A SIMULATED APPROACH TO EA-6B EW AIRCRAFT TRAINING

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The EA-6B Prowler is the U.S. Navy's most sophisticated electronic warfare aircraft. Designed to employ high-power jammers and other electronic countermeasures to disrupt enemy radar and communications and thus screen strike force aircraft from surface-to-air missiles, the EA-6B also is used to protect surface ships from radar detection by enemy aircraft and from cruise missiles.

Operation of the complex, advanced electronics gear on the EA-6B demands a high degree of crew training and readiness. In response to this requirement, Sperry SECOR of Fairfax, Va., has designed and is building an EA-6B Weapons System Trainer under a prime contract from the Naval Air Systems Command. The trainer will help ensure that U.S. Navy pilots and electronics countermeasures officers (ECMO's) receive realistic training in the operation of their aircraft.

The EA-6B trainer which will be the U.S. Navy's largest and most technically advanced flight simulation training device is scheduled for installation at the Naval Air Station, Whidbey Island, Washington. At present, delivery is projected for 1979. Simulation of the EA-6B aircraft involves complete aerodynamic modeling of aircraft performance, including all flight instruments and aircraft systems. The trainer also provides simulation of all EW systems and on-board avionics, including a digital radar landmass simulation. A computer generated image provides an out-the-window display for shore-based and carrier operations. Full simulation of the electromagnetic environment in which the aircraft will operate is also provided. The training device is designed to operate in two modes: integrated full-crew flight and tactics operation; and independent operation of flight or tactics subsystems for specialized training.

The Navy will realize substantial savings in training costs by directly substituting EA-6B trainer flight hours for actual aircraft flight hours. These savings will accrue from: reduced aircraft flight hours; lower personnel and logistics costs in maintenance and expendables; accident reduction; extension of aircraft life through flight hour reductions; and improved and increased training capability. The EA-6B WST is shown in Figure 1.

The hourly operating cost of the EA-6B trainer is projected to be 10 percent of the hourly cost of actual aircraft operation. Based on the Navy's plan to substitute 3,400 simulator hours for 1,930 hours of flight time from 1980-1981, a total savings of about $3.2 million could be possible. This projection is based on the experience of DOD and commercial airline users. It assumes that the capital costs of an EA-6B aircraft (fly away configuration) and an EA-6B trainer are roughly comparable. The potential dollar savings are realized primarily from flight hour reduction and accident reduction. Other cost saving factors such as improved training and lower maintenance and support costs offer potential for additional savings.

Other training benefits, too, contribute to the cost-effectiveness of this simulator. Some of these are difficult to quantify and can be estimated only by employing assumptions based on empirical data. For example, improved and increased training capability is achieved by providing training scenarios that would be impractical to produce using the actual aircraft. The simulator permits training in emergency situations, such as engine fires on takeoff, which would not normally be induced in the actual aircraft. Also, certain combat situations can be duplicated in the simulator with exact fidelity and realism which are

not possible in the aircraft except during wartime conditions. For example, the EA-6B trainer provides the capability to simulate training missions over contested areas and enemy territory. Also, the trainer can reproduce wind, turbulence, and visibility conditions in simulated flight with precisely controlled and realistic fidelity. These same weather conditions may never be encountered on actual training flights or would more likely be avoided for reasons of safety.

Major components of the EA-6B trainer include: a modified EA-6B aircraft cockpit/student station; six degree-of-freedom motion simulation system; a dusk-night visual simulation system employing computer generated image technology; a three-position instructor station for control of the flight and tactics scenarios; a main simulation computer complex which has 1.3 megabytes of core memory and 1,000 megabytes of disc memory. A block diagram of the EA-6B WST is shown in Figure 2.

In addition, the device has a maintenance intercommunication system, hydraulic power units for the motion and flight controls, and other support equipments for test and repair.

The heart of the system is the computer complex and associated software programs. These integrate the various simulator components and provide the basis for operation and control of the device. The software development effort is a major achievement of the EA-6B program.

The EA-6B trainer computer complex consists of four Central Processing Units (CPU's), including their associated peripherals and a four-way shared memory. Each of these CPU's controls a distinct functional subsystem: (1) master computer for input-output, control of instructional features and synchronization of all four computers, (2) flight computer for aerodynamic calculations and motion system control, (3) tactics computer for control of ECM functions and implementation of tactics and instructional features, and (4) digital radar landmass simulation computer for implementation of the APQ-129A radar and control of input-output flow to cockpit and instructor station displays. A fifth computer, independent of the four, is used for on-site software development. A sixth computer is used to synthesize the visual scene. In addition to allowing for orderly development of software functions, this architecture allows for degraded mode operation in event of computer failure. For example, should the tactics computer malfunction, training for pilots and the ECMO-1 can still continue. If the master or flight computer fails, ECMO 2 and 3 training will not be interrupted.

