DESERT STAARS: SUSTAINMENT TRAINING FOR ARMY AVIATION READINESS THROUGH SIMULATION

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ABSTRACT

As last year's I/ITSC papers were being written, the prospects for world peace were having significant effects on military strategies and priorities. Many analysts, however, were cautious. Their concerns were based primarily on the potential for low–intensity and regional conflicts. A paper proposing the need for advanced mission training and rehearsal (Monette, et al.[1]) noted that "while uncertainty surrounds the perception of a diminished threat of world war, there is little question that there exists an inevitable threat of armed conflicts with radicals, revolutionaries, terrorists, and drug cartels. It can also be anticipated that the severity of these conflicts will continue to increase..." As described in that paper, the non–conventional nature of such conflicts has resulted in increased war fighting emphasis on timeliness and precision. To support training in these skills, new concepts were proposed, including a recommendation for integrated mission training and rehearsal facilities. These facilities would employ advanced simulation technologies and specialized training programs which would be dedicated to enhancing the mission readiness of aviation crews. By the time I/ITSC '90 commenced, events in the Middle East had significantly reinforced the need to pursue such advanced training capabilities.

The previously referenced paper also noted that it would take teamwork to meet the changing military training environment for the 1990's–teamwork between users, military planners, analysts, and industry. This year's paper is intended to discuss such a team and the program implemented by that team to develop the sustainment and mission–similar training capabilities proposed in the 1990 paper.

INTRODUCTION

Military aviators receive primary skills training during their first few years of service. The main training emphasis during the rest of their career of possibly sixteen or more years is to enhance and sustain what was initially learned (Miller[2]). While ground–based simulations have been used extensively and effectively for primary training, the military has historically resisted utilizing the same types of assets for sustainment training. A reason often noted is the ever present concern that actual flight time will be reduced.

Recently the United States Army deployed to the Middle East to assist in executing a United States policy and a United Nations directive. As the timeline for deployed aviation units stretched into weeks and months, the unit commanders were forced to enhance and sustain the combat skills of their flight crews with the only asset available that could meet the training challenge: combat aircraft. This situation brought to the forefront an age–old problem of military command: How much of my combat assets do I allocate to training, and what additional burdens will my logistics system bear in terms of ammunition, fuel, parts, etc.?

The challenges of Desert Shield dramatically showed a specific need for deployable sustainment training devices. However, it is becoming widely recognized that the basic requirement for such devices exists even during peacetime.

MISSION–SIMILAR TRAINING

In our 1990 I/ITSC paper (Monette[1]) an integrated mission training and rehearsal program was proposed which would include dedicated resources to support an extensive hierarchy of advanced crew readiness training. This hierarchy, as shown in Figure 1, is divided into mission graduate sessions and mission–specific sessions. Figure 2 illustrates that the mission graduate sessions are intended to produce and maintain mission–capable crews, while the mission–specific sessions serve to optimize crew readiness for specific missions.

