2012-03

The Sea of Simulation : Improving Naval Shiphandling Training and Readiness through Game-Based Learning

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THESIS

THE SEA OF SIMULATION: IMPROVING NAVAL SHIPHANDLING TRAINING AND READINESS THROUGH GAME-BASED LEARNING

by

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March 2012

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This thesis was performed at the MOVES Institute
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REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704–0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202–4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704–0188) Washington DC 20503.			
1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** March 2012	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE The Sea of Simulation: Improving Naval Shiphandling Training and Readiness through Game-Based Learning			**5. FUNDING NUMBERS**
6. AUTHOR(S) Ethan A. Reber, Benjamin J. Bernard			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943–5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number NPS.2011.0101-IR-EP7-A.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words)

Currently, a gap exists between seminar-style shiphandling training and higher fidelity simulations available to the U.S. Navy Surface Warfare Officer (SWO). There is currently no individually accessible, low cost, intermediate level, interactive modality shiphandling resource that would allow SWOs to practice shiphandling skills without requiring instructor oversight. A student research team from the Naval Postgraduate School's MOVES Institute exposed newly commissioned SWO students at the Surface Warfare Officers School to basic task scenarios designed to be complementary to material covered in their introductory course of instruction utilizing VSTEP's "Ship Simulator Extremes" game. The students completed the treatment task trainer protocol utilizing a Coast Guard High Endurance Cutter model and continued with the standard introductory course curriculum where they utilized the fully immersive Conning Officer Virtual Environment (COVE) shiphandling trainer. Students were later evaluated in COVE on their ability to maneuver a Guided Missile Destroyer, a similarly configured but larger ship, underway from a San Diego pier. The students exposed to the game-based scenarios performed at a statistically significantly higher level in the categories of "Standard Commands" and "Margins of Safety Maintained"—two key indicators of shiphandling proficiency—following their normal course of instruction, than the control group. Also of note, the novice level students encountered difficulty in unlearning the handling characteristics of one model and learning a new one through the course of their instruction. Our findings suggest that an individually accessible, game based, shiphandling task trainer with ship models matching those found in the COVE and Full Mission Bridge would benefit newly commissioned SWOs by reinforcing classroom instruction. This trainer could potentially be used by SWOs of all skill levels as a self-study tool prior to participation in high level, fully immersive, and manpower intensive, naval shiphandling simulators.

14. SUBJECT TERMS Game Based Learning, Shiphandling Training, Shiphandling Simulation			**15. NUMBER OF PAGES** 188
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540–01–280–5500 Standard Form 298 (Rev. 8–98) Prescribed by ANSI Std. Z39.18

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN
MODELING, VIRTUAL ENVIRONMENTS AND SIMULATION (MOVES)

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

Currently, a gap exists between seminar-style shiphandling training and higher fidelity simulations available to the U.S. Navy Surface Warfare Officer (SWO). There is currently no individually accessible, low cost, intermediate level, interactive modality shiphandling resource that would allow SWOs to practice shiphandling skills without requiring instructor oversight. A student research team from the Naval Postgraduate School's MOVES Institute exposed newly commissioned SWO students at the Surface Warfare Officers School to basic task scenarios designed to be complementary to material covered in their introductory course of instruction utilizing VSTEP's "Ship Simulator Extremes" game. The students completed the treatment task trainer protocol utilizing a Coast Guard High Endurance Cutter model and continued with the standard introductory course curriculum where they utilized the fully immersive Conning Officer Virtual Environment (COVE) shiphandling trainer. Students were later evaluated in COVE on their ability to maneuver a Guided Missile Destroyer, a similarly configured but larger ship, underway from a San Diego pier. The students exposed to the game-based scenarios performed at a statistically significantly higher level in the categories of "Standard Commands" and "Margins of Safety Maintained"—two key indicators of shiphandling proficiency—following their normal course of instruction, than the control group. Also of note, the novice level students encountered difficulty in unlearning the handling characteristics of one model and learning a new one through the course of their instruction. Our findings suggest that an individually accessible, game based, shiphandling task trainer with ship models matching those found in the COVE and Full Mission Bridge would benefit newly commissioned SWOs by reinforcing classroom instruction. This trainer could potentially be used by SWOs of all skill levels as a self-study tool prior to participation in high level, fully immersive, and manpower intensive, naval shiphandling simulators.

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LIST OF ACRONYMS AND ABBREVIATIONS

ATG	Afloat Training Group
ARPA	Automatic Radar Plotting Aid
BRM	Bridge Resource Management course
BSH	Basic Ship Handling course
CG	Ticonderoga Class Guided Missile Cruiser
CI	Confidence Interval
CNSF	Commander Naval Surface Forces
CODAG	Combined Diesel and Gas
CO	Commanding Officer
COGAG	Combined Gas and Gas
COTS	Commercial Off-the-Shelf
COVE	Conning Officer Virtual Environment
CRESST	Center for Research on Evaluation, Standards, and Student Testing
DDG	Arleigh Burke Class Guided Missile Destroyer
DIVTACS	Division Tactics
ECDIS	Electronic Chart Display and Information System
FCAs	Fleet Concentration Areas
FMB	Full Mission Bridge
FOM	Freedom of Movement
FOV	Field of View
FRTP	Fleet Response Training Plan
GUI	Graphical User Interface
OCS	Officer Candidates School

IMO	International Maritime Organization
ID	Identification
IRB	Institutional Review Board
ISIC	Immediate Superior in Command
ITS	Intelligent Tutoring System
MOVES	Modeling, Virtual Environment, and Simulation
NAWCTSD	Naval Air Warfare Center,Training Systems Division
NPS	Naval Postgraduate School
NROTC	Naval Reserve Officers Training Corps
NSST	Navigation Seamanship and Shiphandling Training
NVGP	Non-Video Game Player
OCS	Officer Candidate’s School
OOD	Officer of the Deck
PC	Personal Computer
POV	Point of View
SA	Situational Awareness
SD	Standard Deviation
SET	Special Evolutions Trainer
SFTM	Surface Force Training Manual
SME	Subject Matter Expert
SOG	Speed Over Ground
STA-21	Seaman to Admiral-21
SWO	Surface Warfare Officer
SWOI	Surface Warfare Officer Introduction
SWOS	Surface Warfare Officers School

TFT	Thin Film Transistor
ULTRA	Unit Level Training
UNREP	Underway Replenishment
U.S.	United States
USB	Universal Serial Bus
USCG	United States Coast Guard
USNA	United States Naval Academy
USN	United States Navy
VE	Virtual Environment(s)
VESUB	Virtual Environment Submarine
VGP	Video Game Players
WHEC	High Endurance Cutter
XO	Executive Officer

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ACKNOWLEDGMENTS

The authors would like to thank our thesis advisors, Professor Perry McDowell and Dr. Joseph Sullivan of the MOVES Institute. We appreciate all of the insight and support you provided to us throughout this research effort. You always found the time to listen, to suggest new directions, to share your experiences at sea, and to ensure we had funding to pursue something we believe in. Thank you.

We thank the officers and staff of Surface Warfare Officers School Command for opening their doors to us, providing research space, and making this thesis concept a reality. This effort would not have succeeded without the willing support and time of the consummate professionals of Fleet Training (N72) and Trainers and Simulation (N71) who bent over backwards to ensure we had whatever we needed. Thank you.

We thank Dr. Stanley Peters, of the Center for the Study of Language and Information, and Dr. Susan Kirschenbaum, of Naval Undersea Warfare Command. Your willingness to share your COVE ITS findings, research lessons learned, and comment on our experimental design was invaluable. Thank you.

We thank the students of the Surface Warfare Officer Introduction course who volunteered for our study. Your participation and feedback made our time worthwhile. Thank you.

Ethan would like to thank the following people who were critical to his success at NPS. To my beautiful wife, Nicole, for her love, patience, and understanding. Your support never wavered or faltered during my tour at NPS or numerous weeks away in support of research. I could not have made this journey on my own. I love you.

To Robert and Brylee, the best kids a Dad could ever hope to have. You help me stay grounded, keep me beaming with pride, and let me appreciate my most fulfilling job, being a father.

To my Mom, Sherry; my Dad, Rick; my mother-in-law, Victoria; and sister-in-law, Alyea; you were always there to support us in any way we needed, usually flying out before we could even ask. We would not have beat cancer without you. We love and value you always, and do not ever forget it.

Ben would like to thank his family for their support during the process of earning his master's degree. To my wife, Wendy, who put up with me cranky and stressed and never complained, for sixteen years you have always been there for me when I needed you. You are the best wife, friend, and companion I could have hoped for. I love you!

To my daughters, Alyssa and Alexis, thanks for understanding when I missed games, gymnastic viewings, and when I was just too busy to listen. Your laughter and love gave me the strength to achieve more than I ever thought I would. I love you girls!

I. INTRODUCTION

A. PROBLEM STATEMENT

There is currently no readily accessible, low cost, intermediate level, interactive modality, shiphandling resource to fill the existing gap between seminar-style shiphandling training and the higher fidelity simulations currently available to United States Navy (USN) Officers.

This presents a significant problem vis-à-vis U.S. Naval Officers reporting to the fleet, especially those from commissioning sources other than the United States Naval Academy (USNA) and other maritime specific institutions (e.g., United States Merchant Marine Academy), to whom watercraft and high quality shiphandling simulations are not available. Some leveling of the playing field can occur for the Naval Reserve Officers Training Corps (NROTC) First Class Midshipmen who participate in four weeks of Summer Cruise training, where, based on the ship's operational schedule, they may stand watch on the Bridge as a Conning Officer. However, officers commissioned via Seaman to Admiral-21 (STA-21), Officer Candidate's School (OCS), and Direct Commissioning programs such as Limited Duty Officers (LDOs) and Chief Warrant Officers (CWOs) are not afforded these same opportunities, and as a direct result, can show up to their first assignment significantly behind the shiphandling learning curve when compared to their peers.

Surface Warfare Officer's School (SWOS) in Newport, RI, has taken steps to ensure entry-level junior officers are exposed to common shiphandling evolutions prior reporting aboard their first ship through the implementation in December 2007 of the Surface Warfare Officer Introduction (SWOI) course. During this three-week course of instruction, the students are exposed to, among other topics, seamanship and shiphandling instruction. This shiphandling instruction includes four sessions in the Conning Officer Virtual Environment

(COVE), a fully immersive virtual environment used to simulate shiphandling tasks where a qualified instructor mentors the student.

The practice of providing entry-level training to junior officers prior to reporting aboard their first ship is a welcome change from the practice that existed between 2003 and the implementation of SWOI course. Until the implementation of SWOI course, junior officers were provided solely with a self-study course immediately prior to, and in some cases after, reporting to their ship. The course included lectures on shiphandling physics and videos of shiphandling tasks, but no environment where shiphandling evolutions could be rehearsed or practiced.

While the exposure of junior officers to shiphandling instruction and simulations in the COVE is certainly a step in the right direction, there is no real guarantee that the graduates of the SWOI course will be provided an opportunity to practice shiphandling evolutions upon reporting to their ships at the frequency necessary to develop competency. These limited training opportunities are a function of reduced operating budgets for the ships, the infrequency of evolutions for officers to conn the ship during (e.g., mooring to a buoy), and limited throughput of the Fleet Concentration Area (FCA) shiphandling simulators relative to the number of officers stationed there.

A low cost, individually accessible, desktop shiphandling simulator would be highly beneficial to these entry-level officers, filling the existing gap between seminar style training and higher fidelity simulations. The benefits of such a simulation would not be restricted to this group alone, but could be used by the whole officer corps as a valuable virtual reality training aid to fill the gap in fleet shiphandling training resources.

B. RESEARCH QUESTIONS

1. Do SWOI course students who use semi-immersive, voice interactive, shiphandling game to practice tasks covered in classroom shiphandling theory,

prior to using the COVE, perform at a higher level than those not currently using shiphandling games? In which assessment categories will they perform better?

2. Do SWOI students who use a semi-immersive, voice interactive, shiphandling game to practice standard commands covered in classroom lecture, prior to using the COVE, perform their standard commands at a higher level than those not currently using shiphandling games?

C. HYPOTHESIS

1. Participants will perform at a higher level in the “Aggregate Maneuver” score category. The Maneuver score category for this study is composed of four subcategories:

- Margins of Safety Maintained
- Use of Rudder, Propulsion, and Tugs
- Anticipates and Evaluates Ship Responsiveness
- Standard Commands

2. Participants will perform at a higher level in the “Standard Commands” assessment subcategory in the COVE.

3. Participants will perform at a level consistent with the control group in the “Use of Rudder, Propulsion, and Tugs” subcategory. We expect this result due to the lack of representation of verbal tugboat control in the game-based task trainer.