The EA-6B simulator incorporates the most modern features of digital flight simulation technology. These features permit simulation of the entire envelope of aircraft aerodynamic performance and flying qualities, including stalls and spin. Simulation of the full range of engine performance, all aircraft, auxiliary systems, ground handling, carrier catapult launch and recovery wing fold, ejection seats, G suits, environmental control systems, and oxygen, are included in the trainer. All flight instruments and communications/navigation systems are also simulated. The device includes digital radar landmass simulation of the AN/APQ-129A search radar. This system contains 1.6 million square miles of landmass data base storage; terrain and cultural features, including shadows, refraction and earth curvature, far shore brightening, and range attenuation; and moving targets and emitter occulating.

ECM simulation covers the AN/ALQ-99 Tactical Jamming System, AL/ALQ-92 Communications Jammer, AN/ALQ-126 Defensive Jamming System and AN/ALE-129 Chaff Dispenser.

The EA-6B trainer simultaneously simulates fixed and moving tactical emitters. These simulated emitters are provided in sufficient quantity to train EA-6B aircrews to operate effectively in a real world tactical environment. Various types of

emitters are programmable (e.g., search radar, communications facilities, fire control radars), with each having the appropriate electromagnetic characteristics and signal strength location in the gaming area.

The visual presentation is provided by a three-window, two-channel, dusk/night computer generated visual image simulation system. Realistic visual presentations of NAS Whidbey Island and the USS Nimitz are provided for training in shore-based and carrier operations. Integration of visual scene elements, including lights, beacons, etc. and proper correlation of radio, enhance the realism and training effectiveness of the device. The visual scene will display carrier dynamics up to sea state 9. A generic countryside is included, with horizon and sky for cross-country navigation missions.

The hostile area scene is a unique feature of the visual simulation. It includes special effects such as antiaircraft fire, SAM launches and flares. As part of the visual simulation, developmental work is being done to provide a visual scene which includes a KA-6D tanker aircraft with drogue for training in in-flight refueling operations of the EA-6B aircraft crew.

With all these capabilities and technical features, the EA-6B simulator can have up to three instructor operators to coordinate and control the training scenario in integrated flight and tactics operation. The instructor station includes five graphic CRT displays with interactive terminals. Also, repeat displays of the visual scene, AN/APQ-129 Radar, digital radar landmass simulator and AN/ALQ-99 Tactical Jammer are provided at the instructor console. The instructor station is designed to provide maximum flexibility in trainer operation. Ten sets of initial conditions are included to accelerate the start-up of training. A number of pre-programmed demonstration maneuvers are provided. Other special features include twenty-minute dynamic replay, with fly-out capability and computer evaluation of trainee performance in flight and tactics mode.

The EA-6B weapons system trainer will provide better training at substantially lower costs over traditional training techniques. It offers new opportunities to the EA-6B training community in utilizing the extensive range of features and capabilities of the device. By integrating this flight simulator into the training cirriculum, the U.S. Navy's Naval Air Systems Command will take a major step forward in providing vitally needed qualified aircrews for the EA-6B.

