LPD 17 TOTAL SHIP TRAINING SYSTEM
MAINTAINING PEAK COMBAT READINESS
THROUGH CONTINUOUS, AT SEA TRAINING

Abstract

Technological advances in computational, network, communication and display systems open the way for cost effective approaches to achieving “Start to Finish” onboard training for the entire ship’s crew. Advanced technology training applications are being brought aboard the LPD 17 Class of Ships to conduct a complete range of operations and support training. Success of the on-board training program is ensured through a Training Management System function which provides the tools that facilitate the scheduling of training resources and automates the selection and assignment of training exercises through performance based curriculum sequencing. The Training Management System also facilitates the transfer of training and qualification records of each crewmember and automatically updates these records as the individual progresses through assigned training courses. State of the art technologies in network and communications provide affordable Interactive Distance Learning (IDL) that allow off-board training resources to be used for on-board training. Virtual reality techniques will be incorporated to support training in fighting fires and handling hazardous material spills without risking crew injuries or damage to the ship. Another approach to training is achieved by stimulating ship systems to simulate realistic shipboard situations. In this approach, referred to as organic training systems, the training function is embedded in actual shipboard systems to conduct full fidelity training.

The ultimate training goal of the LPD 17 Total Ship Training System (TSTS) is not only to conduct total ship crew training but also to support embarked troop training. TSTS will be capable of networking a series of appended trainers for vehicles that the LPD 17 class of ships transports in its well deck and flight deck. Embarked vehicles could include AAAV, LCAC, M2A3, V-22, and helicopters. By incorporating Virtual Reality, Interactive Distance Learning, Organic Trainers and interfacing with the Battle Force Tactical Trainer (BFTT), the LPD 17 Total Ship Training System will be capable of conducting not only combined forces team training, but also full scale mission rehearsals.

Biography

Mr. Masaki graduated from the University of Colorado with a BSEE degree. He has spent 25 years of his 35 year career directing the development of Training Systems. One of his major accomplishments included the development of a "Data Directed" behavior modeling system that is being used in large scale trainer systems today. Currently Mr. Masaki is the Technical Director on the LPD 17 Total Ship Training System development project. This project is one of the key support projects within the LPD 17 Program.

Mr. Simpson has a Masters degree in Systems Management from the University of Southern California and a BS from the United States Naval Academy. He spent over 9 years on active duty with the US Navy prior to joining the civilian work force. Mr. Simpson has been employed by Hughes Aircraft Company and Raytheon for 17 years. He has worked on the Advanced Combat Direction System Block 1, was lead engineer for the embedded Onboard Training System portion of the Ship Self Defense System Mk 1 and is currently the Integrated Product Team leader for the LPD 17 Total Ship Training System. Mr. Simpson retired from the Naval Reserve after 22 years of total service. His last assignment with the Naval Reserve was as Commanding Officer of the Fleet Intelligence Training Center, Pacific, Unit 0194.

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BACKGROUND

LPD 17 San Antonio**,** the Navy's newest class of ships, is scheduled to replace the majority of the Navy's amphibious fleet. Its primary mission is to transport Marines to the Amphibious Objective Area, and disembark them via helicopter, landing craft, and other means including the MV-22 VTOL Aircraft. The LPD 17 class ships operate within an Amphibious Ready Group (ARG) and are capable of carrying 704 Marines. These modern amphibious command and control platforms incorporate the latest in shipbuilding and warfighting technologies. A fleet of twelve San Antonio class ships is currently planned. These ships will be highly reliable, warfare capable and the most survivable amphibious ships ever put to sea. Reduced operational costs and adaptability to technological advances over its 40 year service life are fundamental design principles. LPD 17 also incorporates the latest quality of life standards for the embarked Marines and Sailors with the flexibility to accommodate women Marines and Sailors as part of the crew and embarked troops.

