## Recommendation 16-6: Delivery of Cross-Functional CRM Training

### I. Submission

The recommendations below were submitted by the Crew Resource Management Enhancement Workgroup (CRM WG) for consideration by the Air Carrier Training Aviation Rulemaking Committee (ACT ARC) Steering Committee at F2F-10. The ACT ARC Steering Committee adopted the recommendations with unanimous consent, and they are submitted to the Associate Administrator for Aviation Safety (AVS-1) as ACT ARC Recommendation 16-6.

### II. Statement of the Issue

Title 14 of the Code of Federal Regulations (14 CFR), part 121 requires each certificate holder to have an approved crew resource management (CRM) training program that includes both initial and recurrent training. The Federal Aviation Administration (FAA) has published several Advisory Circulars (AC) to assist certificate holders in developing, implementing, reinforcing, and assessing CRM training for pilots, flight attendants, aircraft dispatchers, maintenance personnel, air medical personnel, and other personnel essential for flight safety.

AC 120-51E, Crew Resource Management Training (1/22/04), when promulgated addressed joint CRM training as an evolving concept of CRM with the objective to improve the effectiveness and safety of the entire operations team. In addition, FAA guidance for Aviation Safety Inspectors (ASI) in FAA Order 8900.1 discusses joint CRM training and encourages joint training and other activities to improve crewmember communication and coordination in emergency situations.[1]

Recognizing that enhancing safety requires a proactive approach, the CRM WG was formed to recommend updates and/or improvements to current CRM/dispatch resource management (DRM) guidance in order to enhance current CRM training. Specifically, the Steering Committee tasked the CRM WG to study and address the specific topic of cross-functional CRM training and the current methodologies used to deliver cross-functional CRM training, including joint training.

Although the FAA covers CRM training, current industry and FAA guidance does not adequately address cross-functional CRM training. The recommendations build upon the concept of “joint training” as one method of delivery of “cross-functional” CRM training and suggest additional methodologies that can be used to deliver cross-functional CRM training based on the specific training objectives. Several of the recommendations are byproducts of the CRM WG’s in-depth review of training methodologies.

[1] FAA Order 8900.1, Volume 3, Chapter 19, Section 4, paragraph 3-1167.B, Policy
FAA Order 8900.1, Volume 3, Chapter 23, Section 4, paragraph 3-1792.B, Policy

## III. Recommendations

The ACT ARC proposes the following recommendations for FAA consideration:

> ***16-6(a)*:** The ACT ARC recommends the FAA develop advisory guidance for industry stakeholders on cross-functional CRM training, which emphasizes the importance of specific learning objectives and their operational applications, as well as methodologies and tools for delivery.

(See Attachment A: Sample Content and Concepts for Determining Learning Objectives for Cross-Functional CRM training)

(See Attachment B: Sample Cross-Functional CRM Training Methodologies)

The following foundational assumptions apply to this recommendation:

- An air carrier should conduct a comprehensive review of its processes for developing learning objectives and familiarize itself with the information in Attachment A. In addition, an air carrier should conduct a comprehensive review of its training delivery methodologies for current cross-functional CRM training to ensure that the concepts in Attachment B are addressed.
- Cross-functional CRM training should be provided by a highly qualified cross-functional CRM facilitator and its effectiveness periodically evaluated. See ACT ARC Recommendation 16-2: Facilitator Training to Deliver Cross-Functional CRM Training. The intent of that recommendation is to provide guidance to assist with the development of training standards for the cross-functional CRM facilitator.

***16-6(b)*:** The ACT ARC recommends FAA advisory guidance related to CRM training, including cross-functional CRM training, not be limited to multi-pilot, multi-flight attendant operations.

***16-6(c)*:** The ACT ARC recommends the FAA update its definition of "Distance Learning" as referenced in its advisory guidance, handbooks, and orders to reflect current practices.

***16-6(d)*:** The ACT ARC recommends the FAA update the information on "human factors" used in its advisory guidance related to crewmembers and aircraft dispatchers.

## IV. Rationale

***Recommendation 16-6(a):*** The ACT ARC recommends the FAA develop advisory guidance for industry stakeholders on cross-functional CRM training, which emphasizes the importance of specific learning objectives and their operational applications, as well as methodologies and tools for delivery.

The CRM WG reviewed current regulatory requirements and guidance material related to delivery methodologies for CRM training and discussed the various methods used by air carriers and training providers when developing the proposed recommendation on cross-functional CRM training.

After much review, consideration, and discussion, the CRM WG described Cross-functional CRM as follows:

> ***Cross-functional CRM* is the CRM performance, skills, and knowledge used to enhance operational effectiveness and resiliency when members of more than one work group have coordinated responsibilities and actions.**
>
> > ***Resiliency* is the ability to adapt successfully to threats, errors, or undesired states.**

The CRM WG agreed that this description encompasses the elements needed to conduct effective cross-functional CRM training.

The CRM WG further agreed that there is no one-size fits all solution for cross-functional CRM training, which must be tailored to the individual air carrier's operation. Guidance on cross-functional CRM training should incorporate industry best practices to provide as much information as possible for an air carrier developing such training. Each air carrier meets CRM training requirements by incorporating those requirements in its approved program under 14 CFR part 121, subparts N and O or subpart Y (Advanced Qualification Program (AQP)). The CRM WG provided a sample summary of core CRM skills each workgroup would attain before participating in cross-functional CRM training (see Attachment A, Core CRM Skills.) The CRM WG noted that air carriers conducting training under the traditional training requirements of part 121, subparts N and O may benefit more from the recommendation for delivery of cross-functional CRM learning objectives and training methodologies than those air carriers with AQP training. For example, those air carriers operating under a traditional training program may need guidance on how best to evaluate skills needed for cross-functional CRM training as opposed to an air carrier with an AQP that is required to evaluate CRM skills as an integral part of its approved programs. Under either training model, the air carrier should have a process to evaluate the effectiveness of its cross-functional CRM training.

In addition, the CRM WG suggested that FAA guidance consider International Civil Aviation Organization (ICAO) and European Aviation Safety Agency (EASA) guidance, which promotes joint (combined) CRM training exercises between pilots, flight attendants, and technical crew[2]. EASA guidance specifically notes joint training is not limited to crewmembers but could include other operational personnel.

*Learning objectives and training methodologies*

The foundation for the CRM WG's recommendation is that the appropriateness of any cross-functional CRM training format only can be determined AFTER the air carrier has established the learning objectives. Other factors typically considered include: audience analysis; corporate culture; training footprint; training cycles; operational impact; available delivery methods; financial impact; effectiveness; motivational value; available resources; and training model logistics.

The CRM WG provided operational examples of how cross-functional CRM may be applied in training and recommended that these learning objectives be combined with case examples, scenarios, or live simulator training. See Attachment A. In developing the applied cross-functional CRM training examples, the CRM WG recognized that core CRM knowledge, skills, and behaviors associated with pilots, flight attendants, and aircraft dispatchers are the source for developing cross-functional CRM training. Examples of core CRM knowledge, skills,

[2] ICAO Human Factors Digest No. 15 AN/173 Cir 300, 2003. EASA Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Annex III—Part-ORO, February 2016.

and behaviors are listed first in Attachment A followed by the applied cross-functional CRM training examples.

Regarding specific training methodologies, the CRM WG held lengthy discussions related to facilitated training which led to the CRM WG's first recommendation, ACT ARC Recommendation 16-2, Facilitator Training to Deliver Cross-Functional CRM Training. Facilitated training for CRM has been the basis of the WG's discussions since its inception. ACT ARC Recommendation 16–2 notes that the success of an effective cross-functional CRM training program depends on the skill of proficient facilitators (1) to help the CRM trainee understand the roles and responsibilities of others and (2) to further facilitate discussions which may be more complex and context-based than relaying technical knowledge. Therefore, the CRM WG's discussions on facilitated training carried forward to recommendation 16-6(a), in that the CRM WG divided the cross-functional CRM training methodologies by facilitated and non-facilitated. See Attachment B.

The CRM WG acknowledged non-facilitated training can provide the trainee an excellent knowledge base for CRM including cross-functional CRM, some cognitive skills, and/or some performance evaluation depending on the level of interaction provided by the training methodology. However, the CRM WG determined that the non-facilitated training methodologies in use by air carriers today (specifically Level 1 and Level 2 of eLearning as described later in this document) should not be used as the sole source of cross-functional CRM training. See recommendation 16-6(c) discussion below.

The CRM WG also discussed other approaches that might be used as a learning tool for cross-functional CRM such as observation flights and social learning.

> ***Observation Flights***. The CRM WG encouraged the FAA include in guidance that air carriers consider the practice of flight attendants observing flights on the flight deck, which were discontinued after 9/11, as a tool to deliver cross-functional CRM training. These observation flights could be conducted during simulator training but not during a checking event. Further, aircraft dispatchers are required under 14 CFR § 121.463 to complete familiarization flights on the flightdeck or in a simulator annually. Also, encouraging aircraft dispatchers to conduct his/her familiarization flights during periods common for irregular operations would be ideal for cross-functional CRM training. In addition, to address cross-functional CRM training for all workgroups covered under this recommendation, pilots should be allowed to observe dispatchers working live shifts in the operations center.
>
> ***Social Learning***. The CRM WG considered Social Learning as a methodology to deliver cross-functional CRM. The CRM WG recognized social learning is being used as a training methodology in non-aviation industries but determined it may not be a viable option for delivery of cross-functional CRM training unless it is conducted in a closed forum that is strictly moderated.

The CRM WG noted the FAA should periodically review technological advancements for delivering cross-functional CRM training and revise its guidance as additional viable delivery options emerge.

The CRM WG recognized during its discussions that advisory guidance cannot require specific timeframes for air carriers to provide cross-functional CRM training. Timeframes would be based on learning objectives and other factors. However, it is expected that an air carrier develop a periodic training schedule to ensure that a long-term employee receives cross-functional CRM training more than once during their employment with the air carrier. Some CRM WG members felt strongly that a minimum frequency for air carriers to deliver cross-functional CRM training to pilots, flight attendants, and aircraft dispatchers should be recommended. See discussion on page 36.

