of questions, critique, and the offering of information.
- (3) The briefing establishes a “team concept” ( for example, the captain uses “we” language, encourages all to participate and to help with the flight)
- (4) The briefing covers pertinent safety and operational issues.
- (5) The briefing identifies potential problems such as weather, delays, and abnormal system operations.
- (6) The briefing provides guidelines for crew actions centered on SOP’s, division of labour and crew workload is addressed.
- (7) The briefing includes the cabin crew as part of the team.
- (8) The briefing sets expectations for handling deviations from standard operating procedures.
- (9) The briefing establishes guidelines for the operation of automated systems ( for example, when systems will be disabled; which programming actions must be verbalized and acknowledged).
- (10) The briefing specified pilot flying(PF) and pilot not flying duties (PNF) or Pilot monitoring (PM)and responsibilities with regard to automated systems.

**B. Inquiry/Advocacy/Assertion:** These behaviours relate to crewmembers’ promoting the course of action that they feel is best, even when it involves conflict with others.

## **Behavioural Markers.**

- (1) Crewmembers speak up and state their information with appropriate persistence until there is some clear resolution.
- (2) Challenge and response environment is developed.
- (3) Questions are encouraged and are answered openly and non-defensively.
- (4) Crewmembers are encouraged to question the actions and decisions of others.
- (5) Crewmembers seek help from others when necessary.
- (6) Crewmembers question status and programming of automated systems to confirm situation awareness.

**C. Crew Self-Critique Regarding Decisions and Actions.** These behaviors relate to the effectiveness of a group and/or an individual crewmember in critique and debriefing. Areas covered should include the product, the process, and the people involved. Critique may occur during an activity, and/or after completing it.

## **Behavioral Markers**

- (1) Critique occurs at appropriate times, which maybe times of low or high workload.
- (2) Critique deals with positive as well as negative aspects of crew performance.
- (3) Critique involves the whole crew interactively.
- (4) Critique makes a positive learning experience. Feedback is specific, objective, usable, and constructively given.
- (5) Critique is accepted objectively and no defensively.

**D. Communications/ Decisions.** These behaviors relate to free and open communication. They reflect the extent to which crewmembers provide necessary information at the appropriate time (for example, initiating checklists and alerting others to developing problems ). Active participation in the decision making process is encouraged. Decisions are clearly communicated and acknowledged. Questioning of actions and decisions is considered routine.

## **Behavioural Markers**

- a. Operational decisions are clearly stated to other crew members
- b. Crew members acknowledge their understanding of decisions
- c. Bottom lines for safety are established and communicated
- d. The big picture and the game plan are shared within the team, including cabin crews and others as appropriate
- e. Crewmembers are encouraged to state their own ideas, opinions, and recommendations.
- f. Efforts are made to provide an atmosphere that invites open and free communications.

Initial entries and changed entries to automated systems are verbalized and acknowledged.

## **2. TEAM BUILDING AND MAINTENANCE CLUSTER.**

**A. Leadership Followership/Concern for Tasks** : These behaviors relate to appropriate leadership and followership. They reflect the extent to which the crew is concerned with the effective accomplishment of tasks.

### **Behavioral Markers.**

- (1) All available resources are used to accomplish the job at hand.
- (2) Flight deck activities are coordinated to establish an acceptable balance between respect for authority and the appropriate practice of assertiveness.
- (3) Actions are decisive when the situation requires.
- (4) A desire to achieve the most effective operation possible is clearly demonstrated.
- (5) The need to adhere to SOPs is recognized.
- (6) Group climate appropriate to the operational situation is continually monitored and adjusted (e.g., social conversation may occur during low workload, but not high).
- (7) Effects of stress and fatigue on performance are recognized.
- (8) Time available for the task is well managed.
- (9) Demands on resources posed by operation of automated systems are recognized and managed.
- (10) When programming demands could reduce situation awareness or create work overloads, levels of automation are reduced appropriately.

**B. Interpersonal Relationships/Group Climate** : These behaviors relate to the quality of interpersonal relationships and the pervasive climate of the flight deck.