4. Participants will perform at a higher level in the “Margins of Safety Maintained” subcategory.

5. Participants will perform at a level consistent with the control group in the “Anticipates & Evaluates Ship Responsiveness” subcategory. We expect the dissimilarity between the ship models in the game-based task trainer and the COVE to have a negligible effect on student performance.

D. OTHER EXPLORATORY QUESTIONS

Do the participants believe the game-based simulation helped prepared them for their use of the COVE?

Are the participants likely to use a tool of this type in the future and/or recommend it to their peers?

E. SCOPE

The scope of our thesis focuses on answering these research and exploratory questions. The research team developed five hypotheses to guide the experiment and ultimately answer the research questions. This research endeavor developed four prototype task trainer scenarios using Ship Simulator Extremes. The team then exposed a sample population of USN ensigns over the period of two evenings to the task scenarios. The ensigns then completed their normal SWOI course, after which they were evaluated in a standardized pier side shiphandling scenario. After the evaluation, the team analyzed the data, identified trends and explained the results. Finally, the report concludes with recommended future work.

F. DEFINITION OF TERMS

- Modality: One of the main avenues of sensation (as vision) (Merriam-Webster, 2012).
- Presence: defined as the subjective experience of being in one place or environment, even when one is physically situated in another (Witmer & Singer, 1998).
- Semi-Immersive: Modalities are manipulated to induce the appropriate degree of presence required to achieve a task (Sanchez-Vives & Slater, 2005).
- Fully Immersive: 360-degree displays and sound, with possible ceiling and floor displays, that affect the modalities of the environment change. Often incorporated with haptic modalities to increase presence (Sanchez-Vives & Slater, 2005).
- Individually Accessible: Being able to be accessed and utilized by one individual at whatever interval that individual requires.

- Interactive Modality: A mode that has both input and output activity to influence the user to believe something exists or is experienced or expressed.
- Intermediate Level: a level that is in between two extremes; in the application of this study- having a simulation between the low level seminar style environment and high level fully immersive environment of the COVE.
- Standard Commands: A set of consistent commands used by naval vessels to direct the use of rudders and engines.

G. MOTIVATION FOR RESEARCH

The study began with the question of whether or not a desktop computer game-based simulation could help a Surface Warfare Officer (SWO) maintain proficiency while he or she was not on a sea tour. As SWOs, we are judged on our ability to competently handle a ship through a range of evolutions. While assigned to duties ashore, there is a paucity of opportunities to exercise this skill set.

After playing and experimenting with the commercially available shiphandling computer games, we began to ask the question, “What if this had been available to us when we were brand new ensigns preparing to join the Fleet? Would this have made a difference in our shiphandling learning experience?” We believed that the answer to the question was an emphatic “Yes,” and polled other SWOs at NPS who concurred with us. It was at this point that we down selected a game to work with and began constructing our task trainer scenarios.

As previously discussed, there have been significant improvements already in shiphandling training methodology during our brief careers. Our motivation towards this research topic is not to reinvent the wheel when it comes to naval shiphandling training, just do our small part to improve it for our fellow and future officers and ourselves.

H. BENEFITS OF STUDY

We believe that by demonstrating that basic shiphandling skills trained in a desktop part task trainer will transfer to the COVE, this research has the potential to make shiphandling training more accessible to the individual user. By highlighting the capabilities of a tool of this type, we hope to provide an additional resource for SWOs of all levels to practice and maintain their shiphandling skills and ultimately move our service closer toward a comprehensive shiphandling training continuum.

I. THESIS ORGANIZATION AND TABLE OF CONTENTS

Chapter I: Introduction. This chapter defines the problem, lists the research questions, presents the hypothesis, and defines the scope and benefits of this study.

Chapter II: Background. This chapter provides a literature review for the study. This review includes current literature on video game use for training, current USN shiphandling training opportunities, current simulations available to USN shiphandlers, shiphandling proficiency requirements, fleet shiphandling training opportunities, fleet shiphandler evaluation, and naval training considerations.

Chapter III: Methodology. This chapter describes how the research team designed the experiment, including participants, procedures, facilities selection, and materials.

Chapter IV: Results and Discussion. This chapter contains the results of experimentation and an interpretation of those results.

Chapter V: Conclusions. This chapter provides an overall assessment of qualitative and quantitative data and recommends future work toward the design and implementation of a readily accessible, low cost, intermediate level, interactive modality, shiphandling game.

Appendix A: Pre-Experiment Instruction and Materials. This appendix contains the protocol followed in order to inbrief student participants and all reference materials provided to the students during the experiment.

Appendix B: Classroom Facility Setup. This appendix describes how the classroom, laptop computer, and audiovisual display equipment was set up in support of the simulation runs.

Appendix C: Approved IRB Protocol. This appendix contains the Institutional Review Board protocol for experimentation with human subjects. This includes approved Informed Consent forms, Demographic Survey, and Exit Survey.

Appendix D: CRESST Standard Surface Force Shiphandling Assessment. This appendix shows the Standard Surface Force Shiphandling Assessment developed by the National Center for Research on Evaluation, Standards, and Student Testing and used by Surface Warfare Officer's School Command for evaluation of students in the Conning Officer Virtual Environment (COVE).

Appendix E: Raw Demographic Survey Data by Question. This appendix displays the raw data in table format of the response to each question by participant.

Appendix F: JMP Raw COVE Data by Participant. This appendix displays the raw data from the instructor evaluated final COVE session for each participant.

Appendix G: Cognitive Task Analysis (CTA). This appendix displays the Hierarchical Task Analysis used in validating the suitability of the tasks developed in Ship Simulator Extremes, including a Critical Cues Inventory for each respective task.

Appendix H: CRESST Shiphandling Task Description and Grading Criteria. This appendix, developed by the National Center for Research on Evaluation, Standards, and Student Testing and used by Surface Warfare

Officer’s School Command, displays the description of each task in the COVE and associated grading thresholds.

Appendix I: CRESST Shiphandling Tasks, Standards, and Conditions. This appendix, developed by the National Center for Research on Evaluation, Standards, and Student Testing and used by Surface Warfare Officer’s School Command, contains the necessary standards, tasks, and conditions to Conn a ship underway from a pier.

Appendix J: Ship Simulator Extremes Scenario Construction. This appendix displays a systematic tutorial for constructing the four task scenarios used in this study.

II. BACKGROUND

A. INTRODUCTION

The military community has long embraced simulation. In 1931, Edwin Link patented the "Link Flight Trainer," which he had designed to teach himself how to fly. The trainer went on to be produced in the thousands and was used by many countries during World War II to train pilots. As simulation has improved, more services have decided to take advantage of it as a training tool. The Air Force has been the biggest user of simulation in the military services with flight trainers. These trainers were expensive and focused on the individual pilot. The Army has also used simulation, like the Advanced Gunnery Training System, to allow tank crews to practice vital communications skills prior to live fire events (Morgan, 2011). With improved technology resulting in better graphics, Artificial Intelligence, and miniaturization, the Army and Marine Corps have begun to embrace simulation for infantry personnel as well (Brown, 2010). The Marine Corps and Army both use Virtual Battlespace 2 (VBS2) as a tool for training (Robson, 2009) (Bohemia International, 2006). The Navy has embraced simulation (Nguyen et al., 2001) with the development of Virtual Environment Submarine (VESUB) for submarine officers to practice surface conning, an event too rare to provide the desired training opportunities. The most recent naval simulation suite, COVE, was developed directly from experience with VESUB (Nguyen et al., 2001). Simulation is vital in reducing cost and enabling multiple units to share a single wargaming experience, whether live, virtual, or constructive.

B. USE OF VIDEO GAMES FOR TRAINING

The term "Serious Game" was introduced in the simulation industry to distinguish between games designed primarily for training and secondarily for entertainment. Examples of serious games developed for use by the U.S. Army include VBS2, Full Spectrum Warrior, and America's Army. Other researchers have examined the application of games for training and reported varying measures of effectiveness (Brown, 2010) (Stinchfield & Caldwell, 2011). Researchers have used measures to determine the effectiveness such as user experience, orientation of user, ease of use, familiarity with input devices, and semi vs. fully immersive environments (Green & Bavelier, 2003).

1. Video Game Experience

A study by Green & Bavelier (2003, Nature, p. 534) showed "action video game playing is capable of altering a range of visual skills." An experiment in the study showed that "non- players trained on an action video game showed marked improvement from their pre-training abilities, thereby establishing the role of playing in this [visual attention] effect." Experienced video gamers have an advantage using serious games for training. The experienced gamers will have an increased capacity of their visual attention system and possess "enhanced attentional capacity," "enhance(ed) number of visual items that can be unerringly apprehended," and "enhanc(ed) task-switching abilities." Together, these newfound abilities could affect the speed of perception and the increased ability to manage several visual tasks (Green & Bavelier, 2003).

2. Orientation Periods

Organizations commonly hold orientation periods where they instruct new members in the organization's goals, methods, and ethos. Institutions of higher learning implement an orientation period that allows students to become accustomed to the location of important buildings and living facilities. These locations are "tools" that the student will need to be successful at the institution and the orientation is provided as a form of pre-training. The training allows students to embrace the main purpose of attending, education, and not worry about how to get to around. The same is true of computer tools that a simulation would use for training. Trying to complete a task in a software package without knowing how to navigate could lead to immense frustration and derail the trainee from the main purpose. Unless the study is examining the ability of learning the software, the basic implementations of input and manipulation of the software should be covered, at least to the point of basic understanding.

3. Ease of Use and Familiarity with Input Devices

Marc Prensky described in his book *Digital Game-Based Learning* that by the time today's average teenager enters the workforce he or she will have "played over ten thousand hours of videogames." He also describes, with a median age of 39, the "oldest employees [from the upper 50 percent of our workforce]- those between the age of 30 and 39, have been able to play, and for the most part *have been* playing, video games since junior high." He goes on to say, "the newest employee hires, just out of high school or college, have never known a world *without* video games." The new officers entering the U.S. Navy today have never known a world without input devices of some type (Prensky, 2000). With thousands of hours playing video games and using a personal computer, common input devices, such as a mouse, will be extremely familiar to the average ensign.

4. Semi-Immersive vs. Fully Immersive Environment

A person is in a fully immersive environment when he or she is completely surrounded by a device or devices that affect the modalities of the environment change. An example is a CAVE (Cave Automatic Virtual Environment) type of simulation in which a person would enter a room and be surrounded by screens displaying the new environment, along with sound, smell, and perhaps haptic (touch) feedback (VRS, 2011). A semi-immersive environment would refer to one that would display the environment to the appropriate degree of presence required to achieve the task. This varies depending on the application. A flight trainer with a complete mock cockpit with a concave projection of only 270 degrees is an example. The trainee is not fully immersed; however, the screen encompasses enough of his or her vision to be effective at training the required tasks (Sanchez-Vives & Slater, 2005).

C. CURRENT U.S. NAVY SURFACE SHIPHANDLING TRAINING RESOURCES

Through our experience as Surface Warfare Officers, and from the knowledge gained from the Surface Warfare Officer School Command website, we will describe the process and application of simulation in a Surface Warfare Officers career.

The U.S. Navy currently trains shiphandling through lecture and high-level simulation. The pipeline for surface warrior training begins at the commissioning source. Midshipmen will receive basic instruction in navigation and shiphandling at the institution they are attending. Depending on the school, midshipmen may pilot a small sailboat (e.g., Laser) and have the opportunity to go on summer cruise aboard ships, or, in the case of Naval Academy midshipmen, on yard patrol craft. Following commissioning, ensigns attend a Surface Warfare Officer Introduction (SWOI) course developed by SWOS. The course is in Newport, RI for OCS graduates and in ATG centers at FCAs for ensigns sent to the fleet from other commissioning sources. The SWOI course shiphandling training consists of a lecture followed by COVE sessions designed to initiate the students on standard commands, basic maneuvers, and pier work.

Ensigns complete the SWOI course and return to their ships and continue shiphandling training as a member of the wardroom.The training includes utilizing Navigation Seamanship and Shiphandling Training (NSST) facilities established in FCAs. Each ship is allotted a specific number of hours for using the NSST resource. Within a 24-month cycle, the command has opportunities to train officers via the U.S. Navy’s Navigation, Seamanship, and Shiphandling Training (NSST) program (see CH2-E, F). NSST provides classroom and Kongsberg V2 system simulator instruction in the form of three main courses: Bridge Resource Management (BRM), Basic Ship Handling (BSH), and Special Evolutions Trainer (SET). A number of ships have also received a shipboard installed Kongsberg V1 system to utilize for training.

