TEAM PERFORMANCE IN MULTI-SERVICE DISTRIBUTED INTERACTIVE SIMULATION EXERCISES: INITIAL RESULTS

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ABSTRACT

Desert Storm has clearly demonstrated the growing reliance on geographically separated, multi-service teams who are called upon to execute specific missions. Future conflicts can similarly be expected to require close coordination between teams from different services. Fortunately, advances in distributed interactive simulation (DIS) technology are paving the way for members of different commands and different services to simultaneously come together to fight a simulated war on a synthetic battlefield. While advancements in simulation and networking technologies hold great promise for training applications, little is known about how multi-service teams perform in a DIS environment. The Multi-Service Distributed Training Testbed (MDT2) was recently used in one of the first tryouts of DIS technology for training personnel from all services in multi-service Close Air Support (CAS). The MDT2 exercises represented a unique opportunity to systematically collect multi-service team performance data in a DIS training environment. The team performance data were collected during a 4-day series of exercises conducted in May 1994 and from a 5-day series of exercises conducted in February 1995. This paper describes one of the techniques used for the team performance measurement, presents trends in the data, delineates the lessons learned, and provides recommendations for evaluating team performance and mission effectiveness in DIS training environments.

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OVERVIEW

Combat missions such as those encountered in Operation Desert Storm have highlighted the critical need for joint-service coordination during military operations. While mission performance within a single service is challenging, multi-service missions are an order of magnitude more difficult to achieve because of differences among the services in executing tactics, techniques, and procedures. Currently, for many types of multi-service missions, live exercises at remote sites offer the only method for practicing joint-service coordination. In the future however, reduced training resources, environmental concerns, and safety restrictions will limit the services' ability to train via live-exercises.

Techniques in simulation that allow for large-scale multi-service training and provide training opportunities at home stations are critical for maximizing mission readiness. Fortunately, technological advances in the area of Distributed Interactive Simulation (DIS) offer promise for bridging the gap between operational training needs and simulation capabilities. DIS technology is paving the way for members of different commands and different services who are geographically dispersed to simultaneously train in realistic, virtual environments. While advancements in simulation and networking technologies hold great promise for training applications, little is known about how multi-service teams perform in a DIS environment.

One program of research that is examining team training performance in DIS is the Multi-Service Distributed Training Testbed (MDT2) effort. The MDT2 is a testbed developed to perform research-oriented team training case studies. To date, two case studies have been conducted. The case studies provided opportunities to systematically collect multi-service team performance data in a DIS-based training environment. This paper will describe a team performance measurement technique used in MDT2, present team performance trends from the two case studies, delineate lessons learned, and discuss future requirements for training in DIS.

Close Air Support

Close air support (CAS) was selected as the specific mission area for MDT2 because of the difficulty and safety issues involved with coordinating air strikes close to and in support of ground force movements. CAS is a complex mission that requires considerable coordination between several multi-service teams for successful and safe integration. CAS involves air action against hostile targets that are in close proximity to friendly forces and which requires detailed integration of each air mission with the fire and movement of those forces.

Currently, live-exercises are used to train CAS tactics and procedures required to conduct air action against hostile targets (i.e., placing bombs on target) without the presence of actual friendly forces. In contrast, practice involving the integration of air strikes with fire support and ground forces is generally trained, to a lesser degree, in dry-fire exercises either with aircraft not carrying live ordnance or without any aircraft. While the current exercises are important for training many skills required for effective CAS, they do not allow CAS to be trained in an integrated manner with all the teams. MDT2 provides the opportunity to train both the control and synchronization of CAS in a realistic, but simulated environment.

Research Objectives

A number of research objectives were generated to guide the analysis of the data from the two MDT2 case studies. These objectives were: (1) to systematically assess multi-service team performance in DIS training exercises, (2) to identify preliminary team performance trends during multiple training exercises, (3) to compare performance for two teams that participated in two separate training exercises,

and (4) to document preliminary results and relevant lessons learned from the case studies.

The overall goal of this research is to enhance the design of current and future DIS team training systems by providing a greater understanding of how to measure team performance in DIS and what team performance trends appear to exist during DIS training exercises.

