Advisory Circular

U.S. Department of Transportation
Federal Aviation Administration
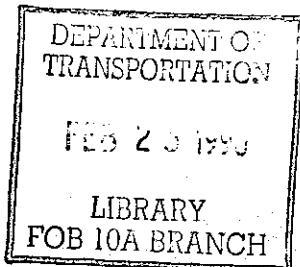
Subject:	Date: 12/1/89	AC No: 120-51
COCKPIT RESOURCE MANAGEMENT TRAINING	Initiated by: AFS-210	Change:

1. **PURPOSE**. This advisory circular (AC) presents guidelines for developing, implementing, and evaluating a cockpit resource management (CRM) training program. This training is designed to be a regular part of all training for crewmembers.

2. **RELATED FAR SECTIONS**.

    a. SFAR 58, Advanced Qualification Program.

    b. <u>Part 121, Subpart N (Training)</u>. 121.400-405, 121.409-421, 121.424, 121.427.

    c. <u>Part 121, Subpart O (Crewmember Qualifications)</u>. 121.432-433, 121.434, 121.440-443.

    d. <u>Part 135, Subpart E (Flight Crewmember Requirements)</u>. 135.243-245.

    e. <u>Part 135, Subpart G (Crewmember Testing Requirements)</u>. 135.293-295, 135.299-301.

    f. <u>Part 135, Subpart H (Training)</u>. 135.321-331, 135.335-351.

3. **RELATED READING MATERIAL**. For detailed information on the recommendations made in this AC, the reader is encouraged to review Cockpit Resource Management Training: Proceedings of a NASA/MAC Workshop, 1987. The National Aeronautics and Space Administration (NASA) Conference Proceedings (CP) number is 2455. Copies may be purchased from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4650.

4. **BACKGROUND**.

    a. Investigations into the causes of air carrier accidents have shown that human error is a contributing factor in approximately 70 percent of all air carrier incidents and accidents. Most airlines, however, provide technical training with little emphasis on the human element. This AC provides guidelines for FAR Parts 121 and 135 certificate holders to establish training that is designed to increase the efficiency with which flight crewmembers interact in the cockpit by focusing on communication skills, teamwork, task allocation, and decisionmaking.

b. Since 1979, an increasing amount of evidence has accumulated suggesting that between 60 and 80 percent of air carrier incidents and accidents have been caused, at least in part, by a failure of the flightcrew to make use of readily available resources. A long-term NASA research program has demonstrated that these types of incidents have many common characteristics. One of the most compelling observations of this program and other research studies is that, often, the problems encountered by flightcrews have very little to do with the more technical aspects of operating a multicrewmember aircraft. Instead, they are associated with poor group decisionmaking, ineffective communication, inadequate leadership, and poor management. In addition, most training programs emphasize almost exclusively the technical aspects of flying and do not deal effectively with various types of crew management strategies and techniques that are also essential to safe flight operations.

c. These observations have recently led to a developing consensus in both industry and government that more training emphasis needs to be placed upon the factors that influence crew coordination and the management of crew resources. Briefly defined, CRM is the effective utilization of all available resources--hardware, software, and people--to achieve safe and efficient flight operations. CRM training programs have been or are being developed by several major air carriers, and although the concept is receiving widespread acceptance, insufficient progress has been made in the industry as a whole. Moreover, there is substantial confusion in the industry with respect to the key elements of CRM training and how to go about developing a CRM training program.

d. A 1987 NASA workshop on CRM training, comprised of various segments of the aviation community, has produced a series of recommendations for training programs in this area. These guidelines, while not mandatory, are very useful in understanding the critical elements of a CRM training program.

5. <u>BASIC CONCEPTS OF CRM TRAINING</u>.

a. <u>General</u>. While there are probably many approaches and techniques useful in CRM training, it seems clear that certain features are necessary. The program should focus on the functioning of crews as <u>intact teams</u>, not simply as a collection of technically competent individuals, and should provide opportunities for crewmembers to practice the skills that are necessary to be good team leaders and members. This requires training exercises that include all crewmembers together in the same roles they normally perform in flight. The program should help crewmembers learn how to use their own personal and leadership styles in ways that foster crew effectiveness. The program should also help crewmembers learn that how they behave during normal, routine circumstances can have a powerful impact on how well a crew functions during high workload, stressful situations. During these emergency situations, it is highly unlikely (and probably undesirable) that any crewmember will take the time to reflect upon his or her CRM training to figure out how to act. However, actions taken during more relaxed times probably increase the chances that a crew will handle stressful situations more competently.

b.   Research studies from the behavioral sciences strongly suggest that behavior change in any environment cannot be accomplished in a short period, even if the training is very well designed.   Trainees need time, awareness, practice and feedback, and continual reinforcement to learn lessons that will endure over long periods of time.   In order to be effective, CRM training must be accomplished in several phases over time.

c.   Therefore, CRM training programs should include at least three distinct phases:

(1)   An awareness phase where CRM issues are defined and discussed.