Upon completion of division officer tours, officers will typically have no shiphandling training exposure until they attend the SWOS Department Head Course. An evolution of the original Destroyer School, the Department Head Course is a demanding and in-depth professional course Surface Warfare Officers attend in preparation for their department head tours. The intensive 24-week course prepares officers for duty as Engineering, Combat Systems, Operations, and Deck department heads on all classes of Navy ships. The course is divided into the Tactical Action Officer module and the SHIPTRAIN module, where students will receive shiphandling training. During SHIPTRAIN, students will attend several COVE sessions focused on improving shiphandling skills. SWOS has established a high standard of shiphandling expertise and all Department Head Course students are required to pass a rigorous shiphandling evaluation.

During a department head tour, an officer’s shiphandling exposure will vary depending upon the type of ship they serve on. Normally, department heads stand watch in Combat Information Centers (CIC) and staff watch centers rather than the bridge. Department heads are generally the primary source of training for new officers as they directly supervise the first and second tour division officers assigned to the ship.

After the department head tours are complete, the majority of surface warriors will have another gap in shiphandling experience until they report to SWOS for the “Command at Sea” courses. Command at Sea courses and curricula are designed to prepare prospective Commanding Officers (COs) and Executive Officers (XOs) with the tactical, operational, material management, and personnel skills to excel in command. The Surface Warfare Officer core competencies of navigation, seamanship, material readiness, and warfighting are reinforced through interactive lectures, seminars, simulators, case studies, and group discussion with subject matter experts (SMEs).

D. CURRENT GAME-BASED SIMULATIONS

1. Seminar-Style Training

Seminar training is the oldest form of shiphandling training. Typically, the Training Officer or Operations Officer provides a shiphandling lecture for the wardroom as part of the ship's continuing training plan. Several topics are discussed, and although each ship will have a slightly different version, the brief will be very similar to the SWOI course PowerPoint presentation (see Appendix J). The first instinct when trying to instruct about the nuances of shiphandling is to take a pen out of a pocket to demonstrate the basic concepts of forces affecting the ship, e.g., how the ship's stern is affected during a turn by controllable forces. For introductory lessons, it is enough for new officers to understand that the ship moves differently depending on the forces that are acting on it. Holistically all the senior members of a wardroom train junior officers through weekly training, occasionally conducting "table top" demonstrations to demonstrate how the ship is expected to behave during various evolutions from man overboard drills to underway replenishments (UNREP). Some ships have gone as far as having scale models made for this purpose.

2. Kongsberg V1 and V2

In 2004, the United States Navy commissioned bridge simulators at forward deployed naval forces bases. This effort represented the start of the USN's NSST program. The result of the NSST project was two PC-based systems, the Kongsberg Version 1 and Version 2, using emulation of shipboard equipment (Meers, 2011).

The Version 1 system or "V1" has been deployed on surface combatants. The V1 system is composed of two workstation PCs installed in a half-rack, an instructor laptop, helm, three Thin Film Transistor (TFT) displays, and sound system. Shore based systems alter this configuration by using a bigger

42” plasma display in lieu of the TFT displays. For ships with more space there is an “extended” version of the V1 that adds four control panels in lieu of two (Meers, 2011).

The V2 system is installed at FCAs and other central training locations. The system is comprised of a generic bridge mockup with 240 degrees of horizontal field of view from projection monitors. V2 measures approximately 15 x 18 feet and has the following equipment: bridge instrumentation console, a centerline pelorus, chart table, ARPA display, and a helm console. If required an ECDIS display can be added near the chart table (Meers, 2011).

Both V1 and V2 are capable of supporting individual officer and bridge team training. Nearly all aspects of general seamanship and navy specific shiphandling, maneuvering, and navigational training can be effectively conducted (Meers, 2011).

3. Conning Officer Virtual Environment (COVE)

In 1996, the Navy funded a multi disciplinary, multi institution research initiative called the Virtual Environment Technology for Training (VETT) program. The VETT program was established to provide submarine officers with a simulator to practice conning while surfaced. With funding from the Office of Naval Research (ONR) and the Naval Air Warfare Center Training Systems Division (NAWCTSD), MIT developed a prototype simulator to train Navy Fast Attack submarine OODs (Nguyen et al., 2001).

SMEs used the prototype created the VETT initiative to develop system requirements for a fully developed simulator. After a list of requirements was developed, Nichols / Advanced Marine developed the software and hardware integration of what is now known as VESUB (Virtual Environment Submarine) Simulator. The VESUB system uses a high-resolution head mounted display (HMD) to provide the trainee with a simulated 360 degree representation of the visual environment containing many of the required cues associated with harbor and channel navigation as well as accurate cultural features and varying environmental conditions. Voice recognition and synthesis provide communications training. A Training Effectiveness Evaluation (TEE), consisting of a survey of 41 naval trainees of various experience levels, verified the efficacy of the system. The system was acquired in 1999 and distributed to five major submarine training facilities where it is still in use (Zeltzer & Pioch, 1996).

VESUB's success in training submarine officers caused NAWCTSD to realize its potential to train surface officers as well. Having already developed the VESUB simulator, NAWCTSD proposed an evolution of VESUB, developed a list of requirements based on its use thus far and corrected also three specific VESUB limitations that needed to be addressed in a next generation simulator: instructor intensiveness, high cost, and "transfer of VE-based training to the real world task" (Nguyen et al., 2001). This improved shiphandling trainer would be known as Conning Officer Virtual Environment (COVE).

COVE was designed to correct the three main limitations of VESUB. Development focused on reducing instructor involvement and increasing capability of supporting the following tasks: basic navigation, shiphandling, seamanship, harbor and strait transits, contact management, pier and tug work, DIVTACs, stationing, plane guard, signals, flags, lights, and day shapes. COVE is also capable of supporting the following special evolutions: anchoring, mooring to a buoy, towing, UNREP, Man Overboard, and Engineering Casualties (NAWCTSD, 2010).

In addition to supporting ships evolutions COVE can be used for tactical operations training such as tactical maneuvering (shouldering, HVU Escort, VBSS approach, etc.), Anti-Terrorism/Force Protection (Anchored, Moored, and Underway), small vessel detect to engage (threat determination, escalation of force, deterrence, etc.), weapons management (M-60, .50 cal, 25mm, 5 inch), multi-ship coordinated tactics, techniques, and procedures (TTPs) (NAWCTSD, 2010).

Due to its purpose built scalability, COVE can train for individuals, bridge teams, or even multiple ships interacting together. COVE integrates several technologies such as the Integrated Technology Head Mounted Display featuring a 360-degree display, tactical and emulated hardware, and speech recognition (NAWCTSD, 2010).

Several FCAs have COVEs installed, SWOS in Newport, RI has twelve COVE 1 stations, six COVE 3 stations, a Full Mission Bridge simulator, and a reconfigurable LCS-1 or LCS-2 Full Mission Bridge simulator (NAWCTSD, 2010). Two stand-alone LCS-1 and LCS-2 simulators are in LCS shore based training facility, San Diego. For the training of pre-commissioning units, there are COVE 1 simulators provided at shipyards in Bath, ME and Pascagoula, MS. NSWC Panama City has installed a COVE RMV/USV Launch and Recovery Trainer. COVE 1 has also been used in some NROTC units for Midshipman Training. Variants of COVE are in use by the U.S. Navy Submarine Fleet, U.S. Coast Guard, and U.S. Army (NAWCTSD, 2010).

The COVE software package incorporates 56 harbor databases of strategic naval ports and operational areas around the world. 27 high-fidelity hydrodynamic ship models of USN warships and various ships and boats of tactical significance are also provided. In addition to USN and threat models, 36 low fidelity models of common ship traffic, target ships, aircraft and personnel models are available. Models are capable of displaying fire, smoke, weapons, and damage effects. The COVE hardware package depends on the required configuration (NAWCTSD, 2010).

4. Full Mission Bridge

The Full Mission Bridge (FMB) is an expansion of COVE that can train an entire watch team instead of focusing on a single officer. The FMB is a mock bridge, similar to Kongsberg V2, which is made up in the same general configuration as a bridge on a ship having a bridge instrumentation console, a centerline pelorus, chart table, ARPA display, and a helm console. COVE FMB is different from V2 in that it is displayed in a CAVE with the “bridge” being placed in the center giving the proper perspective. Trainees can move freely from bridge wing to bridge wing without a change in perspective. The trainer is capable of the full range of COVE scenarios and is equipped with virtual binoculars to simulate binoculars used by bridge watchstanders. The only existing FMB is located at SWOS in Newport, RI (Surface Warfare Officer School Command, 2011).

E. SURFACE FORCE TRAINING MANUAL SHIPHANDLING TRAINING PROFICIENCY REQUIREMENTS

Commander Naval Surface Forces (COMNAVSURFOR) directs shiphandling training via the Surface Force Training Manual (SURFORTRAMAN). The common mission area Navigation Certification Criteria requires a ship to maintain a Continuous Certification Requirement (CCR) called Bridge Resource Management (BRM). In order to accomplish this requirement the command must attend a 40-hour BRM course given at NSST locations in FCAs every 24 months. In addition to BRM, each ship is required to complete 28 hours of special evolutions training (SET) and attend a basic ship handling (BSH) course every 24 months (Commander, COMNAVSURFOR INSTRUCTION 3505.1A, 2010).

F. FLEET SHIPHANDLING TRAINING OPPORTUNITIES

To accomplish the requirements directed by COMNAVSURFOR, each commissioned U.S. Navy ship is allotted time in FCA NSST trainers (Kongsberg V1, V2, and Bridge Wing trainer; depending on location). Every ship has an annual allotment of up to 100 hours to include one formal course, BRM or BSH, plus up to an additional 32 hours of SET, (Commander, COMNAVSURFOR INSTRUCTION 3505.1A, 2010).

For the BRM course, ships are required to send three watch teams. Each team must consist of an Officer of the Deck and Conning Officer, plus a senior observer such as the CO, XO, or Senior Watch Officer. The ship may send junior bridge watch standers for training as well up to a maximum of ten total students (Commander, COMNAVSURFOR INSTRUCTION 3505.1A, 2010).

Ships can request one BSH course every 24 months; however, the ship must be greater than 6 months from completing a BRM and 6 months from the end of periodicity of the 24-month BRM requirement. The BSH course is a five day, 40 hour, simulator intensive course of instruction, designed for the newly commissioned officers and bridge watch standers. The course provides a valuable opportunity for elementary evolutions training, including classroom lecture and instruction, but focusing on and weighted towards simulator time. During the course students address forces on the ship, basic Rules of the Road, standard commands, tugs, getting underway, making a landing, transiting a channel, underway replenishment, man overboard, anchoring and tactical maneuvers. Class size is limited to six students (Commander, COMNAVSURFOR INSTRUCTION 3505.1A, 2010).

Special Evolution Training gives ships the opportunity to train in any evolution(s) the commanding officer believes will benefit his or her watch standers. Ships decide what combination of special evolutions topics and scenarios to schedule. The special evolutions modules are presented in four-hour sessions (approximately 45 minutes of instruction followed by three plus hours in the simulator) (Commander, COMNAVSURFOR INSTRUCTION 3505.1A, 2010).

1. Falling through the Cracks

A key differentiator between the surface navy and naval aviation communities is how the officers are prepared to enter the fleet and where the focus of preparation sits. New officers in the former will report to the fleet with some conceptual knowledge and limited time in the simulator while the latter report to their units knowing how to fly and ready to do so. Typically, without as much experience as their seniors, these pilots are still certified to have the skills. Aviators are the center of focus for preparation in their community as, holding aviation platform type constant; they can still accomplish their mission irrespective of the “side number” of the aircraft they fly. In the case of SWOs, it is and always must be “the ship” that is the focus of preparation. “The ship” performs the mission, “the ship” must be ready for tasking, thus the schedule of all crew members, officer and enlisted, revolves around “the ship.” This holistic team preparation concept must be grasped if one is to move forward in understanding how a newly reporting SWO integrates with their career assignment timing into this picture.

A ship adheres to a 27-month timeline, referred to as the Fleet Response Training Plan (FRTP), to prepare for deployment. It is within this framework that a ship conducts training, scheduled repairs, shipyard maintenance, and fleet exercises in order to be ready for the next deployment. Figure 1 graphically represents a generic ship FRTP timeline. A newly commissioned SWO ensign, upon reporting to their first ship will generally complete a tour of 30 months before rotating to their next afloat assignment. The timelines of the FRTP and a SWO ensign’s reporting and detaching are independent of each other. This could place the new officer, ideally, onboard as the ship prepares for a deployment, thereby ensuring they are exposed to all of the training opportunities previously described. Conversely, this new officer could report after the ship has already completed all of their allotted simulator time.