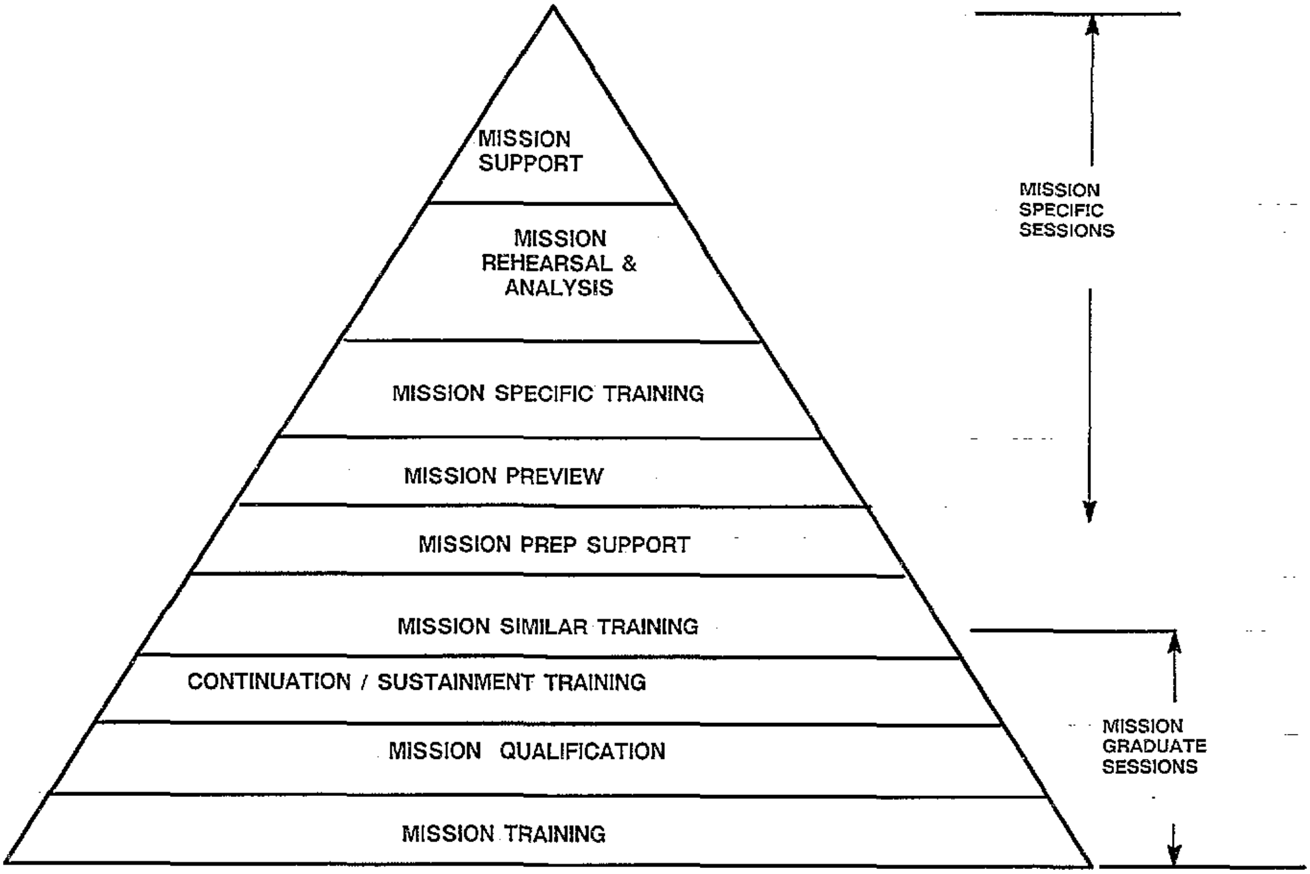

Figure 1 Mission Training/Rehearsal Hierarchy

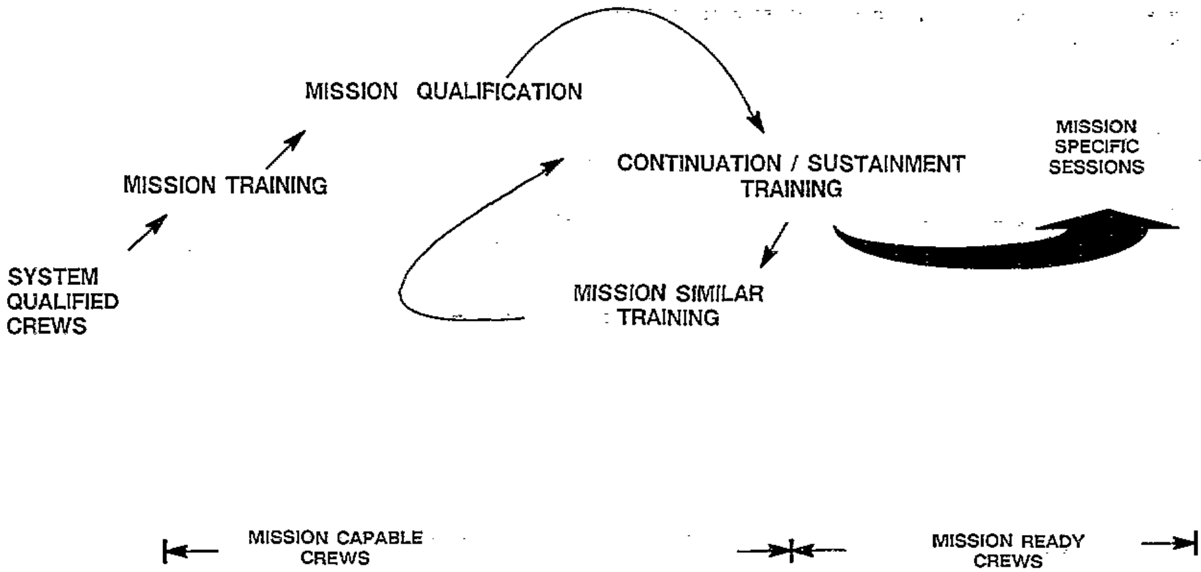

Figure 2 Mission Qualification

Mission–similar training is a significant element of the proposed hierarchy. As shown in Figure 1, it is applicable to both mission–specific and mission graduate sessions. When specific operations are required, crews would practice anticipated types of missions using databases of (or similar to) the designated mission area and employing tactics based on knowledge of the identified threat. This type of training would be employed until more detailed mission plans and associated mission rehearsal databases could be made available. Mission–similar training, however, is also intended for use as an extension of sustainment training. More specifically, crew preparedness can be enhanced by mission–similar training relative to areas of "potential" activity.

As global situations develop, it is very possible to anticipate the need to train for conflict in an unfamiliar type of terrain against an unfamiliar threat. The technology exists to rapidly construct geospecific visual and sensor databases and to populate those databases with appropriate threat arrays. These databases and threat arrays, coupled with the additional training capabilities inherent in advanced conflict simulations, provide an optimum capability for mission–similar training. Utilizing these technologies provides a means by which potential crisis situations may be prepared for in a general sense. It should be further noted that when the capabilities of these technologies are applied to an exact area and threat, the generalities of mission–similar training become the specifics of mission rehearsal. The unique blend of technology and task complexity required for mission training and rehearsal has been successfully met by a program called Desert STAARS (Sustainment Training for Army Aviation Readiness through Simulation).

DESERT STAARS OVERVIEW

