NETWORKED SIMULATION AND COMBAT MISSION TRAINING

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ABSTRACT

Networked simulation to support combat mission training is now a reality at the 58th Special Operations Wing (58 SOW). As part of Annual Refresher Training (ART), trainees perform a challenging tactical mission (airland at night in a medium threat environment) in which four weapon system trainers (WSTs) are netted together: an MH-53J Pave Low, MH-60G Pave Hawk, MC-130P Combat Shadow, and a TH-53A. The latter is used as a dynamic aggressor aircraft. To determine the effectiveness of integrated simulation, nine sessions of ART—totaling 99 crewmembers (pilots, flight engineers, navigators, communications specialist)—were observed over four months. Crews completed a two-page questionnaire where they rated the value of networked simulation to support the training of 33 mission elements (airdrop, terrain familiarization, crew coordination, threat evasion, systems malfunctions, etc.). Crews also critiqued the strengths and weaknesses of networked training for the briefing, planning, execution, and debriefing phases of the mission.

The results of the survey strongly support the value of networked training in a number of key areas: multi-ship tactics, aerial refueling operations, formation flight, situation awareness, command & control, and mission team coordination. However, crew comments and our own observations also revealed a number of areas where the delivery of networked training can be improved. These include a more cohesive mission briefing, establishment of clear-cut training objectives, incorporation of emergency procedures into the scenario, and a “leveling” of task demands across crew positions and weapon systems.

ABOUT THE AUTHORS

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INTRODUCTION

Mission of the 58 SOW

The mission of the 58 SOW, Kirtland AFB involves the training and combat qualification of aircrews in the areas of Special Operations and Combat Search and Rescue (CSAR). Assigned to AETC in 1993, the Wing is responsible for providing initial mission qualification, annual continuation training, and upgrade qualifications (e.g., becoming an instructor pilot or a flight examiner) for a variety of US Air Force Special Operations Forces (SOF) weapon systems. These include the MH-53J Pave Low III, M/HH-60G Pave Hawk, TH-53A Heavy Lift Trainer, MC-130P Combat Shadow, and the MC-130H Combat Talon II.

Since 1990, the 58 SOW has been vigorously developing a sophisticated set of simulation and electronic training technologies as the USAF undergoes massive changes to become combat mission ready for the next century. Pursuing a path of innovative acquisition and an aggressive strategy for system development, along with an integrated approach toward academic instruction, flightline training, and simulation, the 58 SOW has acquired a “can-do” reputation for fielding sophisticated, reliable simulators in a short time period and incorporating these technologies into ongoing initial qualification and combat mission training programs with minimal disruptions. As of 1996, the impressive capabilities available at the 58 SOW included eight high fidelity networked flight simulators; electronic classrooms for advanced academic instruction; a comprehensive database generation facility to construct photo-enhanced, geo-specific visual databases for any location in the world; an integrated training and mission support system employing computer aided instruction (CAI); a cadre of database modelers and programmers; various hardware and software assets to support construction of photo-enhanced, geo-specific databases; and functional links to multiple nodes on the Department of Defense’s (DOD) Distributed Interactive Simulation (DIS) constructive battlefield simulation network.

The combination of realistic training devices, coupled with high-fidelity, geo-specific databases, has enabled a unique combat mission training capability that combines constructive and live simulation of dissimilar devices on a common Area of Operation (AO) in real-time, and linked via a central Training Observation Center (TOC). Networked simulation is the enabling technology for different services, commands, and weapon systems who are geographically dispersed to simultaneously train in realistic, virtual environments. While these advancements hold great potential for training applications, little is known about how an established training program is impacted when networked simulation methods are integrated into the curriculum. This paper summarizes the conduct and results of a project that assessed the impact of the Special Operations Forces Network (SOFNET) training that has been developed by the 58 SOW.

The SOFNET inter-simulator network (ISN) is a fiber optic reflective memory-based network that permits interactivity and shared viewing among the weapon system trainers (WSTs) and operational flight trainers (OFTs) in the 58 SOW complex. ISN treats each non-ownship simulator on the network as a moving model. ISN also provides an efficient way to view all the simulators at once, permitting the TOC to be linked to the network rather than to each simulator individually. ISN creates a true shared rehearsal and training capability since multiple aircraft can plan, prepare for, and execute a joint mission. Three WSTs (MH-53J, MH-60G, MC-130P) and two OFTs (MH-60G, TH-53A) are currently on the network. Recently, ISN has been used as a DIS node for performing concept tests with the Joint Warfighting Center.

