Stick and Rudder Training for the Mind

Mr. Arthur W. Gallo
BMH Associates, Inc.
2602 Challenger Tech Court
Suite 230
Orlando, Florida 32826-2708
gallo@bmh.com

Mr Jonathan P. Glass
NAVAIR TSD
12350 Research Parkway
Orlando, Florida 32826-3275
jonathan.glass@navy.mil

CDR Charlie Frye
NAVAIR TSD
12350 Research Parkway
Orlando, Florida 32826-3275
charles.frye@navy.mil

Ms. Cathy C. Matthews
NAVAIR TSD
12350 Research Parkway
Orlando, Florida 32826-3275
cathy.matthews@navy.mil

Mr. Dave M. Kotick
NAVAIR TSD
12350 Research Parkway
Orlando, Florida 32826-3275
david.kotick@navy.mil

ABSTRACT

"Only perfect practice makes perfect." Said another way, warfighters must train as they would expect to fight in order to ensure that sound mental habits are established, which will increase the Warfighter's opportunities to make good (and winning) decisions in stressful situations. Unfortunately, for many reasons (e.g., lack of resources, inadequate technology, legacy system limitations, time, etc.) military personnel have not always been able to train in a manner consistent with their doctrine and tactics. Recent Department of Defense (DoD) and Navy "Transformation" doctrine emphasis on realistic integrated training, along with significant advances in Modeling and Simulation (M&S) technology, have resulted in training opportunities that aircrews could once only dream about.

This paper will describe a new initiative to enable netted tactical team training within the Navy. The initiative, part of the ONR-funded Virtual At Sea Training (VAST) program, is called Anti-Submarine Warfare (ASW) Air VAST. ASW Air VAST will result in a system of deployable and networked laptop trainers for the aircrew of the SH-60B (LAMPS MK-III). As part of this program, a new system called the Mission Rehearsal Tactical Team Trainer (MRT3) has been developed to allow the aircrew to perform mission rehearsal as a team with the crew's ship and other ASW air platform counterparts. The MRT3 is designed as a fully integrated tactical team trainer for the LAMPS aircrew and the entire ASW Team. It is not a flight trainer; rather, the focus of this deployable system is on providing a capability to develop ASW tactical team expertise, specifically the cognitive aspects associated with performing a tactical mission. Therefore, MRT3 can be described as a "stick and rudder trainer for the mind" that facilitates collaborative decision making and enables Warfighters to train in an operationally relevant synthetic battlespace, just as they would perform during combat operations.

ABOUT THE AUTHORS

Arthur W. Gallo is a Senior Systems Engineer with BMH Associates, Inc., in Orlando, Florida, USA. Currently he is the Requirements Manager for the ASW Air VAST MRT3 program, and he also supports the DARPA DARWARS training program. Mr. Gallo recently retired from the U.S. Navy as a Captain after a very successful thirty year career. His last tour of duty was at NAVAIR Orlando, Training Systems Division as the Program Director for Special Emphasis. His expertise is in Naval Aviation (Pilot), specifically ASW Rotary Wing (SH-2F LAMPS MK-I) with over 2800 flight hours and seven deployments. Mr. Gallo holds a Bachelor of Arts degree in History from Alfred University.

Jonathan P. Glass is a Project Manager with the Naval Air Systems Command, Training Systems Division, Project Director Special Emphasis Branch (PDSE), in Orlando, Florida. He is currently the PJM for ASW Air VAST. Mr. Glass has 7 years experience as a PJM and 14 years of experience in systems engineering in both combat weapon systems and simulations. He is a graduate of the University of Central Florida (UCF) with a BS EE degree. Previously, he worked as the WARSIM C4I Technical Lead and as an Inertial Navigation Systems Engineer for the Naval Undersea Warfare Center in Norfolk, VA.

CDR Charles Frye is a Program Manager at the NAVAIR Orlando Training Systems Division. He manages a variety of programs leveraging PC based simulation to enhance military training. He is a Naval Aviator with 2000hrs as mission commander in the SH60B aircraft. He has been awarded the Navy proven subspecialty codes in Operations Research and Modeling and Simulation. He received his B.S. in Engineering from the University of Florida and M.S. in Operations Research/Systems Analysis from the Naval Postgraduate School.

Cathy C. Matthews is an Electronics Engineer at NAVAIR Orlando with 21 years of experience in military training systems. She received her Bachelors Degree in Acoustical Engineering from Florida Atlantic University and a Masters Degree in Computer Engineering from the University of Central Florida. Ms. Matthews is currently Branch Manager for the acquisition of Surface Platform Training Systems. She has previously worked Research and Development programs with DARPA, ONR and DMSO. Ms. Matthews has also participated in the development of training systems for all the Navy communities. She has diligently worked toward transition of R&D products to acquisition programs.

