USING THE MH-53J WEAPON SYSTEM TRAINER/ MISSION REHEARSAL SYSTEM: INITIAL ASSESSMENTS AND LESSONS LEARNED

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ABSTRACT

The MH-53J Weapon System Trainer/Mission Rehearsal System (MH-53J WST/MRS) was developed by the Aerospace Division of General Electric and delivered to the Air Force in 1990. During an initial assessment of system capabilities, it was used to support mission preparation for a joint 1550th Combat Crew Training Wing/U.S. Army Special Operations Forces training exercise that was then executed at White Sands Missile Range, NM. The exercise was designed to simulate a strike mission to recover critical avionics equipment from a remote research facility in a hostile third-world nation. An existing training database was enhanced to provide additional detail in the areas of operation for this exercise. This enhanced database was used for both crew rehearsals and development of products for inclusion in aircrew mission planning folders. Questionnaires were administered to aircrews at the conclusion of rehearsal and after completion of the mission. Crew reactions to this simulation-based rehearsal were very positive. These data were supplemented by direct observations of database enhancement, planning, and rehearsal activities and by extensive interviews with participating aircrews, planners, and intelligence personnel. This paper describes the MH-53J WST/MRS, the use of the device to support preparation for this joint training exercise, and an initial assessment of system capabilities to support rehearsal. It also discusses implications and lessons learned.

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USING THE MH-53J WEAPON SYSTEM TRAINER/MISSION REHEARSAL SYSTEM: THE MISSION PREPARATION PROCESS AND LESSONS LEARNED

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INTRODUCTION

Recent technological advances are making simulation-based rehearsal feasible for military operations. The Department of Defense has entered into several partnerships with industry to build mission rehearsal capabilities based on these emerging technologies. For example, Vestewig, Bergsneider, and Richardson [1] described a mission rehearsal capability being developed by Loral Defense Systems for the Special Operations Forces (SOF) as part of the Special Operations Forces Aircrew Training System (SOF ATS). Rehearsal devices are currently planned to be reconfigurable among SOF weapon systems to enable rehearsal with the correct complement of SOF aircraft. In another program, the Aerospace Division of General Electric delivered the MH-53J Weapon System Trainer/Mission Rehearsal System (WST/MRS) to the 1550th Combat Crew Training Wing (1550th CCTW), Kirtland AFB NM in 1990. (1550 CCTW has since been redesignated the 542d Crew Training Wing). More recently, TH-53A and MH-60G simulators have been added to the system.

A number of behavioral issues accompany the introduction of simulation-based mission rehearsal capabilities into the operational community. Andrews, Nullmeyer, and Fuller [2] reported that although several authors had discussed definitions and requirements for designing a rehearsal capability, there were no guidelines for how best (effectively) to use the capability once it had been developed. In large part, this is due to the recency of using simulation technology for mission rehearsal; it is in a stage of infancy. But utilization strategies for simulation-based mission rehearsal and the associated effects are important issues that must eventually be addressed. A more fundamental issue is the very nature of mission rehearsal itself. For example, what is involved, descriptively, in the process of preparing for an operational mission, and what are some of the more salient variables in this process that are likely to have an impact on mission execution? These types of questions were a principal focus of this study. An exploration of the mission preparation process can set the stage for more systematic, high-payoff investigations in the future by building a framework for approaching and understanding the problem in the first place. Relevant variables can then be investigated within this context.

The 1550th CCTW and the Aircrew Training Research Division of Armstrong Laboratory established a research partnership to explore mission rehearsal and planning issues using the MH-53J WST/MRS. The objectives of this paper are: (1) provide an overview of the MH-53J Weapon System Trainer/Mission Rehearsal System; (2) describe a case study where these capabilities were used to support mission preparation for a joint Army/Air Force training exercise; (3) provide an overview of the mission preparation process, (4) present initial evaluation results including critiques from the aircrews who used it; and (5) discuss implications and lessons learned that are applicable to other mission rehearsal programs still in the development stage.

MH-53J WEAPON SYSTEM TRAINER/ MISSION REHEARSAL SYSTEM

The MH-53J WST/MRS was developed for the Air Force by the Aerospace Division of General Electric. The major elements of this rehearsal system are a mission planning system, a database generation system, and the MH-53J WST. The remainder of this section will highlight selected portions of the MRS.

