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Following this checklist will help to ensure proper design, delivery, and evaluation of CRM training – and ensure transfer of training to the job.

Teams are a way of life in organizations. Many industries, organizations, and agencies seek, promote, and encourage teamwork. Teams are dispatched to solve complex problems, handle stressful tasks, and promote productivity and better service. But not all teams succeed – some derail, fail, or don't produce the desired outcomes. As such, organizations rely on team training to solve these problems. Organizations, especially the aviation and medical communities, seek team training to enhance team performance and safety in cockpits and to manage errors in operating rooms. And so CRM (crew resource management) training was born.

In this article, we provide a checklist to help CRM training designers systematically think about the design, delivery, implementation, and evaluation of CRM training.

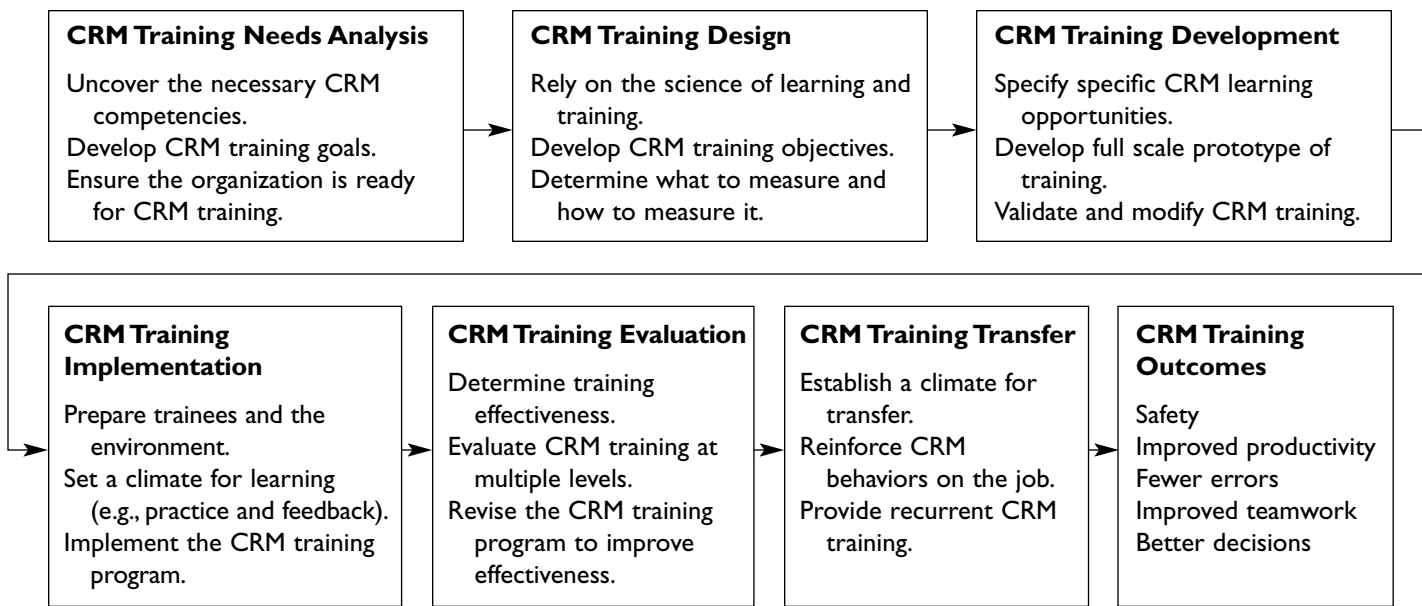
Background of CRM

Following a number of tragic aircraft accidents in the 1970s (e.g., United Airlines Flight 173 near Portland, OR; Eastern Air Lines Flight 401 in the Florida Everglades), the aviation community took notice of the concept of CRM training, whereby team members are taught to use all available resources – people, information, and equipment (Lauber, 1984). CRM training is now the most widely used instructional strategy for training teams. Recently, Salas and colleagues (1999) defined CRM as a “family of *instructional strategies* that seek to improve teamwork . . . by applying well-tested training *tools* (e.g., simulators, role-playing, videos) targeted at specific *content* (i.e., teamwork knowledge, skills, and attitudes)” (p. 163).