The need to be prepared to fight and fly in different types of terrain against varying threat arrays was pointed out in the recent Middle East war. Most of our crews were trained in the techniques and tactics appropriate for wooded temperate zones populated with a specific type of threat. The requirements imposed on them to modify their existing tactics and to develop new desert tactics on the fly demonstrated in the strongest possible terms the need to provide mission–similar training prior to their arrival in the area of conflict.

This need, coupled with the overall requirement for a sustainment training capability, provided the incentive for the U.S. Army's Desert STAARS program. Desert STAARS is a training modification to the Army's existing AH–64 Combat Mission Simulator (CMS). This program employs advanced mission training and rehearsal capabilities which were demonstrated (proof–of–concept) on August 4, 1990 (two days after the invasion of Kuwait). The primary new technologies involved include geospecific visual/sensor databases, Multi–Simulator Networking (MULTISIM) and Force Level Simulation (FLS). Desert STAARS applied these technologies to create the mission–similar training capabilities described in the previously referenced I/ITSC paper.[1] Desert STAARS development was completed in a very short 90–day period through the concentrated teamwork and dedication of PM TRADE, the Naval Training System Center (NTSC), the Directorate of Training and Doctrine (DOTD) at Ft. Rucker, U.S. Army Subject Matter Experts on aviation training, and CAE–Link and its supporting vendors.

SYSTEM REQUIREMENTS

Three primary systems areas must be addressed to facilitate mission–similar training capabilities. The first area is the simulation of the airborne weapons system in which the crews will train. The second area is the creation of an appropriate simulated mission environment. The third area involves providing system mission control and performance monitoring capabilities.

For Desert STAARS development the U.S. Army provided the AH–64 CMS, which is noted for its capability to accurately simulate the AH–64 and its mission performance capabilities. The Army also provided a UH–60 Flight Simulator (FS) to support testing of the system network modes.