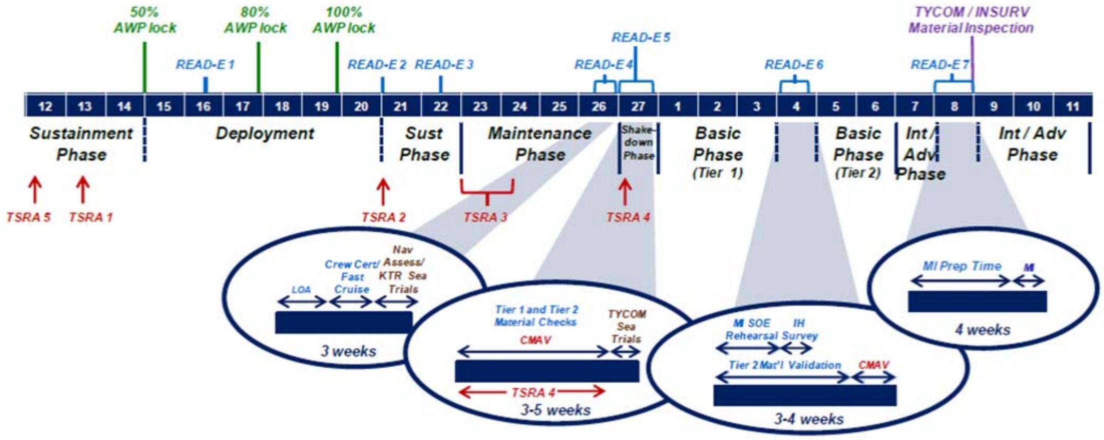

Figure 1. Fleet Response Training Plan

The 27-month FRTP cycle and the 24-month NSST time allotment roughly coincide. A command usually attends the BRM course prior to the basic phase and the BSH course a year later, after the ship returns from deployment. If an officer were to report to the ship after completion of advanced phase qualifications, or at the beginning of a deployment, it is likely that the ship has already expended its time allotted for BRM. In the year the officer is onboard he or she will be trained during watchstanding evolutions at sea, with perhaps only one or two pier side shiphandling evolutions.

As the cycle progresses, new officers will arrive and begin to train onboard. When the ship returns and the training cycle recommences, the ship will select who will attend the upcoming BSH. In order to take the most capable withstanders on the *next* deployment, the command will typically choose the officers who most recently reported. By this time in the training cycle the officer that reported just after completion of the last training cycle will likely be a qualified Officer of the Deck (OOD) and the command may not see the benefit in his attending BSH as he or she is close to transferring before or during the next deployment.

Though much effort has been expended in the attempt to ensure that each ship has fair and equitable access to simulation training facilities, the fact remains that they are a constrained resource in any given FCA. The possibility exists, as in the case of the officer reporting after all pre-deployment ship training has concluded, that individual officers may not receive as much NSST simulator time as their peers. The officer that has less NSST simulation time is at a disadvantage when compared to officers trained in BSH or BRM. The NSST BSH and BRM courses are more capable training environments due to the smaller class sizes and much larger body of knowledge of the highly experienced (most are former ship commanders) instructors. It is possible that an officer will depart from his first ship with his SWO qualification having attended only the SWOI course introduction to COVE and the SWOS Advanced Shiphandling and Tactics (ASAT) course.

While the hypothetical example given above is certainly the exception to the rule, it is worth illustrating that under the right circumstances, with respect to report date and FRTP phase, an officer could miss most if not all allotted FCA shiphandling simulator opportunities with no checks in place across the surface force to alert command leadership. If such checks existed, they would likely be tracked locally at the individual command level.

G. EVALUATION OF SHIPHANDLING EVOLUTIONS

Evaluations of shiphandling evolutions are conducted during a ship's preparation for deployment. These evaluations are part of a group of ship wide inspections called ULTRA (Unit Level TRAining). While a majority of the evaluations involve seamanship, the majority of shiphandling evaluation is done in the Navigation (Tab M/ MOB-N) and Seamanship (Tab N/ MOB-S) mission areas, which are typically reviewed by the Afloat Training Group (ATG) during ULTRA-C (Commander, SURFACE FORCE TRAINING MANUAL, 2007)

ATG is an organization that exists to support DESRONs (Destroyer Squadrons), surface major commands, and individual ships in the preparation and execution of training and evaluation events (Commander, SURFACE FORCE TRAINING MANUAL, 2007).

During the course of ULTRA-C, ATG will assess how well the ship has completed CCRs. Once the ship has met all of the CCRs to ATG's satisfaction, the organization will inform the ship's DESRON or Immediate Superior in Command (ISIC) that it is ready to deploy. If there are any discrepancies in the evaluations, the ship will receive remediation to meet standards (Commander, SURFACE FORCE TRAINING MANUAL, 2007).

H. TRAINING CONSIDERATIONS

In the Navigation portion of ULTRA-C, ATG will examine the proper completion of the NSST BRM course and the completion of the SURFOR prescribed SET hours. NSST resources are limited and each ship must be ready to take advantage of the time they are allotted in the trainer. The ship does not get another opportunity in the trainer once the allotted hours are used. To make the best of the simulation training opportunity the ships senior department head or “Senior Watch Officer” will determine who will form the watch sections underway. Typically the men and women that form these watch sections will attend the trainer and complete the BRM requirement. Nominally, all officers will utilize the SET hours as organized by the Senior Watch Officer. The men and woman attending NSST training probably have not conducted the evolutions they will perform in the trainer since last deployment or perhaps never have in the case of a newly commissioned officer. Depending on when an officer reports to a ship, and the need to train qualified watchstanders, he or she may never get simulation training with the ship prior to qualification. Practicing the evolutions with a game based trainer onboard ship prior to high-level simulation training would be ideal in order to maximize the limited amount of training available.

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III. METHODOLOGY

A. INTRODUCTION

This study uses a quasi-experimental design (Mitchell & Jolley, 2007) based on the simple experiment. The treatment design utilizes a test group and control group with the test group receiving a treatment. The design differs from the simple experiment in that the researchers used data from a previous study as the control group data due to time, resources, and SWO Introduction class size restraints.

The research team was able to make three visits to SWOSCOLCOM, Newport, RI in order to conduct a preliminary fact finding visit and recruit participants from two SWOI classes. The design focused on giving student volunteers a treatment and then measuring its effect on their total learning experience.

The researchers asked SWOI student participants to sign up for a time after class in which to participate in the treatment. The times were staggered based on the 45-minute length of the treatment. The participants would be required to complete two 45-minute treatment sessions broken down into three parts, introduction, familiarization, and task scenario.

1. Tasks

Participants performed the role of conning officer, or conn, aboard a ship. The conn gives orders to control ship’s engines, rudders, and ground tackle (Barber, 2005). The participants familiarized themselves with the ship’s handling characteristics by issuing orders and assessing responses of the ship in a game. The participants used available controllable forces to get the ship underway from a pier and make a landing on a different pier further down the channel.

2. Simulator: Choosing a Desktop Virtual Environment

The researcher team searched extensively for available COTS game based shiphandling software to be used for this study. After compiling a list of candidates, the team decided to evaluate three games that fit best the study: Ship Simulator Extremes by VSTEP, Ports of Call Simulator 3D II, and Virtual Sailor. The criteria for selecting the game were ease of use, graphics, manipulation of camera viewpoint, robust mission editor, apparent physics, environmental effects, and variety of ports available for use. Based upon these criteria, Ship Simulator Extremes by VSTEP stood out against the rest due to above average scores in all criteria and having an extremely comprehensive mission editor required to create customized scenarios for participants.

3. Scenarios

Researchers used two types of scenarios in the study, a familiarization scenario and a task scenario. They chose a section of the New York City harbor map which was relatively void of distracting or confusing landmarks. In the familiarization scenario, the ship model started in the middle of the channel during mid-day, with the rudder centerline, the engines generating no thrust and no environmental forces affecting the ship. The scenario provided participants an opportunity to practice controlling the movement of the ship using standard commands and to familiarize themselves with the available visual range of the third person camera, controlled by wireless mouse. A researcher, acting as the helmsman, converted the verbal commands given by the participant to orders to the software. The familiarization scenario for the second day of treatment was the same with the time of day advanced to civil twilight in order to slightly change the scenario aesthetics and keep the participant challenged.

In task scenario one, given on the first day of treatment immediately after the familiarization scenario, participants started with a Coast Guard High Endurance Cutter (WHEC) moored to a long straight pier with no obstructions. The participant began by reading written instructions in-scenario called “Captains

Orders" to maneuver the ship off the pier and proceed to a berth further down the channel. Once the participant maneuvered the ship to within approximately 100 ft from the ordered pier and below 1-knot speed over ground (SOG) he participant would order the helmsman-researcher to "Put over all lines." When Line 2 was fast to the bollard, the scenario would end. During the second treatment session, which occurred after the second familiarization scenario, the student completed task scenario two. The scenario time of day and environmental forces are the same as scenario one. In scenario two, the captain's order instructed the participant to pull into a berth after transiting the channel a short distance. The assigned berth had a ship moored aft and on the inboard positions of the berths on the adjacent pier. This required the participant to maneuver between two moored ships and then attempt a landing on the limited area ahead of the ship moored on the participant's starboard side.

B. PARTICIPANTS

1. Recruiting

The researchers coordinated with SWOS N72 staff and SWOI instructors to present the opportunity to volunteer for the study to the students. The research team spoke to the students, absent of instructor staff, in a classroom with the aid of a PowerPoint presentation. At the end of the presentation, the research team provided sign-up sheets the students could fill out if they wanted to participate.

2. Randomization

There was no group randomization since all received part the treatment and the treatment was the same for every participant. The third visit by the research team resulted in the need to use randomization to choose participants due to having more volunteers than time allowed. In that case, a random sample of seven participants was selected using the random numbers method (Mitchell & Jolley, 2007; Peters, Bratt, & Kirschenbaum, 2011).

C. AVAILABILITY OF CONTROL POPULATION DATA SET

The research team used control group data provided by a study of an Intelligent Tutoring System combined with the COVE, titled “Automated Support for Learning in Simulation: Intelligent Tutoring of Shiphandling” (Peters, Bratt, & Kirschenbaum, 2011), in order to maximize the treatment group with the limited number of student volunteers the research team had available. The COVE ITS study utilized similar SWOI participants receiving the standard course of instruction as their control group. Instructors utilized the CRESST Standard Surface Force Shiphandling Assessment to collect performance data to evaluate the control group participants on their ability to conn a DDG 51 COVE model underway from a San Diego Naval Station pier, with no active environmental forces.. Ten students participated in the control group for this study.

D. PROCEDURES

1. Before the Treatment

Approximately 60 minutes prior to the first treatment scenario, the research team arrived to set up the equipment. The researchers used a commercially available shiphandling game console input device to apply standard commands announced by the participant as he or she observed the simulation on an overhead projector. A Dell laptop computer was connected by VGA cable to a projector installed in the classroom.

Upon arrival, the individual participants completed the demographic survey and signed the consent form. The researchers pointed out that the dry erase board contained key elements of the SWOI shiphandling and standard commands lecture as a “kneeboard” guide by the research team. The dry erase board also contained the syntactic breakdown of standard engine and rudder commands. The researchers briefed the students on the handling characteristics of the Ship Simulator Extremes WHEC to include: length, beam, engine, shaft, and propeller configuration.

The students were directed to the dry erase board where a diagram, adapted from their classroom lectures, illustrated the basic effects of prop walk and position of rudders and engines to twist a ship (e.g., for a port twist: left full rudder, starboard engine ahead, and port engine back.) Finally, the students were informed that there would be a 10-knot harbor speed restriction for scenarios 2 and 4.

The students received printed copies of the SWOS shiphandling and standard commands lectures, a copy of “Naval Shiphandlers Guide” (Barber, 2005) identical to the one issued by SWOS, and a SWOS COVE standard commands reference sheet to refer to if needed.

A researcher demonstrated how the mouse would allow them to pan the camera around the ship model and zoom the camera in and out on the WHEC. The researcher, acting as helmsman / lee helm, told the student to request a “center view” if required due to the ease of centering by a preprogrammed control console button. If the participant had no further questions, the research team started the scenario. For the second day’s treatment, the researchers began with pointing out the reference material location and re-familiarizing the participants with mouse and treatment specific commands.

2. During the Treatment

Treatment group participants performed the role of the conning officer aboard a WHEC in port getting underway from and mooring to a pier. The treatment group participants issued standard commands to a researcher serving as the helmsman / lee helmsman. Each participant reported at a specific time for the treatment. The treatments were staggered 45 minutes apart.