Dave M. Kotick serves as the NAVAIR Orlando Concept Development and Integration Laboratory (CDIL) Principal Engineer. Mr. Kotick has over 20 years of experience in the Navy Modeling and Simulation Research and Development arena. His works have been published extensively in technical journals, conference proceedings and NAVAIR technical and special reports. Mr. Kotick has co-written numerous papers dealing with complex subjects such as training system interoperability and digital communication techniques for training. He currently holds multiple patents (pending and granted) in the fields of digital communications and simulation technology. Mr. Kotick holds a Bachelors and Masters Degree in Electrical Engineering from the University of Central Florida.

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NAVAIR TSD
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Orlando, Florida 32826-3275
charles.frye@navy.mil

Ms. Cathy C. Matthews
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Orlando, Florida 32826-3275
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NAVAIR TSD
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Orlando, Florida 32826-3275
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INTRODUCTION

Define and Focus the Problem: To "Train As We Would Fight!"

By way of history, the Quadrennial Defense Review Report emphasizes the need for investments that would enable U. S. forces to defeat anti-access and area denial threats and to operate effectively in critical areas. Such investments will include addressing the growing threat posed by submarines. The Chief of Naval Operations (CNO) has said that the Navy of tomorrow is about projecting offensive power as well as defensive power. Under the "Sea Power 21" operational construct, this defensive power projection concept, along with the Anti-Submarine Warfare (ASW) mission, aligns with the Naval Capability Pillar of "Sea Shield" and will provide the foundation for battlespace dominance.

In May 2003, the CNO directed the implementation of a new concept to meet the high operational tempo demands placed on the service by the National Security Strategy. Based upon Sea Power 21, this new concept, called the "Fleet Response Plan" (FRP), has standardized the Navy Inter-Deployment Readiness Cycle by providing a sequence of building block type events to rapidly achieve optimal readiness within the fleet. The evolving Fleet Readiness Training Plan (FRTP) will allow the Navy to better meet both emergency surge and routine deployment requirements by providing a force that is more employable and ready to carry out their assigned missions. The CNO has called this "presence with a purpose."

To accomplish all this, the Navy will rely heavily on synthetic training and simulation technologies, and expects to harvest large gains in effectiveness and efficiency relating to inport training. Therefore, the FRP strategy acknowledges the need to develop an improved Inport Training Architecture (ITA) based upon the expanded use of Modeling and Simulation (M&S), and further requires that the current training architecture be expanded to include more participants and more warfare areas such as ASW and joint training. It also states the requirement for a richer ASW synthetic training environment to allow the entire ASW team to train in an operationally relevant, common synthetic battlespace.

In "CNO's Guidance for 2004", the CNO has directed that Commander Fleet Forces Command (CFFC) explore options for expanding simulation, leveraging from technology to enhance training, and for joining with selected exercises within the Joint National Training Capability (JNTC). He specifically cites the need for multi-platform, mission-linked tactical flight training.

The CFFC Fleet Training Strategy (FTS) recognizes that Navy training has to be tailored to meet the specific needs of the Warfighter, especially those needs identified as unique naval core competencies, such as ASW proficiency. The FTS also recognizes that the "end state" for Fleet training is to provide forces trained as they would fight in that "specific theater". Therefore, shore components must provide opportunities for the Warfighter to conduct netted inport multi-unit training.

CNO (N6M) and CFFC have also conducted a Fleet Training M&S Study, which advocated the increased use of M&S for training. The study concluded that the Navy needs to employ simulation to replicate deployed systems. By taking advantage of the significant advances in M&S technologies along with rigorous matching of M&S capabilities to training objectives, the study concluded that the Navy could increase training effectiveness while reducing training costs.

More recently, the ITA is transforming to become the Navy Continuous Training Environment (NCTE). The NCTE, in conjunction with the JNTC, will provide the capabilities to conduct training on demand by providing a "persistent network" to connect training assets that are geographically separated.

As can be seen by these examples, there is currently a very strong emphasis to transform Navy (and DoD) training. Selected use of promising M&S technologies will enable military forces to better meet the increased operational demands and surge requirements of the National Security Strategy.

The need for realistic, integrated, and netted training in all warfare areas is fully recognized at all levels of leadership. The requirement is in place. The decision to take full advantage of promising M&S technologies has been made.

So, what is one area in which the Navy could incorporate many of these developments?

Anti-Submarine Warfare (ASW) Training Requirements

The Fleet (and Aviation) ASW Improvement Program (ASWIP) identified long ago that ASW staffs and platforms could significantly benefit from improved coordinated and integrated/netted training in an ASW synthetic environment, which is now required by the FRP. The current ITA, as well as many of our simulators, must better support aviation platforms for example, to fully participate in the Multi-Battle Group / Battle Group In port Exercise (MBGIE) training program. The entire ASW Team, down to the operator/crew level, must train together to identify and resolve operational and tactical issues prior to their at-sea training period. ASW Commanders have long recognized that they could better prepare to conduct integrated operations at sea.

