Developing Advanced Crew Resource Management (ACRM) Training: A Training Manual

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Acronyms and Definitions

Above Standard	Point on a rating scale or criteria for performance that signifies a level of crew performance that exceeds (in specific ways) the expected level of individual or crew performance (i.e., the Standard).
ACRM	*Advanced Crew Resource Management* - a comprehensive implementation package including CRM procedures, training of the instructor/evaluators, training of the crews, a standardized assessment of crew performance, and an ongoing implementation process providing an integrated form of CRM by incorporating CRM practices with normal and emergency SOP.
Agreement Index	Agreement is the degree to which a group of raters give the same rating for the same performance or items. Agreement is from 1 to –1, where 1 means complete agreement and 0 to -1 is no agreement. A .6 or .7 has been used as a minimum level of agreement in crew performance ratings.
AQP	*Advanced Qualification Program* - An alternative training and assessment program based on proficiency-based training where the Proficiency Objectives are systematically developed, maintained, and validated.
ASRS	*Aviation Safety Reporting System* - A NASA sponsored reporting system where reports are submitted voluntarily, deidentified, and entered into a database.
Assessment Scale	A set of points used to measure a targeted behavior.
ATA	Air Transport Association.
ATC	Air Traffic Control.
Attitude	A predisposition to react in a given manner to individuals, objects, or situations. Attitudes have affective, behavior, and cognitive components.
Backup Plan	Plan to be used in case the Bottom Line has been exceeded. Backup Plan may be developed into a CRM procedure under ACRM.
Bottom Line	One or more limits, beyond which an alternate or Backup Plan is initiated. The Bottom Line may be expressed in time, location,

	fuel quantity or other flight critical items. Bottom Line may be developed into a CRM procedure under ACRM.
Brief	A specific briefing such as the Takeoff Brief or the Approach Briefing. Under ACRM, CRM procedures may be added to certain briefs.
Cognitive Skill	Those mental skills that are a prerequisite to performing a task or subtask. Most skills have both cognitive and non-cognitive components, but a cognitive skill has a substantial mental component.
Conditions	In Event Sets, conditions are the elements that provide the realism and operational relevance. Event set conditions include visibility, wind, turbulence, traffic, and other elements that further constrain the operational environment.
Congruency	Assessment of the distribution of the ratings of each rater as compared to that of the group. Complete congruency is represented by the number 1.
Consistency	Correlation between rates representing the degree of consistent shifting of responses across items. Complete correlation is represented by the number 1.
CQP	*Continuing Qualification Program* - The ongoing program during which the proficiency objectives are trained and evaluated. A continuing qualification cycle may last two years and be made up of two evaluations taking place at 12-month intervals.
CRC	*Camera-Ready Copy* - The final version of the procedure, QRH, QRC, or guide that is sent to the printers for reproduction.
CRM	*Crew Resource Management* - The effective use of all resources to include human and other aviation system resources.
CRM Objectives	Training objectives related to CRM or the CRM Skills, the crew and team elements.
CRM Procedure	Procedures developed to emphasize specific CRM elements by incorporating them into SOP for normal as well as abnormal and emergency flight situations.
CRM Skill	Crew performance elements associated with the more cognitive and management aspects of flying. These skills are contrasted with Technical Skills associated with the more psychomotor aspects.

Distracters	Events used in an event set to hide the trigger or to increase crew workload or distraction for critical tasks.
DOT	Department of Transportation.
EO	*Enabling Objective* - A lower level learning or training objective that is required to achieve higher level objectives such as Supporting or Terminal Proficiency Objectives.
Event Set	A relatively independent segment of a scenario made up of several events including a Trigger, possible Distracters, and Conditions.
FAA	Federal Aviation Administration.
First Look	Initial look at crew proficiency, generally specific maneuvers in a PC or Maneuver Validation. With First Look, individuals are generally allowed to repeat maneuvers when required.
FOM	Flight Operations Manual.
FSM	Flight Standards Manual.
GPWS	Ground Proximity Warning System.
ICAO	International Civil Aviation Organization
I/E	*Instructor/Evaluator* - Those conducting the training, especially in the simulator, as well as those providing the assessment, such as checkairmen.
IRR	*Inter-Rater Reliability* - The extent to which rater data would be replicated in other, similar situations, and thus are descriptive of consistent phenomena.
ISD	*Instructional Systems Development* - A systematic process for planning, developing, and evaluating instructional programs with an emphasis on the required Tasks, Subtasks, Knowledge, and Skills.
Knowledge	The concepts and information required to perform skills such as recalling facts, identifying concepts, and applying rules or principles in the appropriate context.
KSA	*Knowledge, Skills, and Attitudes* - (see Attitude, Knowledge, or Skill for definitions).
LOE	*Line Operational Evaluation* - LOE is an evaluation of individual and crew performance in a flight training device or flight simulator

	conducted during real-time LOS under an approved AQP program as described in SFAR 58. The LOE must be designed by an approved design methodology described as a part of the AQP.
LOFT	*Line-Oriented Flight Training* - Under AQP, LOFT is categorized by Qualification LOFT and Recurrent LOFT. Both types of LOFT are conducted as a line mission, allow for minimum or no input from the facilitator during the session, and are conducted for training, not evaluation, purposes.
LOS	*Line Operational Simulation* - A simulator training session conducted in a "line environment" setting. LOS includes Line Oriented Flight Training (LOFT), Line Operational Evaluation (LOE) and Special Purpose Operational Training (SPOT).
Maneuver Validation	A simulator evaluation of technical maneuvers, usually a required part of recurrent training in the U.S.
NASA	National Aeronautics and Space Administration.
Needs Questionnaire	A questionnaire designed to collect data about own airline needs in the area of CRM training. This type of questionnaire is more specific than the Organizational Survey and is usually given to instructor/evaluators and checkairmen.
NTSB	National Transportation Safety Board.
Observable Behavior	Individual or crew behavior used in the assessment of crew performance. Specific Observable Behaviors may be used in the assessment of crew performance within the context of Event Sets.
Organizational Survey	A general type of questionnaire developed in the early stages of ACRM to collect information on how different departments view job, safety, and training issues at their airline.
PAD	Program Audit Database.
PC	Proficiency Check.
PF	*Pilot Flying* - The pilot flying the aircraft, either PIC or SIC.
Phase of Flight	The standard stages that occur in most operational flights to include preflight, taxi, takeoff, climb, cruise, descent, approach, landing, and after-landing.
PIC	Pilot In Command.
PNF	Pilot Not Flying.

POI	Principal Operations Inspector.
PPD	Performance/Proficiency Database.
Proficiency Objective	A statement of the behavior that must be demonstrated on the job, including the statement of performance, conditions, and a standard.
QRC	*Quick Reference Card* - Brief set of guidelines and procedures, often taking the place of memory items, used during abnormals and emergencies.
QRH	*Quick Reference Handbook* - A document designed to be used in the cockpit that specifies emergency and abnormal procedures.
Sensitivity	Index of how accurately a rater evaluated a crew with different levels of performance or evaluated different crews representing a range of behaviors relative to the Standard.
SIC	Second In Command.
Skill	Goal-directed actions, both cognitive and psychomotor, that are acquired through practice. A skill is evaluated through performance; performance characterized by an economy of effort.
SME	Subject Matter Expert.
SOP	Standard Operating Procedure.
SPO	*Supporting Proficiency Objective* - Training objective created at the subtask level that may include the knowledge and skills in that subtask.
SPOT	*Special Purpose Operational Training* - SPOT is a simulator training session designed to address specific training objectives. SPOT may consist of full or partial flight segments depending on the training objectives for the flight.
Standard	Parameters or criteria of performance that signifies the expected level of individual or crew performance. Standard may also be used as a point in a rating scale to designate the expected level of performance.
Standard Scale	Scale based on a Standard and used throughout most of an airline's assessment and rating process.
Statement of Condition	CRM procedure used in briefings to maintain situation awareness and make the briefs relevant to the current operation conditions.

	Conditions may include a combination of WX, airspeed, altitude, fuel, and traffic.
Subtask	Unit of work below the Task level representing a required step in the performance of a task.
Systematic Differences	Comparison of the mean score of an individual rater with the mean score of the group. Significant differences indicate that the individual rates crew performance are higher or lower than the group.
Task	A basic unit of work with a clear beginning and ending point, a goal, and one or more products. A task is a high-level unit for Instructional Systems Development and includes one or more subtasks.
TCAS	Traffic alert and Collision Avoidance System.
Technical Objectives	Training objectives related to maneuvers and procedures. These are related to, but different than, the CRM Objectives.
Technical Skill	Maneuvers, procedures, and other crew performance elements associated with the process of flying. These skills are contrasted with CRM Skills that represent the more cognitive and crew components of flying.
Theme	A higher-level training objective for a training event such as a LOFT or LOS session.
TOC	Table of Contents.
TPO	*Terminal Proficiency Objective* **-** The highest level of definition for a training objective. Successful accomplishment of a terminal objective (task) includes all of its subtasks.
Trigger	Instructor controlled element that defines the start of focused observation within an Event Set.

Summary

CRM and the Need for ACRM Training

U.S. airlines have implemented Crew Resource Management (CRM) training with an emphasis on principles and concepts that improve crew performance and flight safety. This has resulted in crew requirements that have been trained and assessed as additions to, rather than as part of, Standard Operating Procedure (SOP). Advanced Crew Resource Management (ACRM) provides a more integrated form of CRM by incorporating CRM practices with normal and emergency SOP.

ACRM is a comprehensive implementation package including the CRM procedures, training of the instructor/evaluators, training of the crews, a standardized assessment of crew performance, and an ongoing implementation process. ACRM has been designed and developed through a collaborative effort between the airline and research community. ACRM training is an ongoing development process that provides airlines with unique CRM solutions tailored to their operational demands. Design of CRM procedures is based on critical CRM principles that require emphasis in airline's specific operational environment. Procedures were developed to emphasize these CRM elements by incorporating them into SOPs for normal as well as abnormal and emergency flight situations.

As can be seen in this Manual, ACRM is an ongoing, dynamic, development process and should not be confused with a single set of products. The Manual does present some products of the ACRM training development process, but these are to be used as examples only and should not be used as a substitute for the process. Reproducing a briefing card from another airline will not, by itself, produce the type of organization change that the ACRM training development process can.

FAA Evaluation of ACRM Training

The Federal Aviation Administration (FAA) has sponsored a Grant, Analysis of CRM Procedures in a Regional Air Carrier, conducted by a team including George Mason University and Subject Matter Experts (SMEs) from a regional airline, a major airline, and other research organizations. The Grant is in the process of evaluating the effectiveness of CRM procedures in a regional airline environment. Both the airline and the FAA are

interested in determining whether the implementation of CRM procedures can improve overall crew performance. Under the Grant, the regional airline's key CRM principles were translated into procedures that have been implemented through ACRM training. The regional airline involved in this Grant was authorized to develop an innovative approach to crew training and assessment under the Advanced Qualification Program (AQP).

The results of this Grant have significant ramifications for flight crew training, specifically in the area of integrated CRM and technical skill training. The airlines have not had the capability to perform detailed assessments of CRM skill training, nor have they had the ability to assess different forms of CRM training. The results of this Grant provide guidelines for the training of CRM procedures (see Appendix A for a complete list of the guidelines) as well as a framework for the assessment of skill-based crew performance. With this capability to train and assess CRM performance, airlines can become proactive and improve training based on the assessment data rather than having to rely exclusively on accident and incident information.

Key Elements of ACRM Training

Key elements of an ACRM program are the development of CRM procedures, training of the instructor/evaluators, training of the fleet crews, and assessment of crew performance based on the airline's operational environment. Supporting elements to the development of ACRM training include the survey forms, changes to the Flight Operations Manual (FOM), Flight Standards Manual (FSM), and Quick Reference Handbook (QRH), the Line Oriented Flight Training/Line Operational Environment (LOFT/LOE) development process, and the Inter-Rater Reliability (IRR) process to standardize crew assessment. These are important supplements and examples are presented in the appendices.

Organization of this Manual

This Training Manual is organized around the steps an airline would follow to develop an ACRM training program. Those steps are based on the key elements of ACRM training development. The first two parts present background and introductory information an airline should consider prior to starting the development of a training program. The next four

parts, Part 3 through Part 6, describe the actual steps, starting with the development of the CRM procedures to their implementation. The remainder of the document contains examples to guide and support the development process.

Acknowledgments

Several individuals and organizations were instrumental to the progress of this Grant and their strong commitment has made this work operationally relevant. Captain Kim Schultz remains an active champion of this work and has given greatly of her time and expertise to the effort. The individual reviewers of this Manual also made valuable suggestions on how to improve content and structure.

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Questions and Additional Help

This Training Manual is designed to provide a complete set of steps to develop ACRM training. If you should have questions or require additional help, please contact one of the following:

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Part 1. Introduction to ACRM Training

Part 1 of the Manual explains the background of ACRM training and describes the main elements for developing an ACRM training program. The last section in this part outlines the major benefits of developing and implementing ACRM training. That section should be particularly useful for those needing justification for implementing ACRM.

Part 1 was written for those not familiar with ACRM training and its elements. Those with knowledge of or experience with ACRM can jump to Part 2, Guiding the Organization, or Part 3, Developing CRM Procedures.

Background to ACRM Training

Advancing from CRM Principles to CRM Procedures

√ CRM principles lack performance standards.

Most airlines emphasize CRM principles in the form of topics or markers. These principles include topics such as crew coordination, decision making, and situation awareness. These principles are in the form of recommended practices, and crews are encouraged to implement these practices when and how they see fit. The resulting behavior is not always predictable, and most airlines have found it difficult to specify standards of performance for CRM principles.

√ CRM procedures can be made part of existing or new procedures.

Some operationally relevant CRM principles can be translated into airline-specific procedures that will benefit crew performance in certain situations. These CRM-based procedures can be integrated with existing normal or non-normal procedures, or they can be designed into new procedures.

The identification of CRM procedures normally starts with existing principles and moves to forming preliminary procedures. This process includes:

- Reviewing existing CRM principles.
- Identifying crew performance problem areas.
- Reviewing procedures at other airlines.
- Identifying possible procedural changes or additions.

√ CRM procedure identification is an ongoing process.

The identification of CRM procedures should first address the most important crew performance problems. Once ACRM training has been developed and implemented, additional CRM procedures can be developed. CRM procedure identification should be treated as an ongoing process involving the entire organization in constantly looking for ways to improve crew performance.

How CRM Procedures Work

ACRM is directed to the training and assessment of CRM skills within crew training programs. CRM procedures become a focal point in CRM training, and those procedures allow crews to practice specific CRM behaviors both in normal and non-normal situations. The procedures help crewmembers develop a consistent pattern of crew coordination allowing crews to know what to expect from each other. The CRM procedures also serve as a constant reminder to the importance of CRM within the operational environment.

CRM procedures are an integral part of SOP. CRM procedures may be integrated within briefings, checklists, and emergency or abnormal procedures, such as those found in a QRH, the FSM, or the FOM. These procedures promote good CRM in consistent ways during appropriate times for normal and non-normal flight situations.

√ A CRM procedure can be integrated with the takeoff brief to help crews address relevant conditions.

For example, crew communication and situation awareness can be improved by requiring specific items in briefings prior to takeoff. A takeoff brief that requires the crew to address situationally relevant items critical to that particular takeoff can be inserted during times with lower levels of workload. By having the takeoff brief address important conditions related to the airport, weather, and performance, the crew discusses those conditions that affect the takeoff. The brief should include specific plans for abnormals that may occur during takeoff. Having the briefing scheduled for the lower workload period prior to taxi helps improve situation awareness and decision making during a critical phase of flight.

Example of a CRM Procedure

√ CRM procedures may be embedded in most critical crew activities.

CRM procedures may be embedded in a range of crew activities. Some CRM procedures, as the one shown in this example, are inserted into required crew briefings prior to critical times of flight such as approach/landing.

There are a number of cases where an airline may notice a pattern or crews are being rushed during the approach that results in the following type of incident (from ASRS Reports):

> *Due to the proximity of the airport, the high indicated airspeed, the excess alt and the flight crew's anticipation of the ILS 34 approach, the workload of the flight crew was quite high...The PF descended from the published segment alt (3500' MSL) at the 18 DME position to the published straight in landing MDA of 2000' MSL. The FAF for the procedure was at the 13 DME position and the PF's premature descent put the aircraft 1500' below the published segment alt.*

The following Arrival Brief was designed to help crews address the main conditions relevant to each arrival. The brief was placed at the end of cruise phase when crews have more time to review and plan for the critical conditions.

Arrival Brief

- **ATIS / NOTAMS**
- **Brief Descent Profile**
- **Statement of Conditions**
  - Select and Prioritize:
  - Fuel status/delays
  - Runway conditions
  - Low visibility procedures
  - Terrain / MSA
  - Convective activity
  - Crosswinds / windshear
  - Hydroplaning
  - Aircraft performance
  - GPWS/TCAS alerts

- **Bottom Lines for arrival, approach & landing**
- **Backup Plan for arrival, approach & landing**

Overview of CRM Procedures

√ CRM procedures may be added to or integrated with normal or non-normal procedures.

√ CRM procedures help to brief and debrief technical and CRM performance on an equal basis.

CRM procedures, instructor/evaluator training, crew training and assessment, and the ongoing implementation of ACRM form the essential elements of ACRM. CRM procedures are the basis of ACRM training. They are SOPs that contain significant CRM elements. These Procedures can be used to add required CRM to an airline's briefings, calls, and checklists for normal and non-normal conditions.

It has been demonstrated that CRM procedures can be successfully developed and fully implemented within a regional airline's SOP helping to integrate the technical with the CRM performance in training, assessment, and, most importantly, in the operation of aircraft. CRM procedures are designed to integrate CRM with standard aircraft operation and provide structure to crew management training and assessment. During training, the procedures become a major focus in CRM skill development. These procedures help crews form a set of beneficial and predictable CRM behaviors that increase crew coordination, communication, awareness, planning, and decision making.

During crew assessment, CRM procedures help instructor/evaluators brief and debrief the technical and CRM performance more objectively. The assessment of a crew's procedural performance is more focused than the traditional evaluation of general CRM markers. This permits a more accurate understanding of crew performance leading to the identification and development of better targeted CRM training.

Part 3 of this Manual provides guidance in developing CRM procedures, starting with the identification of general industry and own airline needs and moving on to the development and finalizing of CRM procedures.

Overview of Instructor/Evaluator Training

Training of the instructor/evaluators is the key to combining ACRM training and assessment into a well-structured training system. For airlines implementing this approach to crew training and assessment for the first time, the new methods can seem

complicated and difficult to assimilate. Therefore, it is important to identify a few basic training areas that can serve to organize instructor/evaluator training. For the first year, the main focus of the instructor/evaluator training can be the CRM procedures, the LOE or other forms of assessment, and the use of a gradesheet (such as the LOE Worksheet).

√ Initial instructor/ evaluator training should focus on CRM procedures and their assessment.

The first part of instructor/evaluator training should provide instructor/evaluators with an understanding of ACRM. Next, training can be developed to provide instructor/evaluators with the knowledge and preliminary skills required to train the CRM procedures and how to brief, administer, assess, and debrief the LOE or other forms of ACRM assessment. Then, instructor/ evaluators should be given ample practice to build up their skills in standardizing the assessment process using some form of IRR. This practice can be provided initially during the final part of the basic instructor/evaluator training. Thereafter, IRR should be refined on a regular basis throughout standardization training in order to maintain quality control and encourage ongoing instructor/evaluator participation in the ACRM process.

√ Instructor/evaluator need substantial practice to develop assessment skills.

The evaluator part of the training can be organized around the primary IRR tools allowing the instructors to practice developing assessment skills by working with real grading sheets, observing the actual scenarios they will be using, and rating tapes of real crew performance. Assessment skills should be trained in a task-specific context providing the instructor/ evaluators with multiple observations of the range of crew performance that they will likely encounter.

Part 4 of this Manual provides guidelines for developing instructor/evaluator training, including the development of the introductory modules, instructional skills development modules, the ACRM assessment modules, and modules on instructor/evaluator standardization.

Overview of Crew Training

Crew training under ACRM should be viewed as an extension of existing CRM training with emphasis on the new CRM procedures. ACRM can provide a number of training improvements. First, the CRM procedures provide a new focus for the training emphasizing the most critical aspects of crew coordination and communication. By merging CRM with SOP, ACRM training integrates CRM with the technical training,

giving both aspects equal importance.

A thorough crew training program should be based on specific behavioral objectives such as those developed under an AQP. Objectives are essential for training development and ultimately direct crew performance assessment. Crew training should present the new CRM procedures in a clear and compelling manner, and demonstrate how the procedures improve crew performance. This part of crew training can be based on the concept of crew effectiveness where individual pilots improve their coordination by developing CRM skills that lead to overall improved crew effectiveness.

Part 5 of this Manual provides guidance in developing crew training including how to develop the introductory modules, modules that explain crew effectiveness in relation to CRM skills and procedures, and modules about how crew performance will be assessed.

Overview of Crew Assessment

√ A combination of LOE and Line Checks provides a complete CRM assessment.

Two forms of crew assessment can provide resource management performance data within the constraints of an operational setting. First, an LOE-based assessment allows for the collection of a wide range of crew performance data within the carefully designed and controlled event set environment. This precise method of crew assessment should be augmented with a second type of assessment, the Line Checks. Line Checks provide valuable data about the state of the CRM procedures and overall crew performance on the line. Line Checks, although not as controlled as LOEs, provide an efficient method for collecting more general crew performance data.

√ ACRM evaluations must be reliable and valid.

Crew assessment techniques are an essential part of instructor/evaluator training and should be based on the collection of reliable data. The IRR analysis tools (discussed in Part 4 and in Appendix D) are designed to increase that reliability. Computer-based IRR analysis tools can be used to inform one or a group of instructors on how they are rating crew performance in relation to the other raters. The IRR analysis tools focus on rater standardization by addressing Agreement, Congruency, and Consistency. Agreement allows instructor/evaluators to determine how close the ratings are for each item being rated. Congruency helps individual raters understand how their use of the rating scale compares with the total group of raters, and

Consistency shows how individual raters correlate with the group.

Crew assessment is discussed in Part 4, dealing with the development of instructor/evaluator training. ACRM crew assessment is based on clear standards and the ongoing process of collecting reliable crew performance data.

ACRM Implementation

√ ACRM should be implemented as an ongoing process involving the entire organization.

Once CRM procedures and training have been developed, there are a number of activities that will help ensure that ACRM is implemented throughout the organization. From experience at one airline it is evident that ACRM should be implemented as an ongoing process and not as a one-shot training and SOP package. ACRM provides a set of steps for improving crew performance that can be reused to develop additional CRM procedures and requires the involvement of the entire organization, not just the training department.

√ Review sessions can help to keep key personnel informed about ACRM development.

To help ensure successful ACRM implementation, an airline should make sure the organization, instructor/evaluators, and crews are ready for the new training process. Prior to ACRM implementation, the organization should be involved with training scheduling an announcement of ACRM, and setting a date when ACRM will become company SOP. From an organizational perspective, key personnel should be kept informed of the development progress. Review sessions with those key personnel can help to ensure that the organization is informed and supportive of the effort.

√ Steps can be taken to ensure instructors are informed and practiced in the new training.

Instructor/evaluators represent the front line of ACRM implementation, and steps should be taken to make sure they are informed, practiced, and comfortable with the new training. Experience has shown that certain activities will help develop instructor/evaluators into a training and assessment team. These activities include having training sessions where the instructor/evaluators establish a good level of agreement in their assessment of CRM performance. Accurate and timely feedback should be given to instructors prior to and throughout ACRM implementation. In addition, standardization meetings should be planned to allow the instructors to voice problems and to work as a team to identify solutions to those problems.

A key to ongoing successful implementation is the reporting and use of crew performance data. Once an airline has established that they are collecting reliable and stable data, they should start reporting crew performance data and trends to appropriate departments within the organization. Different types of data and formats should be used when reporting to the crew, the instructors, fleets, or management. When properly reported, that data will direct changes or additions to the CRM procedures and modifications to ACRM training.

Part 6 of this Manual provides guidance on how to implement ACRM within the organization, discusses the important implementation requirements, and presents considerations for keeping a standard assessment and collecting usable performance data.

Benefits of ACRM Training

Promoting a Standard CRM for Crews

Both training and flight operations should benefit from ACRM. The crews are a major beneficiary in that they are provided with a standard, proceduralized form of CRM. CRM procedures promote a predictable form of crew coordination that is shared and understood by all crewmembers. This results in a more standard crew performance that helps crewmembers participate in planning, decision making, and situation awareness.

√ CRM procedures promote standard crew communication and coordination, which will improve crew performance.

Research has shown that predictable patterns of interaction, especially in the area of crew communication (Kanki, Lozito, and Foushee, 1989) are associated with better performing flightcrews. It has been suggested that when communication is more predictable it tends to be more reliable and more likely to succeed. CRM procedures promote that standard crew communication and coordination which should result in improved crew decision making and situation awareness.

Standardizing CRM Training and Assessment

The airline benefits from ACRM through the development of a standard CRM training and assessment process. CRM procedures allow instructors to focus their training on key areas of the operation and allow the evaluators to concentrate on well-specified areas of crew performance. This promotes a standard training and assessment environment.

√ ACRM provides a set of standards for crew performance and its assessment.

One complaint about CRM training has been the lack of objective standards leading to a range of performance and, ultimately, to substantial variability in the effectiveness of CRM. ACRM addresses this problem on two critical fronts by 1) providing clear procedures for the crews to follow, and 2) giving airlines a set of unambiguous standards for the assessment of crew performance.

√ ACRM's standards can reduce instructor workload during crew assessment.

A complaint about CRM assessment has been that instructors are provided with insufficient training and given too high a workload during LOFT or LOE sessions. ACRM training ensures that instructor/evaluators are given ample practice to build up their skills in standardizing the assessment process. This can be done initially during the final part of the basic instructor/evaluator training, and should be done on a regular basis thereafter under some form of standardization training. With the standard and focused approach that ACRM gives to the assessment process, instructors are able to manage their workload by concentrating on the essential elements rather than trying to assess many poorly defined concepts.

Expanding CRM Skill Practice

√ Frequent execution of CRM procedures helps crews to develop superior CRM skills.

Once ACRM is implemented, the crews are provided with focused opportunities to practice CRM procedures under normal, non-normal, and training conditions. Crews, through the normal CRM procedures, are provided with the opportunity to practice specific CRM behaviors every time they fly. This frequent practice of learned behaviors promotes the development of CRM skills, skills that an airline has identified as essential to good performance within its operational environment.

In addition, crews are provided with the opportunity to practice good CRM behaviors under emergency and abnormal conditions when training in flight simulators. By inserting CRM procedures into an airline's Quick Reference Handbook or emergency procedures, crews are given CRM skill practice every time they follow one of those procedures. As an example, one airline inserted a preparation and planning cycle into certain emergency procedures where the malfunction has a significant impact on future phases of flight. That preparation and planning cycle provides crews with practice in discussing the critical conditions and stating a detailed plan for their specific situation. This focused CRM skills practice under normal and training conditions is designed to improve crew performance. The

objective is for crews to develop that higher level of CRM skill to help them manage real emergency or other non-normal situations.

Focusing on Airline-Critical Procedures

√ ACRM promotes the development of procedures tailored to specific airlines.

The ACRM development process is airline-specific, because there is not a single set of CRM procedures that will address the crew coordination needs of all airlines. This approach to ACRM development is aware that one size does not fit all organizations. Airlines have different missions, philosophies, and SOP, and ACRM development helps an airline refine its procedures to best meet its unique operational needs. ACRM development is a process, and that process helps the entire organization focus on the procedures that will most improve crew performance in the airline's operational environment.

√ Raising CRM to the level of SOP magnifies the importance of good crew communication and coordination.

This operational focus should be used to involve training and flight operations in the process of improving CRM. Traditionally, CRM training has been the responsibility of a relatively small group, or in some cases an individual, within the training department. ACRM training, by addressing procedures and fundamental issues of crew performance, extends involvement to the entire flight operations, involving those in standards, training, and operations. Raising CRM to the level of SOP magnifies the importance of crew coordination and activates all critical parts of the operation in the development, training, and assessment process.

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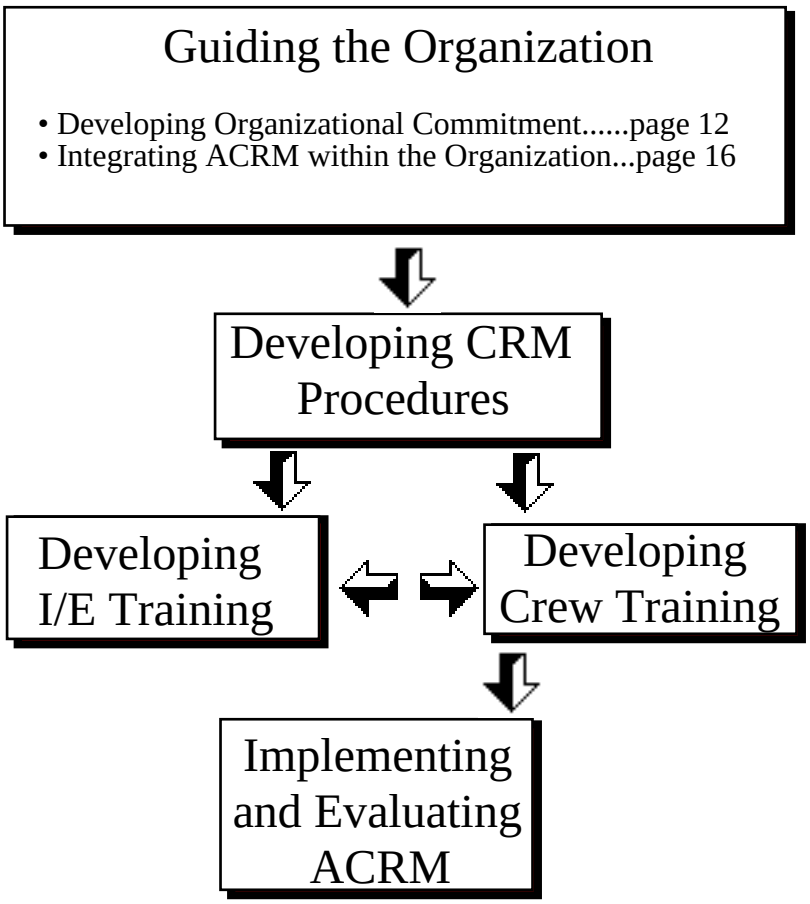
Part 2. Guiding the Organization

Complete organizational involvement is required in order for ACRM training to be successful. This involvement is needed prior to the start of ACRM development and should follow through to implementation and become an ongoing part of the program. Often the need for ACRM is identified at the training department level, so a key challenge is to communicate that need to the rest of the organization and to establish a strong commitment from top management on down.

Part 2 has been written for individuals who have not established a CRM training program at an airline, and is based on some useful lessons learned through working with an airline over a four-year period. Those with experience in this area can move on to Part 3, Developing CRM Procedures.



Preliminary Organizational Presentations

The need for an ACRM-type training program often is identified at the training department level. Sometimes that need is identified by the individual or group in charge of CRM training, and on occasion by those developing an AQP. Once the need has been identified, training objectives and supporting data should be organized into one or more presentations to gain organizational support.

√ Consider having instructors help prepare the organizational presentations.

Your instructor/evaluator group will ultimately act as the front line for the ACRM training program. Consider using a group of these instructor/evaluators to help in preparing the organizational presentations. At the very least, have instructor/evaluators review your presentations before you show them to management or training department supervisors.

Organizational presentations should include a set of higher-level objectives, additional lower-level objectives, primary development and implementation steps with dates, organizational requirements, and organizational benefits. The higher-level objectives might include some of the following:

- Standardized form of CRM crew training.
- Standardized form of CRM assessment.
- Improved CRM skill and performance development.
- Improved integration of CRM with technical training.

Additional, lower-level objectives might include:

- Updating critical briefings.
- Updating the Quick Reference Handbook (QRH).
- Improved CRM assessment training for instructor/evaluators.
- Improved reliability of instructor/evaluator ratings.

Ensuring Ongoing Management, Union, and Inspector Commitment

Once initial organizational involvement has been established, steps should be taken to further develop and ensure ongoing management, union, and Principal Operations Inspector (POI) commitment. Each airline has a different management structure

and a unique relation with union and POI, but some common steps can be taken to build a strong commitment for the ACRM training program.

√ Management should be informed about the types of questions that can be addressed by CRM performance data.

On the management side, an important step is to develop an understanding of what will be achieved under ACRM training, and then provide regular reports to show the progress and trends. In developing the preliminary understanding it can be helpful to provide data on current trends in training, and if CRM data is not available, use technical data such as maneuvers to demonstrate the type of crew and instructor data that will be collected. At many airlines this may be the first carefully evaluated CRM program linked to crew performance and SOP. In such cases, management should be familiarized with the methods that will be used to collect CRM performance data and the types of questions that can be answered with that type of data. Use the commitment-building presentations to identify the types of reports most useful to management. One important outcome of this process is to develop strong commitment for the ACRM program from top management on down.

On the union side, consider getting one or more union representatives involved in the development as early as possible in the process. In the preliminary meetings it should be established that ACRM offers a much more complete form of CRM training that is well integrated with the technical. Further, crew assessments under ACRM are objective, based on SOP, and well specified based on observable crew behaviors. Work closely with at least one representative, and invite them to fly or ride the new LOE or LOFT. Also invite them to be present at the ACRM crew training course and at crew assessment sessions such as the LOE or line check. Invite union feedback and keep them informed as the program develops.

The working relationship with the FAA's POI is also very important. Some airlines have developed ambitious new training programs only to find that the POI either does not understand the program or does not see the need for change. The POI should be included, informed, and consulted as soon as is practical within the specific organization. If possible, make the POI, as with union representatives, a part of the process. Take the time early in the process to explain the need for the new training and make explicit the approach that will be taken.

Developing and Maintaining Organizational Links

√ Both formal and informal communications are essential to maintaining good organizational links.

Although the need for ACRM training may originate from the training department, links should be established with other departments to ensure the ongoing viability of the program. The main links that should be established and maintained are between the ACRM training development group, the customer fleets, and the standards department as well. Whether formal or informal, it is important to have cooperation from the different departments that will be affected by the ACRM training.

The preliminary organizational presentations, mentioned at the beginning of Part 2, are one of the preliminary ways to establish links. Once the link has been established, open communication needs to be developed and maintained. This should be encouraged by the ACRM development team, both formally and informally. The formal communication should include several scheduled reviews allowing the fleet and standards representatives to see and comment on intermediate versions of the new CRM procedures as well as the training materials. Other formal communications may include scheduled briefings and other meetings to ensure that other departments are informed of progress and issues in the development process.

Informal communication links are also important, especially in the maintenance of flexible and strong links. During the formal communication process, identify individuals from the fleets and standards who are interested in the ACRM training and who understand the advantages of cooperation between departments. Develop these informal links by inviting interested individuals to the informal discussions where decisions that affect fleet policy or standards are made. These informal links should not require additional time or meetings on the part of the ACRM development team, and they can be essential to getting good input and cooperation from the different departments. In addition, identify a champion within the higher levels of the organization who can lend strong support to the program at key periods such as initial funding and ACRM implementation.

Involving Instructors in the Ongoing Process

Early and continuous involvement of instructor/evaluators is the key to a well-implemented and well-received ACRM training program. The instructors can be very helpful throughout the

development and implementation process, and they are the main role models of ACRM for the crews. Ultimately, ACRM training works best if the program becomes their idea and they are its main architects.

A key to good instructor/evaluator involvement is to start early and involve several of the more experienced instructors in the initial development steps. Consider having one of these early adopters present the ACRM training program at an instructor meeting so the audience can concentrate on the benefits of the new program rather than on the difficulties and issues of change. Keep as many instructors as possible actively involved in both the development and implementation steps.

√ Keep as many instructors as is practical involved in the ACRM process.

Instructor/evaluators can be very helpful in many of the ACRM development steps including:

- Identifying own airline CRM training needs.
- Specifying gaps in existing procedures and documents.
- Providing feedback on the prototype CRM procedures.
- Providing input when identifying instructor/evaluator training requirements.
- Providing SME input to the instructor/evaluator training course development and LOFT/LOE development.
- Standardizing inter-rater reliability.
- Developing and refining the gradesheets.

Once the instructors have received their ACRM training and the program has been implemented, there are a number of other areas where instructors can help:

- Refining instructor/evaluator training/assessment tools.
- Providing ongoing feedback.
- Planning and establishing standardization meetings.
- Identifying instructor and crew performance problems.
- Identifying training areas that need improvement.
- Specifying new ACRM procedures.

Part 4 explains the steps in developing instructor/evaluator training, and shows how instructors should be involved in many of those steps. Also, Part 6 presents the implementation and evaluation process. Again, instructors should remain active, not only in training and assessing ACRM, but also in being role models and support-persons throughout the organization.

Working with Management

ACRM offers the opportunity to change not only the crew's acceptance of CRM, but also the instructor/evaluator and organizational understanding and involvement. Preliminary acceptance of ACRM training should be developed into an ongoing appreciation for the substantive changes being made in crew performance and the meaningful data that is being reported back to the different levels within the organization.

The previous section discusses the use of commitment-building presentations to identify the types of reports best understood by, and most useful to, management. The reports are important, but they are just one part of developing an ongoing working relationship with management. In order to establish a vital working relationship, an understanding of the benefits of ACRM training is important, and should be combined with a strong level of communication between the training department and airline management.

√ ACRM can help management move from a general understanding of CRM to an appreciation of what CRM can do for their operations.

