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**NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.**

**ADVISORY CIRCULAR - AC 120-51A  
CREW RESOURCE MANAGEMENT TRAINING  
(22 PAGES)**



# Advisory Circular

Subject: CREW RESOURCE MANAGEMENT  
TRAINING

Date: 2/10/93  
Initiated by: AFS-210

AC No: 120-51A  
Change:

1. PURPOSE. This advisory circular (AC) presents guidelines for developing, implementing, reinforcing, and assessing Crew Resource Management (CRM) training programs for flight crewmembers and other personnel essential to flight safety. These programs are designed to become an integral part of training and operations. Guidelines are for reference by Federal Aviation Regulations (FAR) Parts 121 and 135 certificate holders to increase the efficiency with which flight personnel perform by focusing on communication skills, teamwork, task allocation, and decisionmaking.

2. CANCELLATION. AC 120-51, Cockpit Resource Management Training, dated 12/1/89, is cancelled.

3. RELATED FAR SECTIONS.

a. Part 121, Subpart N - Training. Sections 121.400-405, 121.409-422, 121.424, and 121.427.

b. Part 121, Subpart O - Crewmember Qualifications. Sections 121.432-433, 121.434, and 121.440-443.

c. Part 135, Subpart E - Flight Crewmember Requirements. Sections 135.243-245.

d. Part 135, Subpart G - Crewmember Testing Requirements. Sections 135.293-295 and 135.299-301.

e. Part 135, Subpart H - Training. Sections 135.321-331 and 135.335-351.

f. Special Federal Aviation Regulation No. 58. Advanced Qualification Program.

#### 4. RELATED READING MATERIAL.

a. AC 120-35B, Line Operational Simulations: Line-Oriented Flight Training, Special Purpose Operational Training, Line Operational Evaluation.

b. AC 120-54, Advanced Qualification Program.

NOTE: These AC's may be obtained from:

Department of Transportation  
M-443.2  
General Services Section  
Washington, DC 20590

c. For detailed information on the recommendations made in this AC, the reader is encouraged to review *Crew Resource Management: An Introductory Handbook* published by the Federal Aviation Administration (FAA) (Document No. DOT/FAA/RD-92/26). Additional background material can be found in *Cockpit Resource Management Training: Proceedings of a NASA/MAC Workshop, 1987*. The National Aeronautics and Space Administration (NASA) Conference Proceedings (CP) number is 2455. *The National Plan for Aviation Human Factors* defines research issues related to crew coordination and training. Copies of the preceding publications may be purchased from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4650.

d. Descriptions of current research findings, methodological issues, and organizational experience can be found in Helmreich, R.L., and Wilhelm, J.A., (1991) "Outcomes of CRM Training," *International Journal of Aviation Psychology*, 1, 287-300; in Helmreich, R.L., and Foushee, H.C., "Why Crew Resource Management: Empirical and Theoretical Bases of Human Factors Training in Aviation"; in Orasanu, J., "Decisionmaking in the Cockpit"; and in Gregorich, S.E., and Wilhelm, J.A., "Crew Resource Management Training Assessment". Each of the preceding appears as a chapter in Wiener, E.L., Kanki, B.G., and Helmreich, R.L. (in press), Cockpit Resource Management, Academic Press, Orlando, FL.

5. BACKGROUND. Investigations into the causes of air carrier accidents have shown that human error is a contributing factor in 60 to 80 percent of all air carrier incidents and accidents. Long term NASA research has demonstrated that these events share common characteristics. Many problems encountered by flightcrews have very little to do with the technical aspects of operating in a multiperson cockpit. Instead, problems are associated with

poor group decisionmaking, 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.

a. These observations have led to a consensus in industry and government that training programs should place emphasis on the factors which influence crew coordination and the management of crew resources.

b. Coordinated efforts by representatives from the aviation community have produced recommendations for CRM training programs. While compliance is not mandatory, these recommendations provide a useful reference for understanding the critical elements of CRM training.

c. Continuing NASA and FAA measurements of the impact of CRM training show that after initial indoctrination significant improvement in attitudes occurs 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 flightcrew performance during Line Oriented Flight Training (LOFT) and during actual flight. CRM-trained crews operate more effectively as teams and cope more effectively with nonroutine situations.