Though first introduced to pilots, CRM training has since spread to others within aviation, such as air traffic controllers and maintenance personnel, and beyond (e.g., health care professionals, first responders, off shore oil producers). We and others have conducted several reviews of the CRM training efforts in aviation and other domains (see O'Connor, Flin, Fletcher, & Hemsley, 2002; Salas, Burke, Bowers, & Wilson, 2001). We have found that despite the money and effort expended to implement these training programs over the past two decades, the aviation domain (and now the medical as well) continues to struggle with implementation. Therefore, the true impact of CRM training on safety is still not known.

It does not appear that the CRM community fully utilizes what is known about the science of learning.

But why, despite the many years of designing and implementing CRM training, is this the case? There are several potential reasons that CRM training has not delivered the desired safety outcomes (yet). First, based on our reading of the literature, it does not appear that the CRM community fully utilizes what is known about the science of learning (Bransford, Brown, & Cocking, 2000) and training (Salas & Cannon-Bowers, 2001). In the absence of a science from which to draw, practitioners (e.g., subject matter experts) and opinions rule. Second, scientists don't translate what they know about learning, training and simulation into tools, procedures, and/or mechanisms that can be used to enhance the design and delivery process, and practitioners don't demand it. Third, CRM training is not implemented in organizations in any systematic way; guidance, standards, or credible methodologies are lacking. Finally, organizations struggle with the institutionalization of CRM training – that is, CRM training is not fully integrated into the everyday activities of the organization. Unless it is institutionalized, CRM training cannot get the support (and respect) it deserves.



Progression of CRM training design, implementation, evaluation, and transfer.

What we believe to be lacking (among other things) is a simple, practical, scientifically based tool that outlines the critical steps to be taken when designing, implementing, and evaluating CRM training – a guide. In this article we provide such a tool, illustrated in Table 1: a checklist to help CRM training designers and others throughout the process. The checklist is broken down by the six phases discussed above and provides a number of steps and expected outcomes of each step.

We acknowledge that the checklist may not be new. In fact, all the information included in it is available in the literature. However, this particular checklist constitutes a complete and integrated source for CRM training developers. We believe it can shape the thinking about and design and implementation of CRM.

Checklist Development

There are a number of general instructional frameworks for training designers to follow. The checklist draws on several sources. First, we examined two frequently cited frameworks for developing training.

Goldstein (1993) suggested taking a systems approach to training, which follows four principles:

- Training program design is iterative and thus feedback is continuously used to update and modify the program.
- Complex interactions are formed between training components (e.g., trainees, tools, instructional strategies).
- A framework for reference to planning is provided.
- There is recognition that training programs are only a small component of the overall organizational system, and as such, components of the organization, task, and person need to be considered in the design.

This systems approach led to a number of training design models. Specifically, we use the Instructional Systems Design

(ISD) model (Branson, Rayner, Coxx, Furman, King, & Hannum, 1975). The ISD model was developed more than 20 years ago and continues to be widely used today, as it is the most comprehensive training design and implementation model available in the literature (Swezey & Llaneras, 1997). The premise of the ISD model is that a training program should be developed such that (a) specific behavioral objectives are addressed, (b) criterion measures are developed to assess the objectives, and (c) trainees are taught to pass the tests and achieve the requisite criteria. There are five basic phases in training: analysis, design, development, implementation, and evaluation.

In creating the checklist, we added a sixth phase to the process: transfer of training. Next, from the science of training, we extracted recent findings in the literature to support the six phases. For example, studies suggest how important findings from the science are, but they are often overlooked by training developers. We also integrated what we know about the science of training and designing training systematically (see Salas & Cannon-Bowers, 2000, 2001) to delineate each phase and to develop the included items in the checklist. We depict this process in the figure above.