Treatment scenario one provided the student with a fifteen-minute free play scenario in which they could give any standard command they wanted. Upon completion of fifteen minutes, the scenario would automatically end. The research team then asked if he or she had any further questions and allowed a five-minute break. The research team would then begin the task scenario. The task scenario gave participants a ship-maneuvering task, which they would attempt to use their knowledge from classroom presentations to accomplish. In the study's first task scenario the task was getting the ship underway from and then mooring to a pier. When the participant had accomplished the task, run out of time, or expressed their desire to stop, the treatment would end and the participant would depart.

In the second 45-minute session, the researchers started the second familiarization phase using a free play scenario similar to the first day's treatment The time of day and starting position of the ship had been adjusted to prevent participant complacency. After completion of the familiarization scenario, researchers asked the participant whether he or she had any questions and allowed a five-minute break. Then research team would begin the second task scenario. The second task scenario was more challenging than the first. The participant attempted to maneuver the ship underway from a relatively simple mooring and make a landing in a more complex pier layout. The assigned berth had a ship moored aft and on the inboard positions of the berths on the adjacent pier. This resulted in the participant having to maneuver between two moored ships and then attempt a landing on the limited area ahead of the ship moored on the participant's starboard side. When the participant had accomplished the task, run out of time, or expressed their desire to stop, the treatment would end and the participant would depart.

3. After the Treatment

The researchers reminded the participant of the time for the next session or thanked for their willingness to participate. The researchers requested the participant complete an online survey after graduation from SWOI, at their convenience, by February 2012.

4. Researcher Interaction During Treatments

The research team went to great lengths to minimize any undue coaching interaction from the researchers to the participants during the treatments. Some interaction was unavoidable, to include clarification of the “Captain’s Orders,” clarifications of the illustrations on the dry erase board, and questions asked by the participants about standard command pronunciation. The helmsman-researcher would respond to commands that were not in accordance with SWOS instruction by saying, “Orders to the Helm” as would occur on a ship.

5. SWOS COVE Training Sessions

Post treatment, the participants resumed the SWOI course of instruction consisting which included four instructed COVE sessions. The instructed COVE sessions introduce new officers to COVE and shiphandling in general. COVE sessions one through four consist of rudder and engine familiarization and maneuvering, man overboard procedures, UNREP, and maneuvering underway from and making a pier landing, respectively.

6. Final COVE Evaluation Session

Each volunteer participated in an evaluation scenario given by a qualified SWOS COVE instructor. The evaluation scenario was the same one used in the COVE ITS study, and under the same conditions, to reliably compare the control group data from that study.

The instructor conducting the evaluation was qualified to instruct and evaluate students in the COVE. The instructor evaluated the participants on their ability to conn a DDG 51 COVE model underway from a San Diego Naval Station pier, with no active environmental forces. Instructors utilized the Center for Research on Evaluation, Standards, and Student Testing (CRESST) Standard Surface Force Shiphandling Assessment to collect the same “Maneuver” category data as the COVE ITS control group. Eleven students participated in the treatment group for this study.

E. MATERIALS

1. Hardware and Software

Laptop computer (Dell Model PP28L, XPS M1530, Windows Vista Ultimate), VRinsight ship control console input device (www.vrinsight.com), Computer speakers (Dell), and Wireless three-button mouse (Microsoft), Ship Simulator Extremes (Build 1066 – Version 1.3.5). Please note that the subjects had no contact with the ship control console, so that future researchers might run the experiment without it. However, this is not recommended, as the console provided a more realistic response and is easier for the helmsman to control.

2. Data Collection

The same qualified instructor generated the data for all experimental group participants. He used the CRESST Standard Surface Force Shiphandling Assessment utilizing the “Maneuver” category employed in the COVE ITS study.

3. Exit Survey

The research team created an exit survey by and implemented through SurveyMonkey using the Naval Postgraduate School Research account.

IV. RESULTS AND DISCUSSION

A. DEMOGRAPHICS

Participants in this experiment were volunteers from the SWOI course. Eleven volunteers, serving as the treatment group, began and completed the study. Five of eleven completed the voluntary exit survey. Of the eleven volunteers, all were ensigns with less than one-month service as an officer. Two of the volunteers were female; nine were male. The age of the volunteers ranged between 22 years to 28. The average age was 23.4 with a standard deviation of 1.776 years.

Category	Specific Category	Total
Do you play video games on computers (e.g., PC/MAC)?	Yes	5
	No	6
Have you ever played simulation video games on your computer?	Yes	6
	No	5
If the answer to the previous question is "Yes," have any of the computer simulations been related to naval or commercial shipping?	Yes	0
	No	6
	N/A	5
If you have played video games on your computer as described in question 3, what amount of time would you say you have contributed to the game in the last six months? (e.g. hours, days, weeks, months, etc.)	N/A	11
What amount of time have you spent playing simulations other than those related to question 3? (e.g., hours, days, weeks, months, etc.)	None	7
	Hours	2
	Months	2
What amount of time have you spent playing any video game on a computer in the last six months (non-console, Xbox, PS3)?	None	6
	1–10 hours	2
	> 10 hours	3
What level of shiphandling experience do you have (e.g., recreational, military, commercial)?	None	9
	Recreational	2
Do you have sailing experience?	Yes	2
	No	9

Table 1. Demographic data by survey question

Table 1 shows the summary totals for each demographic category of the test group. Demographic data for the control group is available for reference in "Automated Support for Learning in Simulation: Intelligent Tutoring in Shiphandling" (Peters, Bratt, & Kirschenbaum, 2011) and is similar to test group data.

B. ANALYSIS OF FINAL COVE EVALUATION

1. Analysis of Margins of Safety Maintained Scores

The SWOS instructor assessed the study participants on their ability to maintain proper margins of safety while maneuvering through their final COVE evaluation session. The assessment criteria and definition for proper margin of safety utilized for both the test and control groups are contained in Appendix H, Figure 35. Table 2 displays the descriptive statistics for both groups.

	Margins of Safety Maintained					
	n	Mean	Standard Deviation	Standard Error	Lower 95% CI	Upper 95% CI
Treatment	11	17.273	4.671	1.408	14.135	20.411
Control	10	14.000	9.660	3.055	8.013	19.987

Table 2. Treatment vs. Control Descriptive Statistics for Margins of Safety Maintained

Figure 2 displays the distribution of treatment group scores in histogram form. Eight participants performed at the "Meets Standards" level, three participants performed at the "Needs Improvement" level. Individual participant data for the control group was not available at the time of our study due to IRB restrictions on the data.

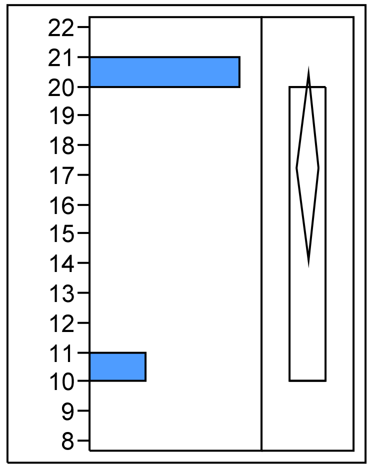


Figure 2. Histogram of Treatment Margins of Safety Maintained Scores

Table 3 displays the results of a One-Tailed Z-Test and Wilcoxon Signed Rank Test performed on the treatment data after fitting the distribution in JMP. Researchers utilized control set mean and standard deviation as the hypothesized mean and true standard deviation. Treatment set data displayed statistical significance to the 0.0039 level, suggesting improved student performance in the “Margins of Safety Maintained” scoring category in the final COVE evaluation session.

Test Mean

Hypothesized Value	14
Actual Estimate	17.2727
DF	10
Std Dev	4.67099
Sigma given	9.66

	z Test	**Signed-Rank**
Test Statistic	1.1236	27.0000
Prob > |z|	0.2612	0.0078*
Prob > z	0.1306	0.0039*
Prob < z	0.8694	0.9961

Table 3. JMP Output for Margins of Safety Maintained Scores One-Tailed Z-Test and Wilcoxon Signed Rank Test

Figure 3 shows the comparative means with associated whisker plots representing the 95% confidence intervals for the treatment and control groups.

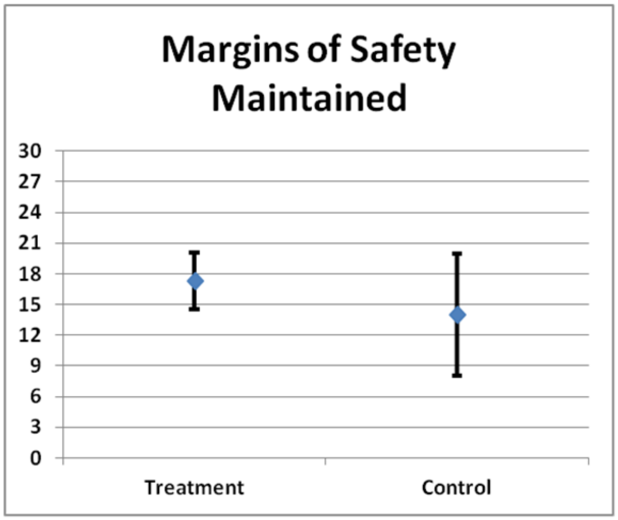


Figure 3. Comparative Means Whisker Plot of Margins of Safety Maintained Mean Scores Treatment versus Control with 95% CI

2. Analysis of Use of Rudders, Propulsion, and Tugs Scores

The SWOS instructor assessed study participants on their ability to employ correctly the ship's rudders (steering) and propulsion (thrust control) during their final COVE evaluation session. Additionally, they had a tractor tug available for lateral, forward diagonal and aft-diagonal movement. The assessment criteria and definition for proper use of rudders, propulsion, and tugs utilized for both the test and control groups is contained in Appendix H, Figure 35. Table 4 displays the descriptive statistics for both groups.

	Use of Rudder, Propulsion, and Tugs					
	n	Mean	Standard Deviation	Standard Error	Lower 95% CI	Upper 95% CI
Treatment	11	45.455	10.113	3.049	38.661	52.249
Control	10	45.000	15.810	5.000	40.000	50.000

Table 4. Treatment vs. Control Descriptive Statistics for Use of Rudder, Propulsion, and Tugs

Figure 4 presents the distribution of treatment group scores in histogram form. Nine participants performed at the "Meets Standards" level, two participants performed at the "Needs Improvement" level. Individual participant data for the control group was not available due to IRB restrictions on the data.

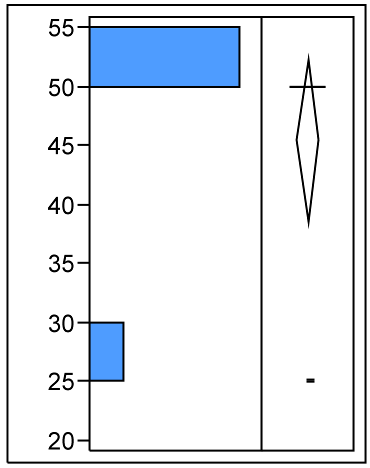


Figure 4. Histogram of Treatment Use of Rudder, Propulsion, and Tugs Scores

Table 5 displays the results of a One-Tailed Z-Test and Wilcoxon Signed Rank Test performed on the treatment data after fitting the distribution in JMP. Researchers utilized control set mean and standard deviation as the hypothesized mean and true standard deviation. Treatment set data displayed no statistical significance, suggesting no discernible effect on student performance in COVE through exposure to the game based protocol.

Test Mean

Hypothesized Value	45
Actual Estimate	45.4545
DF	10
Std Dev	10.113
Sigma given	15.81

	z Test	**Signed-Rank**
Test Statistic	0.0954	12.0000
Prob > |z|	0.9240	0.3408
Prob > z	0.4620	0.1704
Prob < z	0.5380	0.8296

Table 5. JMP Output for Use of Rudder, Propulsion, and Tugs Scores One-Tailed Z-Test and Wilcoxon Signed Rank Test

Figure 5 shows the comparative means with associated whisker plots representing the 95% confidence intervals for the treatment and control groups are in.