The Database Generation System (DBGS)

The DBGS is a contractor-operated network for the rapid production of digital databases for simulating out-the-window views compatible with Night Vision Goggles (NVG) use, and for simulating radar and Forward-Looking Infrared (FLIR) imagery of the MH-53J. At the time of the exercise, the DBGS consisted of Sun Sparc work stations and a Sun 4/260 file server connected by an Ethernet Sun Local Area Network. Connected to this file server are a disk drive, a 1/2" tape drive, a laser printer, an Eikonix camera stand and light box, and a digitizer tablet for data input and output. A LENZAR scanner digitizes maps, charts, and images in color. The system configuration used at that time had Polyfit software to extract three-dimensional models and geospecific phototexture from digitized photographs. Compu-scene Database Generation System II software generates digital databases from Defense Mapping Agency (DMA) Digital Terrain Elevation Data (DTED), DMA Digital Feature Analysis Data (DFAD), satellite/aerial imagery, hand-held photography, Aim Point Graphics, 1:50,000 or 1:25,000 city maps, Joint Operations Graphic (JOG) charts, Operational Navigation and Tactical Pilotage Charts (ONC & TPC), target area blueprints, and Flight Information Publications (FLIP) charts. Using these types of source data, the DBGS constructs a digital database of the specific terrain and features in the mission area.

The MH-53J WST

The WST provides a high-fidelity simulation of all MH-53J flight station systems for the pilots and flight engineer and includes an eight-window CRT display system with infinity optics. The WST also has a six degree-of-freedom motion platform. The major subsystems for simulating a mission rehearsal environment are the image generating system, the Digital Radar Land Mass (DRLMS), the electronic warfare (EW) environment system, and the helicopter flight simulator (HFS).

The Compu-scene V image generator produces an out-the-window view that can be viewed using NVGs. It also produces the FLIR. Compu-scene V has a large texture map capability (240 512x512 maps) that can be dynamically updated during the mission simulation. This feature allows the image generator to produce high-resolution, geospecific photovisual images over large areas when satellite/aerial/hand-held photos are available during database development. Compu-scene V uses a process called micro-texture to allow the observer to view an object at very close range with significantly reduced blurring. This capability is necessary for landing and hovering. When source imagery resolution is inadequate for viewing at close range, micro-texture combines one of four fine generic texture patterns with the photo-specific texture pattern to provide the necessary reduction in blurring.

SOF-NET: As additional simulators come on line a local intersimulator network or, "SOF-NET," will enable networked training and rehearsal. The initial system connects the MH-53J WST, MH-60G WST, and the TH-53A Operational Flight Trainer (OFT). Planned expansions include an electronic combat simulation system in December 1992, and integrating the HC-130P WST into the network in 1993. The potential for adding the MC-130E and MC-130H WSTs to the network in the future is still awaiting requirements definition. A training observation center (TOC) will be operational by February 1993. It will allow flight following and observation of all trainer operations on the SOF NET.

CASE STUDY

Participants and Mission

1550 CCTW personnel arranged a joint exercise involving the 1550th CCTW and Army SOF. The exercise was designed to simulate a strike mission to recover critical avionics equipment from a remote research facility in a hostile third-world nation, and was executed at White Sands Missile Range, NM. The 1550 CCTW participants included an intelligence officer, two wing planners, two MH-53 instructor crews, and three MH-60 instructor crews. Three of the 10 participating pilots indicated that they had previously been to the objective area, a facility on Oscura Peak.

The Army Concept of the Operation included four phases:

Phase I - Mission preparation/posturing the force. Army SOF would be transported to Stallion Army Air Field and conduct final mission preparation.

Phase II - Insertion of support element. One night prior to the assault, approximately 90 Army personnel would conduct a night rotary wing insertion into Bruton Canyon, which is in the general vicinity of the objective area (Oscura Peak). These personnel would move into final support positions near the objective area prior to the actual assault.

Phase III - Assault on the Oscura Peak research facility. The support element would occupy positions in the vicinity of a barracks housing off-duty security personnel at the facility in order to prevent the entry of these personnel into the objective area. Then an MH-53 and an MH-60 would provide fire support to suppress on-duty security personnel (2 guards at the gate, 2 guards on a roof top, and 2 roving guards), and an assault force would fast rope into the objective area from one MH-53 and 2 MH-60 helicopters to search for the captured avionics equipment.

Phase IV - Desired cargo and force extraction. Following the search, the assault team would assemble at a pickup zone near the objective area and call for extraction. Similarly, the support group would assemble at a pickup zone near the barracks and call for extraction. Two MH-53s and the 3 MH-60s would transport the assault team, the cargo, and the support element to a landing zone at Hunter's Lodge, near Oscura Peak.