SOFNET TRAINING ENVIRONMENT

The SOFNET training environment may be conceptualized as the intersection of three modularized components: (1) Training Devices, (2) Scenario Command & Control, and (3) Mission Elements (Figure 1).

Training Devices

The first component, Training Devices, may be defined for our purpose as those participant crews who are represented as players in their respective training devices on the network. This component may be composed of any combination of network participants, and the training scenario is manipulated based upon the matrix of participants scheduled for training. The combination of participants dictates the direction that a training scenario may take, and it is reasonable to assume that the potential for different mission outcomes is a function of the number and composition of participants in the training session. For example, one training scenario may have MC-130P, MH-60G, and MH-53J participant crews flying their respective WSTs,

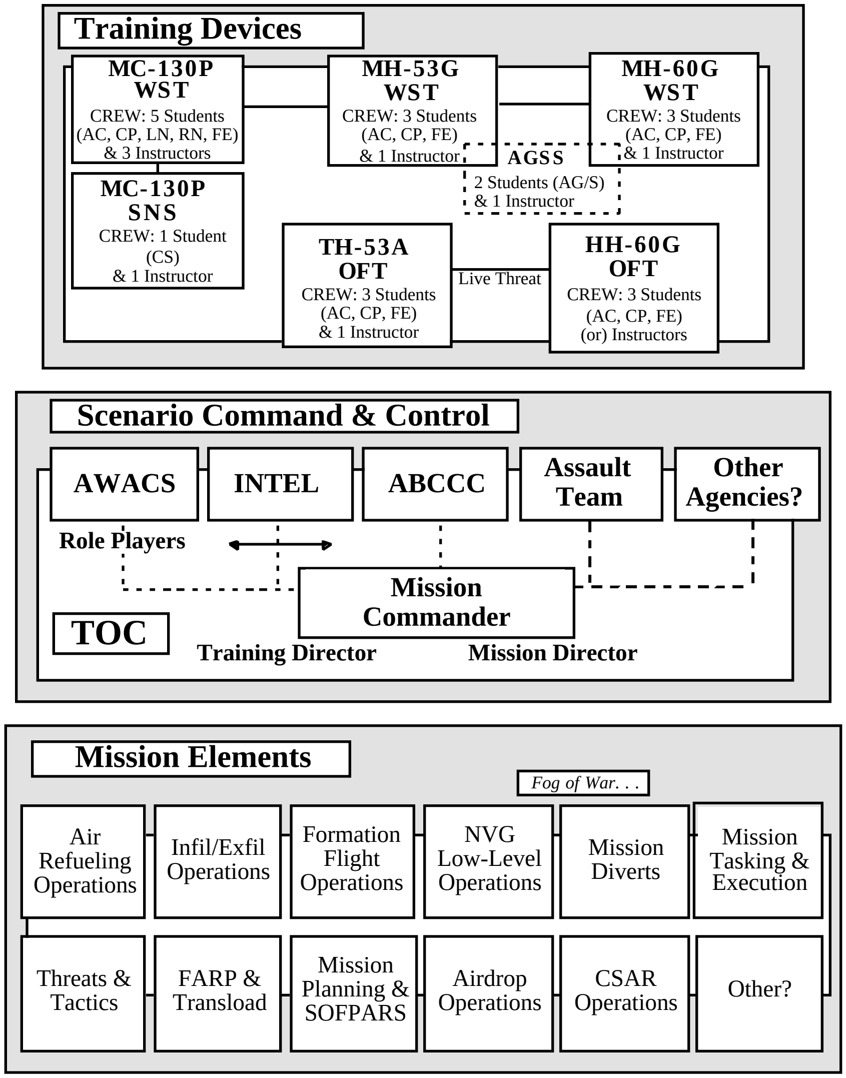

Figure 1. Three-Tier SOFNET Conceptual Model.

with an instructor crew tasked to fly the TH-53A in an aggressor mode. For each matrix of to-be-trained participants, an acceptable set of mission variables or outcome parameters must be established for that scenario. It is thus reasonable to assume that the potential for different mission outcomes in the SOFNET training session is a direct function of the number and composition of participant crews, as described below.