In ASW, close coordination among the aircrew, between the aircrew and its surface platform, and between the aircrew and other ASW platforms is required to carry out a successful mission. To make a sport's analogy here, ASW is the ultimate team sport. We need to practice as a full team. We need to train as we fight.

In order to make a unit's valuable at-sea training days more effective, it is essential that all the platforms involved with fighting the ASW battle become connected in a common, operationally relevant synthetic battlespace while in port to better learn how to coordinate and communicate as a team. **Integrated synthetic training will not replace flight and steaming hours. It will, given the proper chance, prove to <u>enhance</u> them significantly.**

Ultimately building a robust ITA/NCTE, as defined by CFFC, will be a giant step towards integrating Live, Virtual, and Constructive (LVC) ASW training for geographically dispersed units. The concept is certainly needed in order to allow the Navy to achieve the "Capabilities for the Navy After Next" as envisioned by the CNO.

Let's make another sport's analogy here to further illustrate the point. Suppose that we were talking about a baseball team whose practice schedule allows only 3-5 players on the field at once. The team does this everyday, allowing a different group of 3-5 players onto the practice field. Then on game day, the entire team goes on the field and is expected to turn double-plays, steal bases, and win the game without ever practicing together. This obviously won't work for any team to be successful. So if team sports have taught us anything, it's that perfect practice makes perfect.

Warfighters have to build sound mental habits through repetition to ensure that they do the right thing consistently, especially under stress. They can't just practice – they need to practice perfectly too. Said another way, in the heat of battle the military will fight just as they have trained, so there is a need to design an integrated and netted environment to allow Warfighters to train just as they want to fight.

The question we pose to you is this: **If the Navy cannot increase flight and steaming hours to better resolve these team training issues, can M&S technology provide an alternative solution for integrated tactical training prior to the at-sea period?** Absolutely!

A WORD CALLED "FIDELITY"

Fidelity is a word that is too often used in the wrong context, especially when the words "high" or "low" are placed in front of it. Many feel that high fidelity equates to high capability and cost, and low fidelity means just the opposite.

Fidelity in an M&S context is used to determine how a system may be modeled. It comes from the root word "faith" and signifies to what in the real world the simulation is being faithful. In a paper titled "Simulation Fidelity: Technology's Faithfulness to the Concept Today and Tomorrow," Dennis K. McBride, Ph.D. (1992) expertly discusses this very topic.

At the risk of doing his paper gross injustice, he discusses Man-System Interfaces (MSIs), and divides them into "Low-Order" (LO) and "High-Order" (HO). LOMSIs include "…fidelity attributes such as console appearance, aircraft roll, pitch, and yaw obedience…" HOMSIs "…reflect the essence of the supersystem." "…the simulator and its inhabitants are necessarily viewed as *but one* system *behaving*, as do MANY others, in the environment of reference."

The problem is that today (12 years after his paper was written), when "fidelity management" is used in the context of system acquisition, there is still a focus on the LOMSI at the expense of the HOMSI. In other words, the military services tend to design simulators to teach high level "skills" when in fact what they really need to focus on is "expertise" (tactics, for example). Program managers must better understand the concept of "fidelity" as it relates to requirements in the context of what a simulator really needs to do.

ASW Air Virtual at Sea Training (VAST) program's Mission Rehearsal Tactical Team Training (MRT3) system is a good example of a HOMSI system as discussed by Dr. McBride, and his HOMSI/LOMSI concept supports our decision to use PC-based simulation to rehearse/teach team ASW tactics.

BACKGROUND

The Helicopter Antisubmarine Squadron Light (HSL) Crew

In the HSL Community, the standard ASW Tactical LAMPS (Light Airborne Multi-Purpose System) ASW aircrew is made up of three: Pilot, Co-Pilot and Sensor Operator. The Pilot is dual-hatted as both a Helicopter Aircraft Commander and the Mission Commander. The Pilot is the crewmember that is ultimately responsible for both the safety of the aircraft and the success of the tactical mission. The Co-Pilot, often an H2P (Helicopter Second Pilot) is also designated as the Airborne Tactical Officer (ATO) responsible for running the tactical displays in the cockpit and with coordinating with the SENSO and Pilot on the tactics to be executed. The SENSO is the crewmember that operates the many various sensors (e.g., radar, acoustics, and non-acoustic, etc.). There is a significant amount of crew coordination, communication, and teamwork that must take place between these crewmembers and the other members of the ASW team in order to successfully complete a mission.