1550 CCTW directly supported phases II, III, and IV of the operation. On night one, 2 MH-53s and 3 MH-60s moved approximately 90 Army personnel from Stallion Field to landing zones in the general vicinity of the objective area. On night two, one MH-53 and one MH-60 provided simulated fire support to suppress on duty security personnel. Three additional helicopters (1 MH-53 and 2 MH-60s) transported a 26-member assault team from Stallion Field to the research facility on Oscura Peak, where the assault team fast roped into the objective area. Following the recovery of the precious cargo, all 5 helicopters extracted the support element, the precious cargo, and the assault team from the objective area to Hunter's Lodge.

Operational Test of WST/MRS Database Enhancement Capability

The Contractor Logistics Support (CLS) contract for the MH-53J WST/MRS requires the capability to go from an existing DMA Level 1 database to an enhanced database sufficient for mission rehearsal within 72 hours of notification. This exercise was used to evaluate the contractor's ability to meet this requirement. The entire exercise took place in areas already in the existing database. This served as the DMA level 1 baseline.

Mission Preparation Procedures

General Electric was notified at noon, 24 July that a rehearsal preceding the joint Air Force/Army training exercise was to commence at noon 27 July, that an enhanced database was to be generated, and that an assessment would be made of the capability to enhance the existing database in 72 hours. In approximately 30 minutes the appropriate contractor and Air Force people were assembled for an in-brief by Air Force intelligence and the Air Force liaison with the Army. It is of note that the audience for the initial in-brief had expanded to include not only the wing planners, but also contractor database development personnel.

Following the in-brief, the 1550 CCTW planners began general mission planning and contractor personnel began enhancing the areas of the existing Kirtland training database that would be of use in preparing for the joint training exercise. Concurrent mission planning and rehearsal database development activities involved considerable interaction between Air Force planners and contractor tactical analysts, as well as between database developers and the tactical analysts. Oscura Peak in the original DMA Level 1 database is depicted in Figure 1. Figure 2 depicts Oscura Peak in the enhanced rehearsal database, and Figure 3 depicts the objective area in the enhanced database. A comparison of Figures 1 and 2 shows the dearth of features on Oscura Peak that existed in the Level 1 database and the lack of accurate positioning for the few cultural features that were included. Database enhancements included a more detailed and accurate depiction of the terrain along the ridge line and at potential landing zones. In addition, buildings, roads, telephone poles and lines, fences, and other cultural features were accurately modelled and positioned.

The contractor generated a number of products for inclusion in crew mission folders, including enhanced photographs and maps with photo insets that depicted the infil site, exfil site, and Hunter's Lodge. In addition, the contractor provided enlarged and enhanced photographs that highlighted light poles, antennas, and electric wires. These enlarged photographs were used to support intelligence and operations briefings.

Crews arrived at noon, 27 July (72 hours after the Air Force notified the contractor of the exercise) for the crew in-brief to initiate detailed mission planning and rehearsal. First, an intelligence officer briefed the situation surrounding the need for the mission, the request for support, the objective area, threats enroute (in this case, virtually none), and threats in the objective area. This was followed by an operations briefing of the general mission plan for the infiltration of the support team on night 1, and a general mission plan for the assault and recovery phases on night 2. Crews were informed that the WST/MRS was available to support rehearsal, and would remain so all day and evening. They were also told that rehearsal should focus on the assault and recovery phases of the operation. Finally, crews were told that a rehearsal of the joint exercise would be conducted at Oscura Peak prior to actual execution of the joint training exercise.

Following the briefings, the five helicopter crews began to discuss exactly what they were being asked to do to support the Army SOF. It is noteworthy that the crews had no access to the Army during this period to provide clarification. This required crews to develop on their own a set of assumptions about customer needs and desires so they could proceed with detailed planning. Detailed mission planning and rehearsal occurred concurrently. In rehearsal, all MH-53 and MH-60 pilots and copilots flew the MH-53J WST/MRS. Each set of pilots flew approximately 45 minutes, and spent most of their time in the objective area trying alternative approaches and profiles.

