INNOVATIVE STRATEGIES AND METHODS FOR TOTAL SHIP TRAINING ON LPD-17

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INTRODUCTION

Pressures to reduce system acquisition and life cycle costs are at the heart of acquisition reform. Indeed, the challenge of designing a platform that achieves performance goals akin to those obtained in current systems but with fewer people and at a dramatically lower cost is daunting. One way to meet these challenges is by developing effective and responsive training systems that allow for maximum flexibility in crew resources. This can only be achieved through careful consideration of human performance and training requirements early in the system design and acquisition process. It also demands that a "Total Ship Training" philosophy be adopted, where the platform becomes a focal point for the management of crew competencies, development and training.

The purpose of this paper is to describe a Total Ship Training approach for the LPD-17 class of ships. We begin this discussion by first delineating the 21st century challenge for training in afloat systems. Next, we describe LPD-17, its mission and its training drivers. We then lay out a philosophy about human performance in complex systems and about how and where training resources are made available to the crew to ensure that crucial missions are accomplished. We then briefly describe our efforts to design training for LPD-17 and to accomplish training technology insertion. We conclude by discussing some acquisition reform issues as they relate to training system design and development.

The Challenge Of Training For Afloat Systems

U.S. naval forces must enter the 21st century properly equipped, sized, and organized in order to respond to changing world threats. The proliferation of weapons of mass destruction, terrorism, political unrest, and economic instabilities throughout the world have created an operating environment for ships, submarines, and aircraft which is profoundly different than that of just a few years ago. Moreover, the capabilities of surface combatants will need to continue to evolve to keep pace with dramatic technological advances in automation, precision strike munitions, space-based surveillance, stealth, and information processing. Providing warfighting skills to the men and women assigned to, and embarked in, these ships will be the crucial force multiplier for enhancing readiness and enabling the reshaping of the surface fleet.

Future surface Navy training will encompass a spectrum of highly integrated and networked elements more responsive and capable of preparing trained and ready forces than is possible today. Advanced training concepts and improvements in information delivery will make it possible to provide **global, real-time access to training and technical assistance**. As the more promising of these technologies are transitioned into educational systems, instructional tools, and job performance aids, much of the traditional shore-based training and technical support will migrate "inside the lifelines" of the ship. However, the time and manpower needed to conduct unit and individual training evolutions aboard ship will place increasingly extraordinary demands on the ship's managers and training teams to achieve and maintain high states of readiness. Therefore, as training for future platforms is designed, it must be done so with the idea that training cannot become a burden to the ship's crew. Rather, training must be integrated seamlessly into everyday operations. This provides an even greater challenge to training system designers, but one that we believe can be achieved. Before proceeding to describe our approach to this problem, we first describe the LPD-17 class of ships and its training drivers.

The LPD-17 Mission

The LPD-17 (San Antonio Class) Amphibious Transport Dock Ship's primary mission is Expeditionary Warfare. Its central source of combat power is the embarked Marines and equipment that it houses. In accomplishing an amphibious operation, naval and landing forces embarked in helicopters, landing craft, and amphibious vehicles confront a hostile shore. Therefore, LPD 17 will be able to embark, transport, and land elements of a landing force

in an assault. This will be accomplished via helicopters, Vertical Takeoff and Landing (VTOL) aircraft, landing craft, amphibious vehicles, and through a combination of these methods.

In addition to participating in amphibious operations, LPD-17 class ships will be called upon to conduct a wide variety of military missions. In fact, these ships will figure prominently in Joint Task Forces that are participating in low intensity conflicts such as peacekeeping operations because of their significant troop and cargo carrying capacity. They might also be called upon to act as the focal point for an international disaster relief/humanitarian assistance operation, or to assist the naval expeditionary force in operations such as mine hunting and clearing through the embarkation of specially-equipped helicopters.

The LPD-17 Class is the functional replacement for the 41 ships of the LST 1179, LKA 113, LSD 36 and LPD 4 classes built in the 1960s. With twelve ships planned as part of the LPD 17 class, they are a key to providing the 2.5 ship Marine Expeditionary Brigade (MEB) amphibious lift requirement and are the focal point of the 12 Amphibious Readiness Groups (ARGs) planned for the 21st Century.