The **MC-130P** WST is a six degree of freedom, high fidelity aircrew training device that uses, among others, a CompuScene V image generator system, fully correlated Infrared Detection/Forward Looking Infrared System (IDS/FLIR), a digital radar landmass system, navigation systems, and out-the-window (OTW) displays. Navigation systems include Doppler, inertial navigation system (INS), control display units, and a central flight computer that integrates various flight systems.

The **MH-53J** WST is also a six degree of freedom, high fidelity aircrew training device based on the MH-53J Pave Low helicopter. The device uses a CompuScene V image generator system, and fully correlated FLIR, radar, navigation systems, and OTW displays. Correlated sensor operations can be performed with both head-up and head-down displays.

The **MH-60G** WST is another six degree of freedom, high fidelity aircrew training device based on the MH-60G Pave hawk helicopter. Like the MH-53J, the MH-60G WST uses an 8 channel, fully correlated CompuScene V image generator for both OTW and FLIR, a DRLMS for multi-mode radar, and a fully replicated cockpit with all tactical and conventional avionics systems either simulated or stimulated.

The **TH-53A** OFT is a six-degree-of-freedom, high-fidelity simulator based on the TH-53A helicopter. It is a modification of an H-53 simulator and uses a CompuScene V visual system to provide a photo-specific training environment. The TH-53A is typically used as a part-task-trainer (PTT) to train students in basic contact, emergency procedure, instrument, and initial day and night tactical (including NVG) operations. All cockpit switches and instruments in this device are functional, where required, to support these training tasks. When in the network mode, however, the TH-53A is designed to function as an aggressor attack helicopter, allowing advanced defensive air combat maneuvering training to be conducted.

The **HH-60G** OFT is a non-motion device used to augment the training capabilities of the MH-60G WST. This device features a "cross-view" wide display system and a six-channel PT-2000 image generator that allows day, dusk, night, and NVG flight operations in highly realistic database AOs. A replicated cockpit includes operational radar, FLIR, and navigation systems. Seat shakers and a digital audio system help prevent simulator sickness, and provides realism for basic and combat training tasks including low-level flight and shipboard operations.

Besides the devices already mentioned, a second training device, the remotely located Satellite Navigation System (SNS), is used to support training of the communications specialist (CS) in the MC-130P since there is no station for that crewmember in the WST. Also, an aerial gunner/ scanner simulator (AGSS) is expected to become integrated during 1997. The AGSS is a head-mounted virtual reality training device that will be used to support "back end" crewmembers (flight engineer, gunners/scanners) for MH-53J and MH-60G rotorcraft.

Scenario Command & Control

The Command & Control component encompasses the host of role players who are scripted into the particular combat mission training scenario, as well as the Training Director (TD) or Mission Director (MD) who is tasked to weave these simulated coordination elements into a cohesive joint mission execution. Role players may represent, for example, ABCCC, AWACS, the ground assault team commander, a simulated transload aircraft at the forward LZ site, INTEL, and so forth. These entities, when represented by live role players, are located in the TOC, described below, and fall under the control and discretion of the MD. They are tasked to follow the mission script as the training scenario develops, and intervene as necessary to steer the mission to its intended training conclusion.

In this regard, mission participants may be reacting to dynamic training conditions in a manner that was not originally intended. To get these participants on the correct track, they might be "steered" to a successful outcome. For example, a helicopter crew might have failed to push a frequency change after inserting a ground assault team into an unsecured DZ. Consequently, the ground team commander would be unable to call for fire support, and the mission objective would be in dire jeopardy. The MD, recognizing a need to intervene before the mission comes to an abrupt and unsuccessful conclusion, could task the ABCCC role player to inform the helicopter crew of the ground team's attempts to make contact in accordance with the Communications Execution Operating Instructions (CEOI). In this manner, the scripted mission would remain fluid without direct instructor intervention to correct a faulty course of action, and the crew could be guided to a successful training outcome.