HSL Crew ASW Tactical Training

Until recently, the Sea Based Weapons and Advanced Tactics School (SWATS, now known as the Center of Maritime Dominance (CMD)) located in San Diego, had the mission to train post-Fleet Replacement Squadron (FRS) aviators in coordinated ASW tactics. The syllabus included a stair-stepped approach that began in the classroom, moved on to the Weapons System Trainers (WST), and then exercised two days at the Southern California Off-Shore Range (SCORE), a fully instrumented training range where flight and steaming hours are expended. Inevitably, the first day's range events discovered tactical coordination issues that could not be anticipated in the classroom or resolved in the non-netted FRS WSTs. A pertinent belief posed by the school's staff at the time, was how much better the live range training would have been if netted training could have been conducted ashore beforehand in an integrated synthetic environment. Netted, integrated synthetic training ashore could have focused on solving the inherent tactical coordination and communication issues prior to the first day's at-sea range period; making that flight time much more valuable. (NOTE: CMD now conducts the battle group level Maritime Integrated Tailored Training (MITT) ASW exercise event for both the east and west coasts. CMD and their mission will soon be absorbed into the new Fleet ASW Command (FASWC).

This shortfall in coordinated ASW tactical team training led SWATS to publish a Mission Needs Statement (MNS) in 1997; it was later called the Maritime Integrated Training Architecture (MITA) and was endorsed by Commander, Naval Air Force, U.S. Pacific Fleet (COMNAVAIRPAC) and Commander In Chief, U.S. Pacific Fleet (CINCPACFLT). (Recently, the MITA MNS has been re-invented as an Initial Capabilities Document by CNO N74P and sent to CFFC as a draft ASW synthetic training environment requirement within the ITA). The requirement that the ASW Community (Aviation, Surface and Undersea) must train in a richer integrated / netted environment in order to facilitate realistic mission rehearsal tactical team training ashore prior to the at-sea period is now well recognized.

Unfortunately, neither the state of technology available at that time nor its high cost could support the major investment that would have had to occur to modify the entire Navy legacy WST trainer inventory for integrated/netted operations. Navy legacy trainers were not designed to be interoperable; they were designed to focus on individual "platform" training, not coordinated/integrated tactical "mission" team training.

In 1999 the Chief of Naval Education and Training Assessment Division began a program called "MicroSims", which looked to PC-based technology for assistance with some very basic aviation skills training such as learning course rules, airway navigation, and flight maneuvers. Development of a low cost procedure trainer on a PC-based laptop was initiated using a Commercial Off-The-Shelf (COTS) product called Microsoft Flight Simulator™ (Flight Simulator™). MicroSims allowed Navy Flight Students to "chair fly" their flights before climbing into the actual aircraft. Additionally, the CNO N79 Office of Training Technology had continued to invest in breaking down the technical and acceptance barriers for low-cost simulation technology.

The Navy took advantage of PC-based technology development, which could now support, at a reasonable price, the use of COTS applications for aviation basic skills training. The networking of simulation systems had also taken a giant step forward with the maturation of the Distributed Interactive Simulation (DIS) networking protocols and the development of the High Level Architecture (HLA). By 2002 it became clear that PC-based technology could offer an affordable and workable solution to the synthetic, integrated tactical team mission training problem.

One of the first PC-based tactical team training solutions came out of the NAVAIR Orlando Training Systems Division (TSD) research and development labs in 2002. The original prototype called SH-60B Training for Active, MAD and Passive Sensors (STAMPS) was demonstrated at I/ITSEC 2002. In March 2003, the ONR VAST Program Manager funded an R&D prototype improvement to the existing SH-60B STAMPS device, which resulted in what is now called the ASW Air VAST MRT3.

The goal for MRT3 in 2003 was to build, in a short period of time, a prototype of a deployable and networkable PC-based tactical team trainer. It would use existing M&S technologies that would allow interaction with the Battle Force Tactical Trainer (BFTT) and the ITA, and would be in compliance with the Naval Aviation Simulation Master Plan (NASMP). The SH-60B MRT3 was demonstrated to the Center of Maritime Dominance (CMD) in October 2003. (The primary focus of CMD (formerly SWATS) is to improve integrated ASW and Surface Warfare (SUW) for Carrier Strike Groups (CSG) and Expeditionary Strike Groups (ESG) in both the Atlantic and Pacific Fleets. It is for this reason that CMD was selected as the lead Fleet advocate for MRT3.) In addition to CMD, the HSL Weapons and Tactics Units (WTUs) from both coasts are providing SH-60B Subject Matter Experts (SMEs) for this project.