The CRM WG noted that following FAA guidance is not mandatory but such guidance material provides important information for understanding and conducting cross-functional CRM training.

Further, the CRM WG noted that although these learning objectives and cross-functional CRM delivery methodologies can be applied to other work groups that regularly interact with pilots, flight attendants, and aircraft dispatchers (for example, ATC, Ground Operations, and Maintenance), this recommendation is limited to the development of learning objectives and delivery of cross-functional CRM training for pilots, flight attendants, and aircraft dispatchers to remain within the scope of work assigned by the ACT ARC Steering Committee.

***Recommendation 16-6(b):*** The ACT ARC recommends FAA advisory guidance related to CRM training, including cross-functional CRM training not be limited to multi-pilot, multi-flight attendant operations.

The CRM WG noted that the application of cross-functional CRM training guidance should not be limited to multi-pilot, multi-flight attendant operations but should include other configurations of pilot, flight attendant, and aircraft dispatcher operations. For example, the learning objectives and cross-functional CRM delivery methodologies can be applied to Single-Pilot Resource Management (SRM) where a single pilot interacts with an aircraft dispatcher as well as single flight attendant operations where a single flight attendant interacts with a single pilot or multi-pilot flightcrew.

***Recommendation 16-6(c):*** The ACT ARC recommends the FAA update its definition of "Distance Learning" as referenced in its advisory guidance, handbooks, and orders to reflect current practices.

During its development of Recommendation 16-6(a) on cross-functional CRM training methodologies, the CRM WG discussed the FAA's current definition of "Distance Learning" and determined the definition is outdated due to changing technology for delivering training.

The FAA's current definition of distance learning in FAA Order 8900.1[3] reads as follows:

> **Distance Learning, Definition.** Distance learning is a term currently not used in FAA regulations. It is a term used in the FAA and in the aviation industry with various meanings depending on context. For the purposes of this order, distance learning means learning that is accomplished by any training method not including an instructor and a gathering of trainees collocated in a traditional classroom. (Distance learning is known by other terms such as E-learning, home

[3] FAA Order 8900.1, Volume 3, Chapter 19, Section 5, paragraph 3-1209.C, Distance Learning Definition.
FAA Order 8900.1, Volume 3, Chapter 22, Section 3, paragraph 3-1661.C, DL Definition.
FAA Order 8900.1, Volume 3, Chapter 23, Section 5, paragraph 3-1833.C, Distance Learning Definition.

study, self-guided training, virtual classroom, distributed training, computer-based training, WEB-based training, and others.)

The statement that reads “For the purposes of this order, distance learning means learning that is accomplished by any training method not including an instructor and a gathering of trainees collocated in a traditional classroom.” needs to be updated. The grouping of different types of training methodologies as referenced above into one definition for distance learning has not kept pace with current industry methodologies that generally divide distance learning into facilitated and non-facilitated.

***Virtual Classroom***. Web-based training or what is now commonly referred to as “Live Learning” or ”Virtual Classroom” is conducted over a live, real-time feed with an instructor that leads or facilitates the lesson or subject being taught. The advantages and disadvantages of delivery of training using a virtual classroom are listed below.

| Pros | Cons |
|---|---|
| • Questions may be answered via a live instructor or facilitator.<br>• No travel required for the trainee (computer and internet access is required.)<br>• Ability to have multiple disciplines in the virtual classroom for needed interaction (Cross-functional capabilities).<br>• Scheduling is much more flexible. | • Visual feedback from trainee is limited.<br>• Instructor or facilitator should have training/ practice to lead a live learning course to provide proper interaction and use of technology.<br>• Video and voice capabilities could be limited based on the speed and capacity of the internet used.<br>• Role playing scenarios by group could have limited interaction between trainees. |

***eLearning***. Computer Based Training (CBT), commonly referred to as “eLearning”, can be accomplished from anywhere and anytime on a computer or personal tablet (for example, iPad). This is typically done without the use of a live instructor or facilitator to answer questions verbally and immediately.

eLearning courses are based on the amount and type of interaction and feedback the trainee receives during the lesson. eLearning is organized into different levels (shown below) based on the interaction and feedback between the lesson and the trainee.

| eLearning Level | Interaction | Relationship to Knowledge, Skills, and Performance |
|---|---|---|
| **Level 1** — The course is linear and could be considered basic training, in which the trainee acts only as an information receiver. | Passive. No Interaction | **Knowledge** --- Carries the ability to transfer knowledge.<br><br>**Skills** — Has the ability to test some cognitive skill but no psychomotor skill.<br><br>**Performance** — Has no ability to test one’s performance. |

| eLearning Level | Interaction | Relationship to Knowledge, Skills, and Performance |
|---|---|---|
| **Level 2** — The course continues to be basic, but the trainee has more control over his/her training; the trainee has the ability to do more than just watch, read, and navigate. This level is used for non-complex operations and maintaining lessons. | Limited Interaction | **Knowledge** --- Carries the ability to transfer knowledge.<br><br>**Skills** — Has the ability to test cognitive skill and limited psychomotor skill.<br><br>**Performance** — Has no ability to test the trainee's performance. |
| **Level 3** — There is a high degree of complexity and customization of the course. In addition, the trainee has more control over his/her training and perceives the course as a participative and dynamic activity and not just a presentation of content.<br><br>Customized feedback is provided based on participant's response.<br><br>Sequence and complexity of content is based on participant's performance. | Moderate Interaction (multiple branches/ multiple decision points with immediate feedback from the computer) | **Knowledge** --- Carries the ability to transfer knowledge.<br><br>**Skills** — The ability to test cognitive skill and psychomotor skill is increased at this level.<br><br>**Performance** — Has the limited ability to test the trainee's performance in varying degrees based on the interaction and feedback designed in the course. |
| **Level 4** — This level gives the highest degree of interaction by the trainee. The course includes simulations and the contents are transmitted through the use of educational games to keep the trainee motivated.<br><br>Customized feedback is provided based on participant's response.<br><br>Sequence and complexity of content is based on participant's performance. | Simulation and game-based learning | **Knowledge** --- Carries the ability to transfer knowledge.<br><br>**Skills** — The ability to test cognitive skill and psychomotor skill is highest at this level.<br><br>**Performance** — Has the ability to accomplish useful work by combining knowledge, skill, and intangibles, such as inference and judgment (sometimes called "soft skills"). Performance objectives are typically validated through performance of multiple related tasks, sometimes grouped together in event sets. This level should also be able to show interaction between workgroups and facilitators and provide real time feedback. |

During the CRM WG discussions, the workgroup determined that currently used eLearning methodologies (Level 1 and Level 2) did not meet the needs for cross-functional CRM training and that this type of training should only supplement a facilitated training methodology. However, as discussions continued, the CRM WG noted that under the described eLearning schemes, Level 3 and Level 4 eLearning may be able to deliver cross-functional CRM training similar to facilitated cross-functional CRM training. Although the technology exists and is being applied in other industries, the CRM WG is unaware of any air carrier that provides Level 3 or

Level 4 eLearning meeting the proposed description of cross-functional CRM training as of the date of submission of the proposed recommendation to the ACT ARC Steering Committee (July 1, 2016). Additionally, even in the other industries, the CRM WG does not know if their Level 3 and Level 4 eLearning would meet the cross-functional CRM training needs as described below. This does not mean that eLearning under Level 3 or Level 4 could not be used for cross-functional CRM training if approved by the FAA. The CRM WG included these non-facilitated methodologies as a way to allow creativity or innovation in the development of delivery methods.

The CRM WG further noted when learning content does not have the benefit of a live CRM facilitator, such as Level 3 and Level 4 eLearning, the responsibility for providing appropriate cross-functional CRM content would fall more heavily on the training developer. While it was beyond the scope of the CRM WG's tasking to include recommendations for training developers, the CRM WG noted that as non-facilitated training becomes more interactive, especially eLearning under Level 3 and Level 4, increased expertise may be required for developers to appropriately achieve learning objectives.

In summary, the CRM WG concluded if Level 3 and Level 4 eLearning or future training developments in non-facilitated training methodologies (1) replicates the interactivity of facilitated training with feedback loops and (2) meets the elements in the description of cross-functional CRM then the FAA should consider including those non-facilitated training methodologies for delivery of cross-functional CRM training in its advisory guidance. The CRM WG noted the non-facilitated training methodologies should address interaction between the workgroups and interactivity that is received when delivering training with a cross-functional CRM facilitator.

***Recommendation 16-6(d):*** The ACT ARC recommends the FAA update the information on "human factors" used in its advisory guidance related to crewmembers and aircraft dispatchers.

Internationally aviation authorities have treated human factors as a multidisciplinary field, including but not limited to: engineering, psychology, physiology, medicine, sociology, and anthropometry.[4] The concept of CRM is one component of the larger concept of human factors and line-oriented flight training (LOFT) is used to facilitate practice and feedback in crew coordination and CRM.

In the United States, the regulatory and guidance focus has been on the concept of CRM with a mention of human factors. Although research, operators, and individuals focus on the subject as part of the overall safety strategy, the FAA does not have overarching guidance on human factors and its many underlying concepts. The term "human factors" has grown increasingly popular as the commercial aviation industry has realized that human error, rather than mechanical failure, underlies most aviation accidents and incidents. If interpreted narrowly, human factors is often considered synonymous with CRM or maintenance resource management (MRM). However, it is much broader in both its knowledge base and scope. Human factors involves gathering information about human abilities, limitations, and other characteristics and applying it to tools, machines, systems, tasks, jobs, and environments to produce safe, comfortable, and effective human performance. In aviation, human factors is dedicated to better understanding the interaction between human performance and technology

[4] ICAO Circular 217-AN/132, 1989.

so they can be safely and efficiently integrated. This understanding is then translated into design, training, policies, and/or procedures to improve human performance.[5]

Although human factors is a well-known concept, like CRM, it too has evolved over time so the concept and training regarding human factors needs to evolve to keep pace with industry changes and increased complexity in the flight deck and Air Traffic System and technology in general. The CRM ACs for crewmembers and aircraft dispatchers, AC 120-51E and AC 121-32, reference human factors in the definition sections of each AC. However, if the reader compares the level of human factor information referenced in these two documents to similar ACs for maintenance and air medical personnel, AC 120-72 and AC 00-64, respectively, the level of detail related to the multiple human factors concepts is substantially different.