The **TOC** is an advanced multi-media auditorium and electronic classroom that is specifically designed to serve the primary function as a secure simulator scenario control center. As the pivot point for the SOFNET ISN, there are six role-player stations with communications capability to each of the simulators, and either a TD or MD position that controls all activities in the TOC. The TOC uses a simulator display system with eight 35" monitor displays and two 60" displays. Each of the 35" monitors is linked to a particular simulator, and the TD/MD can select any combination of OTW or sensor displays currently being used by a particular simulator for display on the monitor. One large 60" display is used to display a projected map that can be stepped through various scales. This chart displays cultural features, and iconic representations of constructive and real simulation entities. This feature allows the TD/MD and role-players to follow the development of a particular scripted mission or exercise. The TOC also uses a Computer-Aided-Podium (CAP) to provide a multi-media control interface for an electronic classroom capability. The CAP allows the user to select a variety of visual options for the wall monitors, such as computer-based training, live video from any of the simulators in the SOFNET, or pre-recorded video played on any of the four available VCRs in the TOC (Nullmeyer & Spiker, in press).

Another key technology in the Command & Control environment is the **Integrated Electronic Combat Simulation System** (IECSS) which provides a full electronic warfare (EW) simulation capability for the MH-53J, MH-60G, and MC-130P WSTs. The IECSS is used to realistically simulate (1) the electromagnetic and infrared EW environment, (2) threat weapons dynamics and engagement including command, control, and communications (C3) characteristics, (3) EW defensive systems processing and environment interactions, (4) countermeasures effectiveness calculations, and (5) EW systems' audio and video interface to the aircrew. The fidelity level of the IECSS simulation is sufficient to support mission rehearsal for qualified aircrews in addition to programmed, repeatable training to qualify or upgrade new aircrew members.

Mission Elements

The Mission Elements component may be envisioned as the particular mission objectives that may be accomplished, depending upon the capability of the participants and the designated mission. In essence, the C&C element may use this component as the "toolbox" of events which may be performed by a particular combination of participants in the network training environment. For example, a SOFNET training session may comprise a combination of aircrew participants with differing mission requirements and capabilities. The "toolbox" of mission elements that would emerge as possible joint training objectives might include aerial refueling, CSAR operations, formation flight, threats and tactics, and so forth. Upon considering the matrix of available participants, the MD might consider tasking a different set of mission objectives for the session. In a recent training session, a helicopter crew that was not qualified to conduct formation operations was authorized by the MD to fly as wingman to the other helicopter crew, so that valuable training was received in a live mission environment. The following paragraphs describe the training setting that was in place during our observations of the SOFNET environment.

Mission Scenario. The training mission was conducted in an unclassified, Southwestern USA database, and entails a high-level mission authorization and Warning Order to conduct POW rescue operations. The mission scenario included forced entry into a POW compound to return coalition force detainees to friendly control. After recovery had been completed, the assault force was to transport recoverees and a medical team to an abandoned airfield for transload to fixed wing assets. All forces were also tasked to be prepared to pickup downed crewmembers as required.

Crew Mission Taskings. The MC-130P WST/SNS was tasked to conduct NVG low-level operations to a pre-coordinated Air Refueling Control Point (ARCP), and provide refueling support for a two-helicopter formation (MH-53J and MH-60G) prior to their crossing into hostile enemy territory. After the refueling operation was complete, the MC-130P was to continue its NVG low level operations to perform an airdrop of a reconnaissance-reception team at a transload airfield. This site was to be used by the helicopter formation, and others, to conduct blacked-out Infil landing operations, and transfer personnel to a waiting (simulated visual model) MC-130H Talon aircraft.

The MH-53J WST was tasked to fly a NVG low-level route as formation lead with the MH-60G. The helos were to fly to the pre-planned air refueling point, conduct refueling operations with the MC-130P, and "cross the fence" deep into hostile territory. This territory has a medium-level threat saturation, and formation tactics and altitudes were to be flown appropriate to the environment. After the AR, their objective was to fly to the hostile POW compound and insert a special forces team via fastrope procedures. The team was to secure the compound, with helicopter air cover and fire support, and extract the friendlies back onto the helos. Following this action, the helos would fly to the transload site for transfer and evacuation of the expatriated POWs.