Airline management realizes the importance of CRM training, especially at a general level. That is, they understand that many accidents in commercial aviation have a human factors or CRM component. What is more difficult to understand is the relationship between own airline incidents and human factors. Most airlines do not report possible or actual human factors causes of incidents, so there can be a tendency to concentrate on a crew's technical problems. ACRM, over time, should bridge this gap in understanding to help management understand the CRM problems that impact daily operations and the training and assessment steps that should be taken to remove those problems. The precise methods used to develop this understanding will vary from airline to airline, but there are two important elements. First, the training department should establish and clearly represent to management the link between ACRM training and a crew's development of CRM skills. Second, a clear understanding of the ongoing, feedback-driven nature of the ACRM program should be developed. These two elements are essential in establishing a good working environment with management.

Formal reports, discussed in the last section of this part, are just one dimension of the required communication process.

Informal communications and frequent updates must also be worked into the ACRM process. The training department can start by providing management with preliminary crew performance data before a quarter of trend analysis data is available. It should be made clear that the data are incomplete and that any interpretation is preliminary. The training department can use these update sessions to identify the types of questions that are important to management and refine their understanding of the ACRM training process.

Conducting an Organizational Survey

√ The organizational survey can be used to introduce ACRM.

Conducting an organizational survey during the early stages of ACRM development can help identify organizational elements that need to be involved in the process. The survey can show which elements understand and want to be involved with the ACRM program and which will require more communication and information. In addition, the organizational survey can be used to increase organizational awareness of ACRM and its benefits in improved safety, communications, and cooperation.

Consider using the survey development and administration process as a way to get essential parts of the organization introduced to the new program. You can ask key individuals from different departments to provide material for the survey or have them review specific survey items. Make sure that the survey addresses issues and concerns of the flight attendants, dispatchers, maintenance, and other key parts of the operation.

Some of the items that should be considered for inclusion in an organizational survey are:

- Airline safety climate.
- Communication and cooperation.
- Departmental management and structure.
- Job responsibilities and standards.
- Organizational management.
- Professionalism and job performance.
- Quality and frequency of training.

Part 3 presents the steps to identify own airline needs that are related to the conduct of the organizational survey. The organizational survey may be planned and administered during the identification of own airline needs. Appendix B provides sample questions that can be used to develop the survey.

Reporting Results to Organizational Elements

√ Different organizational elements require different data and formatting to fully benefit from ACRM reports.

Timely, accurate, and relevant data reporting is one of the most visible contributions an ACRM program can make to the various organizational elements. Under ACRM it is possible to collect a large amount of CRM performance data. In addition, the IRR tools allow airlines to analyze different dimensions of instructor/evaluator reliability. The large amount of data combined with the different forms of analysis can result in an overwhelming amount of information, so the challenge is to report the essential data in a usable format to the appropriate organizational elements.

The four main organizational elements to consider are:

- Crews and union representatives.
- Instructor/evaluators.
- Training department management.
- Fleet managers.

Consider reporting on some of the following within fleet data:

- Distribution of overall performance by position (Capt., F/O, S/O).
- Distribution of technical performance by position.
- Distribution of CRM performance by position.
- Maneuver validation ratings by type of maneuver.
- Distribution of event set performance where there are problems.
- Overall crew performance trends (quarterly and annually).

Consider some of the following across fleet data:

- Distribution of overall performance by fleet.
- Distribution of technical performance by fleet.
- Distribution of CRM performance by fleet.
- Maneuver validation ratings by type of maneuver and by fleet.
- Event set performance by fleet where there are crew performance problems.
- Overall crew performance trends by fleet.

Sections in Part 6 discuss the crew and instructor performance data reporting process.

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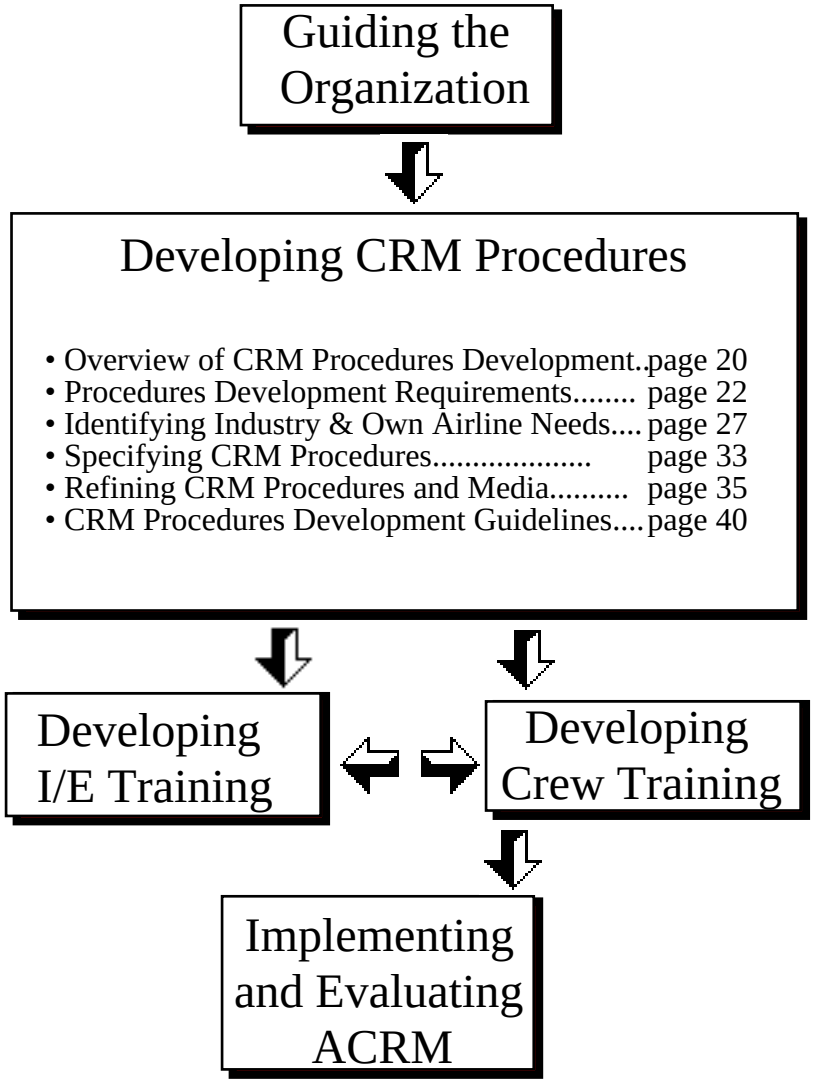
Part 3. Developing CRM Procedures

Part 3 of the Manual presents the steps for developing CRM procedures. This part has been written for those who need to develop a set of CRM procedures at an airline. The development process starts with identifying industry trends and own airline needs and goes through to finalizing the actual procedures and the media that will be used to disseminate those procedures. Two keys to a well-managed development effort are careful planning and good communications with the rest of the organization. The last section in this part summarizes the CRM procedure development guidelines.



Planning for the Main Development Activities

√ All airlines should plan these three steps: 1) identifying CRM needs, 2) specifying procedures, and 3) refining procedures.

The development of CRM procedures is based on airline-specific operations, but there are several basic steps that should be considered by all airlines. Those steps are presented in this part, and include the identification of CRM needs, the specification of the procedures, and the refinement of those procedures.

Identification of CRM needs is based on the most important crew performance problems at an airline. Training departments may not know how to start looking for these problems, so it can be useful to first review industry-wide reports to learn where other airlines have the greatest crew performance problems. Industry sources of information can help locate general problem areas that are more likely to be accepted by an airline which might otherwise be defensive about its own pilot population. When several general areas have been identified, the airline can then look at its own safety and training reports to start pinpointing its own specific problems in those areas. The identification of CRM problem areas is ongoing, as initial problems are resolved and new problems surface. To ensure initial success and long-term acceptance, it is vital for the airline to identify a few operationally significant CRM-related performance problems for procedure development. Once the problems have been isolated, they are reviewed to determine if they point to operating standards, training, or a combination of those needs.

√ It is vital for an airline to identify a few operationally significant CRM-related performance problems.

Specification of CRM procedures uses the airline performance problems and CRM needs to determine the procedures that will address them. This is the first pass at specifying the new procedures, so the development team should be encouraged to examine a range of possible procedures and consider a number of different areas where these procedures could be implemented. This is a major step for the development team, and planning considerations include making sure the team members have sufficient time and access to airline resources so they can develop a credible set of initial CRM procedures.

The refinement step is based on a comprehensive review of the CRM procedures. Individual procedures, along with other options, must be reviewed by all departments affected by the

changes including training, flight operations, and fleet management departments. The refinement process is essential for improving the CRM procedures and for gaining acceptance across departments. These three steps require forming a broad-based development team and continued communications with the organization; elements are that discussed next.

Establishing a Broad-Based Development Team

The training department, in cooperation with flight standards, will likely perform most CRM development, but additional members should be considered in forming the development team. In smaller airlines, there may be only one or two individuals who have the time to work on CRM procedure development, but it can be better to have more individuals working as a team rather than only one person doing all the work.

√ Consider forming a CRM procedures development team rather than having just one developer.

There are several reasons to consider a team approach to developing CRM procedures and the ACRM training as well. First, with just one person you risk losing the entire effort if that person moves to another department or airline. Also, when the development is performed by just one person, it can be more difficult to establish the links to other departments and ACRM can be perceived as just a one-person effort rather than an organizational effort.

The functions of the CRM procedures development team include developing the CRM procedures, building links throughout the organization, and providing input for the ACRM training development. At smaller airlines it is more likely that the CRM procedures development team will go on to develop much of the ACRM program. At larger organizations, where functions are more specialized, the procedures development team will become a resource for the individuals who develop instructor and crew ACRM training.

Working within a team can facilitate this development process. A successful team can help to distribute the effort beyond the training department to other areas of the organization. Also, a team can ensure continuity in the development effort, even when some of the members are not present. Finally, a successful team can achieve more than just the sum of its individual members, thus providing the airline with a more efficient way of developing the CRM procedures.

Ensuring Organizational Communication and Coordination

Good communication with key elements of the organization ensures a well-coordinated effort. Communication starts at the beginning of the process with activities such as the preliminary presentations (see Part 2) and continues throughout the ACRM program. The CRM procedures development team should establish formal as well as informal communications to achieve ongoing, open communication with the main elements of the organization.

Formal communication should include several scheduled reviews, allowing the fleet and standards representatives to see and comment on intermediate versions of the new CRM procedures. Other formal communications may include scheduled briefings and meetings to ensure that other relevant departments are informed of progress and issues in the development process.

Informal communications are important to maintaining flexible and strong links. Inviting interested individuals to attend the working sessions where decisions affecting fleet policy or standards are made enhances communication. Those individuals should participate in the process and be encouraged to contribute their ideas to the development of CRM procedures. This broader audience will ensure that the CRM development team gets input from the rest of the organization and identifies potential problems during the design phase rather than later in development.

Procedures Development Requirements

Outlining the Personnel Requirements

CRM procedure development has personnel, time, and budget requirements. Lack of planning in any one of these areas can delay or terminate the development process.

As indicated in the previous section, there can be a substantial range in personnel requirements from just a single individual to a team with members from key organizational departments. Even small operations should consider the team approach that team personnel requirements will be considered first. Developing the first set of CRM procedures can best be managed as a small and efficient project, and the team composition should match that

objective. A CRM procedures development team can be formed with three to eight members; larger airlines can work with a larger team. However, even in the major airlines the team should be kept manageable by not growing too large.

√ In addition to having one or more people from the training department, consider having someone from flight standards and flight safety.

The composition of the team will depend on the organizational structure and the requirements of the development plan, but certain departments should be able to provide valuable team members. In addition to the training department with its instructors, consider someone from flight standards and someone from the safety department. If you are considering concentrating the development effort with one fleet, an approach that can make procedure development more manageable, have a representative from that fleet on the team.

Additional team formation considerations include selecting individuals who work well together. Concentrate on those personnel who have show a strong interest in the project and have experience in procedures development. Finally, have a limited timeline (see the next subsection) and clear plan to help in your recruitment. It is much easier for individuals to join a team when its purpose is clear and its product will enhance the organization's performance.

Establishing a Development/Implementation Timeline

A realistic and efficient timeline can help in team formation and in getting the project off to a good start. Preliminary timelines can be based on the development team composition and planned activities. That preliminary timeline for those early presentations can be used to elicit team participation. Once the team membership has been finalized, the timeline should be reviewed to ensure that it is compatible with the member schedules.

√ When estimating the timeline, limit planning to essential activities and do not overload the development team members.

Time is a limited commodity in aviation, so restricting the amount of time needed for the development process is an important aspect of planning. At least two areas should be considered when making the best use of development time. First, planning should be limited to essential activities. Second, actions should be assigned to team members in such a way that no one becomes overloaded and slows down the team.

In planning activities, consider how much time it will take the development team to identify the needs, specify the procedures, and refine them. If an airline already is collecting crew performance data and has trend data for the last few years, then that airline will not need to spend much time identifying crew performance problem and needs. For needs identification, you may be able to budget as little as 40 hours or as much as several hundred hours. The second activity, specifying the CRM procedures, has a narrower range, especially if an airline limits the number of procedures to introduce at the start. With two to six procedures, a good number to start with, an airline should be able to develop the initial procedures taking about 20 hours per procedure. The refinement process is very important and, because it requires organizational input, may require several hundred hours, especially in larger airlines.

In addition to estimating the amount of time required for each step, there are a number of other considerations. Once you have an estimate of total time, consider assigning and scheduling the activities in such a way that some items can be performed in parallel. Also, schedule the key products and milestones in a way that the team can meet them at the same time so the organization will have a sense that progress is being made.

Depending on team size and the number of hours required for each activity, CRM procedures development should take between one and three months. Time less than a month risks not completing some of the essential activities, and taking much longer than three months risks losing the interest and commitment of the organization. A sample ACRM development timeline might look like the Sample Timeline on the next page. Each organization will establish a timeline to best fit the pace of its individual departments, but a 12-month timeline is a reasonable starting point.

SAMPLE ACRM DEVELOPMENT TIMELINE

Month 1	**GUIDING THE ORGANIZATION**	Present to Organizational Elements
Month 2		Conduct Organizational Survey Establish CRM Procedures Development Team
Month 3	**DEVELOPING CRM PROCEDURES**	Determine Carrier Needs Develop CRM Procedures
Month 4		Review CRM Procedures
Month 5	**DEVELOPING I/E TRAINING**	Establish Training Development Team
Month 6		Develop Instructor/Evaluator Training
Month 7		Develop LOFT/LOEs and Gradesheets Train Instructor/ Evaluators
Month 8	**DEVELOPING CREW TRAINING**	Develop Crew Training
Month 9		Train and Refine Gradesheets Announce ACRM Program
Month 10	**IMPLEMENTING & EVALUATING ACRM**	Train Crews
Month 11		Implement CRM Procedures
Month 12		Hold Instructor/Evaluator Standardization Meetings Evaluate Crew Performance

Budget Considerations

The procedures development process itself can be accomplished with a relatively small budget, but associated elements such as changes to operations documents and training can result in substantial expenses. With careful planning, development and establishing the CRM procedures can be achieved efficiently by reducing or eliminating some of the larger expenses.

For major airlines, one change in a procedure can result in the need to reprint one or more pages of 40,000 manuals. That could become a very large cost, and those who do not fully support or understand the need for CRM may use it as an argument to limit or terminate the program. However, a strong case can be made that procedural changes can be integrated into a scheduled manual update for little or no additional cost.

√ Coordinating the introduction of new CRM procedures with scheduled document updates can greatly reduce your costs.

Major airlines have scheduled Flight Operations Manuals (FOM) updates, and if the changes proposed by the CRM procedures are coordinated with those updates, the cost can be greatly reduced. In addition, documentation that is normally kept in the cockpit deteriorates over time and may have other reissue requirements. Coordinating checklist and Quick Reference Handbook (QRH) changes with the update cycle will further reduce costs.

Additional considerations for managing the budget include integrating some of the team members' development time with their normal responsibilities. New activities should not be assigned without providing the hours, but ways often can be found to replace some of the existing activities with the CRM procedures development work. Also, the development process should be kept on schedule; delays that can increase costs in time and resources should be anticipated. CRM procedures development can be the least expensive set of activities (as compared with ACRM training). It is important to demonstrate fiscal responsibility as the first step in the ACRM process.

Reporting to the Organization and Union

Part of a successful development process includes good two-way communication between the CRM procedures development team and the rest of the organization. If the development team

√ The organization must understand the objectives of the ACRM program before or as the development work begins.

includes representatives from key parts of the organization, the need for additional communication is substantially reduced. In all cases it is important that the organization understand the ACRM objectives and the team's plans before or as work begins, and it is equally important that proposed CRM procedures are presented to all key departments during the refinement step.

On the management side, it is important to communicate what the CRM procedures development team will accomplish and then schedule reviews to show management what has been developed. On the union side, it is important to consider involving one or more of the union representatives in the development of the procedures. At the very least, union representatives should participate in the review process. In general, union feedback should be solicited, and representatives should be kept informed as the procedures are developed.

Identifying Industry and Own Airline Needs

Defining the Scope of the Needs Analysis

The CRM needs analysis is used to identify the most important crew performance problems, and then determine what form of intervention will best correct those problems. For training departments that do not have data pointing to specific problems, it is useful to review industry-wide reports to learn where other airlines have crew performance problems. Industry sources of information can help locate those general problem areas more likely to be accepted by an airline that might otherwise be defensive about its own pilot population. The next subsection presents some sources that can be used for this purpose. Then, when several general areas have been identified, the airline can look at its own safety and training reports and start pinpointing its own specific problems in those areas.

If an airline has crew performance and trend data for the last few quarters or years or has good safety and incidents information, it does not have to spend much time at the industry level. Such airlines can focus on their own documented problem areas. Once the problem areas have been identified at the industry or own airline level, the airline can perform a preliminary analysis to better identify the source or sources of the problem. Once the problem or problems have been pinpointed, possible solutions, in the form of CRM procedure and/or training, should be evaluated.

The needs analysis can be planned based on an understanding of the airline's background, data, and endorsement of CRM performance. If an airline has good data and a strong CRM program, the needs analysis should require a smaller level of effort. If, on the other hand, the airline has no data and/or little experience with CRM, the needs analysis may require a substantial effort so that the results can be understood and accepted by the organization.

It should be remembered that the identification of CRM problem areas is ongoing, and it is vital that the airline identifies operationally significant problems at the start of the process. Once procedures to address those problems have been implemented, the airline should be alert to new crew performance problems that point to the need for additional procedures.

Reviewing NASA and NTSB Data, Reports, and Studies

Airlines may want to obtain a snapshot of industry performance problems before concentrating on their own airline. A number of sources provide general accident trends as well as specific incident information. Airlines that do not have detailed CRM performance data can use accident analysis reports to identify general problem areas, and then use specific aircraft accident and incident reports to obtain the details.

In 1994, the National Transportation Safety Board (NTSB) published a Safety Study that reviewed major U.S. airline accidents from 1978 through 1990 (see NTSB, 1994). The study was based on an analysis of performance and operational environment characteristics associated with 36 accidents and 1 incident, and their analysis showed patterns that can help an airline identify some crew performance problem areas. For example, in about 80% of the accidents the Captain was the pilot flying. In addition, where data was available, Captains had been awake on average 10.5 hours, and First Officers about 10 hours. The safety study analyzed both priory errors, such as aircraft handling, communication, and situational awareness, and the secondary error of monitoring/challenging. A review of the Safety Study can help airlines identify a number of problem areas related to their own operations.

Additional NTSB aircraft accident reports, such as the 1993 Uncontrolled Collision with Terrain at Guantanamo Bay, highlight some specific crew performance problems. Also, a large number of Aviation Safety Reporting System (ASRS) incident reports can be searched for specific operational characteristics such as type of aircraft, flight conditions, and type of anomaly. Once an airline has identified several problem areas, an ASRS database search is useful to determine the reported incidents in those areas (see Appendix G for some Sample ASRS incident reports).

Reviewing Airline Safety and Training Reports

With the problem areas identified, either from the analysis of industry or own airline trends, it is now time to take a closer look at the safety and training data. The purpose of this review is to pinpoint specific incidents or crew performance trends that will help the CRM procedures development team better understand the nature of the performance problem at their own airline.

Crew performance problem areas may be in several forms. Some problems can be grouped by phase of flight, such as runway incidents during taxi to takeoff. A review of this type of incident should provide the main causes for such incidents. For example, some type of distraction may be taking place, or there may be a lack of monitoring and backup. Other problem areas may be associated with a specific aircraft system or subsystem, and the review will help pinpoint causal factors. For airlines collecting more detailed CRM data, the problem area may be in decision making or situation awareness. This review should identify probable causes both proximal to the problem such as "task overload," and possibly more distal causes such as "failure to divide flying duties."

When existing data or reports do not point to a clear cause, the development team should consider interviewing one or more individuals from the department collecting the data or producing the report. The structured interview can be a more efficient way of collecting causal data and, if successful, should reduce or eliminate the need to conduct a survey such as that described in the next subsection.

The safety and training review process can be used to familiarize the training and safety departments with the ACRM program and the performance problem identification process. If structured interviews are conducted, good introductory material should be provided to inform the interviewee about the ACRM project and the identification of CRM procedures. The interview process should be designed to be a positive and informative experience, leaving the interviewee inclined to help in future activities.

Collecting Additional Needs Data From the Organization

After a review of what has been collected to this point, a decision should be made about the evidence for CRM performance problems. If the data and information can be used to establish several patterns of crew performance problems and there are likely causal factors, no additional data collection is required. If, on the other hand, the data do not show a pattern, or if there are a number of performance problems with no particular areas of concentration, it may be useful to collect additional data via some type of needs questionnaire.

This is a more focused effort than the organizational survey, but results from the organizational survey can be used in the design of the needs questionnaire. Those results can be used to determine which departments or groups of respondents were best able to provide CRM performance data. The organizational survey items also should be reviewed to see if any of them could be used in the needs questionnaire. If a questionnaire is required, there is a good chance that the airline does not have very detailed or conclusive CRM data. The needs questionnaire should be designed primarily for instructors, evaluators, and check airmen, and should investigate at least two areas: CRM performance problems by phase or sub-phase of flight, and performance problems by CRM topic or element area (see Appendix B for a sample Instructor/Evaluator Questionnaire).

The phase of flight portion of the survey can ask for crew performance problems and possible causes by phase or flight or sub-phase. Respondents can be asked to rank or rate each phase of flight based on frequency or severity of CRM performance problems. The CRM topics portion of the survey should ask about performance problems with crew decision making, inquiries and assertiveness, leadership/followership, and preparation/
planning. Again, respondents can be asked to rank, rate, and/or

provide specific information for each topic (see Appendix B). As with the data review, use this additional data collection effort to further involve the organization. Consider asking individuals from different departments to provide material for the questionnaire or have them review a draft. This helps to ensure that the survey will address a broader set of issues, including those that concern flight attendants, dispatchers, maintenance, and other key parts of the operation.

Identifying Primary Airline CRM Procedure Needs

The preceding activities will provide you with sufficient data to pinpoint the CRM problem areas and provide possible causes. This last step is used to choose those problems that point to the need for one or more CRM procedures. The primary determination to be made is whether a performance problem would be resolved best by training, equipment redesign, or through new or modified procedures. Working with airline needs is at a higher level than SOP; it involves understanding an airline's philosophy and policy to determine whether a procedural solution is the right one for that specific operation and organizational climate.

Determining whether a CRM procedure will alleviate a specific performance problem in a specific organizational environment requires reviewing all available data and information about the CRM problem. Industry data, whether from NTSB, NASA, the ATA, etc., can confirm the key issues, such as phase of flight, pilot flying, operational conditions, and general types of errors. Then airline-specific data can be used to pinpoint where a CRM procedure might be implemented. At this point it may be helpful to review procedures from other airlines to determine if they have integrated CRM at those key points in the SOP.

The exact nature of a procedure is not specified at this point, but the development team needs to specify where a procedure should be considered for insertion into SOP and be clear how a CRM procedure would substantially improve crew performance. The CRM procedures development team should be aware of the benefits and possible liabilities of each procedure they plan to add. Their role of identifying areas for new or modified procedures should be tempered with the realization that too many procedures, or ones in the wrong place, can be as dangerous as no procedures at all.

Example of a CRM Procedure Needs

√ CRM procedures may be embedded in most critical crew activities.

In order to pinpoint the types of briefing and workload problems that crews were having, one carrier sent out an instructor/evaluator questionnaire similar to that in Appendix B. They received back valuable information about the specific types of problems observed in recurrent training. For example, "Briefing - sets tone, calls for questions, participation encouraged, states how SOP deviations will be handled," was ranked as the number one or two problem by a number of instructors who provide the following remarks:

INSTRUCTOR ONE REMARKS: BRIEFINGS

Briefings I have seen are typically too "general" & often fail to specifically address how a problem should be handled. Also, I think the briefings to flight attendants are usually cursory and often totally inadequate.

INSTRUCTOR TWO REMARKS: BRIEFINGS

It is rare that any crew gave good briefings, therefore there were many unanswered questions.

This same group of instructor/evaluators identified "Workload/distractions avoided - Overload in self and others reports. Task prioritized to deal with primary flight duties first, recognize distractions," as another important problem. Their specific comments read:

INSTRUCTOR THREE REMARKS: WORKLOAD

Crews can often be distracted by an ATC call or some other non-related distraction. I think the main reason for this is failure to distribute and delegate specific duties.

INSTRUCTOR FOUR REMARKS: WORKLOAD

Crew usually performs too fast. PNF usually over loaded.

Specifying Gaps in Existing Procedures and Documents

With the problems, their location, and probable cause specified, the next step is to propose one or more procedures to address the problems. Working with the location and probable cause, it is possible to look at the existing briefs, documents, and procedures used in that immediate environment and determine if a change or addition would address the performance problem.

If nothing in the current SOP addresses the specific CRM performance problem, then there is a gap. It is also possible that an inconsistency in procedures is actually causing the problem. A problem with an existing procedure, such as distracting or confusing crews in certain conditions, may also be causing a problem. When reviewing existing SOP and documentation, look for problems with existing procedures and lack of consistency, as well as gaps, where the performance problem is not being addressed. Identify the procedural causes or obstacles to better crew performance.

Linking Needs to Procedures and Documents

For a specific performance problem, there may be several possible systemic causes, whether gaps or inconsistencies with existing SOP. The objective is to link the performance problem to the most likely cause in the operational system. That linkage should be based primarily on the need identified, based on the organizational environment. Although ACRM emphasizes the implementation and training of CRM procedures, developers should keep in mind that CRM procedures are not always the best solution. CRM procedures do offer a good solution when they match an organizations needs based on its philosophy and policies.

An example of modifying procedures is the case where crews may have problems with workload management when executing specific emergency procedures. The CRM procedures development team might consider a range of strategies to address that problem. First, the procedure in question could be reviewed

to determine if it could be simplified. The team could also look at the division of crew responsibilities. It may be that assignment of specific duties at the start of the procedure would help in managing workload. If such an approach is compatible or can be made compatible through policy modification, then that CRM procedure links well with the organization and has a good chance of improving the workload management problem.

Identify Points of Lower Workload for Normal and Abnormal Conditions

√ Look prior to the location of the performance problem when considering where to insert the procedure.

Looking beyond the exact location of the problem is key to finding the optimum solution. The point where the CRM performance problem surfaces may not be the best place to insert a procedure. In many cases, crew performance problems become apparent at times of relatively high workload, and adding a procedure at that point would only increase the crew's workload. The CRM procedures development team should look at points in time prior to the buildup in workload to identify periods of lower workload where a procedure would be more effective.

At the very least, the appropriate phase of flight should be examined to determine the points of lower workload. In a few situations the team may have to look at the previous phase of flight, especially if the performance problem tends to surface at the start of the landing phase. In such cases, the approach phase should be reviewed to determine if there are points of low workload where a CRM procedure could be inserted.

Developing Preliminary Procedures

With the location for the procedure identified, the next step is to consider the appropriate form of procedure. The main forms include briefs, calls, checklist items, guides, flows, non-normal procedures, and other forms of quick reference items. One of these forms should be sufficient to address most problems, but there may be cases where the integration of two forms is less intrusive and provides a better fit with the airline's SOP.

In selecting the form of the procedure, consider the airline's overall policy and approach to standardization. For example, some airlines place a greater emphasis on specific checklist items, and, consequently, that may be a good format to consider. Another airline may place greater emphasis on the flows and, for that airline, consider introducing a CRM element into the flows.

In a few cases, departing from an airline's policy will actually improve crew performance. When an airline places an emphasis on a specific format but that format is heavily used at the needed point in time, then consider integrating the CRM procedure into another form.

Once the form and location are set, the content of the procedure needs to be developed. For the first pass, all that is required is a verbal description of the procedure with examples of the type of wording that should be considered. In the next step, actual prototypes are developed.

Refining CRM Procedures and Media

Preparing Prototypes of Procedures

At this point, the CRM procedure development team has a written description of the preliminary CRM procedures. However, clear examples or prototypes are needed to communicate those procedures to other parts of the organization. The prototypes are more than just a written description of the procedures; the development team should prepare mockups of the sample checklists, guides, or parts of manuals to clearly show what these procedures will look like.

Prototype development is an important part of the refining process, where the development team interacts with a range of users to determine the best form and content for the CRM procedures. This last step should be iterative, with the feedback from each review being incorporated into the design to achieve one or more CRM procedures that will be adopted by the users to improve performance.

What is required for this step is a paper prototype of the actual checklist, brief guide, QRH, or other form of CRM procedure (see Appendix I for Sample QRH and Briefing Guide). Even if the final form will be an electronic display, such as the electronic checklists, it is not necessary to develop the prototype in the final media unless it can be done relatively easily and efficiently. The prototype should reflect the content and format of the proposed CRM procedure and, in some cases may include alternative representations. Documentation for the prototype should also include an explanation of why the CRM procedure is being proposed and what performance problem is being addressed.

Sample Prototype of Arrival Brief Procedure

The sample prototype does not have to be the finished product, but it does need to be presented in sufficient detail so that the development team can obtain meaningful feedback from instructor/evaluators and other important groups within the organization.

√ When reviewing a prototype, ask reviewers to give feedback in whatever form they are comfortable with

The following prototype was an earlier version of the Arrival Brief presented on page 3 of this Manual. In comparing the two, it can be see that a number of items were eventually added and the order of items to prioritize were changed. All of those changes were due to comments from those who had carefully reviewed the prototype. Encourage reviewers to mark directly on the prototype or generate a new example. In other words, give the reviewers freedom to provide feedback in whatever form they are most comfortable with.

PROTOTYPE
Arrival Brief

~**Statement of Condition**
Select and Prioritize:
Runway conditions
Low visibility procedures
Hydroplaning
Crosswinds/windshear
Terrain/MSA
Aircraft performance
Convective activity
GPWS/TCAS alerts
Fuel status/delays

~**Bottom Lines**
~**Backup Plan**

Eliciting Instructor/Evaluator and Other User Feedback

Two forms of feedback should be collected during this prototype refinement stage. The first form is feedback from the users, both pilots and instructors. This is detailed feedback, and is generally best collected first. Once the prototype has been refined through user feedback, the second form of feedback to be collected is the more general organizational feedback discussed in the next subsection.

Prototype presentations to the users allow the development team to collect informal comments during the presentation, and more formal, quantitative feedback through a form that can be handed out or administered during the user feedback sessions. The user feedback sessions should be designed and scheduled so that the development team can collect good data in an efficient manner. Ideally, airlines would be able to perform usability testing, where the procedures are evaluated in some operational or simulated context. That is not possible in most cases, so working with small groups provides a good alternative. If possible, the sessions should be scheduled for five to ten individuals who are likely to work well together. Working with too small a group (less than five) is less efficient, and the individuals are less likely to be stimulated by a wider range of comments. Working with too large a group (substantially more than ten) is more difficult to manage, and the feedback will likely cover a broad range of topics but not in depth.

In scheduling these sessions, there are a number of additional considerations. If instructors and crews are very busy and it is difficult to schedule a meeting, consider scheduling the prototype feedback sessions as part of other planned meetings. If resistance is likely from a specific group, consider having a separate session with that group addressing their issues as soon as possible within the feedback process.

The feedback sessions should have two parts. The first part is a more general presentation of the CRM procedures and their rationale, followed by encouraging users to ask questions and make general comments. Once the group has a good understanding of the procedures and their purpose, a form can be administered to ask for comments or ratings about the different aspects of the procedures. Items may include questions about the effects of a proposed procedure on workload, ease of

understanding the procedure, how the procedure interfaces with the rest of the SOP, possible problems, and how the procedure might be improved. In most cases the development team is less interested in consensus and more interested in individual feedback, so the forms should be completed individually and not as part of the group discussion.

If formal user feedback sessions are not possible, consider holding informal small group or individual sessions as pilots and instructors are available in the training center or flight operations. Obtaining meaningful feedback from a cross section of pilots and instructors, either formally or informally, is critical.

Presenting Prototype CRM Procedures to the Organization

Similar to the initial presentations, the development team should present the refined prototype CRM procedures to the essential elements of the organization. These prototype presentations serves three primary purposes: 1) familiarizing the organization with the procedures while collecting general comments during the presentation; 2) involving the key players in the organization in the development and feedback process; and 3) checking on other necessary changes in training, management or documents that should be made to fit the CRM procedure.

The primary objective is to explain the CRM procedures and encourage organizational feedback, which tends to be more general than the user feedback discussed in the previous subsection. The presentations are similar to those made to the users, but with fewer operational details and more process details. Emphasis should be on the need for the procedures, the development process, and the feedback process. Again, the development team should be prepared to collect the general comments made throughout the presentation. If difficulty in obtaining organization support is anticipated, the development team should consider designing a feedback form that can be distributed during the organizational presentations. The form should be designed to collect data in areas that may be at issue within the organization. The results of such a form should prove helpful in resolving specific organizational controversies or concerns.

Preparing Final Version of Procedures

Both the general and specific feedback should be considered in preparing the final version of the CRM procedure. With most

of the user comments and issues having already been made, this activity involves reviewing the general comments at the organizational level to determine whether additional changes are required. If there are a large number of general comments, consider grouping them into categories and then attending first to those categories with the greatest number of comments.

This can be used as an opportunity for final revisions and, in the case where general comments conflict with the more specific user data, to give more weight to the user feedback. Finally, if some issues cannot be resolved by an examination of the development process and feedback, consider presenting those issues to a small group of procedure design experts. This can be done through a letter and/or form showing the specific CRM procedure and asking for comments about the issues.

The final version of the procedure should be prepared in camera-ready format so they are in the precise form that will be sent to the printers or publishers. In addition to the Camera-Ready Copy (CRC), prepare a specification sheet stating on what material the CRC will be printed, what type of additional punching, tabbing, or binding will be used, and related specifications such as color and size of printing job.

Getting Fleet-Level Approval

The fleet-level approval process is an essential step that will vary depending on organizational requirements. If the organization has been included in the CRM procedures development process, fleet approval should be a routine matter of following the submittal process. This is one reason why it is important to have the organization and affected fleets involved from the beginning. Some considerations include whether it would be helpful to prepare a fleet-specific presentation, what additional materials should be included to help the fleet approval process, and who from the CRM procedures development team will be the point of contact for a specific fleet. In larger organizations, different approaches may be required for different fleets.

Informal contacts with fleet personnel can be very useful during this final activity in the development process. Supporters within the fleet can ensure that the approval process is kept on track and can help answer fleet-specific concerns or issues.

Guidelines for Identifying Own Airline Needs

1) The identification of CRM problem areas is ongoing, and to ensure the long-term success of the ACRM program, an airline should identify a few operationally significant CRM problems at the beginning of the development process.

2) Airlines that do not have detailed CRM performance data should use industry accident reports and incident summaries to identify general problem areas, and then the airline should use specific aircraft accident and incident reports to obtain the details.

3) When existing airline data or reports do not point to a clear CRM cause, the development team should consider interviewing one or more individuals from the department that collected the data or produced the report.

4) The needs survey should be designed primarily for instructors, evaluators, and checkairmen, and should investigate at least two areas: 1) CRM performance problems by phase or sub-phase of flight, and 2) performance problems by CRM topic or element.

5) The CRM procedures development team should be aware of the benefits and possible liabilities of each procedure they plan to add. The team's mandate to identify areas for new or modified procedures should be tempered with the realization that too many procedures, or ones in the wrong place, can be as problematic as not adding any new procedures.

Guidelines for Specifying CRM Procedures

1) For initial procedure development, an airline should first identify weaknesses in existing procedures and then review airline philosophy and policy to clarify those needs. Based on that information, an airline should then identify possible locations for the new procedure as different forms (e.g., briefs, checklists, etc.) are being considered. Once that is done, the airline should work on the procedure's content.

2) When reviewing existing SOP and documentation, look for problems with existing procedures, lack of consistency, and gaps, where the performance problem is not being addressed.

3) In many cases, crew performance problems become apparent at times of relatively high workload, and adding a procedure at that point could further increase workload. The CRM procedures development team should consider times prior to the buildup in workload to identify periods of lower workload where a procedure would be more effective.

4) The main forms of CRM procedures include briefs, calls, checklist items, guides, flows, non-normal procedures, and quick reference items. One of these forms should be sufficient to address most problems, but there may be cases where the integration of two forms is less intrusive and provides a better fit with the airline's SOP.

Guidelines for Refining CRM Procedures and Media

1) The procedure prototype development (working with a mock-up of the procedure) is an important part of the refining process where the development team interacts with a range of uses to determine the best form and content for the CRM procedures. The refinement step should be iterative with the feedback from each review being incorporated into the design to achieve one or more CRM procedures that will be adopted by the users and will contribute to performance improvements.

2) User feedback sessions should include five to ten individuals who work well together. Working with too small a group (less than five) is less efficient and the individuals are less likely to be stimulated by a wider range of comments. Working with too large a group (substantially more than ten) is more difficult to manage, and the feedback will likely cover a broad range of topics but not in depth.