At first the CRM WG envisioned making specific recommendations to the CRM AC to incorporate a more thorough discussion of the other human factors and human performance concepts but realized that was a larger task that the FAA needs to complete when AC 120-51E is updated. The CRM WG recognized that the human factors topic and human performance is beyond the scope of its work but suggested the FAA place more emphasis on the important human factor topics in its next revision to the CRM AC.

## V. Background Information

These recommendations address the remaining components of the CRM WG Scope of Work and Initiative #3 and complete the CRM WG tasking:

CRM WG Scope of Work:

1. Develop recommendations for guidance material about cross-functional crew resource management (CRM)/dispatch resource management (DRM) training for initial and recurrent training for pilots, flight attendants, and aircraft dispatchers. The recommendations should include:
    - A description of cross-functional CRM/cross-functional CRM training and [one] that identifies a learning objective that addressees interaction between pilots, flight attendants, and aircraft dispatchers.
    - Current (and any proposed) methodologies for delivery of cross-functional CRM training to pilots, flight attendants, and aircraft dispatchers.
    - Descriptions of terminology used in the recommendations (when applicable):
        - Where terms are defined in current FAA guidance, explain (with rationale) any changes to current definitions.
        - Where terms are not otherwise defined in current FAA guidance, include the description/definition used to develop the recommendations.

ACT ARC Initiatives:

Initiative #3: Revise guidance and training for pilots, flight attendants, and aircraft dispatchers on communications during emergency and unusual situations to reflect current industry knowledge.

[5] Boeing: http://www.boeing.com/commercial/aeromagazine/aero_08/human_textonly.html

## Attachment A: Sample Content and Concepts for Determining Learning Objectives for Cross-Functional CRM Training

### I. General

The concept of cross-functional CRM is operationally focused. The CRM WG describes Cross-functional CRM as follows:

> ***Cross-functional CRM*** **is the CRM performance, skills, and knowledge used to enhance operational effectiveness and resiliency when members of more than one work group have coordinated responsibilities and actions.**
>
> > ***Resiliency*** **is the ability to adapt successfully to threats, errors, or undesired states.**

### II. Core CRM Skills

Air carrier CRM programs have progressively expanded and matured as associated skills and behaviors have been identified and validated for pilots and flight attendants. In addition, the concept of the CRM team has been expanded to include the key role played by aircraft dispatchers.

Thus, it is crucial to identify the required knowledge, skills, and behaviors of pilots, flight attendants, and aircraft dispatchers to ensure training is systematically analyzed, designed, developed, implemented, evaluated, and maintained. The table below provides examples of core CRM knowledge, skills, and behaviors associated with pilots, flight attendants, and aircraft dispatchers which serve as the building blocks for developing cross-functional CRM training. Any curricula incorporating cross-functional CRM training should be based on analysis to ensure complete and appropriate learning objectives are identified and addressed within the curricula. While generic CRM knowledge, skills, and behaviors are sometimes specific to the workgroup roles, many are the same for all workgroups.

# Core CRM Skills

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Threat and Error Management[6]** | | | | |
| | Detect, address and mitigate operationally significant threats and operational errors. | • Identify, manage and mitigate significant operational threats.<br>• Identify, manage, and mitigate significant latent threats.<br>• Emphasize effective pilot monitoring to identify and trap errors in a timely manner.<br>• Identify, manage, and mitigate undesired states where safety margins are reduced.<br>• Demonstrate the ability to proactively mitigate threats and manage errors by—<br>o Recognizing the difference between a non-time critical and time critical threat.<br>o Creating sufficient time to handle non-critical threats.<br>o Understanding the importance of progressively planning ahead to prevent time critical (no-time) threats. | • Identify, manage and mitigate significant operational threats.<br>• Identify, manage, and mitigate significant latent threats.<br>• Apply error prevention, detection, and recovery/management techniques.<br>• Demonstrate the ability to proactively mitigate threats and manage errors by—<br>o Recognizing the difference between a non-time critical and time critical threat.<br>o Creating sufficient time to handle non-critical threats.<br>o Understanding the importance of progressively planning ahead to prevent time critical (no-time) threats. | • Identify, manage and mitigate significant operational threats.<br>• Identify, manage, and mitigate significant latent threats.<br>• Emphasize vigilance and effective monitoring/ cross-checking to identify and trap errors in a timely manner.<br>• Identify, manage, and mitigate undesired states where safety margins are reduced.<br>• Demonstrate the ability to proactively mitigate threats and manage errors by—<br>o Recognizing the difference between a non-time critical and time critical threat.<br>o Creating sufficient time to handle non-critical threats.<br>o Understanding the importance of progressively planning ahead to prevent time critical (no-time) threats. |

[6] Threats are defined as events that increase operational complexity (off nominal conditions) both external and internal to the cockpit. Threat and Error Management (TEM) (or similar concepts) is trained by many operators as part of CRM (as depicted in this table) or as an overarching concept ("what you do") utilizing CRM skills for effective management of threats, errors, and risk (the "how you do it"). TEM is included in this table to ensure that the knowledge and skills required for TEM are included in the discussion, no matter how it is taught.

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Leadership and Teamwork** | | | | |
| | Demonstrate effective leadership to maximize performance and minimize risk. | • Identify the expanded team concept.<br>• Identify the attributes of professionalism and how the individual pilot, workgroup, and expanded team performance are affected by professional and unprofessional acts.<br>• Recognize how personality traits affect individual and group performance.<br>• Recognize various dimensions of professional culture, company culture, and national culture and how each may affect teamwork.<br>• Use chain of command appropriately. Understand individualism/collectivism and uncertainty avoidance, which may affect teamwork.<br>• Use optimum level and type of automation for each type of situation.<br>• Look for and react to the adverse performance effects from stress, fatigue, and illness; and countermeasures to reduce those effects. | • Identify the expanded team concept.<br>• Identify the attributes of professionalism and how the individual flight attendant, workgroup and expanded team performance are affected by professional and unprofessional acts.<br>• Recognize how personality traits affect individual and group performance.<br>• Recognize various dimensions of professional culture, company culture, and national culture and how each may affect teamwork.<br>• Use chain of command appropriately. Understand, individualism/collectivism and uncertainty avoidance, which may affect teamwork.<br>• Look for and react to the adverse performance effects from stress, fatigue, and illness; and countermeasures to reduce those effects. | • Identify the expanded team concept.<br>• Identify the attributes of professionalism and how the individual aircraft dispatcher, workgroup, and expanded team performance are affected by professional and unprofessional acts.<br>• Recognize how personality traits affect individual and group performance.<br>• Recognize various dimensions of professional culture, company culture, and national culture and how each may affect teamwork.<br>• Use chain of command appropriately. Understand individualism/collectivism and uncertainty avoidance, which may affect teamwork.<br>• Use optimum level and type of automation for each type of situation.<br>• Look for and react to the adverse performance effects from stress, fatigue, and illness; and countermeasures to reduce those effects. |

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Planning** | | | | |
| | Demonstrate effective planning skills by consistently anticipating current and future operation requirements and form a suitable action plan. | • Anticipate foreseeable contingencies (stimulate thinking with experienced-based imagination.)<br>• Plan ahead. Understand how planning for anticipatable contingencies improves reliability, and the ability to react to changes.<br>• Adapt to changes and factors that affect the current or future flight status.<br>• Plan for and prebrief operational prioritization of upcoming tasks.<br>• Plan for and brief the levels, modes, and configurations of automation to be used.<br>• Execute plans as briefed or communicate changes/deviations from the plan. | • Anticipate foreseeable contingencies (stimulate thinking with experienced-based imagination.)<br>• Plan ahead. Understand how planning for anticipatable contingencies improves reliability, and the ability to react to changes.<br>• Adapt to changes and factors that affect the current or future flight status.<br>• Plan for and prebrief operational prioritization of upcoming tasks.<br>• Execute plans as briefed or communicate changes/deviations from the plan. | • Anticipate foreseeable contingencies (stimulate thinking with experienced-based imagination.)<br>• Plan ahead. Understand how planning for anticipatable contingencies improves reliability, and the ability to react to changes.<br>• Plan ahead to maintain a proactive level of awareness<br>• Adapt to changes and factors that affect the current or future flight status.<br>• Plan for and prebrief operational prioritization of upcoming tasks.<br>• Execute plans as briefed or communicate changes/deviations from the plan. |

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Decision making** | | | | |
| | Demonstrate decision making skills by consistently selecting a logical, safe, and effective course of action. | • Match decisions with available time or recognize the ability/necessity to make time.<br>• Review assumptions before selecting a course of action.<br>• Look for multiple cues when identifying a problem.<br>• Actively monitor and identify tolerance exceedance (outside of limitations) for proactive decision making.<br>• Expand the team as appropriate to solicit input. Understand why an expanded team is particularly useful in unfamiliar situations. | • Recognize the need to take action.<br>• Assess the situation.<br>• Match decisions with available time.<br>• Review assumptions before selecting a course of action.<br>• Look for multiple cues when identifying a problem.<br>• Actively monitor and identify tolerance exceedance (outside of limitations) for proactive decision making.<br>• Expand the team as appropriate to solicit input. Understand why an expanded team is particularly useful in unfamiliar situations. | • Match decisions with available time.<br>• Review assumptions before selecting a course of action.<br>• Look for multiple cues when identifying a problem.<br>• Actively monitor and identify tolerance exceedance (outside of limitations) for proactive decision making.<br>• Expand the team as appropriate to solicit input. Understand why an expanded team is particularly useful in unfamiliar situations. |

