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Guidelines for Incorporating CRM in the First Stages of Flight Training

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ABSTRACT

Despite the importance of crew resource management (CRM) training in the aviation industry, CRM skills are at best neglected and at worst ignored in the first stages of pilot training. This study, based on action research, provides guidelines for program design aimed at incorporating CRM at the initial stages of flight training.

Team-based program design provides the means for the instructional staff to (a) diagnose the current level of CRM, (b) develop CRM criteria, (c) design relevant training exercises, and (d) create an implementation, assessment, and re-diagnosis plan.

The goal is to close the gap between what exists and what is desired.

Since curricula designed for applicability in the workplace should be characterized by continual assessment to ascertain whether the outcomes are occurring, an on-going assessment component is part of the implementation process.

The Importance of CRM at the First Stages of Pilot Training

More than two decades ago, air carriers initiated and implemented Crew Resource Management (CRM). In spite of the importance placed on CRM training and human factors' skills by the aviation industry, the integration of CRM into early pilot training is still nearly nonexistent. Most early pilot training remains focused on the individual pilot, rather than the pilot as a member of a team and of an aviation community of expertise. The individualistic approach remains common in flight training programs.

This paper will address several important questions.
What CRM skills are required of professional pilots?
How does a curriculum incorporating CRM differ from the current training curriculum?
What subject matter and teaching strategies can be implemented in first stages of flight training to include CRM skills?
What are the essential elements of a plan that will incorporate CRM in the first stages of flight training?

What CRM skills are required of professional pilots?

As CRM programs developed, a variety of non-technical skills were identified as necessary skills for professional pilots. The number of CRM skills identified in the human factors literature ranged from as few as four to as many as 24 defined skills (Antersijn & Verhoef, 1995; Faulkner, 1996; Houle, 1995; Orasanu, 1994; Smith & Hanebuth, 1996; Young, 1995). However, the following skills were always included as essential CRM skills (a) **communication, (b) crew coordination or teambuilding, (c) problem-solving and decision-making, and (d) leadership and followership.** The United States Navy and the International Civil Aviation Organization (ICAO) identified these skills in the curricula of major air carriers, including United, American, Southwest, KLM, Northwest, and TWA. Two additional skills appeared in all but two of the above named air carrier curricula. These were **(a) situation awareness and (b) workload management.** The labels used to identify CRM skills sometimes varied. For example, Northwest dubbed the term "workload management" (Johnston, Fuller, & MacDonald, 1995, p.148) while KLM used the term "stress management" (Johnston, Fuller, & MacDonald, 1995, p. 243) to describe the need to avoid overloading a pilot crew member. Other CRM skills named were (a) planning, (b) briefings, (c) crew inquiry/advocacy, and (d) conflict resolution

(Johnston, Fuller, & MacDonald,1995). The need for the professional pilot to integrate these CRM pilot skills with technical skills is an important goal of future pilot training (Johnston, 1993; Maurino, 1996).

How does a curriculum incorporating CRM differ from the current training curriculum?

Current curriculum

The traditional curriculum used for training flight students has been linear, sequential, and oriented toward technical proficiency alone. In the United States, for example, it is based on the FAA's Practical Test Standards (PTS) manuals that focus on technical performance parameters, such as, "maintains heading plus or minus 10 degrees" (FAA Practical Test Standards for the Private Pilot, 1997). These manuals, which serve as the norm for flight tests and the granting of FAA certificates and ratings have become the basis of training course designs.

Commercially produced syllabi based on the PTS manuals have become the norm for early pilot training. Generally, the syllabi are divided into "stages" of training for each pilot certificate or rating (Jeppesen, 1996b). Each stage of training provides a "stage objective," as a guide for the student and the flight instructor, and a "stage completion standard" which will be used by the FAA Designated Examiner to assess the student throughout the training process. Although the FAA Practical Test Standards mentions crew resource management as an important objective, there is little if any delineation of CRM outcomes in the examiner's checklist for the flight test. Similarly, the standard flight curricula mention skills such as communication, problem-solving, and situation awareness, but there are no specific objectives related to these skills, and no outcome measures related to CRM skills. Instead, the outcomes listed in the syllabi are strictly based on technical performance, suggesting to the instructor and student alike that the student need only to acquire technical proficiency.