MRT3 PROGRAM DEVELOPMENT STRATEGY

The MRT3 program adopted a three phase, spiral design strategy. Phase I became a five month Proof of Concept task that used existing M&S technologies to prove that PC-based simulation could be configured as an acceptable host for a tactical team trainer. The main goal of this phase was to demonstrate the usability of the basic laptop design while soliciting fleet users' comments on its potential application for providing ASW tactical team training. Phase II commenced in 2004 and was based on the lessons learned in Phase I. The goal was to network **three** SH-60B MRT3s, and to begin integration into the ITA. Phase II supported a specific set of HSL Training and Readiness events within an ASW federation.

Phase II also addressed engineering design solutions (analysis of alternatives) to the SH-60B data link system. The SH-60B has a unique piece of equipment called the HawkLink which allows the LAMPS aircraft to link with and pass raw tactical data to its surface platform (e.g., a DDG-51 class ship). This Ship / LAMPS team operates in unison to accomplish the tactical mission.

Phase III will continue the MRT3 spiral design process. This phase of the project will address, in part, usability and reliability issues, provide the Fleet a deployable ASW team training capability, expand on the integration into the ITA (primary focus), improve on the After Action Review (AAR) functionality, and will look to increase the types of ASW platforms that are a part of the current ASW federation, i.e., P-3C, SH-60F, and MH-60R.

The long-term goal is a deployable, integrated, netted system that will cognitively challenge its users to think, plan, and employ coordinated / integrated ASW tactics. Metaphorically, it will enable tactical "stick and rudder training for the mind." Tactical training that would have previously been expensive to develop and difficult to provide will be readily available to Warfighters on a laptop with a relatively low cost and small footprint. **PC-based simulation has the potential to do for tactical team training what the Internet has done for creating communities of learners. It will facilitate access and act as the catalyst to spur "in-situ" tactical thought: anywhere and at anytime.** If this is done correctly, the quality of the training accomplished during the precious few at-sea ASW training periods will be improved. The tactical proficiency of teams/crews will also increase.

This in turn will significantly enhance combat readiness, which is ultimate goal of the program, and the bottom line.

The MRT3 Phase I prototype SH-60B MRT3 demonstrated the capability to support tactical team training and was judged a success by the Fleet. The laptop MRT3 design proved to be effective, and the Fleet determined that ASW tactical team training could be performed using this kind of system. Commander, U.S. Pacific Fleet (COMPACFLT) endorsed the ASW Air VAST initiative in a letter to ONR on 1 April 2004. COMPACFLT stated that this "…initiative is significant…a key step toward a complete ASW Synthetic Training Environment…COMPACFLT fully supports development of the SH-60B MRT3 device." Further Fleet feedback is summarized at the end of this paper.

PHASE I

Proof of Concept

Synthetic integrated training is a complex task. The first decision point for the team was to narrow the focus for the short term Phase I proof of concept. The NAVAIR Orlando / BMH Team focused on the SH-60B LAMPS and the HSL-coordinated ASW mission. As time and resources were short, the team had to leverage from work that had already been completed and tested. For example, in order to ensure integration into the current ITA (and by extension the JNTC), a Computer Generated Forces (CGF) application called Joint Semi-Automated Forces (JSAF) was chosen, as well as other major components, such as the Battle Master Exercise Control (BMEC) station, and the Multi-Host Automation Remote Control and Instrumentation (MARCI) tool. The acoustics engine was leveraged from the Complete Acoustic Analysis Training System (CAATS). The system utilized a shallow water ocean modeling approach that could be run on small footprint off-the-shelf PC-based computers. The CAATS contact generation and acoustic propagation components were reused, but the SH-60B signal processing and display and control system needed to be developed in order to tailor the simulation to represent the helicopter's platform capabilities. **CAATS is a high fidelity system in that its focus is on providing an accurate (as possible) representation of the acoustic environment.**

The team needed a low fidelity flight model and therefore chose to leverage the work completed under the MicroSim program using the Microsoft Flight Simulator™ application. On the communications side, the team leveraged the work done with BFTT under the BFTT Digital Voice (BDV) and Marine Digital Voice (MDV) programs. All of these technologies were previously developed, tested, and already in use. Our challenge was to find a rapid means to integrate them into a common synthetic battlespace using laptop hardware.

For many reasons, there is a negative perception attached to any program that advocates placement of any kind of flight training on a laptop. Therefore, the NAVAIR Orlando / BMH team knew they had to be careful about managing expectations. The perceived use of low physical fidelity flight simulations, in this case a laptop simulator, for procedural skills training was a source of contention. In fact, the Air VAST / MRT3 system is <u>not</u> a procedural flight skills trainer; it does not train "stick and rudder" skills. The aircrew members who employ the MRT3 are already experts in the operation of their aircraft systems. (In other words, the focus here is on Fleet experienced / post-FRS aviators.) Instead, the MRT3 uses a lower fidelity flight model to give the pilot the general look of an SH-60B, but its main purpose is to allow the SH-60B to "fly" in the tactical problem while training the crew on the <u>cognitive aspects of performing an integrated ASW tactical mission</u>. The team sacrificed physical fidelity on this laptop trainer (at no expense to this type of training) in order to achieve high mission space fidelity, which is the primary goal. Therefore, it has a high fidelity acoustics application which allows the Sensor Operator to process sonobuoys acoustically and aurally, and also allows the Airborne Tactical Officer (ATO) to coordinate the tactical problem. The project's main goal was to give the SH-60B crew the functionality needed to perform the tactical ASW mission as a team. The goal for Phase I was to prove the concept that PC-based simulation technology would allow a LAMPS aircrew to perform ASW Tactical training together as a crew.