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Communication** | | | | |
| | Demonstrate effective communication skills by consistently informing crewmembers through both verbal and nonverbal activities while balancing the demands of the flight deck or passenger cabin. | • Share observations, uncertainties, ideas, intentions, and concerns.<br>• Use standardized or prebriefed terminology.<br>• Communicate changes or expected changes to automation, systems, flight status, etc. as necessary.<br>• Seek information, clarification, and guidance from others when necessary.<br>• Clearly communicate operational decisions, and when possible, the reason for those decisions.<br>• Provide constructive feedback and accept self-critique without becoming defensive.<br>• Encourage crew to ask questions about actions and decisions.<br>• Establish and reinforce crew and team communication channels.<br>• Conduct adequate, relevant, and timely briefings and invite feedback.<br>• Brief operational requirements and expectations. | • Share observations, uncertainties, ideas, intentions, and concerns.<br>• Seek information, clarification, and guidance from others when necessary.<br>• Convey information clearly, accurately and concisely to all members of the crew, and when possible, the reason for those decisions.<br>• Use standardized or prebriefed terminology.<br>• Provide constructive feedback and accept self-critique without becoming defensive.<br>• Encourage crew to ask questions about actions and decisions.<br>• Establish and reinforce crew and team communication channels.<br>• Conduct adequate, relevant, and timely briefings and invite feedback. | • Share observations, uncertainties, ideas, intentions, and concerns.<br>• Use standardized or prebriefed terminology.<br>• Seek information, clarification, and guidance from others when necessary.<br>• Clearly communicate operational decisions, and when possible, the reason for those decisions.<br>• Inform the team of unanticipated contingencies in a timely fashion.<br>• Offer or assert perspective with appropriate level of persistence as required.<br>• Conduct adequate, relevant, and timely briefings and invite feedback.<br>• Read back critical information.<br>• Use minimum effective level of assertiveness. |

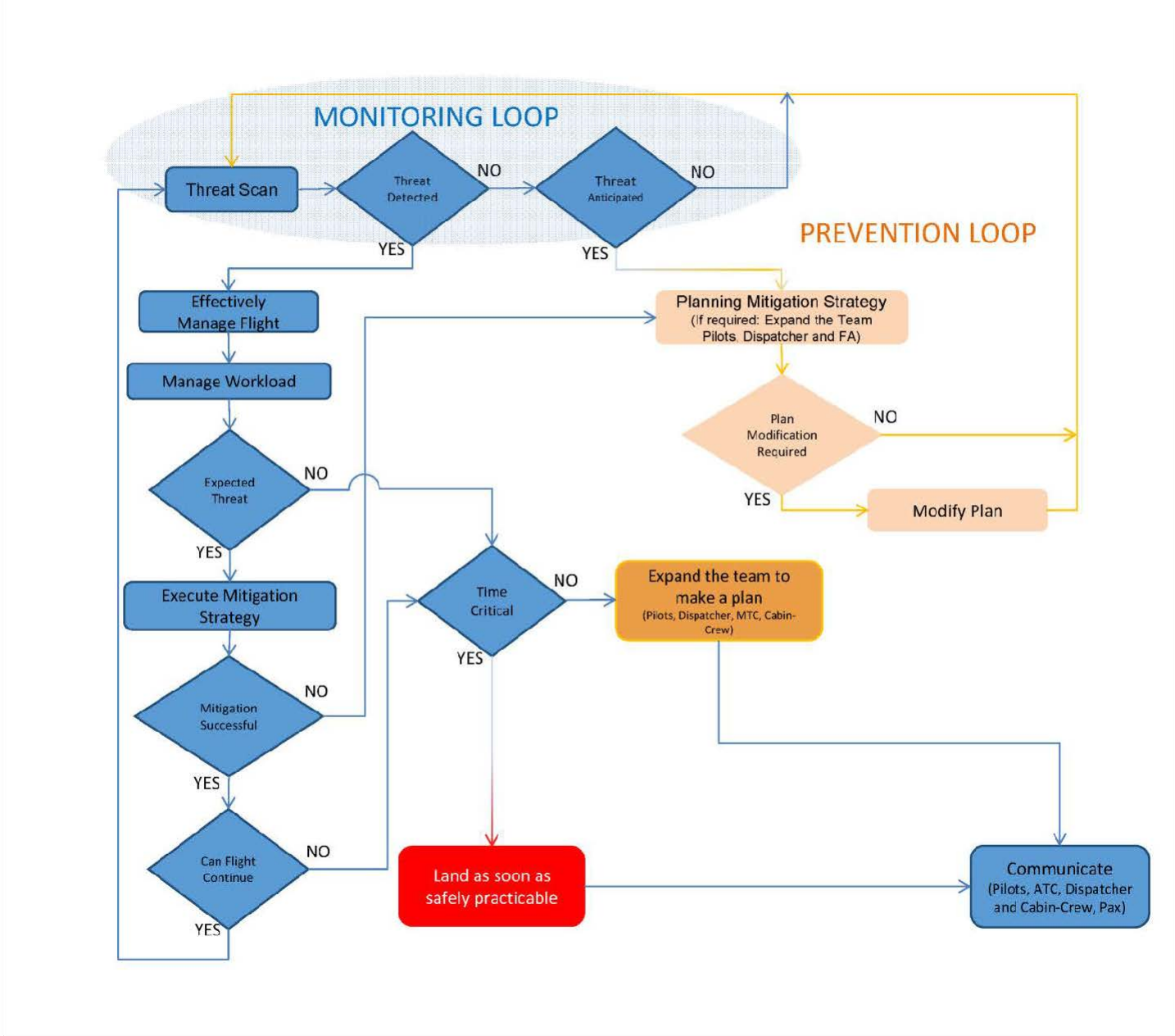
| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| | | • Inform the team of unanticipated contingencies in a timely fashion.<br>• Offer or assert perspective with appropriate level of persistence as required.<br>• Read back critical information.<br>• Use minimum effective level of assertiveness. | • Brief operational requirements and expectations.<br>• Inform the team of unanticipated contingencies in a timely fashion.<br>• Offer or assert perspective with appropriate level of persistence as required.<br>• Acknowledge and interpret non-verbal elements.<br>• Read back critical information.<br>• Use appropriate influence strategies (up to evoking consequences to gain passenger compliance during normal operations.)<br>• When appropriate, be firm and direct during aircraft or cabin emergencies.<br>• Use minimum effective level of assertiveness. | • Choose the optimum mode of communication for the situation (e.g. radio, phone, email, IM, ACARS).<br>o Initiate contact with flightcrew to discuss/advise marginal or restrictive operational conditions as warranted. |

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Situation Awareness** | | | | |
| | Demonstrate proper situation awareness by comprehending all relevant information and anticipate threats to the operation. | • Anticipate foreseeable contingencies.<br>• Regularly update awareness of aircraft energy location and trajectory at a sample rate that is adequate to prevent symptoms of passive monitoring: | • Anticipate foreseeable contingencies.<br>• Actively monitor conditions in the aircraft cabin.<br>• Ensure that distractions do not degrade overall crew situation awareness.<br>• Alert crew when added vigilance or attention may be necessary.<br>• Inform other crew when individual awareness is low (ask questions to validate).<br>• Recognize other flight attendant's capabilities and task accordingly.<br>• Think about next steps in order to maintain proactive awareness.<br>• Use an external reminder any time that you need to remember to initiate or complete a non-routine task at a future time.<br>• Perform inspections and door checks with deliberate focus. | • Regularly update awareness of physical location of the aircraft you are tracking.<br>• Anticipate foreseeable contingencies.<br>• Think about next steps in order to maintain proactive awareness.<br>• Use an external reminder any time that you need to remember to initiate or complete a non-routine task at a future time.<br>• Read and check deliberately. Look for errors (slips). Final check the dispatch release. Look for planning errors. Read carefully. Recheck interrupted work, and work that you have taken over.<br>• Recognize distraction events and react by reviewing tasks underway prior to distraction. Offload flights as necessary. |

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| | | | • Recognize distraction events and react by reviewing tasks underway prior to distraction.<br>• Temporarily set aside any distractions that occur while arming or disarming doors. | |

| Category | Description | Pilots — Knowledge and Skills | Flight Attendants — Knowledge and Skills | Aircraft Dispatchers — Knowledge and Skills |
|---|---|---|---|---|
| **Task/Workload Management** | | | | |
| | Manage available resources and efficiently prioritizes tasks. | • Balance communications (all crew, ATC, passengers, operations) with operational demands and priorities.<br>• Prioritize and distribute tasks to maximize efficiency and effectiveness.<br>• Prepare for high workload phases of flight during low workload phases of flight. Utilize Areas of Vulnerability for recognition of specific areas that require focused attention, no non-essential tasks.<br>• State when becoming overloaded.<br>• Use an appropriate level of automation to reduce workload.<br>• Create time to manage tasks and make decisions to prevent task saturation. | • Balance operational demands and priorities.<br>• Prioritize and distribute tasks to maximize efficiency and effectiveness.<br>• Prepare for high workload phases of flight and low workload phases of flight.<br>• State when becoming overloaded.<br>• Create time to manage tasks and make decisions to prevent task saturation.<br>• Continue monitoring of progress. | • Balance communications (all crew, ATC) with operational demands and priorities.<br>• Prioritize and distribute tasks to maximize efficiency and effectiveness.<br>• State when becoming overloaded.<br>• Create time to manage tasks and make decisions to prevent task saturation.<br>• As a general rule prioritize planning/monitoring airborne (and soon to be airborne) flights over planning activities for later departures. |

**One Example of the Practical Application of CRM Skills**




(Source: Air Carrier Member of CRM WG provided the sample flowchart.)

**Note**: Flowchart focuses on pilot actions but the concepts can be modified by any workgroup to show its specific workflow.