3) If formal user feedback sessions are not possible, consider holding informal small group or individual sessions as pilots and instructors are available in the training center or flight operations. Meaningful feedback should be obtained from a cross section of pilots and instructors, either formally or informally.

4) Organizational presentations, generally made after user feedback sessions, are similar to those made to the users but with fewer operational details and more information about the ACRM program. Emphasis should be on the need for the CRM procedures, the development process, and the feedback process.

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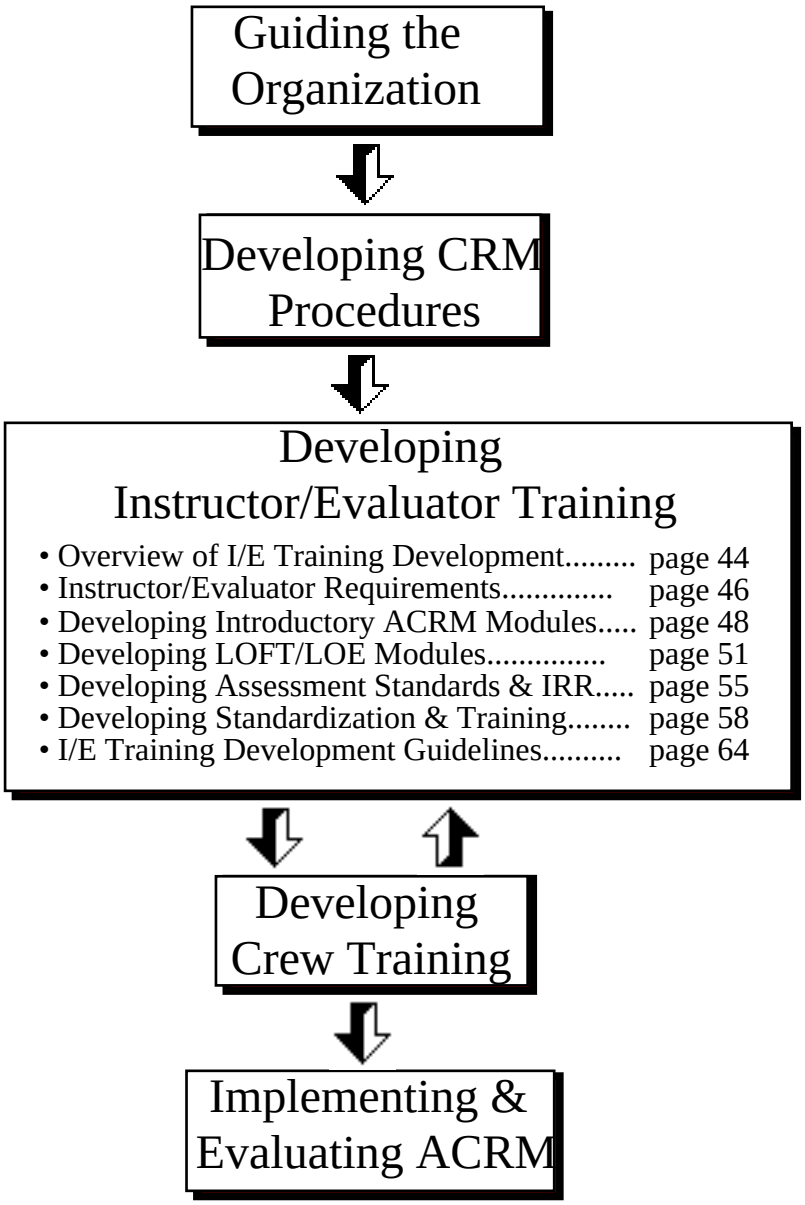
Part 4. Developing Instructor/Evaluator Training

Part 4 of the Manual presents the steps for developing ACRM instructor/evaluator training. This development process starts with planning, and goes through the development of the modules that are required to familiarize instructors with the CRM procedures and the assessment process that can provide a more systematic assessment of CRM performance.



Overview of Instructor/Evaluator Training Development

Instructor/evaluator training development may start ahead of or in parallel with the development of crew training. Instructor training generally requires a lower investment in time and cost compared to crew training with its larger number of trainees, so it is a good idea to develop instructor training first and use the lessons learned from that process in the development of the crew training. In addition, developing and conducting instructor/evaluator training can be a source of instructor feedback that can help tailor ACRM crew training.

This part has been written for training developers and those managing the development of instructor/evaluator training. It emphasizes the development of the CRM procedures and their assessment, pointing to some of the issues about developing a standard and reliable assessment program. Developing reliable and valid CRM assessment is an essential part of a successful ACRM program, but it is beyond the scope of this Manual. Therefore, references and additional information about Inter-Rater Reliability (IRR) is provided, but not discussed in detail in this part (see Appendix D for information on facilitating an IRR training workshop). Those requiring detailed information about the IRR process are urged to use Improving Crew Assessment, a workshop manual developed by George Mason University and the FAA in 1996 and available from:

Deborah A. Boehm-Davis
HFAC Program/ARCH Lab
George Mason University
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Planning Development Activities

When planning for the development of instructor/evaluator training, consider not only the development process but also the actual implementation of the training. Try to plan so that the ACRM training will be ready at the point when the instructors receive some part of their regular recurrent training. ACRM instructor training should be as integrated as possible with the rest of their training, and in many cases can be treated as a minor expansion of existing training rather than a substantial addition.

√ In planning, try to coordinate the training completion to coincide with scheduled instructor recurrent training.

In planning activities, consider how much time it will take the new or existing development team to develop the range of instructor training modules. If an airline is already using LOFTs/LOEs based on event sets and/or some form of IRR, the instructor training process can concentrate on the CRM procedures and maintaining (rather than establishing and maintaining) reliable crew performance assessment (see Appendix C for a sample instructor/evaluator training outline).

Several additional considerations can help in planning the development of instructor training. This development process can be viewed as a preliminary to developing the ACRM crew training, and as such, the instructor training does not need to be as highly refined as the crew training. Thus, parts of instructor modules may have options that can be presented for instructor feedback and outlines for instructor activities that can be refined through instructor input during the process of the training. Further, if the instructors are brought in from the beginning and encouraged to be involved in this "work in progress," they will start to take ownership, not only in their own training but also in the ACRM crew training they will ultimately need to conduct. Finally, some of the modules for instructor/evaluator training can be conducted in parallel, an approach that can expedite the development process.

Establishing an Instructor/Evaluator Development Team

The training department should work with the instructor/evaluator group or its representatives to develop the ACRM instructor/evaluator. In smaller airlines there may be only one or two people working as training developers, but it is generally better to have more individuals working as a team, especially if the airline needs to develop some of the modules in parallel.

As with the development of the CRM procedures, there are reasons for using a team approach to developing ACRM training. First, with a single person the entire effort is at risk if that person becomes unavailable. Further, it is unlikely that any single person has the full scope of expertise to develop the required modules. Consequently, with a small or one-person development team there is a greater need for outside expertise as well as a stronger possibility that the effort will encounter bottlenecks through the process.

For a complete package, the instructor/evaluator training development team should develop introductory ACRM modules, LOE/LOFT briefing/debriefing modules, assessment modules, and standardization and recurrent training modules. Having someone from the CRM procedure development team can be most helpful in preparing the introductory modules; while experienced instructors and evaluators can help with the LOFT and assessment modules. Working with a team of different experts can facilitate this development process and allow for parallel development efforts. A coordinated development and review process can ensure that the different individuals stay informed about the issues and progress across all modules.

Coordinating with Instructor and Training Department Schedules

The development of instructor/evaluator training should be coordinated with the implementation of the training. ACRM training should be completed in time for scheduled instructor recurrent training. ACRM instructor training should be integrated with recurrent training and should be designed to have as small an increase in required hours as possible. With careful planning, ACRM modules can replace or augment existing CRM recurrent training.

A realistic timeline is required to ensure good coordination. A preliminary timeline should be developed based on instructor/ evaluator training schedules. The development team members can then be selected so they can meet planned deadlines. Once the team membership has been finalized, the timeline should be reviewed to ensure it is compatible with member schedules and, if necessary, add team members. The instructor/evaluator training development team should establish and maintain a good relationship with the person in charge of scheduling instructor recurrent training to ensure a high level of coordination.

Instructor/Evaluator Requirements

√ SMEs should represent all stakeholders in the development process.

Selecting Subject Matter Experts

The Subject Matter Experts (SMEs) may come in part from the instructor/evaluator group as well as from the fleets and the standards group. SMEs with extensive involvement in the training development should be part of the development team.

This approach can help insure both their greater involvement and their availability throughout the process.

The number of SMEs should be as small as possible while making sure the SMEs represent all of the topics that will be covered under the ACRM training. If this is the first time an airline has developed training in areas such as LOFT/LOE design or IRR modules, consider looking for an SME from another airline or developing those modules jointly with another organization. Joint development is far preferable to borrowing or using a module developed for another organization. Borrowed modules rarely address the operational needs of an airline and the development team may not understand the material sufficiently well to modify it to meet own airline needs.

Scheduling Instructor/Evaluator Training

Training of the instructor/evaluators is the key to combining all ACRM elements into a successful training and assessment process. For smaller airlines implementing this approach to crew training and assessment, the new methods can seem complicated and difficult to implement. Therefore, it is important to identify a few basic training areas and integrate them with existing CRM and technical training. For the first year, the main focus of the instructor/evaluator training can be the new CRM procedures, the LOE, and the use of an LOE gradesheet or worksheet.

The first part of the training can be designed to provide instructor/evaluators with an understanding of the CRM procedures and how those procedures should contribute to CRM skill development. The next part can concentrate on the LOFT/LOE, and how to brief, administer, assess, and debrief it. The final part of the training should help instructors standardize the assessment process. As much as possible of these three areas should be incorporated into existing recurrent training. Further, where possible, instructor/evaluators should be scheduled for this training as part of their normal recurrent training. The first year may require additional and special training, but a substantial part of ACRM training can be integrated with existing training.

Ongoing Standardization Requirements

A major departure from traditional instructor/evaluator training is the requirement for ongoing training and standardization. In order that the airline has confidence in the crew performance data, instructor/evaluators need to have

periodic checks to determine whether they are within the airline's training and assessment standards. This involves group meetings or short workshops, with the instructors assessing crew performance, often videotaped LOE or LOFT sessions. These standardization sessions can include instructor discussions of issues they have faced in making assessment.

Consider turning the standardization requirement into a positive attribute of ACRM. This can be done by encouraging instructor/evaluators to take a team approach to crew performance assessment. The evaluators or check airmen now have a support team to help them develop and maintain the standards. Instructor/evaluators must control their standardization meetings and turn these sessions into positive experiences where meaningful tips are exchanged and standards are further clarified. Finally, encourage the development of group consensus when clarifying standards or settling specific assessment issues.

Developing Introductory ACRM Modules

Background and Theory of CRM Procedures

This first set of modules, normally one or two modules, should introduce the CRM procedures and how they work to enhance crew. The initial module can explain how airlines have been very good at training technical flight skills for some time. However, they are only now in the process of identifying and developing training for the CRM skills. This module can start by outlining the status of CRM training and its evolution toward skill-based training.

Traditionally, CRM has emphasized an awareness of pilot attitudes and personality factors. More recently there has been a shift toward trainable skills that help crews in the management of resources. Currently, there is no complete listing of required CRM skills, but the CRM procedures development is a first step in identifying the key CRM skills. Over the next few years, airlines will introduce specific procedures that will help crews to practice and perfect specific CRM behaviors. At present, the instructor/evaluator training makes general references to CRM skill training, but over the next few years that training will become much more precise as the specific CRM skills required for CRM procedures are identified.

√ General CRM principles have been translated into operational procedures.

Another of the initial instructor/evaluator training modules should explain that the procedure development process has translated CRM principles, something very familiar to the instructors, into operational procedures, providing the airline with an opportunity to emphasize some important CRM actions that should be taken by all crews. This explanation should include these points: 1) The development of these initial CRM procedures is the first step in an ongoing process that will result in a complete set of CRM procedures for all crews. 2) The current CRM procedures were developed by a team using a set of systematic steps including the identification of airline needs, specification of the procedures, and the refinement of the procedures. 3) Instructor/evaluators were involved in the procedure development process and will be involved in the ongoing identification and specification of additional procedures.

Explaining Characteristics of New Procedures

√ When presenting a procedure, include its rationale and an instructor activity to insure their understanding.

The specific form and rationale for each CRM procedure should be explained in the introductory modules. This should include a presentation of why the specific procedure was developed based on airline needs incident data. The procedure, in its actual form, should then be presented, highlighting each of its main features. Finally, a set of questions or other form of instructor activity should be included to ensure the instructors understand all the main elements of the new CRM procedure.

For example, if the normal checklist has been expanded to include one or more briefings, the nature of the briefings and their effects on crew performance should be presented. One might explain that briefings were shifted toward lower workload times during the takeoff and approach phases of flight, and that all briefings were restructured to contain effective information relevant to the phase of flight.

At some point in the module consider repeating the main features of the new CRM procedures. For example, in the case of new briefings one might itemize the following characteristics:

- The new briefings take place at lower workload times during the course of a flight.
- They are structured to contain relevant information specific to the relevant phase of flight.
- These briefing have become part of SOP by being included in the normal checklist.

Training Implications of CRM Procedures

√ Each new CRM procedure has implications for CRM skill training.

Each of the new CRM procedures has implications for crew training because it places an emphasis on the crew's development of specific CRM behaviors in the operational context. Because of this emphasis it is important for instructor/evaluators to have an understanding of the nature of skill performance and its implications for the training of these new CRM procedures.

CRM skill training can be a complex topic, and many of its issues have yet to be resolved by the aviation research community. Still, there are some basic guidelines for CRM procedures and skill training that should be imparted to instructor/evaluators:

- Skills should be trained in a task-specific context.
- Skills training requires some degree of practice that is followed by specific feedback.
- Skill training can positively affect both technical and CRM performance.
- CRM skill training and assessment should be emphasized throughout ACRM crew training

Assessment Implications of CRM Procedures

√ The new CRM procedures have profound implications on how crew performance is assessed.

In addition to implications on training, the new CRM procedures have profound implications on the way that crew performance is assessed. To provide a complete picture of crew performance across an airline's operations, two different forms of crew assessment can be used.

First, a detailed simulator-based method of assessment can be developed to collect crew performance data both before and after the ACRM crew training has been implemented. This form of crew assessment, based on the LOE, allows for the collection of substantial crew performance data within a carefully designed and controlled environment. This comprehensive method of crew assessment should be augmented with a second type of assessment; the less structured Line Check. Line Checks are not as controlled as LOE sessions, but they provide an efficient method for collecting more general crew performance data.

New standards will have to be developed for the assessment, and instructor/evaluators should be told about their involvement in setting up this more systematic form of crew assessment. Instructor/evaluators should also be reminded of the shift from the stand-alone, individual check airmen to the team approach to evaluation. The instructors should work as a team to support each other in the development and maintenance of this more reliable form of assessment.

Developing LOFT/LOE Modules

Briefing the LOFT/LOE and ACRM

ACRM training emphasizes the use of LOFT and LOE in the training and assessment of crew performance. These modules about the instructor/evaluator conduct of the LOFT/LOE should provide the knowledge and some of the preliminary skills required to:

- Brief the LOFT/LOE.
- Administer the LOFT/LOE.
- Assessing crew performance.
- Debrief the LOE.

√ Crews should be briefed to act as they would in line operations.

Instructor/evaluators should be provided the specific information to brief the LOFT and/or LOE that will be used for that year in training and assessing the effects of the new CRM procedures. A standard briefing and standard administration of the LOFT/LOE are very important because lack of standardization can affect crew performance. The role of the instructor and crews should be established during this briefing. Inadequate briefings often set the stage for problems that later interfere with operational realism.

The most common difficulty is a failure to convince the crew that the instructor/evaluator is not present as an instructor during the simulation. Rather, his or her role is to provide communication as ATC, company dispatch, flight attendant, maintenance, etc., as needed. Instructor/evaluators should brief crews to act as they would in a line operation, which includes dealing with everyone, including the Flight Attendants, as if they were actually present throughout the session.

In addition, consider providing instructor/evaluators with training on how to brief crews about some of the following topics:

- Overall objective of LOFT/LOE.
- The role of the new CRM procedures in the LOFT/LOE.
- The role of the instructor in the LOFT/LOE session.
- What is expected from the crew.
- The nature of crew performance and its assessment.

Administering the LOFT/LOE

√ Careful scripting of the scenario details lead to LOFT/ LOE session effectiveness and realism.

The effectiveness of a LOFT/LOE relies on script detail and proper administration of that script during the simulator session. To accomplish this, the scenario should be carefully scripted, including ensuring that all ATC communications use correct terminology, timing, and routing. Precise communication scripting will enhance the realism of the session. Providing instructor/evaluators with one document to use in the simulator, and a more detailed document, such as a guide, to help them learn the new scrip and the rationale behind its key elements, is very useful.

If an airline decides to develop a guide, instructors should be provided with and trained on how to use it. The LOFT/LOE guide is an essential training and reference document that can provide detailed information on:

- Events and conditions for that phase of flight.
- Alternate crew decisions besides the “expected” response.
- Event set number, phase of flight, communications. (including frequency and radio call), key events, and expected actions).
- Detailed success criteria such as CRM performance criteria.

Other topics could be included in this module. One important topic is how to establish and maintain operational realism throughout the session. A primary goal of LOFT/LOE administration is to allow the crew to perform as they would in an actual line flight given the same set of circumstances as those developed in the scenario. Flight realism is supported through routine activities such as flight paperwork, manuals, and communications.

Another topic could address the need to be ready to accept and manage alternate courses of action that the crew may wish to follow while remaining as unobtrusive as possible within the physical limitations of the simulator. Some airlines have included appendices either in the guide or the LOFT/LOE script that present alternative crew actions and administrator considerations.

Assessing Crew Performance by Event Set

√ Event sets help evaluators pinpoint key aspects of crew performance.

An important element of LOFT/LOE assessment under ACRM is the use of event sets to help instructor/evaluators pinpoint key aspects of crew performance (see Appendix F for some specific event set topics). Instructor/evaluators should be trained in the role of the event set as a tool to administer the LOFT/LOE session and as the primary unit of crew performance assessment in an LOE (Hamman, Seamster, Smith, & Lofaro, 1993). The event set is a refinement of the concept of event and is an integral part of training as well as assessment. The event set is made up of one or more events, including an event trigger, supporting conditions, and distracters. The event trigger is used to fully activate the event set. Supporting conditions are other events used primarily to maintain event set realism. Finally, a distracter may be inserted within the event set time in order to divert the crew's attention or to increase their workload.

If instructors are not experienced in the use of event sets, they should be provided with information about the role of event sets in assessing crew performance. Event sets divide a LOFT/LOE session into a set of manageable elements leading to a structured evaluation process based on systematic and reliable observations and ratings. Each event set is designed to concentrate on specific CRM and technical training objectives and allows the instructor/evaluator to concentrate on a limited range of observable behaviors. There is evidence (Seamster, Edens, & Holt, 1995) that assessments made at the event set level result in more reliable assessments compared with the overall assessments that have been used at airlines.

Event sets are carefully design to support the instructor and evaluator functions. Although a LOFT/LOE session is more than just the sum of its event sets, a clear understanding of a scenario's event sets is essential to a standard assessment of crew performance.

Debriefing the LOFT/LOE

Debriefing is an essential part of the LOFT/LOE and very important in the training of CRM procedures. The modules addressing LOFT/LOE debriefing should cover the following topics:

- How an instructor should state the debriefing agenda, soliciting agenda topics from the crew on items they would like to cover.
- How an instructor can set time limits and ask the crew for their overall self-appraisal of the flight.
- How to guard against making the crew defensive and exercise patience in directing the crew to the main points of the session.
- How to integrate technical and CRM feedback into the debrief.
- How to ensure that all crewmembers participate in the discussion and effectively draw out quiet or hostile crewmembers.
- How to provide a clear summary and recap of key learning points.

Additional tips and techniques to help instructor/evaluators in the debriefing process can be included. For example, explaining how the instructor/evaluator should operate as a resource to crewmembers by highlighting different portions of the LOE that may be suitable for review, critique, and discussion can be useful. Tips on how to ensure that the discussion is led by the crewmembers can also be helpful.

LOFT/LOE debriefing has been the topic of some recent NASA and FAA funded research. One of the products of that research has been a training manual, Facilitating LOS Debriefings (McDonnell, Jobe, & Dismukes, 1997), available from NASA Ames Research Center:

Key Dismukes
NASA Ames Research Center
MS-262-4
Moffett, Field, CA 94035-1000

Standardizing Crew Assessment and Inter-Rater Reliability

Another important element of ACRM instructor/evaluator training is developing and maintaining superior assessment standards. The module that addresses this set of topics should explain that LOFT/LOE crew performance assessment is based on observations by a trained instructor/evaluator (see Appendix D for facilitating an IRR training workshop). The reliability of those observations is critical to the airline in determining the performance level of its crews as well as the organizational training needs. Reliable ratings mean that all raters provide the same scores or grades to the same performance, both technical and CRM. Instructor/evaluators need to constantly maintain a high standard of reliability, something that can best be developed in a group setting. Without this high level of reliability, the crew performance score or ratings may say more about the instructor's biases than about the crew performance being assessed.

√ There is a high probability of rater bias, and that bias should be addressed through training.

There is a high probability of some rater bias when making crew performance assessments. The most common forms of bias that can be addressed through instructor/evaluator training are central tendency, the halo error, and leniency error. One of the most common biases in LOFT/LOE performance rating is that of central tendency, where the rater tends to rate most performance toward the middle, average, or standard point on a rating scale. The halo error occurs when raters are biased by an overall positive or negative impression of the crew rather than specific performance elements. Without training in assessment standards and IRR, raters may develop a bias toward leniency where they unintentionally rate crew performance as being higher than it really is. The instructor/evaluators should be informed of these biases and provided with training to avoid them.

Developing and Maintaining General and Specific Standards

The ACRM process supports the use of both general and specific standards for the assessment of crew performance. General standards include a standard rating scale used throughout the airline and guidelines for how to assign overall ratings to the

individual and crew performance. Specific standards are associated with observable behaviors and technical procedures. Instructor/evaluators should be informed of and trained in the use of both sets of standards.

√ General standards can help improve a group's use of the basic assessment parameters.

A standard rating scale can be used across the full range of evaluation environments, from simulator sessions to line checks. This is important because using a standard rating scale can reduce the training time required to familiarize instructor/evaluators with different assessment instruments. Its use can also increase the amount of practice instructor/evaluators have with that scale, resulting in better instructor/evaluator assessment skills. The specific points of the standard rating scale should be presented, along with examples of how to rate a range of performance using that scale.

A second general set of standards includes how to formulate overall individual and crew ratings based on the ratings of specific technical and CRM items. Some airlines have general standards that address what to do in such cases as when an individual gets one unsatisfactory rating. Other airlines develop general standards for event set failure. Such standards (e.g., "three strikes and you're out") may apply to the LOFT/LOE sessions rather than specific event sets. When an instructor/evaluator group shows low rater reliability, in addition to more training there may be a need for better general standards to help the group work together on the basic steps of the assessment process.

Specific standards should also be established for all rated elements that may cause problems or may be new to the instructor/evaluators. In most cases this will include standards for the new CRM procedures. The standards are presented to the instructor/evaluators as criteria of performance that signifies the expected level of individual or crew performance. Instructor/evaluator training may start with the standard for certain elements anticipated to cause rater problems. In this process the development team should not overlook the technical items, which may have standards that for some reason are difficult to interpret or rate. In providing specific standards, developers should concentrate on the criteria for "standard performance" (note that standard performance is not the *average* crew performance, rather, it is the *expected* crew performance). If instructor/evaluators are still having problems rating a specific element, the criteria for unsatisfactory performance should be added. In most cases, criteria for Above and Below Standard can be inferred from the Standard criteria.

Understanding the Components of Inter-Rater Reliability (IRR)

√ If the airline has not implemented some form of IRR training, it should develop a module that introduces IRR and its components.

If the airline has not implemented some form of IRR training, IRR should be presented as a group process. This should begin with an overview of the IRR process, followed by the critical nature of crew assessment, the IRR measures, the assessment form or worksheet, and rating scales and examples of the criteria for each point on the scale. The module should explain that IRR training needs to take into account key organizational elements. This should include the individual instructor or rater, the pilots being assessed, the instruments and scales being used, the specific values and implications of the rating scale, the types of analyses used on the data, and the organizational use of the results.

Consideration must also be given to organizational and regulatory environment. Airline philosophy and policy must support, or may have to be revised to support, developing a high level of instructor standardization. IRR training was developed to provide a more reliable technical and CRM assessment, and consideration needs to be given to the entire system and organization when planning for IRR training.

IRR training may include the use of one or more measures to determine the key elements of rater reliability. The main IRR measures and their functions are:

- Systematic Differences: Shows whether a rater is substantially or significantly above or below the group.
- Congruency: Shows the general relationship between an individual's ratings and group ratings by comparing the score distribution of individual rates with that of the entire group.
- Consistency: Shows the degree to which rater scores correlate or shift in unison.
- Sensitivity: Shows the degree to which raters can discriminate small differences in crew performance.
- Agreement Index: Shows the degree to which raters have the same rating for a specific item or performance.

Additional IRR information may be found at the end of the first page of this part and in Appendix D.

Working with IRR Data Under AQP

With the advent of AQP and its requirement for a more systematic LOFT/LOE design and assessment process, the aviation industry needed a more robust form of reliability training. IRR training has been developed to meet the data collection requirements under AQP that reduce or eliminate the subjective nature of CRM rating while providing airlines with consistent data that can be compared over time. Consistently reliable data are very important because they allow organizations to conduct historical analyses of crew performance.

IRR training has been developed to provide airlines with a more precise, longer-term form of crew performance assessment. The IRR approach compares ratings to organizational standards based on the development of benchmark data. This allows airlines to maintain a systematic rating of crew performance over time, even as instructor/evaluators are replaced, new LOFT/LOEs are developed, and new CRM procedures are added to the SOP.

A high level of reliability is required for airlines to be able to make sound decisions about the state of crew performance. AQP allows airlines to modify their training programs based on an accurate assessment of crew performance at specific points in time. If a particular form and cycle of training produces Above Standard results, it may be possible for that airline to extend the training cycle for that content. Conversely, if the crew performance data show specific deficits, the airline will be required to strengthen those training areas. In order to make such strategic decisions, the airlines and the FAA require highly accurate data.

Developing Standardization and Training Modules

Working with Videotapes of Real Crew Performance

A key to developing and maintaining standard assessment of crew performance is to train and evaluate assessors using videotaped crew performance. Videotapes allow a group of instructors to observe and rate the same crew performance, but require that the tapes be prepared using some specific guidelines.

√ ACRM assessment training requires tapes of actual crews flying the actual LOFT/LOE.

Traditionally, crew performance videotapes have been developed with pilots acting a part rather than performing naturally. This results in tapes of a stereotypic good crew or bad crew, what some call, "The Good, the Bad, and the Ugly." What is required under ACRM is a substantial departure from that kind of tape. Standardization tapes should represent the types of behaviors evaluators will see during real simulator sessions. From experience, one of the best ways to prepare such videotapes is to work with real crews, flying the actual LOFT/LOE for that year in a representative simulator without the benefit of coaching or preparation (see Appendix E for videotaping considerations).

There are a number of reasons for these guidelines. First, consider working with real crews to capture actual crew performance, the type that instructor/evaluators are likely to observe in the simulator. This means avoiding working with other instructors because they are likely to model a training department form of behavior rather than realistic line behavior. Second, if scripted videotapes are used, instructors are likely to notice the acting and not pay attention to the actual crew performance. Third, by working with the upcoming LOFT/LOE, instructors learn about the new script as well as the specific standards that they will be using. Following these guidelines makes the training or standardization session substantially more relevant for the instructor/evaluators.

Finally, when using these tapes in the standardization process, the instructor/evaluators should be informed that the crew performances they will observe are real crew responses to the LOFT/LOE session, and that no coaching was provided to these crews to act either as superior crews or below standard crews. The crews were instructed to act as they would on the line. Further, it should be explained that the tapes were made this way to capture the types of behaviors that evaluators are most likely to see during actual LOE sessions.

For good IRR results, both the audio and video quality of the videotape must be excellent. Ensuring audio quality may require auxiliary microphones and control of extraneous noise. Ensuring video quality may require a special light-sensitive camera, auxiliary lighting and careful adjustment of panel lights and other ambient light sources (for more details, see Appendix E). The objective is to capture as much detail of the crew performance as possible on the video tape while not interfering with the simulator environment.

Developing and Refining Gradesheets

A LOFT/LOE gradesheet or worksheet can be an important tool in achieving standard crew performance assessment. A number of guidelines should be considered in the design of these gradesheets. The gradesheet should be organized around event sets; that unit of assessment which helps instructors to standardize the implementation as well as the assessment of LOE sessions. The gradesheet should use a standard rating scale and should depict that scale on every page. The gradesheet should include observable behaviors or topics that have been carefully identified and validated as being central to successful performance on a specific event set. The well-designed gradesheet simplifies what could be a relatively complex process: providing the instructor with debriefing areas, both the CRM and technical elements for each event set.

After ACRM instructor/evaluator training, the LOFT/LOE is the main tool used to guide the assessment process. The development of that worksheet should be based on the above guidelines as well as a number of working sessions with the instructor/evaluators. The training development team may want to prepare the first draft of the gradesheet based on event set samples from other airlines or some of its own efforts. Once the draft is prepared, it should be given to the instructor/evaluator group for comments and feedback. Some of the instructor comments will point to the need for a particular form of training, while other comments may point to needed changes in the gradesheet. This form of instructor/evaluator feedback is essential to the development of a viable gradesheet. The following two examples show the refinement process moving from a draft set to more targeted observable behaviors.

DRAFT CRM OBSERVABLE BEHAVIORS
SITUATION AWARENESS OBSERVABLE BEHAVIORS
Crew discusses WX at destination and alternate prior to approach
Crew discusses terrain prior to approach
Crew manages workload and distractions
Crew manages time and resources effectively
OTHER OBSERVABLE BEHAVIORS
Crew discusses relevant airport information and performance issues
Crew states bottom lines for arrival/approach

FINAL CRM OBSERVABLE BEHAVIORS FOR GRADESHEET
SITUATION AWARENESS OBSERVABLE BEHAVIORS
Crew discusses WX at destination and alternate prior to approach
Crew discusses terrain prior to approach
BRIEFING OBSERVABLE BEHAVIORS
Crew discusses relevant airport information and performance issues
Crew states bottom lines for arrival/approach
Crew states back-up plan for arrival/approach

Providing Instructor/Evaluators with Immediate Feedback

Instructors/evaluators should be provided with accurate and immediate rating feedback from the start of their assessment training through the standardization sessions. The first rating sessions may take place in a larger group using taped pilot performance to present the crew behavior that must be rated. The group results may be presented via a spreadsheet and charts showing both individual and group data along with appropriate benchmarks or standards the group is trying to meet. This feedback is an essential part of IRR training and should take place as soon as possible after the ratings are made.

As assessment training progresses, it is advisable to work in smaller groups with fleet-specific performance as the object of the ratings. One reason for the smaller group is that it allows the individuals to start working as a team. This is something that can be done with 5 to 15 instructor/evaluators, but is much more difficult to achieve with substantially larger groups. Small group feedback should be provided on the agreement for each item being rated along with the average agreement for all items. In addition, small group feedback should include the systematic differences, average congruency, and average consistency.

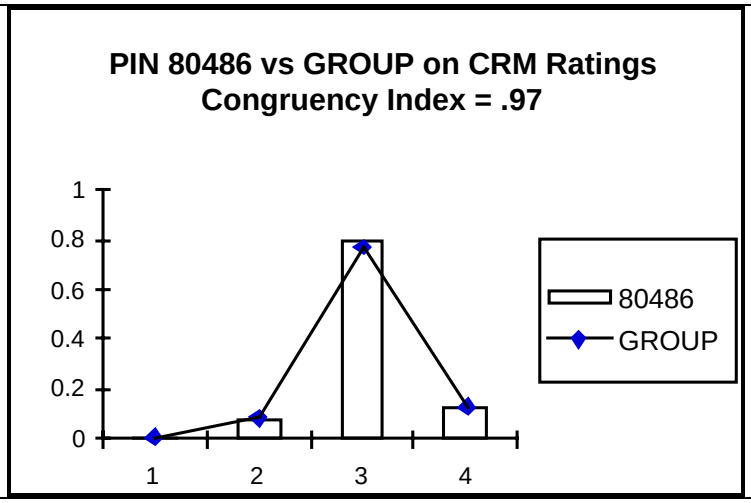
When working with small groups and assessment teams, individual feedback is also important. A smaller group permits greater attention to be paid to individual feedback. Individual feedback includes systematic individual differences, individual congruency with the group's distribution, individual consistency with other raters, and sensitivity to small performance

differences. Discussion should focus on the individual and group problems for each of these measures.

Using this feedback approach over several rating sessions and providing feedback before going on to the next session can reduce the divergence found in many raters, and the measures allow the instructors to concentrate on the quantitative components of this process. After individual and group feedback is provided and explained, instructor/evaluators should be encouraged to develop new rating rules and strategies. This cycle of practice, feedback, and discussion allows the participants to improve their reliability, and should continue until corporate IRR benchmarks have been met. After that, the methods are used periodically in the standardization sessions.

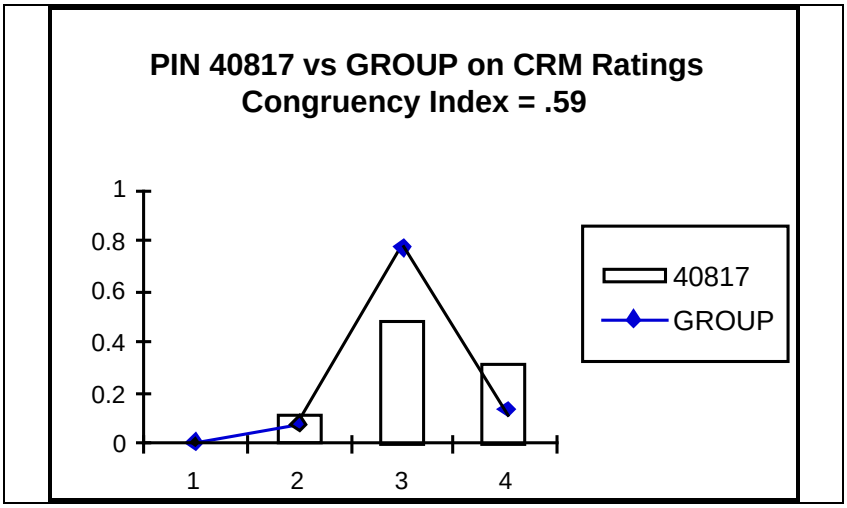
√ ACRM assessment requires ongoing training and standardization.

One type of feedback that can be helpful when some of the instructor/evaluators depart from group norms is to provide individuals or a small group with Congruency graphs. In the following two examples, the first graph shows a rater who closely mirrors the group averages. With a Congruency Index of .97, this instructor has rated CRM the way the rest of the group is rating with about 80% of the ratings as "3" and about 15% as "4."



This second graph shows the Congruency of a rater who tends to be more generous than the group. This rater has given close to 55% of ratings as "3" and about 35% as "4." With "4" representing "Above Standard," this rater is giving higher marks in CRM. If these results were based on a large number of observations, then this rater is departing from the group, and the team should work to help this rater understand the criteria for

"Standard" and "Above Standard." Immediate feedback allows individuals and the group to spot these differences and to address them as a team before they become established rating practices.



Planning and Establishing Standardization Sessions

ACRM assessment requires ongoing standardization. Standardization is required so the airline will have confidence in the crew performance data and its indications about CRM procedures. During training development, plans should be made for scheduling at least two standardization sessions. As a rule of thumb, if it is anticipated that instructor/evaluators will have few difficulties with the new approach to assessment, two sessions, spaced about three months apart, should be planned. If substantial difficulties are anticipated it would be better to plan to hold the two sessions one month apart. Once an airline has collected data from the two sessions it can determine whether the frequency of the standardization sessions should be increased or decreased. Those few airlines that presently collect standardization data tend to work with an annual cycle. Twelve months is far too long to go without collecting standardization data, especially when introducing a new system.

Instructor/evaluators should be encouraged to take an active, team approach to these standardization sessions. The instructor/evaluators should see these sessions as an essential part of maintaining their assessment standards. One way to ensure this is to encourage the instructor/evaluators to control the standardization sessions and ultimately to determine their own schedule and length of cycle between sessions.

Guidelines for Planning and Developing Introductory ACRM Modules

1) When planning for the development of instructor/evaluator training, consider not only the development process but also the actual implementation of the training. Try to plan so that the ACRM training will be ready at a point where instructors receive scheduled recurrent training. ACRM instructor training should be as integrated as possible with the rest of their training and should be treated as a minor expansion of existing training rather than a substantial addition.

2) One initial instructor/evaluator training module should explain that the procedure development process has translated CRM principles into operational procedures, providing the airline with an opportunity to emphasize important CRM actions that should be practiced by all crews.

3) When presenting CRM procedures to instructors it should be explained how each procedure was developed based on airline needs and incident data. The procedure, in its actual form, should then be presented, highlighting each of its main features. Finally, consider including a set of questions or other form of instructor activity to ensure that the instructors understand the main elements of the new CRM procedure.

4) Each new CRM procedure has implications for crew training because it places an emphasis on the crew's development of specific CRM behaviors in the operational context. Because of this emphasis on CRM skills, instructor/evaluators should have an understanding of the nature of skill development and its implications for the training of these new CRM procedures.