There was a requirement to ensure that the right team training objectives were targeted, and there was a need to ensure that the right training transfer to the user would occur. These requirements were addressed by including a research psychologist on the team to focus on training and training transfer issues.

Phase I MRT3 High Level Requirements

Since the team was under significant time and budget constraints, the objective for Phase I was limited to delivering a basic SH-60B that could perform the ASW tactical mission called the Quick Kill. This is an event that is practiced on the SCORE range (usually at the end of an ASW event), which challenges the ASW air platform to make an urgent attack on a located ASW threat (usually the MK-30 target). The only thing that was modified in this Quick Kill event was the amount of time that the crew had available to score a hit; for demonstration purposes, the crews were give additional time to locate the threat and to launch a weapon.

All of the requirements for Phase I were focused on allowing the SH-60B crew to successfully rehearse the Quick Kill exercise, including correctly configuring the weapons armament panel and dropping a MK-46 anti-submarine torpedo. Phase I did not include any electronic warfare or tactical data link operations, although these are recognized requirements and will be addressed in later phases. Also, Phase I was kept at an unclassified security level to facilitate design. The capability to support SECRET level training will be included in Phase II.

The team established the following high level requirements for a successful Phase I prototype system:

1. Portable (laptop based)
2. Networkable (DIS / HLA)
3. Compatible with BFTT, NASMP and the ITA.
4. Non-proprietary
5. Focused on ASW tactical team training within the SCORE Range (unclassified)
6. Represent a single SH-60B
7. No electronic warfare or data link (HawkLink) capability
8. Prosecute a single submarine target using a MK-46 anti-submarine torpedo
9. Use active and passive Navy sonobuoys, radar, and Magnetic Anomaly Detector (MAD) sensors
10. Accept known requirements beyond Phase I
11. Include After Action Review (AAR) and Instructor / SME control
12. Function in either a networked or a stand-alone training mode

Marine Digital Voice (MDV) Communications

It is appropriate to comment here on the technical strategy that the team used to deliver administrative, tactical (virtual radio), and internal crew communications, in view of the implications that this design will have on future systems. Every station / crew member was required to have a headset with a microphone and a footswitch to activate both radio and ICS (Inter-Communications System) communications. This design approach was chosen in order to allow multiple, distributed stations to interact, regardless of their location. This is reflective of the real world communications systems. MDV utilizes the DIS protocol standard. (MDV communication concepts were originally developed for the BFTT program and have been used quite successfully.) The advantage of using MDV (other than it is already DIS-based and BFTT compatible), is that requirements can be input into MDV to allow real world environmental and physical representations to be made in the virtual training environment. This capability includes calculations for effects such as over the horizon signal loss, terrain masking, power and signal loss and degradation, jamming, and other environmental effects. MDV not only allows users to communicate in the DIS/HLA world, but it allows them to train realistically. If a user is not supposed to get radio communications, he or she will not receive them. Additionally, MDV utilizes standards that are compatible across services, which will become a significant issue in view of the requirement to integrate into the joint training arena. MDV may also be modified to be compatible with other voice standards as required in the future.

Phase I MRT3 System Requirements

From June through October 2003, work centered around designing the basic system. Using four laptop computers, the team designed, built, and tested the following stations:

Pilot Station

Using Microsoft Flight Simulator™ as the foundation application, a basic pilot station was designed, which allowed the Pilot to have the minimum aircraft flight control and instrumentation needed to fly the ASW mission. The aircraft is controlled using a low cost COTS "joy stick". Navigation and communication functions are also provided. A basic "outside the cockpit" visual display is included above the instrument panel, but this is not considered essential to training success. The Flight Simulator™ application was also improved to allow it to work in a DIS environment. It was envisioned that the Pilot will need to be closely involved in the cognitive aspects of the tactical problem in order to properly train his crew; however, it is also recognized that minimum flight Situational Awareness (SA) will need to be maintained to allow the Pilot to maneuver the aircraft in response to crew commands and the tactical situation. Our task is to use available technology to successfully function in the gray area between tactical training requirements and necessary flight SA.