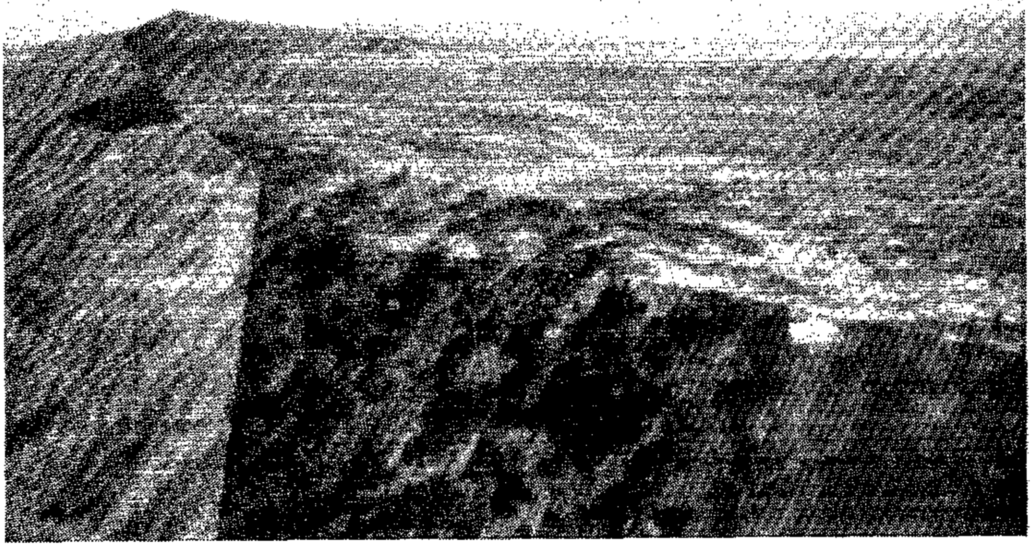

Figure 1. Oscura Peak in the original DMA Level 1 database

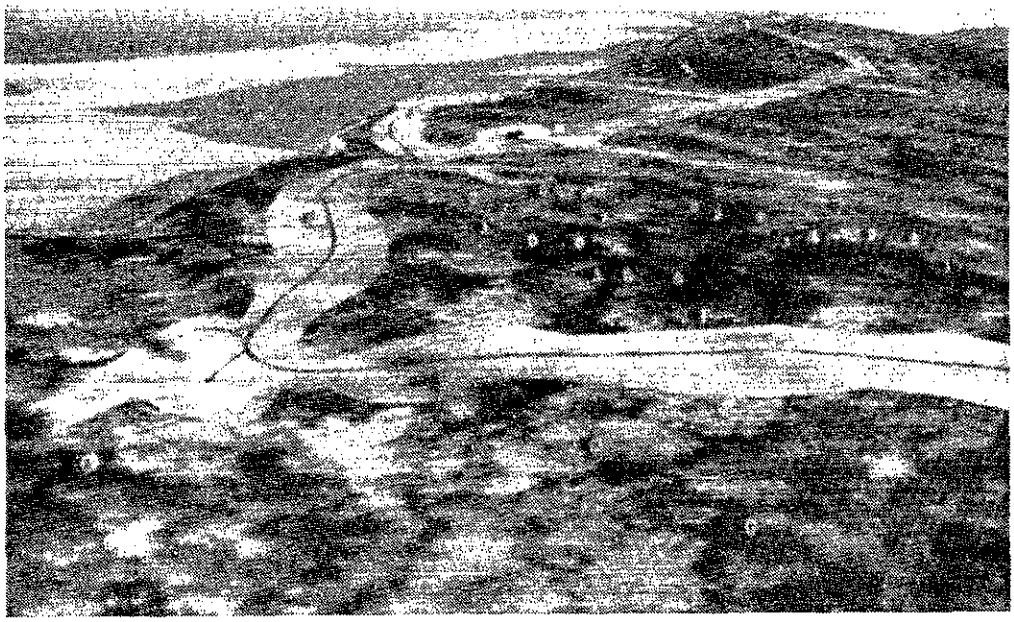

Figure 2. Oscura Peak in the enhanced database

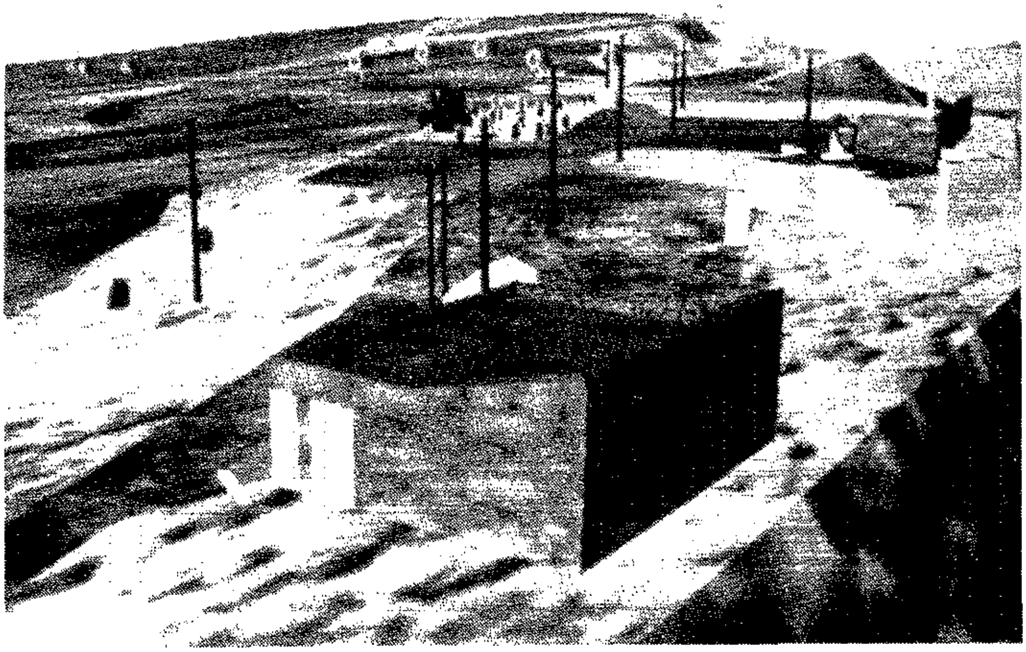

Figure 3. A close-up view of the enhanced objective area

A variety of techniques were used by the pilots in the WST. Although most were initialized at Stallion Field in the database, they were primarily interested in the objective area for night 2 operations. Most participants observed the objective area from different vantage points. Much use was made of the "freeze" capability of the simulator and slewing the aircraft to different headings, approaches, and altitudes to preview and select the best course inbound for their particular part of the mission. The freeze/slew capability was also used on the ground at the objective area to determine distances between buildings/objects, relative size of the landing zones, etc. Others used the simulator to assess the rate of climb capability, power requirements, and single-engine capabilities of the MH-53J, given the altitude of the Oscura Peak facility. Most crews flew a combination of daytime and NVG conditions. For example, one crew flew the route from Stallion Field to Oscura Peak and shot different approaches to the research facility under daytime conditions to ascertain "the lay of the land." Subsequently they flew from the Initial Point (IP) inbound with NVGs. Pilots that were not in the simulator were in another part of the facility finalizing their crew mission plans.

Flight engineers, aerial gunners, and scanners observed rehearsal activities on a television monitor that repeated the images being displayed to the pilots in the WST.

Data Collection Procedures

Our data collection procedures consisted of (a) administering formal, open-ended questionnaires following rehearsal and again following mission execution, (b) interviewing participants, and (c) directly observing the mission preparation process including pre- and post-mission briefings. One evaluator flew with the lead MH-53 crew during Night 2 operations. Pertinent questioning of planners and crew members was included, when appropriate, in order to understand the processes as they unfolded. This "over the shoulder" approach throughout the entire series of events made more likely the detection of potential and actual problems in mission preparation, possible solutions, and the identification of salient process variables.

Results: Post-Rehearsal Critiques