Guidelines for Developing LOFT/LOE Modules

1) The effectiveness of LOFT/LOE sessions depends in good part on script detail and proper administration of that script during the simulator session. The scenario should be carefully scripted with ATC communications using correct terminology, timing, and routing. Precise ATC communication scripting will also enhance session realism.

2) LOFT/LOE briefings are an important part of the session, and instructor/ evaluators should brief crews to act as they would in line operations dealing with everyone, including the Flight Attendant, as if they were actually present throughout the LOFT/LOE.

3) Event sets should be used in the development of LOFT/LOS scenarios under an ACRM program to help instructor/evaluators pinpoint key aspects of crew performance for each segment of the flight. Instructor/evaluators should be trained in the functions and use of event sets.

Guidelines for Establishing Assessment Standards

1) When an instructor/evaluator group shows low inter-rater reliability, in addition to more training there may be a need for a better rating form or clearer rater standards to help the group work together on the basic parameters of the assessment process.

2) The instructor/evaluator group should establish specific standards for elements to be rated. This is especially true for elements that may cause problems or are new to the instructor/evaluators. In most cases the new CRM procedures should have explicit standards to reduce rating difficulties.

3) When making crew performance assessments there is a high probability of rater bias, and the common forms of bias that should be addressed through instructor/evaluator training include central tendency, halo error, and leniency error.

4) If the airline has not already implemented some form of IRR training, IRR should be presented as a group process beginning with an overview of IRR, followed by the critical nature of crew assessment, the IRR measures, the gradesheet, rating scales, and examples of the criteria for each point on the scale.

Guidelines for Developing Standardization and Training Modules

1) Under ACRM, a substantial departure from a scripted and acted videotape is required. Consideration should be given to preparing standardization tapes working with real crews flying the actual LOFT/LOE for that year in a representative simulator without the benefit of coaching or preparation.

2) Instructor/evaluators should be provided with accurate and immediate rating feedback from the start of their assessment training through standardization sessions. The first rating sessions may take place in a larger group using spreadsheets and charts showing individual and group data along with appropriate benchmarks that the group is trying to meet.

3) After individual and group feedback is provided and explained, instructor/evaluators should be encouraged to develop new rating rules and strategies. This cycle of practice, feedback, and discussion allows the participants to improve their reliability, and should continue until group benchmarks have been met.

4) Under ACRM assessment there should be ongoing training and standardization to establish confidence in the crew performance data, its indications about CRM procedures, and the procedures' effects on overall crew performance.

5) Instructor/evaluators should be encouraged to take an active team approach to standardization sessions. Instructor/evaluators should see these sessions as an essential part of maintaining their assessment standards. One way to ensure team involvement is to encourage instructor/evaluators to control the standardization sessions, and ultimately to determine their own schedule and length of cycle between sessions based on their rating performance.

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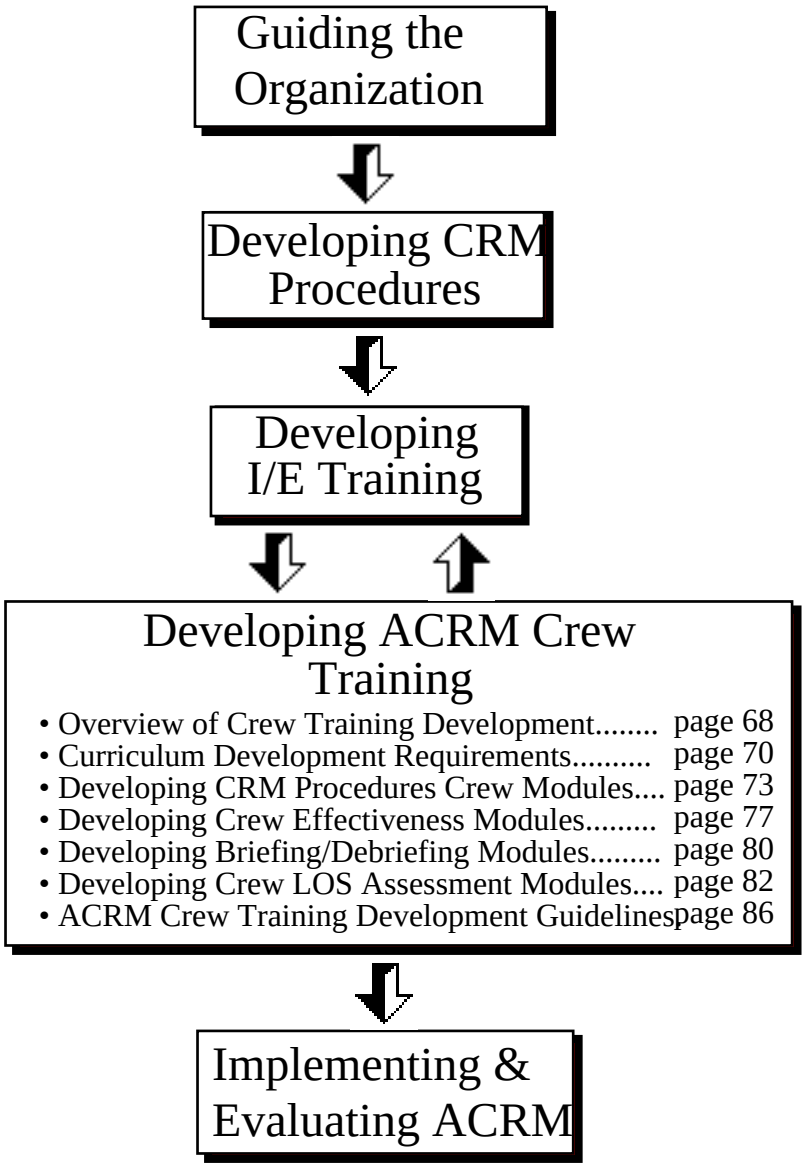
Part 5. Developing ACRM Crew Training

Part 5 of the Manual presents the steps for developing ACRM crew training. This development process may parallel the development of instructor/evaluator training especially where similar module content can be used for both types of training (see Appendices C and H to compare two sample outlines). The development of crew training starts with the planning process and works through the development of the modules that are to be used to train crews in ACRM.



Planning for Crew Training Development Activities

√ Crew training can be a significant cost of the ACRM program, so determine ways to reduce its cost.

Planning for ACRM crew training should consider the development process in the context of ACRM implementation within the organization. Crew training should be completed and ready for delivery at a point when crews receive their recurrent or other form of scheduled training. ACRM crew training should be integrated with the rest of the training as much as possible. Crew training can be the largest cost of the ACRM program, so determine ways for reducing the cost of that training. For example, ACRM crew training may be implemented as an extension to existing crew training rather than a new addition.

In planning, consider how much of the instructor/evaluator training material can be adapted to crew training. Much of the CRM procedure training material for I/Es should transfer to crew training. That material can then be expanded to include incidents and examples that support the need for the new procedures. The instructor/evaluator material on crew assessment will have to be changed from representing the evaluator's perspective to a crew perspective. From experience at one airline, most of the instructor/evaluator training material does transfer to crew training; this is one of the advantages of developing most of the instructor training before starting work on the crew training.

Several additional considerations can help in planning the development of crew training. It is helpful to have the instructors involved in the development process. As with the development of the instructor/evaluator training (see Part 4), if the instructors are brought in at the beginning and encouraged to be involved, they will take ownership in the ACRM crew training. Finally, some of the crew training modules can be developed in parallel. This is a strategy to consider if crew training needs to be developed in a relatively short period of time.

Establishing the Development Team

ACRM crew training is generally developed by the training department with the cooperation of the instructor/evaluator group. In smaller airlines there may be only one person available to develop the training material, but even in that situation it is

better to have several individuals working as a team. A development team provides more flexibility, especially if there is a need to develop some of the modules in parallel. With a single developer the entire effort is at risk if that person becomes unavailable. In addition, it is less likely that just one person has the full scope of expertise to develop the required modules. Establishing a development team whose members have most of the expertise required to design and refine the ACRM crew training materials should be considered.

√ Consider establishing a development team whose members have most of the expertise required to design the ACRM crew training.

The functions of the ACRM crew training development team include developing the CRM procedures modules, the crew effectiveness modules, the evaluation modules, and the briefing and debriefing modules. Members from the instructor/evaluator development team can be very helpful in preparing many of these crew modules because much of the content is similar to that for the instructors. Therefore, consider keeping as many developers from the instructor/evaluator team as possible.

The materials for crew training may require additional design considerations such as strategies for getting the trainee's attention and ways to maintain crew interest. If this is the case, a professional writer and artist may be required to develop a set of compelling materials. As with the development of the CRM procedures and instructor/evaluator training, a coordinated development and review process ensures that team members stay informed about the issues and progress taking place across the different modules being developed.

Coordinating with Crew Training Cycles and Requirements

During planning, consider a thorough review of all crew training with special attention to existing CRM training. A number of existing training areas can be extended or modified to meet ACRM training needs. Much of the existing CRM recurrent training can be modified from an emphasis on general CRM principles to a concentration on the specific CRM procedures. Depending on how the airline conducts CRM training, that can provide between 8 and 24 hours of training time that can go toward ACRM crew training. ACRM crew training

√ There are existing training areas that can be extended to meet ACRM training needs.

should be integrated with recurrent training and should be designed to have as small an increase in required hours as possible. Because the crew training component of ACRM can be its single largest cost, time should be taken during the planning stage to keep the number of additional training hours to a minimum while providing comprehensive ACRM training to all the affected crews.

Good coordination should be directed by a development timeline that ensures that the crew training will be available at the appropriate time in the training cycle (see the next section). A preliminary timeline based on the crew training cycle needs to be developed. The size of the development team can then be scaled to meet the schedule. Once the team has been formed, the timeline should be reviewed to ensure that it is compatible with team member schedules. If necessary, team members can be added or the schedule adjusted so that the training material can be developed within the time specified. Maintaining a good relationship with the person in charge of scheduling crew training can help ensure a high level of coordination.

Curriculum Development Requirements

Developing ACRM Crew Training Footprint

√ Consider what of the existing CRM training can be replaced or expanded to include the ACRM crew training material.

In planning for the ACRM crew training, the training footprint can be developed so that it will result in a minimal increase in training hours. Working with existing CRM training modules and times, consider what can be replaced or expanded to include the ACRM crew training material. Some of the ACRM training can be coordinated with crew classroom training. Additional means for training include the release of a video showing the new CRM procedures being used in operational settings and guides or other written material supporting elements of ACRM. In addition, give consideration to simulator-based training and evaluation, two important components of ACRM crew training.

Classroom and simulator training can be used for the more interactive portions of ACRM crew training while the other forms of media can be used to introduce the key concepts of ACRM and the details of the CRM procedures. The ACRM crew training footprint can be from 4 to 16 hours depending on the number of new CRM procedures and the type of CRM

training that crews have been given (see Appendix H for an ACRM crew training outline). Consider the need for each of the following modules:

- Advanced Crew Resource Management
- CRM Procedures.
- Examples of CRM procedure performance.
- Crew Effectiveness.
- Implementing LOEs and Line Checks.
- LOFT/LOE Sessions.

Establishing Development Timeline

√ The development timeline has to serve the organization and the ACRM crew training has to be completed and ready to meet established training cycles.

The development timeline should be established during the planning stage to ensure good coordination between the development team and the actual crew training. Consider developing a preliminary timeline based on the crew training cycle. Once the development team has been formed, the timeline should be reviewed to ensure that it is compatible with team member schedules. Ultimately the development timeline has to serve the organization and the ACRM crew training has to be completed and ready to meet established training cycles.

The development timeline should be planned to meet the airline's crew training needs in the context of its available resources. With a substantial part of the content developed for instructor training, crew training development can concentrate on refinement of that material and appropriate media selection. If the development team decides on extensive use of different media, the media production considerations, especially those involving video, computer-based training, and high quality manuals, will strongly influence the timeline. Advanced forms of media can take one to several months to produce and require scripts and storyboards before being ready to go into production.

In establishing the crew training development timeline, there are a number of other considerations. Once the total development time has been determined, consider assigning and scheduling the activities in such a way that some items can be performed in parallel. Parallel development is particularly suited for crew training because of all the available material from instructor training. Usually, the LOFT/LOE scripts and the CRM procedures materials have been developed for instructor training, so different team members can proceed with the process of tailoring the content to crews. If possible, consider developing

those modules needed first, and wait for actual crew trainee feedback on them before completing those modules that are needed later.

Coordinating Development of Crew Training with Other ACRM Elements

√ Crew training should be coordinated with crew training cycles, instructor/evaluator training, and the implementation of the new CRM procedures.

The development of ACRM crew training should be coordinated not only with crew training cycles but also with the instructor/evaluator training and the implementation of the new CRM procedures. There are several points of coordination. First, consider the LOFT/LOE instructor/evaluator training, specifically the administration and assessment of the Line Operational Simulation (LOS) sessions. For an airline that has not made extensive use of this form of simulator training, it may take some time to ensure that there are sufficient instructors to give and assess the LOFT/LOE sessions. With the increased reliance that ACRM places on LOFT/LOE, it is important to have that part of the instructor/evaluator training completed prior to the start of crew simulator sessions. Some airlines have increased instructor/evaluator training in this area, making sure that the instructors actually fly the new LOFT/LOE and then administer one under the supervision of a qualified individual prior to working directly with the crews. This can take additional time that needs to be accounted for in scheduling the crew training.

A second consideration is coordinating the development of crew training with the training of classroom instructors. For best coordination in this area, consider having the instructors trained in time, but not too early, for the scheduled classroom training. The classroom training can be a crew's first exposure to ACRM, and it is important that the instructors are current in the ACRM concepts and training strategies.

A final consideration is the coordination between crew training and the implementation of the CRM procedures. Each organization may take a slightly different approach to timing these two critical events, but should consider a sequence where the CRM procedures are announced, crews are trained, and then the procedures are implemented. This should be planned as a short sequence, where the crew training and implementation follow closely. Because crews should receive training prior to implementation, consider scheduling ACRM crew initial training to occur within a narrow window. This will reduce situations

where crews have ACRM training eight or more months prior to implementation and tend to forget some of the key elements.

Establishing a Curriculum Review Process

√ Successful training development and implementation includes a good review process.

Successful training development and implementation includes a good review process. Consider scheduling ACRM crew training curriculum reviews for the key organizational elements that control the future of the ACRM program. At most organizations this will include instructor/evaluator representatives, the training department, airline management, and union representatives. If there are groups that work well together, they can be scheduled as one review, but in cases where there are very different agendas, consider scheduling those reviews as separate events.

On the management side it is important to communicate the progress being made, the efficiency and effectiveness of the crew training, and the coordination taking place between crew training and the rest of the training system. The management-level review concentrates on an overview, plan, and schedule. On the union and instructor side, consider a more detailed review of the curriculum content and trainee requirements. Union representatives should participate in the review process. It may also make sense to include instructors in this review. Having instructor and union participation on the crew training team can help with those reviews and ensure a higher degree of acceptance.

Developing CRM Procedures Crew Modules

Establishing the Need for ACRM

The first modules in ACRM crew training should introduce ACRM and establish the need for this program within the organization. ACRM may be introduced as a comprehensive implementation package including the CRM procedures, training of the instructor/evaluators, and the crew training that they are about to receive. The point should be emphasized that ACRM has been designed and developed by the airline to address specific problems that exist both in industry and at the airline. For example, it might be explained that this ACRM training was based in part on the results from the NTSB Safety Study along with information provided by its instructor/evaluators to identify the types of training and procedural changes that could improve CRM performance.

√ Emphasize that the crews are an essential part of this development process.

If more general industry trends, such as those found in the NTSB Safety Study, were used in developing the CRM procedures, then the specific results should be presented in some detail. The NTSB study has some clear trends that can help crews understand some of the crew conditions present in recent U.S. commercial accidents. If general industry trends were a main source of the needs justification process, consider presenting several documented incidents, such as those in ASRS incident reports, that support the type of problems the new CRM procedures will address (see Appendix G for sample reports).

In explaining the airline data or reports that established the need for ACRM training, provide sufficient detail to fully establish what the problem area is. In other words, do not provide just one piece of data or a statistic, because that type of data can usually be subjected to multiple interpretations. Provide several pieces of supporting data that more firmly establish and describe the problem area. Specific incidents can be very helpful in elaborating the operational relevance of the problem.

√ The new CRM procedures are designed to support CRM skill development.

Once the problem area or areas have been established, introduce how ACRM and its CRM procedures will address those areas. In this part of the training, consider introducing ACRM as an ongoing development process that provides airlines with unique CRM solutions tailored to their operational demands. ACRM is ongoing and dynamic, and it should not be confused with a single set of products. For example, reproducing a product, such as a briefing card, from another airline will not, by itself, produce the type of organizational change that the ACRM training development process can produce. It should be emphasized that the crews are an essential part of this development process, so crew representatives should be involved in developing the current training. Further, individual crewmembers should stay involved and help identify new CRM procedural needs as they become apparent.

Explaining the Move from CRM Principles to CRM Procedures

One of the early modules in crew training should explain the role of CRM principles as well as that of CRM procedures. One way of introducing these concepts is to explain that the design of the CRM procedures is based on critical CRM principles that are needed in an airline's specific operational environment. General

CRM principles, such as good decision making and maintaining situation awareness, dominate traditional CRM training. Recently, there has been a shift toward trainable skills that help crews in the management of resources. Although there is no complete listing of required CRM skills, the new CRM procedures developed under ACRM are designed to support the development of CRM skills. It should be explained that over the next few years the airline will be introducing specific procedures which will help crews to practice and perfect specific CRM skills.

Compared with the traditional CRM principles, the CRM procedures are more specific, more operationally relevant, and they emphasize CRM actions that should be taken by all crews. Consider explaining that the development of these initial CRM procedures is the first step in an ongoing process which will result in a more complete set of CRM procedures. It should be explained that these new CRM procedures were developed by a team that identified airline needs, specified the procedures, and then refined the procedures.

Reviewing the Components of ACRM

√ Introduce the main components of the ACRM program.

The main components of an ACRM program include the CRM procedures, training of the instructor/evaluators, crew training, a standardized assessment of crew performance, and an ongoing implementation process. An explanation of each of these components helps trainees understand the entire program rather than just one or two of its key elements.

The specific content and format for each CRM procedure should be presented. The procedure, in its actual form, should be presented, highlighting each of its main features. Consider including an incident that highlights the need for one or more procedures or some other form of interactive activity to ensure that the crews understand all the main elements of the new CRM procedure.

Instructor/evaluator and crew training can be presented in a parallel manner, and this can help crews understand the elements in common between the two forms of training. For any given airline, ACRM can present a new direction in specific areas such as SOP, the use of LOFT/LOE, and crew assessment. These relevant new directions should be emphasized so that the crews understand the need for the new training.

√ Crews should expect a more systematic assessment under ACRM.

Emphasis on crew performance assessment should be introduced at this point in crew training. With the implementation of the new CRM procedures, total crew performance takes center stage both in how crews coordinate their tasks and in how evaluators assess those crews. CRM is no longer assessed as a group of general principles; rather, it is systematically evaluated based on specific actions and the intermediate and final crew outcomes. This part of the presentation can introduce the concept of crew effectiveness, which is covered in more detail in the next section.

Explaining Crew Training Improvements

ACRM crew training has some noticeable improvements over traditional ACRM training. Although individual implementations of ACRM training may highlight some different improvements, there are general elements of most ACRM training that should be brought to the crews' attention.

A major improvement, referred to in several of the previous subsections, is the specificity and operational relevance that CRM procedures bring to what has often been a set of vague concepts. ACRM crew training presents specific CRM steps for crews to follow under certain flight conditions. Encourage crewmembers to ask questions at any point through the presentation of the CRM procedures to ensure that those procedures are clear to the entire group.

Another improvement the crews should expect under ACRM is a more systematic assessment of their performance, both CRM and technical performance. It should be explained to crews that precise measures of crew performance were required in the research stages of ACRM development. That requirement has resulted in a more detailed and accurate measurement of crew performance, a form of measurement that has helped evaluators provide more standard crew assessments. Crews should expect a fair and even assessment from all instructor/evaluators, and the evaluators are consistently working to improve the accuracy of crew performance assessment. The ACRM training will include one or more detailed modules on this new form of assessment, and the crews will have substantial opportunity to ask questions and to fully understand the improvements in this area.

Developing Crew Effectiveness Modules

Understanding the Role of ACRM in Developing CRM Skills

√ Crew effectiveness is a core concept of any ACRM program.

Crew effectiveness is a core concept of any ACRM program, and crew training should present its main characteristics. Crew effectiveness is based on a set of CRM skills that are reinforced by the new CRM procedures. The CRM procedures help individuals and crews integrate CRM with technical performance by improving overall crew coordination and communication. The purpose of these new CRM procedures is to improve overall crew effectiveness.

The relationship between the CRM procedures and CRM skills is complex, and many issues have yet to be resolved by the aviation research community. However, there are a number of guidelines related to the CRM skills and procedures that crews should understand. First, CRM skills should be trained in a task-specific context providing crews with practice and feedback. Because CRM procedures require crews to perform specific CRM actions under certain conditions, they lead to the development of particular CRM skills when those procedures are properly trained through practice and feedback. The basic form of a CRM procedure, such as a required statement of the pertinent takeoff conditions, can be fairly simple. The skill comes into play when a crew can perform the important parts of the briefing quickly and effectively under a variety of conditions and in a way that improves crew effectiveness.

The ACRM program provides crews with an operational environment in which they are encouraged to improve their CRM and technical performance. Further, ACRM, with its emphasis on continual development, allows the crews as well as the airline to further identify CRM procedures that can improve crew effectiveness. Thus, the new CRM procedures should improve crews' CRM skills, and the ongoing development of these procedures will further support CRM skill development.

Integrating CRM with Technical Performance

Crew effectiveness includes both the CRM and technical elements of performance, and the new CRM procedures are designed to support technical performance. The ACRM

√ ACRM allows airlines to integrate CRM with the technical at the SOP level.

program provides a framework that allows airlines to integrate the CRM with the technical at the SOP level. ACRM crew training should emphasize this integration at the operational level as well as at the crew performance assessment level.

Crews should be informed that the CRM procedures were carefully developed to support the technical side of the operation. The content of these procedures should help crews to communicate about and coordinate the technical tasks, especially at points where crews are working on multiple tasks. If relevant, crews should be shown how the new procedures are placed at points of lower workload and precede points in time when crews will have to be aware of certain conditions or will require certain information. Therefore, the new CRM procedures help crews better perform their technical tasks, and those procedures should improve overall crew effectiveness.

With ACRM's emphasis on an integration of CRM with technical performance, there is a corresponding push for a balanced assessment. ACRM provides instructor/evaluators with specific behaviors to assess, and this helps to place CRM evaluation at a similar level of objectivity with the technical and maneuver validations. The crews should be encouraged to join with instructor/evaluators to look beyond the technical reasons for a specific difficulty and consider what CRM actions could have prevented or averted the problem. If crews start to see areas where the SOP needs to be changed or could be improved through a CRM procedure, they should make specific recommendations to the ACRM program manager.

Training and Assessing Crew Performance

Each of the new CRM procedures has implications for crew training and assessment because it places an emphasis on the crew's development of specific CRM behaviors in the operational context. It is important for crews to have an understanding of the nature of skill performance and its implications for the training of these new CRM procedures.

√ The new CRM procedures have profound implications on the assessment of crew performance.

In addition to implications on training, the new CRM procedures have profound implications on the way that crew performance is assessed. A detailed simulator-based assessment has been developed to collect crew performance data after the ACRM crew training has been implemented. This form of crew assessment, based on the LOE, allows for the collection of

performance data within a carefully designed and controlled set of flight conditions. This comprehensive method of crew assessment is augmented with a second type of assessment, the Line Check. Line Checks provide an efficient method for collecting more general crew performance data.

Assessment under ACRM involves a set of standards, and crews should be presented with the standards along with an explanation of how the standards will lead to a more systematic form of crew assessment. With the team approach to crew performance, all members should work together to improve crew effectiveness. Individual pilots are now expected to work as a team to support each other in working with the new CRM procedures and in developing a set of CRM skills.

Using CRM Procedures to Improve Crew Effectiveness

The new CRM procedures are part of SOP, but they should not be viewed as just some additional procedures to worry about. These procedures have been developed in order to increase CRM awareness and skill development, and the procedures should lead directly to improved crew effectiveness.

The new procedures should help individuals and crews in several areas. First, they should help crews integrate CRM with technical performance by providing direct support to some of the critical tasks in areas such as takeoff and landings. Once these procedures are mastered, crews should see better-coordinated task execution because crews are more aware of each other's duties and decisions. Second, the new CRM procedures should help crews in very specific CRM areas such as being aware of the conditions affecting takeoff, the need for a backup plan, or the assignment of duties in the case of non-normal situations. Third, ACRM helps CRM skill development based on continual practice of relevant skills and feedback on the quality of skilled performance.

The entire organization should stay involved with the ACRM program and crews should be recognized as the core of this program. If the new CRM procedures are not improving crew effectiveness, the crews should help determine whether better training or modifications to the procedures is required. It is the crews that will be the first to see the effects of these procedures, and the crews should be encouraged to provide feedback about

the new procedures as well as additional CRM procedures that can improve crew effectiveness.

Developing Briefing/Debriefing Modules

Briefing the LOFT/LOE

With ACRM's emphasis on the use of LOFT and LOE in the training and assessment of crew performance, there should be one or more crew training modules that explain the LOFT/LOE briefing and debriefing process. These modules differ from the instructor/evaluator modules on the same topic in that the crew modules should be more general in nature and they will not address specific LOFT/LOE scenarios. These modules are particularly important in organizations that have not conducted LOFT/LOE sessions in the past.

√ The LOFT/LOE briefing should prepare the crew for an effective training or assessment experience.

The LOFT/LOE briefing should prepare the crew for an effective training or assessment experience. One of the first things a briefing should do is establish the role of the instructor and crew throughout the session. Generally, the crew should be informed that the instructor/evaluator is not present as an instructor during the simulation; rather, his or her role is to provide communication as ATC, company, flight attendant, maintenance, etc. The crew's role is to act as they would in a line flight and deal with everyone, including the flight attendants, as if they were actually present throughout the LOFT/LOE. A good briefing is operationally thorough and interesting, and will provide an overview of the overall LOE.

When developing the briefing modules, consider including some of the following topics:

- The briefing's primary function of establishing an environment for open, interactive communication between crewmembers.
- The LOFT/LOE's joint emphasis on technical and CRM performance.
- The role of the instructor in providing all communications and resources normally available under the LOE scenario conditions.

- The fact that crews will have access to all the resources they would have on an actual line flight.
- Crewmember responsibilities during debriefing.

Explaining the Role of Crew During LOFT/LOE

√ During a LOFT/LOE, crews should act as they would under similar situations on the line.

The part of the LOFT/LOE session that takes place in the simulator should mirror line operations as closely as possible. This part of the ACRM crew training should emphasize what the crew should do to make the session both realistic and a valuable training experience. The crews should act as they would under similar situations on the line and not try to operate in a manner calculated to provide the ideal training department solution. This is a very important point for crews who have not been exposed to substantial LOFT/LOE training and assessment.

Some of the following actions that crews can take to ensure a realistic LOFT/LOE flight could be considered:

- Perform their normal flight preparation duties.
- Use radios as they would normally during flight with frequencies changed as required.
- Perform all normal communications, such as final weight checks, departure reports, and in-range reports.
- Act and operate as if on the line and interact with all resources such as maintenance, dispatch, and flight attendants.
- Plan the flight as one would a real line flight, with any service the Company or ATC normally provides available to the crew.

Debriefing the LOFT/LOE Session

√ Crews should understand that debriefing is an essential part of the LOFT/LOE and main way of providing feedback.

After the simulator segment of the LOFT/LOE is completed, the debriefing is of key importance in reinforcing the good behaviors and identifying areas that could be improved. ACRM crew training should introduce or reinforce good crew practices in conducting a constructive debriefing. Crews should understand that debriefing is an essential part of the LOFT/LOE and the main way of providing crew performance feedback.

The modules addressing LOFT/LOE debriefing should cover all of the following topics that are directly relevant to how the airline will be conducting debriefings:

- Understanding the debriefing agenda and time limits.
- Stating overall appraisal of the flight.
- Leading the discussion using the instructor as a resource.
- Avoiding the pitfall of making another crewmember defensive.
- Integrating technical and CRM feedback into the debrief.
- Ensuring all crewmembers participate in the discussion and encouraging quiet crewmembers.
- Taking away a good summary and list of key learning points.
- Developing debriefing skills that can be used on the line in cases where crew critique and review is appropriate.

For further details, see McDonnell, Jobe, and Dismukes (1997) for guidelines for effective crew-focused debriefs of LOFT/LOE sessions.

Developing Crew LOS Assessment Modules

Primary Technical and CRM Training Objectives

With ACRM's reliance on the LOFT/LOE as an integral part of crew training and assessment, it is important that crews understand the objectives, development cycle, and event set framework of LOFT/LOE scenarios. This module or set of modules should be developed to give crews confidence in the fairness and standardization of the LOFT/LOE assessment process. In the past there have been incidents where LOS has been used in non-standard ways, with instructors inserting additional elements when the crew seem to be doing well with the events of the regular scenario. Also, there have been questions about the operational relevance of some of the older scenarios. Crews should be assured that LOS assessment under ACRM is based on specific objectives and the scenarios are operationally relevant and systematically developed. They should also be informed that all crews will be trained and assessed using the same objectives, and this will be the case no matter which instructor/evaluator they will be working with.

√ It can be helpful to present crews with the CRM objectives in the context of relevant technical objectives because they may be easier to understand and more familiar.

ACRM crew training is based on specific training objectives used to develop the crew training and to direct crew performance assessment. The high-level objectives of ACRM crew training should be presented so that crews have a clear sense of the purpose of the training session. Some of the higher-level CRM objectives will include learning the content and context of the new CRM procedures. At some point there will be further objectives such as developing skills in performing the new CRM procedures. ACRM crew training may also have some technical objectives. In some cases these objectives will be associated with the tasks being performed either during or after the CRM procedure. For example, an improved takeoff briefing will have as one of its objectives a better-executed takeoff (possibly under certain specific conditions). It can be helpful to present crews with the CRM objectives in the context of relevant technical objectives because crews may initially be more familiar with and better able to understand the technical objectives.

Incidents that Support Training Objectives

√ Crews should understand that the LOS is based on operationally relevant incidents.

A structured development process is used in preparing the LOS assessment scenarios. ACRM crew training should explain that this process starts with the analysis of the airline's training needs and follows through to the development of the LOS and its validation. A major step in this development process is the identification of incidents that highlight the need for specific CRM procedure and that can be used to support the training objectives. These are incidents that may have happened at the airline or at other airlines with a similar type of operation. Crews should understand that the LOS is based on actual incidents that have happened to pilots flying in conditions similar to theirs.

Crews are usually interested in such incidents and in the incident identification process. Consider explaining that incidents can be identified by searching ASRS reports, talking with one's own airline flight safety manager or searching the airline database. The search usually starts based on a set of categories identified by the airline as being primary issues for the LOS scenario. Then either the NASA/ASRS or airline staff can perform a search using these categories as keywords, or the airline can access the report database on CD-ROM and perform their own searches.

Examples of topics that have been searched to identify supporting incidents include rerouting/amended clearance incidents, low fuel during excessive vectoring, delayed approaches, similar call signs, auto-flight incidents, flight toward terrain, and runway incursion. The specific training objectives and the new CRM procedures are used to refine the topics and conduct the search for incidents that are to be used in the development of LOFT /LOE event sets.

Consider planning a crew training activity that can take place within this module which allows crews to work with several incidents used to develop the new CRM procedures. Additional sources for incidents include:

- Incident reports from industry databases such as the ICAO incident database.
- Maintenance problems identified through operational reports.
- Poor crew performance areas identified in line and simulator proficiency checks and training.
- Airline safety reporting system.

SAMPLE INCIDENT REPORT

(see full report in Appendix G, Report 56)

BGM information 800' scattered, 1200 broken, 2300' overcast, 2 mi. light snow, temp 27, dew point 21, winds 270 at 8 kts, altimeter 29.97, breaks in the overcast, NDB 34 approach in use, localizer 16/34 out of service, runway 34 plowed and sanded full width and length, braking action good reported by a vehicle. PF and PNF discussed possibility of using runway 28 due to surface wind component. Further inquiry with BGM approach confirmed runway 28 plowed and sanded full width and length and previous inbound company reported braking action as poor. Surface wind was also reported as unchanged. PF (PIC) requested and was cleared for VOR DME approach runway 28... The PF descended from the published segment alt (3500' MSL) at the 18 DME position to the published straight in landing MDA of 2000' MSL. The FAF for the procedure was at the 13 DME position and the PF's premature descent put the aircraft 1500' below the published segment alt...

SAMPLE INCIDENT ANALYSIS

During the approach the crew focused on the runway choice but lost situation awareness of the aircraft's altitude with respect to the Minimum Safe Altitude. Crew was rushed due to the slam dunk approach into the airport which increased workload. Not setting and monitoring a bottom line for the minimum safe altitude allowed the PF to execute a premature descent to an inappropriately low altitude for that segment.

SAMPLE LESSONS LEARNED

Crews can benefit from this incident by recognizing the role of good workload management and clear communication of critical aspects of the approach. Good workload management would suggest briefing of the overall plan for the approach and relevant situational details such as the MSA prior to the high workload period of the approach or as early in the approach phase as possible. Prior briefing of the overall plan would enhance crew situation awareness during approach and reduce the number of necessary communications during approach. Setting explicit bottom lines for critical aspects of the approach such as the MSA and assigning the monitoring of the bottom line to a crewmember would help maintain situation awareness of these safety-critical conditions despite the heavy approach workload.

Event Sets and the LOFT/LOE Scenario

√ Crews should be given an explanation of how the event set is used under ACRM.

Crews should be given an explanation of how the event set is used under ACRM to help focus the specific aspects of crew performance in the LOFT/LOE assessment. An event set divides a LOFT/LOE session into sections, with each section or event set having specific training or assessment objectives. Event sets are designed to concentrate on specific CRM and technical training objectives allowing the crews to concentrate on a narrow range of performance.

Crews do not need to be concerned with the start and end point of each event set, but they should understand that instructor/evaluators have been trained in the role of the event set as a tool to administer the LOFT/LOE session and as the primary unit of crew performance assessment. An event set is made up of one or more events, including an event trigger, supporting conditions, and distracters. The event trigger is used to fully

activate the event set and can be the introduction of a malfunction or the activation of one or more environmental or operational conditions. Supporting conditions are other events used primarily to maintain realism. Finally, a distracter may be inserted within the event set time in order to divert the crew's attention or to increase their workload.

Event sets are carefully designed to support the training and assessment objectives and the consistent administration of the LOFT/LOE scenario. In addition, event sets can be designed to an equivalent level of difficulty to make sure that different scenarios present a fair and equal group of problems. Difficulty levels initially can be judged by SMEs, and later checked by data analysis of average crew performance across the event sets.

ACRM Crew Training Development Guidelines

Guidelines for Planning ACRM Crew Training

1) Crew training can be the largest cost of the ACRM program, so the development team should use the planning stage to determine ways for reducing the cost of that training. The team should consider integrating ACRM with existing CRM training (see Guideline 2 below) and coordinating ACRM training with other training cycles (see Guideline 3 below).

2) The development team should consider extending or modifying existing crew training to meet ACRM training needs. Much of the existing CRM recurrent training can be modified from an emphasis on general CRM principles to a concentration on the specific CRM procedures.

3) The development of ACRM crew training should be coordinated not only with crew training cycles but also with instructor/evaluator training and the implementation of the new CRM procedures.

4) ACRM crew training development and implementation should include a review process by scheduling ACRM crew training curriculum reviews that involve key organizational personnel who control the future of the ACRM program.

Guidelines for Developing CRM Procedures Crew Modules

1) When training crews about the need for CRM procedures, it should be emphasized that the crews have been an essential part of the development process with crew representatives involved in developing the current training. In the future, crewmembers should stay involved and help identify new CRM procedural needs as they become apparent.

2) A key component of new CRM procedures is the degree to which they support the development of CRM skills. To help crews practice and master the appropriate skills, crews should be informed of the relationship between the CRM procedures and their CRM skill development.

3) Early in crew training it should be explained that the main components of an ACRM program include the CRM procedures, training of the instructor/evaluators, crew training, a standardized assessment of crew performance, and an ongoing implementation process.

4) It should be explained that detailed measures of crew performance were developed in the research stages of ACRM specification and analysis. These more accurate crew performance measures will help evaluators provide more standard crew assessments, and crews should expect a fair assessment from all instructor/evaluators.

Guidelines for Developing Crew Effectiveness Modules

1) Crew effectiveness is a core concept of any ACRM program, and crew training should present its main characteristics. Crew effectiveness should be enhanced by using the new CRM procedures that will help crews develop better CRM skills.

2) The ACRM program provides a framework that allows airlines to integrate CRM with technical at the level of SOP. ACRM crew training should emphasize this integration at the operational level as well as at the crew performance assessment level.

3) It should be explained that the new CRM procedures have profound implications on the way crew performance is assessed. For example, if it is the case, crews should understand that a detailed simulator-based assessment has been developed to collect crew performance data after the ACRM crew training has been implemented.

4) It should be emphasized that crews form the core of the ACRM program, and crews should be encouraged to provide feedback about the new procedures as well as additional CRM procedures that can improve crew effectiveness.

Guidelines for Developing Briefing/Debriefing Modules

1) The LOFT/LOE briefing should prepare the crew for an effective training or assessment experience. One of the first things that the LOFT/LOE briefing should do is establish the role of the instructor as well as the role of the crew throughout the session.

2) The LOFT/LOE briefing should emphasize specific things the crew can do to make the session realistic and a valuable training experience. The crews should act as they would under similar situations on the line, and they should not try to operate in a manner calculated to provide the ideal training department solution.