The MH-60G WST was tasked to fly low-level, as formation wingman to the MH-53J. They would also fly low-level to a pre-planned ARCP, conduct a refueling operation with the MC-130P, and cross the fence into hostile territory. Their objective was to assist the MH-53J with the insertion of a special forces team via fastrope procedures into a POW compound. The MH-60G would accompany the MH-53J to the transload site for transfer and evacuation of the POWs.

Either the TH-53A or the HH-60G OFT were represented in the visual model set as a threat helicopter (Hind), that was located at a pre-coordinated attack point. For the purpose of this mission, one of these devices was used to conduct live aggressor tactics, and was manned by two instructor pilots and one instructor FE/simulator operator. Their tasking was to run multiple attack runs on the helicopter formation, and attempt to divert them from their primary mission tasking.

METHOD

Mission Participants

Across the nine SOFNET sessions observed, a total of 99 crewmembers participated in the survey. This included 22 MH-53J pilots, 17 MH-53J FEs, 14 MH-60G pilots, 9 MH-60G FEs, 13 MC-130P pilots, and 24 MC-130P navigators, FEs, and CSs.

Design

To be effective, an evaluation methodology must support the insertion of data collection "probes" into each component of the SOFNET training program. Not only must the data capture the reactions of participants as they experience the different aspects of this novel training approach, it should also result in concrete suggestions for improving the training process that could be folded back into the curriculum in a timely manner. Accordingly, a mix of interviews, observations, and surveys were used to collect the user-reaction data (Tourville, Spiker, & Nullmeyer, in press).

Observations

Observations of the entire mission process—including briefing, planning, execution, and debrief—were made by the second author, a subject matter expert (SME)-researcher. A naturalistic observation technique was used to record salient data concerning the conduct and quality of the SOFNET training sessions. Most of the observations were made in the TOC, where student performance and mission progress could be perceived from the monitor displays, and from commentary by the MD and role player personnel. Additionally, mission preparation and mission briefing sessions were observed for each of the student crews. These observations were made in the respective mission planning rooms, which presented the opportunity to openly discuss with students and instructors those training concerns associated with operational mission requirements.

Survey

Upon the completion of a SOFNET training session, the SME-researcher administered a two-page questionnaire to each of the participating crewmembers. The first page of the questionnaire contained four questions regarding the briefing, planning, execution, and debriefing phases of the mission. Crewmembers were to record their comments, in free form, under each question. The questions were:

Question 1: How clear was your specific role as a network player in the mission script once the in-brief ended? What might have been done during the in-briefing to help clarify your role or requirements?

Question 2: Were there aspects of the mission script that required you to support the actions of another crew that were artificial or unrealistic?

Question 3: In what ways did your mission plan change as a result of interaction with other mission team players? What team interactions were helpful or not helpful? What other team interactions would have made the training more realistic?

Question 4: How is training in a joint networked simulation mode likely to affect your real-world chances for mission success? Which areas of the mission are most likely to be affected? Please explain.

Space was also provided at the bottom of the page for crewmembers to note additional comments concerning any aspect of the training session.

On the second page of the questionnaire, crewmembers completed a five-point rating scale that assessed their perceptions of the value of networked training relative to standalone training for 33 mission elements. A rating of "1" corresponded to "unacceptable;" "2" was "less value than standalone;" "3" was "same value as standalone;" "4" was "better value than standalone;" and "5" was "networking is essential for this element."

The mission elements covered all aspects of the mission. These included major mission functions (e.g., mission planning, tactics planning, low-level planning, multi-ship tactics); tactical tasks (e.g., airdrop operations, AR operations, formation flight, systems malfunction); and higher level cognitive processes (e.g., situation awareness, crew coordination, time management, mission team coordination). Next to each rating, space was provided for crews to note any comments that might help explain or amplify their judgments.

RESULTS

Quantitative Rating Data

The results of the participant survey showed that *all* of the mission elements received high ratings, with all but two of the mission elements rated positive (i.e., above the scale midpoint, 3.0) by the SOFNET crews. Table 1 lists the mission elements in descending order of mean rating. Since some of the elements were not applicable to certain crew positions and weapon systems, the total N is typically less than 99.

Table 1.
Mean Rating of SOFNET Mission Elements.