(2)   A practice and feedback phase where trainees gain experience with CRM techniques.

(3)   A continual reinforcement phase where CRM principles are addressed on a long-term basis.   Each of these phases is discussed in more detail in paragraph 7 and in NASA CP number 2455.

d.   Summary.   CRM is defined by the following basic concepts:

(1)   It is a comprehensive system for improving crew performance.

(2)   It is designed for the entire crew population.

(3)   It can be extended to all forms of aircrew training.

(4)   It concentrates on crewmember attitudes and behaviors and their impact on safety.

(5)   It provides an opportunity for individuals to examine their own behavior and make individual decisions on how to improve cockpit teamwork.

(6)   It uses the crew as the unit of training.

(7)   It is a training program that requires the active participation of all cockpit crewmembers.

6.   PHASES OF CRM TRAINING.

a.   Overall Objective of CRM.   CRM training is designed to prevent incidents and accidents.

b.   Awareness Phase.

(1)   The awareness phase of CRM training consists of classroom presentations and focuses on interpersonal relations and crew coordination. This part of the training also provides a common terminology and conceptual framework for identifying and describing crew coordination problems.

(2)   This training phase can be accomplished by a combination of training methods such as lecture presentations, discussion groups, role-playing exercises, computer-based instruction, and videotape examples of good and poor team behavior in the cockpit.

(3)   A useful way of beginning the awareness phase may include the development of a curriculum addressing CRM skills that should be acquired, such as:

(i)   <u>Communication</u>. (E.g., cultural influences, barriers such as rank, age, and position, assertiveness, participation of all crewmembers, cockpit-cabin crew coordination, listening, feedback, and legitimate ways of expressing dissent.)

(ii)   <u>Situation Awareness</u>. (E.g., reality versus perceptions of reality, fixation, monitoring, incapacitation.)

(iii)   <u>Problem Solving/Decisionmaking/Judgment</u>. (E.g., conflict resolution, review.)

(iv)   <u>Team Management</u>. (E.g., team building, managerial skills, authority, barriers, cultural influences, roles, workload management.)

(v)   <u>Stress Management</u>. (E.g., fitness to fly, fatigue, incapacitation.)

(vi)   <u>Team Review</u>. (E.g., premission analysis and planning, critique, ongoing review, postmission.)

(vii)   <u>Interpersonal Skills</u>. (E.g., listening, conflict resolution, and legitimate avenues of dissent.)

(4)   Awareness promotes credibility and helps in changing attitudes, however, it is important to recognize that it is only a necessary first step. Many programs rely almost exclusively on this aspect of training, but classroom instruction alone may not fundamentally alter crewmember attitudes and behavior over the long term.

c.   <u>Practice and Feedback Phase</u>.

(1)   The practice and feedback phase of CRM training is designed to provide participants with self- and peer-critique in order to improve communication, decisionmaking, and leadership skills. This phase is best accomplished through the use of simulators and video equipment. Video feedback, under the direction of a facilitator, is particularly effective because it allows participants to view themselves from a third-person perspective; this promotes acceptance of one's weak areas, which encourages attitude and behavior changes.

(2)   Practice and video feedback during debriefing can be accomplished as follows:

(i)   Line oriented flight training (LOFT) sessions or other simulated or actual operation scenarios can include CRM training. In these cases, crewmembers would be in a simulator and asked to respond to a series of incidents which could or could not lead to emergencies. They would be evaluated for technical expertise, as well as communication, coping, and coordination abilities (as part of the CRM training).

(ii)   Video feedback during debriefing should optimally be provided so that crewmembers could evaluate their skills.

(iii)   In cases where simulators are not available, crewmembers can participate in complicated group problem-solving exercises. Through video feedback during debriefing, they can then evaluate the positive and negative actions of all crewmembers.