According to the document, "Operational Maneuver From The Sea (OMFTS)" which defines concept of Expeditionary Warfare that LPD 17 will operate under, expeditionary warfare employs a combination of strength, speed, and flexibility to exploit enemy weaknesses, create gaps in enemy defenses, and attack where the enemy least expects it. The Amphibious Task Force (ATF) will support the OMFTS by operating initially well beyond the enemy's visual or sensor horizon from shore. This Over-The-Horizon (OTH) amphibious approach emphasizes the principles of tactical mobility, operational speed, and operational flexibility and makes full use of the ATF's operational capabilities.

LPD- 17 Training Drivers

The nature of littoral operations and expeditionary warfare is that of battle space compression, ambiguity with respect to contact identification and intent, severe time pressure, and ever-increasing levels of information overload. In order to cope with these challenges, training strategies, methods, and systems must be developed to help prepare the warfighters for the varied, unexpected, stressful, and rapidly changing environment that will be typical of LPD-17's multi-purpose role. Of particular importance is the need to develop total ship training that is flexible and can be adapted readily to changing missions and demands. This will require the development of **organic** training systems which can support full mission rehearsal and **continuous learning** for the officers and crew of LPD-17, as well as its embarked Marines and detachments.

A second driver of training involves reduced life cycle costs (LCCs). The cost to own and operate existing ships has always competed with funds for recapitalization and modernization. LPD-17 has established aggressive lifecycle cost reduction targets as part of its initial design considerations, a part of which is training costs. Therefore, it is imperative that we conceptualize and design systems that exploit available commercial off-the-shelf (COTS) technology and that leverage existing training R&D. Moreover, we must consider the implications of reduced manning--another of LPD-17's goals--on training system and skill management systems.

STEPS IN ACHIEVING TOTAL SHIP TRAINING FOR LPD-17

The vision for LPD 17 is a Total Ship Training capability that is flexible enough to accommodate individuals and teams with different levels of expertise across the spectrum of tasks performed on board ship (including combat systems, engineering, maintenance, damage control, navigation and administration). The vision for such a system is that it includes provisions for meaningful shipboard training at the discretion of the Commanding Officer, the crew, and the embarked personnel; that it adapts to the needs of the trainee; that it addresses both individual and team aspects of performance; and that it minimizes human intervention in the training process. Further, it must include shipboard training integration, familiarization, precommissioning (precomm) training, crew phasing, and the integration of school house and shipboard training.

Overall, the LPD 17 Total Ship Training Program must provide this ship class with a training system that:

- provides the ship's crew and embarked personnel a continuous learning environment that allows for effective and efficient individual and team training;
- offloads shipboard instructors to the extent possible;
- reduces life cycle and total ownership cost;

- provides the ship with organic capabilities for achieving and maintaining warfighting readiness of the crew, embarked troops, and other embarked detachments;
- exploits emerging innovations in learning technologies and methodologies; and
- manages training information effectively.

In order to reach these goals, we must first adopt an overall training philosophy, then establish specific training needs, apply emerging technologies, and address a number of related factors. These topics are discussed further in the following sections.

Establishing a Total Ship Training Philosophy

As noted, battle scenarios for LPD-17 will be littoral in nature--characterized by reduced time to reach complex decisions (battle space compression), ambiguous scenarios that unfold rapidly and provide difficult contact identification and intent problems, high degrees of auditory and information overload, and rapidly changing and evolving scenarios. In addition, LPD-17 will likely be called upon to accomplish a wider range of missions and requirements than has been the case in past operations. Further, an increase in the extent and frequency of joint and allied operations can be expected. Taken together, these factors place unprecedented demands on human operators, teams, and systems. In order to cope with these challenges, a new strategy for training must be devised. This strategy must place viable training resources at the disposal of the ship's crew so that training may occur **anywhere, anytime, on demand.** Training strategies and methods must be developed to help prepare warfighters for the varied and rapidly changing environment that will be typical of a future multi-purpose platform. This implies that a total ship training philosophy be adopted that is flexible and can be adapted readily to changing missions and demands. In fact, we believe that the success of LPD-17 training is that is can be molded to the needs of the crew and embarked forces.