FEATURE AT A GLANCE: Crew resource management (CRM) training was developed more than 20 years ago, yet we still do not know its impact on safety. One reason might be that a simple, practical, scientifically based tool is lacking that outlines the critical steps to be taken when designing, implementing, and evaluating CRM training. In this article, we provide such a tool: a checklist to help CRM training designers and others throughout the process. We take a systematic approach to provide this heuristic as a means to shaping the thinking, design, delivery, implementation and evaluation of CRM training.

KEYWORDS: team training, CRM training, aviation training, safety, training design

TABLE 1. POTENTIAL CRM SKILLS

CRM Skill	Definition	Alternative Names	Reference
Communication	Ability of two or more team members to clearly and accurately send and receive information or commands and to provide useful feedback.	<i>Closed-loop communication</i>	Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995
Briefing	Ability of team members to develop plans of action by organizing team resources, activities, and responses to ensure tasks are completed in an integrated and synchronized manner.	<i>Mission analysis, Planning</i>	Salas & Cannon-Bowers, 2001
Backup behavior	Ability of team members to anticipate the needs of others through accurate knowledge about each other's responsibilities, including the ability to shift workload between members to create balance during periods of high workload or pressure.	<i>Advocacy</i>	McIntyre & Salas, 1995; Porter, Hollenbeck, Ilgen, Ellis, West, & Moon, 2003
Mutual performance monitoring	Ability of team members to accurately monitor other team members' performance, including giving, seeking, and receiving task-clarifying feedback.	<i>Workload management</i>	McIntyre & Salas, 1995; Salas & Cannon-Bowers, 2001
Team leadership	Ability of a team leader to direct and coordinate the activities of team members, encourage team members to work together; assess performance; assign tasks; develop team knowledge, skills, and abilities; motivate; plan and organize; and establish a positive team atmosphere.	<i>Management</i>	Cannon-Bowers et al., 1995; Zaccaro, Rittman, & Marks, 2001
Decision making	Ability of team members to gather and integrate information, make logical and sound judgments, identify alternatives, consider the consequences of each alternative, and select the best one.	<i>Judgment, Problem solving</i>	Salas & Cannon-Bowers, 2001
Task-related assertiveness	Willingness/readiness of team members to communicate their ideas, opinions, and observations in a way that is persuasive to other team members and to maintain a position until convinced by the facts that other options are better.	<i>Confidence, Aggressiveness, Authoritarian</i>	Salas & Cannon-Bowers, 2001
Team adaptability	Ability of team members to alter a course of action or adjust strategies when new information becomes available.	<i>Flexibility</i>	Cannon-Bowers, et al., 1995; Klein & Pierce, 2001
Shared situation awareness	Ability of team members to gather and use information to develop a common understanding of the task and team environment.	<i>Shared mental models, Situation assessment</i>	Salas & Cannon-Bowers, 2001

What Are the CRM-Related Competencies and Needs?

The first phase in training is needs analysis. The purpose is to develop a plan for the design, implementation, and evaluation of CRM training. Important to the development of a sound training program is analyzing the training needs. This step is important because the decisions made early in the training design will drive the remainder of the process (Salas & Cannon-Bowers, 2000). The ultimate intention is to determine skill deficiencies and forecast new skill requirements.

Typically, a task analysis is conducted to uncover the knowledge (i.e., what we need to know), skills (i.e., what we need to do), and attitudes (i.e., what we need to feel) necessary to accomplish a task. Because CRM training focuses on the team, a team task analysis should also be conducted. However, unlike a traditional task analysis, which identifies the taskwork skills, teams must be trained on both taskwork (e.g., “stick and rudder” skills) and teamwork (e.g., communication, coordination, decision making) skills if they are to be successful. A team task analysis seeks to identify the necessary task work *and* teamwork skills (e.g., McNeese & Rentsch, 2001).