The most extensive area of development for Desert STAARS was the mission environment. An obvious large–scale task was that of creating correlated geospecific visual/sensor and tactical databases. The government–specified 80 km by 100 km databases that were generated encompassed primary areas of tactical interest in Kuwait.

The geospecific visual/sensor database was created from numerous sources. The initial basis for this database was Defense Mapping Agency (DMA) Digital Terrain Elevation Data (DTED). This data was used to provide terrain boundaries and contour. DMA DTED was also used to provide a correlated FLS terrain database. The database was then supplemented with DMA Digital Feature Analysis Data (DFAD). This data provided information on such cultural features as international boundaries, city areas, airfields, major roads, power lines, oil fields, pipelines, water towers, and major buildings. All source data was supplied at Level 1. In those instances where DMA data resolutions were too coarse, maps and photos were used to provide more detailed placement of features.

Both military and non-military maps were employed, with special emphasis applied to areas of tactical or navigational interest. Three examples of these areas of interest are the American Embassy in Kuwait City, a political prison, and the Kuwait City International Airport.

Numerous techniques were used to develop cultural areas. These techniques included the use of previously existing models, the implementation of 2D models, as in representing sewage treatment facilities, and the use of new 3D models. For example, in developing the Kuwait City International Airport, the only features provided by DMA were the two main runways and the main highways providing access to the airport. Photos were used to determine additional cultural requirements. Hangers and the main tower were implemented using previously existing models. New modeling provided additional access roads, taxiways, and the main terminal. Throughout the database phototexturing was used extensively to enhance the realism of cultural and terrain features. To allow extended ingress and egress operations, the geospecific database was supplemented to 300 km by 300 km with generic roll-on terrain on three sides and roll-on water on the fourth side.

To support tactical operations, ten new target types were added, at government request, to the AH-64 CMS existing inventory of 58 targets. Moving target pathways were added to the database and a new system capability was developed to allow relocatable fixed target sites. This was an important step in the evolution towards mission rehearsal capabilities since it allows sites to be rapidly changed in response to updated intelligence data.

To support unique desert flight requirements, special visual/sensor effects were added to simulate sand storms and blowing sand caused by rotor wash.

An important detail in allowing simulation of real-world operations is the provision for accurate, correlated navigational capabilities. (The correlation affects the position of the ownship and other vehicles as well as cultural features relative to real-world map positions.) Numerous navigational models of varying accuracy are used in different simulation systems. Engineering analysis, however, showed that positional errors in the thousands of meters could occur if a common system was not implemented. The World Geodetic System 1984 (WGS 84) was employed in Desert STAARS because of its accepted accuracy, its usage in military systems such as AH-64, the availability of accurate conversions to and from military grid systems, and the acceptance of WGS 84 for the forthcoming Distributed Interactive Simulation standards.

The previously referenced I/ITSC paper[1] noted that for advanced mission training and rehearsal to be effective, the environment of the mission must be closely replicated. This replication must transcend the traditional notion that allowing a flight crew to experience a set piece situation is mission rehearsal. True mission training and rehearsal requires two dissimilar elements within its environment to function properly: precision and chance. More succinctly put, to be effective the simulation must be precise in presenting the known details of terrain, weapons, enemy disposition, etc., and simultaneously allow the vagaries of combat. Hopefully this blending of opposites will allow the crews to safely experience the happenstance that is a part of tactical operations.

The key to replicating the "fog" of war in Desert STAARS is the FLS conflict simulation. In general the FLS provides a "thinking" type threat rather than an "if met" automated threat. This thinking opponent introduces the element of chance and sharply increases the realism of the training. The FLS creates a knowledgeable opponent by modeling not only the threat's parametrics but also its tactics, command and control structures, communications links, short- and long-term memory functions, and even misperceptions. A special feature added for Desert STAARS was a manual control allowing operator-controlled FLS kills. This provided an ability to simulate team fire support during missions where a networked wing man was not available. Another feature added was the ability to store and review FLS scenarios for crew debriefing.