Airborne Tactical Officer (ATO) Station

The ATO crew station was designed to represent the functions required for the ATO to complete the ASW

Quick Kill mission. It simulates acoustic and non-acoustic sensors available in the real aircraft. It was developed using digital photography of the actual ATO station, placing those pictures on the laptop with the corresponding hot buttons. The ATO station includes the tactical display and the associated control panel. A separate Weapons Armament Panel was also designed using touch screen technology. The same digital photography model with representative hot buttons was used for the Weapons Armament Panel, which is located next to the ATO panel.

NOTE: It became clear early in the project that a major requirement for ASW training was proper selection and entry of weapon and sensor settings by the crew. Touch screen technology was chosen in order to begin to gather user feedback on the best technology implementation for this requirement.

Sensor Operator (SENSO) Station

The SENSO Station display was also developed using a digital photograph with hot buttons incorporated to provide the necessary functionality to support Quick Kill mission execution. The sensors included are radar, MAD, and acoustic (active and passive) sonobuoys. The acoustic engine leveraged from CAATS was a passive implementation, and it was modified to include active sensors and processing for the operator. As discussed earlier, for this kind of tactical (expertise) training to be successful, it must ensure that the SH-60B operators perceive the threat to be real. That is, the system is accurately represented, the threat submarine behaves realistically and challenges the operators, and realistic acoustic information is displayed that reflects what would normally be seen.

To enhance future training exercises, the team is investigating use of the JSAF-coupled atmospheric model called Ocean and Atmospheric Services Environmental Simulation (OASES), a data server that provides environment data (descriptions of the acoustic and meteorological conditions) to be consistent with other networked acoustic simulation environments. OASES currently provides environmental descriptions to a propagation loss server called the Acoustic Transmission LOss Server (ATLOS) system. ATLOS is based on the transmission loss model called FeyRay, which is consistent with the Transmission Loss (TL) model used by ASW Air VAST. ATLOS would receive that environment description via the network and input it into its model to calculate the TL, and then distribute those TLs as needed for networked simulations. This approach will foster interoperability between a range of ASW simulation systems.

Interim Instructor Operator Station (IIOS)

There was a requirement to provide a device to control the exercise (function of the Instructor or SME), so the team used the BMEC technology, which was developed as part of the ONR Virtual Training and Environments (VIRTE) program. The BMEC provides an intuitive, common interface to most of the major system components. The BMEC is divided into three parts. The Runtime Manager provides the user with the ability to load and manage sets of components (processes and applications) known collectively as a configuration. The Configuration Wizard allows the user to create, edit, and store multiple, unique system configurations. The BMEC Daemon process is an application that resides on each component's processor, providing the Runtime Manger with a component identity, machine statistics, and process monitoring and control functions. Developers were able to use the current After Action Review (AAR) system supplied with BMEC. They also added the capability to flag events as they occur and to record and playback all voice communications (both inter-communications within the aircraft as well as tactical radio communications).

Figure 1 below, shows pictures of the four MRT3 Station displays as developed for Phase I.

Figure 1. MRT3 Phase I Station Displays

Phase I Proof of Concept Demonstration

In October 2003, the NAVAIR Orlando / BMH Team traveled to CMD in San Diego to demonstrate the first SH-60B MRT3 prototype as described above. Observers from many interested Navy commands attended (see Figure 2).

The demonstration took place over a two day period and consisted of running four different crews through the ASW Quick Kill scenario. Standard ASW tactical and environmental briefings were given to the crews, and each crew was given some time to become familiar with the trainer. However, each crew was able to fully operate their stations within a few minutes with little or no instruction, largely due to the fact that the keystrokes on the MRT3 are identical to those that would be used in the aircraft.

Figure 2. ASW Air VAST MRT3 Phase I prototype demonstration at CMD, San Diego, October, 2003

The basic scenario began with the SH-60B airborne and flying at 400 feet within one mile of its ship. MAD was deployed and streaming, and the LAMPS was provided an estimated range and bearing to the threat submarine. The submarine, at periscope depth, reacted to the LAMPS radar and submerged. The LAMPS crew had limited time to re-locate the submarine, launch its MK-46 torpedo, and set up for a re-attack. Radar, MAD, and active and passive sonobuoys were employed. An Instructor / SME provided by CMD as well as personnel from the HSL WTU acted as the ASW Tactical Air Controller. Once launched by the MRT3 crew, the torpedo ran its pattern. If the Weapons Armament Panel was set correctly based upon the threat/environment and the torpedo was dropped in the correct area, the weapon hit and detonated. If the pre-set torpedo configuration parameters were not correct, or if the torpedo was not dropped in the correct position relative to the submarine, the weapon would continue to run to exhaustion (miss). These weapons events are seen both graphically on the IIOS display, and heard aurally on the SENSO's headset.