METHOD

MDT2 Testbed

The MDT2 testbed used for the case studies consisted of a network of simulators located at various sites (i.e., Armstrong Laboratory, Aircrew Systems Training Division, Mesa, AZ; Naval Air Warfare Center Aircraft Division - NAWCAD, Manned Flight Simulator, Patuxent River, MD; Mounted Warfare Testbed, Ft. Knox, KY; Naval Command Control & Ocean Surveillance Center Research and Development - NRaD, San Diego, CA). MDT2 allowed the key participants across the services to perform CAS in real-time with each other. Digital voice was used to provide communications among the sites. The network among the sites was established via the Defense Simulation Internet (DSInet) and T-1 lines. The network used a database that corresponded to an area frequently used at the National Training Center (NTC) for live field exercises.

MDT2 Measurement Tools

A number of performance measurement tools were developed for the MDT2 effort. Each of the tools represented slightly different approaches for team performance measurement. This paper focuses on only one of the measurement tools which was based on the Targeted Acceptable Responses to Generated Events or Tasks (TARGETs) methodology (Fowlkes, Lane, Salas, Franz, & Oser, 1994). The TARGETs methodology for performance measurement was selected for application in the MDT2 effort for four major reasons. First, previous team performance research has suggested that observers accept and use the TARGETs measures in a reliable manner. Second, previous research has suggested that the TARGETs are considered to be face valid to instructors and participants. Third, TARGETs data can provide a detailed record of team performance. Fourth, TARGETs data allow some flexibility for researchers to investigate general or specific components of team performance.

The TARGETs performance measurement approach uses a behaviorally focused checklist format for collecting structured observations of team behaviors during operationally relevant scenarios. A key characteristic of the method is that tasks are identified that are indicators of the team behaviors important for mission effectiveness. TARGETs can be developed for routinely occurring tasks (e.g., the specific interactions that are required for task performance) or for events that typically occur at low frequencies (e.g., emergency procedures). A second aspect of this approach is that the TARGETs (i.e., acceptable responses) for each task and event are identified *a priori* through task analyses and subject matter expert consultation.

Each of the items in a TARGETs checklist is scored as either present or absent (Fowlkes, Lane, Salas, Oser, & Prince, 1992, Fowlkes, et al., 1994). In a previous application of TARGETs, inter-observer reliability and internal consistency estimates were $r = .94$ and $r = .81$, respectively. Because of the nature of the TARGETs data, team performance can be analyzed in a variety of ways. One method of analysis involves calculating team performance scores as the proportion of TARGETs correctly performed by the team. This type of analysis provides an overall indication of how teams performed in general terms. A second method of analysis involves identifying a set of specific TARGETs that can be grouped into meaningful clusters of behaviors (e.g., those TARGETs involving communications about enemy movements). These clusters of behaviors could then be analyzed as a subset of the TARGETs to provide an indication of how teams performed in the cluster of interest.

CASE STUDY 1

The first MDT2 case study was conducted over a four day period in May 1994. Thirteen participants were the specific focus of the CAS exercises for this case study. All participants were previously trained to a sufficient degree of proficiency in their single-service skills. These individuals were the key participants in the execution of the multi-service CAS missions. Additional personnel participated as tank drivers and gunners but were not involved in training multi-service CAS procedures and were not the focus of the performance measurement effort.

The MDT2 configuration for the first case study consisted of a network of simulators at Ft. Knox, Armstrong Lab, NAWCAD Patuxent River, and NRaD. At Ft. Knox, an Army battalion task force and Air Force Tactical Air Control Party (TACP) operated in a simulated tactical operations center (TOC) and in command group vehicle simulators. In addition, an Army company team participated in vehicle simulators. At Armstrong Laboratory, a pair

of Air Force F-16 simulators provided the attack aircraft for the simulated missions. A Marine Corps pilot at the NAWCAD emulated an Airborne Forward Air Controller (A-FAC) in an OV-10 aircraft simulator. A modular universal laser equipment (MULE) simulator was manned by a Marine Corps Forward Air Controller (FAC) and a MULE operator at NRaD. These forces supported the battalion at Ft. Knox.

Performance Measurement

A set of TARGETs measurement tools was developed specifically for this case study. Development of the tools was supported by use of joint-service source documents and input provided by project subject matter experts (SMEs). Initial drafts of the checklists were reviewed by SMEs and revisions were made based on these inputs resulting in the final checklists. The measurement tools emphasized the multi-service interactions among the following players: the F-16 pilots, Air Liaison Officer (ALO), Fire Support Officer (FSO), A-FAC, and the Ground FAC who was a member of the MULE team. These positions are responsible for performing the key multi-service tasks required for successful accomplishment of the CAS mission.

