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# CRM Vectors 2007

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## Abstract

CRM leaders and participants in military, academe, government, and the aerospace industry were invited. The symposium was attended by 80 participants from foreign governments, military flight operations, general aviation operations, Part 135 and 121 air carriers, and several non-aviation industries using CRM techniques and theories. The objectives of the symposium were two-fold: identify the current generation of CRM theory and practice; and, predict where CRM training was headed in the next decade or two.

**KEYWORDS:** CRM, resource management, flight training, pilot

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## Introduction

Today's Crew Resource Management (CRM) trainers implement the training methodologies supported by the Federal Aviation Administration (FAA). However, it was not the FAA that first created and then perfected these training methods. Modern CRM training, as opposed to the disjointed programs in cockpit management and crew coordination, got its start in the 1970s, particularly after the findings of H. Ruffell Smith were published. After reviewing the events during which 18 aircrews flew on a trip from New York to London in the simulator, Smith found that the aircrews became preoccupied with minor mechanical problems, failed to delegate tasks, failed to set priorities, failed to set priorities, and failed to communicate the intent of plans changed by abnormal operations. These findings, along with some catastrophic commercial aircraft accidents, where the deficiencies noted by Smith resulted in accident and death, led to U.S. governmental involvement (FAA and NASA). The series of events and training decisions that formed the separate generations in CRM training development were well chronicled in *Cockpit Resource Management* edited by Wiener, Kanki, and Helmreich (1995).

Centers of attention, regarding CRM research, appear to be shifting. Helmreich and others of his age and stage will be retiring within the next decade, just as Billings and Ruffell Smith retired after setting the stage for modern CRM training. Some university efforts appear to be waning, while other university efforts are just beginning. Therefore, it seemed fitting for Embry-Riddle Aeronautical University, Bombardier, and Frasca to cooperatively host a symposium on CRM in February 2007. The symposium was called, ERAU: CRM Vectors 2007.

CRM leaders and participants in military, academe, government, and the aerospace industry were invited. The symposium was attended by 80 participants from foreign governments, military flight operations, general aviation operations, Part 135 and 121 air carriers, and several non-aviation industries using CRM techniques and theories.

The objectives of the symposium were two-fold: identify the current generation of CRM theory and practice; and, predict where CRM training was headed in the next decade or two. Figuring out where CRM training had been before convening this

symposium was an easy task, since Helmreich, Wilhelm, Klinect, and Merritt had presented the evolutionary changes in *Culture, Error, and Crew Resource Management* (2001). In the book chapter, the authors had inferred that many trainers had lost their way, and that everyone needed to get caught up on those foundational theories and methods of instruction that had been used in CRM training programs for U.S. military aviators and U.S. commercial air carrier pilots since the 1980s.

The promoters of the symposium were relatively sure that most of the U.S. participants would be in agreement with past training methods; but since there were non-U.S. participants in the group, sufficient time had to be planned for the presentation of CRM training methodologies different from those generally accepted by U.S. CRM training programs.

Therefore, the symposium was conducted in a rather unusual format. The first day was a plenary session, the intent of which was to allow experts in the field of CRM state where CRM training is now, and where they envision it going. During the second day each attendee was given the opportunity to nominate CRM-related discussion topics of his or her own choosing. After all the discussion topics were listed, a mediator instructed the group members to write their name under those discussion topics in which they were most interested. Out of the more than 20 suggested topics, 13 remained after the selection process. The nominators of those 13 sessions became the discussion facilitators and each convened a 75-minute session—throughout the rest of the day—during which key ideas were captured by ERAU faculty and staff members. At the end of the symposium, each of the 13 discussion facilitators presented 10-minute summations, which were recorded by videotape.

Major themes appeared during the selection process. Those themes are listed here.

| | |
|---|---|
| Training and Evaluation | 5 Sessions |
| Error Management | 2 Sessions |
| Is CRM Working? | 2 Sessions |
| Airplane/Automation | 2 Sessions |
| Single-Pilot Resource Management | 1 Session |
| Perceived Command Erosion | 1 Session |

Each group's opinions, conclusions and recommendations were considered during a review of the videotaped summations. The most salient points of each summation were preserved for dissemination in the following sections. Although some assertions may appear to be old news, the purpose of the symposium was to capture evidence, whether that evidence appeared to indicate something new or something old.