Upon completion of the event, an AAR debrief was conducted. The system provided the capability to record pertinent entity state and event data, and it enabled the Instructor / SME to flag key events for playback and display to facilitate the AAR debrief. This included voice communications, sonobuoy drops, ground truth for the target / LAMPS, and weapons run information.

AFTER ACTION REVIEW (AAR)

A good AAR capability will allow commanders to be much more analytical about how they choose to train their forces by providing detailed information on force readiness. In an interview with "SeaPower" magazine (May 2004), Vice Admiral Gary Roughead (Commander, Second Fleet and NATO Striking Fleet Atlantic) says it this way: "…I have a group here. I know things about that group. How can I make them most effective? At the end of the day, we will get to higher levels of readiness with less expenditure of resources than we have in the past." Only simulation, along with the data basing / tagging of key metrics, and knowing ground / perceived truth will enable the Navy to arrive at this point. ASW Air VAST MRT3 fully supports this requirement.

FLEET REVIEW AND FEEDBACK

The Fleet response to the Phase I MRT3 capability demonstrated was very positive. The crews felt that they received valuable crew ASW training and were challenged to perform the Quick Kill tactical mission. They agreed that they had just completed a good "stick and rudder workout for their mind". They stated that they received excellent crew tactical training, despite the fact that this was an early prototype version of the future system and it was on a laptop. Here are some actual quotes from the Phase I demonstration:

"Great training value, especially with tactics and crew coordination." (Navy HSL WTU Pilot)

"…way to practice real life scenarios…huge loss if not delivered." (Navy HSL WTU Pilot)

"It's exactly what we need…extremely high training value." (Navy HSL WTU SENSO)

"…can be used anytime, anywhere." (Navy HSL WTU SENSO)

"…once integrated, this system will really enhance BGIE participation." (Navy HSL WTU Pilot)

"Fantastic and can only get better." (Navy HSL WTU SENSO)

The West Coast HSL Commodore summed it up best: "This is an extremely high value training tool that will help us meet our need to do integrated [ASW] training, as well as support our Training and Readiness matrix – it's exactly what we need, and the vision is right on the mark."

HOW COULD THIS TRAINER BE USED

How it could be used is totally a Fleet decision. It is envisioned that there are potentially many different ways that this kind of tactical team training device could be applied; some of which have never been readily available to the Fleet before because it was a "too hard" or it was "too expensive". For example, this type of trainer could be used by the Fleet to:

- Fold into current training to maintain tactical crew proficiency (and currency) while ashore or deployed to maintain expertise, and to compliment other training
- Rehearse tactics prior to any tactical flight or range event
- Rehearse tactical T&R (Training and Readiness) qualification events
- Rehearse in M/BGIE integrated tactical events
- Rehearse in preparation for MITT or other exercises
- Rehearse / train with the Weapons and Tactics Instructor
- Allow each HAC/Mission Commander to tactically train & stress his/her crew as desired
- Train on some basic "motor skills"
- Train individually or as a crew as desired; for refresher, for fun
- To tactically compete with other networked crews as desired

WHAT IS NEXT

At the time of this writing, the MRT3 team is improving the system based upon Fleet feedback from Phase I and as directed and funded by ONR and CFFC. The goal is to produce a Phase II "leave-behind" system by March 2005 based upon the work completed to date. Phase II has four main objectives:

1. Improve the current SH-60B simulation
2. Network three SH-60Bs
3. Begin integration into the current ITA
4. Provide engineering design recommendations for HawkLink compatible with BFTT and NASMP

This PC-based simulation concept applies to other ASW platforms including SH-60F, P-3C, and the MH-60R, as well as to other warfare areas besides ASW (e.g., Surface Warfare). Plans for Phase III and beyond will address these issues as well as provide architecture and User-Interface improvements, further ITA/NCTE integration (primary objective), and AAR improvements such as automatically capturing ASW metrics. We plan to use Tactical Decision Aid tools such as Personal Computer – Interactive Multisensor Analysis Trainer (PC IMAT), and Tactical Warfare Instructional Support Environment (TacWISE) as a part of the environmental and AAR packages. Additionally, work in the torpedo arena will include efforts to partner with Naval Undersea Warfare Center, Newport RI, in order to capitalize on their world-class ASW weapons expertise. The team will also look in the SUW (Surface Warfare) arena to examine the potential to assist the Fleet with training for the Hellfire, Harpoon and Maverick weapon systems and with their associated missions.

A FINAL POINT

Clayton M. Christensen of the Harvard Business School (1997) describes "disruptive technologies" as ones that "…bring to market a very different value proposition than had been previously available. …they have other features that a few fringe (and generally new) customers value. Products based on disruptive technologies are cheaper, simpler, smaller, and frequently, more convenient to use."

PC-based simulation does seem to fit Mr. Christensen's definition. Is PC-based simulation a disruptive HOMSI technology within the training and simulation industry? Only time will tell.

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