

Chapter 3. Team Training in High-risk Contexts

Team Training in Commercial Aviation

Because it is an industry where mistakes can lead to an unacceptable loss of life and property, commercial aviation has been at the forefront of risk reduction through teamwork training. Among the best-known team training strategies to emerge from the aviation setting is Crew Resource Management (CRM) training. CRM training has endeavored to improve the margin of aviation safety for more than 30 years.

Recent research suggests that CRM training has led to heightened safety-awareness attitudes; improved communication, coordination, and decision-making behaviors; and enhanced error-management skills.^{14, 61} CRM training also has demonstrated consistently positive results across a wide range of team structures, including flight crews, maintenance teams, dispatchers, and air traffic control teams.⁶²⁻⁶⁴

Furthermore, CRM training has advanced significantly through different generations.⁶⁵ Once focused solely on awareness and attitude changes, the field of CRM has expanded to blend behavioral skills and teamwork training concepts with technical flying techniques, as seen in the Federal Aviation Administration's (FAA) new Advanced Qualification Program (AQP). Recent studies suggest that CRM training cultivates positive reactions to teamwork concepts, increased knowledge of teamwork principles, and improved teamwork performance in a situational simulator.⁶⁶ In addition, pilots trained using the AQP model claim to better enjoy training, perceiving it as function-oriented and useful activity.⁶⁷

CRM's impact on the most important criterion—the number of human-attributed accidents—has yet to be empirically established.⁶⁶ Moreover, accidents are a poor benchmark for comparison because of their extremely low rate of occurrence.⁶² Researchers instead have relied on surrogate measures, such as improvements in teamwork-related knowledge and skills; demonstrations of CRM skills during flight simulations; flight instructor evaluations; and changes in an organization's safety culture to demonstrate CRM training effectiveness.^{62, 66, 69-72}

Viewed in isolation, each piece of evidence concerning the effectiveness of CRM training can be disputed. Nevertheless, the pattern of results suggests that CRM training does improve the margin of aviation safety. In short, the scientific evidence appears to support a reasonable inference that gains achieved during training in critical teamwork-related competencies can transfer directly to actual flights and flight safety, provided the application of learned skills by the trained individuals is consistent.

Evolution of the CRM Model in Commercial Aviation

Many commercial airlines actively recruited individuals who previously had flown for the military, to meet the demand for qualified pilots. These pilots brought with them a culture that valued respect for authority and reluctance to question orders, even in situations where the orders

contradicted standard operating procedures. The earliest CRM training programs, developed during the 1980s, were designed to offset this military mindset. They were structured in such a way as to decrease authoritarianism among flight crew captains, while at the same time encouraging assertiveness among the first officers.⁶⁵

Many of these programs were based on a leadership development course that was popular at the time, the Managerial Grid.⁷³ Drawing on research from the manufacturing industry, this model called upon managers to direct their subordinates' task-related efforts, while at the same time remaining considerate of the workers' feelings.^{74, 75} The early CRM programs did much to educate pilots about the importance of teamwork in a cockpit setting, but because the programs focused on generalized CRM concepts, rather than specific behavioral skills, they were not universally accepted.⁶⁵

The National Aeronautics and Space Administration (NASA) hosted an aviation industry conference in 1986 aimed at identifying the best practices in CRM training.⁷⁶ The participants identified a number of strategies with the potential to improve CRM training effectiveness. One such strategy emphasized behavior-based training for specific teamwork skills including communications, situational monitoring, decisionmaking, and stress management. Another recommendation involved the use of behavioral models to contrast effective and ineffective teamwork behaviors in the cockpit. These changes helped the pilots to accept the validity of CRM training.⁶⁵

Several aircraft manufacturers made automated navigation and propulsion controls a standard cockpit feature in the early 1990s—an advance that fundamentally changed the nature of flying. Flight crews began to control the aircraft through the use of electronic systems, abandoning the old-fashioned steering yoke and rudder pedals. In essence, pilots became information managers who intervened only when changes were necessary or when unanticipated situations arose.^{77, 78}

The advent of automation ushered in a new series of problems, among them mode-awareness errors (i.e., the automation does something that the crew had not expected) and complacency errors (i.e., the crew fails to monitor the automation).^{77, 78} The airlines began offering their flight crews special courses in automation management and combined CRM training with technical skills training to remedy these problems. At present, all commercial airlines are required by the FAA to provide their flight crews with CRM skills training, including the high-fidelity Line Operational Simulations (LOS) that mimic realistic flight conditions.^{79, 80} These programs are part of a federally recommended approach that provides trainees with the instructional information, practice and feedback, and recurrent training opportunities necessary to become safe pilots.⁸¹ This approach has a proven track record and remains the hallmark of CRM training, wherever it is implemented.