TABLE 2. EXAMPLES OF LEARNING PRINCIPLES

Principle	Reference
1. Set a climate for learning.	Salas & Cannon-Bowers, 2000, p. 44
2. Achieve operational fidelity.	Kyllonen & Alluisi, 1987, p. 143
3. Maintain active learner participation.	Kyllonen & Alluisi, 1987, p. 144
4. Provide immediate feedback on errors.	Kyllonen & Alluisi, 1987, p. 144
5. Learning occurs over time; it is not a one-time event, single program, or isolated lecture.	Salas & Cannon-Bowers, 2000, p. 49
6. Trainees learn when they are presented with relevant examples or models of effective (or ineffective) performance.	Salas & Cannon-Bowers, 2000, p. 48
7. Trainees come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information, or they may learn them for purposes of the test but revert to their preconceptions outside the classroom.	Bransford, Brown, & Cocking, 2000, p. 14-15
8. Multimedia design effects are stronger for low-knowledge learners than for high-knowledge learners.	Mayer, 2001, p. 161
9. To develop competence in an area of inquiry, trainees must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.	Bransford et al., 2000, p. 16
10. A metacognitive approach to instruction can help trainees learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.	Bransford et al., 2000, p. 18

It is important throughout this process to rely on subject matter experts because they know more about the job than training designers and can help articulate the task requirements. Training/learning experts are needed to design and deliver the training because they know more about creating learning environments.

Building one or more prototypes of the CRM training program prior to actual development is much more cost-effective than making necessary changes later on.

In addition to the task analysis, an organizational analysis should be conducted to determine the organizational components (e.g., climate, norms), resources, and constraints that may affect how CRM training is delivered (Goldstein, 1993; Salas & Cannon-Bowers, 2001). Is the organization ready to implement CRM training? Finally, a person analysis should be conducted to uncover who needs to be trained and what training each person needs (e.g., initial vs. refresher training; see Tannenbaum & Yukl, 1992).

With the information obtained from the needs analysis, one can establish the goals of the training and the competen-

cies to be trained. Thus, the outcomes of this phase serve as the building blocks of the training program.

In Table 1, we offer a set of team-based skills. These are examples of the kind of skills on which CRM training could be targeting; the specific skills chosen should be based on the needs of the organization. Additionally, training must focus beyond just what these skills are and how they are defined: One must also teach pilots (and others) why these skills are important and how they can be used to improve team performance and safety. We have also found that different labels are given to similar terms. As such, the table also highlights the different labels we use for the skills listed.

What Should the Learning Environment Look Like?

Phase two, CRM training design, is probably the most critical. Here CRM-based training objectives and measures are systematically designed, and the progression of the training is storyboarded. After the outcomes of the analysis phase are integrated, the training design phase ends with a blueprint of what the training program should look like for development.

When designing any training program, it is important that the design be guided as much as possible by the science of learning. Table 2 provides some examples of learning principles that should be used to guide the training development

process. CRM training designers must not lose sight of the fact that learning is a behavioral/cognitive event and that technology and/or delivery methods should not be the main focus of training. That is, the use of simulations with lots of bells and whistles doesn't necessarily lead to skill and knowledge acquisition – what matters are the instructional features embedded in the simulations.

The purpose of CRM training is to ensure that trainees learn and transfer what they have learned to the job environment. We know that trainees learn when (a) they are presented with information about the task, (b) examples of effective and ineffective performance are illustrated, (c) opportunities for practice are provided, and (d) meaningful and timely feedback is given during and after task performance (Salas & Cannon-Bowers, 2000). In addition, learning is a dynamic and continuous process. Therefore, CRM training designers must consider conditions for practice, selecting the appropriate

instructional strategy (i.e., how information will be presented and demonstrated), how to facilitate transfer from training to the job (e.g., through reinforcement), and how to evaluate training effectiveness (i.e., what to measure and how).

Finally, training objective(s) should be written to include a specification of what behaviors are to be observed, the conditions under which they are to be exhibited, and standards to which they should be performed or demonstrated. In short, CRM training objectives must be specific, measurable, and task relevant so that performance can be evaluated.