## III. Learning Objectives

The CRM WG provides learning objective examples in this Attachment but notes the air carrier ultimately must develop the cross-functional CRM training program to identify and accomplish the learning objective. The air carrier also should jointly develop concepts for the training curriculum with the training curriculum developer.

The following learning objectives are examples of how cross-functional CRM may be applied in training. The CRM WG believes that cross-functional CRM training is best presented with rich context and in a highly operationalized way. The CRM WG recommends that these learning objectives would be combined with case examples, scenarios, or live simulator training.

***Context***. Context is crucial for trainees to understand this material, because context provides the activating events that trigger a behavioral response. Context allows personnel to (1) discern the relative importance of different factors in the environment and (2) anticipate the consequence for adaptive or maladaptive behaviors. Context should provide a range of similar situations that are easily recognizable to personnel when they encounter those situations in the operation or under stressful conditions.

***Operational Environments.*** Training that is operationally focused conveys the relevance of CRM behaviors and illustrates the way those behaviors are integrated into their overall performance. Training in operational context illustrates how CRM behaviors are performed with other operational tasks.

Cross-functional CRM training builds upon the core knowledge of CRM general philosophies and skills — threat and error management; leadership and teamwork; planning; decision making; communication; situation awareness; and task/workload management. For cross-functional CRM training, creating compatible foundational assumptions allow for the creation, maintenance, and repair of common ground (a shared understanding of the goal/outcome)[7] and facilitate exercising coordinated responsibilities between workgroups.

An air carrier should consider that the trainee understands the core skills of CRM; that understanding is what will help ensure cross-functional CRM initial training is effective. Additionally, an air carrier should conduct an audience analysis to determine the trainee's experience with the operational environment. Workgroups with operational experience will have a better understanding of CRM skills so the complexity of cross-functional CRM training can be increased.

The following cross-functional CRM examples represent best practices and presume that personnel have previously received training on specific CRM behaviors and skills targeted for their workgroup. These examples incorporate communication; leadership and teamwork; problem solving and decision making; situation awareness; and task/workload management skills.

Example 1: Pre-evacuation Decision making Period

- Learning Objectives for Pilots
- Learning Objectives for Flight Attendants

[7] Identify expectations, priorities, perspectives, and required skills.

Example 2: Cabin Smoke Event

- Learning Objectives for Pilots
- Learning Objectives for Flight Attendants

Example 3: Pre-divert Decision Period

- Learning Objectives for Pilots
- Learning Objectives for Aircraft Dispatchers

# Coordinating Pilot and Flight Attendant Responsibilities during Pre-evacuation Decision Period

| | Pilots | Flight Attendants |
|---|---|---|
| **Common Foundational Knowledge** | **Typical Pre-Evacuation scenarios and complications:**<br>• If not immediately obvious, information is gathered to determine if evacuation is warranted<br>• If evacuation is not required immediately, but the threat of escalation dictates Flight Attendants remain at Alert stations<br>• The Flight Attendants initiate evacuation in accordance with their SOP<br>• The passengers initiate an unwarranted/uncommanded evacuation<br>• Intercom/PA failure<br>**Typical reasons why a flight attendant may initiate an evacuation**<br>• Uncontrollable fire in the cabin<br>• Dense smoke in the cabin<br>• Major structural damage<br>**Typical reasons for commanded evacuation**<br>• Risk of smoke/fume inhalation<br>• Risk of thermal injury<br>• Risk of aircraft cabin flooding<br>**Evacuation-Decision Options:**<br>• Evacuate<br>• Remain on board<br>• Not Yet<br>• (A “Not Yet” decision creates an inherent information vacuum in the cabin. If “alert stations” window is significantly extended, further instructions such as, “Standby for further instructions, remain at stations,” may be warranted (as allowed or not by the air carrier’s SOP)). A decision maintain readiness to evacuate (a Not Yet decision), is common under the following circumstances: | **Typical Pre-Evacuation scenarios and complications:**<br>• If not immediately obvious, information is gathered to determine if evacuation is warranted<br>• If evacuation is not required immediately, but the threat of escalation dictates Flight Attendants remain at Alert stations<br>• The Flight Attendants initiate evacuation in accordance with their SOP<br>• The passengers initiate an unwarranted/uncommanded evacuation<br>• Intercom/PA failure<br>**Typical reasons why a flight attendant may initiate an evacuation**<br>• Uncontrollable fire in the cabin<br>• Dense smoke in the cabin<br>• Major structural damage<br>**Typical reasons that flightcrew command an evacuation**<br>• Risk of smoke/fume inhalation<br>• Risk of thermal injury<br>• Risk of aircraft cabin flooding<br>**Evacuation-Decision Options:**<br>• Evacuate<br>• Remain on board<br>• Not Yet<br>• (A “Not Yet” decision creates an inherent information vacuum in the cabin. If “alert stations” window is significantly extended, further instructions such as, “Standby for further instructions, remain at stations,” may be warranted (as allowed or not by the air carrier’s |

| | Pilots | Flight Attendants |
|---|---|---|
| | o Awaiting ARFF assessment, or initial attempt at suppression<br>o Fumes<br>o Haze<br>o Suppressed cargo smoke/fire<br>o Landing Gear collapse<br>o Hot Brakes/Brake Fire<br>o Fuel Leak<br><br>**Communication Challenges**<br>• Stress<br>• Workload<br>• Time Pressure<br>• Implications of varying access to information and levels of situation awareness<br>To decrease ambiguity—<br>o Use intercom if information exchange is required during pre-evacuation decision phase<br>o Use PA for commands<br>o Use standard terminology | SOP)). A decision maintain readiness to evacuate (a Not Yet decision), is common under the following circumstances:<br>o Awaiting ARFF assessment, or initial attempt at suppression<br>o Fumes<br>o Haze<br>o Suppressed cargo smoke/fire<br>o Landing Gear collapse<br>o Hot Brakes/Brake Fire<br>o Fuel Leak<br><br>**Communication Challenges**<br>• Stress<br>• Workload<br>• Time Pressure<br>• Implications of varying access to information and levels of situation awareness<br>• Passenger influences<br><br>• To decrease ambiguity—<br>o Use intercom if information exchange is required during pre-evacuation decision phase<br>o Use PA for commands<br>o Use standard terminology |
| **Perspective of Other Workgroup** | What it is like to be in the Cabin (time and stress) during pre-evacuation decisions | Flightcrew performing evacuation checklist and then coordinating with ARFF |
| **Operational Situation Knowledge** | Typical ARFF response times<br>Effect of crosswind on external fires<br>Expected passenger injuries from an evacuation | Typical ARFF responses during an evacuation<br>Effect of external conditions on a possible evacuation<br>Passenger demographics and their influence on possible evacuation<br>Realistic knowledge about aircraft smoke and fire designed to prevent fear that may be unwarranted |

| | Pilots | Flight Attendants |
|---|---|---|
| **Key Success Skills—Pre-event** | Effective Brief, set tone that creates safe communication<br>Environment (Pre-departure Briefing and/or Emergency Briefing as the case may be) | Dependable 30-second Review (silent review)<br>Awareness of negative or positive panic from passengers<br>Review of manual, time permitting |
| **Workgroup Specific—Key Success Skills, during Event** | Condition Action Assessment — Time? Or no time? (i.e., was the triggering event catastrophic?)<br>Deal with startle. Take a deep breath. Do not hurry.<br>If time (not time critical), build a picture of what is going on. Look, talk and assess.<br>Use decision making resources (for example, open cockpit window and look if needed).<br>Use decision making resource: ARFF.<br>Plan ahead, review Evacuation Checklist. If possible, review a planned evacuation scenario. | Flight attendants promote and maintain calm to instill confidence by exhibiting strong leadership in the cabin to avoid or stop panic:<br>• Slow breathing<br>• Supportive gestures<br>• Constructive impact of appearing calm<br>• Understanding time distortions under pressure<br>Remain alert to continually assess the situation for changes. |
| **Key Cross-Functional Skills for Effective Performance** | Update flight attendants (time permitting) if unanticipated contingencies arise.<br>Speak in an unhurried, specific, clear, and concise manner. | Communicate problems to the pilots or seek clarification (ask questions).<br>Speak in an unhurried, specific, clear, and concise manner. |

# Coordinating Pilot and Flight Attendant Responsibilities during Cabin Smoke Event

| | Pilots | Flight Attendants |
|---|---|---|
| **Common Foundational Knowledge** | **Typical sources of cabin smoke**<br>• Pack<br>• Galley Equipment<br>• Entertainment Systems<br>• Avionics<br>• Aircraft Electrical<br>• Fuel Lines<br>• Engine Damage<br>**Smoke events taxonomy**<br>• Source: Known, Unknown<br>• Duration: Transient, continuous, increasing<br>• Intensity: Fumes, Haze, Smoke, Smoke and Heat<br>• Isolatable: Yes, no, not sure<br>**Operating environments factors:**<br>• Remote (i.e., Oceanic)<br>• Solid Divert Options<br>• Critical Divert Options (for example, night, mountainous, non-radar, international) | **Typical sources of cabin smoke**<br>• Pack<br>• Galley Equipment<br>• Entertainment Systems<br>• Avionics<br>• Aircraft Electrical<br>• Fuel Lines<br>• Engine Damage<br>**Smoke event taxonomy**<br>• Source: Known, Unknown<br>• Duration: Transient, continuous, increasing<br>• Intensity: Fumes, Haze, Smoke, Smoke and Heat<br>• Isolatable: Yes, no, not sure<br>**Operating environments factors:**<br>• Remote (i.e., Oceanic)<br>• Solid Divert Options<br>• Critical Divert Options (for example, night, mountainous, non-radar, international) |
| **Perspective of Other Workgroup** | **Potential cabin workloads**<br>☐ Searching for smoke source<br>☐ Passenger responses to situation | **Potential pilot workloads during Initial call up**<br>☐ High workload — smoke caused by malfunction (e.g. engine failure) that flightcrew is stabilizing<br>☐ Low workload — smoke report is the only information that the flightcrew has |
| **Operational Situation Knowledge** | Shared assumptions between pilots | Passenger $O_2$ mask may not be helpful for certain smoke events<br>Evaluate smoke threat including understanding of past incidents and frequency of similar events |
| **Key Success Skills— Pre-event** | Conduct effective brief, set tone that creates safe communication environment | Recognize and resolve doubts and discrepancies |