*Transforming Theory into Classroom Design*

*Discussion Point*. A learning environment must be created that encourages teamwork and the sharing of ideas.

The standard classroom arrangement of all forward-facing desks is ineffective. Classroom configuration must conform (orientation of students to media) to the needs of the instructor and the needs of the student, without jeopardizing either set of needs. A CRM classroom should be configured to accommodate the usage of video, scenario re-enactments, group exercises, teamwork exercises, role-reversal exercises, and learn-by-doing/sharing experiences. Instructors are encouraged to follow company or institutional best practices on the sharing of training experiences and procedures, to include uses of training equipment.

*Training for Regulatory Requirements for Parts 91/135/142*

*Discussion Point*. Part 121 operators appear to have well-defined CRM training programs, supported by tools that enhance the training experience. Many Part 91, 135, and 142 operators do not have a well-defined CRM training program and lack the necessary tools to enhance the training experience.

A concerted effort must be made to raise the level of excellence in CRM training for Part 91, 135, and 142 operations. The areas in most need of standardization are methods, tools, and assessment. Some of these operators are already partnering with others who have well-established training programs, but there is still a need to define an industry standard for outstanding CRM training. One method to accomplish this would be through the Aviation Rulemaking Committee (ARC). The committee could poll industry users, asking for their best training practices. A subsequent ARC team would assess the results, translate practices to standards, and transform standards to rules. The anticipated result would be closer to a Part 121-type training program, emphasizing Non-Technical (No-Tech) skills, rather than technical skills.

*Teaching/Learning Strategies for Collegiate Aviation CRM Courses*

*Discussion Point*. Collegiate aviation program faculty and staff members have a unique perspective of CRM training and the strengths of their programs are in their theory-development, methods, and their integration of theory and practice.

Aviation faculty reported that they are very good at encouraging students to keep open minds, while at the same time fostering a learning environment where open-mindedness is admired and appreciated. CRM training programs are often governed by rigid rules, in order to maintain a high internal and external reliability. College, CRM instructors are governed by a syllabus, but the syllabus does not frustrate innovations to

curriculum where the instructor sees an advantage for the students. Industry-based training might be overly influenced by FAA guidance in AC-129-51e. While not ignoring the benefits of FAA guidance or the need of students to gain FAA pilot certification, collegiate CRM programs embrace much more than regulatory requirements. Fundamental changes in thinking cannot be achieved in short CRM courses. Judgment formation in collegiate, student pilots is a coordinated activity, ranging over more than two years, between CRM classroom instructors, simulator instructors, and flight instructors. The longer training period in collegiate CRM programs also ensures that students develop critical thinking skills, which are an affect of a good education.

Industry and collegiate CRM instructors agreed that a clearinghouse of CRM information should be created and made available to everyone. The most logical manager of such information, according to the participants, was the university, since universities often share information and they often create focus groups for special interests. The information would be made available via the World Wide Web, and no one would be restricted from joining the focus group. Applied CRM research would be encouraged, and CRM thesis and dissertation research would be encouraged at the Masters and Doctoral levels. The Web site would also encourage trainers to create programs that develop higher order cognitive skills, such as application, analysis, and synthesis.

*When Should We Introduce CRM into the Training Process?*

*Discussion Point*. Collegiate, CRM training-effect is better realized when CRM principles are introduced in the first year of a four-year degree program.

Whether the pilot candidate is from a Part 141 flight school or other pilot training entity, the ‘human factors’ implications of CRM should be introduced on the first day of pilot training and these ‘factors’ should be reinforced throughout all pilot training courses. For example, during Private Pilot training, the emphasis would be on individual error management; during Commercial Pilot training, the emphasis would be on crew concepts; and, during Airline Transport Pilot training, the training would be tailored to the training objectives of specific air carriers.