The FAA initiated the Advanced Qualification Program (AQP) in the 1990s, as a voluntary alternative to standardized pilot flight certification.^{82, 83} AQP differs from traditional airline pilot training in its less regimented, skills-based training strategy. The standardized flight training formally used across all airlines requires trainees to devote a specific number of hours to practicing each skill or set of skills. AQP requires trainees to demonstrate proficiency in a skill, regardless of how few or many hours necessary to achieve the standard. Moreover, AQP blends CRM techniques and technical skills throughout the training curriculum; conventional training includes CRM as a stand-alone topic. AQP training culminates with whole cockpit crews flying a simulation-based evaluation of CRM and technical skills, rather than the standard maneuvers check used to certify pilots for passenger flying. Most of the nation's major air carriers presently train some or all of their fleets using the AQP. Recent research suggests that AQP-trained pilots

enjoy their training more and perceive it as more realistic and more useful, than do their conventionally trained counterparts.^{67, 68}

CRM Summary

CRM training, as it is currently practiced, focuses on trainable, measurable skills crucial to successful performance outcomes. As such, the component theories of CRM are applicable to any medical domain in which effective teamwork has been shown to reduce errors and enhance patient safety.

Team Training in the Military

A second high-risk context in which the consequences of error can be dire is military service. Not surprisingly, the armed forces have contributed significantly to the growth and advancement of team training concepts.

The History of Military Team Training

Despite the fact that teamwork has long been recognized as one of an armed fighting unit's most important assets, structured team training has been adopted only recently by our military services. Team training originally focused on the role of the team leader. Team spirit and teamwork were regarded as the unit commander's responsibility.^{84, 85} The trend toward more distributed team training began with work by Briggs and his colleagues in the mid-1960s and early 1970s.⁸⁶ These researchers distinguished team or unit skills from individual, task-related skills, and in doing so demonstrated the military potential of coordinated team training. The Navy and the Army sponsored similar research into team performance.^{87, 88}

A watershed moment for military team training research came in 1988, after the naval warship USS Vincennes fired inadvertently on an Iranian commercial airliner over the Persian Gulf. In the wake of the tragic shootdown, the Navy began a multiyear, multimillion dollar research program to formally study teamwork and team training interventions. The program, known as Tactical Decision Making Under Stress (TADMUS), began in 1990 and led the Navy to breakthrough advances in team training. As noted by William Howell, then head of the Science Directorate of the American Psychological Association, "By almost anyone's standard, TADMUS has turned out to be an unqualified success."⁸⁹ Results of the Navy's program have brought about new approaches to team training. Interpositional knowledge training (cross-training), mental-model training, and team self-correction training all have become essential components of the current team training model.

Later, in the 1990s, the Air Force and the Army also commissioned theoretical and applied research into team performance and team training.^{90, 91} Both programs spurred further advances in team training techniques.⁹¹ In fact, as Salas, Bowers, and Cannon-Bowers pointed out in 1995, "Much (had) been accomplished since Dyer's (1984) seminal review."

Military Team Training in the Present

Most branches of the U.S. Armed Forces currently invoke some type of team training approach. For example, all branches of the Armed Forces provide pilots and other aircrew members with military CRM training, ranging from Fighter Resource Management (FRM) for single-seat fighter pilots to CRM training for the large crews that fly transport and patrol aircraft.⁹² Military aviation team training is again coopting the best practices of civil aviation—including the Advanced Qualification Program—and combining them with traditional training and cutting-edge technology.

Pilots and other aircraft crewmembers are not the only ones to benefit from team training techniques. Sailors, soldiers, airmen, and Marines also are learning to function in highly coordinated teams. For example, the Navy has tested several team-training approaches and recently adopted an approach called Team Dimensional Training (TDT), an outgrowth of the TADMUS program.⁴¹ TDT helps teams to analyze and correct their operational mistakes, while at the same time teaching team leaders to guide their members through the self-correction process. The techniques have been introduced in settings as diverse as submarine attack center teams, seamanship and shipboard damage control teams, naval aircrews, and surface warfare teams.

The importance of military team training will continue to grow, given the current trends toward combined-arms operations, improved communications and control, and increasingly complex weaponry. New training development and delivery technology—including scenario-generation software, virtual environments, and distributed-simulation facilities—has made it possible for widely dispersed personnel and units to train together and to exchange feedback. In response to these innovations, team training and team-training researchers must sharpen their focus, to combine results from research on teams with existing and emerging technologies.⁹⁵

Additionally, team performance measurements and the adoption of advanced training technologies will give rise to new issues.^{96, 97} The military, for example, will face the challenge of incorporating into team training such emerging research topics as meta-cognition, team adaptation, and stress management.^{54, 98, 99}

Summary

Given that serious misfortunes resulting from human error are relatively rare in commercial aviation and in military forces not involved in warfare, empirically linking team performance to the “ultimate criterion” of reducing these errors is difficult, at best. Nevertheless, the literature represents a strong argument for the interrelationship between well-coordinated, effective team performance and important proxy criteria, such as adaptability, resourcefulness, readiness, mutual trust, and stress resistance. Additionally, teams yield valuable process-oriented benefits, including cohesion, retention, peer respect, and positive morale.^{100, 101}

Given the pervasiveness of these findings, the inference that successful teamwork might substantially reduce severe life-threatening medical errors is not unreasonable. Therefore, we consider the relationships presented as the foundation for this chapter—as well as the more generalized information presented in Chapter 2—to be entirely relevant to medical team training.