In the development of the TARGETs checklists for this case study, multi-service interactions required for effective performance were identified for three CAS mission phases: planning phase, contact point phase, and attack phase. The planning phase included pre-exercise preparation and briefings and continued through the exercise start up until the attack aircraft arrived at a pre-designated contact point (CP). The CP phase was the period of time that the attack aircraft orbited the contact point. The attack phase began when the aircraft departed the CP and lasted until the aircraft egressed the exercise area. Because the scenarios were allowed to unfold in a freeplay manner, the TARGETs focused on the routine multi-service interactions that occur within each of the CAS phases.

Additionally, subsets of TARGETs related to three key CAS elements during the planning phase (integration of CAS, multi-service planning interactions, and intelligence information exchange) were identified for detailed analysis. The 'integration of CAS' element involved: the integration of CAS into the scheme of maneuver, the conduct of CAS rehearsals, and the update of battle plans based on the results of the rehearsal. The 'multi-service planning interactions' element involved communications between the FSO and ALO critical for coordination between air and ground teams. The 'intelligence information exchange' element involved interactions between the FAC and FSO or ALO regarding CAS intelligence.

Observer/Controllers

An observer/controller (O/C) team was composed of SMEs with an understanding of current CAS doctrine and experience in CAS operations through either exercises or actual combat. Seven O/Cs were responsible for performing data collection tasks using the TARGETs checklists. Four were located at Ft. Knox, one at Armstrong Lab, one at NAWCAD, and one at NRaD. One of the Ft. Knox O/Cs served as the senior O/C for the training exercises and was responsible for data collection and for leading after action reviews (AARs) at the completion of each scenario. The other O/Cs were responsible for either controlling computer generated enemy forces or role-playing higher echelon positions.

Because of limited access to the communications between participants, each O/C was requested to focus on specific phases to enhance the potential that performance measures were obtained for all exercise phases. Of the four data collection O/Cs at Ft. Knox, three observed the battalion CAS activities during the planning phase and one observed the CAS activities for the remaining phases. Since O/Cs at the other sites had no access to the communications that occurred at Ft. Knox during the planning phase, they focused on the CP and attack phases.
O/C familiarization and practice with the data collection forms was planned to occur prior to the conduct of the actual exercise scenarios. While the Ft. Knox O/C responsible for completing the measurement tools during the contact point and attack phases of the exercises received training on the use of TARGETs prior to the conduct of the exercises, he was not able to practice using the forms due to network and simulator problems (e.g., node intermittence, network reliability). The Ft. Knox O/Cs responsible for observing the planning phases of the exercises were able to practice with the forms prior to the actual exercises because many of the planning items did not require the network to be operational. The O/Cs located at the other sites received limited training and practice using the measurement forms.

Exercise Implementation

Several weeks prior to the exercise, scenario information packages were provided to the key participants for review and dissemination to other team members. Upon arrival at their respective training sites, participants were pre-briefed on the purpose of the overall effort, the upcoming exercises, and relevant limitations of the simulators. Following

this introductory brief, all participants were then individually briefed and given practice on their simulators. At the completion of the simulator practice, the battalion task force at Ft. Knox conducted their planning brief that described the commander's intent and battle plan for the upcoming exercise. Supplemental planning briefs were conducted via telephone between key participants at Ft. Knox and participants at the remote sites. Following the planning briefs, all participants entered their simulators and the exercise began.

The exercises were implemented such that offensive scenarios (i.e., days 1 and 3) and defensive scenarios (i.e., days 2 and 4) were presented. The capability of the enemy was increased the second time the scenario was presented. The scenarios specified the overall battle situation and the initial battle conditions for the point at which play began. In addition, scenarios were structured to encourage the employment of CAS. However, beyond this, scenarios were allowed to unfold in a free play fashion. Specific events (e.g., increases in enemy capability) were interjected at times during play at the discretion of the senior trainer, but these were not preplanned, nor were they explicitly tied to training objectives.