Desert STAARS modifications were also implemented to enhance the previously existing AH-64 CMS threat algorithm to be operable with the geospecific database and new threats. This feature allows instructors to conduct, when necessary, sustainment training in individual skills which may not be as easily concentrated on in the FLS total mission environment. This stand-alone capability enhances the flexibility of the training system and makes it more responsive to user needs.

Another important element of Desert STAARS is the MULTISIM network interface which couples the AH-64 CMS to the FLS. The network is designed to be expandable to allow other compatible training devices to interoperate with the AH-64 CMS and the FLS (e.g., devices such as the UH-60 FS). A significant feature of MULTISIM is the ability to prioritize and sort network data going to the simulator. More specifically, in Desert STAARS the FLS scenarios can involve up to thirty players, while the AH-64 CMS can visually display only ten of the players. An elaborate prioritization algorithm determines which targets are to be displayed during FLS operational modes. The algorithm considers such factors as threat lethality, target line-of-sight, out-the-window and sensor fields of view, weapon employment, and target range. A separate sorting algorithm is used for sorting threats to be processed by the EW (electronic warfare) simulations. These algorithms significantly increase the target density of the AH-64 CMS virtual battlefield.

Another area of development in Desert STAARS was that of creating mission control and performance monitoring capabilities. Modifications were made to the AH-64 CMS instructional pages to allow operation in the geospecific environment. These included page changes to allow mode and FLS scenario control as well as extensive digitizing to create the various cross-country and tactical map pages. Modifications were also made to implement the instructor capability to relocate fixed target sites, including provisions to observe the desired relocated position from various points of view before storing the new position.

A Tactical Operation Center (TOC) was also developed to allow observers to monitor Desert STAARS training scenarios. The TOC includes a large-screen monitor which graphically displays an overview of the FLS scenarios, including player interactions. The TOC also includes repeater monitors of the AH-64 CMS out-the-window and sensor imagery as well as a monitor to repeat selected map displays from the AH-64 CMS instructor station. Audio provisioning allows TOC communications with the AH-64 CMS and networked devices via a simulated radio link. The FLS digital voice for selected players can also be monitored in the TOC. The TOC is intended to provide a facility for commanders, other aviation crews, and mission analysts to observe and critique mission performances.

USER/ANALYST/ENGINEER TEAMWORK

To provide the capability for mission-similar training, especially under time constraints similar to Operation Desert Storm, requires the user, analyst, and engineer to work as a team. Each of the team members brings a synergistic skill to bear on the training problem. The user has the best intelligence-gathering capability. He knows which information is most important to his training, where it may be obtained, and has better access to the information. He knows what types of targets need to be on what sort of visual database to provide the mission-similar or mission-specific training he needs. The engineer, in turn, knows what type of information is required to enable the technology to support the training.

Streamlining the development of the system requires an on-site user Subject Matter Expert (SME). The SME, provided that he has decision authority, can radically shorten the time required to develop a training tool by expediting or eliminating Preliminary Design Reviews (PDR), Critical Design Reviews (CDR), and Progress Reviews. In the Desert STAARS program the rapid timeline was made possible by the use of two full-time SMEs. One SME was dedicated to the visual database and the other was dedicated to the tactical enhancements, including FLS.

Unit training programs are a blend of mission requirements and available technology. The user knows what skills are required to accomplish his mission and the training analyst knows how to employ the technology to best support the training of those skills. The analyst will also bring additional knowledge of the technology that could result in training enhancements in unexpected areas. Desert STAARS technology, incorporating a geospecific database, FLS, and relocatable target sites, provides Army aviation units the necessary tools to construct complex mission scenarios. These mission-tailored scenarios, under strict user control, will be instrumental in the accomplishment of the unit's sophisticated tactical training.

SCENARIO GENERATION

The training scenarios associated with mission-similar or mission-specific training fall within the design of the FLS. Scenario generation involves the definition of all participating players, player locations, command structure, communication nets, and areas of responsibility. These definitions, developed using any word processor text file, are interpreted by the FLS. Once FLS has digested the file, it is able to present operational information graphically to aid in scenario planning. As an example, the threat Air Defense Artillery (ADA) might be instructed to report all contacts to higher command and request permission to engage targets within its range. In such a situation, if the ownship enters into the acquisition zone of the ADA his position will be reported, but the ADA weapon system would not engage without permission from his chain of command. Five scenarios were generated as part of Desert STAARS development. The initial three were developed by the engineering team with SME support. The final two were developed by the SMEs.