Storyboarding Production

Phase three is the actual production of the CRM training program. This phase should follow an iterative process whereby a prototype is developed and then shown to subject matter experts who can provide useful feedback, and revisions are made if necessary. If time and resources allow, the training

TABLE 3. CHECKLIST FOR DESIGNING, IMPLEMENTING, AND EVALUATING CRM TRAINING

Step	Considerations	Outcome
I. CRM Training Needs Analysis		
<input type="checkbox"/> Analyze requirements.	What are the organizational goals? Who needs to be trained? What are the task work and teamwork skills that need to be trained? What resources are available? Are there any external or legal constraints?	Needs of organization, task, and team identified. Resources and constraints are identified.
<input type="checkbox"/> Develop CRM training goals.	What are the desired goals/outcomes of CRM training? What are the assumptions regarding CRM training? Any givens or nonnegotiables?	Desired outcomes/goals are outlined. Assumptions about CRM training are identified.
<input type="checkbox"/> Analyze existing CRM training programs.	Is any information useful to incorporate into the new training program? Is the training program modifiable? How feasible are the modifications?	Relevant CRM training programs are identified and potential for modification determined.
<input type="checkbox"/> Develop an evaluation plan.	What are the criteria for CRM training success? How will success be measured?	Criteria for success are identified. Evaluation plan is established.
<input type="checkbox"/> Conceptualize performance measures.	What CRM skills do you want to measure? What performance measures do you want to use?	Measurement plan is identified. Criteria for success are developed. Performance measures are established.
<input type="checkbox"/> Select the instructional setting/location.	Will it be on site or remote? Undecided at this point? Does the site have the necessary capabilities (e.g., access to the Web, space for simulator, lighting)?	Available training site is identified.
<input type="checkbox"/> Ensure the organization is ready for CRM training.	Has CRM become a part of the organization? Do upper-level managers support training?	Organization is prepared for training and posttraining transfer of knowledge and skills.
<input type="checkbox"/> Select CRM knowledge, skills, and abilities to be trained.	What is the purpose of CRM training? What should trainees know? How should trainees behave? What attitudes toward CRM should they have?	A set of team-based competencies are selected.

TABLE 3. CHECKLIST (continued)

Step	Considerations	Outcome
II. CRM Training Design		
<input type="checkbox"/> Describe trainee entry behavior.	Is the trainee a pilot or crew member? At what level is the trainee (e.g., new crew member, experienced)? What should trainees' knowledge level be? What should trainees' skill level be? Are there any prerequisites for attending the training program?	Trainees' backgrounds are determined. Prerequisites are identified.
<input type="checkbox"/> Develop CRM training objectives.	What are the learning outcomes? How should they be prioritized? What are the behavioral and cognitive learning objectives? Can they be tied back to the needs analysis? What should trainees be able to exhibit? Are objectives stated in performance terms? What CRM behaviors will be trained? Under what conditions will the learning be demonstrated? What standards of performance are considered acceptable? How do these behaviors translate into the terminal learning objectives? How can trainees meet the training's goals? Are objectives well written, reasonable, attainable, and suitable for the content? Has the mastery criterion been defined so that success in achieving the objectives is clear? What is the source of the objectives and their particular emphasis?	Objectives are documented. CRM competencies are established. Objectives are specific, measurable, and task-relevant.
<input type="checkbox"/> Develop criterion-referenced tests.	What do trainees need to know or do to perform their job as a part of the crew? Will each of the learning objectives be measured? How will testing be done – paper and pencil? simulation performance? other methods?	Established measure of what people need to know or do to perform the job. Test items are developed to measure each learning objective.
<input type="checkbox"/> Determine sequence and structure of CRM training.	How will the CRM training proceed? Is the flow logical, consistent, and coherent? Is an advanced organizer provided to trainees? Are the following components in each unit of instruction: topical outline, lists of concepts to be learned, lists of objectives, demonstration exercises, case problems, and tutorials for hands-on experience?	Progression of training is identified. Logical, consistent, and coherent flow is determined.
<input type="checkbox"/> Determine hardware and software requirements.	What are the hardware requirements for training? Is it easy to use? What are the software requirements for training? Does the software have a backup? Can the software be copied?	Hardware requirements for training are determined. Software requirements for training are determined.
<input type="checkbox"/> Describe training delivery methods.	By what means will the instruction be delivered (e.g., information, demonstration, practice)? What is the cost-effectiveness of the delivery system? Is it cost-effective to develop the materials? Are management, maintenance, and replacement costs reasonable?	Means of instruction delivery are determined. Cost-effectiveness of means is determined.
<input type="checkbox"/> Review initial design.	Who will review the design? Do any modifications need to be made?	Suggested modifications are identified.
III. CRM Training Development		
<input type="checkbox"/> Specify CRM learning scenarios and events.	How many opportunities for learning are being made available? Are the scenarios/events realistic? Who will guide the learning scenarios/events? How will learning be measured? How and when will feedback be provided? Are the responsibilities of the instructors included?	Scenarios/events are developed. Opportunities for assessing and diagnosing individual and team performance are established.