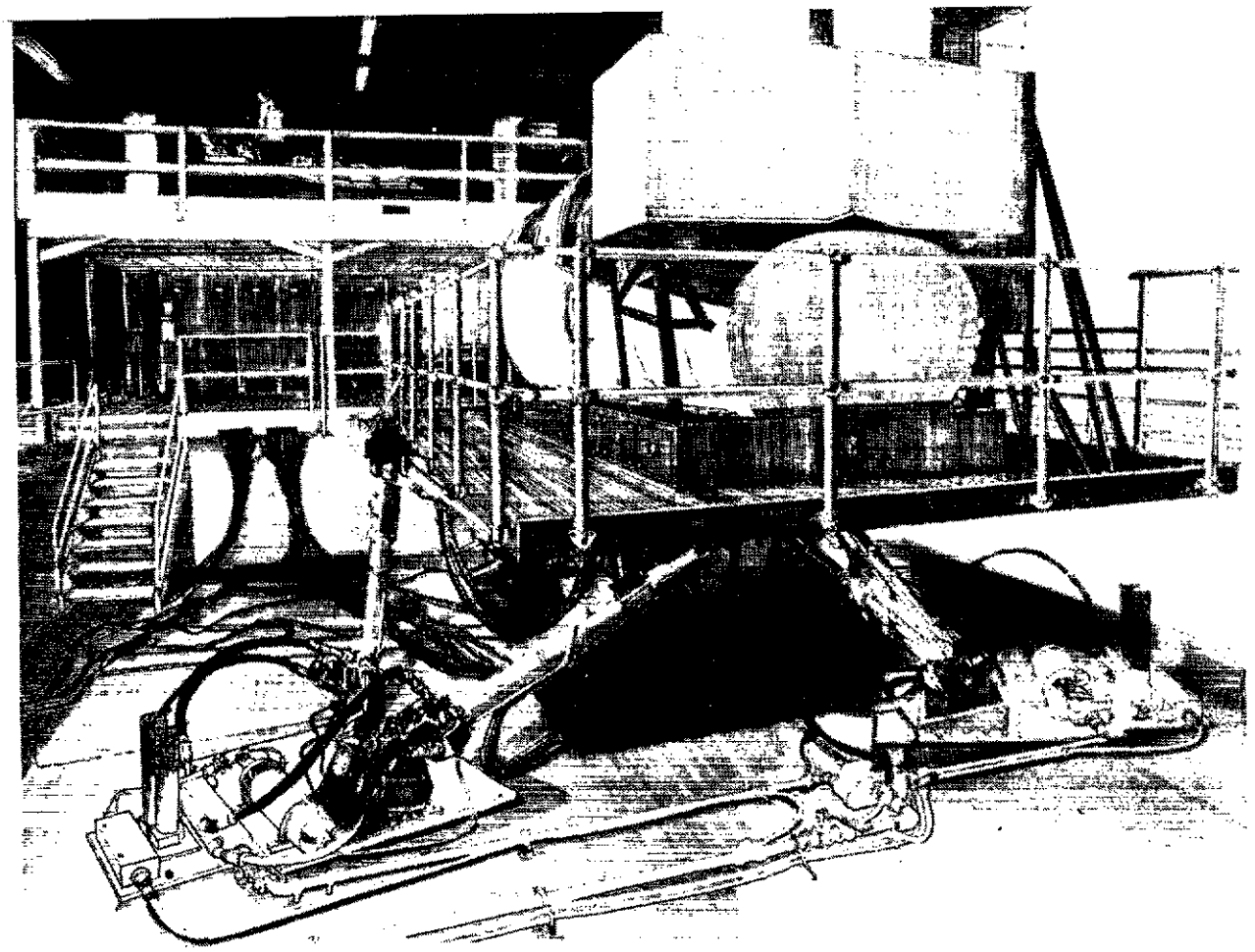

Figure 1. EA-6B Weapons System Trainer

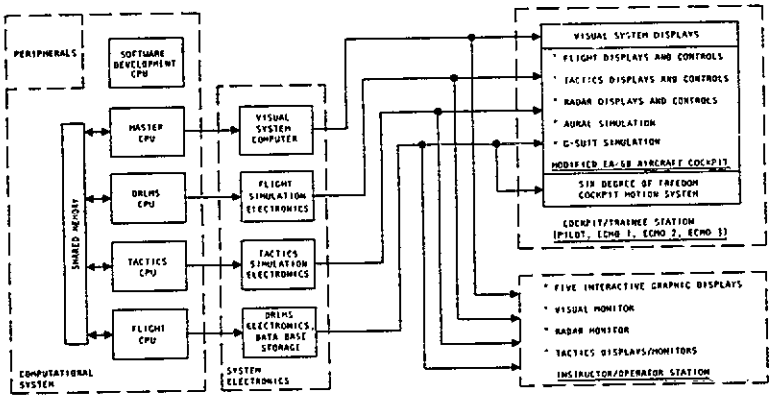

Figure 2. EA-6B Weapons System Trainer System Block Diagram

ABOUT THE AUTHOR

MR. ROBERT G. WATKINS, JR. is Manager of Naval Systems Marketing at Sperry SECOR, Fairfax, Virginia. He is responsible for Sperry SECOR's marketing activities on U.S. and International Naval simulation training programs. He has five years experience in the simulation industry, primarily in the field of military training device applications. He is also a Lieutenant in the U.S. Naval Reserve. Mr. Watkins graduated from the Monterey Institute of Foreign Studies, Monterey, California and received the M.B.A. degree from American University, Washington, D.C.