At the conclusion of each exercise, each site conducted a site-specific AAR, while the O/Cs met to prepare for a multi-service AAR. Approximately 1.5 hours following the end of the exercise, the multi-service AAR was conducted. A structure to focus the AAR on the critical multi-service interactions was provided that made use of the data recorded on the measurement tools. In general, the framework for the debrief provided an overview of the battle and the CAS missions flown, and identified general strengths and weaknesses. Each CAS mission was then specifically debriefed by mission phase using inputs from each user site and the performance measures.

Results

Planning Phase. Three O/Cs from Ft. Knox provided the TARGETs data for the planning phase. Figure 1 shows the averaged TARGETs scores for the planning phase. It can be seen that overall performance (OVERALL) in the planning phase appears to improve across the four days, from approximately 60% on day 1 to over 90% by the final day of the exercise. In an effort to further focus on specific elements of the planning phase, TARGETs associated with critical planning elements (i.e., CAS integration, interactions between FSO and ALO, and intelligence exchange between the FAC and the ALO or FSO) were identified and analyzed. It can be seen that scores on TARGETs items pertaining to CAS integration (INTEG) decrease on day 2 but then appear to improve on days 3 and 4. The performance in the planning interactions (INTER) appear to decrease on day 2, but then improve to perfect scores on days 3 and 4. Items pertaining to intelligence information exchange (INTEL) begin at approximately 50% on day 1 and then reached asymptotic levels of over 90% by day 2.

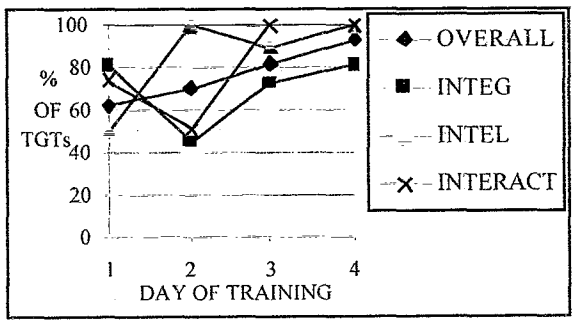

Figure 1. Planning Phase TARGETs dat

Contact Point Phase. Five O/Cs (four at Ft. Knox and one at Armstrong Labs) provided data for the CP Phase. The TARGETs scores for that phase are shown in Figure 2. The overall scores (OVERALL) show an increase across days, beginning at approximately 30% on day 1 and reaching over 80% by day 4. It is interesting to note that scores demonstrated a marked increase between days 1 and 2, and then only improve slightly from day 2 through day 4. In an effort to examine the extent to which the team performance varied as a function of the O/C perspective (i.e., the site from which the O/C observed the multi-service interactions), the data were further analyzed. The same general shape of the performance curve is seen from the data obtained at both nodes. While the Ft. Knox O/Cs (KNOX O/C) observed team performance at approximately 20% on day 1 and at approximately 70% on day 4, the Armstrong Lab O/C (F-16 O/C) scored performance at approximately 40% on day 1 and at 100% on day 4.

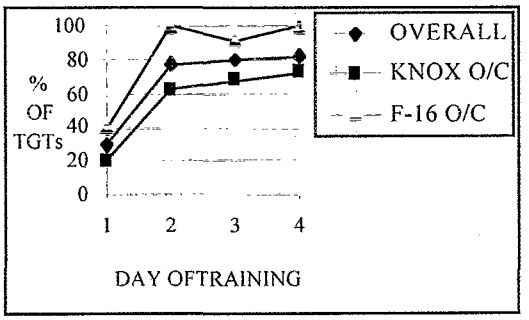

Figure 2. CP Phase TARGETs data.

Attack Phase. TARGETs data for the attack phase were obtained from four O/Cs at Ft. Knox and one O/C at Armstrong Lab. TARGETs scores are shown in Figure 3. The overall scores (OVERALL) appear to increase from the first day of training to the last day of training, beginning at approximately 45% on the first day and reaching over 80% by the last day of training. The TARGETs data were further analyzed to determine whether the team performance appeared to vary depending on the location of the O/C. On day 1, team performance was observed at 30% and 65% from the perspective of the Ft. Knox O/Cs (KNOX O/C) and Armstrong Lab O/C (F-16 O/C), respectively. On day 2, both O/Cs recorded team performance at approximately 50%. The same general shape of the performance curves was obtained for days 2, 3, and 4 at both sites. While the TARGETs data between the O/Cs appear to vary widely at the beginning of the exercises, there is less variability in the data over the last three exercise days.