(iv)   Crewmembers can also participate in role-playing exercises designed to provide practice in developing strategies for dealing with incidents and to allow analyses of behaviors during incidents. Again, video feedback is recommended for evaluation and feedback during debriefing of crewmember abilities in such areas as decisionmaking, team participation, and team leadership sharing.

(v)   Personality and attitude measures can also be used to provide feedback to participants, thereby allowing them to assess their strengths and weaknesses.

d.   Reinforcement Phase.

(1)   The third phase is reinforcement. No matter how effective the classroom curriculum, interpersonal drills, LOFT exercises, and feedback techniques are, a single exposure will be insufficient. The attitudes and norms which contribute to ineffective crew coordination are ubiquitous and have developed over a crewmember's lifetime. Thus, it is unrealistic to expect a short training program to make up for a lifetime of development. To be maximally effective, CRM should be embedded in the total training program. It should be continually reinforced, and it should become an inseparable part of the organization's culture. The latter is often overlooked, but it is clear that effective CRM training requires the support of the highest levels of management.

(2)   CRM training should be instituted as a regular part of the recurrent training requirement. Recurrent CRM training should include refresher curriculum and practice and feedback exercises such as LOFT with video feedback, or a suitable substitute employing video feedback. It is particularly important that some of these recurrent CRM exercises take place with a full crew--each member operating in their normal crew position. For example, recurrent training LOFT exercises designed for CRM should be conducted only with an actual crew.

(3)   There is a natural tendency to think of CRM as training only for the "managers" or captains. However, this notion misses the essence of the

primary CRM training objective--the prevention of <u>crew-related</u> incidents and accidents. It should be most effective in the entire crew context, and this requires training exercises that include all crewmembers working together and learning together. In the past, much of flightcrew training has been separated by crew position, and while this may be effective for certain types of training (e.g., technical skills and systems knowledge, etc.), it is not appropriate for CRM training.

7. <u>THE ROLE OF CRM INSTRUCTORS AND CHECK AIRMEN</u>.

   a. <u>General</u>.

      (1) The success of any CRM training program should ultimately depend upon the skills of the personnel responsible for administering the training and observing its effects. Thus, it is vitally important that CRM training instructors, facilitators, and check pilots be highly skilled in all areas related to CRM performance, and they should also be expert observers of crew coordination dimensions. These skills are different from those associated with traditional flight instruction. Gaining proficiency in CRM instruction and observation will require special additional training for instructors and check pilots in CRM training methods such as role-playing exercises, systematic crew observation, providing effective feedback, and LOFT administration.

      (2) In addition, simulator and line check pilots should utilize every available opportunity to emphasize the importance of crew coordination skills and techniques. This should be accomplished by not only pointing out deficiencies, but by noting and reinforcing instances of highly effective crew coordination whenever such behavior is observed.

8. <u>EVALUATION OF CRM TRAINING PROGRAMS</u>.

   a. <u>General</u>.

      (1) CRM training is a relatively new concept still in the process of evolution. For this reason, it is vitally important that each program be evaluated in order to determine whether it is achieving the desired result, the improvement of flightcrew coordination and performance. Thus, each organization should organize a systematic evaluation program to track the effect of their training program and as a means of making continuous improvements. The emphasis of this evaluation process should be on crew performance, not at the individual level of analysis. The major areas that should be assessed are: interpersonal coordination and communication; problem-solving and conflict resolution; workload management; and technical performance.

      (2) The purpose of this evaluation is <u>not</u> to assess individual crewmembers on CRM-related dimensions as a means of assessing their fitness for duty. The current state-of-the-art in the measurement of CRM-related behavior does not allow such fine discriminations at the present time. However, the importance of these dimensions should be emphasized to individual

crewmembers at all available opportunities, and improvements in assessment techniques may allow CRM-related criteria to be utilized on a more formal basis in the future.

9. <u>COLLECTION OF EVALUATION DATA</u>. In an optimal research design, data on crewmember's CRM attitudes and behavior should be collected prior to the awareness phase of CRM training and again at intervals after training to determine both initial and enduring effects of the program. In many cases, however, this pure evaluation strategy cannot be applied, as many crewmembers may have already completed some type of CRM training. The goal should be to obtain an accurate picture of the state of the organization before formal adoption of this type of training and to continue to monitor the same elements after adoption.