TABLE 3. CHECKLIST (continued)

Step	Considerations	Outcome
III. CRM Training Development (cont.)		
<input type="checkbox"/> Specify the CRM instructional management plan.	Is how the instruction will be delivered included? Is how the trainees will be guided through the training included? self-paced? group mode? both? Is how the curriculum will be presented included? lectures? training aids? simulators? job performance aids? television? Web based? demonstration? audiovisual methods?	Instructional management plan is developed.
<input type="checkbox"/> Develop instructional materials for classroom learning.	Have existing CRM instructional materials been reviewed? In what forms will the materials be available (e.g., paper based, web based)? How is the sequence/organization of the materials? Do they relate to the training objectives and goals? Have subject matter experts reviewed them?	Existing materials are reviewed and modified (if applicable). Instructional materials are developed.
<input type="checkbox"/> Develop full scale prototype.	What does the full scale prototype look like? Is there consistency throughout the training program? Are the events based on the training objectives and goals? Are criterion measures included?	Full scale prototype is developed.
<input type="checkbox"/> Validate and identify.	Has the CRM training been reviewed by subject matter experts? Has the CRM training been tried on typical trainees? Are any modifications needed? Does training receive the appropriate signatures and approval?	Suggested modifications are identified. Sign off/approval is obtained.
IV. CRM Training Implementation		
<input type="checkbox"/> Prepare trainees and environment.	How are trainees being motivated? Is there management support? How is training framed? Is training voluntary or mandatory?	Individuals are ready for training. Training environment is prepared.
<input type="checkbox"/> Prepare trainers/instructors for training.	Are instructors knowledgeable about CRM? Are instructors able to adequately answer trainees' questions? Are instructors able to provide constructive performance feedback?	Instructors/trainers are ready to teach training.
<input type="checkbox"/> Implement the management plan.	Have trainees been scheduled? How many trainees per class? What is the trainee-to-instructor ratio? Have instructors been scheduled? Are all facilities, equipment, and materials ready for use?	Training program is live and functional.
<input type="checkbox"/> Conduct the instruction.	Is the management plan being followed? Is training occurring under actual conditions in the specified setting? Are the final course materials being used?	Developed instructional materials are put into practice. CRM training program is completed.
<input type="checkbox"/> Create an event-based approach.	Are instructional features embedded within simulation? What do the event sets look like?	Trainees practice CRM skills taught.
<input type="checkbox"/> Use simulation (whenever possible)	Is the simulation role-play, PC-based, fixed-based, or motion-based? Are the scenarios carefully crafted and embedded within simulation?	Trainees are able to practice in a realistic environment.
<input type="checkbox"/> Provide feedback to trainees.	Who will provide feedback (e.g., instructors, other trainees)? If trainees provide feedback, who will facilitate the feedback process? Is an advanced organizer provided to tell trainees how the feedback process will proceed? Are the training's objectives restated? Are key events (i.e., examples) from the training recapped?	Trainees know how they did. Trainees know where improvements are necessary.