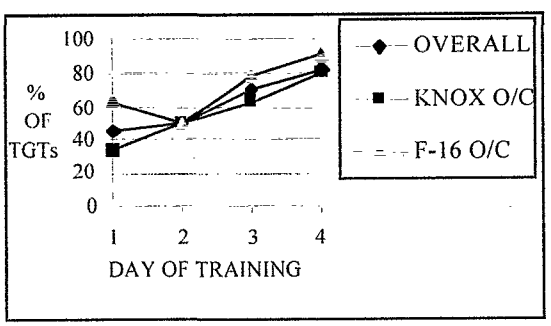

Figure 3. Attack Phase TARGETs data.

Summary of Case Study 1

Results from the first case study show that: (a) TARGETs appeared to provide a manner in which multi-service team performance measures could be collected during training in a DIS environment, (b) positive trends were observed over the course of the training for both overall team performance and for specific planning elements, (c) positive trends were generally observed for each of the critical CAS phases, and (d) a general consistency existed among data collected from the perspectives of O/Cs at different sites. In total, these results provide evidence for a practice effect.

It should be noted, however, that a host of technology and training implementation shortfalls degraded the performance measurement effort for this case study. The technology difficulties often precluded some TARGETs items from being included in the current analysis. For example, items pertaining to the tasks performed by the A-FAC were omitted if this position was role played by one of the O/Cs because of loss of the A-FAC at the Patuxent River node. Despite these problems, the team performance measurements showed encouraging sensitivity and consistency.

CASE STUDY 2

The second MDT2 case study was conducted over five days in February 1995. Eighteen participants were the specific focus of the CAS practice exercises in the second case study. These individuals were the key participants in the planning and execution of the multi-service CAS missions. Additional personnel participated in the exercises as tank drivers and gunners but were not the focus of the performance measurement effort because they were not involved in multi-service CAS procedures. The MDT2 configuration for the second case study was identical to the testbed used in the first case study, except that the MULE simulator was located at the Armstrong Laboratory site as opposed to the NRaD site.

Performance Measurement

TARGETs measurement tools used in the first case study were modified slightly for the second case study. The modifications were made based on the lessons learned during the first case study and from input from the O/Cs and project SMEs. Changes to the measurement tools were reviewed by SMEs and additional revisions were made as appropriate. The focus of the performance measurement was similar to the first case study (i.e., the interactions between the key participants).

In addition, TARGET behaviors associated with four key elements important during planning (target selection, control of CAS aircraft, synchronization of CAS with other fire support activities, and airspace coordination areas) were identified for further analysis. The 'target selection' element involved those multi-service interactions required by the air and ground

teams to coordinate selection of targets. The 'control of CAS aircraft' element consisted of behaviors necessary to ensure effective handling and use of the attack aircraft during the CAS missions. The 'synchronization of CAS with other fire support activities' element related to interactions involving the timing of field artillery firing with the weapons release by the attack aircraft. The 'airspace coordination areas' element involved those communications that related to the separation of aircraft flight paths and field artillery firing.

O/Cs

A different O/C team, familiar with CAS doctrine and operations, was formed for the second case study. The O/Cs (three at Ft. Knox, three at Armstrong Lab, and one at NAWCAD) were responsible for data collecting, controlling the movement of computer generated enemy forces, or role-playing higher echelon positions. One O/C at Ft. Knox site served as the senior O/C for the training exercises and was responsible for data collection and leading the 'after action reviews' at the completion of each scenario.

Because of the limited accessibility to participant communications and the workload experienced by the O/Cs in the first case study, O/Cs were assigned to complete the measurement tools during specific exercise phases to increase the potential for performance measurements throughout the exercises. At Ft. Knox, one O/C observed the battalion CAS activities during the planning phase, while two O/Cs focused on all exercise phases. The remaining four O/Cs, three at Armstrong Lab and one at NAWCAD collected data only during the CP and attack phases.

Training in the use of the performance measurement tools was provided to all of the O/Cs during a one-day workshop several weeks prior to the implementation of the exercise. Questions were resolved and all of the O/Cs indicated an understanding of the forms and assignments and a readiness to use them during the evaluation week. Practice using data collection forms was planned to occur prior to the conduct of the actual exercise scenarios. Unfortunately, archival exercises were not available at that time.