Overall, then, our philosophy for developing training to meet the LPD-17 demand is to provide the most flexible and adaptive systems possible. This means that the systems must be able to be easily tailored to whatever is determined to be the knowledge and skill deficiencies of shipboard personnel. This is particularly true when considering the implications of reduced manning. In such cases, the redundancies that currently exist in crew knowledge and skill will not be present. This means that when a crew member leaves, the unique knowledge and skill that he or she holds must be quickly replaced in the new crew member. Therefore, it must be possible to tailor shipboard training systems to the specific deficiencies. This also implies that performance can be measured accurately so that deficiencies can be identified and assessments made regarding when effective performance is achieved. It also suggests that shipboard personnel maintain and have access to detail records of personnel performance, and that these records are updated often enough to ensure crew readiness.

LPD-17 training systems must also be flexible enough to be easily tailored to new missions and tasks. As noted, LPD-17 (as well as other modern ships) must be ready to confront a host of varied missions which can change during the course of a deployment. This means that training systems must be able to handle new tasks and scenarios, and be updated with little effort on the crew's part. Therefore, mechanisms to update training objectives, create meaningful scenarios, collect performance data, diagnose training problems, and provide feedback must be available to the crew. Moreover, systems must be sufficiently automated so that they require little or no effort to run or maintain. In particular, adequate aids must be provided to instructors so that their role is minimized to the extent possible.

Determining Training Needs

Once we have adopted a training philosophy, we must determine the particular training needs associated with LPD-17 so that training can be developed. In this phase, we will conduct a comprehensive, ship-wide training front-end analysis (FEA) to determine the entire ship's crew, embarked troop, and other embarked detachment training requirements. In order to be effective, this analysis must address the competencies (knowledge, skills, and attitudes) needed to perform the individual and team duties of all billets represented on the ship. It must also account for all equipment, establishing the individual operator, maintenance, and team skill requirements to support that equipment. Using a relational database, we will be able to identify common competencies so that potential cross-training opportunities (where an individual in one rating might be capable of performing a job traditionally assigned to another rating) can be pursued.

As part of the process, we will investigate ways to streamline and automate the Instructional Systems

Development (ISD) process for application to LPD-17. That is, we will identify automated tools that might be available to streamline the training development process while improving training at reduced costs. The relational database created through the FEA process will be integrated with the LPD-17 Integrated Product Data Environment (IPDE), to ensure that all initial training requirements are addressed and that a mechanism exists to respond to new requirements such as those resulting from policy or configuration changes.

Application of Emerging Technologies

Since a stated goal of LPD-17 training development is life cycle cost reduction, we must consider carefully and prudently the manner in which we apply training resources. Fortunately, training that is well designed has the potential to become a crucial force multiplier by enhancing readiness through better preparation of warfighters.

One way to simultaneously improve training effectiveness, while containing costs, is to move training to the shipboard environment. In terms of cost effectiveness, this strategy has the advantage of saving travel costs associated with trainees attending training at shore facilities. Perhaps more important, however, is the fact that on board training allows trainees to "train the way they fight", a strategy that is advocated when preparing individuals to cope with difficult operational environments. Therefore, we plan to make full use of emerging technologies in designing LDP-17 training. In fact, the LPD-17 class will employ a blend of training capabilities utilizing the latest in cost effective, state-of-the-art training technologies and learning methodologies, and also take advantage of existing training programs and methods. We intend to pursue the following strategies:

- *On-demand training*--refers to training that can be tailored to meet current performance deficiencies at the discretion of the CO or other team leaders. In a sense, such capability can "empower" the ship by putting control of training in the hands of the CO and his/her crew. However, this requires that appropriate mechanisms and tools (e.g., performance measurement techniques, training for shipboard instructors, instructional strategies, debrief guidelines, etc.) are in place.