Out-the-window scene. Overall, the visual scenes in the rehearsal system were judged to be very realistic. Pilots rated the terrain and cultural features in the visual database as good, excellent, or outstanding. Pilots indicated that the features were accurately positioned in the database. The need for wires on poles in the target area was pointed out, as these could be dangerous obstacles for helicopters (these wires were highlighted on the target area photographs provided to the crews at their initial briefing). One pilot indicated that he had difficulty distinguishing between roads and streams when using NVGs.

Handling qualities. Most pilots rated the handling qualities of the WST as sufficient to support their mission rehearsal requirements. MH-53 pilots had no critique items. MH-60 pilots would have preferred some previous exposure to the device. They did not have a simulator of their own at that time, so they were faced with learning to fly a simulator and to control a helicopter with MH-53 characteristics rather than the familiar MH-60 characteristics. Lack of familiarity with simulation or with MH-53 characteristics did not, however, preclude it from being rated as a useful vehicle in which to accomplish MH-60G mission rehearsal, the issue of importance here. MH-60 participants felt that prior training for them in the MH-53 WST would have eliminated the problems they encountered.

Limitations. One limitation of the device is that cross-cockpit visual scene access is basically not available. Another important limitation was that crews were not able to conduct multi-ship operations since, at the time, there was only one MH-53 device. Some crews did make use of a single moving model as a "lead aircraft" to enable them to fly in formation behind.

Impact of rehearsal on the mission plan. Most pilots reported that rehearsing in the simulator resulted in a better understanding of the mission plan. In addition, several changes to the crew mission plans resulted from the simulator sessions. Some examples included the selection of a new course to minimize the climb angle into the target area and the selection of a new final approach into the target area to avoid power lines. One pilot reported that rehearsal did not impact the plan.

Impact of rehearsal on perceptions of crew readiness. Most aircrews indicted that mission rehearsal was likely to improve (in some cases, greatly improve) the chances for executing a successful mission during the joint training exercise. The capability to rehearse in the target area was typically mentioned as being the most beneficial. One pilot indicated that rehearsal was of minimal benefit because of his prior familiarity with the target area.