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

## 6. DEFINITIONS.

a. Human Factors. Human factors is a multidisciplinary field devoted to optimizing human performance and reducing human error. It incorporates the methods and principles of the behavioral and social sciences, engineering, and physiology. Human factors is the applied science which studies people working together in concert with machines. Human factors embraces variables that influence individual performance and variables that influence team or crew performance.

(1) 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

2/10/93

is recognized that inadequate design and management of crew tasks can contribute to group errors that lead to system performance degradation.

b. Crew Resource Management (CRM). The application of team management concepts in the flight deck environment was initially known as Cockpit Resource Management. As CRM programs evolved to include cabin crews, maintenance personnel and others, the phrase Crew Resource Management has been adopted:

(1) CRM now refers to the effective use of all available resources; human resources, hardware, and information. A current definition includes all other groups routinely working with the cockpit crew who are involved in decisions required to operate a flight safely. These groups include but are not limited to:

- (i) dispatchers
- (ii) cabin crewmembers
- (iii) maintenance personnel
- (iv) air traffic controllers

(2) CRM 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, decisionmaking, maintaining situational awareness, and dealing with automated systems. CRM training is comprised of three components: initial indoctrination/awareness, recurrent practice and feedback, and continual reinforcement. Each component must be continually renewed.

7. THE MISSION OF CRM TRAINING. CRM training has been conceived to prevent aviation accidents by improving crew performance through better crew coordination.

8. 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 period, even if the training is very well designed. Trainees need awareness, practice and feedback, and continuing reinforcement: in a word, time to learn attitudes that will endure. In order to be effective, CRM concepts must be permanently integrated into all aspects of training and operations.

2/10/93

AC 120-51A

b. While there are various useful methods in use in CRM training today, certain essentials are universal:

(1) CRM training should focus on the functioning of crewmembers as teams, not as a collection of technically competent individuals.

(2) CRM training should instruct crewmembers how to behave in ways that foster crew effectiveness.

(3) CRM training should provide opportunities for crewmembers to practice the skills necessary to be effective team leaders and team members.

(4) CRM training exercises should include all crewmembers functioning in the same roles (e.g., captain, first officer, and/or flight engineer) they normally perform in flight.

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

d. CRM is defined by 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.

00005

2/10/93

(i) LOFT sessions provide an extremely effective means of practicing CRM skills and receiving reinforcement.

(ii) 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.

(iii) 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.

(iv) Crewmembers may also participate in role-playing exercises. Such exercises permit practice in developing strategies for dealing with incidents and allow analysis of behaviors during those incidents. Again, taped feedback is useful for assessment and feedback during debriefing. Crews' abilities can be clearly observed in such areas as decisionmaking, teamwork, and leadership.

(v) 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 a CRM training program depends upon check airmen and instructors who are highly qualified and specially trained in CRM.

9. 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 flightcrews, 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.

00006

Flight operations manuals and training manuals should embrace CRM concepts by providing crews with necessary policy and procedures guidance.

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. This approach increases the relevance of training for crewmembers.

d. Define the Scope of the Program. Institute special CRM training for key personnel including check airmen and instructors. It is highly beneficial to provide training for these groups before beginning training for linecrews. CRM training may be expanded to include dispatchers, cabin crews, maintenance personnel and other company team members as appropriate. It is also helpful to develop a long term strategy for program implementation.

e. Communicate the Nature and Scope of the Program Before Startup. Training departments should provide crews 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.

10. 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.

a. Initial Indoctrination/Awareness.

(1) Indoctrination/awareness typically consists of classroom presentations and focuses on communications and decisionmaking, interpersonal relations, crew coordination, and leadership. 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.



(2) Indoctrination/awareness can be accomplished by a combination of training methods. Lectures, audiovisual presentations, discussion groups, role-playing exercises, computer-based instruction, and videotaped examples of good and poor team behavior are commonly used methods.

(3) 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.

(4) Effective indoctrination/awareness training increases understanding of CRM concepts. That understanding, in turn, often influences individual attitudes favorably regarding human factors issues. Often the training also suggests more effective communication practices.

(5) 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.

b. Recurrent Practice and Feedback.