- *Just-in-time training*-- is advanced skill/knowledge training that can be designed to address specific situational/environmental needs (e.g., operations in the Persian Gulf) conducted immediately prior to when the skill/knowledge is required. For this capability to be realized, it must be possible for shipboard personnel to easily develop/adapt scenarios, measures of effectiveness (MOEs) and training strategies as necessary.

- *Mission rehearsal*--is the most specific form of training that enables operators to practice an actual evolution prior to conducting it. With this capability, the problems of skill decay become less debilitating because personnel can practice crucial skills immediately prior to the operational need. However, the use of mission rehearsal to remediate basic skills is not appropriate. Other forms of refresher training are needed to maintain basic knowledge and skill.

- *Distance learning*-- involves providing training to crew members via video teleconferencing (or similar technology) that is conducted at a centralized location and broadcast to a host of learning sites (i.e., ships). While the possible types of training that can be accomplished in this manner are vast, it is not well suited for complex tasks that require extensive hands-on practice.

- *Continuous learning systems*--continuous learning refers to a training philosophy whereby all evolutions are treated as a training opportunity. To accomplish this, performance goals must be set prior to the start of an evolution (e.g., unreping, navigating through a channel), performance data must be collected relative to the goal, and specific feedback must be provided at the conclusion of the evolution. In this manner, the evolution itself has learning value as performance is expected to improve in subsequent evolutions. One way to accomplish continuous learning is to develop operational systems that can collect performance data and provide feedback to operators on a continual basis. For example, by tracking keystrokes, it may be possible to improve knowledge of "buttonology" by providing operators with feedback on their performance.

- *Job/Training aids*--a number of technologies are becoming available that can serve both as training aids and also as job aids. For example, electronic technical manuals and tacmemos may be used as a basis for training or as an "on-line" aid during performance. In addition, a technique called "augmented" or "enhanced" reality is being developed for use in the commercial sector. Briefly, the goal is to provide a head-mounted display surface on which information can be presented to an operator in training

or during an actual evolution (e.g., a schematic for a computer that is being repaired). The information presented in this manner may serve several purposes: as a memory aid; to provide amplifying schematics or graphics; to present pertinent data, facts, or information; and/or to provide feedback, hints or cues.

- *Distributed/Joint training*--the advent of distributed interactive simulation (DIS) has provided an opportunity for distributed training to occur. The potential uses and application of this technology are vast (e.g., battle group, battle force, joint, etc.). However, to be most effective, attention must be devoted to developing the human performance technologies associated with DIS (e.g., exercise design guidelines, performance measurement techniques, debrief mechanisms, etc.).

- *Multimedia training*--current technology affords the opportunity to provide multimedia training for many learning task. However, research into cognitive functioning and human learning suggest that initial encoding and subsequent retrieval of knowledge in decision making situations may be fostered (or hindered) by the manner in which information is presented initially. Therefore, effort is needed to investigate the appropriate application of video, graphics, text, simulation, and animation to optimize retention and availability of knowledge (particularly under stressful conditions).

- *Virtual Reality*--one of the emerging technologies that will impact the way training is delivered in future systems is virtual reality (VR). VR systems "immerse" the trainee in a simulated training environment so that crucial competencies can be learned. The advantages of VR are that it does not rely on specialized hardware or equipment, that is can be easily reconfigured to accommodate new tasks, and that it can be designed to allow practice on tasks that cannot be trained viably by other means for safety or cost reasons (e.g., shiphandling). The potential of VR for training is only beginning to be realized; effort is needed to advance this technology for application to LPD-17 and other future platforms.

- *Intelligent Tutoring*--another emerging area of research is in intelligent tutoring. This refers to systems where the computer contains information about student performance that enables it to automatically track, diagnose and remediate student performance. The underlying technologies required to accomplish intelligent tutoring--cognitive modeling, intelligent diagnostic mechanisms and performance assessment--are beginning to mature to the point where effective instructorless training is feasible. Intelligent tutoring systems should figure prominently into the training strategy for LPD-17.