Aerial Gunner/Scanner Critiques. Although these crewmembers did not rehearse the mission in the device, their critiques contained some key points. They suggested that the entire crew be included in mission rehearsal. They also indicated that the scanners need a visual capability of their own. They also suggested the need to communicate with the front-end portion of the crew during the rehearsal. All these crewmembers rated the quality of the visual database as good to excellent, and they indicated that the device would greatly increase the probability of mission success.

Results: Wing Leadership Eliminated the Requirement for Real-World Rehearsal

Prior to rehearsal in the WST, the mission commander (who had previously flown to the objective area) stated that pilots who had not been to Oscura Peak needed to fly there prior to the Night 2 mission in order to become familiar with the area. His primary concern was that the terrain in the area, including a noticeable slope in one of the recovery zones, and the high altitude of the objective area (approximately 8000 feet) would add to the difficulty of the mission. But following the rehearsal, the mission commander stated that the rehearsal environment in the WST was sufficient to prepare crews to execute their part of the joint exercise, and that it was not necessary for crews to actually fly to Oscura Peak prior to the joint training exercise. The wing deputy commander for operations also observed the rehearsal and canceled a real-world rehearsal prior to carrying passengers on Night 2. However, the flying training squadron commander recommended that crews with no prior experience at Oscura Peak fly over the objective area on Night 1 after inserting the support team.

Results: Post-Mission Critiques

Impact of rehearsal on mission execution. Crew responses concerning the impact of mission rehearsal on actual performance of the mission ranged from "helpful" to "it helped tremendously". It enabled good awareness and orientation to the target area. One pilot stated, "When I flew the mission, I felt that I had been there--within the limits of MR." At least three pilots were familiar with the target area, and this attenuated the effectiveness of rehearsal for them.

Match between simulated visual database and real world. Pilots rated the match between the visual database and the terrain/cultural features of the real world from good to excellent. The terminal area of operations was rated better in quality than the enroute portion of the database. The enroute portion could have contained more terrain features such as rocks and bushes, and one pilot indicated that the trees in the simulator should have been more variable in height. Four pilots stated that at least one and possibly two towers were missing from the rehearsal database. In addition, one pilot critiqued the slope of the landing zone in the objective area. Interestingly, one pilot stated that he thought the crew mission folder photographs that had been generated from the rehearsal system database were the most effective part of the mission rehearsal package.

Restructuring the flow of planning and rehearsal activities. A major finding of the post-mission critique process was that all 10 pilots stated that more planning (e.g., map preparation, overall mission management, etc.) was necessary prior to rehearsal in order to receive the most benefit from the rehearsal system. They suggested that planning commence from 24-48 hours before actual mission rehearsal. If the time period for the rehearsal is short, it was recommended that the planners create a more definitive plan prior to box time. It was also recommended that the plan be refined after rehearsing the mission.

Conclusions and Lessons Learned

The potential of simulation technology to support mission rehearsal. The reactions of the operational community to the MH-53J WST/MRS in this case study strongly indicate that digital simulation can play a useful role in mission preparation. A great majority of pilots reported that rehearsal in the MH-53J WST gave them a better understanding of the plan and concluded that rehearsal would likely improve their chance for successful completion of the training exercise. Following mission execution, all participating pilots reported that rehearsal had helped their actual performance. It is of interest that both MH-53 and MH-60 pilots reported benefits given both groups rehearsed in an MH-53 simulator. Perhaps the most compelling data point regarding the value of rehearsal in this case was the elimination of the real-world rehearsal at Oscura Peak prior to the exercise.

Coordination among participating organizations. Developing a database and preparing for a mission require close coordination among the contractor, the government contract point of contact, intelligence, planners, aircrews, and the customer. In our case study, this valuable integration and coordination function was fulfilled by the General Electric tactical analysts.

The need for coordination in SOF missions goes beyond the aviation community to encompass the customers being served. In our case study, face-to-face interactions with the Army SOF did not occur until after crews had begun rehearsing. In the absence of this direct contact, crews spent considerable time debating the air support requirements of the customer. Clearly an efficient process would require all participants to understand how their activities fit into the overall process and schedule, so they could act accordingly.

Participants must also know what resources are available to support them, and when these resources are available. General Electric personnel had completed the basic enhancements to the database in 24 hours, and the remaining 48 hours were used to make minor adjustments and fill in detail. Wing planners could have "flown" the database using this time to validate their basic plan well in advance of crew rehearsal had they known about the capability of the system to allow such activity. These is a clear need for a consolidated concept of operations that specifies in sufficient detail the activities and approximate time lines of all participants--contractor, Air Force, and customer--and describes how the activities of these participants must fit into the overall development, planning, validation, and rehearsal processes.