TABLE 3. CHECKLIST (continued)

Step	Considerations	Outcome
IV. CRM Training Implementation (cont.)		
<input type="checkbox"/> Provide feedback to trainees. (cont.)	<ul style="list-style-type: none"> Are trainees encouraged to participate? Is feedback constructive? Is feedback behavior- or solution-based rather than personal? Is feedback timely? Are strengths and weaknesses identified? Are strategies for correcting negative behaviors discussed? Are strategies and goals for improvement discussed? 	
V. CRM Training Evaluation		
<input type="checkbox"/> Evaluate CRM training program.	<ul style="list-style-type: none"> Have both utility and affective reaction data (i.e., attitudes) been collected? Has learning been assessed at multiple levels? Has behavior been assessed in a transfer situation? Has the impact of training on the organization been evaluated at multiple time intervals (e.g., immediately, 3 months after, 6 months after)? Have the data been analyzed to determine instructional effectiveness? 	Data on CRM training's effectiveness are collected at four levels. Data on job performance are collected.
<input type="checkbox"/> Revise CRM training program.	<ul style="list-style-type: none"> Are any revisions needed based on the empirical data? How will the revisions be implemented? What impact will the revisions have? Are the revisions cost-effective? How long will the revisions take? How will it affect upcoming training sessions? 	CRM training is revised on the basis of empirical data.
VI. CRM Training Transfer		
<input type="checkbox"/> Establish the climate for transfer.	<ul style="list-style-type: none"> Is there supervisor support? Are the resources available to support the transfer of knowledge and skills? What rewards system is in place? Are trainees encouraged to learn from mistakes? 	Supervisors support CRM competencies on the job. Organization supports CRM competencies on the job. Continuous learning is climate established.
<input type="checkbox"/> Reinforce CRM behaviors.	<ul style="list-style-type: none"> Are trainees being rewarded to encourage the transfer of the trained CRM competencies? Are behaviors that contradict what was taught in CRM training discouraged? 	Trainees are rewarded. Behaviors that contradict CRM are discouraged.
<input type="checkbox"/> Provide recurrent CRM training.	<ul style="list-style-type: none"> How often does training need to be offered? 	CRM competencies remain stable over time.

program should be pilot tested on a group of typical trainees. Based on the feedback received, the prototype should be re-designed again and again until the deficiencies of the program are worked out to the greatest degree possible.

Building one or more prototypes of the CRM training program prior to actual development is much more cost-effective than making necessary changes later on (Mayhew, 1999). As a part of this development, the learning scenarios and/or activities (e.g., simulations) should be specified and developed. It is important that practice scenarios be carefully laid out and storyboarded before the start of training, as this provides trainers and researchers with greater control over what competencies are being presented to participants and when. Scenarios and activities should be as realistic as possible,

with varying levels of difficulty to get a more complete picture of individual and team performance. Scenarios should also allow trainees to demonstrate the learned knowledge and skills in multiple ways and on multiple occasions (Prince, Oser, Salas, Woodruff, 1993).

Well-crafted scenarios will engage trainees, allow them to gain experience and confidence, and help them develop accurate mental models of what to expect and how to respond more quickly in similar situations on the job. But practice alone is not enough. Practice must be guided and feedback provided. Without feedback, trainees will not know what they did wrong or how to improve performance. Feedback allows trainees to compensate for incorrect behaviors and readjust or correct their strategy to be more appropriate for a future

situation. Kozlowski and colleagues (1999) argued for the use of process and outcome feedback. It has been found that process feedback is more appropriate for strategic behaviors, whereas outcome feedback leads to better performance for task elements.

Furthermore, a management plan should be provided that lays out the responsibilities of instructors, when opportunities for practice and diagnosis will be provided, and how and when feedback will be provided. This enables those involved in the training implementation phase to gain a clear picture of what is expected of them. Once the go-ahead is given, the actual training program should be developed for implementation in the next phase.