10. <u>EVALUATION TOOLS</u>.

   a. Data collection could include a survey of crewmember's attitudes regarding CRM concepts and also their evaluation of the impact of formal CRM training, LOFT, or of an operational scenario. (An example of a crewmember survey is provided in Appendix 1.)

   b. Additional data could be collected by check airmen, qualified line observers, and/or LOFT instructors trained in the formal evaluation of crew coordination. An evaluation worksheet could be completed after LOFT periods or other operational simulations. The evaluation worksheet should contain evaluations of the crew's utilization of the key concepts of CRM described in paragraph 6, as well as a global evaluation of overall technical performance and crew coordination. Additional information for each crew should include a description of special circumstances (i.e., abnormal or emergency situations imposed or encountered) and amplifying comments regarding extremely good or poor instances of CRM behavior. (An example LOFT CRM Evaluation Worksheet is provided in Appendix 2.)

11. <u>DATA BASES</u>. Information collected from line crewmembers, check airmen, qualified line observers, and other evaluators should be maintained in computer-resident data bases. The data should be oriented toward group rather than individual performance. Data should not identify individual crewmembers by name, but should include the following demographic identification:

   a. Aircraft type.

   b. Crew position.

   c. Approximate age (range).

   d. Approximate experience in position and aircraft.

   e. Formal training in CRM.

   f. Experience with LOFT of operational scenarios.

(1) On both crewmember surveys and evaluations, the instructor or check airman <u>should</u> be identified. Information from participants in training and the characteristics of evaluations given by check airmen and other evaluators may be used as measures of the quality of instruction and evaluation.

(2) It should be stressed that the reasons for collecting evaluation data include:

(i) To measure the operational state of the organization.

(ii) To determine areas in need of further instruction.

(iii) To find which aspects of training work most effectively.

(iv) To ensure that all individuals involved in training and evaluation are well prepared and standardized.

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APPENDIX 1. SAMPLE CRM SURVEY

Please fill out this short survey to give us your opinion about the usefulness of LOFT in general and of the LOFT scenarios you have just completed. This survey is part of the NASA-sponsored research evaluating the impact of Cockpit Resource Management training. The questionnaire is anonymous and will be used to develop summary statistics and recommendations regarding CRM and LOFT. Please place the completed form in the envelope provided and place it in Company mail.

Aircraft _____   LOFT from _____ to _____

Inflight problem _____

Position: ___ CA ___ FO ___ FE   Completed CRM Seminar? ___ YES ___ NO

How many LOFT sessions have you completed before today? _____

1. Were you aware of the nature of the scenario and problem in this LOFT?

    _____ No information about any aspect of it.
    _____ Slight familiarity with problem and scenario.
    _____ Considerable familiarity with problem and scenario.
    _____ Detailed information on problem and scenario.

1a. If you indicated some awareness of the scenario, please check the statement below which is closest to your opinion.

    _____ This awareness greatly reduced the training value.
    _____ This awareness slightly reduced the training value.
    _____ This awareness had no effect on the training value.

2. How realistic was the scenario? (Circle a number on the scale)

         Unrealistic in   Realistic in
            every way   1 2 3 4 5 6 7   every way

3. How difficult was the scenario?

          Extremely   Extremely
            easy   1 2 3 4 5 6 7   difficult

4. How well did your crew perform the mission?

          Extremely   Extremely
            poor   1 2 3 4 5 6 7   well

5. How well did you personally perform?

    Extremely   Extremely
      poor   1 2 3 4 5 6 7   well

6. Overall, how would you rate the value of this LOFT session for crew
   coordination training?

    Completely   Completely
      useless   1 2 3 4 5 6 7   useful

7. Overall, how would you rate the technical training value of this LOFT
   session?

    Completely   Completely
      useless   1 2 3 4 5 6 7   useful

8. Overall, how much have you learned in this simulation that you will
   actually use on the line?

    Absolutely   A tremendous
      nothing   1 2 3 4 5 6 7   amount

Use a number from the following scale to indicate your level of agreement
with each of the following statements. Write the number in the space to the
left of the statement.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree

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_____   9. Our crew really worked as a team.