| | Pilots | Flight Attendants |
|---|---|---|
| **Workgroup Specific— Key Success Skills, during Event** | Deal with startle. Take a deep breath. Do not hurry<br>Prioritize aircraft control<br>Build a picture of what's going on: look, talk, and assess<br>Use additional resources, pilot flying utilize ATC to off-load task and monitor position, if necessary<br>Perform Smoke Checklist in a deliberate fashion | Promote and maintain calm in the cabin:<br>• Slow breathing<br>• Supportive gestures<br>• Constructive impact of appearing calm<br>• Understanding time distortions under pressure<br>Remain alert to continually assess the situation for changes |
| **Key Cross-Functional Skills for Effective Performance** | Ask questions<br>Maintain frequent communication with the cabin and monitor changes<br>Challenge your assumptions, do not assume the situation is not changing<br>Speak in an unhurried, specific, clear, and concise manner<br>If pilots are under high workload during an initial call set a call back time | Speak in an unhurried, specific, clear, and concise manner<br>Share thoughts, concerns and status changes, particularly for worsening or accelerating conditions<br>Read back key information<br>Ask clarifying questions<br>If pilots are under high workload during an initial call set a call back time |

# Coordinating Pilot and Aircraft Dispatcher Responsibilities during Pre-divert Decision Period

| | Pilot | Aircraft Dispatcher |
|---|---|---|
| **Common Foundational Knowledge** | Understand difference between command authority and operational control, and when to defer to operational control guidance.<br>Common ground (shared mental models) is deceptively difficult to create, maintain, and rebuild.<br>People tend to fill in lack of objective knowledge with overly optimistic assumptions.<br>Contingency planning expands your reaction window.<br>Contingency planning has the extra benefit of lessening the chance of continuing with a bad plan. When we have a plan B, we notice when plan A is falling apart. | Understand difference between command authority and operational control, when to provide operational control guidance.<br>Common ground (shared mental models) is deceptively hard to create, maintain, and rebuild.<br>People tend to fill in lack of objective knowledge with overly optimistic assumptions.<br>Contingency planning expands the pilot's reaction window.<br>Contingency planning has the extra benefit of lessening the chance of continuing with a bad plan. When we have a plan B, we notice when plan A is falling apart. |
| **Perspective of Other Workgroup** | Radio vs. ACARS with your aircraft dispatcher. Pros and cons from the aircraft dispatcher perspective.<br>Resources available through the Systems Operations Center.<br>The Divert Management Program, what it is and why it is important to pilots. | Consequences of creating unnecessary time compression for the pilots.<br>Implications of airspace on cockpit workload and ease of diversion. |
| **Operational Situation Knowledge** | | Knowledge of suitable airfields for diversion.<br>Knowledge of operational constraints.<br>Knowledge of services available. |

| | Pilot | Aircraft Dispatcher |
|---|---|---|
| **Key Success Skills— Pre-event** | Anticipate foreseeable contingencies.<br>Monitor marginal conditions for deterioration. | Identify threats that would delay landing.<br>Anticipate foreseeable contingencies.<br>Communicate volume issues in preflight brief.<br>Highlight known threats in preflight brief.<br>Effective brief or release remark may allow pilots to anticipate potential for holding.<br>Build a picture of:<br>• Resources available at nearby stations.<br>• Conditions and aircraft performance at nearby stations.<br>• International and customs requirements at nearby stations. |
| **Workgroup Specific — Key Success Skills, during Event** | Prioritize Flight Path Management.<br>Divide workload.<br>Verbalize flight path constraints at beginning and end of distracting task.<br>Determine divert fuel independently and compare results. | Anticipate foreseeable contingencies.<br>Identify critical planning assumptions and monitor those variables.<br>Offload flights (if necessary).<br>Delay shift handover until diversion is complete.<br>Use closed-loop communication when coordinating divert station resources, especially for offline diverts.<br>Plan diversion and minimum fuel to initiate. |
| **Key Cross-Functional Skills for Effective Performance** | Share thoughts and concerns<br>(Weather, fuel, runways, services).<br>Identify critical planning<br>assumptions and monitor those<br>variables. Provide timely<br>holding/status updates to the<br>aircraft dispatcher. | Share thoughts and concerns (weather, fuel, runways, services).<br>Update status to pilots if reevaluating alternate. Explain your decisions.<br>Plan and coordinate early.<br>Use closed-loop communications with divert stations to assure they are ready.<br>Offload flights to maintain priority of potential diversions. |

## Attachment B: Sample Cross-Functional CRM Training Methodologies

### I. GENERAL.

The CRM WG reviewed the knowledge, skills, and performance aspect of cross-functional CRM. The following definitions for knowledge, skills, and performance are found in FAA Order 8900.1[8]. The CRM WG used these definitions to evaluate the training methodologies listed in the cross-functional CRM methodologies tables in section II below.

| | Definition | Examples |
|---|---|---|
| **Knowledge** | Specific information required to enable a trainee to develop the skills and attitudes to effectively recall facts, identify concepts, apply rules or principles, solve problems, and think creatively. Because knowledge is covert, trainees usually are assigned overt activities to demonstrate their knowledge base. Knowledge objectives are typically validated through written, electronic, or oral testing. | Learning facts by rote, such as an operator's history, organization, and general policies; committing limitations to memory; or gaining a basic understanding of airplane systems.<br><br>Learning facts by rote, such as the regulatory requirements regarding carry-on baggage, preflight requirements for emergency equipment or function of controls, switches, and indicators on F/A panels.<br><br>Learning facts by rote, such as an operator's history, organization, and general policies; committing an Aircraft Flight Manual's (AFM) limitations to memory; or getting a basic understanding of an airplane's systems. |
| **Skill** | An ability enabled by knowledge to perform an activity or action. Skills are often grouped into cognitive skill and psychomotor skill categories. | |
| *Cognitive Skill* | Ability to perform a task requiring the manipulation of words, numbers, and symbols. Requires the application of knowledge. Usually involves classification; the application of (mental) rules, procedures, or principles; the solution of problems; or the application of creative thinking. Cognitive skill objectives are typically validated through written, electronic, or oral testing, or through simple task performance. | Applying knowledge of airplane limitations to a weight and balance computation or applying basic systems knowledge to the operation of aircraft systems.<br><br>Challenging a flight attendant to apply knowledge of regulatory requirements for carry-on baggage in an interactive exercise, or to perform a preflight inspection of emergency equipment, or to operate the systems on a F/A panel in an actual or simulated cabin environment.<br><br>Challenging a dispatch trainee to apply knowledge of an airplane's limitations to a W&B computation; or to apply basic systems knowledge to operating aircraft systems, and populating data in the flight planning system. |

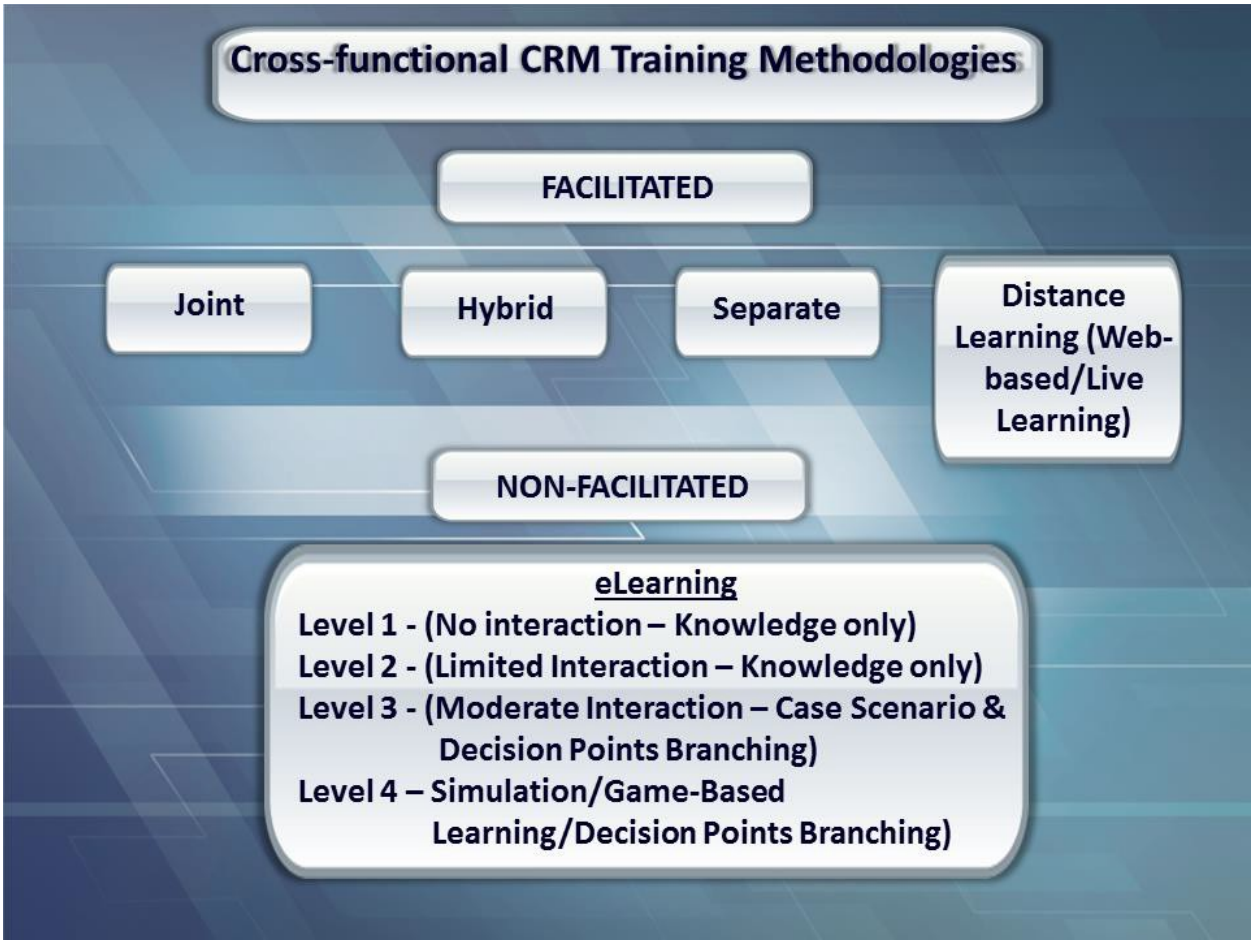
[8] FAA Order 8900.1, Volume 3, Chapter 19, Section 5, 3-1209.E, Training Objectives and Proficiency.
FAA Order 8900.1, Volume 3, Chapter 22, Section 3, 3-1661.E, Training Objectives and Proficiency.
FAA Order 8900.1, Volume 3, Chapter 23, Section 5, 3-1833.E, Training Objectives and Proficiency.