Mission Element	Mean Rating (1=lo,5=hi)	N
Multi-Ship Tactics	4.2	84
AR Operations	4.1	93
CSAR Operations	4.0	59
Formation Flight	4.0	74
Situation Awareness	4.0	97
Command & Control	4.0	95
Mission Team Coordination	4.0	93
Transload Operations	3.9	61
Time Management	3.9	97
Mission Debrief	3.9	93
Mission Briefing	3.8	96
Secure Comms	3.8	84
In-Flight Formation	3.8	96
Crew Coordination	3.8	96
Mission Diverts	3.8	77
Mission Planning	3.7	95
Threat ID and Response	3.7	87
Infil/Exfil Operations	3.7	74
Threat Avoidance/Evasion	3.6	93
Fuel Management	3.6	90
Low Altitude Operations	3.5	93
Weapons Employment	3.5	65
Tactics Planning	3.4	94
Night Operations	3.4	92
Radar/FLIR Interpretation	3.4	85
Chaff/Flare Management	3.4	82
Low Level Planning	3.3	93
Airdrop Operations	3.3	36
Terrain Familiarization	3.3	90
Systems Malfunctions	3.3	95
Minimum Wx Operations	3.3	81
Checklist Procedures	3.1	94
Overall Value	3.7	88

Only Airdrop Operations and Checklist Procedures failed to achieve a statistically significant positive rating. Statistical assessment was based on a simple t-test, in which a Bonferroni adjustment was imposed to control for multiple testing (Harris, 1994).

Importantly, the overall value of networking simulation (element #33) was rated positively. This assessment was particularly conservative, since the maximum rating scale for this element was "4." This was done because we felt that the "5" rating used for the other elements, signifying "networking is essential for this element," was not a logical possibility for an overall value assessment. Despite this conservatism, a statistically significant positive rating for the overall value was obtained. Hence, clearly most participants felt networked combat mission training represents a substantial benefit over traditional standalone simulator training.

The most positively rated elements involved coordination among multiple players. The seven elements with mean ratings of 4.0 or higher were Multi-Ship Tactics, AR Operations, CSAR Operations, Formation Flight, Situation Awareness, Command & Control, and Mission Team Coordination. All of these elements require integration of crew efforts to be successfully completed and, as such, their positive ratings are consistent with the stated purpose of the network training to support integrated crew operations.

Although the ratings suggest that the SOFNET training was highly valued overall, we probed the survey rating data further, to ascertain if there were any notable differences in ratings across crews, weapon systems, and crew positions. With regard to crew, the average rating of the 32 mission elements varied only between 4.1 and 3.5 across all nine crews, where there was no clear evidence for either a downward or upward trend over time in the ratings over sessions. Similarly, there was no statistical evidence of differences in perceived training value across weapon systems. This was somewhat surprising, since we had suspected that MH-53J crews might have given SOFNET a higher rating since its mission scenario was originally designed to enhance the Pave Low's training capability.

However, when the survey data were broken out by weapon system *and* crew position, we found that pilots exhibited a strong preference for integrated over standalone simulation training (M=3.9) compared to their non-pilot counterparts (M=3.6). This difference is particularly evident for the MH-53J and MC-130P weapon systems.

Qualitative Comments on the Mission Elements

One-third of the 99 participants took the opportunity to amplify their ratings of the mission elements with comments. Commonality analysis showed that responses could be grouped into five higher level categories: planning and briefings, visuals and terrain, tactics and operations, communications and procedures, and team interactions.

Examples of the most frequent comments included a desire for more planning time and a dissatisfaction with computerized planning products. There was a mixed reaction to the quality of the visuals, with a number of crewmembers expressing particular difficulty seeing the terrain while flying low level and performing formation flight. Many of the crews indicated a desire for a more intensive threat environment. While comments regarding the difficulty in achieving reliable communications were reported, many noted that this provided an unintentional replication of the "fog of war." Finally, despite the many problems encountered during the simulator sessions, most participants thought the networked environment provided an excellent opportunity to practice team interactions, thereby enhancing team awareness and offering opportunities to try out different solutions to problems that arose during the scenario

Qualitative Responses to Networked Training Questions

Crews were quite responsive to the comment portion of the survey, with 95% of the available slots (4 questions x 99 participants) containing comments. Space limitations prevent us from describing these insightful comments in detail. The following is intended to convey the essence of some of the major points that were reported.