The situation in general aviation training contrasts dramatically with what is the norm for the professional pilot operating in the commercial aircraft in the industry. Thus primary learning does not lay a foundation for the professional pilot role.

CRM-based pilot training curriculum

After the analysis of a number of serious aviation accidents in which it was clear that human factors were a significant element, the aviation industry began to consider important training revisions. In 1989, the Flight Safety and

Human Factors Study Group (a division of ICAO) published a digest entitled Flight Crew Training: Cockpit Resource Management and Line Oriented Flight Training. The publication was a guide for the introduction of CRM into flight training and was applicable for "all forms of flight crew training" (ICAO Circular 217-AN/132, 1989, p. 5).

Since the early ICAO publications, industry training initiated a number of modifications to traditional flight training. These modifications have gradually introduced non-technical skills into the flight training process. Line Oriented Flight Training (LOFT) offered a significant opportunity to analyze technical proficiency in a real-time simulation that includes communication, decision-making, leadership, and other important professional skills that are commonly referred to as CRM skills. However, as Maurino (1996) suggested, "technical and CRM skills may perhaps be separated for research purposes, but in the real world they never live an independent existence" (p. 101).

An example of a curriculum strategy that incorporates CRM is the LOFT scenario. A team of three trainers, Hamman (United Airlines), Seamster, and Edens (FAA) (1995) developed a framework for the development of LOFT scenarios. The framework included (a) a group of related events inserted into a training session for specific CRM objectives, and (b) a scenario that produces an operationally realistic environment that gives the crew the opportunity to combine CRM and technical skills. The event sets are complex enough to require coordinated action of all crew members for successful completion, but not complex enough to induce failure. LOFT methodology is non-linear and non-sequential. Rather, it blends non-technical and technical skills in an ongoing process.

Training the trainer is an important aspect of the LOFT methodology (Maschke, Goeters, Hörmann, and Schiewe,1995). Amundson stated: "The most important aspect of LOFT is the facilitator's ability to get the crew members to assess and discuss their performance as a crew in the LOFT and transfer that learning back to line operations. The debrief is where the real learning takes place" (p. 84). It is here that pilots have an opportunity to reflect on what has taken place and to consider decisions, communications, and actions in the light of alternatives and options. Hackman (1993) agreed. "Together, a well-designed scenario, video feedback, and an expert facilitator can provide a pilot with precisely the kind of experience

that is needed to hone a new [CRM] skill and to become comfortable using it" (p. 7).

Another example of incorporating CRM in pilot training is a strategy recommended by Biegalski (1995) who developed training for the United States Air Force. The strategy involves the use of videotaped re-creations of illustrative accidents (p.9). These videos are meant to present pilots with a "real time" opportunity to assess their methods of enhancing situation awareness. Videos should include humor and ought to be short. It is more important to use examples of good performance rather than bad. For facilitators and evaluators, it is essential to have learners analyze negative situations - especially those which are subtle - - and then follow-up with a segment that shows appropriate behavior.

What CRM subject matter and strategies can be implemented from the very first stages of pilot training?

A number of CRM strategies can be effectively implemented at initial flight training levels. First, student pilots can become aware of the necessity of CRM skills through the distribution of informational articles (Cruse, 1995). Second, experiential exercises can be developed to underscore the synergy that develops from group problem-solving (Young, 1995). Young developed CRM training at Purdue University incorporating airline models. He recommended that the curriculum include a focus on skills such as interpersonal communication, situation awareness, problem solving/decision-making/judgment, leadership/followership, stress management, and self-critique. The four major course design areas that he developed were (a) teambuilding, (b) psycho-and aeromedical factors affecting airmen, (c) crew coordination and standardization (use of checklists) and (d) conflict resolution. According to Young (1995), lectures are useful to introduce CRM concepts. However, experiential exercises are more meaningful. Synergy exercises and role-playing demonstrate the benefits of group versus individual problem-solving.