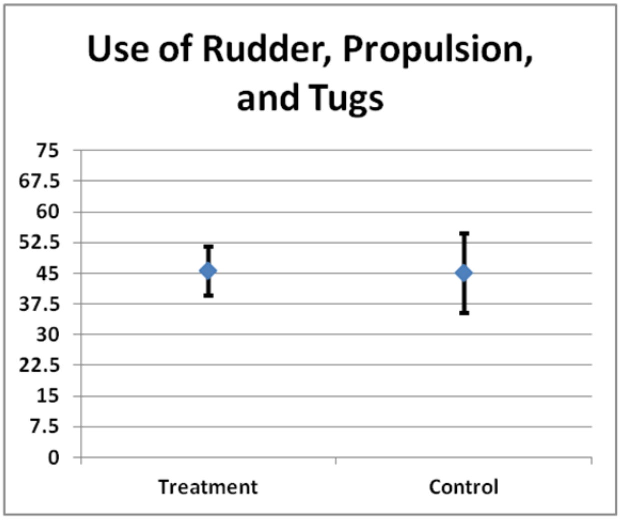


Figure 5. Comparative Whisker Plot of Use of Rudder, Propulsion, and Tugs Mean Scores Treatment versus Control with 95% CI

3. Analysis of Anticipates and Evaluates Ship Responsiveness Scores

The SWOS instructor assessed study participants on their ability to anticipate and evaluate the ship's responsiveness to control inputs during their final COVE evaluation session. The assessment criteria and definition for proper anticipation and evaluation of ship responsiveness for both the test and control groups is contained in Appendix H, Figure 36. Table 6 displays the descriptive statistics for both groups.

	Anticipates and Evaluates Ship Responsiveness					
	n	Mean	Standard Deviation	Standard Error	Lower 95% CI	Upper 95% CI
Treatment	11	11.818	4.045	1.220	9.101	14.536
Control	10	16.000	8.430	2.666	13.334	18.666

Table 6. Treatment vs. Control Descriptive Statistics for Anticipates and Evaluates Ship Responsiveness

Figure 6 displays the distribution of treatment group scores in histogram form. Two participants performed at the “Meets Standards” level, nine participants performed at the “Needs Improvement” level. Individual participant data for the control group was not available due to IRB restrictions on the data.

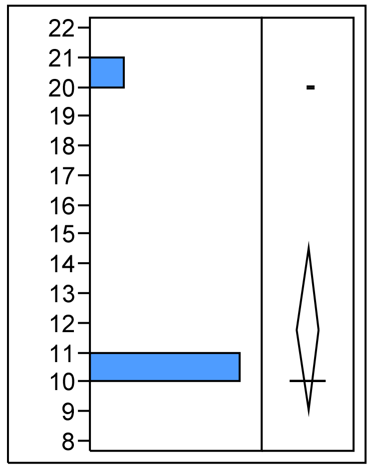


Figure 6. Histogram of Treatment Anticipates and Evaluates Ship Responsiveness Scores

Table 7 displays the results of a One-Tailed Z-Test and Wilcoxon Signed Rank Test performed on the treatment data after fitting the distribution in JMP. Researchers utilized control set mean and standard deviation as the hypothesized mean and true standard deviation. Treatment set data displayed a statistically significantly lower value than the control to the 0.05 and 0.002 level for the One-Tailed Z-Test and Wilcoxon Signed Rank Test respectively. This suggests that the students exposed to the game based task trainer scenarios performed at a lower level than the control group in the final COVE evaluation.

Test Mean

Hypothesized Value	16
Actual Estimate	11.8182
DF	10
Std Dev	4.0452
Sigma given	8.43

	z Test	Signed-Rank
Test Statistic	-1.6453	-30.0000
Prob > |z|	0.0999	0.0039*
Prob > z	0.9500	0.9980
Prob < z	0.0500*	0.0020*

Table 7. JMP Output for Anticipates and Evaluates Ship Responsiveness Scores One-Tailed Z-Test and Wilcoxon Signed Rank Test

This result was unexpected and will be discussed in more detail in Chapter V.

Figure 7 displays the comparative means with associated whisker plots representing the 95% confidence intervals for the treatment and control groups are in.

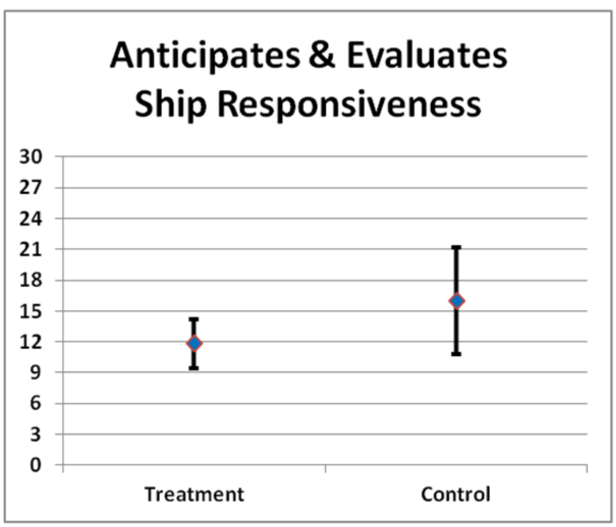


Figure 7. Comparative Whisker Plot of Anticipates and Evaluates Ship Responsiveness Mean Scores Treatment versus Control with 95% CI

4. Analysis of Standard Commands Scores

The SWOS instructor assessed study participants on their ability to properly formulate and execute standard shiphandling commands appropriate to the maneuvering situation throughout their final COVE evaluation session. The assessment criteria and definition for proper standard commands for both the test and control groups is contained in Appendix H, Figure 36. Table 8 displays the descriptive statistics for both groups.

	Standard Commands					
	n	Mean	Standard Deviation	Standard Error	Lower 95% CI	Upper 95% CI
Treatment	11	10.909	2.023	0.610	9.550	12.268
Control	10	8.500	3.370	1.066	7.434	9.566

Table 8. Treatment vs. Control Descriptive Statistics for Standard Commands

Figure 8 shows the distribution of treatment group scores in histogram form. Two participants performed at the "Proficient" level, nine participants performed at the "Meets Standards" level. Individual participant data for the control group was not available due to IRB restrictions on the data.

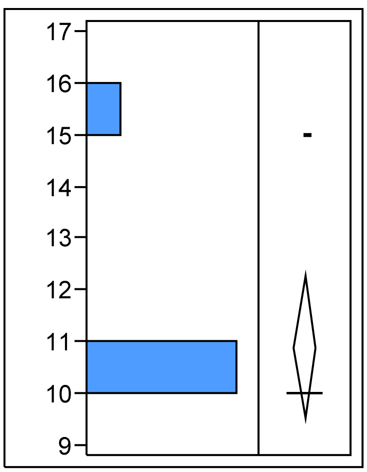


Figure 8. Histogram of Treatment Standard Commands Scores

Table 9 displays the results of a One-Tailed Z-Test and Wilcoxon Signed Rank Test performed on the treatment data after fitting the distribution in JMP. The researchers utilized control set mean and standard deviation as the hypothesized mean and true standard deviation. Treatment set data displayed statistical significance to the 0.0089 and 0.0005 level for the One-Tailed Z-Test and Wilcoxon Signed Rank Test respectively, suggesting improved student performance in the "Standard Commands" scoring category in the final COVE evaluation session.

Test Mean

Hypothesized Value	8.5
Actual Estimate	10.9091
DF	10
Std Dev	2.0226
Sigma given	3.37

	z Test	**Signed-Rank**
Test Statistic	2.3709	33.0000
Prob > |z|	0.0177*	0.0010*
Prob > z	0.0089*	0.0005*
Prob < z	0.9911	0.9995

Table 9. JMP Output for Standard Commands Scores One-Tailed Z-Test and Wilcoxon Signed Rank Test

Figure 9 presents the comparative means with associated whisker plots representing the 95% confidence intervals for the treatment and control groups.

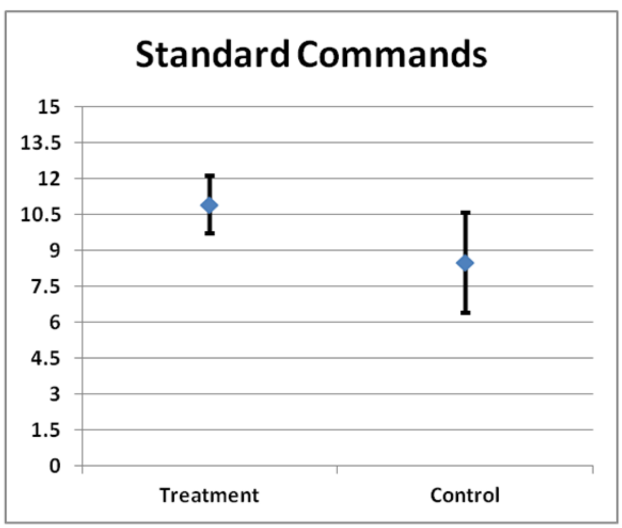


Figure 9. Comparative Whisker Plot of Standard Commands Mean Scores Treatment versus Control with 95% CI

5. Analysis of Aggregate Maneuver Scores

The Aggregate Maneuver Score category consists of the previous four score categories standardized to a point value of 300. The aggregate score provides the most direct comparison method with the control data collected by Peters and Kirschenbaum. Table 10 displays the descriptive statistics for both groups.

	Aggregate Maneuver Score					
	n	Mean	Standard Deviation	Standard Error	Lower 95% CI	Upper 95% CI
Treatment	11	170.909	25.082	7.562	154.059	187.759
Control	10	167.000	74.540	23.572	143.428	190.572

Table 10. Treatment vs. Control Descriptive Statistics for Aggregate Maneuver Score

Figure 10 displays the distribution of treatment group scores in histogram form. Six participants performed at the "Meets Standards" level, five participants performed at the "Needs Improvement" level. Individual participant data for the control group was not available due to IRB restrictions on the data.

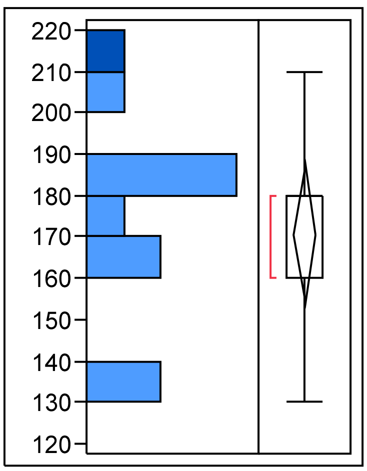


Figure 10. Histogram of Treatment Aggregate Maneuver Scores

Table 11 displays the results of a One-Tailed Z-Test and Wilcoxon Signed Rank Test performed on the treatment data after fitting the distribution in JMP. The researchers utilized control set mean and standard deviation as the hypothesized mean and true standard deviation. Treatment set data displayed no statistical significance, suggesting no discernible effect on student aggregate maneuver performance in COVE through exposure to the game based protocol.

Test Mean

Hypothesized Value	167
Actual Estimate	170.909
DF	10
Std Dev	25.0817
Sigma given	74.54

	z Test	**Signed-Rank**
Test Statistic	0.1739	9.0000
Prob > |z|	0.8619	0.4551
Prob > z	0.4310	0.2275
Prob < z	0.5690	0.7725

Table 11. JMP Output for Aggregate Maneuver Scores One-Tailed Z-Test and Wilcoxon Signed Rank Test

Figure 11 shows comparative means with associated whisker plots representing the 95% confidence intervals for the treatment and control groups.

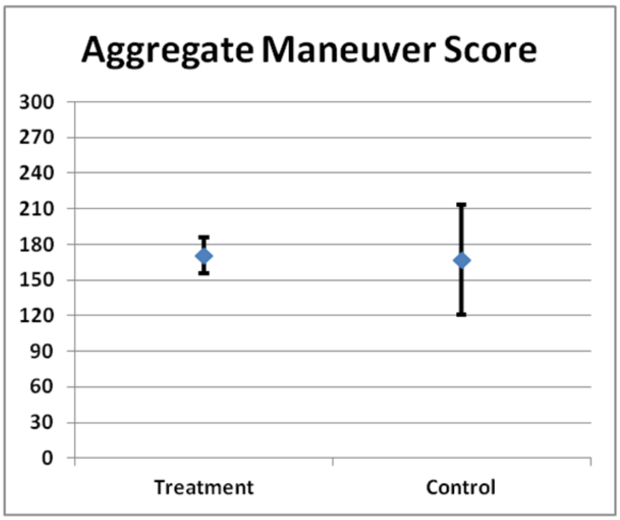


Figure 11. Comparative Whisker Plot of Aggregate Maneuver Mean Scores Treatment versus Control with 95% CI

C. EXIT SURVEY

1. Participant Quantitative-Subjective Responses

The researchers requested participants in the experiment to complete a voluntary web based survey on SurveyMonkey after completing and detaching from their SWOI course of instruction. Responses were on a Likert Scale with graduating point values from one to five, with five representing maximum subject agreement with the survey question. Five of eleven participants completed the survey.

Figure 12 displays the participants' responses to survey question number one, which sought feedback on the student's perceived level of difficulty in with seeing the video output of the game based task trainer. Three participants responded that the tool was "easy to see." Two participants responded that the tool was "somewhat easy to see." Based on an average participant response of 4.6, the participants experienced little difficulty seeing the game clearly.