Clarity of mission script--For the most part, all SOFNET crews indicated that their specific role was clear from the briefing. A typical response was that it was "mostly clear except for ..." The specific response varied across the crews, and included issues such as "no h-hour established," "comm package was weak," "limited imagery in the objective area," and "an ATO should have been included in the briefing package."

Did mission script require unrealistic actions--An impressive two-thirds of the participants responded that the mission script did not require them to perform in an artificial way to support actions of crews in the other WSTs. This suggests that the SOFNET mission script struck a fairly even balance between establishing objectives for an actual combat mission while ensuring that each participating weapon system had some meaningful tactical tasks to perform. Critiques were noted by the other one-third of the participants, and they fell into one of five categories: simulator capabilities, mission conditions, terminal area tactics, role playing, and mission objectives.

With regard to *simulator capabilities*, five of the participants noted that, although the demands of the mission required that the MH-60G have the more capable 701C engine (which is in the actual aircraft), the WST has the less powerful 700 engine in the aero package. The result was an inability to perform the required AR on a consistent basis.

With regard to *mission conditions*, four participants cited the unrealism of the original temperature and density altitude parameters within the LZ given the limited power available for the MH-60G. One helicopter pilot indicated they had to "lower the temperature" in order to perform the required pick-up.

Within the *terminal area*, several tactical aspects of the mission were criticized. These included reports of "bogus" indications from one of the SAM sites, the use of secure radios during calls for fire support, and reports that the simulated threat level in the DZ was too high for the tactical requirements of some weapon systems.

Several aspects of SOFNET *role playing* were critiqued. One crew experienced problems with their visual system, which forced them to "role play" more of the scanners' functions. Also, lack of wraparound visuals in the WST gave them less scanning ability than they would have in an aircraft.

With regard to the SOFNET *mission objectives,* several MC-130P pilots noted that one of the required helo ARs was unrealistic given the threat level in the DZ. Another MC-130P pilot complained about the lack of a role player in the scenario whose inputs would "affect our (MC-130P) decision making realism." In addition, several pilots doubted that both the MH-60G and MH-53J would be able to fit into the terminal area to drop the special forces team in the building.

How plan changed as a result of interaction with other players--The vast majority of survey participants responded to one or more parts of this question. Regarding mission plan changes prompted by team interactions, four changes were cited most often, all considered positive from a training impact. The specific change to the plan varied across crews, reflecting minor modifications to the mission script imposed by the instructors.

First, many crew members lauded the training benefits associated with having to slip the MC-130P's AR control time because of the late takeoff time by the helos. Second, the nature of the AR (i.e., orbit point, track) had to be changed due to the helo "going single engine." Third, one of helicopter crews noted that they had to change their planned ingress after diverting to pick up a downed HIND crew. Fourth, another crew had to alter its plan in-flight in order to perform an unplanned AR. In all cases, these changes to the mission plan were viewed favorably since they are "very helpful for coordinating with other aircraft."

Other frequently lauded aspects of networked training included the ability to meet face to face with crews from other weapon systems, the training benefits from the manned aggressor impact on ingress route and enroute times, and the opportunity to interact with role players.

<u>How training in joint networked simulation mode affects real world chances of success</u>--All but four of the survey participants responded to this question. With regard to the first part of the question, respondents were uniformly positive regarding the impact of networked simulation on the perceived chances for mission success. In fact, only four of the 95 participants who responded to this question expressed negative sentiments concerning impact of networked training. Comments like "not likely to affect role personally as an FE" were typical of this minority viewpoint.

SME Observations

Despite some inevitable technical problems during the early stages of SOFNET implementation, there were a number of areas in which clear improvements, indicative of a true "learning curve," were exhibited. For example, over the course of the study, the MD continually worked to enhance the mission in-brief. At the beginning of the study, the in-brief consisted of paper notes that were "read" to the crews. However, by the end of the period, the in-brief had progressed to high-quality Powerpoint slides with embedded cartographic and objective area photographs.

Another area of improvement concerned the quality of mission preparation materials. Early on, SOFNET instructors were dissatisfied with the limited materials available to support real-world type planning activities. Once network problems were isolated and corrected, the MD, with assistance and input from several instructors, began to improve the mission preparation materials with an enhanced set of crew-tailored mission packets that included weather, route details, intelligence information, and so forth.