Making CRM Training Happen

The CRM training program is now ready to be put into play. But before this can happen, the training environment must be established. Specifically, the location where training will be provided should be comfortable for trainees and have the necessary resources (e.g., lighting, equipment, well-prepared trainers; Salas & Cannon-Bowers, 2000). In addition, trainees need to be prepared for training. Without the proper motivation and management support, training will not be as

To ensure that posttraining performance levels are maintained, CRM training should be provided again and again.

successful. Training must become more than just a check-the-box exercise. Trainees should also be provided with an advanced organizer (e.g., brief abstract, bulleted list of items) of what to expect in training. Finally, instructors must be properly trained to understand and teach the CRM knowledge and skills, as well as provide constructive performance feedback. Once the training environment is established, the instruction and opportunities for practice are implemented and feedback on performance is provided.

Does It Work?

Training has been provided, but was it successful? The next step is to evaluate the training program. Although training designers often ask trainees how they liked the training program in order to determine the success of training, these subjective reactions (though important) are not enough. In order to get a complete picture of the training's effectiveness, multiple measures should be used that also assess trainees' learning, skills and applications of these skills in a simulated or real environment. Kirkpatrick (1976) developed a training evaluation typology to do just that, which was further expanded by Kraiger and colleagues (1993). This typology argues for four levels: (a) affective and utility attitudes or reactions (i.e., did trainees like the training and did they find it useful?); (b) learning (i.e., did trainees learn the material and/or did they have a change in attitude toward CRM following training?); (c) behaviors (i.e., do trainees apply CRM skills and knowledge on the job or in a simulation? This should include

behavioral and cognitive skills.); and (d) organizational impact (i.e., did training improve organizational goals – in other words, safety?).

Reactions to CRM training are the most commonly measured outcome (e.g., O'Connor et al., 2002), but these alone are not enough to determine the success or failure of CRM training. Training must be evaluated at multiple levels to validate its effectiveness. Based on the outcomes of the evaluation efforts, revisions to the training program should be made so that training will be improved in the future.

Can You See the Results?

The last phase of the training cycle is the transfer (or application) to the job of what has been learned. Just as the pretraining environment was important to the success of the training program, so is the posttraining environment to the transfer of learned CRM knowledge and skills. It has been argued that three characteristics of the posttraining environment will influence transfer: (a) supervisor support (e.g., open discussions, role modeling), (b) organizational transfer climate (e.g., reward system, resources available), and (c) a continuous learning culture (see, for example, Baldwin & Ford, 1988; Ford & Weissbein, 1997; Tannenbaum & Yukl, 1992). The overarching theme of this phase is the reinforcement of CRM behaviors.

To ensure that posttraining performance levels are maintained, CRM training should be provided again and again. Training should not be a one-time event. The few longitudinal studies conducted to determine the stability of CRM behaviors over time suggests that without recurrent training, knowledge and behaviors regress to pretraining levels (see Salas et al, 2001; Salas, Wilson, Burke, & Wightman, in press). If safety is the main concern, then recurrent training is a must.

Conclusion

Taking the information presented (and more) in the previous sections, we developed a comprehensive yet practical tool that outlines the steps one should take in order to design, implement, evaluate, and ensure the transfer of a CRM training program. Although the checklist presented here is specific to CRM training, the steps would be the same or very similar for other training programs as well. We understand that some CRM training programs may be at different stages of evolution, development, and maturation than others and, therefore, some of the items on the checklist may not be relevant. But we hope that it can serve as a guideline as to whether sound training principles have been followed.

We conclude this article with some advice. Training design, development, and implementation should be guided by the science of training and learning. Furthermore, training should be designed systematically such that all the necessary ingredients for training are considered to help organizations reach their training goals – whether that goal is safety, productivity, or better service. It is our hope that the information provided here and in the checklist will help organizations to reach the desired results and have an impact where it matters most: on the job.

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