This collateral learning is another example of the advantages of employing dedicated SMEs.

READINESS ASSESSMENT

Readiness assessment is the logical step to follow up any training advancement. The Desert STAARS assessment was based on mission-oriented design concepts (Stark[3]). Specific testing was conducted to verify the new features. Training readiness, however, was determined in the crucible of operational mission training using tactical scenarios.

LESSONS LEARNED

Precision, realism, and time are critical factors in preparing and presenting a mission rehearsal scenario. Perhaps the most difficult obstacle to overcome is time. Within this constraint you must achieve all other elements of the mission rehearsal requirements. To make the process of achieving such time-critical programs easier in the future, a few lessons are noted which were learned on Desert STAARS.

After the need and requirements have been determined through the Statement of Work (SOW), the teamwork begins. The first task is the data collection process. To support this awesome task, a centralized collection point should be established. Authorized agencies could use the one point of contact to "shop" for the individual data that would satisfy the SOW. The agency would be in constant touch with other subordinate agencies so as to facilitate continued buildup of more detailed databases.

Higher levels of DMA data should be made available. As stated, the Desert STAARS project was generated from Level 1 information. With the application of higher-detailed data a project would benefit in two critical areas: precision and time. A more exact geospecific database would be generated which would allow the crews to encounter the area in an even more realistic manner. Also, because more details would be provided from the DMA sources, the time required for tedious hand modeling would be reduced.

Another recommendation to allow generation of detailed databases in minimum time is to generate comprehensive library files. These files would contain enhancements that would be available for use throughout the simulation community. Typical files would include but would not be limited to natural entities (trees, shrubs, etc.), cultural objects (buildings, bridges, power lines, etc.), and environmental effects (blowing sand and dust, fog, rain, clouds, etc.). Advanced texture patterns would serve to add realism to the library files. These texture files should be continuously expanded to allow for added dimensions of realism.

An important task of Training Systems Engineering (TSE) is to display the mapping/training information to the Instructor Operator (IO) in the same exacting detail as the geospecific database is displayed to the crew. Accordingly, TSE should be closely involved with the database generation. Because the Desert STAARS program development was not completely collocated, the database and instructional maps were generated separately. In future programs techniques should be implemented to automatically extract map data during the database development process.

CONCLUSIONS

Our future opponents may not allow us the time to conduct mission-similar training, much less mission-specific training, once we arrive within the theater of operations. The tools that provide us that training capability need to be with our soldiers now. We must present our troops the opportunity to fine-tune their perishable mission skills and to continually stimulate the growth of those skills. The geospecific databases and tactical enhancements of Desert STAARS, when resident within available simulators, will provide our combat aviation crews the opportunity to sustain the specific mission skills required to successfully prosecute combat operations. In the pursuit of that skill sustainment it is also possible to discover mistakes or potential mistakes that are mission critical. Given a specific mission, this ability to analyze performance and detect mistakes prior to combat is, in actuality, MISSION REHEARSAL.

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ABOUT THE AUTHORS

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CW4 Robert Monette is a Senior AH–64 Instructor Pilot assigned to D Co. 1–14 Avn. Reg., Ft. Rucker, Alabama. With 20 years of experience and two aviation tours to Vietnam logging over 1400 hours of combat missions, he is a subject matter expert in attack helicopters and simulators. Mr. Monette *was an Army aviation SME for the Desert STAARS* program. He previously evaluated both the AH–1Q and modernized Cobra Flight and Weapons System Simulators from 1979–1982. Presently his special duties include being a member of the AH–64 CMS acceptance team and also an assignment as the AVSCOM New Equipment Training team chief for all CMS device training. He received the AAAA Trainer of the Year Award in 1988. He has an A.S. degree in Aviation Science from Embry Riddle University. CW4 Monette has published work in the areas of simulator networking, simulator fidelity, and mission rehearsal.