(1) CRM training should be included as a regular part of the recurrent training requirement. Recurrent CRM training should include refresher practice and feedback exercises such as LOFT with taped feedback; or a suitable substitute such as role-playing in a flight training device and taped feedback. It is particularly important that these recurrent CRM exercises take place with a full crew, each member operating in his or her normal crew position. A complete crew will always be scheduled, and every attempt will be made to maintain crew integrity. Recurrent training LOFT which includes CRM should be conducted with current linecrews, and preferably not with instructors or check airmen as stand-ins.

(2) Recurrent training and feedback allows participants to practice newly improved skills in communications and interpersonal relationships and to receive feedback on their effectiveness. Feedback has its greatest impact when it comes

2/10/93

AC 120-51A

from self-critique and from peers, together with guidance from a facilitator with special training in assessment and debriefing techniques.

(3) Effective feedback refers to the coordination concepts identified in Indoctrination/Awareness training and relates to specific behaviors. 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 a 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. Attitudes and behaviors are easily seen, and appropriate adjustments are often self-evident.

c. Continuing Reinforcement.

(1) 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 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.

(2) CRM should become an inseparable part of the organization's culture.

(3) There is a common tendency to think of CRM as training only for the managers and captains. This notion misses the essence of the CRM training mission: the prevention of crew-related accidents. CRM training is most effective in the context of the entire crew. Training exercises are required that include all crewmembers working together and learning together. In the past, much of flightcrew 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 CRM training.

(4) 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. Joint training with dispatchers, maintenance personnel, and gate agents can also reinforce CRM concepts.

00009

11. SUGGESTED CURRICULUM TOPICS. 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 1 offers a set of behavioral markers fitting subtopics within each topic cluster. These markers may be helpful in curriculum development and in LOFT design.)

a. Communications Processes and Decision Behavior. This topic includes internal and external influences on interpersonal communications. External factors include communication barriers such as rank, age, gender, and organizational culture. Internal factors include listening skills and decisionmaking skills, conflict resolution techniques, and the use of appropriate assertiveness and advocacy. More specific subtopics include the following:

(1) Briefings. Training in addressing both operational and interpersonal issues, and training in establishing open communications.

(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 behavior.

(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 Decisionmaking. 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.

2/10/93

AC 120-51A

b. Team Building and Maintenance. This topic includes interpersonal relationships and practices. Effective leadership/followership 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/Followership/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 tone in the cockpit. The importance of recognizing symptoms of fatigue and stress, and taking appropriate action.

(3) Workload Management and Situational 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 situational awareness. The following operational practices may be included:

(i) Preparation/Planning/Vigilance. Issues include devoting appropriate attention to required tasks, asking for and responding to new information, and preparing in advance for required activities.

(ii) Workload Distribution/Distracti~~on~~ Avoidance. Issues involve proper allocation of tasks to individuals, avoidance of work overloads, prioritization of tasks during periods of high workload, and preventing nonessential factors from distracting attention from 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 flight 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

00011

2/10/93

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 decisionmaking.

12. SPECIALIZED TRAINING IN CRM CONCEPTS. As CRM programs have matured, some organizations have found it beneficial to develop and implement additional courses dealing with issues specific to their operations.

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 flight crewmembers required under the FAR.

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.

13. ASSESSMENT OF CRM TRAINING PROGRAMS. It is vital that each program be assessed to determine if it is achieving its goals. Each organization should have a systematic assessment program. 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 of the training process 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 processes, decisionmaking, team building and maintenance, workload management, and situational 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 programs. Crewmembers must receive continual reinforcement to sustain CRM concepts. Effective reinforcement depends upon usable feedback to crewmembers on their human factors 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 human factors behaviors. It is not expected or intended that crewmembers should be formally evaluated and graded on the practice of CRM concepts. Rather, CRM concepts should be included during briefing/debriefing phases of training.

e. To summarize, the assessment program 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 check airmen and instructors are well prepared and standardized.

#### 14. THE CRITICAL ROLE OF CHECK AIRMEN AND INSTRUCTORS.

a. 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, and course designers must be skilled in all areas related to the practice and assessment of CRM. It is important to note that these skills comprise an additional level to those associated with traditional flight instruction and checking.

b. Gaining proficiency and confidence in CRM instruction, observation, and measurement requires special training for instructors and check pilots in many CRM training processes.