<u>Complete crew rehearsal concept</u>. Flight engineer, gunner, and scanner critiques strongly supported the value of this technology to support mission preparation for these crew positions. They strongly recommended including the entire crew in rehearsal. A complete crew concept is established in most aircrew training programs, and rehearsal for helicopters should be no exception. Recognition of obstacles, threat lookout, break procedures, etc., could be included with these crewmembers. An enhanced observation room that provides an appropriate field of view and a communication link with the rest of the crew, used in conjunction with the WST, may be sufficient to support full crew participation.

<u>Expanding the range of mission rehearsal techniques</u>. Aircrews spent most of their time in the WST in the objective area (Oscura Peak), validating and fine-tuning this portion of the plan. Despite the decided preference of participants in our case study to focus on the terminal area of operations, the most effective rehearsal techniques are likely to depend upon the type of mission and the special requirements of particular mission segments. For example, one can easily imagine that crews would be interested in a difficult coastal penetration in an area that was miles from the target. Enroute threats could also present challenging rehearsal/mission requirements to be worked out in the WST. The point is that specific rehearsal techniques should be tailored to the specific requirements of each mission.

<u>Fidelity requirements</u>. The participating MH-53J helicopter pilots reported that the performance characteristics of the WST/MRS were adequate for mission rehearsal. Many participants used the device to validate approach methods, assess turns, assess climb performance at the high altitudes required by the mountain top objective area, and to hover over landing/drop zones. In addition, the device was used to determine if two helicopters could operate simultaneously using a single landing zone. These uses by the participating crews suggest that high fidelity performance models of the MH-53J and high fidelity databases of the mission area are critical, because the system is being used to determine the validity of the tactics developed and decisions made during planning. Fidelity that merely approximates real world characteristics of the helicopter or mission area increases the risk of faulty decision making due to incorrect input data. Accordingly, the performance models for simulating real-world helicopter performance under a wide variety of conditions require close attention. Similarly, the database of the mission area must accurately portray all mission critical information such as size and contour of landing areas, positions of buildings in the objective area, and threats throughout the entire route.

Crew readiness for mission rehearsal. Rehearsal effectiveness is likely to depend quite heavily on the extent to which crews "hit the ground running" during an actual mission rehearsal session. The effective use of a rehearsal capability assumes that the people who are using the system are knowledgeable about the concept of operations as discussed above so that they know what they can expect from the system and how to use these capabilities to gain maximum benefit from rehearsal. A training program to impart this knowledge to aircrews will be a critical element of any effective rehearsal system. This training must include basic rehearsal processes (as discussed in paragraphs 2 and 3). Participants must also learn, preferably in hands-on fashion, about rehearsal techniques and system capabilities, such as freeze/slew capabilities for viewing the objective area from varying vantage points, day and nighttime visual scenes, objective area emphasis for brief rehearsals, and so forth. Further, information to suggest that any one technique or set of techniques is especially well suited for a specific application could be passed on to aircrews.

Mission Rehearsal Data Collection and Analysis capability. A systematic data collection and analysis capability needs to be incorporated into early rehearsal systems, both to improve operations within the system, and to assist designers, developers, and users of future systems by providing lessons learned. The collection of information from actual combat operations should be of great importance for assessing what (if anything) might have been done differently and assessing whether mission rehearsal had any discernable impact on the execution of the mission. This information could be "fed back" into aircrew training to improve the use of the mission rehearsal system.

A data collection system could play an important role in providing an ongoing, historical record of program development and effectiveness. Air Force personnel have traditionally been assigned to programs for relatively short durations, and a carefully developed system of program documentation could be of tremendous value to those who are newly assigned.

Database Development Lessons Learned. The development of the database for this joint training exercise was highly dependent upon inputs from intelligence personnel and mission planners. General Electric has employed two tactical analysts who are highly experienced in SOF intelligence and mission planning to facilitate interactions among intelligence, mission planning, and database development personnel. In this exercise, these two people provided considerable information to aircrews concerning the joint training exercise environment. They were also an essential part of the database development team because of their ability to select critical environmental and threat features. This information was then passed on to the database developers who modeled these mission critical features. These individuals provided an essential integrative element to the mission rehearsal system. Since this exercise, the Air Force has employed a government civilian who also has an extensive SOF intelligence background.

A strategy for incorporating rehearsal capabilities into mission preparation. The effectiveness of a mission rehearsal capability will be strongly affected by how the capability is actually used. This is a lesson that gets learned, and relearned, as the military acquires increasingly capable simulation devices to support training and combat operations. Post-mission critiques and interviews with all 10 participating pilots unanimously supported the need for a strategy to incorporate this capability into the mission preparation process.