TRAINING CHALLENGE

The ship's design incorporates state-of-the-art self-defense capabilities, C4I, reduced signature technologies and integrated electronic systems. A fiber-optic Ship Wide Area Network (SWAN) integrates navigation, machinery control, ship steering, administrative systems, tactical communications and combat systems. Major ship systems include Ship Control System (SCS), Engineering Control System (ECS), Magnetic Signature Control System (MSCS), Collective Protection System (CPS), Integrated Combat Direction System (ICDS) and Cooperative Engagement Capability (CEC). The training challenge is to develop an onboard, Total Ship Training System (TSTS) for the purpose of conducting efficient and effective operator and maintainer training for both ship's crew and embarked marines. This Total Ship Training System is expected to handle a comprehensive "beginning to end" instructional curriculum including familiarization, procedural, proficiency, and advanced training exercises. While most training systems support individual training, the LPD 17 Total Ship Training System will be required to accommodate or support individual, subteam, single system team, multi-system team, Expeditionary and Battle Force Training.

TRAINING SYSTEMS APPROACH

There are several reasons that an effective, onboard, total ship training system is not in existence today. Operator and maintenance training are typically addressed after the ship and its systems are designed, developed, integrated and tested. The argument being that operator and maintenance tasks cannot be specifically identified until the systems are built and tested. A total ship training system should be conceptualized, designed, developed and integrated with the ship's systems to be effective. The "bubble gum and bailing wire" approach to building an onboard trainer by grafting training functions onto a system not designed to host training features in most cases turns out to be detrimental not only to the host system but also to the effectiveness of the training being delivered. Another reason is that a total ship training system developed to train the entire ship's crew and embarked troops to operate and maintain the shipboard systems and Marine vehicles and their combat systems would be too costly.

Training System in Ship Design

The LPD 17 Program Team, also known as Team 17 formed a Total Ship Training System IPT

(Integrated Product Team) consisting of both contractor and government personnel within a few months after the contract was awarded to take on the training challenge head on. Goals and objectives of all shipboard training were first established. Next, a training system intended to completely satisfy the functional requirements derived from the shipboard training goals and objectives was developed. The training system architecture consisted of three major functional areas: Training Development, Training Management and Training Delivery. Detailed requirements were generated for these areas and the LPD 17 Total Ship Training System began to emerge. To successfully operate within the ship environment, TSTS depended on support from various ship systems. The SWAN received training support requirements in terms of interface, throughput response times, and numbers of interface ports through which training workstations would connect to the training source and each other. The communications system received requirements to support Interactive Distance Learning (IDL). The SCS, ECS, and SSDS Mk 2 received organic or embedded training requirements to support individual and team training. A ship was finally being designed from the beginning to support onboard, total ship training!

Cost Management

The problem of the high acquisition costs was resolved through cooperative planning and agreements with engineering, contracts and Navy Training personnel. Team 17 agreed on implementing the total ship training system in increments. LPD 17 would develop the foundation or "core" of TSTS that included ICW Development, Training Management, Training Control and ICW Delivery components. New features and technology upgrades are planned to be incorporated into the TSTS with each new ship construction. Design and development of an Integrated Team Trainer (ITT) for the purpose of conducting team training for SCS and ECS operators is planned to be accomplished under the LPD-18 modification contract. Initial total ownership cost analysis predicts that implementation of ITT will reduce the 40-year life cycle cost for each ship by $2.5M. ITT capabilities will be expanded to include interfaces with SSDS Mk 2 and embarked Marine training systems. Additional cost reductions will be attained by incorporating existing trainer systems and legacy courseware. Currently, cost optimization is accomplished in developing the "core" LPD 17 TSTS through the use of COTS hardware and software products. Team 17 recommends that additional TSTS cost reductions be pursued by encouraging two or more programs to share the cost of developing trainer system components. This cost savings concept can be realized only through program management cooperation, government buy-in and early planning.

ADVANCED TRAINING SYSTEM

LPD 17's TSTS open architecture design consists of structured, modular components interconnected through a high speed, fiber optic network. Its training development, management, control and delivery components are distributed throughout the ship. TSTS's training mission is supported by major ships systems such as the Communication System, Ship Wide Area Network, Close Circuit TV and ships primary systems which hosts training functions. TSTS is designed to conduct a complete range of training beginning with individual instruction and continuing through team training all the way to multi-ship, battle force and expeditionary force exercises. All of this is made possible through early planning and concurrent design engineering efforts of the TSTS in parallel with the ship's prime systems. The following is a brief description of TSTS's training components.