3) ACRM crew training should reinforce good crew practices in conducting a constructive debriefing. Crews should understand that debriefing is an essential part of the LOFT/LOE and the main way of providing crew performance feedback.

4) ACRM crew training should introduce the concept that briefings can also be extended to line operations and used by crews to reinforce positive performance and learn from any problems experienced during the flight.

Guidelines for Developing Crew LOS Assessment Modules

1) Crews should be presented with the LOS CRM training objectives in the context of relevant technical objectives because crews are generally more comfortable and familiar with the technical objectives.

2) A major step in the LOS development process is the identification of incidents that highlight the need for specific CRM procedure, and crews should understand that the LOS is related to actual incidents that have happened to pilots flying in conditions similar to theirs.

3) Crew training should include one or more activities that allow crews to analyze incidents used to develop the new CRM procedures. One activity that has provided valuable crew training is having crews identify the CRM causes for each incident.

4) Crews should be given an explanation of how the event set is used under ACRM to help focus the specific elements of crew performance in the LOFT/LOE assessment. The event set helps training and evaluation move from general CRM markers to specific crew behaviors.

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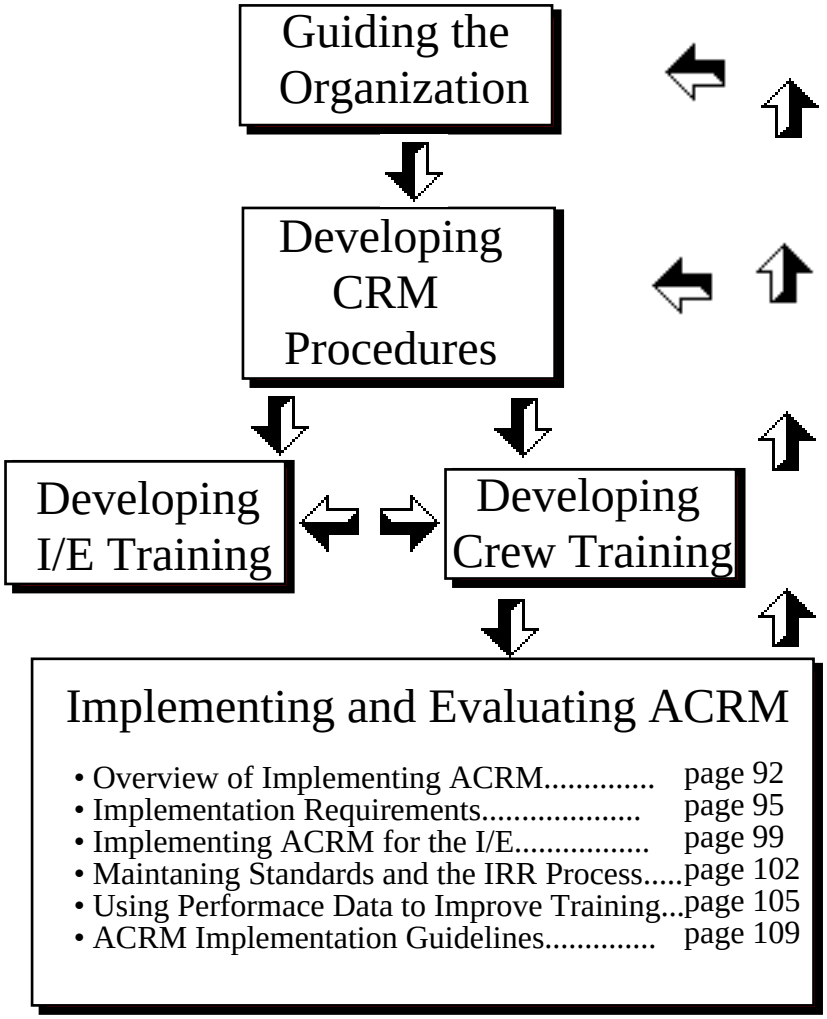
Part 6. Implementing and Evaluating ACRM

Part 6 of the Manual presents the steps for implementing and establishing a solid ACRM evaluation. The implementation process is ongoing and generally follows the development of the ACRM crew training. Implementation starts with organizational announcements and continues by working with the instructor/evaluators to maintain evaluation standards. The ongoing implementation and evaluation cycle concludes by using the performance data to improve the training, with the cycle starting over again.



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Preparing Organizational Announcement of ACRM

To ensure successful ACRM implementation, the content and timing of the organizational announcement should be carefully planned. It is assumed that key personnel have been kept informed of the ACRM development progress and they should be very helpful in designing and scheduling the announcement. The organizational announcement sets the stage throughout the airline for the start of crew training and the implementation of ACRM. Throughout the development process, representatives from different departments and groups have been kept informed, and the announcement is a way to put out a strong, unified message that ACRM and its CRM procedures are about to become part of SOP.

The content of the announcement should be relatively brief and yet sufficiently complete to convey critical information. The announcement should provide a brief summary of most of the following items:

- Organizational endorsement of the program.
- Why the airline needs an ACRM program.
- The key features of ACRM.
- The main dates through ACRM implementation.
- Departments and/or individuals who supported the development effort.

√ The organizational announcement should be timed based on instructor training, crew training, and the implementation of CRM procedures.

Timing of the organizational announcement is important. Instructor training, crew training, and the implementation of the CRM procedures will all affect that timing. Each organization may take a slightly different approach to the timing of these critical events, but a sequence where the CRM procedures are announced prior to the start of crew training and possibly before or during instructor/evaluator training should be considered. Ideally this should be planned as a relatively short sequence, where the crew training and implementation follow closely to avoid the situation in which some crews have initial ACRM training eight or more months prior to implementation. When

that happens there is a tendency on the part of crews to forget some of the key ACRM elements.

Ensuring Ongoing Management and Union Support

Just as management and union representatives should have been involved in the development process, they should be encouraged to maintain that involvement once the ACRM program has been implemented. This ongoing involvement can provide valuable input to the program and should result in continued support.

√ For management, it is important that they be kept informed of the general trends, both crew performance and instructor standardization.

It is important that management be kept informed of the general trends, both crew performance and instructor standardization. Throughout the development cycle, management should have been familiarized with data on current trends in training and the method used to collect CRM performance data and instructor standardization data, and the types of questions that can be answered with these types of data. During and following ACRM implementation, work closely with management to refine the types of reports most useful to them. Have management discuss the types of questions they would like answered through the data and decisions they need to make that could be informed by the data. Then consider presenting a range of data at an informal meeting, and ask management which data and formats are most useful for the decisions that they need to make. Work to provide them with a report that presents the data they have asked for in the formats they have requested. Initially provide some preliminary analyses that address their most important questions, and ask management to provide feedback about additional data, questions, and frequency of reports.

With union representatives, continue offering data that establish the reliable and accurate qualities of the ACRM crew assessments. Continue working closely with one or more union representatives in developing new CRM procedures as well as new LOFT/LOE scenarios. Historically, pilot unions have had some serious objections to the assessment of CRM. Other union representatives have supported the use of CRM procedures; however, they may still have a number of reservations. Union representatives who are kept informed about the specific CRM procedures and the objective CRM assessment are more likely to support the ACRM program and want to see it further established within the airline.

Reporting Meaningful Crew Performance Data

√ The reporting of meaningful crew performance data is one of the most important ways to ensure the ongoing success of the ACRM program.

The reporting of meaningful crew performance data is one of the most important ways to ensure ongoing success with the ACRM program. It can be difficult to understand the relationship between own airline incidents and CRM, in part because airlines do not tend to report CRM causes of incidents. The reporting of ACRM data should be used to develop an understanding of CRM problems. ACRM goes beyond reporting CRM attitudes or opinions, and it looks for solid links between crew performance and the CRM procedures. No two airlines will approach this in exactly the same way, but all airlines should be looking at 4 to 12-month trends that show a positive relationship or correlation between performance on CRM procedures and overall crew performance. In addition, it may be possible to identify an inverse relationship, or negative correlation, between the performance on CRM procedures and number of incidents.

Care should be taken not to report too much data. There may be and inclination to report everything, but do not overload those who need the information. It is better to hold off presenting an initial set of results with multiple interpretations until addition data can be collected and the interpretation refined. Consider reporting some of the following types of data:

- Distribution of overall performance by position and fleet.
- Distribution of CRM performance by position and by fleet.
- Distribution of problem event set performance.
- Distribution of overall performance by fleet.

Data on instructor or evaluator standardization can come from the recurrent inter-rater reliability sessions. Further, the LOFT/LOE performance information can be used to isolate problems with systematic differences among instructors, low congruency, or low consistency of evaluation profiles.

LOE quality can also be evaluated during initial development of the LOE and later from rating data. The internal relationship of ratings gives an indication of how well each event set is working as part of crew evaluation. LOE performance can also be used to target areas that need increased training emphasis and those areas that require less. The pilot performance profiles can target the necessary re-allocation to optimize the effectiveness of training.

Announcing the New Policies and Procedures

Although implementation of ACRM affects the airline's philosophy, the announcement of the CRM procedures affects airline policy and procedures. The organizational announcement sets the stage throughout the airline for the start of crew training, while the announcement of the procedures is a more detailed specification of the new policies and procedures. The content and format of the procedures announcement is of paramount importance and should be carefully coordinated with flight standards and documents departments.

The content of the procedures announcement should include the rationale and format of the new procedures. The policy segment of this announcement presents the rationale or need for these procedures, along with any required additions or changes to airline policy. Generally, the policy segment is fairly brief, and it can be included in its entirety in the announcement. In addition to the text of the new policy, references should be provided to all applicable operating documents. The procedures segment is more detailed, and consideration should be given to whether the new procedures will be printed along with the announcement or whether they will just be referenced with their location in the operating documents. If there are only a few new CRM procedures and they can be displayed on a few pages, consider including the full procedure with the announcement. If, on the other hand, there are many new procedures or they occupy many pages, then consider just having references in the announcement with one or two key examples.

The procedures announcement should be made close to the implementation time. An airline can consider including supporting material. For example, one airline included a videotape showing examples of crews using the new procedures. This can be particularly helpful for procedures where crews have had many questions or difficulty performing the procedure during ACRM crew training or where time has elapsed since initial training.

Implementing the New Documentation

Implementing the new operating documents can become a substantial expense of the ACRM program, but there are ways to minimize or eliminate some of those costs. By coordinating closely with the document update cycle, the implementation can be achieved at little or no expense.

Before presenting the coordination considerations it should be noted that in some cases a new document is essential to the success of the CRM procedure. For example, an airline may identify a need for a QRH or guide that they are currently not using. In such cases, the new document will be an additional cost. However, these costs can be moderated by carefully using more expensive resources, such as color. In many aviation situations, only one or two additional colors are needed. In such cases, it can be more cost-effective to go with black and white plus one or two specific colors rather than going with full color. Also, the type of lamination, drilling, and tabs can add substantial expense. Use such features only when they substantially improve the usability of the document.

√ Ensure a formal review of the camera-ready material because there will be errors, and the more informed people that review the material, the greater the chance of noting them.

The need for coordination with the update of existing documents is most evident at larger airlines where even one change in a procedure can result in the need to reprint one or more pages for 20,000 manuals. That can be a substantial cost and should be reduced or limited through planning and coordination. Major airlines have scheduled document updates, and if the changes required by the new CRM procedures are coordinated with those updates, the cost can be greatly reduced. Depending on the type of document, it may have a quarterly or annual update cycle. As is suggested in Part 3, most or all of the costs can be included as part of an update by working out the coordination details during the ACRM planning stage. As part of this coordination, ensure a formal review of the camera-ready material because there will be errors. The more informed the people who review the material are, the greater the chance of noting those mistakes.

Scheduling Crew Training

Scheduling ACRM crew training should be coordinated not only with crew training cycles but also with the instructor/ evaluator training and the implementation of the new CRM procedures. Often, crew training starts with the classroom segment which may then be followed at a later date with simulator sessions. Make sure that the instructors needed for classroom training have completed that portion of their training prior to the start of crew training. For the simulator portion, make sure that trained instructor/evaluators are available in sufficient numbers prior to the start of crew simulator sessions.

As discussed in Part 5, ACRM crew training should be integrated with the rest of the training to reduce the additional required training time. Consider integrating ACRM crew training with recurrent training with a minimum increase in required hours. Follow through with scheduling to make sure that all crews are scheduled with minimum disruption to training and flight operations. Be aware that poor or disorganized scheduling reflects poorly on the ACRM program, so ensure that this training scheduling runs as smoothly as possible.

Selecting Strategies to Reinforce Crew Awareness and Feedback

√ In order to promote an ongoing ACRM program, crew awareness should be reinforced and crew feedback should be elicited and collected.

In the past, CRM training has been implemented as a one-shot deal. In order to promote an ongoing ACRM program, crew awareness should be reinforced and crew feedback should be systematically elicited and collected. These two requirements are particularly important during the first year of the program as the organization becomes familiar with it. Consider having one or more individuals from the development team tasked with keeping ACRM visible and eliciting crew feedback.

The entire organization should stay involved, but crews form the core of an ACRM program. It is their acceptance and use of the CRM procedures that will produce a successful program, so crews should be reminded of the procedures and training at appropriate times. Crews have many things competing for their attention, and ACRM crew training can be perceived as just one of a number of training routines that need to be completed. The challenge is to select the proper form and time to remind crews of

the new procedures and their role in improving crew effectiveness. Some organizations may write up positive crew reactions or operational stories that underscore the value of the procedures, and place one or more articles in an existing organizational publication with good crew readership and acceptance. In smaller organizations, consider having a respected crewmember speak up about the new procedures at a scheduled crew meeting. Instructor/evaluators can also be influential in sustaining crew awareness, and they may be asked to make an announcement or comment on improved crew performance in specific ACRM areas.

The crews are often the first to see the effects of the new CRM procedures and the training, and they should be encouraged to provide feedback about all aspects of the program. Consider doing this not only during ACRM training, but also during line checks and other points of crew interaction with instructor/evaluators. In addition to feedback on the new CRM procedures, ask crews for ideas about additional procedures that should be considered for implementation. Crews may come up with their own ideas or they may have heard about or used a useful CRM procedure at another airline. Consider a range of ways of collecting information on additional procedures to include an item on a feedback form, a specific question during LOFT/LOE debriefing, or request for information at the end of a ACRM awareness article or reminder.

Developing Additional CRM Procedures as Needed

Crew feedback and performance data provide essential information to determine the need for additional procedures. Another important source is instructor/evaluator feedback about what they are seeing in the simulator and on the line. Finally, airline safety reports may show a rise in a particular type of incident whose frequency could be reduced through some combination of procedure and training. If an airline actively collects information about possible CRM problem areas, need identification and development of additional procedures is facilitated.

Airlines should treat the development of the first set of procedures as a valuable learning process, and they should maintain key elements of that team to help with additional development. By utilizing the experience gained from the first

round, airlines can simplify the development process and work with a more efficient team. Therefore, one of the keys to the successful development of additional CRM procedures is planning for that need during the initial procedures development. At that point an airline should evaluate who the long-term players will be and take steps to ensure that those individuals can stay involved in the ongoing elements of the ACRM program.

Implementing ACRM for the Instructor/Evaluator

Refining Instructor/Evaluator Assessment Tools

√ Refinement of the LOFT/LOE gradesheet is one of the most important steps in maintaining a reliable and standard crew performance assessment team.

The instructors should consider the refinement of the LOFT/LOE gradesheet as one of the most important steps in an organization's drive to advance a reliable and standard crew performance assessment team. As discussed in Part 4, a number of guidelines should be considered in the design of the gradesheets, including organizing them around event sets using a standard rating scale and representing that scale on every page. Once the basic elements of the gradesheet are in place, the instructors should be encouraged to refine any of the elements that may be causing assessment problems.

Early indicators of problems with the gradesheet include finding that required fields are not being completed or are being completed with out-of-range values. These types of problems can easily be addressed at an instructor/evaluator meeting, and normally the refinement involves correcting a data field heading or adding more information or instructions. More subtle problems may emerge when lack of agreement or a large amount of variance is observed for specific items on the gradesheet. This lack of agreement often is associated with one or more observable behaviors that have not been well worded or require additional standards. One of the benefits of ACRM's reliance on good data collection is that these problem items can be readily identified. Again, instructor/evaluator meetings can be used as a forum for refining the wording or further specifying the standard.

The rating scale is another area that may require refinement. When airlines start to use a more precise rating scale, as is required under ACRM, difficulties can arise in defining what is "Standard" and what is "Not Acceptable" in specific situations. One point of confusion can develop around the difference

between “Standard” performance and “Average” performance. Some evaluators consider what they normally see on the line or in the simulator as “Standard” performance. Under ACRM, that is defined as “Average” performance; “Standard” performance is the behavior that meets specific criteria. Instructor/evaluators can benefit from the further specification of “Standard” and/or “Not Acceptable” criteria for specific items. Specification of these criteria can be time consuming, so evaluators must work to select those items causing the greatest amount of difficulty.

Ensuring Evaluator Reliability Prior to LOFT/LOE Assessment

√ ACRM promotes the use of videotapes of crew performance in conjunction with the IRR process to establish evaluator reliability.

ACRM promotes the use of videotapes of crew performance in conjunction with the IRR process to establish evaluator reliability. Videotapes of real crew performance, as opposed to tapes of crews acting a part, allow a group of instructors to observe and rate the type of performance they are likely to see in LOFT/LOE sessions. The IRR process is used to provide those crews with the results of their ratings along with measurements of their agreement, congruency, consistency, and sensitivity.

An airline should strive for a specified level of reliability prior to conducting the LOFT/LOE portion of crew training. One way to ensure that the instructor/evaluators reach that level is to pick a realistic set of benchmarks. If an airline does not have substantial experience in the standardization of assessment, it is reasonable to establish a more moderate set of benchmarks. For example, Williams, Holt, & Boehm-Davis (1997) propose a range between .7 and .8 for an Agreement Index benchmark. For airline with little or no experience in this area it would prudent to select a goal of .6 to .7 across all items being rated and work diligently to establish that level. From experience with a range of airlines, it is difficult to establish a .8 to .9 level of agreement, especially when working with a complex LOE and real crew behaviors. Over time, an airline can raise its benchmarks as the assessment team develops strategies to maintain good reliability. The proposed benchmarks for the IRR components (Williams et al., 1997) are:

Agreement	.70 to .80
Congruency	.50 to .80
Consistency	.65 to .80
Sensitivity	.40 to .60

√ Other strategies for meeting an IRR benchmark include removing some items that are causing rating problems.

An airline should also consider several other strategies in meeting a level of reliability prior to the start of LOFT/LOE assessment. If a particular item on the gradesheet is causing problems, and if, after trying to refine the items, that problem persists, consider the importance of that item and whether it could be removed. Sometimes, the refinement or removal of just a few items allows an airline to meet its Agreement Index benchmark. An airline may also have to look at its assessment team and determine whether all the members can be trained to the benchmark within the time required. Additional training may be an option for some team members and, in other cases, some individuals may decide they do not want to be part of the assessment team. Benchmarks give airlines a concrete way of knowing whether they have established the reliability goals.

Providing Instructor/Evaluators with Ongoing Feedback

The training department should plan on providing instructors/evaluators with ongoing rating feedback at appropriate times. By maintaining current instructor data, the training department and instructor/evaluators can determine the frequency and exact form of that feedback. In general, if an assessment team continues to meet its benchmarks and there are no indications of rater bias, the feedback can be on a monthly or quarterly basis depending on instructor preference and airline resources to provide the feedback. If the assessment team cannot maintain the benchmarks, then more frequent feedback is necessary.

Several forms of feedback should be considered. Instructor/evaluators should be provided with both individual and group measures of IRR. Consider emphasizing the group measures by presenting the results that emphasize group averages rather than individual scores. This should be done to promote the team approach to assessment where the goal is to have all individuals meet a standard. When there are problem areas it can be helpful to provide some members with individual feedback that shows the areas where they depart from the group norm. Encourage those individuals with specific problems to work with the group in resolving the issues. ACRM assessment should always be approached as a group effort, where the team, and not just one individual, needs to solve any outstanding problems.

Planning and Establishing Standardization Meetings

The airline and training department should help the instructor/evaluators plan and hold ongoing standardization meetings. To maintain confidence in the crew performance data, instructor/evaluators need to meet periodically and develop a procedure that will allow them to determine whether they are still keeping their IRR benchmarks. An assessment team may have achieved a good level of reliability, but with the change in team members and shifts in individual rating standards, it is important to get the team together and determine their level of reliability at regular intervals. The standardization meetings can take the form of group meetings, short workshops, or part of an instructor/ evaluator recurrent training session. These meetings usually include discussions of group and individual problems, refinement of the gradesheets and standards, and rating of new crew performance tapes based on two or more event sets from current LOEs.

√ Assessment standardization is a long-term development process which instructor/ evaluators should direct with organizational support.

Consider ways to involve instructors in the planning and implementation of the standardization meetings. This fits in with the team approach to crew performance assessment, where the group looks out for the individuals and takes responsibility for maintaining its standards. Turn each session into a positive experience even if the group is having substantial difficulties maintaining the desired level of reliability. This can be done by emphasizing several positive data trends, and by making sure that everyone leaves with some good tips about how to manage or assess the LOFT/LOE session, use the gradesheet, or provide better debriefings. The airline should treat this as a long-term development process, which the instructor/evaluators should be able to direct with organizational support.

Maintaining Standards and the IRR Process

Identifying LOE/LOFT Event Set Problems

√ The IRR process permits identification of probable causes with a greater degree of certainty.

When LOFT/LOE crew performance data shows a drop in ratings, there can be a range of causes from properties of the LOE scenario to lack of crew training in specific areas. The IRR process allows the airlines to isolate probable causes with a greater degree of certainty than has been possible up to this point.

Some early warnings about problems with one or more event sets can surface during instructor/evaluator training. Whether in large or small group assessment sessions, if one or two event sets show less agreement and follow up analysis shows lower consistency for those event sets compared with all or just the remaining event sets, then there is likely a problem with the items being rated. If there is no pattern of problems during the training phase but a pattern arises after the instructor/evaluators start to administer a number of LOFT/LOE sessions, then the problem may be caused by some element within the event set or by a limitation with the simulator. When analyzing the crew performance data, if crew performance is lower for just one or two event sets, look for problems in administering a particular item in the event set. For example, the event set may require simulating a certain malfunction, but the simulator fails to display or simulate all required cues. These types of problems should surface early in the new LOFT/LOE cycle and are some of the easier to solve. Once the cause has been isolated within a specific element of an event set, the solution is usually a minor change to the scenario, script, or gradesheet. If that does not solve the problem, then the data could be pointing to crew performance difficulties.

Identifying Individual and Group Instructor/Evaluator Problems

One point of this causal analysis is that lower ratings do not automatically mean poor crew performance. Once an airline has established and maintains a standard assessment, they can use the resulting data to more quickly and accurately pinpoint the problems. In addition to problems with the scenario and the gradesheet, there may be either individual or group problems with the instructor evaluators.

√ Lower ratings on several items may point to areas where instructors do not have the same interpretation of an event set or standard.

Under ACRM, a substantial amount of instructor/evaluator training is provided, but it is never possible to cover all items that are to be graded anticipating every possible crew behavior. Once instructor/evaluators start administering LOFT/LOE sessions, the data may show a pattern of lower ratings in certain areas and that some of the group IRR benchmarks are not being met. This could indicate a problem where the instructor/evaluators do not have the same interpretation of an event set or the standards of performance. This type of group problem can arise when what was thought to be a clear criterion or standard was actually ambiguous or did not account for the observed crew responses.

In such cases, instructor/evaluators cannot give a standard assessment and better LOE specification or additional group training is required.

In some cases, the IRR measures will show specific individual problems. For example, one or two instructors will not meet the individual level consistency benchmark, while the group measure does. In such a case, those individuals may also fail to meet the sensitivity benchmark, and it is likely that they are having a problem discriminating standard vs. non-standard performance. This problem may arise with rater bias or not using the group criteria when applying the rating scale. An airline may decide to work directly with those individuals, but should consider having the assessment team work as a group to resolve the problems. Any lack of standardization, whether group or individual, is a team problem, and members should feel comfortable turning to the team for help.

Identifying Individual or Crew Performance Problems

√ Monitoring for group crew performance problems allows an airline to be proactive by addressing a minor problem before it turns into a set of incidents or an accident.

Once the event set, gradesheet, and instructor/evaluator causes have been eliminated, then the assessment team and the organization can have confidence in identifying either individual or larger group performance problems. Of the two, individual crew performance problems are most frequent and show up as below average ratings in one or more performance areas. Statistical methods can be used to objectively identify these below-standard patterns of performance. With ACRM, the training department can draw better inferences from such patterns, going beyond the old conclusion that the must be a weak individual or crew. First, the training department can verify that this is a bona fide problem with the individual by making sure the instructor/evaluator has good congruency and consistency with the rating team. This is a particularly important step to take if the case involves a possible failure. All involved need to be confident that this is not a case of one instructor placing unreasonable demands on a particular crew or individual.

A careful analysis of all the gradesheet results, along with the debriefing summary, can help the instructor/evaluator or training department analyst pinpoint the problem areas that will require additional training. The old approach of just giving the crew more CRM training does not apply. Under ACRM, remedial training addresses specific behavioral and skill grouping aspects of CRM where the crew was below standard.

If over time a pattern of crew problems becomes evident in a specific area, it is likely that crew training in that area needs to be modified. This is one reason the "Below Standard" rating is so important, because it allows you to identify marginal problems before they turn into "Unsatisfactory" performance. Monitoring for group crew performance problems allows an airline to be proactive in its training development where it can address a minor problem before it turns into a set of incidents or an accident.

Identifying Trends in Crew Performance

√ A major payoff to establishing and maintaining a standard assessment is the ability to identify long-term trends in crew performance.

A major payoff to establishing and maintaining a standard assessment is the ability to identify long-term trends in crew performance. Without the team approach to assessment and the data establishing that the IRR benchmark have been met, there is too much variation in the data to make meaningful interpretations of performance trends. In such cases, a significant increase or decrease in crew ratings may be due to many factors not directly related to crew performance.

With a standard assessment established over a period of time, significant improvements or decrements in crew performance can be analyzed with confidence. For example, if there is a consistent trend over a year or more showing improvement in some aspect of crew performance, the training department can conclude that aspect of the training is working as designed. If that positive trend is in the 'Above Standard' area, it may be possible to move some of the training time from that area to another area of crew performance. In cases of significant negative trends, a detailed analysis should help the airline to pinpoint the problem area and improve or redesign that part of the training.

Using Performance Data to Improve CRM Procedures and Training

Ensuring Reliable Data

With the large amount of data that can be produced under ACRM it is easy to lose sight of the big picture. The ACRM program, coupled with the use of the IRR process, is designed to

Provide an airline with ongoing improvements in CRM performance. Once the CRM procedures have been developed and the ACRM training implemented, an important short-term goal is to establish and maintain the collection of reliable crew performance data. This may sound like a relatively easy task, but it should be noted that very few airlines to date have been using appropriate procedures or collecting the proper type of data to assure reliability.

√ Reliable crew performance data are a minimum requirement for airlines to successfully improve the ACRM program.

Reliable crew performance data are a minimum requirement for airlines to successfully improve the ACRM program, and airlines should be prepared to follow certain steps to ensure that reliability. Reliable crew performance data allow airlines to pinpoint the problems and their causes. With confidence in specific causes, an airline can then invest the needed resources to correct the problem. Within the ACRM framework, airlines do not solve crew performance problems by increasing or changing their CRM training based on what other airlines or organizations are doing. Rather, an ACRM airline develops airline-specific CRM procedures or provides focused training to address locally defined CRM skills.

In order to ensure reliable crew performance data, an airline should start with the instructor/evaluators empowering them to develop standard assessment teams. In addition, airlines should ensure that the instructor/evaluators have standardization meetings to strengthen the teams and collect assessment performance data. Along these lines, the organization should provide the training department and instructors with all the support needed to maintain that standard assessment. Finally, the organization should place a high value on reliable data throughout the organization and act on that data when it points to the need for additional procedures or training.

Linking Performance Problems to CRM Skills

√ Knowing a specific performance problem is a first step. The next step is to link that performance problem to one or more CRM skills.

The discussion of crew performance problems up to this point has concentrated on the identification of specific observable behaviors or CRM areas based on LOFT/LOE gradesheets or checks. Recognizing a specific performance problem is an important first step. The next step is to link that performance problem to one or more CRM skills; this step is needed to determine the exact training and/or CRM procedural needs.

Research work under ACRM has focused on the development of CRM procedures and a structured assessment based on the

IRR process. Other airlines have started work on developing CRM skills lists. Both of these efforts should be combined so that airlines can link their crew performance problems to CRM skills. Presently there are no accepted standards for developing CRM skill listings, but there are a number of guidelines that should help airlines determine whether they have a usable listing.

Like the CRM procedures, a CRM skill listing should have been developed by a team rather than by one or two developers. The team should recognize the organizational needs, and should have a clear definition of CRM skills. For example, one airline specified that CRM skills have to be trainable, related to one or more CRM topics, can be evaluated by instructor/evaluators, and have to improve individual performance in a crew setting. From experience with aviation task analyses it is evident that there are at least 30 CRM skills, and that an airline should be concerned with training at least half of those skills. Airlines that list just a few CRM skills are probably talking about skill clusters which are at too high a level to help in specifying required training or additional CRM procedures.

Once the airline has a CRM skill list, they can work with instructor/evaluators or other forms of SMEs to link the crew performance problems to the most likely skills. This linkage should not be limited only to CRM performance problems. When making that linkage, the instructors and SMEs should also review the technical problems to see if there may be a CRM cause. The first attempt at this linkage may be tentative, but, over time, an airline should establish a tested set of links between what they are assessing and what they need to train.

Identifying Training Areas that Need Improvement

√ ACRM is not limited to the development of CRM procedures, rather, It is strongly linked to all CRM development and training.

ACRM is not limited to the development and assessment of CRM procedures. It is strongly linked to the improvement of crew effectiveness throughout the organization. Therefore, crew performance problems do not automatically lead to the development of additional CRM procedures. Once the performance problems have been linked to CRM skills, the training department can determine whether just training or a new procedure with training is required based on the type of skills, SOP, and training currently in place.

An airline under ACRM has a number of things to consider

when analyzing possible training needs, and most of them are related to the nature of the CRM skill that is linked to the performance problem. If it is the type of CRM skill that does not require substantial practice in order to master, then it may be a good candidate for a limited training intervention. Some strategies or advanced skills fall into this category, and all that may be needed is an additional module and a small amount of practice in LOFT sessions. Other types of skills require a lot of practice, making them good candidates for a CRM procedure. It is the repetitive nature of SOP that provides crews with much practice and the opportunity to master specific procedures along with their related CRM skills.

Specifying Additional CRM Procedures

The ongoing nature of ACRM does not mandate a constant stream of additional CRM procedures, but when crew performance problems and skill types point to the need for an additional CRM procedure, the ACRM framework is there to facilitate its specification and implementation. It should be emphasized that the success of an ACRM program is not measured by the number of CRM procedures it has produced, but by the improvements to crew effectiveness. It is possible to have an excellent ACRM program with relatively few CRM procedures.

√ The organization should maintain key elements of the development team to help with additional CRM procedure development.

An organization should consider the development of the first set of CRM procedures as a learning process that can be stored and reused in the case where additional procedures are needed. The organization should maintain key elements of the original team to help with additional development by capitalizing on the experience gained from the first round. This can be difficult at many airlines where individuals tend to cycle in and out of departments, especially the training department. If an airline places a premium on making key members available, it can simplify any additional development and have a much more efficient team. A key to the successful development of additional CRM procedures is planning for that eventuality during the initial procedures development. An airline should identify the long-term players and ensure that those individuals stay involved in the ongoing ACRM program.

Guidelines for Organizational Implementation

1) Management should be kept informed of the general trends, both crew performance and instructor standardization, and union representatives should be provided with data that establishes the reliable and accurate qualities of the ACRM crew assessments.

2) Under ACRM it is possible to collect a large amount of CRM performance data which can result in an overwhelming amount of information. There is a tendency to try and report everything, so care should be taken not to report too much data and overloading those who need the information.

3) In planning for the organizational announcement, consideration should be given to a sequence where the CRM procedures are announced prior to the start of crew training and possibly before or during instructor/evaluator training. This should be planned as a relatively short sequence, where the crew training and implementation follow closely.

4) The announcement of CRM procedures should include a detailed specification of the new policies and procedures. With content and format of paramount importance, the announcement should be carefully coordinated with flight standards and documents departments.

5) As part of coordinating the release of new CRM procedures with document updates, a formal review of the camera-ready material should be scheduled because there will be errors, and having a number of informed people review the material increases the chances of catching those mistakes.

Guidelines for Implementing ACRM for Instructor/Evaluator

1) The gradesheet should be used as a focal point in establishing reliable crew assessment. Instructor/evaluators should be encouraged to work on the refinement of the LOFT/LOE gradesheet as an effective way to develop an assessment team.

2) The airline should work with the instructor/evaluators to establish a specified level of rater reliability prior to conducting the LOFT/LOE portion of crew training. One way to ensure that the instructor/evaluators reach that level is to work with a realistic set of benchmarks.

3) Individual instructors with specific assessment problems should be encouraged to work with the group in resolving the issues. ACRM assessment should be approached as a group effort where the team and not just one individual needs to resolve any outstanding problems.

4) The airline should treat assessment standardization as a long-term development process, giving the instructor/evaluators the organizational support that will allow them to direct the process.

Guidelines for Maintaining Standards and IRR

1) When LOFT/LOE crew performance data shows a drop in ratings, the airline should consider a range of causes from properties of the LOE scenario to lack of crew training in specific areas. The IRR process allows the airlines to isolate probable causes with a greater degree of accuracy than has been possible up to this point.

2) Once instructor/evaluators start administering LOFT/LOE sessions, the data may show a pattern of lower ratings for certain items, with some of the instructor-group IRR benchmarks not being met. In such cases the airline should consider the possibility that some instructor/evaluators do not have the same interpretation of an event set or the standards of performance.

3) Airlines should monitor for crew performance problems in order to address minor problems before they turn into incidents or accidents. Minor problems are often identified by the rating of acceptable but "below standard."

4) Airlines should understand that a major payoff to establishing and maintaining a standard assessment is the ability to identify long-term trends in crew performance. Without data establishing that benchmarks have been met, airlines will find it difficult to make meaningful interpretations of performance trends because of the unknown reliability and accuracy of the data.

Guidelines for Improving CRM Procedures and Training

1) Once an airline has identified a specific performance problem, it should work to link that performance problem to one or more CRM skills. This step is needed to determine the exact training and/or CRM procedure needs to address the problem.

2) Airlines should recognize that the collection of reliable crew performance data is a minimum requirement for improving crew performance. Airlines should be prepared support the training department and instructor/evaluators in their efforts to establish and maintain a reliable assessment system.

3) Airlines should understand that ACRM is not limited to the development and assessment of CRM procedures. ACRM is strongly linked to improving overall crew effectiveness at all levels.

4) The organization should maintain key members of the original ACRM development teams to help with additional development by capitalizing on the members' experience gained from the initial program effort.

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Appendix A

Summary of ACRM Guidelines

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CRM Procedures Development Guidelines

Guidelines for Identifying Own Carrier Needs

1) The identification of CRM problem areas is ongoing, and to ensure the long-term success of the ACRM program, an airline should identify a few operationally significant CRM problems at the beginning of the development process.

2) Airlines that do not have detailed CRM performance data should use industry accident reports and incident summaries to identify general problem areas, and then the airline should use specific aircraft accident and incident reports to obtain the details.

3) When existing airline data or reports do not point to a clear CRM cause, the development team should consider interviewing one or more individuals from the department that collected the data or produced the report.

4) The needs survey should be designed primarily for instructors, evaluators, and checkairmen and should investigate at least two areas: 1) CRM performance problems by phase or subphase of flight, and 2) performance problems by CRM topic or element.

5) The CRM procedures development team should be aware of the benefits and possible liabilities of each procedure they plan to add. The team's mandate to identify areas for new or modified procedures should be tempered with the realization that too many procedures, or ones in the wrong place, can be as problematic as not adding any new procedures.

Guidelines for Specifying CRM Procedures

1) For initial procedure development, an airline should first identify weaknesses in existing procedures and then review airline philosophy and policy to clarify those needs. Based on that information, an airline should then identify possible locations for the new procedure as different forms (e.g., briefs, checklists, etc.) are being considered. Once that is done, the airline should work on the procedure's content.

2) When reviewing existing SOP and documentation, look for problems with existing procedures, lack of consistency, as well as gaps, where the performance problem is not being addressed.

3) In many cases, crew performance problems become apparent at times of relatively high workload, and adding a procedure at that point could further increase workload. The CRM procedures development team should consider times prior to the buildup in workload to identify periods of lower workload where a procedure would be more effective.

4) The main forms of CRM procedures include briefs, calls, checklist items, guides, flows, non-normal procedures, and quick reference items. One of these forms should be sufficient to address most problems, but there may be cases where the integration of two forms is less intrusive and provides a better fit with the airline's SOP.

Guidelines for Refining CRM Procedures and Media

1) The procedure prototype development (working with a mock-up of the procedure) is an important part of the refining process where the development team interacts with a range of uses to determine the best form and content for the CRM procedures. The refinement step should be iterative with the feedback from each review being incorporated into the design to achieve one or more CRM procedures that will be adopted by the users and will contribute to performance improvements.

2) User feedback sessions should include five to ten individuals who work well together. Working with too small a group (less than five) is less efficient and the individuals are less likely to be stimulated by a wider range of comments. Working with too large a group (substantially more than ten) is more difficult to manage, and the feedback will likely cover a broad range of topics but not in depth.

3) If formal user feedback sessions are not possible, consider holding informal small group or individual sessions as pilots and instructors are available in the training center or flight operations. Meaningful feedback should be obtained from a cross section of pilots and instructors either formally or informally.