| | Definition | Examples |
|---|---|---|
| *Psychomotor Skill* | Ability to perform a task requiring dexterity, coordination, and muscular activity. Requires the application of knowledge. Usually involves the manipulation of objects or materials and the use of fine and gross muscular movement in a coordinated manner. Psychomotor objectives may be validated through performance of individual tasks. | Operation of an emergency exit by normal and alternative methods.<br>Operation of a floor-level exit in the normal and emergency modes, firefighting equipment, and medical oxygen equipment for passengers.<br>Proper and efficient utilization of performance and flight planning tools to achieve the desired results. |
| **Performance (outcomes)** | Ability to accomplish useful work by combining knowledge, skill, and intangibles, such as inference and judgment (sometimes called "soft skills"). Performance objectives are typically validated through performance of multiple related tasks, sometimes grouped together in event sets. | Demonstrating competence as pilot-in-command during an instrument approach, demonstrating competence as a flight attendant during passenger/cabin management, or applying crew resource management skills in an operational environment.<br>Demonstrating competence as a flight attendant during a performance drill that requires preparing the cabin for a land evacuation.<br>Demonstrating competence as a [aircraft] dispatcher in any operational situation or simulation involving flight planning, dispatch release, or flight following. |

Knowledge, skills, and performance are linked to each cross-functional CRM training methodology in the tables in section II below. For effective cross-functional CRM, the training methodology should address all three concepts: knowledge, skills, and performance, as applicable.

## II. Cross-functional CRM Training Methodologies

The concepts of communication, teamwork, decision making, and leadership remain the hallmark of CRM training. Cross-functional CRM training is an essential tool to support CRM. Cross-functional CRM training should be based on learning objectives (see Attachment A), taught by a trained cross-functional CRM Facilitator (ACT ARC Recommendation 16–2), and accomplished by the methodologies in the tables below. ACT ARC Recommendation 16–2 notes that the success of an effective cross-functional CRM training program depends on the skill of proficient facilitators to help the CRM student understand the roles and responsibilities of others and to further facilitate discussions which may be more difficult than relaying technical knowledge. Therefore, the CRM WG divided the cross-functional CRM training methodologies by facilitated and non-facilitated.




Currently, a non-facilitated training methodology (eLearning Level 1 and Level 2) may only be used as a supplement to facilitated cross-functional CRM training as non-facilitated training typically only provides knowledge and/or some cognitive skills to the trainee and some minimal performance evaluation. The CRM WG determined that future training methodologies for cross-functional CRM training may be incorporated in advisory guidance if proven as a viable means to administer the training.

*Other Considerations*

**Messaging**. As an air carrier develops the curriculum it should take into account the various messaging styles. For example, one group may not be as electronically savvy as another group. Same as when teaching the new generation of learners who are technological savvy.

**Media**. AC 120-54A, Advanced Qualification Program (6/23/06) states that "AQP encourages innovation in the methods and technology that are used during instruction and evaluation, and efficient management of training systems" therefore identification of appropriate media[9] for cross-functional CRM training should occur as each air carrier conducts its training analysis and determines the best training methodology to reach its learning objective.

[9] Physical means for providing the instructional content and experience to the student. Includes entire set of instructional presentation materials (e.g., workbook, videotape, overheads, computer-based training, mock-ups, FTDs, simulators, etc.)

**Frequency**. Current FAA guidance references that CRM training is comprised of three training components:

- Initial indoctrination/awareness,
- Recurrent practice and feedback, and
- Continual reinforcement.

Each component includes learning topics that support effective CRM training. Although the guidance references the training components, there are no specific timelines associated with providing cross-functional CRM training except the reference to "recurrent" which implies annual training. The CRM WG discussed the need for specifying timelines related to providing cross-functional CRM training as part of the desire to support the concept of bringing similar and dissimilar groups together to enhance aviation safety.

Air carriers noted that many of their training programs already provide varying levels of cross-functional CRM training and suggested that air carriers would support the cross-functional CRM training concept as appropriate and as needed. For example, while one air carrier may need to conduct cross-functional CRM training on an annual basis, it is recognized that another air carrier may not have that same training need based on its current learning objectives or safety needs as dictated by the air carrier's SMS. The CRM WG recognized that air carriers should have some flexibility related to the need for periodic cross-functional CRM training, however, there was concern that too much flexibility also could result in an unexpected situation where an air carrier provides cross-functional CRM training only once in a long-term employee's work history.

This led the CRM WG to further research how other authorities or agencies address cross functional CRM training. An air carrier may need to consider if any of its training requirements are subject to review and approval by other authorities or agencies. For example, the European Aviation Safety Agency (EASA) standard on recurrent CRM training recommends combined CRM training for flightcrew and flight attendants during annual recurrent training and further states the combined training should be a minimum of 6 hours over a period of 3 years.[10]

Further, air carriers doing business with the Department of Defense (DOD) must follow the Department of Defense Commercial Air Transportation Quality and Safety Review Program regulations which for aircrew training require crew coordination training that facilitates full cockpit crews training and full crew interaction using standardized procedures including the principles of CRM. An air carrier must provide appropriate emergency procedures training (e.g., evacuation procedures) to flight deck and flight attendant personnel as a total crew whenever possible; such training focuses on cockpit and cabin crews functioning as a coordinated team during emergencies.[11]

CRM WG member organizations have different opinions on the frequency of cross-functional CRM training delivery to pilots, flight attendants, and aircraft dispatchers. The organizations also had different opinions related to "facilitated" training recommendations. These opinions are provided in the following table by organization:

[10] European Aviation Safety Agency, GMC3 ORO.FC.115, Crew resource management (CRM) training, paragraph (a)(1)(i), GM2 ORO.CC.115(e), Crew resource management (CRM) training, paragraph (a)(1)(i).
[11] Title 32 of the Code of Federal Regulations, § 861.4(e)(3)(iv), Aircrew training.

| **Aircraft Dispatcher Federation (ADF)**<br>**Association of Flight Attendants (AFA)**<br>**Airline Pilots Association International (ALPA)**<br>**Association of Professional Flight Attendants (APFA)**<br>**CAE Inc.**<br>**Flight Safety International**<br>**Regional Airline Association (RAA)** | **Airlines for America (A4A)**<br>**Delta Air Lines** |
|---|---|
| Recognizing that cross-functional CRM skills can be perishable, these CRM WG member organizations adopted and support the philosophy that facilitated cross-functional CRM training using any of these methodologies: joint, hybrid, separate, and distance learning [web-based/live learning] and FAA approved Level 3 and Level 4 eLearning, at a minimum, should be provided to pilots, flight attendants, and aircraft dispatchers over a period not exceeding 3 years. These organizations further noted that most air carrier training programs and/or SMS would provide cross-functional CRM training within a 3-year timeframe so this philosophy should not be burdensome but would ensure the industry program corresponds to world standards. | These CRM WG member organizations support the air carrier determining the frequency of cross-functional CRM training delivery and suggest air carriers should consider if any of its training requirements are subject to review and approval by other authorities or agencies. A4A and Delta further noted air carriers should incorporate applicable considerations into the analysis of its organization's SMS to determine appropriate training frequency. For those air carriers who are unable to conduct a robust training needs analysis, A4A and Delta suggest cross-functional CRM training should be provided within a 3-year period.<br><br>A4A and Delta Air Lines expressed concern that requiring cross-functional CRM training be facilitated might be too restrictive and is not supportive of innovation. Further, A4A and Delta do not consider Level 1 or Level 2 eLearning to be effective as a standalone methodology for delivering cross-functional CRM training. However, A4A and Delta noted because Level 3 and Level 4 eLearning can meet the applicable learning objectives and provide the appropriate interaction and feedback, it should be considered an acceptable option for standalone cross-functional CRM delivery. |

a. Facilitated Cross-Functional CRM Training — All facilitated training methodologies can be used as a standalone for cross-functional CRM training.