### **Behavioral Markers.**

- (1) Crewmembers remain calm under stressful conditions.
- (2) Crewmembers show sensitivity and ability to adapt to the personalities of others.

- (3) Crewmembers recognize symptoms of psychological stress and fatigue in self and in others (e.g., recognizes when he/she is experiencing "tunnel vision" and seeks help from the team; or notes when a crewmember is not communicating and draws him/her back into the team).
- (4) "Tone" in the cockpit is friendly, relaxed, and supportive.
- (5) During times of low communication, crewmembers check in with others to see how they are doing.

### **3. WORKLOAD MANAGEMENT AND SITUATION AWARENESS CLUSTER.**

**A. Preparation/ Planning/ Vigilance.** These behaviours relate to crews anticipating contingencies and the various actions that may be required. 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. (They may engage in casual social conversation during periods of low workload and not necessarily diminish their vigilance.)

#### **Behavioral Markers**

- (1) Demonstrating and expressing situation awareness (e.g., the "model" of what is happening is shared within the crew).
- (2) Active monitoring of all instruments and communications and sharing relevant information with the rest of the crew.
- (3) Monitoring weather and traffic and sharing relevant information with the rest of the crew.
- (4) Avoiding "tunnel vision" caused by stress (e.g., stating or asking for the "big picture").
- (5) Being aware of factors such as stress that can degrade vigilance, and watching for performance degradation in other crewmembers.
- (6) Staying "ahead of the curve" in preparing for planned situations or contingencies, so that situation awareness and adherence to SOPs is assured.
- (7) Ensuring that cockpit and cabin crewmembers are aware of plans.
- (8) Including all appropriate crewmembers in the planning process.

- (9) Allowing enough time before maneuvers for programming of the flight management computer.
- (10) Ensuring that all crewmembers are aware of initial entries and changed entries in the flight management system.

**B. Workload Distributed/Distractions Avoided.** These behaviors 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.

### **Behavioral Markers**

- (1) Crewmembers speak up when they recognize work overloads in themselves or in others.
- (2) Tasks are distributed in ways that maximize efficiency.
- (3) Workload distribution is clearly communicated and acknowledged.
- (4) Non-operational factors such as social interaction are not allowed to interfere with duties.
- (5) Task priorities are clearly communicated.
- (6) Secondary operational tasks (e.g., dealing with passenger needs and communications with the company) are prioritized so as to allow sufficient resources for primary flight duties.
- (7) Potential distractions posed by automated systems are anticipated, and appropriate preventive action is taken, including reducing or disengaging automated features as appropriate.

**LOFT DEBRIEFING PERFORMANCE INDICATORS**

The effective Line-Oriented Flight Training (LOFT) facilitator leads the flight crew through a self-critique of their own behaviour and of their crew performance during the simulation. The debriefing and crew analysis include both technical and CRM discussion topics. Positive points of crew performance are discussed, as well as those needing improvement. At the conclusion of the session, key learning points are summarized covering all participants, including the instructor. A strong sense of training accomplishment and learning is taken away from the session.

1. The following performance markers may be used to evaluate the LOFT facilitator's performance in the debrief/critique phase of LOFT.
  - a. Actively states the debriefing and critique agenda and solicits topics from the crew on items that they would like to cover; sets time limits.
  - b. Asks the crew for their appraisal of the mission overall.
  - c. States his/ her own perceptions of the LOFT while guarding against making the crew defensive. Comments are as objective as possible and focus on performance.
  - d. Shows appropriate incidents using videotape of the LOFT session, including examples of technical and CRM performance, and selects tape segments for discussion illustrating behaviors that feature the crew performance markers.
  - e. Effectively blends technical CRM feedback in the debriefing; does not preach to the crew, but does not omit items worthy of crew discussion.
  - f. Is patient and is constructive in probing into key areas where improvement is needed.
  - g. Ensures that all crewmembers participate in the discussion, and effectively draws out quiet or hostile crewmembers.
  - h. Provides a clear summary of key learning points.
  - i. Asks the crew for specific feedback on his/her performance.
  - j. Is effective in both technical and CRM debriefing.

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