Additional Training Concerns

There a number of other issues related to LPD-17 training that we believe need to be highlighted. These are summarized in the following sections:

Measures of Effectiveness and Measures of Performance--The key to success for any training system is its ability to measure individual and team performance. In order to be effective, assessment techniques must be built into the training systems so that it is easy to assess when trainees achieve appropriate performance levels. Measurement is crucial as a means to optimize the use of training resources. That is, in order for training to be tailored to the deficiencies of the crew, mechanisms to assess the crew's knowledge and skill states must be available. It is also crucial to at measure performance so that the crew's readiness any given time can be judged. Current technologies do not allow this type of assessment; future systems must be equipped with such capabilities.

***Instructor training and aids*--**As noted, due to the high levels of workload that we can anticipate on LPD-17, it is imperative that we provide instructor aids so that the crew is not burdened with training duties. A number of on-going efforts are aimed at providing tools for shipboard instructors. These include automated performance measurement techniques, hand-held observational tools, observational and debriefing aids, and deployable instructor training. All of these tools must be incorporated into LPD-17 training systems.

Networked training--The LPD 17 fiber optic shipboard wide area network (SWAN) will be used to deliver instruction to appropriate terminals throughout the ship. Through the SWAN, members' training records will be maintained and accessible by appropriate personnel (more will be said about this below). Our vision is that terminals will be available throughout the ship, including crew berthing and lounge areas. The ship's training organization will be able to make use of untethered hand-held computing devices (being developed by the Naval Air Warfare Center Training Systems Division) for performance measurement data collection and access to data on the SWAN. This capability will allow "virtual teams" to train together,

even if they are located on remote areas of the ship. It will also allow for more traditional forms of team and distributed team training.

Learning Resource Center--in keeping with the desire to provide maximal training resources aboard ship, learning resource center facilities will be provided that include Interactive Courseware (ICW) and learning research data sources. For example, ICW in the learning resource center and shoreside can provide basic computer skills, as well as a host of other prerequisite skills. The LRC will also provide ship personnel with opportunities for self-improvement by offering a host of advanced and enrichment courses.

Skill Management Software--as noted, LPD-17 training must be deficiency-based, that is, it must be tailored to the particular knowledge and skill deficiencies of the crew. In order to maintain records that will support this type of a strategy, intelligent skill management software is required. Such software would allow crew personnel to manage skill and knowledge inventories that help to determine what training needs to take place. It would also house information about required tasks and training objectives and be tied to shipboard training resources. Therefore, when a deficiency is discovered, the system would guide personnel in exactly how training should be developed to remediate it.

A WORD ABOUT ACQUISITION REFORM

Acquisition reform is becoming a way of life as we procure new systems. Obviously, these new practices have an impact on how training will be designed for LPD-17. In the following paragraphs, we have noted a few of the effects of acquisition reform on training system design for LPD-17.

Early consideration of training needs--One of the most exciting developments in the LPD-17 program is that training is being considered early in the design process. Moreover, training personnel are represented on many of the platform's Integrated Product Teams. This should lead to much more integrated training systems for the ship and help to ensure that all shipboard tasks are addressed. Perhaps more importantly, it sends the message that training is important and worthy of due consideration, time and effort.

Design for Ownership--Another positive trend in LDP-17 development is a strong emphasis on getting the "users" involved in the design process. From a training standpoint, this means that subject matter experts can be involved through out the design and development process. The outcome should be a training system that is well-suited to the crew's (and embarked troop's) needs.

Working with a Full Service Contractor--The LPD-17 design team, Team 17, is designing the first 21st century ship for the operator, the maintainer and the trainer. In the Team 17 concept, the designers of the Total Ship Training Program work alongside the ship's builders to design training *into* the ship. This requires that the government and industry enter into new cooperative relationships, with the outcome being the best possible product for the Navy. It is as much a cultural change as a procedural one, but necessary if our training and warfighting goals are to be met.

CONCLUSIONS

To this point it should be clear that we have a strong vision of how to develop training for LPD-17. This is no doubt a formidable challenge--the ship will place unprecedented demands on its crew and embarked troops due to the fluidity of missions and sophistication of systems. Clearly, training figures prominently into the ultimate success of LPD-17. It is our hope that a total ship training philosophy will provide effective and efficient training for LPD-17, and help to ensure the platform's on-going readiness.