1. Did you have any problems seeing the tool clearly?

	Hard to See	Somewhat Hard to See	Neither Hard nor Easy to See	Somewhat Easy to See	Easy to See	Rating Average	Response Count
Ease of Viewing	0.0% (0)	0.0% (0)	0.0% (0)	40.0% (2)	60.0% (3)	4.60	5

Figure 12. Participant Exit Survey Question One Summary Responses

Figure 13 displays the participants' responses to survey question number two, which sought feedback on the student's perceived ease of use of the simulation tool. Two participants responded that the tool was "easy to use." Three participants responded that the tool was "somewhat easy to use." Based on an average participant response of 4.4, the participants' experienced little difficulty in using the game based task trainer.

2. How easy was the tool to understand and apply?							
	Hard to Use	Somewhat Hard to Use	Neither Hard nor Easy to Use	Somewhat Easy to Use	Easy to Use	Rating Average	Response Count
Ease of Use	0.0% (0)	0.0% (0)	0.0% (0)	60.0% (3)	40.0% (2)	4.40	5

Figure 13. Participant Exit Survey Question Two Summary Responses

Figure 14 displays the participants' responses to survey question number three, which sought feedback on the perceived level of hindrance the game created toward accomplishing their learning objectives. All five participants responded that the tool was "easy to use" and had no hindrance on their learning or practice of learning objectives.

3. Did the tool hinder learning or practice?							
	None	Low	Medium	Medium High	Extreme	Rating Average	Response Count
Level of Hindrance	100.0% (5)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	1.00	5

Figure 14. Participant Exit Survey Question Three Summary Responses

Figure 15 displays the participants' responses to survey question number three, which sought feedback on whether the students perceived that the game helped them to apply the training given in the SWOS shiphandling lectures. The student response to this question interested us greatly as it provided the litmus test of whether they felt there was any value in the game scenarios in applying the theory taught in the classroom. Two participants responded the game was "very much" helpful. Three participants responded that the game was "much" helpful. Based on an average participant response of 4.4, the participants' found the game based task trainer to be helpful tool in applying classroom shiphandling theory.

4. Did the training tool help you apply training given in the SWOS shiphandling lectures?							
	Not At All	Slightly	Somewhat	Much	Very Much	Rating Average	Response Count
Theory to Practice	0.0% (0)	0.0% (0)	0.0% (0)	60.0% (3)	40.0% (2)	4.40	5

Figure 15. Participant Exit Survey Question Four Summary Responses

Figure 16 displays the participants' responses to survey question number five, which sought feedback on whether the students perceived that the game helped them in their COVE training sessions. The student response to this question provided feedback on whether they felt that the semi-immersive environment offered in the game prepared them for COVE's fully immersive VE. Two participants responded the game was "very much" helpful. Three participants responded that the game was "much" helpful. Based on an average participant response of 4.4, the participants' found the game based task trainer to be helpful tool in applying classroom shiphandling theory to their instructed COVE sessions. Question 5 had an associated free response question, Question 6, which we discuss later.

5. How well did the tool help you in the SWOS Intro COVE training sessions?							
	Not At All	Slightly	Somewhat	Much	Very Much	Rating Average	Response Count
Usefulness for COVE preparation	0.0% (0)	0.0% (0)	0.0% (0)	60.0% (3)	40.0% (2)	4.40	5

Figure 16. Participant Exit Survey Question Five Summary Responses

Figure 17 displays the participants' responses to survey question number seven, which sought feedback on how likely the students would be to use a game based task trainer once in the operational fleet. Two participants responded that they would use such a tool "very often." One student responded that he or she would use such a tool "often." The remaining two respondents said they would use such a tool "little" or "very little." Based on an average participant response of 3.8, the participants' would be more likely than not to continue to use a game based shiphandling simulation to train or practice shiphandling evolutions once in the fleet.

7. If you had this tool to take with you to the fleet, how likely would it be that you would continue to use it to train or practice?

	Not At All	Very Little	Little	Often	Very Often	Rating Average	Response Count
Likelihood of Use	0.0% (0)	20.0% (1)	20.0% (1)	20.0% (1)	**40.0% (2)**	3.80	5

Figure 17. Participant Exit Survey Question Seven Summary Responses

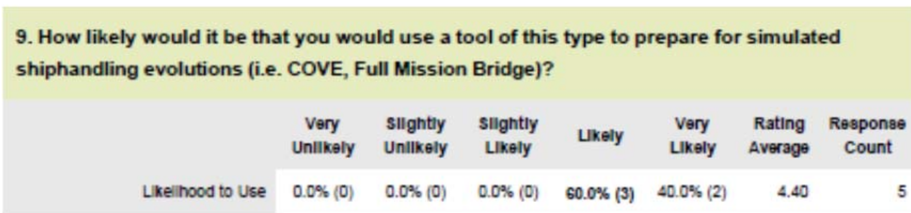
Figure 18 displays the participants' responses to survey question number eight, which sought feedback on how likely the participants would be to recommend a game based task trainer to their peers for training and practice. Positive word of mouth and willingness to recommend a tool to their shipmates can be a powerful indicator of that tool's perceived utility. Four participants responded that they would be "very likely" to recommend a tool of this type to their peers. One participant responded that he or she would be "likely" to recommend it. Based on an average participant response of 4.8, the participants' would be highly likely to recommend a semi-immersive, game based task trainer to their friends to train and practice for shiphandling evolutions.

8. How likely would it be that you would recommend this tool to a friend or shipmate for training or practice?

	Unlikely	Slightly Unlikely	Slightly Likely	Likely	Very Likely	Rating Average	Response Count
Likelihood of Recommending	0.0% (0)	0.0% (0)	0.0% (0)	20.0% (1)	**80.0% (4)**	4.80	5

Figure 18. Participant Exit Survey Question Eight Summary Responses

Figure 19 displays the participants' responses to survey question number nine, which sought feedback on how likely the participants would be to use a game based task trainer to prepare for future high-level shiphandling simulator usage. The responses to this question provide another look into the students' perceived utility of the tool in preparing for periodic CNSF mandated simulated shiphandling evolutions. Though all of the participants are too junior to have participated in a BRM course, the research team still found value in this response as the participants had recently utilized the COVE, another fleet system of record. Two participants responded that they would be "very likely" to use a tool of this type to prepare for simulated shiphandling evolutions. Three participants responded that they would be "likely" to recommend it. Based on an average participant response of 4.4, the participants' would be likely to utilize a semi-immersive, interactive modality, game based task trainer to prepare for simulated shiphandling evolutions.



9. How likely would it be that you would use a tool of this type to prepare for simulated shiphandling evolutions (i.e. COVE, Full Mission Bridge)?

	Very Unlikely	Slightly Unlikely	Slightly Likely	Likely	Very Likely	Rating Average	Response Count
Likelihood to Use	0.0% (0)	0.0% (0)	0.0% (0)	60.0% (3)	40.0% (2)	4.40	5

Figure 19. Participant Exit Survey Question Nine Summary Responses

Figure 20 displays the participants' responses to survey question number ten, which sought feedback on how likely the participants would be to use a game based simulation to prepare for live shiphandling evolutions. The research team felt that the tool could be expanded for use in wardrooms as a means of preparing for live shiphandling events. We knew the student volunteers had limited shipboard experience but used this question to gauge the depth of how they valued the simulation as a tool to train as a team. One participant responded that he or she would be "very likely" to use the game to prepare for live shiphandling evolutions. Three participants responded that use would be "likely." One participant responded that he or she would be "slightly likely" to use a tool of this type to prepare for live shiphandling evolutions. Based on an average participant response of 4.0, the participants' would be likely to utilize a semi-immersive, interactive modality, game based task trainer to prepare for live shiphandling evolutions.

10. How likely would it be that you would use a tool of this type to prepare for "live" shiphandling evolutions?							
	Very Unlikely	Slightly Unlikely	Slightly Likely	Likely	Very Likely	Rating Average	Response Count
Likelihood to Use	0.0% (0)	0.0% (0)	20.0% (1)	60.0% (3)	20.0% (1)	4.00	5

Figure 20. Participant Exit Survey Question Ten Summary Responses

2. Participant Qualitative-Subjective Responses

The voluntary participant survey included seven free response questions. These questions were intended to elicit additional information from the students that the multiple choice Likert Scale responses were unable to encapsulate. Questions with less than five responses were unanswered by some respondents.

Figure 21 displays the participants' free responses to survey question number six, which sought additional feedback to survey question five.

Q6. What specifically helped you?	
1	It helped make you more comfortable with the commands and it also help you get at least a little bit of a feel on how ships handle.
2	It helped to familiarize with the cove faster
3	Becoming familiar with the proper verbiage for giving commands.
4	Just the fact that I had done shiphandling 3 times to my classmates' 1 made me far-and-away better than them, especially in the early rounds of COVE.
5	CONFIDENCE

Figure 21. Participant Exit Survey Question Six Summary Responses

Figure 22 displays the participants' free responses to survey question number eleven, which asked the students if and why they had felt frustrated while using the tool to practice theoretical concepts covered in their SWOS classroom lectures. It should be noted that the frustration described in response 3 is with the current method of giving helm/engine orders on a Navy ship rather than frustration with a part of the game that does not exist in actual shiphandling.

Q11. Did you feel frustrated while using the tool? If so, please explain.	
1	I didn't not feel frustrated with the tool.
2	no
3	Sometimes my brain would know what to do, but it was hard to give the command. If I had actually been behind the wheel it would have been easier than taking that extra step of saying what should be done. But that's just part of being new to this.
4	NO

Figure 22. Participant Exit Survey Question Eleven Summary Responses

Figure 23 displays participants' free responses to question number twelve, which sought student feedback in terms of recommendations to improve the game based task trainer tool or its application to training pedagogy.

Q12. What recommendations would you give for improvement of the tool or its application to training?	
1	I would develop more ships than just the standard one so that you can practice different types. For example: frigates with their APUs
2	Easy to use software for readily available practice
3	Make the program available to everyone prior to their intro to COVE.
4	I thought it was great. Not much I can see to improve on.
5	NONE

Figure 23. Participant Exit Survey Question Twelve Summary Responses

Figure 24 displays participants' free responses to question number 13, which sought the students' opinion of the game as a training tool.

Q13. What was your opinion of the training tool you used?	
1	I thought it was a good tool to use, especially for people who are just starting out. It helped you be more confident in not only giving the commands but on what commands to give.
2	It helped in practicing for the conn
3	Very helpful.
4	I thought it was very helpful.
5	VERY HELPFUL AND GREAT PRACTICE

Figure 24. Participant Exit Survey Question Thirteen Summary Responses

Figure 25 displays participants' free responses to question number 14, which sought student feedback on some of the things they felt the tool specifically lacked. The most common response was variety of ship platform types appropriate to current fleet models was lacking.

Q14. What are some of the things you thought the tool lacked?	
1	As I mention earlier, the only thing it really lacked was different ships to practice with.
2	An immersion experience of being in the pilot house
3	Ship variety.
4	Well, this was the first of this type of thing that I ever used, and I have yet to con a ship in the fleet, so from my standpoint it didn't lack anything.
5	NOTHING

Figure 25. Participant Exit Survey Question Fourteen Summary Responses

Figure 26 displays participants' free responses to question number 15, which sought student feedback on whether they had experienced any difficulties with information and handouts provided by the research team. The aforementioned items are displayed and described in Appendix A and B. While sharing classroom facilities with daytime SWOS courses, the researchers were required to leave critical course information on the dry erase boards from in session classes while ensuring that all information disclosed to participants was displayed consistently for each treatment session. On some occasions, this included the information in Appendix B having to shift vertically or horizontally on classroom dry erase boards. All information in Appendix A and B was presented to all participants at all of the treatment sessions.

Q15. Did you experience any problems with the supplemental information given while using the tool? (e.g. "cheat sheets" or worksheets)	
1	No problems
2	No
3	Consistency between the format of the information provided on the board between the first and second day.
4	We were dealing with an overwhelming amount of new information (standard commands, starboard twists, etc) so to be able to pick out the proper new info from a whiteboard full of it was difficult. Once I learned where on the board each command was (engine is top right, rudder top left, etc) it became more manageable and helpful.
5	NONE

Figure 26. Participant Exit Survey Question Fifteen Summary Responses

Figure 27 displays participants' free responses to question number 16, which sought feedback on additional ideas the students had on means to train or practice shiphandling skills, short of actually conning a real ship. The research team feels that the first response holds merit in follow on research on a zero-fidelity shiphandling task trainer.