Anderson and Henley (1995) advocated a curriculum design, which involved the development of team skills through a problem-based learning approach. They define problem-based learning as active learning in which the learners are presented with problems of "professional realism" and relevance and are engaged in the

analyses of these problems.

Role-playing and low cost simulations are effective teaching strategies for student pilots to develop CRM skills (Biegalski, 1995; Petrin, 1995). The use of Line Oriented Flight Training (LOFT) in which the "student" pilot crew flies a trip in real time, then critiques its performance during a debriefing session is an effective tool at any stage of flight training. The use of videotaping in conjunction with a LOFT scenario is a particularly effective teaching strategy, allowing the pilot crew to view their own performance and engage in self-assessment (Amundson; 1995; Biegalski, 1995; Cruse, 1995; Hackman, 1993). Today's technology provides the trainer with inexpensive videotaping equipment that can easily be combined with desktop simulation.

What are the essential elements of a plan to implement CRM from the first stages of pilot training?

A Team-based Program Design

The work of Mohrman, Cohen, and Mohrman, Jr.(1995), reveals how to reconfigure an organization "to perform work in teams when their strategy and the nature of their work call for such a design" (p.1). In *Designing Team-Based Organizations*, the authors describe a team-based design that would accommodate important CRM program elements advocated by ICAO in *Flight crew training:Cockpit Resource Management and Line Oriented Flight Training* (ICAO 217-AN/132, 1989). The team-based program design includes laying a foundation of acquired knowledge, diagnosing the current situation, agreeing on values, establishing criteria, and finally creating a program design, implementation, and assessment components. A team-based design accommodates important CRM program elements such as staff involvement in the development of training.

Changes take place in three stages according to Mohrman, Cohen and Mohrman, Jr. (1995). Figure 1 illustrates these stages. The initial activity is "laying of a foundation for change through activities that get people involved in developing a shared vision of what the organization is trying to accomplish" (p.28). Laying the foundation means identifying the expected outcomes and values which will drive the design, learning what design strategies will promote these outcomes, and diagnosing the current situation to determine the extent to which these strategies currently are in place.
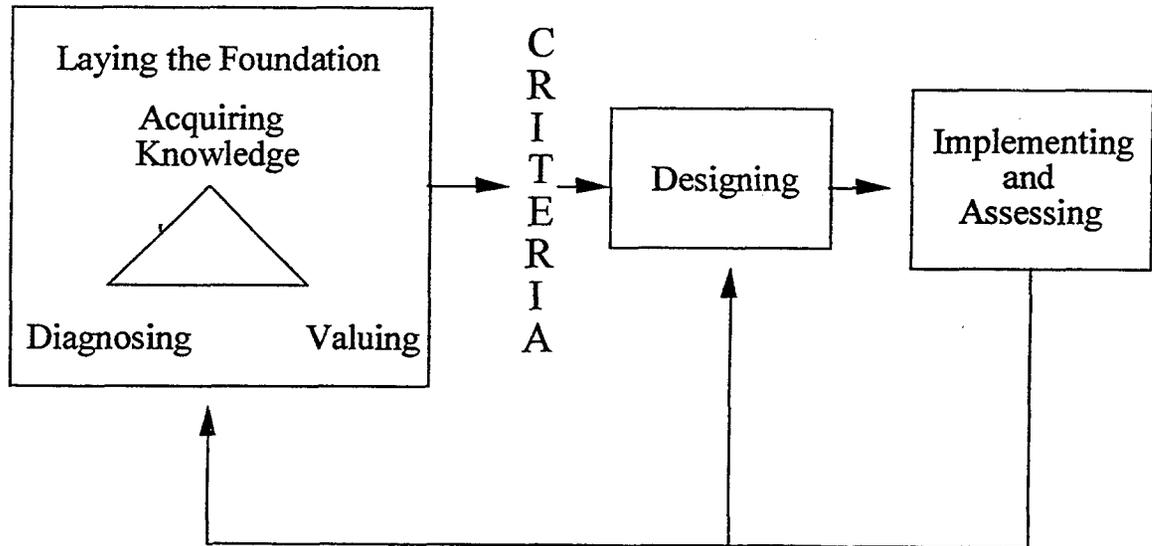
Figure 1. Self-Design Strategy for Team Based Organizations. (Mohrman, Cohen & Mohrman, 1995, p. 28)