Exercise Implementation

Participants received pre-exercise briefings in the same manner as presented in case study 1 with minor modifications. Exercises were implemented over five days during which offensive scenarios (i.e., days 1, 3, and 5) and defensive scenarios (i.e., days 2 and 4) were presented. The scenario presented on day 1 was used for purposes of simulator, exercise, and network familiarization. The capability of the enemy remained constant the second time a scenario was presented.

At the conclusion of each exercise, site-specific and multi-service AARs were conducted in a manner similar to case study 1, with a few changes based on the lessons learned from the first case study. In general, the framework began with an overall summary of the battle planning, including teaching points. The execution of each CAS mission was then debriefed using input from the measurement tools and participants, and teaching points were presented. Finally, training goals for the next exercise were identified.

Results

Planning Phase. Three O/Cs from Ft. Knox completed the TARGETs checklists during the planning phase for the exercises. These data are plotted in Figure 4. For TARGETs, overall performance (OVERALL) began at approximately 60% on day 1 and leveled off at over 90% by day 5.

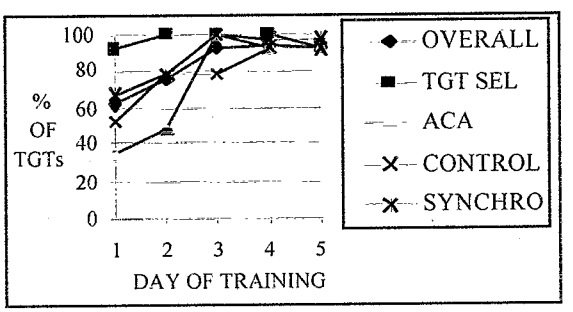

Figure 4. Planning Phase TARGETs data

Overall performance appeared to improve steadily across the five days of exercises. In an effort to further examine specific clusters of TARGETs, the overall data were broken out into the elements of Target Selection (TGT SEL), Airspace Coordination Area (ACA), control of CAS aircraft (CONTROL), and synchronization (SYNCHRO). Team performance associated with TGT SEL was over 90% for all exercise days. In comparison, performance levels involving ACA were at less than 50% for the first two exercise days and then increased to over 90% for the last three exercise days. The elements of TGT SEL, ACA, and SYNCHRO appeared to asymptote by day 3 and all of the components, including CONTROL, appeared to level off by day 4.

Contact Point Phase. Five O/Cs (two at Ft. Knox and one at each of the remaining sites) provided

TARGETs data for the CP Phase of the CAS missions. These data are plotted in Figure 5. In general, the trend in overall performance (OVERALL) across the five exercise days is, once again, in an upward direction, increasing from almost 80% to slightly less than 100% by the last exercise day. The data were further analyzed to determine the extent to which the team performance varied as a function of the O/C perspective (i.e., the site from which the O/C observed the multi-service interactions). An overall upward trend from the first day through the last day of training appears to exist regardless of the O/C location. Team performance from the perspective of the Ft. Knox O/Cs was above 80% on only three of the five days of training. In comparison, O/Cs at NAWCAD (PAX O/C), Armstrong Lab - MULE team (MULE O/C), and Armstrong Lab - attack aircraft (F-16 O/C) observed the team performance at 80% or greater for all days that data were collected. While the TARGETs data between the O/C appear to vary to some extent at the beginning of the exercises, there was less variability by the last day of the exercises.

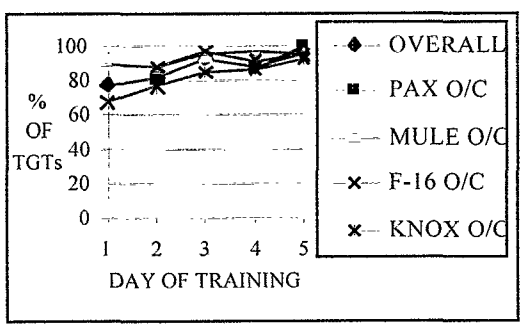

Figure 5. CP Phase TARGETs data.