Training Development

Distribution of the TSTS components extends beyond ownship to shorebased facilities. Although all training courseware material will be developed or imported and managed by a shorebased Training Development subsystem, limited courseware generation capabilities are provided in the onboard segment of TSTS. This capability allows the ship's training department to develop lessons that augment standardized courseware with ship specific lessons and to experiment with training ideas while at sea. Computer controlled configuration management, coupled together with highly disciplined process and procedures, will insure that training standards and courseware configuration baselines are kept from being corrupted from uncontrolled sources.

Training Management

Labor intensive, manual processes carried out by the Training Department on ships today will be automated through the TSTS Training Management System. User registration, student enrollment, courseware management, course scheduling, training resource scheduling, curriculum sequencing, performance evaluation, student record keeping, testing, personnel qualification assessments and training effectiveness evaluations will be automatically supported or accomplished by this subsystem. All of the training functions could be more effectively and efficiently performed by a reduced Training Department staff through this subsystem. The Training Management Subsystem will be capable of conducting automated, instructorless training sessions. When students log on to their workstations, located throughout the ship, the Training Management function will recognize them from their ID and password, and sequence them through the course (curriculum sequencing) that they are currently enrolled in. During the lesson, the student's performance is automatically evaluated using performance criterion references provided in the assigned lesson. After the lesson is completed the student's performance data is automatically recorded and placed in the appropriate student file. Student performance information is collected and statistically analyzed by the Training Effectiveness Evaluation (TEE) function. Instructional Specialists use the results generated by the TEE to look for efficiencies and deficiencies in the training courseware and delivery systems. Recommendations for changes will be made to a combined government and contractor organization.

Electronic Classroom

A shipboard Electronic Classroom (EC) consisting of an instructor station and student workstations netted together through the SWAN will serve to impart training to ship's crew and embarked forces in a modern Electronic Training Environment (ETE). The EC will combine both dedicated multi-media student workstations and dual purpose (ship operations and training) workstations located throughout the ship to form a variable configuration, virtual classroom. Standard COTS software and hardware will be used to implement the entire LPD 17 EC functional component that will feature the training technologies found in latest up-to-date institutional classrooms. The EC will be designed to support a variety of training delivery methods ranging from individualized, self paced lessons to instructor led, interactive, classroom sessions. An additional group of dedicated workstations will be provided to serve as an extension of the EC or operate independently as a Learning Resource Center (LRC) to provide the ships crew and embarked forces with 24 hour computer-based information access for reference and self-paced training.

Advanced Distributed Learning

An effective way to attain a comprehensive training capability despite a reduced training department and limited funds is to conduct training using Advanced Distributed Learning (ADL) technology. Through the application of ADL high quality training can be imported from a large selection of training sources using the Interactive Distance Learning (IDL) features that are expected to be implemented by LPD 19. Training sources include Navy shore based training facilities, public and private universities, specialized commercial training institutions and LPD 17's own Maritime Center of Excellence. Both real time and computer controlled interactive learning from off-board sources will be imported to the ship through its satellite communications resources, distributed throughout the ship on the SWAN and presented through the ships Closed Circuit TV (CCTV) system and workstation displays. The ADL feature will provide the ship's crew and embarked troops not only operations and maintenance training but also continuation education program courses. In addition to the ship's multi-media workstations, laptops will be provided to greatly extend the capability of the EC to deliver both assigned duty related and personal training. The ADL subsystem will also support distributed team training where students located on other ships and at shore based facilities could participate in coordinated team training exercises.

Virtual Reality Applications

Training through the use of Virtual Reality (VR) technologies has proven to be an effective and efficient means of imparting certain operations and maintenance training. It is also a cost effective approach to training as compared to conventional, shore-based institutional trainers which use full scale mock-ups and fully interactive controls. VR based training systems not only cost less to build but also cost less to maintain. A single set of VR training hardware and software is designed to

graphically synthesize many different shipboard systems for training. The VR sub-system will also include tools that allow the user to create and modify virtual ship 3-D models. VR will be used to train the ship's crew how to perform smoothly as a team in handling fire, explosions and hazardous material spills. Other possible training applications include ship wide fault localization, propulsion system support, system level maintenance, medical training, well deck operations and wargaming. In current training applications all VR effects are planned to be coincidental with the ships environment. To minimize disorientation and sea sickness, the plan is for structural damage, smoke, fire and spill effects to be superimposed onto the ships structure and synchronized with actual ship's motion. Currently, training cannot be successfully conducted using VR when the simulated environment is different from ownship's because of the motion sickness problems it causes. The training team will be searching for VR technologies that can overcome this problem. This would open the way to conduct effective, at sea mission planning and mission rehearsal exercises.