The next step in the development of a team-based program design involves generating broad outlines for new design features. These features include structures, processes, systems, people practices, and roles that differ from those currently in place. For example, when teams initiate tasks, the teams should include employee input, so that team output is more likely to be shared by its members (p. 335). Highly specialized individuals can find it difficult to work in teams because they are steeped in their own knowledge and may lack some basic collaborative skills. They often apply their technical knowledge implicitly and find it hard to exchange views. The team approach supports these individuals in developing better communication skill.

Mankin, Cohen and Bikson (1996) suggest the need to test change. They state that "the real test of the system comes within the context of its intended use - the pilot test" (p. 165). It is through the pilot test that change should initially be implemented, and then carefully evaluated with the support and involvement of management until the complete design has been refined and is ready for implementation.

Implementation and Assessment

The final step is the implementation and assessment process. This is a distinct activity from the design stage, yet can be done simultaneously. Important issues include deciding what sequence is best and what activities are required to start the process. "The culture of the organization may limit the speed of the transition" (Mohrman, Cohen, and Mohrman Jr., 1995, p. 341). On-going assessment is a key learning activity. It should take place throughout the implementation process, and it should question whether or not the outcomes are occurring.

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Another important part of the Mohrman, Cohen and Mohrman, Jr.(1995) model is the concept that implementation of new programs is a learning process. When design decisions are made by teams, the teams have an important stake in working through obstacles that may arise throughout implementation.

Critical factors

Hayward (1995), who developed training for Quantas Airlines, outlined some critical factors affecting the success of any CRM program design. These factors included "motivation for the program introduction, the quality of training design, training objectives, the budget for development of materials, training methods, training facilities, principles, ongoing reinforcement of those principles via recurrent training and the amount of real support the program receives from company management" (p. 239). Biegalski (1995) advocated "a systems approach to CRM course design" and suggested that the designers "take care to design into the program only what can be received and internalized within the allotted time" (p. 6). It is obvious that these critical factors require a program design that involves considerable organization and advanced planning.

In terms of sequence, Taggart (1997) stated that CRM program development should begin with assessment of the existing CRM culture, followed by setting objectives, and assessing limitations (Taggart, 1997). Finally, research indicated that training of the trainers is critical to CRM program design (Jensen, Chubb, Adrion-Kochan, Kiekbride, & Fisher, 1995; Maschke, Goeters, Horman, & Schiewe, 1995). Thus, an initial investment in training of instructional personnel is one of the most essential elements of the program design.

Guidelines

The following guidelines have been developed, based on Mohrman, Cohen, and Mohrman's (1995) organizational design model to assist course/curriculum developers to create program designs that implement CRM in the first stages of pilot training. They are aimed at providing a checklist and examples to assist in ensuring that programs are inclusive of all critical factors.❑

Identify factors affecting CRM in initial pilot training

1. Motivate and involve all essential personnel, including top management, instructional staff, dispatchers and support staff
2. Assess the existing culture and identify limitations
3. Agree on important CRM skills
4. Identify expected outcomes and agree on values

Design strategies for implementing CRM

1. Identify any CRM strategies currently in place
2. List specific CRM training objectives
3. Generate outlines for new training strategies and training the instructional staff
4. Consider costs and budgetary factors
5. Define how instructional roles may differ
6. Establish a time frame for transition
7. Consider re-current training needs

Assess the program design and implementation process

1. Identify whether desired outcomes are occurring early in the implementation phase
2. Assess obstacles, materials, equipment, and facilities (an ongoing process)
3. Adjust strategies, materials, equipment, sequence of activities to promote expected outcomes
4. Be sure all stakeholders are involved in the assessment process

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