The group identified the need to identify and train pilots who have never attended a FAA-approved CRM training experience: those who have a lot of pilot experience, but little or no CRM training experience. This CRM training course would be different from initial training courses; in that, these pilots would be introduced to the concepts of behavioral markers (by phase of flight) and NOTECH skills.

*Using Human Factors to Define CRM and Enhance Data-Sharing Across the Industry*

*Discussion Point.* CRM training and the certification of CRM trainers should be standardized, much like how the Civil Aviation Authority in the United Kingdom certifies its CRM programs and its trainers.

The group made the following recommendations:

1. Standardize CRM taxonomy by standardizing terminology internally so researchers can identify trends for future training adaptations.
2. CRM training for the trainer should be accredited, or come from a certified program.
3. CRM programs should be continuously modified as necessary to meet its company's needs and targeted towards industry-wide problem areas. FOQA provides a good tool to accomplish this.
4. Mandate a formal debriefing immediately after a flight.

## Error Management

*How Can CRM and MRM (Maintenance Resource Management) Training Work Together to Improve Communication and Control the Precursors to Human Error?*

*Discussion Point.* A significant number of the participants were concerned about the lack of integrated CRM/MRM training between pilots and maintenance technicians.

The group recommended that both pilots and maintenance personnel be trained together, using curriculum that would emphasize cross-communication, trust, risk management, the unique threats, and teamwork. Scenarios would be presented (DVD, VHS) to show model cockpit debriefs when logbook issues are discussed and to show CRM-enriched behavior during preflight checks. CRM/MRM training instructors should come from firms that teach CRM/MRM principles, whether on site or off site.

*Owning Your Errors: Personal Professional Development*

*Discussion Point*. Corporations should develop a philosophy that includes a self-monitoring of errors, provide organizational support to the individual, if needed, and develop a culture that encourages activity debriefs both personal and crew.

This group agreed that error assessment and error correction was the next evolution of CRM.

## Is CRM Working?

*How Do We Prove CRM Works?*

*Discussion Point*. While the group recognizes it is difficult to prove that it is working (how can you document accidents that did *not* happen?), it felt that there is a need for new measuring techniques.

Operational Resource Management (ORM) must be made to operate along side CRM, if the company is to be successful. CRM policies and procedures must be an

extension of company philosophy, not a separate initiative. The group suggested the following steps toward realizing unity of purpose.

1. Require mission debriefs at the conclusion of a flight.
2. Mandate formal CRM training for *all* pilots at *all* levels.
3. Develop measuring devices based around individual mission-types and not the hours-experience of the pilot.
4. Provide pilot training with examples of actual CRM mishaps in their organization

*How do we measure CRM training success in a way that encourages improvement while measuring their performance*?

*Discussion Point*. We are currently measuring success by a lack of failure. This negative concept has established a paradigm that needs to be broken.

Current methods of measuring success are predominantly subjective tools such as Advanced Qualification Programs (AQP), check rides, and grade sheets. The items that are measured are typically attitude and behavioral outcomes. Tools need to be developed using more quantitative measures, (such as FOQA) to validate and support the qualitative evaluations. Many of these tools do exist in the European CAA CAP 737 document. Next year's CRM Symposium will center on this document, as it has a great deal of valuable CRM information.

## Airplane/Automation

*Airplane Design for CRM*

*Discussion Point.* The current level of technically advanced aircraft now coming on to the market need to allow the pilot to choose the level of automation he/she desires.

The Flight Management Computer must be more "user-friendly", and be simple and quick to reprogram when ATC clearance changes need to be made during critical phases of flight. More effective training methods, designed to fully explain the use of vertical navigation modes, need to be developed and shared across the industry. Audio-visual indications that automated equipment is in use, particularly functions and commands, need to be made very clear and visible to the pilots.

*Coordination of Split-Cockpit During Emergencies*

*Discussion Point.* Shared responsibility, between pilots of crew aircraft, is not always clear in abnormal and emergency situations.

