Cognitive Task Analysis of Fire Support and Coordination Expertise in U. S. Marine Corps Combined Arms Operations: Support of the Combined Arms Staff Trainer (CAST) Upgrade

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Effective command and control is central to success and survivability in United States Marine Corps (USMC) combined arms operations. Preparing personnel to perform the command and control components of indirect fire support effectively is a primary purpose of the Combined Arms Staff Trainer (CAST), an indoor training facility designed to teach and rehearse combined arms, which can be defined as bringing indirect arms (air, mortar, artillery) to bear on a target in support of direct arms (ground vehicles) in a safe and timely manner. Five CAST facilities, used extensively by the USMC in its systematic building block approach to training and force readiness, are slated for future upgrades to improve their overall effectiveness. The purpose of this research was to perform a Cognitive Task Analysis (CTA) of the expertise underlying combined arms fire support and coordination and to relate the findings to ways in which the training features and functions of the CAST upgrade might best be designed. Due to their highly critical roles in combined arms operations, the positions of Fire Support Team (FiST) Leader and Fire Support Coordinator (FSC) were selected for analysis in the present effort.

Multiple challenges, such as effective resource allocation, team coordination, and the need to adapt rapidly to unforeseen contingencies face personnel in the dynamic combined arms fire support and coordination environment. Identification of these challenges, the skills, strategies, and knowledge used to work effectively in the face of these challenges, and experience-related differences in skills, strategies, and knowledge were the focus of the CTA. Differences between experts and novices in making decisions and executing required functions can be important to the identification of skill deficiencies in less experienced personnel and in guiding future training. The first phase of the CTA involved the conduct of a domain analysis encompassing both combined arms operations and the use of the CAST to train combined arms personnel. This analysis served to ‘bootstrap’ the research team into the operational domain and shed light on the training philosophies, strategies, and objectives associated with use of the CAST, the training audience, and the role of the CAST within the larger training continuum. The next phase of the CTA involved eliciting knowledge from subject matter experts (SMEs). Structured interviews with FiST Leaders and Fire Support Coordinators were conducted using an event-based knowledge elicitation protocol (Fowlkes, Baker, Salas, Cannon-Bowers, & Stout; 2000). These protocols stepped through the critical decision points or events of a modified version of the Mobile Assault Course (MAC), a standard Combined Arms Exercise (CAX) that is executed using the CAST and then, on a live-fire range. Eight active duty USMC officers (five FiST Leaders and three FSCs) and four retired officers provided information and data in support of the overall project.

The subsequent phases of knowledge representation and assessment involved the parsing of interview data into analysis tables. Data were then assessed using a coding approach to identify critical skills, strategies, and knowledge. A number of key knowledge areas were identified including knowledge about resource capabilities, scheme of maneuver, limitations affecting operations, potential consequences, and Standard Operating Procedures (SOPs). Major skill categories included situation assessment, planning and decision-making, plan execution, information exchange,
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adaptability, and team coordination. Numerous specific skills were identified within each skill category. These included the strategic use of terrain, map usage, problem detection, proactivity, assumption questioning, and identification of own team vulnerabilities. Experience-related differences were suggested by assessing event-specific representations of interview data organized in a course-of-action-selection centered framework. These differences consist of scheme of maneuver comprehension, strategic use of resources, knowledge of enemy capabilities, knowledge about terrain and its strategic use, knowledge of team member strengths and weaknesses, and deconfliction of arms.

The Scenario-Based Training – SBT (Oser, Cannon-Bowers, Salas & Dwyer, 1999; Fowlkes, Dwyer, Oser & Salas, 1998) model was used as an organizing framework to show how the CTA findings could support recommendations for training products and approaches relevant to the CAST upgrade. The SBT model was chosen for this purpose because it was developed expressly for guiding the design of simulation-based training systems. This model calls for the specification of clearly defined training objectives, which in this effort were suggested by the key knowledge and skill areas and experience-related differences revealed by the CTA. Using SBT, the training objectives should provide a common and integrative theme throughout all components of a training system. That is, they should be used to guide the development of pre-training interventions, selection of trigger events within scenarios, specification of performance measures, and determination of the foci of After Action Reviews (AARs). Because SBT addresses all components of training, it was viewed as a useful framework for comprehensively relating the CTA findings to the CAST upgrade design and making recommendations regarding scenario design, performance assessment, diagnosis and feedback, debriefing, and AAR.

Finally, SME assessments of current CAST capabilities were collected in conjunction with the CTA interviews. Generally, the results and recommendations derived from the SME assessments of the CAST aligned well with the principles of SBT. For example, several SMEs expressed a need for facilitation with exercise preparation to ensure a timely start, but more importantly to ensure that the training planned by unit leaders would be effective. Specifically, the SME’s pointed out that they did not have enough time between receiving unit leader’s training plans and the start time of the exercise to evaluate the efficacy of a training plan and input the plan into the system. The SMEs explained that without enough time, ‘glitches’ could be allowed in the scenario that would stall training execution. The SME’s feedback aligns with CTA data in that the framework calls for definition of specific training objectives before generating a training scenario to ensure efficient and directed training, implicitly suggesting the need for sufficient preparation time. Both the feedback and the framework call for the need for directed preparation before the exercise takes place. Taken together, these findings and recommendations represent a robust set of user-based requirements that can be considered in conjunction with more traditional technology-based requirements as a basis for the CAST upgrade. The present work also underscores the value of CTA techniques for revealing and interpreting critical components of expertise underlying decision making in combat command and control.
References