_____ 10. During the LOFT we spent far too much time talking or arguing.

_____ 11. Dealing with members of the crew left me feeling irritated and
            frustrated.

_____ 12. Our crew practiced inquiry/questioning.

_____ 13. The Captain made most of the decisions about our flight without
            involving other crewmembers.

_____ 14. Our crew practiced advocacy/assertion.

_____ 15. Our crew shared responsibility for its leadership.

_____ 16. Our crew practiced self-critique of decisions and actions.

_____ 17. Our LOFT instructor was knowledgeable and helpful.

_____ 18. The debriefing following the LOFT was highly useful for all
crewmembers.

_____ 19. The videotape of the LOFT provided important feedback to the crew.

_____ 20. Overall, LOFT is an extremely useful training technique.

Please describe what you found most useful about the LOFT.

_____

_____

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_____

_____

_____

Please describe anything that you feel might be done to increase the
usefulness of LOFT.

_____

_____

_____

_____

_____

APPENDIX 2.   SAMPLE LOFT CRM EVALUATION WORKSHEET

FLIGHT AND EQUIPMENT INFORMATION

LINE ROUTING _____   EQUIP. _____   OBSERVER _____

HOURS OBSERVED _____   # LINE SEGMENTS OBSERVED _____

BASE ____/____/____
　　　CA　　FO　　FE

Completed CRM Seminar   CA____   FO____   FE____   (X if completed)
Completed LOFT   CA____   FO____   FE____   (X if completed)

I.   EVALUATION
(LINE CHECK ONLY - "S" OR "U" FOR CREWMEMBER CHECK ONLY) ____/____/____
　　　　　　　　　　　　　　　　　　　　　　　　　　　　CA　　FO　　FE

II.   CREW COMMUNICATIONS AND COORDINATION

1.	Briefing thorough, establishes open communications, addresses coordination, planning, team creation, and anticipates problems...............	(Circle) Poor 1 2 3 4 5 Excellent
2.	Communications timely, relevant, complete, and verified..............	Poor 1 2 3 4 5 Excellent
3.	Inquiry/questioning practiced.......	Poor 1 2 3 4 5 Excellent
4.	Assertion/advocacy practiced........	Poor 1 2 3 4 5 Excellent
5.	Decisions communicated and acknowledged........................	Poor 1 2 3 4 5 Excellent
6.	Crew self-critique of decisions and actions............................	Poor 1 2 3 4 5 Excellent
7.	Concern for accomplishment of tasks at hand..............................	Poor 1 2 3 4 5 Excellent
8.	Interpersonal relationships/group climate............................	Poor 1 2 3 4 5 Excellent
9.	Overall vigilance...................	Poor 1 2 3 4 5 Excellent
10.	Preparation and planning for in-flight activities...................	Poor 1 2 3 4 5 Excellent
11.	Distractions avoided or prioritized.	Poor 1 2 3 4 5 Excellent
12.	Workload distributed and communicated................................	Poor 1 2 3 4 5 Excellent
13.	Overall workload....................	Low 1 2 3 4 5 High
14.	Overall TECHNICAL proficiency.......	Poor 1 2 3 4 5 Excellent
15.	Overall CREW effectiveness..........	Poor 1 2 3 4 5 Excellent

III. **SPECIAL CIRCUMSTANCES**: This section provides data on nonstandard situations or behaviors that may influence crew performance. If abnormal or emergency conditions arise, rate the overall management of the situation. If conflicts occur, rate how effectively they were resolved.

16. Management of abnormal or emergency situation.......................... Poor 1 2 3 4 5 Excellent
17. Conflict resolution................ Poor 1 2 3 4 5 Excellent

In some cases, the actions of a particular crewmember may be particularly significant to the outcome of the mission. In cases where this happens, enter the relevant item number from above, check the position of the crewmember rated, and circle the rating assigned.

_____ Item _____/_____/_____   Poor 1 2 3 4 5 Excellent
　　　　　　　　 CA　　FO　　FE

_____ Item _____/_____/_____   Poor 1 2 3 4 5 Excellent
　　　　　　　　 CA　　FO　　FE

_____ Item _____/_____/_____   Poor 1 2 3 4 5 Excellent
　　　　　　　　 CA　　FO　　FE

IV. **COMMENTS**: Describe abnormal or emergency conditions, conflicts, or individual behaviors rated in Section II. Also comment on extreme (1 or 5) ratings from Section II.

Item #_____ Comments

_____

_____

_____

_____

_____

_____

_____

_____

_____

V. **SUPPLEMENTARY INFORMATION**: Conditions which significantly influenced
    the LOFT (include weather, ATC, preexisting mechanicals, in-flight
    abnormal events, etc.). Describe below:

_____

_____

_____

_____

_____

_____

_____

_____

_____