4) Organizational presentations, generally made after user feedback sessions, are similar to those made to the users, but with fewer operational details and more information about the ACRM program. Emphasis should be on the need for the CRM procedures, the development process, and the feedback process.

Instructor/Evaluator Training Development Guidelines

Guidelines for Planning and Developing Introductory ACRM Modules

1) When planning for the development of instructor/evaluator training, consider not only the development process but also the actual implementation of the training. Try to plan so that the ACRM training will be ready at a point where instructors receive scheduled recurrent training. ACRM instructor training should be as integrated as possible with the rest of their training and should be treated as a minor expansion of existing training rather than a substantial addition.

2) One initial instructor/evaluator training module should explain that the procedure development process has translated CRM principles into operational procedures, providing the airline with an opportunity to emphasize important CRM actions that should be practiced by all crews.

3) When presenting CRM procedures to instructors it should be explained how each procedure was developed based on airline needs and incident data. The procedure, in its actual form, should then be presented, highlighting each of its main features. Finally, consider including a set of questions or other form of instructor activity to ensure that the instructors understand the main elements of the new CRM procedure.

4) Each new CRM procedure has implications for crew training because it places an emphasis on the crew's development of specific CRM behaviors in the operational context. Because of this emphasis on CRM skills, instructor/evaluators should have an understanding of the nature of skill development and its implications for the training of these new CRM procedures.

Guidelines for Developing LOFT/LOE Modules

1) The effectiveness of LOFT/LOE sessions depends in good part on script detail and proper administration of that script during the simulator session. The scenario should be carefully scripted with ATC communications using correct terminology, timing, and routing. Precise ATC communication scripting will also enhance session realism.

2) LOFT/LOE briefings are an important part of the session, and instructor/ evaluators should brief crews to act as they would in line operations dealing with everyone, including the Flight Attendant, as if they were actually present throughout the LOFT/LOE.

3) Event sets should be used in the development of LOFT/LOS scenarios under an ACRM program to help instructor/evaluators pinpoint key aspects of crew performance for each segment of the flight. Instructor/evaluators should be trained in the functions and use of event sets.

Guidelines for Establishing Assessment Standards

1) When an instructor/evaluator group shows low inter-rater reliability, in addition to more training, there may be a need for a better rating form or clearer rater standards to help the group work together on the basic parameters of the assessment process.

2) The instructor/evaluator group should establish specific standards for elements to be rated. This is especially true for elements that may cause problems or are new to the instructor/evaluators. In most cases the new CRM procedures should have explicit standards to reduce rating difficulties.

3) When making crew performance assessments there is a high probability of rater bias, and the common forms of bias that should be addressed through instructor/evaluator training include central tendency, halo error, and leniency error.

4) If the airline has not already implemented some form of IRR training, IRR should be presented as a group process beginning with an overview of IRR, followed by the critical nature of crew assessment, the IRR measures, the gradesheet, rating scales, and examples of the criteria for each point on the scale.

Guidelines for Developing Standardization and Training Modules

1) Under ACRM, a substantial departure from a scripted and acted videotape is required. Consideration should be given to preparing standardization tapes working with real crews flying the actual LOFT/LOE for that year in a representative simulator without the benefit of coaching or preparation.

2) Instructor/evaluators should be provided with accurate and immediate rating feedback from the start of their assessment training through standardization sessions. The first rating sessions may take place in a larger group using spreadsheets and charts showing individual and group data along with appropriate benchmarks that the group is trying to meet.

3) After individual and group feedback is provided and explained, instructor/evaluators should be encouraged to develop new rating rules and strategies. This cycle of practice, feedback, and discussion allows the participants to improve their reliability, and should continue until group benchmarks have been met.

4) Under ACRM assessment there should be ongoing training and standardization to establish confidence in the crew performance data, its indications about CRM procedures, and the procedures' effects on overall crew performance.

5) Instructor/evaluators should be encouraged to take an active team approach to standardization sessions. Instructor/evaluators should see these sessions as an essential part of maintaining their assessment standards. One way to ensure team involvement is to encourage instructor/evaluators to control the standardization sessions, and ultimately to determine their own schedule and length of cycle between sessions based on their rating performance.

ACRM Crew Training Development Guidelines

Guidelines for Planning ACRM Crew Training

1) Crew training can be the largest cost of the ACRM program, so the development team should use the planning stage to determine ways for reducing the cost of that training. The team should consider integrating ACRM with existing CRM training (see Guideline 2 below) and coordinating ACRM training with other training cycles (see Guideline 3 below).

2) The development team should consider extending or modifying existing crew training to meet ACRM training needs. Much of the existing CRM recurrent training can be modified from an emphasis on general CRM principles to a concentration on the specific CRM procedures.

3) The development of ACRM crew training should be coordinated not only with crew training cycles but also with instructor/evaluator training and the implementation of the new CRM procedures.

4) ACRM crew training development and implementation should include a review process by scheduling ACRM crew training curriculum reviews that involve key organizational personnel who control the future of the ACRM program.

Guidelines for Developing CRM Procedures Crew Modules

1) When training crews about the need for CRM procedures, it should be emphasized that the crews have been an essential part of the development process with crew representatives involved in developing the current training. In the future, crewmembers should stay involved and help identify new CRM procedural needs as they become apparent.

2) A key component of new CRM procedures is the degree to which they support the development of CRM skills. To help crews practice and master the appropriate skills, crews should be informed of the relationship between the CRM procedures and their CRM skill development.

3) It should be explained that the new CRM procedures have profound implications on the way crew performance is assessed. For example, if it is the case, crews should understand that a detailed simulator-based assessment has been developed to collect crew performance data after the ACRM crew training has been implemented.

4) It should be explained that detailed measures of crew performance were developed in the research stages of ACRM specification and analysis. These more accurate crew performance measures will help evaluators provide more standard crew assessments, and crews should expect a fair assessment from all instructor/evaluators.

Guidelines for Developing Crew Effectiveness Modules

1) Crew effectiveness is a core concept of any ACRM program, and crew training should present its main characteristics. Crew effectiveness should be enhanced by using the new CRM procedures that will help crews develop better CRM skills.

2) The ACRM program provides a framework that allows airlines to integrate CRM with technical at the level of SOP. ACRM crew training should emphasize this integration at the operational level as well as at the crew performance assessment level.

3) It should be explained that the new CRM procedures have profound implications on the way that crew performance is assessed. For example, if it is the case, crews should understand that a detailed simulator-based assessment has been developed to collect crew performance data after the ACRM crew training has been implemented.

4) It should be emphasized that crews form the core of the ACRM program, and crews should be encouraged to provide feedback about the new procedures as well as additional CRM procedures that can improve crew effectiveness.

Guidelines for Developing Briefing/Debriefing Modules

1) The LOFT/LOE briefing should prepare the crew for an effective training or assessment experience. One of the first things that the LOFT/LOE briefing should do is establish the role of the instructor as well as the role of the crew throughout the session.

2) The LOFT/LOE briefing should emphasize specific things the crew can do to make the session realistic and a valuable training experience. The crews should act as they would under similar situations on the line, and they should not try to operate in a manner calculated to provide the ideal training department solution.

3) ACRM crew training should reinforce good crew practices in conducting a constructive debriefing. Crews should understand that debriefing is an essential part of the LOFT/LOE and the main way of providing crew performance feedback.

4) ACRM crew training should introduce the concept that briefings can also be extended to line operations and used by crews to reinforce positive performance and learn from any problems experienced during the flight.

Guidelines for Developing Crew LOS Assessment Modules

1) Crews should be presented with the LOS CRM training objectives in the context of relevant technical objectives because crews are generally more comfortable and familiar with the technical objectives.

2) A major step in the LOS development process is the identification of incidents that highlight the need for specific CRM procedure, and crews should understand that the LOS is related to actual incidents that have happened to pilots flying in conditions similar to theirs.

3) Crew training should include one or more activities that allow crews to analyze incidents used to develop the new CRM procedures. One activity that has provided valuable crew training is having crews identify the CRM causes for each incident.

4) Crews should be given an explanation of how the event set is used under ACRM to help focus the specific elements of crew performance in the LOFT/LOE assessment. The event set helps training and evaluation move from general CRM markers to specific crew behaviors.

ACRM Implementation Guidelines

Guidelines for Organizational Implementation

1) Management should be kept informed of the general trends, both crew performance and instructor standardization, and union representatives should be provided with data that establishes the reliable and accurate qualities of the ACRM crew assessments.

2) Under ACRM, it is possible to collect a large amount of CRM performance data, which can result in an overwhelming amount of information. There is a tendency to try and report everything, so care should be taken not to report too much data and overloading those who need the information.

3) In planning for the organizational announcement, consideration should be given to a sequence where the CRM procedures are announced prior to the start of crew training and possibly before or during instructor/evaluator training. This should be planned as a relatively short sequence, where the crew training and implementation follow closely.

4) The announcement of CRM procedures should include a detailed specification of the new policies and procedures. With content and format of paramount importance, the announcement should be carefully coordinated with flight standards and documents departments.

5) As part of coordinating the release of new CRM procedures with document updates, a formal review of the camera-ready material should be scheduled because there will be errors, and having a number of informed people review the material increases the chances of catching those mistakes.

Guidelines for Implementing ACRM for Instructor/Evaluator

1) The gradesheet should be used as a focal point in establishing reliable crew assessment. Instructor/evaluators should be encouraged to work on the refinement of the LOFT/LOE gradesheet as an effective way to develop an assessment team.

2) The airline should work with the instructor/evaluators to establish a specified level of rater reliability prior to conducting the LOFT/LOE portion of crew training. One way to ensure that the instructor/evaluators reach that level is to work with a realistic set of benchmarks.

3) Individual instructors with specific assessment problems should be encouraged to work with the group in resolving the issues. ACRM assessment should be approached as a group effort where the team, and not just one individual, needs to resolve any outstanding problems.

4) The airline should treat assessment standardization as a long-term development process giving the instructor/evaluators the organizational support that will allow them to direct the process.

Guidelines for Maintaining Standards and IRR

1) When LOFT/LOE crew performance data shows a drop in ratings, the airline should consider a range of causes from properties of the LOE scenario to lack of crew training in specific areas. The IRR process allows the airlines to isolate probable causes with a greater degree of accuracy than has been possible up to this point.

2) Once instructor/evaluators start administering LOFT/LOE sessions, the data may show a pattern of lower ratings for certain items with some of the instructor-group IRR benchmarks not being met. In such cases, the airline should consider the possibility that some instructor/evaluators do not have the same interpretation of an event set or the standards of performance.

3) Airlines should monitor for crew performance problems in order to address minor problems before they turn into incidents or accidents. Minor problems are often identified by the rating of acceptable but "below standard."

4) Airlines should understand that a major payoff to establishing and maintaining a standard assessment is the ability to identify long-term trends in crew performance. Without data establishing that benchmarks have been met, airlines will find it difficult to make meaningful interpretations of performance trends because of the unknown reliability and accuracy of the data.

Guidelines for Improving CRM Procedures and Training

1) Once airlines have identified a specific performance problem, they should work to link that performance problem to one or more CRM skills. This step is needed to determine the exact training and/or CRM procedure needs to address the problem.

2) Airlines should recognize that the collection of reliable crew performance data is a minimum requirement for improving crew performance. Airlines should be prepared support the training department and instructor-evaluators in their efforts to establish and maintain a reliable assessment system.

3) Airlines should understand that ACRM is not limited to the development and assessment of CRM procedures. ACRM is strongly linked to improving overall crew effectiveness at all levels.

4) The organization should maintain key members of the original ACRM development teams to help with additional development by capitalizing on the members' experience gained from the initial program effort.

Appendix B

Sample Instructor/Evaluator and Organizational Forms

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Sample Instructor/Evaluator Questionnaire

1) *Rank order the following CRM items giving number 1 to the item where crews had the most problems and number 10 to the item that crews had the least problems (in your 199-recurrent training). Use all the numbers from 1 to 10 with no duplicates.*

___Big Picture shared with team F/A, F/O, others.

___Bottom Lines established, communicated and maintained.

___Briefing - sets tone, calls for questions, participation encouraged, states how SOP deviations will be handled.
___Conflicts - Acknowledged and resolved. Atmosphere conducive to open communications.

___Crew self critique - crew provides information to self correct given at appropriate times with whole crew. Covers positive and negative performance (What's right not who's right)
___Inquiries and assertiveness - crewmembers speak up with appropriate persistence until agreement achieved. All are encouraged to state recommendations.
___Leadership/followership - Balance between authority and assertions. Climate appropriate to situation. Adheres to SOP, uses all resources, manages time for task accomplishment.
___Participation in decision process encouraged - operational decision are clearly stated. Crewmembers acknowledge understanding of decisions.
___Preparation/planning - crew stays ahead of curve, monitors developments, maintains S.A., Big Picture shared. Red flags recognized and resolved. Cross checking A.C. status.
___Workload/distractions avoided - Overload in self and others reported. Tasks prioritized to deal with primary flight duties first, recognizes distractions.

Specify one or two typical CRM problems for the items with the most crew difficulty (those you have ranked 1, 2, and 3) and provide a brief reason for the CRM problem.

2) Typical Crew Problems and Reasons for CRM item ranked 1: _____
_____
_____

3) Typical Crew Problems and Reasons for CRM item ranked 2: _____
_____
_____

4) Typical Crew Problems and Reasons for CRM item ranked 3: _____
_____
_____

6) Of the 11 ACA CRM items listed on the previous page, please specify the three for which ACA crews would benefit from additional training (you may use the CRM item numbers or leading word in the description to specify the items).

CRM item requiring additional training _____

CRM item requiring additional training _____

CRM item requiring additional training _____

7) *Rank the following Line Check items giving number 1 to the item where you most frequently observed CRM problems and 14 where you least frequently saw CRM problems. Use all the numbers from 1 to 14. Then, for items ranked 1 to 5, write a typical problem to the right.*

___Flight Planning _____

___Weight and Balance Procedures _____

___Aircraft Doc. & MEL _____

___Preflight _____

___Engine Starts _____

___Taxing _____

___Crew Briefing _____

___V-Speed Compliance _____

___Departure / SID Compliance _____

___Radar Use _____

___Clearance Compliance _____

___Navigation _____

___Stabilized Approach _____

___Approach Clearance Compliance _____

8) Briefly summarize an LOE/LOFT session where the crew had substantial CRM problems.

_____

_____

_____

_____

9) Briefly summarize a recent Line Check where the crew had substantial CRM problems.

_____

_____

_____

_____

10) What are the 3 most significant incidents that should be addressed in recurrent training?

Incident 1 _____

Incident 1 should be trained (check one) __ In Sim __ In Class __ By Home Study

Incident 2 _____

Incident 2 should be trained (check one) __ In Sim __ In Class __ By Home Study

Incident 3 _____

Incident 3 should be trained (check one) __ In Sim __ In Class __ By Home Study

Sample Organizational Climate Survey

This survey is designed to help develop effective ACRM training. The survey deals with your job and your interaction with the training department at this carrier. Please take 15 minutes to answer the questions on the front and back of each page and return it to xxx in the envelope provided. Your answers will be completely confidential--only summary data analyses will be provided to the appropriate departments. If you have any questions, please call xxx or xxx.

Job Satisfaction

ON MY PRESENT JOB, THIS IS HOW I FEEL ABOUT [*EACH STATEMENT BELOW*].

Please circle one of the following for each statement:

Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied

VD D N S VS	Being able to keep busy all the time.
VD D N S VS	The chance to do different things from time to time.
VD D N S VS	The chance to be "somebody" in the aviation industry.
VD D N S VS	The way my supervisor handles his or her employees.
VD D N S VS	The way my director of operations handles his employees.
VD D N S VS	The competence of my supervisor in making decisions.
VD D N S VS	The competence of my director of operations in making decisions.
VD D N S VS	The way my job provides steady employment.
VD D N S VS	Being able to do things that don't go against my conscience.
VD D N S VS	The chance to do things for other people.
VD D N S VS	The chance to tell people what to do.
VD D N S VS	The chance to do something that makes use of my abilities.
VD D N S VS	The way policies are put into practice at this carrier.
VD D N S VS	My pay and the amount of work I do.
VD D N S VS	The chance for advancement on this job.
VD D N S VS	The freedom to use my own judgment.
VD D N S VS	The chance to try my own methods of doing the job.
VD D N S VS	The physical working conditions of the job (e.g. temperature, noise, safety).
VD D N S VS	The way my co-workers get along with each other.
VD D N S VS	The praise I get for doing a good job.
VD D N S VS	The feeling of accomplishment I get from the job.
VD D N S VS	The degree of responsibility I have in this job.
VD D N S VS	The amount of time, personnel, and training this carrier provides for me to complete the job.

Please circle one of the following for each statement:				
Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**

Job Description

SA A N D SD This carrier sets very high job performance standards.

SA A N D SD My job requires strict adherence to exacting standards of quality and accuracy.

SA A N D SD There is pressure to continually improve my personal job performance.

SA A N D SD This carrier rewards a person for doing a good job.

SA A N D SD Job training resources at this carrier are very good.

SA A N D SD Equipment and personnel necessary to do the job are almost always available.

SA A N D SD Some people don't take much pride in their work at this carrier.

SA A N D SD My job gives me the chance to use my skills and abilities**.**

SA A N D SD Rewards and encouragements on the job usually outweigh the criticisms.

SA A N D SD Most employees are strongly motivated to achieve this carrier's work goals.

SA A N D SD My job makes a meaningful contribution and is important at this carrier.

SA A N D SD I get enough feedback so that I always know how well I am performing.

SA A N D SD This carrier's management emphasizes safety.

SA A N D SD Safety training programs are important.

SA A N D SD Safety is a strong priority in scheduling operations.

SA A N D SD Safety training is frequent enough to ensure safety.

SA A N D SD The Safety Officer position is a very important position at this carrier.

SA A N D SD Time pressures on the job can cause a decreased emphasis on safety.

SA A N D SD I wish I had more safety training.

SA A N D SD Some of my co-workers should have more safety training.

SA A N D SD I get the training I need from the Training Center.

SA A N D SD Training center personnel emphasize "what's right" rather than "who's right".

SA A N D SD The Training Center provides high quality training.

I work as a (check one): **__Check Pilot for 19 PAX A/C __Line Pilot for 19 PAX A/C**
__Check Pilot for 29 PAX A/C __Line Pilot for 29 PAX A/C
__ATS Flight Attendant __Line Flight Attendant
__Dispatcher __Ramp personnel __Management __Other

Which of the following statements best describes your contact with the Training Center:
(Please check the appropriate space)

___ I work currently at the Training Center

___ I have worked in the past at the Training Center

___ I have had repeated contact with the Training Center

___ I have had no contact or only occasional contact with the Training Center **(skip to the "COMMENTS" section)**

Please circle one of the following for each statement:				
Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**

Training Center

SA A N D SD	Training center job responsibilities are clearly defined and logically structured.
SA A N D SD	The training center concentrates on getting the right people to get the job done..
SA A N D SD	Who has the formal authority to make a training decision is sometimes unclear.
SA A N D SD	Training productivity sometimes suffers from lack of organization and planning.
SA A N D SD	The training cadres cooperate effectively to achieve this carrier's training goals.
SA A N D SD	Communication from trainers to training management is easy and effective.
SA A N D SD	Communication from training management to trainers is easy and effective.
SA A N D SD	Interactions in the training department are friendly.
SA A N D SD	Coordination in the training department can be a problem.
SA A N D SD	Training center personnel are aloof and distant toward each other.
SA A N D SD	The training department has close working relationships.
SA A N D SD	Training supervisors help develop the careers of the trainers.
SA A N D SD	Effective scheduling, coordinating, and planning comes from the top of the training department.
SA A N D SD	Training management is concerned with how the trainers feel as well as how they perform.

Please circle one of the following for each statement:
Strongly Agree Agree Neutral Disagree Strongly Disagree

SA A N D SD	For a particularly difficult training job, trainers can count on assistance from the top of the training department.
SA A N D SD	All levels of the Training Center participate fully in setting job standards and goals.
SA A N D SD	Training supervisors have trust and confidence in the trainers working for them.
SA A N D SD	Trainers have trust and confidence in the training supervisors.
SA A N D SD	Training supervisors try to enhance feelings of personal worth and importance among the trainers.

COMMENTS:

Thank you for your cooperation in this survey.

Appendix C

Sample ACRM Instructor/Evaluator Training Manual
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Appendix D

Instructions for Facilitating an IRR Training Workshop

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INTRODUCTION

Initially, facilitating an Inter-Rater Reliability (IRR) workshop can seem overwhelming. Yet, proper planning and attention to detail make this task much easier. This document was designed to walk you through an entire IRR training session. Using this facilitation guide, your airline carrier will have the knowledge and tools to be successful at conducting and benefiting from periodic IRR training. There are 6 major sections that proceed in chronological order. These sections describe each of the major steps in preparing for and conducting IRR training sessions, as well as interpreting and using IRR data. We caution you to pay close attention to detail in each step of the process in order to avoid problems down the line. The 6 Sections are:

- Section 1: Preparation for the IRR Workshop
- Section 2: Viewing and Rating the Video Segment
- Section 3: Data Analysis
- Section 4: Feedback and Discussion
- Section 5: Optional Post-Training IRR
- Section 6: Dissemination of Summary Document

It is important that as an IRR facilitator you are familiar with the mechanics of how to run an IRR workshop. In addition, you should be knowledgeable about the purpose and reasoning behind why IRR training workshops are conducted. The main goal of IRR training is to improve crew assessments. Good quality pilot and crew assessment is important for (1) providing fair evaluations of pilot and crew performance, (2) providing accurate information for fleet managers, (3) providing meaningful information for management, and (4) ensuring flight safety. The IRR rating exercises followed by detailed feedback are helpful in calling attention to rating discrepancies. Identification of rating discrepancies followed by IE input on how to resolve rating problems will improve the rating system.

The frequency with which you conduct IRR training is ultimately up to your organization. However, based on past experience training IEs using the IRR training principles and procedures, we recommend that IRR training take place at least on a semi-annual basis. In addition, we recommend that IRR training be part of the indoctrination training for new IEs. Of course, these recommendations are subject to change based on various factors such as frequent turnover in IE personnel, changes in the evaluation forms, or the results of previous IRR training sessions compared to corporate benchmarks.

Section 1: Preparation for the IRR Workshop

Preparation should begin approximately 2-3 weeks before the training workshop. In this section, the necessary training materials are prepared and compiled.

1. Subject Matter Experts (SMEs) select the videotape segments for use in the workshop (1 segment for each Event Set). These segments should cover a range of performance categories. For each video segment, the SMEs should agree on the level of performance exhibited. This is extremely important, as the IEs' (Instructor/Evaluators') ratings will be compared to the SMEs' ratings. In general, 6 segments are sufficient for a 2 hour training session. If you have time, you may also wish to develop 2-6 additional segments for a post-training test (optional, see Section 5, p. 19).

2. SMEs prepare the necessary pre-briefing information for each video segment. This should include contextual information, such as a description of what the crew has performed prior to this point in the video. In addition, critical information such as "gear speed exceeded" (which is not available on the tape) should also be prepared.

3. Copies of the LOE guide should be prepared for each Event Set that will be used in the training.

4. Copies of the LOE worksheets should be prepared. The worksheet pages should appear in the same order as the video segments. To make the rating sheets more user friendly, each sheet should be clearly labeled regarding the crew that is being evaluated and the Event Set that is taking place (e.g., "Crew 1, Event Set 1").

5. Immediately prior to the training, two computers should be prepared. These computers will be used to analyze the data. The optimal choice would be two Pentium computers with Microsoft Excel (Version 5.0) and two laser printers. To test the computers, load Microsoft Excel. From the "Tools" menu, choose "Add-Ins...". Select all of the "Analysis Toolpak" add-ins and all of the "MS Excel 4.0" add-ins. Test the IRR macros on both machines. Lastly, select a workspace area for the data entry task that can accommodate two people.

Section 2: Viewing and Rating the Video Segments

This section should begin on the day of the training workshop, as close to 8:00 am as possible. First, the IEs are given a brief orientation. Following this, the IEs individually rate the video segments. During the orientation and rating process, the facilitator should:

1. Provide the IEs with the day's schedule. An example schedule is:

8:00 - 10:00	Video viewing and rating by IEs
10:00 - 1:00	IEs discuss other issues and eat lunch while data are analyzed by the training facilitator(s).
1:00 - 3:00	Feedback session
3:00 - 5:00	Post-training video viewing and rating

2. Briefly acquaint the IEs with the rating forms, the rating guidelines, and the rating process. IEs should quickly examine the rating forms so that they know what is expected of them. The facilitator should then clarify ambiguities and answer any questions that the IEs may have about the rating process. (This step should take about 20 minutes to complete.)

3. Emphasize the necessity of no interaction among the IEs during the rating cycle. Laughter, emotional outbursts, and non-verbal communication can contaminate the IEs' ratings.

4. Have the IEs provide either their **PIN numbers**, or **3- letter** initials on the cover page of their rating packet. We recommend using 3-letter initials because, on occasion, IEs have had the same 2-letter initials, which created confusion during the feedback/discussion process.

5. Provide necessary contextual information to the IEs before each video segment. However, the facilitator should be very careful to avoid telling the IEs how to make their ratings. The video segment should then be played. If necessary, the facilitator should provide necessary critical information while the tape is running (e.g., "the airspeed exceeded the gear speed while the gear was down").

6. Pause at the end of each segment, so that the IEs have time to finish their ratings. All IEs must finish their ratings before moving on to the next video segment.

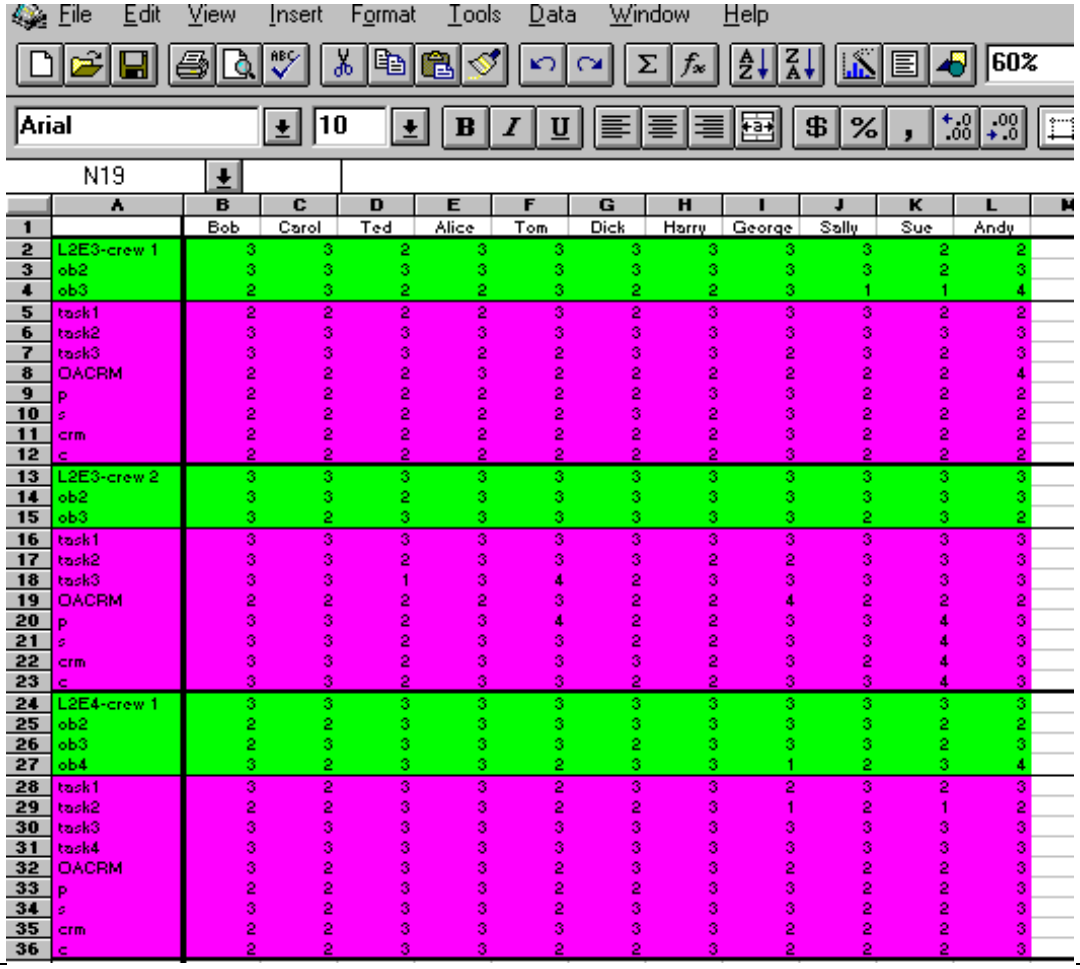
Section 3: Analysis Phase

The data analyses should begin as soon as possible. The analyses typically take 2-3 hours to complete. The analysis phase begins with data entry into the computers and ends with the facilitator preparing for the feedback session.

Getting the Data Ready

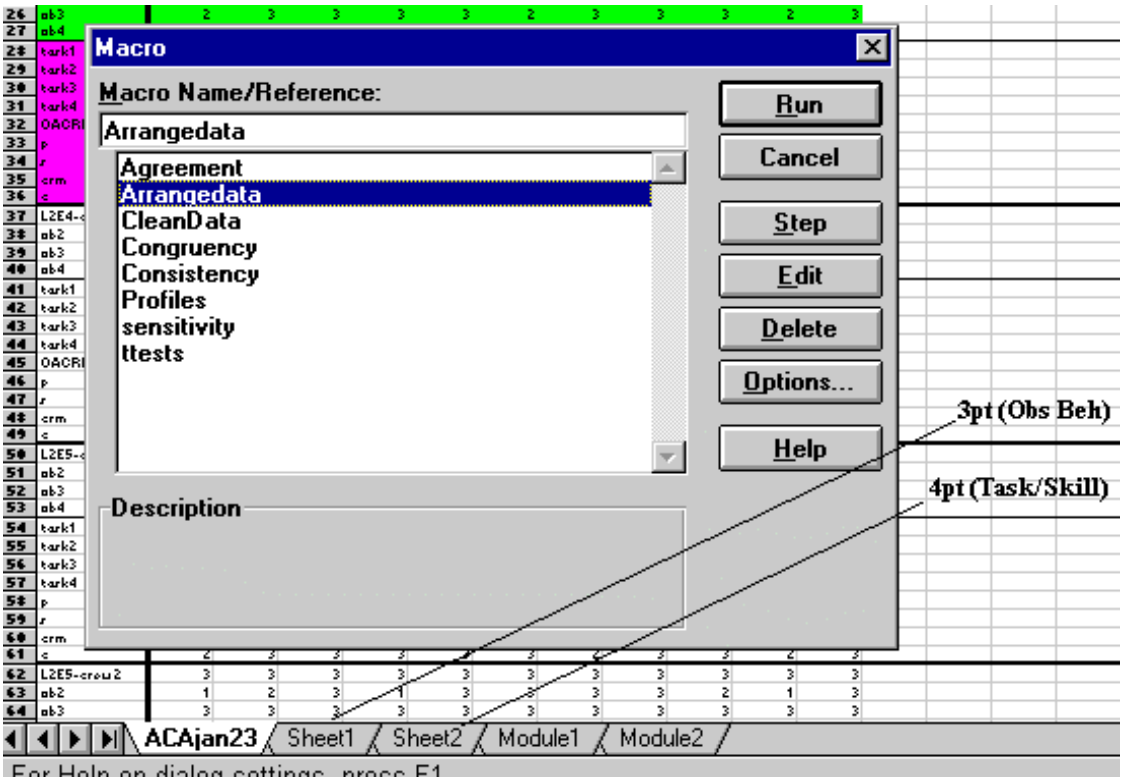
1. Before the IEs leave the room, be sure that they have written their 3-letter initials (or PIN Numbers) on the cover sheet of their rating packet. Then, collect all of the rating packets.

2. Have a 2-person team enter the data (one person reads off the data, while the other enters the data into Excel.) Each IE's ratings should appear as a single column of numbers in Excel. It may be helpful to highlight the rows of observable behavior data in one color, and the task/skill data in another color. (This makes it easier to use the *"Arrange Data" macro* in the next step).



	A	B	C	D	E	F	G	H	I	J	K	L
1		Bob	Carol	Ted	Alice	Tom	Dick	Harry	George	Sally	Sue	Andy
2	L2E3-crew 1	3	3	2	3	3	3	3	3	3	2	2
3	ob2	3	3	3	3	3	3	3	3	3	2	3
4	ob3	2	3	2	2	3	2	2	3	1	1	4
5	task1	2	2	2	2	3	2	3	3	3	2	2
6	task2	3	3	3	3	3	3	3	3	3	3	3
7	task3	3	3	3	2	2	3	3	2	3	2	3
8	OACRM	2	2	2	3	2	2	2	2	2	2	4
9	p	2	2	2	2	2	2	3	3	2	2	2
10	s	2	2	2	2	2	3	2	3	2	2	2
11	crm	2	2	2	2	2	2	2	3	2	2	2
12	c	2	2	2	2	2	2	2	3	2	2	2
13	L2E3-crew 2	3	3	3	3	3	3	3	3	3	3	3
14	ob2	3	3	2	3	3	3	3	3	3	3	3
15	ob3	3	2	3	3	3	3	3	3	2	3	2
16	task1	3	3	3	3	3	3	3	3	3	3	3
17	task2	3	3	2	3	3	3	2	2	3	3	3
18	task3	3	3	1	3	4	2	3	3	3	3	3
19	OACRM	2	2	2	2	3	2	2	4	2	2	2
20	p	3	3	2	3	4	2	2	3	3	4	3
21	s	3	3	2	3	3	2	2	3	3	4	3
22	crm	3	3	2	3	3	3	2	3	2	4	3
23	c	3	3	2	3	3	2	2	3	3	4	3
24	L2E4-crew 1	3	3	3	3	3	3	3	3	3	3	3
25	ob2	2	2	3	3	3	3	3	3	3	2	2
26	ob3	2	3	3	3	3	2	3	3	3	2	3
27	ob4	3	2	3	3	2	3	3	1	2	3	4
28	task1	3	2	3	3	2	3	3	2	3	2	3
29	task2	2	2	3	3	2	2	3	1	2	1	2
30	task3	3	3	3	3	3	3	3	3	3	3	3
31	task4	3	3	3	3	3	3	3	3	3	3	3
32	OACRM	3	2	3	3	2	3	3	2	2	2	3
33	p	2	2	3	3	2	2	3	3	2	2	3
34	s	3	2	3	3	2	3	3	3	2	2	3
35	crm	2	2	3	3	3	3	3	2	2	2	3
36	c	2	2	3	3	2	2	3	2	2	2	3

3. Use the *"Arrange Data" macro* to separate the 3-point observable behavior data from the 4-point task/skill data. **(All macros are found under the "macros" command in the "Tools" menu)**. Follow the on screen prompts and the end result will be two data worksheets, one with observable behavior data (Sheet 1), and the other with task/skill data (Sheet 2).



4. Save the data file onto the C: drive for faster access while running the macros.

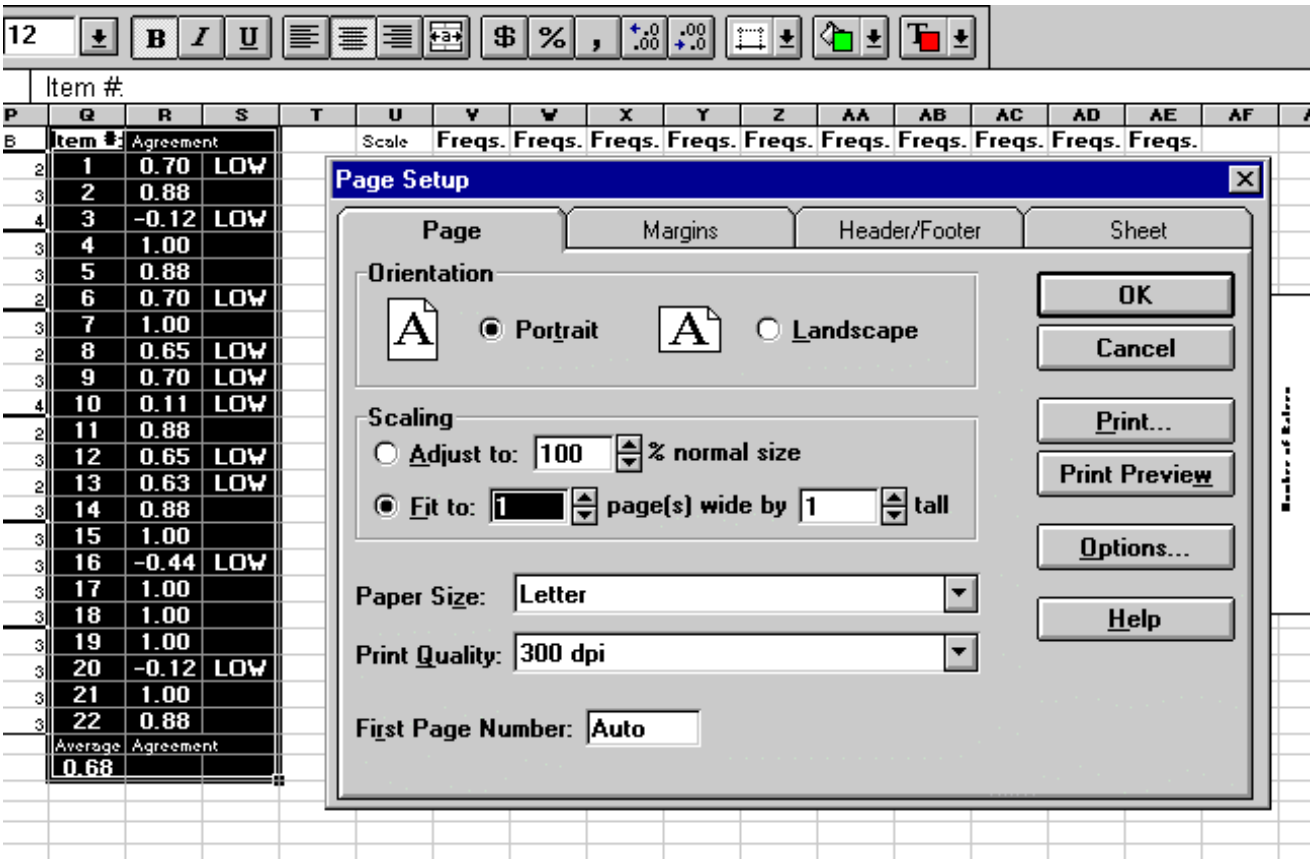
5. Save a copy of the data onto floppy disk (A: or B: drive) for transfer to the other computer. Once the file is loaded on the other computer, be sure to save it to the C: drive for faster operation.