Integrated Team Trainer

Coordinated team training for personnel assigned to the Ship Control System (SCS) and Engineering Control System (ECS) will be conducted through the Integrated Team Trainer (ITT). Trainees will be immersed in realistic operational situations provided through scenarios that simulate natural, tactical and ship environments to effectively train the participants to respond to actual combat and peace keeping situations. The ITT will be implemented by incorporating existing trainer capabilities that are integral functions in the SCS and ECS. The ITT's modular design and open architecture will make it possible to expand its training capabilities to incorporate the ships sensor systems, weapon systems, command and control systems, navigation systems, and propulsion systems operators to participate in coordinated team exercises. Training modules for vehicles and systems transported by the ship will be incorporated into the ITT. These systems will potentially include helicopters, V-22 Osprey, Landing Craft Air Cushion (LCAC), M2A3 Bradley, Advance Amphibious Armored Vehicle (AAAV), Light Armored Vehicle (LAV), Marine Combat Direction System (MCDS, Position Location and Reporting System (PLRS) and portable weapons systems. Ultimately, the ITT will be enhanced to support multi-ship battle force and expeditionary force training exercises via BFTT.

Medical Trainer

A training system consisting of advanced technology training delivery devices may be provided to conduct just-in-time training for the Medical Unit Team so that their medical skills can be maintained during long deployments. Advanced technologies such as virtual-reality, computer controlled patient simulators, and interactive distance learning will be applied to conduct highly effective, medical training sessions. The medical training delivery devices may be interfaced to the TSTS to record trainee actions, evaluate trainee performance, and to provide debriefing features. The Medical Trainer may include a patient simulator for training medical crews. The simulator will provide tutorials, hands-on course work, reenactments of accident and casualty scenarios, and operating room technique scenarios. COTS patient simulators can be configurable to be male or female, of any age, and of any state of health (including pregnancy). The model-driven life-sized mannequin will have the ability to breathe and carry a pulse. The simulator will possess sophisticated models of physiology and pharmacology that allow the mannequin to accurately mirror human responses. The patient simulator will react as a human would to intravenous drugs, defibrillation, intubation, ventilation, catheterization, Cardio-Pulmonary Resuscitation (CPR), and other medical procedures. Students will be able to administer intravenous medications and the simulator is expected to react as a human would. An elaborate pulmonary system simulator will recreate a wide range of breathing disorders (including asthma and collapsed lungs) to provide students with realistic medical experience.

Artificial Intelligence Applications

Automated team and individual performance assessment, surrogate team participant, intelligent opposing forces, smart platforms, surrogate instructors, and interactive scenarios are all potential applications of Artificial Intelligence (AI) for training purposes. The Team 17 training group will be conducting research to develop plans of incorporating AI into TSTS. Near term plans are to incorporate synthetic voice and expert systems, but the ultimate goal is to incorporate a true AI system.

CONCLUSION

In the past training elements of typical government programs were treated like orphans. Standing last in line only to have what little funds it originally had taken away for the “more important” projects of the program. This situation is slowly changing as evidenced by the LPD 17 program and the participation of this I/ITSEC. We are fortunate that our LPD 17 program is staffed with managers that understand the importance of training and are showing it by not only defending its budget but also asking for more to be done. The LPD 17 TSTS could serve as a model for other programs. The Team 17 training group strongly recommends that Government training organizations and industry set up meetings with programs such as Joint Strike Fighter, New Attack Submarine, New Carrier Program CVX, and New Surface Combatant SC 21 to determine how these programs can share ideas, training products development costs of their trainer system. Also, government training organizations have information on legacy training systems and subsystems which can be reused. If all of this information could be shared it would save countless hours of research. It looks like training systems are headed in the right direction. Let’s keep up the momentum.