In general, a strategy for use must provide sufficient guidance to direct the efforts of participants toward well-defined objectives. It is particularly important to facilitate a smooth and timely flow of activity when time is likely to be a critical factor in mission preparation. Yet a strategy to guide this flow must be flexible enough to ensure that aircrews are able to determine how they can best use the device to support their needs in preparing for a specific mission.

The current process reflects accumulated wisdom that is likely to be appropriate with or without digital rehearsal capabilities. For a more detailed description of SOF mission planning activities and the implication for the use of mission rehearsal technologies, see Spiker and Campbell [3]. Many strategies embedded in the traditional mission preparation process, like starting with a general plan and working toward a specific plan, and working from high to low, large to small, and backward from the target area appear to be useful organizers of activity. However, mission preparation procedures need to be revisited in light of the needs and capabilities of the rehearsal system to ensure effective integration of rehearsal technology with the operational community.

During initial mission planning, a general-to-specific strategy used by planners. A similar strategy is also used by database developers. A general database is developed relatively quickly, and much of the development time is spent inserting additional detail. Wing planners could plan the basic mission very early and then validate the plan in the WST using the early, general database. This would enable early adjustments and changes, resulting in a higher quality, validated plan for presentation to the aircrews, and perhaps reduce the number of unknown factors remaining at the beginning of detailed mission planning. The subsequent initial mission briefing to aircrews could also incorporate videotapes of critical mission segments created from the digital rehearsal database. This should increase their understanding of the precise nature of the mission, or conversely, reduce early confusion.

Time permitting, the crews in our study recommended a 24-48 hour period of time for detailed planning and validation prior to final rehearsal. Immediately after the crew briefing, new participants might benefit from flying the general plan in the emerging rehearsal environment prior to extensive detailed mission planning. This would provide a common frame of reference for all subsequent planning and rehearsal activity. During detailed mission planning, the rehearsal capability can support validation of the specific plans for the individual crews participating in the mission. Crews could take advantage of the capabilities of simulation, such as freezing/slewing to different vantage points in the target areas, and executing different approaches as they validate and refine their plans. After each individual crew mission plan was critiqued and validated, a round table critique session involving all crews and planners could be conducted in order to arrive at a more effective and integrated approach to the mission. As more systems come onto the 542d CTW SOF NET intersimulator network, coordination and deconfliction can be assessed much more realistically with rehearsal simulation than is now possible. Once a consensus was reached on the integrated plan, crews could then rehearse the final, detailed plan in the WST, focusing on difficult maneuvers and on skills that benefit from recent practice.

SUMMARY

This early experience with the MH-53J WST/MRS has led us to several general conclusions concerning the use of digital simulation to support mission rehearsal.

First, simulation-based rehearsal was enthusiastically received by the special operators of the 1550th CCTW. Each of the 10 participating pilots reported that rehearsal in the simulator enhanced their performance during the actual mission. Crewmembers that observed rather than participated because the WST simulates only the cockpit environment strongly recommended expanding the rehearsal system to include them. Wing management eliminated the need for a rehearsal at Oscura Peak after observing the simulation-based rehearsal. Even MH-60 pilots reported benefiting from rehearsal in the MH-53 WST despite the lack of a match between the simulator and their weapon system.

Second, our results strongly indicated that users need a structure to guide their use of this technology. MH-60 pilots, who were unfamiliar with the WST, had only limited knowledge of basic system capabilities such as freeze and slewing. All pilots stated that mission preparation activities need to be reconsidered in light of rehearsal system capabilities. In reality, every phase and transition in the process might profit from using digital rehearsal technologies to improve products, save time, and facilitate communication among the people who are involved in mission preparation.

Finally, this case study illustrates the complex nature of mission preparation, and the diverse kinds of people involved--aviators, senior decision makers, intelligence and weather officers, customers, and now, database developers and other contractor personnel who create the rehearsal environment. Mission preparation was further complicated by the geographical separation of key players with whom Air Force planners had no direct communication link. The traditional approach to mission preparation deals with these realities, but at the expense of inefficiencies, particularly with respect to time. In his report on lessons learned from the C-130 ATS [4], Dukes stated that the three most important considerations when managing ATS development are: "integration, integration, and integration". The same is true for SOF mission preparation. With appropriate procedures, mission rehearsal systems can facilitate cooperation and communication among these diverse players, extending the benefits of the rehearsal system well beyond the aviators who are preparing to fly the mission.

UPDATE

The 542d CTW has continued to improve on its advanced training and rehearsal simulation capabilities. Hardware and software enhancements have greatly improved database and model generation capabilities. SOF NET and the TOC will provide a unique "world class" capability to jointly train and rehearse in the near future.

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