6. Divide up the labor. Have one person analyze the 3-point observable behavior data, while the other person analyzes the 4-point task/skill data. Each person should make sure that he/she has only the assigned type of data (i.e. there is no task/skill data mixed in with the observable behavior data).

7. Make a visual inspection of the data. Does missing data cluster by IE or by question? If 30% or more data is missing for a given IE, delete that IE. If 30% or more data is missing for a given question, delete that question. If less than 30% of the data are missing, replace the missing data. You can use the modal (most frequently occurring) value for a given question, or you can use the *"Clean Data" macro* to substitute the mean value.

Agreement Analyses

1. Run the "*Agreement*" *macro*. Follow the on-screen prompts. You will be asked to enter a benchmark value (GMU recommends using .80). Print the block of all ratings and agreement indexes, sized to 1 page. (This can be done by selecting "print 1 page high by 1 page wide" from the "page setup" command in the "File" menu.)



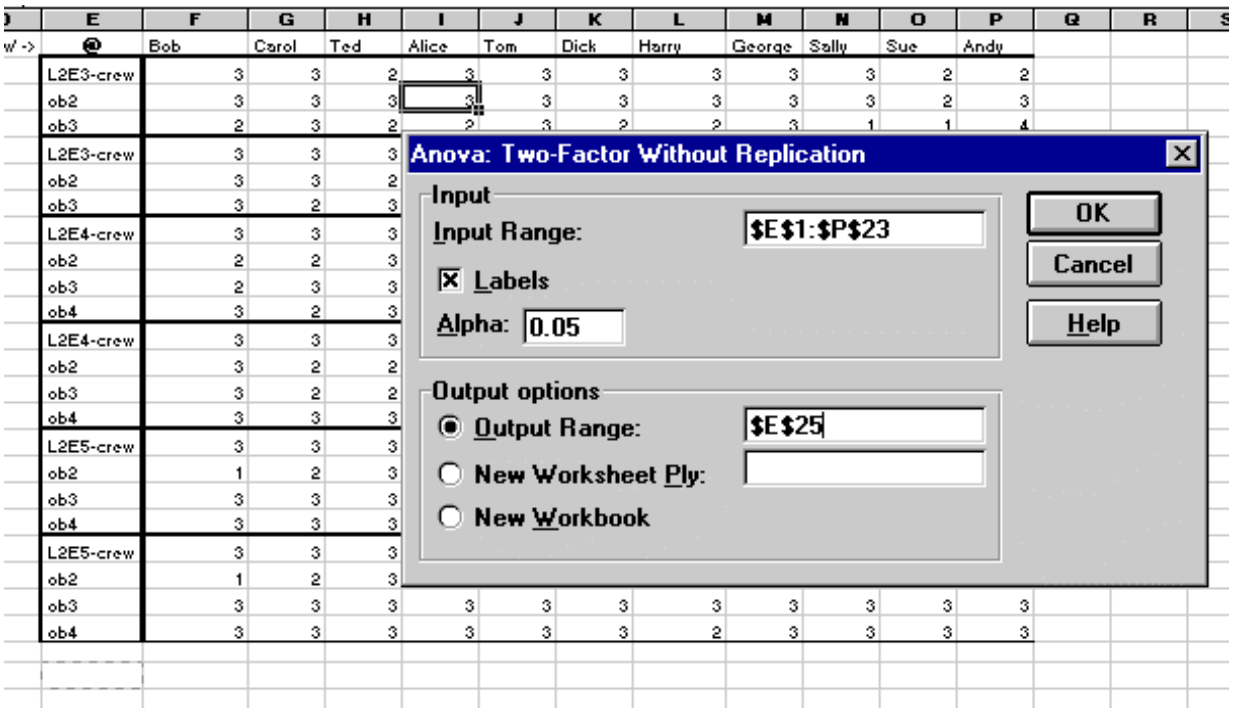
2. Next, examine each of the individual graphs for items that exhibit low agreement. <u>If time permits</u>, it may be helpful to format all of the graphs so that they are on a common metric. To do this, first note which graph has the largest maximum value on the vertical axis. For each graph, change the vertical axis so that they are all on this scale. This can be semi-automated by changing the format of the first graph and then using the F4 key [repeat function] to change the format on the remaining graphs.

3. Individually select and print each graph on a separate page.

4. When all the graphs are printed, hand-label each graph with the event set, item name, and the crew name.

Systematic Differences Analyses

1. From the "Tools" menu, choose "Data Analysis". Select "2 Factor Analysis of Variance Without Replication". Block out the raw data, **<u>starting with the @ symbol</u>.** Click the "Labels" box. Click the "Output" button, click on the output address box, and click on the desired location on the worksheet. Click "OK".



2. After the analysis is complete, find the value for the probability tested (it is the "p-value" in the row labeled "Columns" in the ANOVA source/summary table). If this value is below .05, there are systematic differences among the raters.

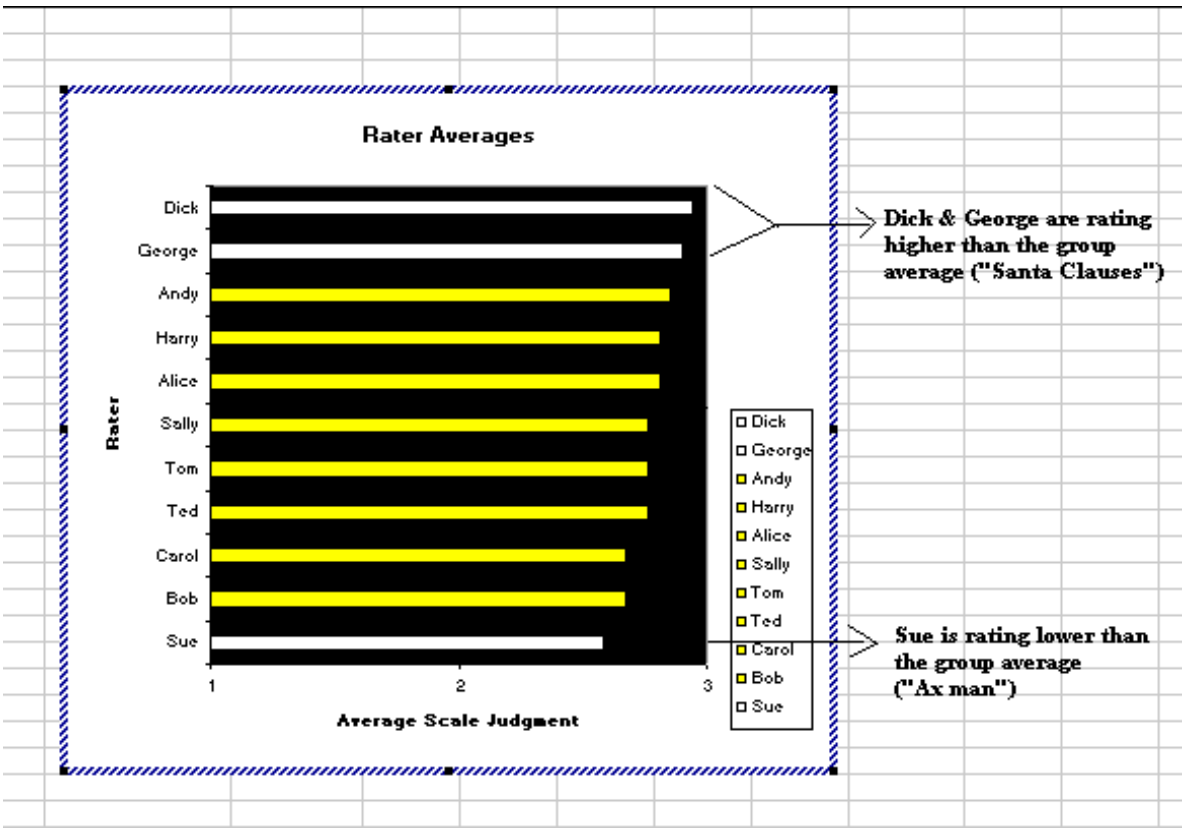
ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	61.125	49	1.24745	6.15704	0.00	1.37156
Columns	15.96	15	1.064	5.25159	0.00	1.68
Error	148.915	735	0.20261			
Total	226	799				

P-value less than .05 (there are systematic differences among raters)

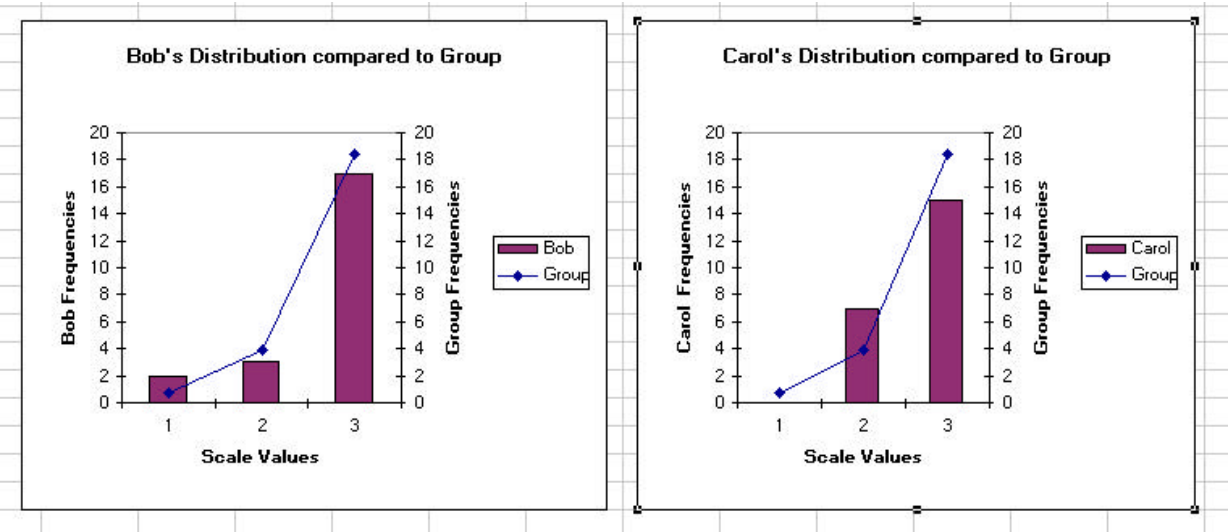
3. Run the *"ttests" macro*. Follow the on-screen prompts. Examine the results to determine which raters are significantly higher or lower than the group mean. Then, use this same information to change the colors of the bars on the graph to indicate these raters. Next, make sure that the horizontal axis of the graph starts with "1", and ends with the appropriate value ("3"

for observable behaviors, “4” for task/skill). Print the t-test graph on a single page. It may be helpful to increase the font size of the title and the legend, so that it is easier to read.



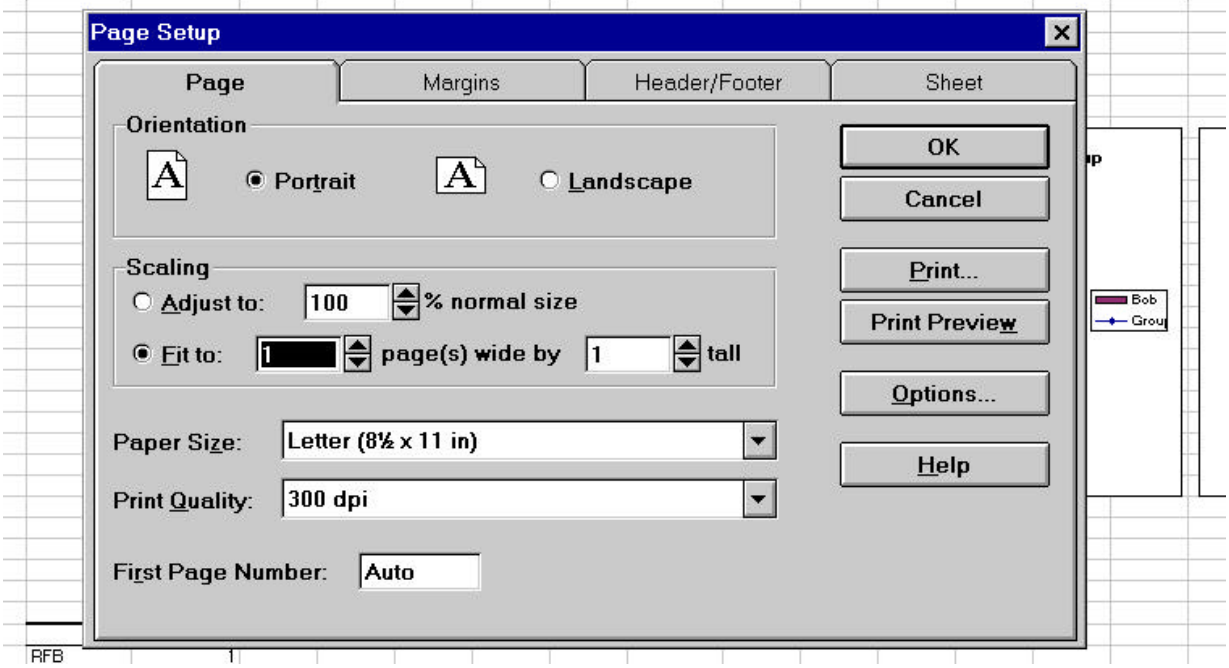
Congruency Analyses

1. Run the “*Congruency*” *macro*. Follow the on-screen prompts. Examine the vertical axes on **both** sides of each graph. Note the maximum value (on either side). For each graph, change the left and right vertical axes, so that they are **all** on the same scale. Print each congruency graph on a single page. (see next page for example)



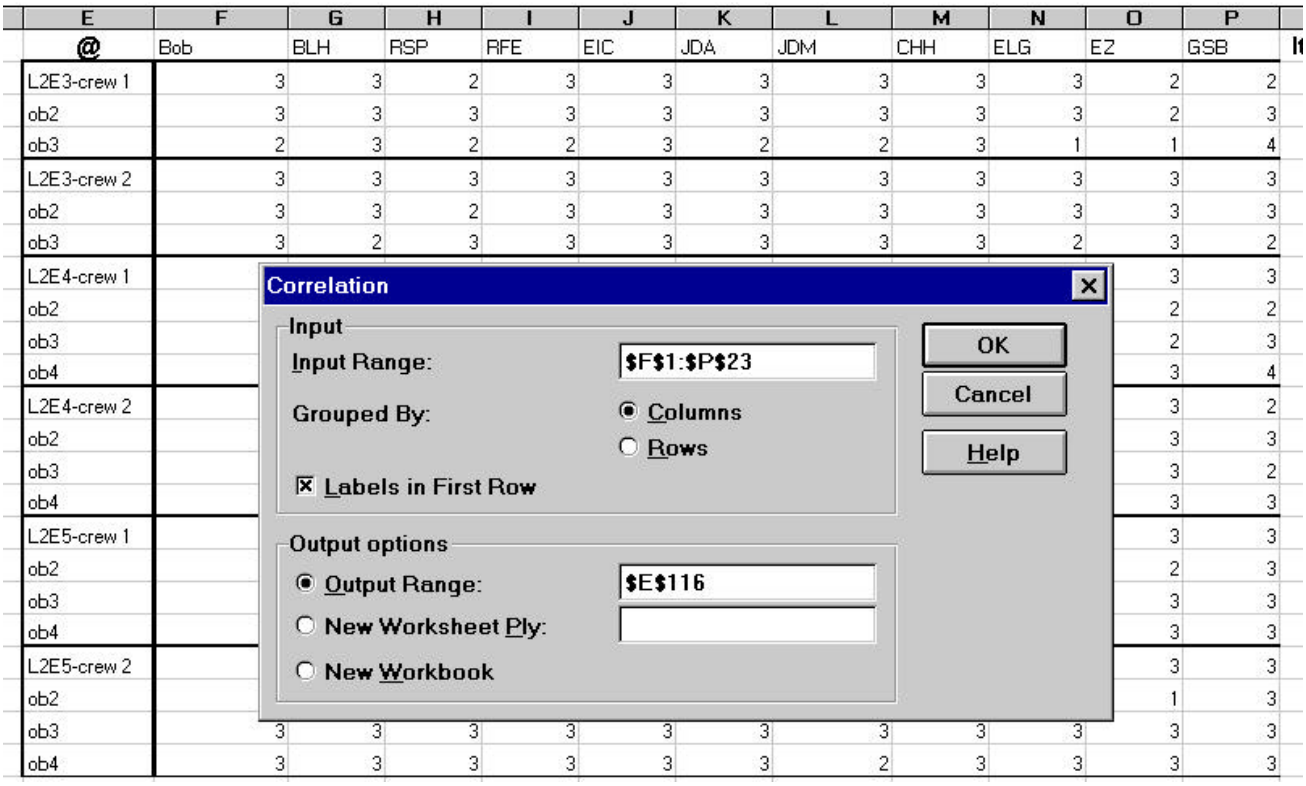
2. Lastly, print the block of congruency results, sized to 1 page.

Freqs Bob	Freqs Carol	Freqs Ted	Freqs Alice	Freqs Tom	Freqs Dick	Freqs Harry	Freqs George	Freqs Sally	Freqs Sue	Freqs Andy	Scale Values	Freqs Group	Expected Group
2	0	0	1	1	0	0	1	1	2	0	1	8	0.77311
3	7	5	2	3	2	4	0	4	5	5	2	40	3.86555
17	15	17	19	18	19	18	21	16	15	15	3	190	18.3613
C. Index	C. Index	C. Index	C. Index	C. Index	C. Index	C. Index	C. Index	C. Index	C. Index	C. Index		Group Avg.	
0.90	0.71	0.89	0.83	0.92	0.81	0.92	0.65	0.91	0.77	0.80		C. Index	
												0.83	



Consistency Analyses

1. From the "Tools" menu, choose "Data Analysis". Choose the "Correlation" option and follow the on-screen prompts. For the "Input Range" highlight the instructor ID labels and the raw data. Be sure to indicate that the data is grouped by columns and that the labels are located in the first row.

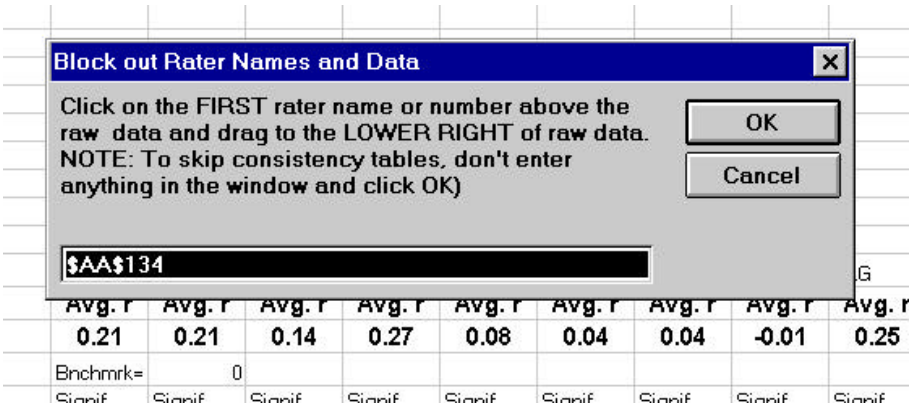


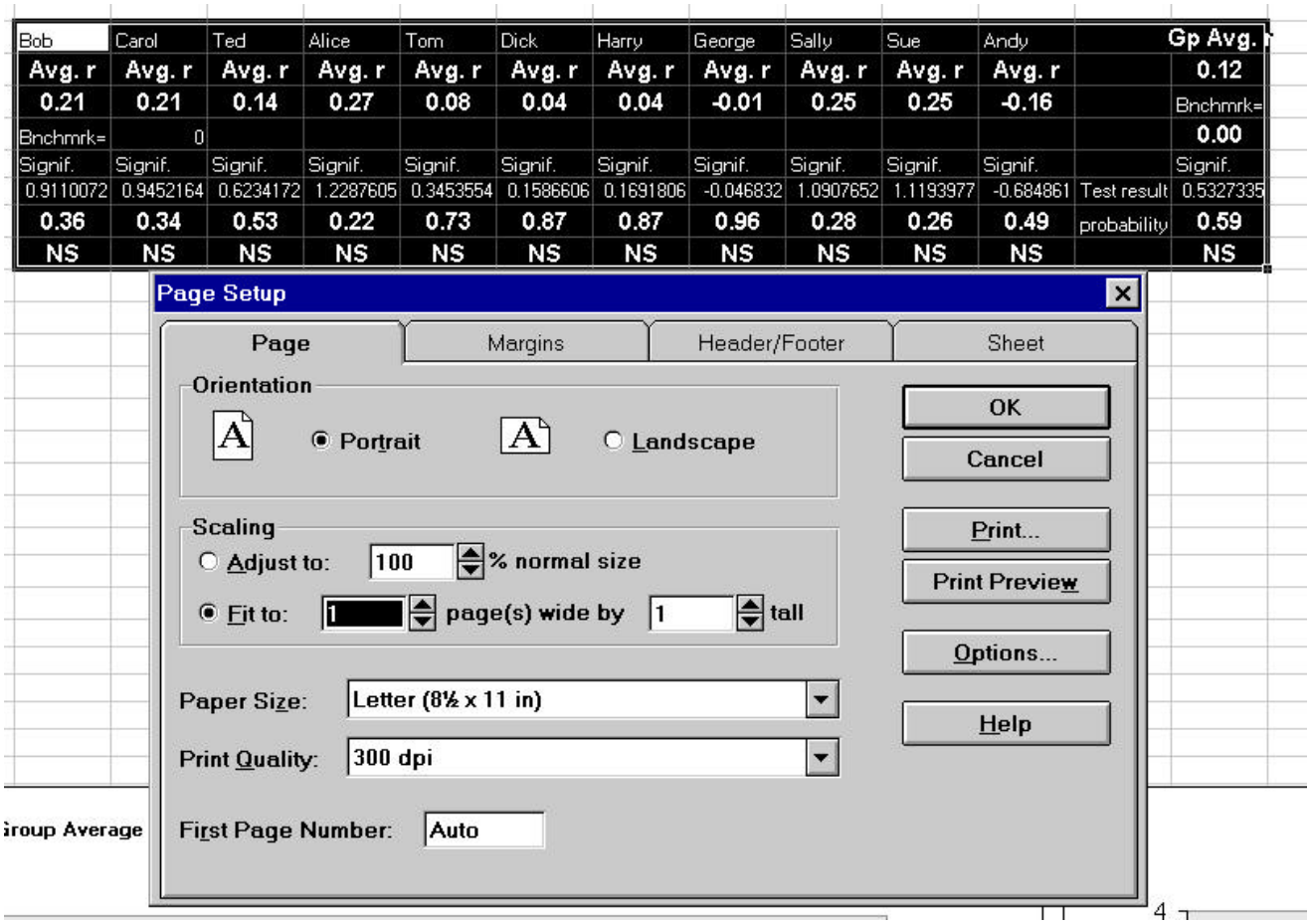
E	F	G	H	I	J	K	L	M	N	O	P
@	Bob	BLH	RSP	RFE	EIC	JDA	JDM	CHH	ELG	EZ	GSB
L2E3-crew 1	3	3	2	3	3	3	3	3	3	2	2
ob2	3	3	3	3	3	3	3	3	3	2	3
ob3	2	3	2	2	3	2	2	3	1	1	4
L2E3-crew 2	3	3	3	3	3	3	3	3	3	3	3
ob2	3	3	2	3	3	3	3	3	3	3	3
ob3	3	2	3	3	3	3	3	3	2	3	2
L2E4-crew 1										3	3
ob2										2	2
ob3										2	3
ob4										3	4
L2E4-crew 2										3	2
ob2										3	3
ob3										3	2
ob4										3	3
L2E5-crew 1										3	3
ob2										2	3
ob3										3	3
ob4										3	3
L2E5-crew 2										3	3
ob2										1	3
ob3	3	3	3	3	3	3	3	3	3	3	3
ob4	3	3	3	3	3	3	2	3	3	3	3

2. Run the "*Consistency*" *macro*. Follow the on-screen prompts. You will use the output from the "Correlation" command (previous step) as your input for the consistency macro. You will be asked to enter a benchmark value in two different steps, one for RATERS and one for the GROUP, in both cases GMU recommends using zero. Consistency indexes range from –1 (perfect negative correlation: individual goes up, group goes down) to +1 (perfect positive correlation: individual goes up, group goes up – or – individual goes down, group goes down) with zero indicating no relationship between individual and group ratings. A benchmark of zero will indicate those raters whose individual ratings have no significant relationship to the groups' ratings as being "NS".

DO NOT ask for the graphs in this macro. Click **"cancel"** to stop the *"Consistency" macro* after you enter the GROUP benchmark, when you come to this prompt:

3. Print the overall block of consistency results, sized to 1 page.





4. Run the *"Profiles" macro*. Follow the on-screen prompts. Examine each IE's profile graph. If the vertical axis does not begin with "1" and end with the appropriate maximum value ("3" for observable behaviors, "4" for task/skill), change the scale of the vertical axis. Print each IE's graph on a single page.

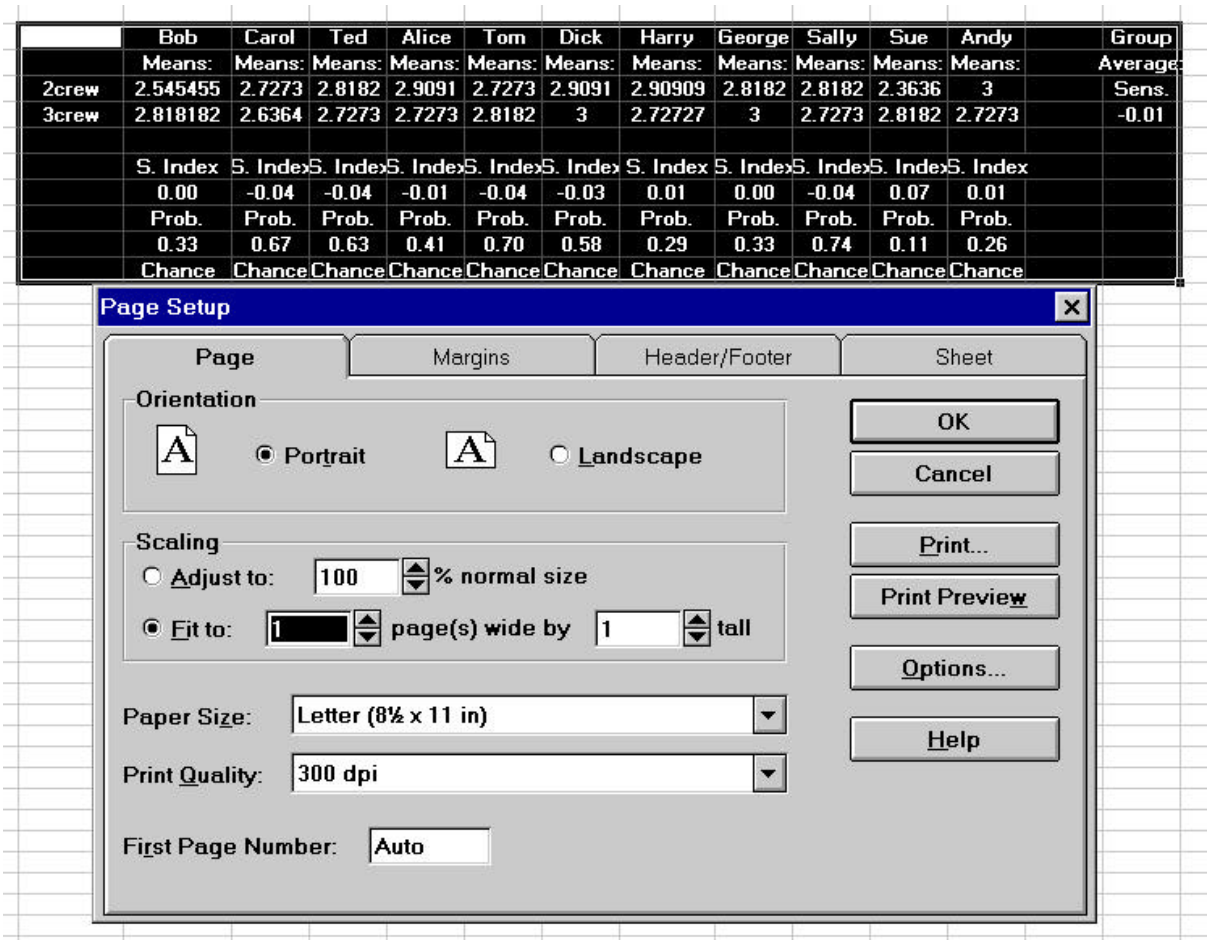
Sensitivity Analyses

1. Run the *"Sensitivity" macro*. Answer the on-screen prompts using the SMEs' pre-determined decisions on how to label the performance segments (e.g., "3 crew", "2 crew"). The final data set should look something like this:

2. Examine each IE's sensitivity profile. If the vertical axis does not begin with "1" and end with the appropriate maximum value, change the scale of the vertical axis. Print each IE's graph on a single page.

Bob											
2crew	3	3	2	3	2	2	3	3	1	3	3
3crew	3	3	3	3	3	3	3	3	1	3	3
Carol											
2crew	3	3	3	3	2	3	2	3	2	3	3
3crew	3	3	2	3	2	2	3	3	2	3	3
Ted											
2crew	2	3	2	3	3	3	3	3	3	3	3
3crew	3	2	3	3	2	2	3	3	3	3	3
Alice											
2crew	3	3	2	3	3	3	3	3	3	3	3
3crew	3	3	3	3	3	2	3	3	1	3	3
Tom											
2crew	3	3	3	3	3	3	2	3	1	3	3
3crew	3	3	3	3	2	2	3	3	3	3	3
Dick											
2crew	3	3	2	3	3	2	3	3	4	3	3
3crew	3	3	3	3	3	3	3	3	3	3	3
Harry											
2crew	3	3	2	3	3	3	3	3	3	3	3
3crew	3	3	3	3	2	3	2	3	3	3	2
George											
2crew	3	3	3	3	3	3	1	3	3	3	3
3crew	3	3	3	3	3	3	3	3	3	3	3
Sally											
2crew	3	3	1	3	3	3	2	3	4	3	3
3crew	3	3	2	3	3	2	3	3	2	3	3
Sue											
2crew	2	2	1	3	2	2	3	3	2	3	3
3crew	3	3	3	3	3	3	3	3	1	3	3
Andy											
2crew	2	3	4	3	2	3	4	3	3	3	3
3crew	3	3	2	2	3	2	3	3	3	3	3

3. Lastly, print the overall block of sensitivity results, sized to 1 page.



	Bob	Carol	Ted	Alice	Tom	Dick	Harry	George	Sally	Sue	Andy		Group
	Means:	Means:	Means:	Means:	Means:	Means:	Means:	Means:	Means:	Means:	Means:		Average:
2crew	2.545455	2.7273	2.8182	2.9091	2.7273	2.9091	2.90909	2.8182	2.8182	2.3636	3		Sens.
3crew	2.818182	2.6364	2.7273	2.7273	2.8182	3	2.72727	3	2.7273	2.8182	2.7273		-0.01
	S. Index	S. Index	S. Index	S. Index	S. Index	S. Index	S. Index	S. Index	S. Index	S. Index	S. Index		
	0.00	-0.04	-0.04	-0.01	-0.04	-0.03	0.01	0.00	-0.04	0.07	0.01		
	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.		
	0.33	0.67	0.63	0.41	0.70	0.58	0.29	0.33	0.74	0.11	0.26		
	Chance	Chance	Chance	Chance	Chance	Chance	Chance	Chance	Chance	Chance	Chance		

Prepare group and individual level feedback

1. Prepare the group level feedback. This will include:
   - 2 pages with blocks of group data for congruency (one page for the 3 pt data and another page for the 4 pt data)
   - 2 pages of t-test graphs for systematic differences (3 pt data and 4 pt data)
   - 2 pages with blocks of group data for consistency (3 pt data and 4 pt data)
   - 2 pages with blocks of group data for sensitivity (3 pt data, and 4 pt data)
   - 1 page block of all ratings and agreement indexes for 3 pt data
   - All graphs of the LOW-agreement 3-pt items in order
   - 1 page block of all ratings and agreement indexes for 4 pt data
   - All graphs of the LOW-agreement 4-pt items in order

   MAKE OVERHEAD TRANSPARENCIES OF ALL THESE PAGES IN ORDER

2. Prepare individual level feedback packets for each IE. These will include:

- pages with his or her Congruency graphs (one page for the 3 pt data and another page for the 4 pt data)
- pages of t-test graphs for 3 pt data and 4 pt data (same graphs as in the facilitator's packet)
- pages with his or her Consistency profile graphs (3 pt graph and 4 pt graph)
- pages with his or her Sensitivity graphs (3 pt graph and 4 pt graph)

WRITE EACH PERSON'S CONGRUENCY, CONSISTENCY AND SENSITIVITY INDEX VALUES ON TOP OF EACH GRAPH (3 PT AND 4 PT).

When writing the values on the top of each graph, we have found it helpful to have one person read aloud the index values from the block of group data while the second person writes the index value on top of the IE's graph. Alternatively, these index values can be added to the title of each graph before the graphs are printed by editing the title of the graph after they have been created by their respective macros. The individual packets are now ready to be stapled and distributed.

OPTIONAL: if facilitators do not have good and bad examples of congruency, consistency, and sensitivity already prepared, then they should choose the best and worst examples from this group of IEs and make overheads of these examples.

Section 4: Feedback and Discussion

Feedback and discussion should begin when the facilitator is ready to present the results to the group. This includes describing what the statistical results mean, as well as facilitating group discussion about the individual items. The facilitator should be familiar with the following most common types of rater errors so that this information can be available and integrated into group discussions:

Leniency and Severity: Raters who on a consistent basis are either inordinately lenient ("Santa Claus") or inordinately severe ("Ax man"). ***Systematic differences*** analyses will tell you if raters are rating consistently lenient or harsh.

Central Tendency: Raters who avoid using high and low extremes and tend to cluster all of their ratings about the center of the rating scale. Low ***congruency*** indices may indicate the central tendency rating error.

Halo: Raters who assign ratings on the basis of a global impression of the ratee. An individual is rated either high or low on many factors because the rater knows that the individual is high or low on one specific factor. Low ***consistency*** indices may indicate halo rating error.

Contrast Effect: When raters evaluate more than one candidate at a time, they tend to use other candidates as a standard. Whom they rate favorably, then, is determined partly by others against whom the candidate is compared. (E.g. If a rater evaluates a candidate who is just average after evaluating three or four very unfavorable candidates in a row, the average candidate tends to be evaluated very favorably, instead of just average.) If two or more crews are taped for each event set, then contrast errors can occur. Extremely high ***sensitivity*** scores may indicate a contrast effect.

Congruency, Systematic Differences, Consistency, and Sensitivity Data (30-45 minutes)

1. The facilitator should begin with an overview of the discussion procedure. Then, a discussion about congruency, systematic differences, consistency, and sensitivity results should occur. Although these components can be discussed in any order, we recommend that your first discuss congruency, then systematic differences followed by consistency and sensitivity.

2. For the **congruency**, **consistency**, and **sensitivity** measures, the facilitator should begin with a 1-sentence definition of the measure, and then explain why it is important. This should be followed with examples of good and bad performance (use overheads to help get the point across). Next, the IEs should refer to their individual feedback packets to see how they compare to the average group index (using both 3 pt and 4 pt data). This should end with a discussion of the implications for IEs who are incongruent, inconsistent, or insensitive in their ratings.

3. For the **systematic difference** data, the facilitator should begin with a 1-sentence definition and then explain why it is important. The facilitator should then present the t-test graph (for both the 3 pt and 4 pt data) and point out the "Ax-Men" and the "Santa Clauses". The IEs will have a copy of these graphs in their feedback packet. This should end with a discussion of the implications for IEs who are significantly high or low in their average ratings. Appropriate judgment standards and fairness to pilots can be discussed as focal points.

Agreement on Individual Items (1-2 hours)

1. For the agreement data, the facilitator should begin with a 1-sentence definition of agreement and then explain why it is important. Then, examples of good and poor agreement should be presented to the group.

2. Following this, the low agreement (below benchmark) items for each tape segment or event set should be discussed and resolved. For each tape segment or event set, low agreement items may include observable behaviors, skill or topic ratings, overall ratings of CRM or technical performance, and/or ratings of the pilots.

For each low-agreement item, an overhead graph showing the disagreement should be presented. Then, the following questions should be asked:

Did the raters SEE the same thing?

Did the raters INTERPRET the same behaviors the same way?

Did the raters JUDGE the behavior the same way using the scale?

Possible sources of divergent judgments must be explored. These could include: poor videotape quality; ambiguous wording of judgment items; unclear judgment criteria; or different judgment processes by the IEs.