The Captain (pilot-in-command) needs to have in mind how tasks will be distributed when there is little time to explain the rationale for the proposed distribution of work. This is particularly true during abnormal and/or emergency situations, where procedures

are a mixture of checklist steps and advanced systems manipulation of automated equipment. The following recommendations were made by the participants of the workshop.

1. Standard operating procedures should encourage using the First Officer as the pilot flying during emergencies.
2. The Captain should handle communications with the Cabin Crew and Dispatch.
3. Flight attendants should be trained to ask six key questions during emergencies, including:
    a. What is the nature of the problem?
    b. Where are we landing?
    c. How much time do I have?
    d. Will we be performing an emergency evacuation?
    e. Will the Flight Deck Crew be making a passenger announcement?
    f. Are there any other items we need to know?
4. Captains and first officers should be trained in a standardized situational briefing that they can give each other when both pilots return their attention to flying.
5. There should be a common industry-wide problem solving model for dealing with flight anomalies.

## Single Pilot Resource Management (SRM)

### *Using CRM Principles to Develop SRM*

*Discussion Point.* How one develops SRM is made more difficult by the diversity of aircraft being flown single-pilot, from the low-powered single-engine airplane to a complex fighter aircraft and the new very light jet (VLJ).

The group discussed the issues at length, and came up with the following recommendations.

1. Train in mental attitude, diligence and risk assessment.
2. Provide incentives for CRM training, such as insurance discounts and/or safety accreditations.
3. Have manufacturers address the addition of advanced technology to assist the pilot in the operation of the equipment.
4. Define, teach, and emphasize NOTECH skills.
5. Improve risk awareness training to include identification of mental attitudes that may compromise safety.

## Perceived Captain Command Erosion

### *Is There a Problem with Command Erosion? If So, How and Why Does This Occur, and What Can Be Done to Correct the Problem?*

*Discussion Point.* Airline Captains within the group were convinced that there was a very visible erosion of command authority and that it was getting worse.

The Captains listed a number of factors that have contributed to this erosion.

1. Leadership is not assigned by the company; it is earned each time a Captain acts as pilot-in-command.
    a. Leadership is challenged by the First Officer.
    b. Leadership is challenged by the Cabin Crew.
    c. Leadership is challenged by Dispatch.
    d. Leadership is challenged by Ground Crew.
2. Company values take precedence over Captain's values, allowing crewmembers to challenge the Captain's values.
3. Co-equality between the Lead Cabin Crewmember (cabin domain) and the Captain (flight deck domain) frustrates unified decision-making.
    a. Horizontal organizational structures compartmentalize command relationships.
    b. Vertical organizational structures prioritize command.

The group recommended that limits of authority should be made clear to all individuals making decisions during a flight, from gate to gate. The Captain's authority must be made clear to all individuals. CRM works well on all levels, if command relationships are understood and the flight and cabin crews participate in integrated CRM training. While it is true that weak leadership by the Captain can diminish the performance of all crewmembers, it is equally true that strong and appropriate leadership by the Captain can improve overall performance of all crewmembers.

## Summary

The attendees were visibly and verbally affirming, saying that the symposium was a good, first step toward discovering an appropriate way forward for CRM training. Until spring 2007, the biannual International Symposium on Aviation Psychology provided a means for researchers, industry trainers, and collegiate aviation faculty members to discuss CRM issues and practices. However, of late, there seems to be a loss of interest among some of the leading universities and research institutions that had supported the evolution of CRM since the 1970s. Embry-Riddle, in concert with many of the University Aviation Association colleges and universities, aims to fill the void left by the early pioneers in CRM education and training and this symposium was a good beginning.

During his closing remarks, Dr. Cass Howell said that the symposium had not established a training vector for CRM, but he said that we had leveled the playing field and had cleared away unworkable or unnecessary elements of CRM training and education and that we were now ready to lay a good foundation. The CRM Vectors event

will convene again in 2008, and this time it is hoped that the participants will come ready to put that foundation in place.

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