Soon after the study began, it became evident that the same network problems were being encountered on a session-to-session basis, and that these problems were simply not getting fixed (e.g., spontaneous system crashes, unrecoverable loss of communications channels). At that time, the MD requested that a dedicated technician sit in the TOC for the duration of each SOFNET session to observe, in real-time, the problems being encountered. This individual also sat through the WST-specific debriefs at the conclusion of training. Through such continued contact, where lessons learned were shared among all participants, the network failure rate was significantly reduced.

A fourth area of improvement involved instructor communications. Early on, the MD established a one-hour meeting—prior to the crews' arrival at the simulator—that was attended by the MD, all SOFNET instructors, and network technicians. This meeting served multiple purposes, including provision of additional instructor training on operating idiosyncrasies of SOFNET, identification of current system problems, and coordination of training strategies concerning joint mission operations.

CONCLUSIONS

Areas Where Networked Training is Beneficial

Taken together, the crew comments, mission element ratings, and observations provide a fairly clear indication of the areas where networked training is beneficial for combat mission training. As noted by the ratings, the main areas where networked training value is high include multi-ship tactics, AR operations, CSAR operations, formation flight, situation awareness, command & control, and mission team coordination.

From the comments, other benefits of networked training include its capability to: simulate the "fog of war," promote the practice and honing of key tactical skills, improve "comm planning" and instill "flexibility in C2 interactions, learn the capabilities and limitations of dissimilar platforms, increase the opportunity to do contingency or "what-if" planning, coordinate higher-level tactics among crews and joint commands, test new tactics, and promote improved methods of task prioritization.

Areas Where Networked Training Needs Improvement

Despite the positive benefits lauded by participants, our observations coupled with crew comments revealed a number of problem areas that need to be addressed in future applications of the networked simulation technology.

Presently, SOFNET mission training practice is not focused on any set of tangible training objectives, nor is it geared to take full advantage of the strengths of the training methodology. SOFNET training also requires a great amount of time to develop and conduct (the training day is often greater than 10 hours). The full-day experience of SOFNET training precludes an opportunity to provide further focused training on, for example, aircraft systems and emergency procedures. Also, the SOFNET scenario is currently scripted in an unclassified database, using a fictitious country setting with made-up names. Crews report that fictional names simply make the scenario more difficult to remember and harder to relate to any personally-held “mental model” of the world. Conversely, students express a preference for conducting complex mission operations in real-world “hot-spot” locations with which they are familiar.

The ability to encounter threats and apply tactics in a real-time networked environment is a simulation training advantage that cannot be replicated in the aircraft. However, many crewmembers report that the mission script should include a greater threat saturation level for all network players. The threat modeling capabilities of the network simulation offer a significant advantage over standalone training because live threat encounters require students to think and act in real-time to the unknown attributes of combat adversaries - a characteristic that can only be partially replicated by the use of a moving model system. Finally, it has been reported that the present SOFNET mission scenario is “fun,” but is only challenging for pilot students. Some non-pilot students are not receiving effective training, and are often only “along for the ride.”

Recommendations for Improving Delivery of Networked Training

We have established that the SOFNET training method is an effective means for mission crews to train for joint operations coordination and procedures. Certain changes are necessary, however, before the full benefit can begin to be realized. For example, the mission training scenario should be restructured to include a greater amount of systems and emergency procedures training. Also, a greater emphasis should be placed on the development of explicit training objectives and focused strategies.

Additionally, student participation roles should also be equalized across WSTs, such that all participants are involved and tasked to perform at similar training levels. The actual time spent in the simulators performing the mission scenario should be shortened. It is counter-productive to prepare students to perform, for example, in the threat environment, and then task them to fly for two hours in the simulator before anything interesting happens. Finally, there is a great need for more face-to-face time between mission crews as they plan and prepare for their joint mission operation. The actual time cut from the simulator period would be better utilized by providing a longer, and more focused, team mission preparation session.

The 58 SOW is presently conducting an in-depth assessment of its training requirements to determine the optimal methods for enhancing the impact of networked training. Of particular interest is the identification and eventual development of Distributed Mission Training (DMT) principles and techniques. This training has the potential to not only significantly improve the combat mission readiness of the warfighter, but also increase the effectiveness of joint combat mission operations.

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