In general, the IEs should work to achieve consensus on each item. Company policies, flight standards, or other issues may surface during this discussion. One team member should document the IEs' comments and input using the Feedback and Discussion Worksheet so that problems and ideas that are generated during the discussion session can be used in the future. At the end, thank the IEs for their efforts.

Section 5: Optional Post-Training IRR Check

Section 5 should begin when the group discussion has ended. This section includes rating new video segments, and meeting (the next day) to discuss them.

1. IEs view new tape segments in the same fashion as before.
2. Team analyzes these new data, and provides individual and group-level feedback as before (overnight or next day).
3. Individual feedback packets are distributed to the IEs the next day.
4. Facilitator presents pre- and post-training IRR results (see sample pre/post form below). As a group, the facilitator and the IEs decide on priorities for the next IRR session.

	Average Consistency Rating	Average Congruency Rating	Average Systematic Differences	Average Agreement Rating	Average Sensitivity Rating
Day 1					
Day 2					

To demonstrate the effect of training, the numbers in the "Day 2" row should be (statistically) larger than the numbers in the "Day 1" row.

Section 6: Dissemination of Summary Document

Immediately after the IRR training session, one team member needs to revise and summarize the IE comments/suggestions solicited during the Feedback and Discussion session. This information should then be distributed to all of the IEs. This will serve to improve the clarity of judgment criteria and judgment processes among IEs. In addition, all key training and management personnel should receive this information so that they can address unresolved rating issues that need to be managed under their authority (e.g. rewording of LOE items, clarification of policy)

Appendix E

Guidelines for Taping Simulator Sessions for CRM Assessment Data Collection

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Guidelines for Taping Simulator Sessions for CRM Assessment Data Collection

Purpose of the Guidelines

The following preliminary set of guidelines is designed for those planning to produce videotapes for collecting CRM assessment data. The guidelines are presented in five groups related to the following LOFT/LOE session elements:

Crew-related
Instructor-related
Scenario-related
Simulator-related
Editing-related
Equipment-related

In this document, the collection of CRM assessment data refers to having aircrew instructors/assessors view tapes and rate CRM performance using one or more rating schemes. These guidelines assume that when videotapes are used to collect that type of data, the production of those tapes should conform to guidelines that are more restrictive than general guidelines for producing CRM assessment training tapes. When videotapes are used to collect CRM assessment data, the video taping process should follow most of the crew-related, instructor-related, and editing related guidelines presented below.

Crew-Related Guidelines

During the taping of the LOFT or LOE sessions, crews should not be interrupted by the instructor or by other avoidable disturbances. The natural flow of the scenario is important for realistic simulation and elicitation of natural crew behavior. Do not provide the crewmembers with scripts on how they should act and make sure they are not familiar with the session's scenario. They should be briefed to perform as they would normally under similar conditions

If the goal is to have a video tape which is representative of an air carrier's crews, the crews selected to make the video tape should have average crew performance, typical crew composition, normal crew attitudes to CRM and training and other observable crew characteristics that could affect their behavior.

When videotapes will be used to collect CRM assessment data:

- Use real crews that are qualified for the equipment and position being flown in the simulator.
- Provide the crew with a regular briefing of the scenario and session (similar to that provided prior to a recurrent LOFT) to include a discussion of the confidentiality of the data collected and then specify how the tapes will be used.
- Schedule the taping session and provide for sufficient briefing time to allow the crew to act as though they were in an actual training or assessment session.

- Have crews should utilize the simulator equipment related to communications as is normally used in the simulator environment.
- the camera or cameras should be placed so that they do not interfere with pilot tasks and so that they are not directly visible by either of the crew members.
- If additional microphones are needed for improved sound quality, the microphones should be positioned before the start of the session with any testing taking place prior to the start of the session.

Instructor-Related Guidelines

- Use an instructor that is qualified in the type of session being taped (e.g., if you are taping a LOFT, use instructors qualified to manage LOFT sessions).
- Use an instructor trained and experienced in the scenario or scenarios being used.
- Make sure that the instructor does not interact with the crew except when providing ATC and other required communication.

Scenario-Related Guidelines

- Have the LOFT or LOE based on a scenario that is clearly structured and that specifies the training or assessment objectives for each of the scenario elements or event sets.
- Provide the instructor managing the scenario and researchers collecting data with a complete script of the scenario.

Editing-Related Guidelines

- Tapes should contain a minimum of edits, and edits should be evident such as through the used of a "fade-to-black."
- The individual shots of segments or events should be of sufficient duration to allow a viewer to understand the context of the events taking place.
- The sound track should be that sound that was recorded simultaneously with the video image, and any narratives or other additions should be clearly identified as such.
- Similar sequences or unique shots should be placed in context either through an accompanying document or by providing context information prior to the actual sequence or unique shot when used for rater training.

Simulator-Related Guidelines

Set the simulator motion, sound, visual system, and lighting to best enhance the image and sound quality of the tape while having a minimum effect on crew performance (see Technical section). Monitor this quality continuously during the taping.

- Place camera and microphone in the simulator so as to collect the best sound and picture with the least effect on crew performance.
- Specify any changes in simulator setting that deviate from normal settings for the type of training or assessment being represented.

Equipment-Related Guidelines

These guidelines review the necessary equipment and procedures for videotaping two-person crews in an aircraft simulator with sufficient quality to use in training applications.

Camera

Videotaping in aircraft simulators requires a professional-quality video camera with interchangeable lenses and adjustable apertures and shutter speeds. Aircraft simulators are cramped and extremely low-light conditions (2-3 lux) for videotaping. Cramped cockpit quarters require a compact camera with a wide-angle lens. The extreme low-light conditions (particularly for a nighttime simulation) require a camera with adjustable aperture and shutter speeds. Even with the widest possible aperture, shutter speeds must be adjustable down to 1/15 (day sim) and 1/10 (night sim) of a second. Briefing sessions before or after the simulator session require normal to mild telephoto lenses. The camera we use is a Canon L-2 Hi-8 camera with interchangeable lenses and shutter speeds adjustable to 1/8 of a second. The lens we use ranges from wide-angle (used in cockpit) to mild telephoto (used for briefings).

Use special Hi-8 grade 8mm videocassettes to obtain effective low-light videotaping in the simulator--these tapes are NOT the consumer-grade 8mm tapes and will cost $15-$20 apiece (e.g. Sony Hi8 tape E6-120HME). We used one 2-hour tape for the briefing before the simulator session and the debrief afterwards, and two 2-hour tapes for the four-hour simulator session. We recommend winding and rewinding the tapes in the camera before use to check if they are faulty--we experienced about 1 out of 15 faulty tapes.

To transfer the video from the Hi-8 tapes, use the Hi-8 camera or obtain a Hi-8 VCR for playback. All components in the taping and playback for transfer (camera, tape, VCR) must be Hi-8 grade to preserve the resolution of the Hi-8 system. Consider using a professional video service to transfer the Hi-8 video to VHS format for instructional use.

Other Equipment

Microphones. For brief and debrief sessions, a lavaliere microphone that clips onto the tie is least obtrusive. For taping in the simulator, the microphone must be small and attachable to the microphone boom on the pilot's headset. (Any other mounting position will give unacceptable levels of background noise from the simulator—simulated engine noise should be set as low as possible). We used a SIMA camcorder Lapel Microphone(TM) miniature clip-on lavaliere microphone (around $30). An equivalent alternative is the Audio-Technica U.S. ATR35s lavaliere microphone. These lavaliere microphones are detachable from the tie clip and small and light enough to be used on the headset boom. This is a battery-powered microphone with an on-off switch for the battery pack, which is in-line on the microphone cord. Each battery is good for 5-10 hours of use, so have spare batteries for microphones and camera.

Connectors. An adapter that takes 2 mini headphone jacks and combines the signal into one output is used to combine the PIC and SIC audio output into one combined signal. A 6" mini "Y" adapter, which connects 2 mini headphone, jacks to a single mini stereo output jack is used to connect the combined PIC and SIC microphones on one channel with the instructor pilot's microphone on the other channel. This stereo output is plugged into the camera's microphone jack.

Auxiliary lighting. Auxiliary lighting is important to increase effective illumination of specific areas such as the control panel. Small, battery-powered fluorescent lights are recommended as the batteries will last for a four-hour simulator session and they do not heat up the cockpit or potentially set off the halon fire control. Arrangement of these lights to avoid reflections in the visual displays or interfering with pilot movements and vision is critical (see diagram). We suggest a variety of sizes of these lights with larger lights used for general increases in illumination while smaller lights increase illumination of specific areas.

Tape. Duct tape is used to tape down the microphone lines to avoid tripping and to secure lighting in overhead or on-the-wall positions. Black electrical tape is used to secure the lavaliere microphone to the pilot's headphone microphone boom. It is important that the lavaliere microphone be taped to be on the OUTSIDE of the boom microphone. This will avoid unwanted breathing sounds and the possibility of electric shock from the lavaliere microphone.

Brief and Debrief Procedures

Pre-simulator briefs and post-simulator debriefs are normal light-intensity situations. Normal shutter speeds and sufficiently narrow apertures to ensure an adequate depth-of-field can be used. To be unobtrusive, position the camera as far from the instructor pilot, PIC, and SIC as possible and use the telephoto lens to frame the three persons appropriately. The lavaliere microphones are mounted on the ties of each person. For soft-spoken persons, mount the microphone just below the tie knot. Route the microphone cords down and along the floor to be as unobtrusive as possible. Avoid microphone cords or any apparatus on the table, as this will interfere with use of the weather pack and the completion of other normal preflight activities. Make certain video consent forms are read and signed before activating any of the equipment. Switch the microphones "on" and do a sound check to check audio recording levels before beginning the brief or debrief.

Simulator Procedures

Before session. Microphone cords for PIC and SIC should be routed around their seats before they enter the cockpit. PIC and SIC can then enter and be seated. We take the headsets and tape the lavaliere microphones to the microphone booms. We request the preflight actions be done with headsets on to improve the audio quality. We also request that the pilots leave the panel lights on the highest possible intensity that will not interfere with their normal routine. Auxiliary lighting is then installed as necessary to obtain the best possible video picture. Low wattage bulbs can be placed on the simulator floor behind PIC and SIC seats or can be taped part of the way up the bulkhead. The simulator instructor is also miked, and final video and sound checks are made.

During session. During the simulator session, the video operator must continue to monitor picture and sound to ensure quality. If the sim is in motion, the operator must be buckled in, but he or she can still wear the headphones to monitor sound quality. We have encountered problems with microphones gradually having more static as batteries wear out and the video camera turning itself off unexpectedly. The operator will notice the latter immediately as the sound in the headphones cuts out when the camera stops recording, at which point the operator must restart the camera and re-check sound and video quality.

After session. After the simulator session, disconnect and remove microphones, lighting, and cables quickly but carefully to move the operation back to the briefing room. After the debrief session, make sure to switch the microphones "off" to avoid draining the batteries.

Appendix F

Sample LOFT/LOE Development Materials

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LOFT/LOE SCENARIO DEVELOPMENT PROCESS

A structured development process is needed for LOFT/LOE that specifies the objectives and related technical and CRM skills that make up LOFT scenarios. This process should start with an analysis of the carrier's training needs and follow through to the development of the LOFT scenario, its validation, and the training of instructors that will implement and assess crew performance (see Table 1 for a listing of LOFT/LOE development steps). This LOFT/LOE scenario development process is based on the concept of event set, a group of related events that are part of the scenario and are inserted into the session for specific CRM and technical training objectives. Event sets may be used in isolation, as in a SPOT, or they may be used in groups, as in the development of a LOFT or LOE scenario. The LOFT/LOE development process makes the design of a new LOFTs easier and more systematic resulting in training that is more manageable and easier to assess by allowing instructors to concentrate on key technical and CRM objectives within any given event set.

The primary unit of both LOFT design and CRM assessment is the event set, a group of related events that comprise the scenario and are inserted into a LOFT session for specific training purposes. The event set is made up of one or more events, including an event trigger, a distracter, and conditions, the supporting events. The event trigger is the condition or conditions under which the event is fully activated specifying the focal problem the pilot/crew must deal with in the event set. The event trigger also functions as the focal point for the assessment of crew performance. The supporting events are other events taking place within the event set designed to further training objectives and add to overall scenario realism. Finally, the distracter is a condition inserted within the event set designed to divert the crew's attention from other events that are occurring, are about to occur, or to increase crew workload. Although distracters may not always add to the realism of the event set, they should not significantly detract from that realism.

Event sets allows the design team to present the appropriate degree of realism in the LOFT. Instead of focusing on a specific technical issue, the event set integrates the entire complex line environment (e.g., terrain, ATC, weather issues, etc.) to provide realism and relevance and evoke crew's performance in response to specified CRM and technical issues. The event set helps the LOFT designer to introduce operational realism through the specification of conditions within and across event sets. In addition, the event set helps the instructor to manage and assess the LOFT by making explicit the purpose of conditions such as terrain, ATC, and weather as they interact with other LOFT elements. With the LOFT scenario made up of one or more event sets, scenario validation and crew assessment is performed at the event set level rather than validating the overall LOFT scenario.

Table 1: LOFT/LOE Development Steps

STEP/SUBSTEP
1) Identification of Incidents and Primary CRM/Technical Objectives
1.1 Develop list of relevant incidents and events
1.2 Identify primary technical and CRM TPOs and SPOs
1.3 Identify related observable behaviors for the CRM categories
1.4 Specify observable behaviors, TPOs, and SPOs in a LOFT Outline
2) Development of LOFT Scenario Event Sets
2.1 Translate incidents into a LOFT Outline by identifying the event set(s) to include event trigger, distracter, and supporting events.
2.2 Review and update the LOFT Outline to ensure a complete scenario
2.3 Prepare and administer the LOFT Check Form to ensure event sets are consistent with the technical/CRM objectives and observable behaviors
2.4 Modify LOFT Outline based on LOFT Check Form results.
3) Validation of the LOFT Scenario
3.1 Expand the LOFT Outline into the LOFT Guide by adding the operational details to include ATC, weather, airport information, etc.
3.2 Fly the LOFT Guide using at least two different crews taping the sessions for use in developing instructor training materials
3.3 Administer the LOFT Validation Form to individuals that have flown or seen the tapes of the LOS
3.4 Develop the LOFT Worksheet based on the LOFT Validation Form results
4) Instructor Training and Standardization
4.1 Review and make changes to the LOFT Guide and LOFT Worksheet based on instructor input
4.2 Conduct instructor calibration session using IRR
4.3 Review IRR results and modify training and retrain as necessary
4.4 Conduct periodic Instructor Standardization Sessions

LOE Observable Behaviors
Validation Form

Instructions: Thank you for your help in providing ratings of crew actions or observable behaviors central to the assessment of CRM. Each of the event sets in this form was designed to assess a primary CRM element. Each scenario event set also has one or more secondary CRM elements. The four CRM elements used in this form have been divided into two groups. The first group of two CRM elements is related to individual mental factors that crew members utilize to identify and solve the problems presented in the scenario event set. The two Individual Mental Factors are:

Decision Making

Situational Awareness

The second group of CRM elements is related to crew or team factors. The CRM elements related to the Team Factors are:

Crew Communication

Team Management

Please work through the following pages of this form by first rating the Primary CRM Element from 1 to 5 based on the probability that the CRM Element is the primary element or objective of the CRM assessment. For example, if there is a "High " probability that the element is the Primary CRM Element, then you would enter a "4" as follows:

PRIMARY CRM ELEMENT: COMMUNICATION	4

Then, please rate the key observable behaviors for that CRM element based on the degree to which you think that the individual behavior is a key behavior for the assessment of the tasks related to that scenario event set. Rate these behaviors by reviewing the event set concentrating on the "CONDITIONS" which specify the tasks that a crew should perform during that event set. Then, determine the probability or likelihood that each observable behavior is an important behavior to observe in the assessment of the tasks being performed.

Please use the following scale for all of your ratings:

1	2	3	4	5
Very Low	**Low**	**Medium**	**High**	**Very High**

If there is an additional CRM element that should be considered for the assessment of the event set, please include it in the ADDITIONAL CRM ELEMENT at the bottom of each page.

EVENT SET 1

PRE DEPARTURE:
Event Set #1 is the pre-departure through the beginning of takeoff. The event trigger is the consideration and ramifications of summer operations, low visibility and wind shear. Other event distracters will include:

Conditions for departure include:

POSSIBILITY OF WIND SHEAR

LOW VISIBILITY TAXI

THUNDERSTORMS

TURBULENCE ON DEPARTURE

ENGINE START:
ABORTED ENGINE START.
TAXI OUT:
Congested ramps and taxiways in low visibility.

CONDITIONS FOR EVENT SET ONE:
DISPATCH -
PREFLIGHT - WITH MALFUNCTIONS
START AND PRE-TAXI - WITH ENGINE START PROBLEM

RATE CRM ELEMENTS from 1 to 5 where 1 = Very Low Probability and 5 = Very High	RATE Obs. Behaviors from 1 to 5 where 1=Very Low Degree and 5=Very High
PRIMARY CRM ELEMENT: TEAM MANAGEMENT	
Obs. Behavior: Encourages crewmember interaction for complex departure	
Obs. Behavior: PF inform crewmembers of intentions before acting	
Obs. Behavior: Crew discussed summer operations SOP	
Additional Obs. Behavior:	

SECONDARY CRM ELEMENT: DECISION MAKING	
Obs. Behavior: PF selected correct action for aborted engine start	
Obs. Behavior: PF analyzed takeoff WX and requested takeoff alternate	
Obs. Behavior: Captain made timely decisions after problems were identified	
Additional Obs. Behavior:	

ADDITIONAL SECONDARY CRM ELEMENT:	
Obs. Behavior:	
Obs. Behavior:	
Obs. Behavior:	

EVENT SET 2

Event Set #2 will be as the aircraft approaches the end of the runway for departure. The trigger will be the stop of departures because of thunderstorms. Conditions include:

TAKEOFF FROM CONTAMINATED RUNWAY NEAR RUNWAY LIMIT WEIGHT

LOW VISIBILITY TAXI

PLANNING FOR WINDSHEAR DEPARTURE.

REROUTE AROUND THUNDERSTORMS

DIFFERENT INTERSECTION FOR DEPARTURE

RATE CRM ELEMENTS from 1 to 5 where 1 = Very Low Probability and 5 = Very High	RATE Obs. Behaviors from 1 to 5 where 1=Very Low Degree and 5=Very High
PRIMARY CRM ELEMENT: SITUATIONAL AWARENESS	
Obs. Behavior: Crew set clear priorities for tasks and their order	
Obs. Behavior: Crew plans for delay and intersection departure	
Obs. Behavior: Red flags recognized and resolved	
Additional Obs. Behavior:	

SECONDARY CRM ELEMENT: COMMUNICATION	
Obs. Behavior: PNF advocated if necessary	
Obs. Behavior: PNF advised company and at appropriate time	
Obs. Behavior: PF asked questions to establish understanding of aircraft condition	
Additional Obs. Behavior:	

ADDITIONAL SECONDARY CRM ELEMENT:	
Obs. Behavior:	
Obs. Behavior:	
Obs. Behavior:	

EVENT SET 3

Event Set #3 is the takeoff and area departure. The event trigger will be a minor system problem after to V1. The conditions include:

*WINDSHEAR **PLANNING** REQUIRED DURING THE TAKEOFF*

THUNDERSTORMS IN THE DEPARTURE AREA

HEAVY WEIGHT, RUNWAY LIMIT TAKEOFF WITH HIGH SURFACE TEMPERATURE

GUSTY SURFACE WINDS ON DEPARTURE

RATE CRM ELEMENTS from 1 to 5 where 1 = Very Low Probability and 5 = Very High	RATE Obs. Behaviors from 1 to 5 where 1=Very Low Degree and 5=Very High
PRIMARY CRM ELEMENT: DECISION MAKING	
Obs. Behavior: Bottom lines established for abort	
Obs. Behavior: crewmember acknowledge operational decisions	
Obs. Behavior: PIC made decision in timely manner	
Additional Obs. Behavior:	

SECONDARY CRM ELEMENT: COMMUNICATION	
Obs. Behavior: PNF advocated if necessary	
Obs. Behavior: PNF advised ATC and at appropriate time	
Obs. Behavior: PF asked questions to establish understanding of aircraft condition	
Additional Obs. Behavior:	

ADDITIONAL SECONDARY CRM ELEMENT:	
Obs. Behavior:	
Obs. Behavior:	
Obs. Behavior:	

Appendix G

Sample ASRS Incident Reports

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Report 01

We were already in a descent from 10000 to 8000' when approach recleared us to continue the descent to 6000'. The Captain, who was flying the aircraft on autopilot, did not descend past 8000'. As we began this flight the Captain was in a not so good a mood. Early morning, late arrival, arguments with the station manager and a very abrasive and intimidating attitude towards myself. At this point in the flight the Captain was flying the aircraft via the autopilot in a descent. I told the Captain I was going off 1 to call company on #2. At the same time approach called and recleared us to a lower alt of 6000'. As I scanned the flight instrument I dialed in 6000' on the alt preselect and noticed the autopilot attempting to level off at 8000' with a 250' fpm rate of descent. I looked at the Captain and said, "O.K., now I'm off 1 to call company on 2 again." He acknowledged with a statement, "fine, knock yourself out." Now as I was on #2 radio I noticed the Captain off #1 and on the P/A. Next I noticed, as I came back on #1, that the Captain had not descended to 6000'. We were level on autopilot at 8000' and approach was calling for us to descend immediately to 6000' for conflicting traffic. The Captain also came back on and heard the calls. We descended to 6000' and the Captain yelled at me to keep my ears open and so on. I decided not make an argument with him sensing it would further endanger the flight as we entered the terminal area and work load was increasing. I wanted to punch out the Captain at first for the way he treated me and the flight. I calmed my self down and concentrated on doing my job, even though I knew there would be a lesser degree of safety due to the Captain's attitude. I learned again not to relax my scan, even when flying with a guy who was as intimidating as this one. I'll always speak up.

Report 02

BGM information 800' scattered, 1200 broken, 2300' overcast, 2 mi. light snow, temp 27, dew point 21, winds 270 at 8 kts, altimeter 29.97, breaks in the overcast, NDB 34 approach in use, localizer 16/34 out of service, runway 34 plowed and sanded full width and length, braking action good reported by a vehicle. PF and PNF discussed possibility of using runway 28 due to surface wind component. Further inquiry with BGM approach confirmed runway 28 plowed and sanded full width and length and previous inbound company reported braking action as poor. Surface wind was also reported as unchanged. PF (PIC) requested and was cleared for VOR DME approach runway 28. PNF briefly studied the procedure, and then gave the approach plate to the PF. Due to the proximity of the airport, the high indicated airspeed, the excess alt and the flight crew's anticipation of the ILS 34 approach, the workload of the flight crew was quite high. The PNF went off frequency to make the range call to company. The PF descended from the published segment alt (3500' MSL) at the 18 DME position to the published straight in landing MDA of 2000' MSL. The FAF for the procedure was at the 13 DME position and the PF's premature descent put the aircraft 1500' below the published segment alt. The airport was sighted prior to the visual descent point and the approach terminated uneventfully. Supplemental information from ACN 104150
it was discovered by approach control just as we passed the final approach fix. I was pushing the aircraft to maintain schedule.

Report 03

Received taxi instructions to runway 22 for first flight of the day. I set heading but for 220 degrees and was about to taxi when ground reported wind as 290 degrees at 8 kts (ATIS reported at 240 degrees at 9 kts). F/O and I were doing preflight checklist as we were taxiing to runway (standard procedure), and even though I had runway 22 in mind, I actually visualized runway 28 and started that way. We checked for traffic on the long runway as we crossed it on the way to 28. Just about the time we finished the checklist I realized that we had just crossed the active runway 22. At this point we had just switched to tower frequency and he just noticed that we were on the wrong side of 22. No traffic conflict occurred, but even though we had looked for traffic, a conflict was possible. Factors were
first flight of the day; at familiar airport, but hadn't been there recently; performing checklist while taxiing; and not checking HSI reading before crossing runway.

Report 04

We were cleared for takeoff when our left-hand pitot heater failed. Our MEL states we can fly w/o the left-hand pitot heater if we stay clear clouds below +4 sat and/or known icing conditions. I was not sure we could comply with those restrictions, but I decided to go anyway. Enroute we checked weather at our destination and alternates. All had high ceilings (6000'), 15+ nm plus visibility and were well above freezing (55 degrees f). We also received reports of heavy icing in clouds at 11000' MSL. Still, I elected to press on. We talked over the possible implications and possibility of losing the left-hand ASI and altimeter. We discussed the procedures for having the pilot in the right seat assume flying duties if I lost my airspeed and altimeter. We were incredibly stupid. In our descent at 9000' MSL due encountered not only very heavy icing, but moderate to severe turbulence. I almost immediately lost both my ASI and altimeter. The right seat pilot assumed flying duties. His ASI showed a warning flag so was suspect and could not be trusted. Because of the turbulence he needed both hands to control the aircraft. I had to control the throttles, monitor his flight ins from my side, assess the situation and make decisions, and handle the radios. The PF also stated he felt he wasn't turning when he was, and vice versa, obviously he was experiencing incipient vertigo due to the turbulence and loss of ins. Even though we had good gyros the loss of other primary flight ins interrupted our normal scan and confused our normal senses. To further complicate the situation, Center couldn't give us a lower alt. I finally communicated the urgency of the situation and they gave us a lower alt. At that point we couldn't maintain alt because of the turbulence anyway. Once we had a clearance to a lower alt we descended by reference to attitude only. We broke out at 5000' MSL in warmer air and almost immediately got all ins back. We made a normal approach and landing. There are many lessons to be learned here. My motivation for continuing the flight with a known deficiency was the result of pressure of a very heavy schedule with upper management aboard, and my desire not to inconvenience them. I also now realize I was getting complacent and felt I could do anything (arrogant). I am appalled by my lack of professionalism. The worst part is I know better, but I still succumbed to outside pressures. Never again. Callback conversation with reporter revealed the following: reporter reiterated self-displeasure for his actions. He said, "I did what the company pays me not to do." The reporter also said how shocked he was at the great speed with which the situation got out of control. One factor not initially related by the reporter is that at the time of the incident, the flight crew had been on duty 14 hours, and that fatigue probably affected judgment. The reporter is also the chief pilot for his company. After this incident, he called all company pilots to a meeting to discuss this incident, its causes and effects. He felt that his flight department could benefit from a discussion of the human factors issues.

Report 05

The problem arose when the Captain (PNF) called "1000' to go" as we passed 8000'. I estimate 20-30 seconds later the Captain suddenly remember to call in our times (out/off) to company. The Captain was unsure of our out/off times and asked me. We both looked at our watches and agreed on the times to be used. Next, the Captain was not sure what company frequency was and asked me. I looked down to retrieve my chart binder to verify the freq. When I looked back up to the panel, we were passing 9300'. I immediately lowered the nose and acknowledged my alt deviation to Captain I began an immediate descent to assigned alt, 9000'. The Captain, who also was looking for frequency to call company and not monitoring the panel either, tried to find the right knob to turn mode c off on transponder, which I had to help him find. I estimate we were at 9300-9400' for 10-15 seconds and never actually level at either. I returned the plane to assigned alt (9000') in about 25-30 seconds. Problem corrected. Being on ready reserve from mid-morning till late evening. The Captain had flown since early morning, and had totaled 7 hours of flying that day. He was tired and appeared to be unfamiliar with aircraft. This made me feel uneasy. Both Captain and I were tired and Captain distracted me and himself when within 1000' of assigned alt. Having been off duty 3 days before the flight caused both scan and judgment to be slowed. I would recommend a strict tolerance to a sterile cockpit anytime climbing or descending within 1000' of an assigned alt; i.e., no paperwork, no calls to company or passengers. Both pilots should be watching the plane and the panel in order to x-check and verify what should be done is being done.

Report 06

Ground control had cleared me to taxi to runway 29. Another company aircraft had been cleared to taxi to runway 34. I misunderstood the controller's instructions and taxied across runway 11/29. My crew and I arrived at the aircraft 1 hr, 30 minutes late due to crew rest requirements. We were hurrying to get back on schedule. Neither my F/O nor myself are that familiar with the Westchester airport. Contributing factors: rushing to get back on schedule, operating on a new airport, and confusing my taxi instructions with those given to another aircraft. I was advised by ground control that I had taxied across runway 11/29. Lessons learned: 1) don't rush, especially when operating on a new and unfamiliar airport. 2) if you are not sure of instructions, stop and ask. Supplemental information from ACN 140815: as the Captain taxied the aircraft I proceeded with the checklist and setting up the radios. Although not mandated, this is usually accomplished prior to taxiing, but because of the behind schedule situation, we elected to set them up while taxiing. I repeated the taxi instructions to the Captain, he acknowledged. I periodically cleared the area during taxi while accomplishing the checklist and setting of the radios. I went back to my duties prior to the intersection of the taxiway and runway 29. I cleared the area 7-10 seconds later and noticed we had crossed runway 29 and were headed for runway 34.

Report 07

Shortly after departure from Johnstown, Pa, after having made contact with Center and radar contact, Center asked us where we were going. I was the F/O and PNF. On taxiout during the before takeoff checklist, the Captain quickly briefed the SID (one of several) for this non-tower controlled airport. This SID climbed us out NE of JST on the 048 deg radial. I was not at all clear about this departure or how it would feed us onto the route (V12 out of JST to AGC). We were IFR in blowing snow and rain, climbing to 8000' MSL. The Captain who did not appear to understand about the filed rte seemed puzzled about Center's inquiry. I told the Captain that the route (V12) was west on the JST 272 deg radial, and we were NE of the vortac. The Captain got very upset and gave me no directions to respond to Center and seemed confused. I took the initiative because I knew the rte to respond to ATC. I said, "aircraft ident is off course, please give us a vector back to course." Center turned us to 270 deg heading, which I assumed was to intercept the course outbound. During this time the Captain told me to fly while he fished through the IFR charts to see what the course was--his first course familiarization. He didn't assume the PNF duties FNAV and COM, so when Center called again there was ambiguity over what anyone was supposed to do. My HSI was set up for the 274 deg radial. I wanted to compare that situation to the RMI needles, which I thought were set to VOR mode for JST. The RMI needles were pointing 180 degrees, so I took it upon myself, since no one seemed to be in charge, to turn to the station on that information and speed up the intercept. However, to my dismay, I had the RMI set to ADF mode. Center called in again as I erringly navigated toward JST on the ADF display and again asked where we were going. The Captain, already fit to be tied, got even more upset and erratic seeing what was taking place. Finally Center told us to forget the intercept and radar vectored us to pit approach controller's airspace and handed us off. I realized my NAV error and my erroneous assumptions--the Captain accepted blame for not doing his job right, and we progressed into pit on the ILS runway 32 w/o further incident.

Report 08

We were taxiing onto the runway (r21) at Hilton Head airport when my F/O said there is an small aircraft y turning final. The aircraft on final initiated a go-around when he noticed that we were taxiing onto the runway. There was nothing we could do to evade the aircraft if he had landed since it was not possible to maneuver light transport x off the runway in time. I did not hear a radio call by small aircraft y before or while taxiing onto the runway, or while taxiing out. However we did not initiate a call, either. There are several contributing factors. One is a fatigue factor of a 15 hr duty day the day before. The other is the F/O announcement to passengers while taxiing. The F/O was still making an passengers announcement while I was calling departure control for clearance. I believe a prerecorded passengers announcement on aircraft w/o a F/A would be of great benefit at airports where there is a short taxi time. This is, however, also a case of not enough diligence on our part and or not making the announcement of our intentions.

Report 09

The deviation from assigned alt occurred because of a nose gear light. Shortly after takeoff from reading airport, we experienced a nose wheel warning light indicating that the nose wheel had failed to lock in the up pos. After cycling the gear twice, the light failed to go out. I (copilot) read the checklist and it was decided to leave the gear down and proceed to the destination. Shortly after, within 10-20 seconds of our decision, I requested to cycle the gear one last time. The Captain agreed and the gear was cycled. On this last attempt the nose wheel locked into the up pos. During this time the Captain failed to level off at 4000' MSL. At 4300' MSL the mistake was brought to our attention by the arrival alt warning system. During our level off and subsequent descent, ATC advised us of our error, and firmly reconfirmed 4000' MSL. The rest of the flight was normal. Captain (PF) and copilot both became preoccupied with light. The deviation from assigned alt (4000') was discovered upon passing 4300', which set off our alt alert system's aural warning. Captain confirmed assigned alt, leveled off and descended back to 4000' (level off was accomplished by 4600' MSL). Human performance factors: 1) the PF diverted too much attention to the problem and not enough attention to his primary function--flying the aircraft. 2) although the primary function of the PNF was to address the abnormality, he should have been aware of the Captain’s failure to level off. Also may have been untimely to ask for one last cycle of the gear.

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Appendix H

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APPENDIX A-1

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Appendix I

Sample Quick Reference Handbook Procedures and Briefing Guide

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OLD QRH PROCEDURE

PROPELLER HEATER FAILURE
AFM 4-10-5

__PROP **ICE**

PROP ICE PROT.....OTHER CYCLE
DOES THE [PROP] CAPTION GO OFF?

YES,CONTINUE FLIGHT
///END

NO

AVOID FLIGHT IN ICING CONDITIONS

IF PROPELLER VIBRATION OCCURS
POWER LEVER.....MINIMUM PRACTICABLE
CONDITION LEVER.....MINIMUM PRACTICABLE

///END

NEW QRH PROCEDURE

Propeller Heater Failure
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Condition: [_ PROP] caption illuminated on overhead Ice Protection Panel

1. Assign PF/PNF duties.
2. Select the opposite cycle (LONG CYCLE or SHORT CYCLE) on the affected prop heat.

? Does the [_ PROP] caption extinguish?

YES - [_ PROP] caption is out.
1. Continue flight using normal procedures
/// End

NO - [_ PROP] caption is not extinguished.
1. Avoid icing conditions.
2. If a propellor vibration occurs, proceed as follows:

Power lever .... Minimum practical
Condition lever .... Minimum practical

Preparation and Planning:
Develop plan
Consider:
- If a diversion is required to avoid icing conditions crew should review: weather / notams / field conditions / alternates / and fuel-time remaining.

Establish Bottom Lines
Establish Backup Plan
Brief Plan

/// End

7-6 (rev orig)

Consistent Features of the New QRH

Condition [_ PROP] caption illuminated on overhead Ice Protection Panel

1. **Assign** PF/PNF duties.

? Does the [_ PROP] caption extinguish?

Preparation and Planning :

Develop plan

Consider:

- If a diversion is required to avoid icing conditions crew should review: weather / notams / field conditions / alternates / and fuel-time remaining.

Establish Bottom Lines

Establish Backup Plan

Brief Plan

Sample Briefing Guide

Preflight Brief

Tone - try to follow SOP, new items for today
Crewmember Roles - back each other up with decisions
Crew Communication - keep all crew members in the loop
Teamwork - call switch movements, both visually identify traffic/airports
Assertion - speak up with questions, doubts or concerns
Operational Issues - low time minimums, DMIs

Clearance Brief

ATIS/NOTAMS
Routing/SID/terrain
Runway/taxi conditions
Assign PF/PNF
Plan for abnormals after takeoff
Performance

Takeoff Brief

Statement of Condition
Select and Prioritize:
- Runway conditions
- Low visibility procedures
- Hydroplaning
- Crosswinds/windshear
- Terrain/MSA
- Aircraft performance
- Convective activity
- GPWS/TCAS alerts
- Fuel status/delays

Bottom Lines for takeoff
Backup Plan for takeoff
Initial heading and altitude

Sample Briefing Guide

Arrival Brief

Descent profile
ATIS/NOTAMS
Statement of Condition
Select and Prioritize:
- Fuel status/delays
- Runway conditions
- Low visibility procedures
- Terrain/MSA
- Aircraft performance
- Convective activity
- Crosswinds/windshear
- Hydroplaning
- GPWS/TCAS alerts

Bottom Lines for arrival
Backup Plan for arrival

Approach Brief

Approach plate information
Required calls/profile
Crew coordination

Debrief Items

Deviations from SOP
Crew coordination - CRM and technical aspects
Unusual situations - positive and negative
Workload management - rushed, overloaded or confusion
Conflict - differences in expectations
Maintenance discrepancies
Planning for aircraft servicing

Advanced CRM Briefing Guidelines

The Captain remains the final authority. These procedures empower all crew members to speak up on any issue before, during or after a flight. They encourage discussion to prioritize, make good decisions, and resolve problems.

Preflight Brief - Completed on the first flight of the day and any crew change. It should focus on crew coordination and aircraft operational issues.

Clearance Brief - Items discussed prior to engine start to aid decision making and review current operational conditions as well as planning for the taxi/takeoff. Planning for items included on the Takeoff Brief is encouraged to reduce workload and enhance situation awareness during taxi.

Takeoff Brief - Helps crews manage workload before potential distractions occur during a critical phase of flight such as the takeoff roll or initial climbout. Crews should prioritize all relevant conditions that exist for that particular departure and establish Bottom Lines and a Backup Plan.

Arrival Brief - Should be accomplished early in the descent to aid in arrival planning. Crews should prioritize all relevant conditions that exist for that particular arrival, approach, and landing and establish Bottom Lines and a Backup Plan.

Approach Brief - Contains approach plate information and any unusual profile or crew coordination issues. Crews should emphasize the critical elements of the approach, missed approach, and landing

Debrief Items - Allows feedback of crew performance (both positive and negative) and allows planning of non-critical items such as aircraft servicing and scheduling issues. Crew debriefs should be conducted discretely.

Use this model to make a decision during an event:

1. Captain: assign PF/PNF duties
2. Clearly identify the problem
3. Consult the QRH if appropriate
4. Crew members propose solutions and choose the best plan
5. Prioritize, sequence, and assign crew duties
6. Monitor the plan's progress (bottom lines)
7. Reevaluate and plan again as necessary (backup plan)

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