Attack Phase. For TARGETs data, five O/Cs (two at Ft. Knox and one at each of the remaining sites) completed the measurement tool during the attack phase. These data are plotted in Figure 6. In general, the overall data (OVERALL) display an upward trend from the first through the last day of training. Multi-service performance across the five exercise days increased from less than 50% on day to over 90% on day 5. Team performance increased rapidly over the first two days of training with a more modest increase over the remaining three exercise days.

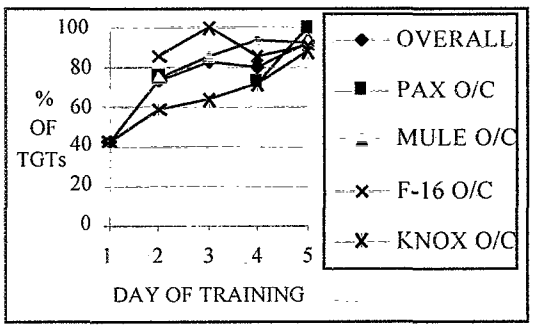

Figure 6. Attack Phase TARGETs data.

Similar to analysis performed for the CP phase, the data were analyzed to determine the extent to which the team performance varied depending on the location of the O/C. Team performance from the perspective of the Ft. Knox O/Cs did not reach a level of 70% until day 4, whereas all other O/Cs observed the team performance at over 70% for all days that data were collected. While the TARGETs data between the O/Cs appear to vary widely at the beginning of the exercises, there was less variability in the data towards the end of the training exercises.

Summary of Case Study 2

Results from the second case study show that: (a) TARGETs continued to provide a technique to measure multi-service team performance during training in a DIS environment, (b) positive trends were observed over the course of the training for overall team performance and for specific planning elements, (c) positive trends were generally observed for each of the CAS phases, and (d) a general consistency existed between data collected from the perspectives of O/Cs at different sites. In addition, the results from the second case study appear to correspond with the performance trends identified in the first case study.

DISCUSSION

This paper described a team performance measurement technique used during multi-service DIS training exercises and presented team performance trends from two case studies. The following section delineates the lessons learned and provides recommendations and future research requirements for evaluating team performance and mission effectiveness in DIS training environments.

In summary, the lessons learned from the two case studies are as follows:

(a) The multi-service teams demonstrated positive trends in critical interaction behaviors over the course

of the training in terms of overall performance and in terms of critical subsets of performance. This evidence suggests that teams generally improve performance when trained in the DIS setting.

(b) The multi-service teams displayed positive trends in the critical interaction behaviors over the course of training for all critical mission phases. This evidence suggests that training in DIS environments may be applicable for planning as well as execution phases of multi-service missions.

(c) The multi-service teams exhibited positive trends in the critical interaction behaviors as assessed by O/Cs at different network sites. The commonality of the O/C ratings is important because it provides a stronger case for the trends observed during the exercises.

(d) The performance trends observed in the two case studies are consistent with each other. This evidence provides a stronger case for the notion that multi-service team training in DIS is feasible, productive, and documentable.

(e) The TARGETs methodology used to develop measurement tools for the case studies appeared to be sensitive to practice effects and were robust in a DIS training environment. The evidence suggests that this measurement approach is feasible for use in DIS environments.

Conclusions and Future Directions

The overall goal of this research was to enhance the design of current and future DIS team training systems. The findings from these case studies provide a greater understanding of how to measure team performance in DIS, what team performance trends appear to exist during DIS training exercises, and what training strategies can be employed to enhance team performance.

While the results are encouraging, additional research is required to understand more fully the nature of team training in DIS environments. Such research should include: (1) examining the transfer of training from DIS to operational environments, (2) determining the value-added of DIS for CAS training, (3) identifying team performance trends for tasks other than CAS, (4) investigating different training strategies to maximize or accelerate the DIS team training benefit, and (5) determining how future technology advances may further enhance the utility of DIS for multi-service team training.

Although the current investigation did provide an opportunity to observe multi-service CAS teams in a unique manner, some constraints (e.g., low number of teams, case study approach) also existed. Even with these limitations, the current results are important because no other study has systematically collected team performance data in a DIS training environment.

While it appears that DIS has the potential to facilitate conduct multi-service team training, existing technology limitations need to be addressed to ensure that DIS reaches its potential. For example, the technological difficulties experienced in the MDT2 case studies often precluded some of the multi-service team members from actively participating in the training exercises. Additional engineering efforts are necessary so that DIS will support the training requirements of all team members.

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