2/10/93

Among those processes are role-playing simulations, systematic crew-centered observation, administering LOFT programs, and providing usable feedback to crews.

c. Instructors and check pilots also require special training in order to calibrate and standardize their own skills.

d. In order to provide maximum learning for all crewmembers, instructors and check airmen must use every available opportunity to emphasize the importance of crew coordination skills. The best results occur when the crews examine their own behavior 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 are discussed and reinforced. Debriefing and critiquing skills are important tools for instructors and check pilots. (Behavioral markers of effective LOFT debriefings are shown in appendix 2.)

e. Feedback from instructors and check airmen is most effective when it refers to the concepts that are covered in the initial indoctrination/awareness training. The best feedback refers to specific cases of specific behavior, rather than to generalities about behavior.

15. EVOLVING CONCEPTS OF CRM: EXTENDING TRAINING BEYOND THE COCKPIT. Several air carriers have found it useful to extend CRM training to other operational groups. Their objective has been to improve the effectiveness of these groups and the quality of interactions between them and cockpit crews.


a. Under the FAR, dispatchers share responsibility for the conduct of flight with captains. Both must agree that the flight can be completed safely. The importance of their coordination is the reason for broader and better interactive training of pilots and dispatchers.

b. Cabin crews are also part of the team responsible for safe flight. The extension of CRM training to cabin crewmembers conditions still other team behaviors needed in normal and emergency situations.

2/10/93

AC 120-51A

c. Maintenance activities are also team efforts that include interactions with the cockpit. CRM training for this group enhances maintenance team performance and joint activities with flightcrews.

  
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00015



2/10/93

AC 120-51A  
Appendix 1

APPENDIX 1. CREW PERFORMANCE MARKER CLUSTERS  
(Italicized Markers apply to Advanced Technology Flight Decks)

These behavioral 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 BEHAVIOR CLUSTER.

a. Briefings. The 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.

Behavioral 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; division of labor 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.

00016

2/10/93

APPENDIX 1. CREW PERFORMANCE MARKER CLUSTERS (Continued)

(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 specifies pilot flying and pilot not flying duties and responsibilities with regard to automated systems.

b. Inquiry/Advocacy/Assertion. These behaviors relate to crewmembers' promoting the course of action that they feel is best, even when it involves conflict with others.

Behavioral 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 nondefensively.

(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 situational 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 may be 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.

APPENDIX 1. CREW PERFORMANCE MARKER CLUSTERS (Continued)

(4) Critique makes a positive learning experience. Feedback is specific, objective, usable, and constructively given.

(5) Critique is accepted objectively and nondefensively.

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 decisionmaking process is encouraged. Decisions are clearly communicated and acknowledged. Questioning of actions and decisions is considered routine.

Behavioral Markers

(1) Operational decisions are clearly stated to other crewmembers.

(2) Crewmembers acknowledge their understanding of decisions.

(3) "Bottom lines" for safety are established and communicated.

(4) The "big picture" and the game plan are shared within the team, including flight attendants and others as appropriate.

(5) Crewmembers are encouraged to state their own ideas, opinions, and recommendations.

(6) Efforts are made to provide an atmosphere that invites open and free communications.

(7) 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.

2/10/93

APPENDIX 1. CREW PERFORMANCE MARKER CLUSTERS (Continued)

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 standard operating practices is recognized.

(6) Group climate appropriate to the operational situation is continually monitored and adjusted (for example, 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 situational 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.

2/10/93

10

3/10/83

2/10/93

AC 120-51A  
Appendix 1

APPENDIX 1. CREW PERFORMANCE MARKER CLUSTERS (Continued)

(3) Crewmembers recognize symptoms of psychological stress and fatigue in self and in others (for example, 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 SITUATIONAL AWARENESS CLUSTER.

a. Preparation/Planning/Vigilance. These behaviors 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 situational awareness; for example, 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; for example, 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.

00020

2/10/93

APPENDIX 1. CREW PERFORMANCE MARKER CLUSTERS (Continued)

(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) Nonoperational factors such as social interaction are not allowed to interfere with duties.

(5) Task priorities are clearly communicated.

(6) Secondary operational tasks (for example, dealing with passenger needs and communications with 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.

APPENDIX 2. LOFT DEBRIEFING PERFORMANCE INDICATORS

The effective LOFT facilitator leads the flightcrew through a self-critique of their own behavior 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 and 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.