<table>
<tr><th colspan="3">FACILITATED</th></tr>
<tr><td>JOINT</td><td>Multiple employee groups participating in a facilitated training event or environment (flight simulation training device). Joint training assumes physical proximity of the trainees.<br><br>Use of a cross-functional CRM facilitator (as suggested in ACT ARC Recommendation 16–2) is necessary for joint CRM training. Number of participants should be limited to ensure interaction so training is not a lecture.</td><td>All combinations (pilots and FAs; dispatcher and FAs; etc.</td></tr>
<tr><th>Pros</th><th>Cons</th><th>Notes</th></tr>
<tr><td>• Allows air carriers to address differing employee cultures to assist with team building and conflict resolution.<br>• Provides an open environment to discuss sensitive issues specific to the workgroup.<br>• Provides an interactive environment between workgroups to allow each group to understand and see the way the other group may respond to an issue. Allows differences in procedures that may not have been discovered had the two groups not been training together.<br>• Helps teach knowledge and skills and measures performance.</td><td>• Learning objectives, messaging styles and prior background may be different between workgroups even when discussing the same general topic. Compatibility of learning objectives, messaging styles, and prior backgrounds must be considered to determine if joint training can be effective.<br>• Costly<br>□ Coordinating different employee schedules.<br>□ Transportation to training site.<br>□ Pay issues for attending training.<br>□ More manpower for running the training.<br>□ Operational impacts.<br>□ Competition with other CRM training topics.<br>• Logistics<br>□ Training cycle (footprints, e.g. 12 months versus 18 months).<br>□ Training location differences.<br>□ Differences in numbers of specific workgroup.</td><td>.</td></tr>
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| FACILITATED | | |
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| **SEPARATE** | One individual employee group training only to his or her specific employee group about cross-functional CRM topics.<br><br>Use of a cross-functional CRM Facilitator (as suggested in ACT ARC Recommendation 16–2) is necessary for separate CRM training. Number of participants should be limited to ensure interaction so training is not a lecture. | |
| **Pros** | **Cons** | **Notes** |
| • Provides an open environment to discuss sensitive issues specific to the workgroup.<br>• Allows air carriers to address differing employee cultures to assist with team building and conflict resolution.<br>• Allows differences in procedures that may not have been discovered had the two groups not been training together.<br>• Less costly than joint cross-functional CRM.<br>• Helps teach knowledge and skills; and measures performance. | • Not as supportive for cross-functional CRM scenario-based training because there is limited interaction between multiple workgroups.<br>• Relays only generic high-level information related to the other workgroup versus in-depth knowledge of that workgroup. | |

| FACILITATED | | |
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| **HYBRID** | Members of one employee group in a class with a facilitator(s) from a different employee group(s) including co-facilitation.<br><br>Use of a cross-functional CRM Facilitator (as suggested in ACT ARC Recommendation 16–2) is necessary for hybrid CRM training. Number of participants should be limited to ensure interaction so training is not a lecture. | |
| **Pros** | **Cons** | **Notes** |
| • Allows air carriers to address differing employee cultures to assist with team building and conflict resolution.<br>• Allows differences in procedures that may not have been discovered had the two groups not been training together.<br>• Provides an open environment to discuss sensitive issues specific to the workgroup.<br>• Facilitators from different groups provide feedback to other employee groups. This can aid in scenario training.<br>• Less costly than joint cross-functional CRM.<br>• Subject matter expert (SME) is present in the room.<br>• The SME delivers a consistent message to other work groups.<br>• Good for knowledge, cognitive skills. Could be used for some performance skill related to some CRM interactions. | • Although interaction and feedback are achieved, scenario/role playing may be diminished without multiple employees available from the other workgroups.<br>• Limited interaction in that you have only one person showing/explaining what that group would do in a scenario. | |

| **DISTANCE LEARNING (LIVE LEARNING OR VIRTUAL CLASSROOM) — FACILITATED** | Cross-functional CRM facilitator is live (remote); students training from different location(s); live interaction with instructor.<br><br>Use of a cross-functional CRM Facilitator (as suggested in ACT ARC Recommendation 16–2) is necessary for live learning/virtual classroom CRM training. Number of participants should be limited so training is interactive and not a lecture. | |
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| **Pros** | **Cons** | **Notes** |
| • Allows air carriers to address differing employee cultures to assist with team building and conflict resolution.<br>• Allows differences in procedures that may not have been discovered had the two groups not been training together.<br>• Provides an open environment to discuss sensitive issues specific to the workgroup.<br>• Less costly than classroom training.<br>• No travel is required. Trainees have a scheduled time to meet and there is video and audio capability which allows for interaction and feedback.<br>• Does not require all participants to be in the same physical location:<br>o Live access to expert.<br>o Ability to interact with cross-functional CRM facilitator.<br>o Ability to interact with other training participants.<br>o Learners able to communicate effectively in real time.<br>• Helps teach knowledge and skills and measure performance. | • Environment for live scenario/role playing (employee engagement) may be diminished without visual feedback from others.<br>• Increased potential for limited student engagement. Limited interaction, trainees only evaluate/respond to facilitator cues not to other trainees.<br>• Logistical issues could hinder effective learning (for example slow Wi-Fi or not staying connected).<br>• The cross-functional CRM facilitator may need additional skills for Web-based live learning instruction because trainee cues, interaction may be different than “classroom” training. | |

The use of training methodologies will fluctuate based on air carrier resources. For example, Separate training may not be the most optimal choice but if the learning objective can only be accomplished this way because a particular issue needs to be addressed quickly or there are resource constraints then Separate training is better than not completing the training objective.

b. Non-Facilitated Cross-Functional CRM Training — Currently, non-facilitated training methodologies eLearning Level 1 and Level 2 may only be used as a supplement to cross-functional CRM training. If aviation training program developers can ensure eLearning level 3 and level 4 can replicate the interaction between the workgroups and the feedback functions of a cross-functional CRM facilitator (the computer serves as the facilitator, provides realistic real time feedback, and can measure trainee understanding and application of course material), those levels may qualify as standalone cross-functional CRM training if approved by the FAA.

| **NON-FACILITATED** | |
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| **eLEARNING** | A single person (trainee) sitting in front of his/her own computer or device; multiple choice response, no live interaction with a human cross-functional CRM facilitator during the learning topic, and no live support in a classroom setting if questions should arise. |
| **Level 1 — Passive – No Interaction (Knowledge only)**<br>Course is linear/considered basic training | At this level, learners do not interact with resources, instead have—<br>• Graphics, images and simple animations.<br>• Rollovers.<br>• Basic quiz questions. |
| **Level 2 — Limited Interaction (Knowledge only)**<br>Considered basic training; level is used for non-complex operations and maintenance lessons | At this level, learners interact with resources such as:<br>• Clickable animated graphics.<br>• Navigation expands to menus, glossaries, and links to external resources.<br>• Often includes simple exercises (i.e., drag-and-drop, matching, and identification components).<br>• Audio and video. |

| NON-FACILITATED | |
|---|---|
| **eLEARNING** | A single person (trainee) sitting in front of his/her own computer or device; multiple choice response, no live interaction with a human cross-functional CRM facilitator during the learning topic, and no live support in a classroom setting if questions should arise. |
| **Level 3 Moderate Interaction — Case Scenario and Decision Points Branching (knowledge and some cognitive skills, and some performance)**<br><br>At this level there is a high degree of complexity and customization of the course (multiple branches with multiple outcomes and immediate feedback from the computer). Customized feedback is provided based on participant's response. Sequence and complexity of content is based on participant's performance. | Some resources are—<br>• Animated Videos.<br>• Customized Audio recording.<br>• Complex simulations where the learners enter data into fields.<br>• Scenario-based cases.<br>• Custom Animations where learners have the ability to investigate. |
| **Level 4 — Simulation and Game-Based Learning/ Decision Points Branching (knowledge, cognitive skills, and performance)**<br><br>This level gives the highest degree of interaction by the trainee (decisions with real-time feedback from other participants on each decision). Customized feedback is provided based on participant's response. Sequence and complexity of content is based on participant's performance. | Some resources are—<br>• Real-time learning.<br>• Use of gaming technology.<br>• 3D simulations: for example software or hardware simulations and serious games.<br>• Includes variety of multimedia (i.e. custom videos and interactive 3D objects).<br>• The usage of digital "avatars".<br><br>Basically involves all of the elements of Levels 1, 2, and 3 plus recharged interactivity; and greater levels of sophistication. |

| Pros — eLearning | Cons — eLearning | Notes |
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| • Saves time and money as employees can do this anywhere without travel and accommodations required. Employees can also learn at their own pace.<br>• eLearning can be an effective way to prepare trainees with knowledge that they apply in a live classroom, scenario-based training, or in higher level eLearning.<br>• Does not require participants to be in same geographical location.<br>• Trainee can easily think, respond and give feedback on the subject.<br>• Offers a stimulating environment where the trainee can learn at own pace.<br>• Trainee can take the course at his convenience without any travel.<br>• Accessible to the widest audience at multi-locations.<br>• Computer-based training technology software allows for information to be broken into bite sized modules for easy and quick understanding.<br>• Can be either in the form of individual or group training.<br>• Content can be easily updated.<br>• Requires minimal technical support.<br>• Access can be controlled.<br>• Can be linked with other training systems.<br>• Good tool to teach certain knowledge subjects.<br>• Allows for safe trials of fixed scenarios, allowing multiple outcomes when practiced by different participants.<br>• Scenarios can be recorded and replayed. Successes and errors can be highlighted.<br>• Allows for customizable training. | • No live interaction with a facilitator.<br>• Not effective as a stand-alone training technique for cross-functional CRM (levels 1 and 2).<br>• Possibility that the trainee does not fully engage at lower levels.<br>• Not viable methodology for some performance skill related to CRM interactions.<br>• Initial set up for game-based learning is expensive.<br>• Measuring trainee performance or training effectiveness for application of knowledge and skills may not be as sophisticated as that encountered in a scenario based training environment. | General pros and cons for eLearning levels. |

| **OBSERVING FLIGHTS OR OPERATIONS** | Trainee(s) observing an actual flight by sitting in the flight deck; or observing an event in a flight simulation training device; or observing a specific operation. | Never should be conducted during a checking event. |
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| **Pros** | **Cons** | **Notes** |
| • Allows awareness of other workgroup roles during a flight event.<br>• Provides realistic environmental and flight context for workgroup activities. | • FAA limitations on flight deck access.<br>• Scheduling issues.<br>• Operational impact.<br>• While those being observed or simulation trainers may be able to provide some explanations in real time, this would vary depending on specific conditions. Such explanations may or may not be equivalent to the level of expertise provided by a cross-functional CRM instructor (as suggested in ACT ARC Recommendation 16–2). | Should encourage aircraft dispatchers to conduct observation flights during irregular operations. |