Q16. Are there any other recommendations you can give (when not actually driving a ship that will help future shiphandlers train or practice shiphandling skills?	
1	I bet there's a way to practice verbalizing what one pictures in one's head, either by giving a multiple choice test with different wordings of a maneuver, or by giving scenarios and having someone answer verbally. This would be helpful to me. Otherwise I thought it was great, and a productive and useful study.
2	NONE

Figure 27. Participant Exit Survey Question Sixteen Summary Responses

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V. CONCLUSIONS

A OVERVIEW

The results of our data collection and analysis indicate that student volunteers performed at a statistically higher level in the category of "Standard Commands" and "Margin of Safety Maintained" than control group students did. These findings, specifically the standard command improvement, are corollary with the qualitative data we have collected from evaluation forms, surveys, and unsolicited instructor feedback. Standard commands improvement was directly observable in SWOI students. Increased comprehension and execution of standard command lecture content was apparent during course of the treatment. The SWOS instructor also observed "Seamans Eye" (comprehension and development of situational awareness between the ship and non-moving objects) increased during the course of the treatment.

The category "Use of Rudder, Propulsion, and Tugs" score of the treatment group proved to be statistically indistinguishable from that of control group. In the case of "Use of Rudder, Propulsion, and Tugs," the reason may lie in the four instructed COVE sessions. These sessions may have sufficiently transferred an equivalent level of knowledge to control group students and negated any measurable positive training effects of the treatment. Additionally, the instructed COVE sessions were the first opportunity for both treatment and control groups to exercise control of tugs.

In the category "Anticipates and Evaluates Ship Responsiveness," the treatment group performed at a significantly lower level than the control group. The research team thinks a possible cause is the treatment group students having difficulty un-learning the WHEC characteristics prior to the evaluation session. Additionally, the 3rd person POV presented in the game based simulation may have induced a visual cue disparity when novice students entered the COVE 1st person POV environment. The effect of viewpoint, model acclimation, and individual model relearning time could account for the significantly lower score when compared to the control group. A solution may be to use models with the exact characteristics of COVE models, provide students with more 1st person POV acclimation time in COVE, and implement a study with a game based trainer capable of robust 1st person and 3rd person POV.

The “Aggregate Maneuver” score of the treatment group was statistically indistinguishable from the control group and proved to be a less accurate measure of overall student performance than previously expected. The true data trends were not evident until viewed at the individual category component level.

B. ANSWERS

1. a. Do SWOI students who use semi-immersive, voice interactive, shiphandling game to practice tasks covered in classroom shiphandling theory, prior to using the COVE, perform at a higher level than those not currently using shiphandling games?

- We believe that the results of the “Standard Commands” and “Margins of Safety Maintained” score categories answer this question. Our findings suggest that exposure to the game based treatments increased the score of the student volunteers when compared to the control group.

b. In which assessment categories will they perform better?

- We found that the student performed better in execution of “Standard Commands” and “Margins of Safety Maintained” than the control group.

2. Do SWOI students who use a semi-immersive, voice interactive, shiphandling game to practice standard commands covered in classroom lecture, prior to using the COVE, perform their standard commands at a higher level than those not currently using shiphandling games?

- The student volunteers exposed to game based treatments performed at a significantly higher proficiency level than the control group in this category.

3. Participants will perform at a higher level in the “Aggregate Maneuver” score category.

- Performance in this category was statistically indistinguishable between the treatment and control group. In this study, the “Aggregate Maneuver” score tends to hide student performance trends encapsulated in the individual category components. Holding all other measured performance levels constant, if the same ship class had been available between the game based simulation and COVE, thereby negating the performance reduction in the “Anticipates and Evaluates Ship Responsiveness” score category, there would have been a much more significant increase in student performance in the “Aggregate Maneuver” score category.

4. Participants will perform at a level consistent with the control group in the “Use of Rudder, Propulsion, and Tugs” subcategory.

- Our findings suggest that student volunteers in the treatment group performed at a statistically indistinguishable level when compared to the control group.

5. Participants will perform at a higher level in the “Margins of Safety Maintained” subcategory.

- Our findings suggest that exposure to the game based treatments increased the score of the student volunteers when compared to the control group.

6. Participants will perform at a level consistent with the control group in the “Anticipates & Evaluates Ship Responsiveness” subcategory. We expect the dissimilarity between the ship models in the game-based task trainer and the COVE to have a negligible effect on student performance.

- The student volunteers performed significantly below the control group in this category. We thought the ship model used for the treatment was similar enough to a COVE DDG model that the difference would be minimal and easily re-learned by the student. This was not the case. In consultation with faculty and staff at NPS and a review of our findings by Dr. Susan Kirschenbaum (personal communication, February 15, 2012), we believe that the characteristics of the WHEC model, learned by the novice level shiphandling students during treatment protocol, may have proven beyond their capability to unlearn or compartmentalize prior to their evaluation session in COVE. Having to “unlearn” the WHEC model and assimilate the new COVE DDG model physical characteristics during the limited amount of time the students have for COVE sessions may have been too much of an adjustment for some treatment group students. For follow on work, we believe a semi-immersive game based simulation incorporating ship models identical to those used in COVE and featuring a robust 1st and 3rd person POV capability could lead to a more upward trend in this category.

- One possible explanation for this result is the differences in the ships simulated between the game and COVE. The COVE ship model for the evaluation scenario was a DDG with the following specifications: 505-foot length; 59 foot width; 31-foot draft; 8,230 long tons displacement; 100,000 shaft horsepower (United States Navy, 2011). The model in Ship Simulator Extremes in a USCG WHEC with the following specifications: 378-foot length; 43 foot width; 15 foot draft; 3,300 ton displacement; 36,000 shaft horsepower when operating gas turbine engines (Wikipedia, 2011). The WHEC is a lighter, more maneuverable platform that responded quicker to rudder and engine orders than the DDG. This difference might have caused students effects to take place quicker after their orders. If this is the case, using a different ship class in the game may have resulted in negative training transfer to the students.

7. Do the participants believe the game-based simulation helped prepare them for their use of the COVE?

- Our feedback from the student volunteers suggests that this tool helped them in preparation for COVE. Instructors were impressed with the student level of knowledge of standard commands and the reduced amount of time required to establish basic proficiency. The students indicated that they felt more confident in executing standard commands and basic ship maneuvers following completion of the treatment protocol and carried this confidence into the COVE sessions.

8. Are the participants likely to use a tool of this type in the future and/or recommend it to their peers?

- Survey feedback indicated that both instructors and students were interested in using this tool in the future. The students, and even some instructors, indicated to us that they would like to buy a copy themselves to practice with. While Ship Simulator Extremes presented a ready candidate for the limited scope of our study, the lack of U.S. Navy specific ship models and the ability to conduct evolutions such as UNREP, Man Overboard, and controlling tugs prevents this software from filling the intermediate training level gap.

C. OVERALL ASSESSMENT

The game based treatment demonstrated statistically significant effects in the areas of execution of standard commands and student abilities to maintain proper margins of safety while maneuvering. The intent of the research team was not to train specific evolutions or categories, but to expose students to a voice controlled game based shiphandling simulation and determine if the exposure led to increased performance in the COVE. Although the effect of the treatment on aggregate maneuver skill was statistically indistinguishable from the control group, the research demonstrated that the specific skills of "Standard Commands" and "Margin of Safety Maintained" increased due to the exposure to the game based protocol.

D. LIMITATIONS AND LESSONS LEARNED

This research endeavor produced many challenges along the way for the research team and provides a rich source of lessons learned to pass down to future research teams if trying to implement a study of this type.

1. Coordination

Foremost were communication challenges due to the long distance between Naval Postgraduate School and SWOS. While the staff of SWOS proved to be of immense help in coordinating our study, we would strongly recommend all who would attempt a study like this to establish contact early and arrange for at least one orientation visit prior to study commencement.

2. Sample Population

The sample size was a function of the number of OCS graduates commissioned by the USN as SWOs. The number of students attending SWOI can vary greatly from class to class, some as high as sixteen students, some as few as four. This is based on USN manpower needs and can prove a challenge to plan for. The research team recommends starting a study early enough to ensure sufficient class cohorts are available during the duration of your study.

3. Tasks

The task trainer missions were extremely time intensive to build and implement. However, once built, the missions can be shared easily with anyone who owns VSTEP's Ship Simulator Extremes software. If a future tool gaming package for shiphandling training is developed, the missions should have the ability to be shared in the same manner.

E. RECOMMENDATIONS

1. Utility of Game-Based Shiphandling Tool for Surface Warfare Officers

As Surface Warfare Officers, the researchers believe that there would be value in an individually accessible game based simulation tool available to naval officers to practice common shiphandling evolutions. No COTS shiphandling game meets the full spectrum requirements of the professional shiphandler. We believe that this topic merits further study and possible funding in order to develop a game based simulation tool for NSST inventory.

2. Instructor Scoring Reliability

A single COVE instructor, fully qualified in all ship types in COVE, evaluated the student volunteers. This same instructor may have trained study participants as part of his duties training the entire SWOI class; however, the researchers did not inform the instructor of participant identity until as close as possible to the actual evaluation session in order to prevent confounds caused by instructor favoritism. The research team believes, if not already being used, SWOS could benefit from an unbiased evaluation database to compare instructor scores in order to drive down point variances in individual instructor scores.

3. Future Work

a. Implement an Intelligent Tutoring System with Game-Based Simulation

The students received no feedback except that given by the helmsman in the course of our treatments. An intermediate game based tool for shiphandling would benefit from having an intelligent tutoring system because the student would be able to receive feedback during their game sessions. The tool would be implemented to teach the student specific aspects of shiphandling as a series of lessons. The in scenario interface could be represented as a "virtual commanding officer" coaching the student through evolutions. The scenario purpose would be to teach students different aspects of shiphandling, e.g., lifting off the pier, evaluate, and give the student feedback in the form of a score for the evolution or perhaps a video replay. The lessons could be organized to best fit the curriculum, perhaps from easiest to hardest lessons, culminating in a final evaluation requiring use of all of the lessons to accomplish.

b. Implement a True Voice Control Software Interface

Our vision of an intermediate game based shiphandling trainer included voice recognition so a solitary student would be able to use it. The limited scope of our study precluded the implementation of software that would enable voice commands. Instead, we used a researcher-helmsman who acted as the interface between the conning officer and the software. We think voice control software implementation is essential for the intermediate game based shiphandling trainer to reach its full potential as an individual, personal, shiphandling tool.

c. Development of a Zero Fidelity Standard Commands Trainer

Throughout our study, the shiphandling skill significantly improved has been standard commands. The treatments had a statistically significant positive effect on the outcome of the final evaluation when compared to the control group. The unsolicited feedback of instructors and the survey given to participants point to the positive effect practicing standard commands during the treatments, prior to the higher level simulation. We think a zero fidelity standard commands trainer utilizing basic ship models and visual representation of effects of forces on the ship could aid new officers in learning and practicing standard commands prior to high level simulation.

APPENDIX A. PRE-EXPERIMENT INSTRUCTIONS AND MATERIALS

1. CHARTS

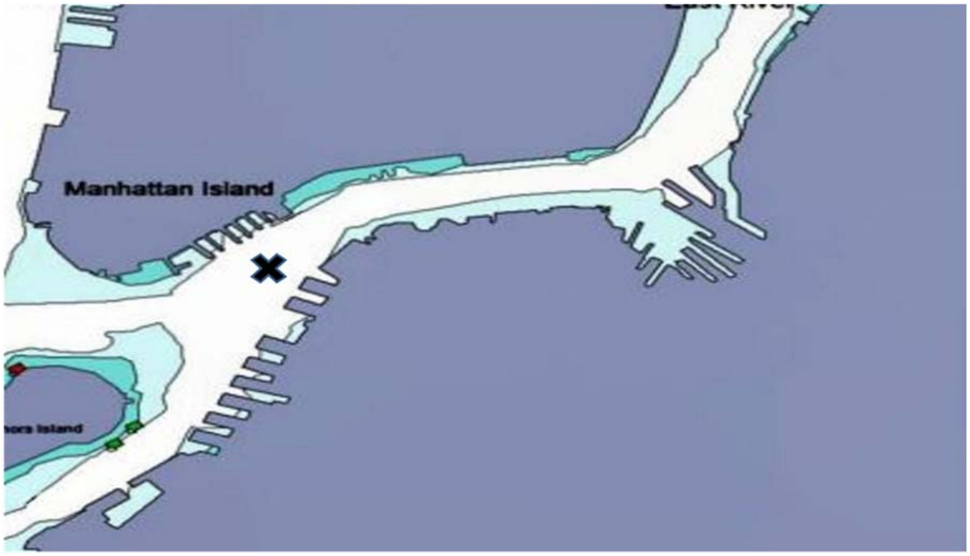


Figure 28. Mission One Participant Harbor Chart

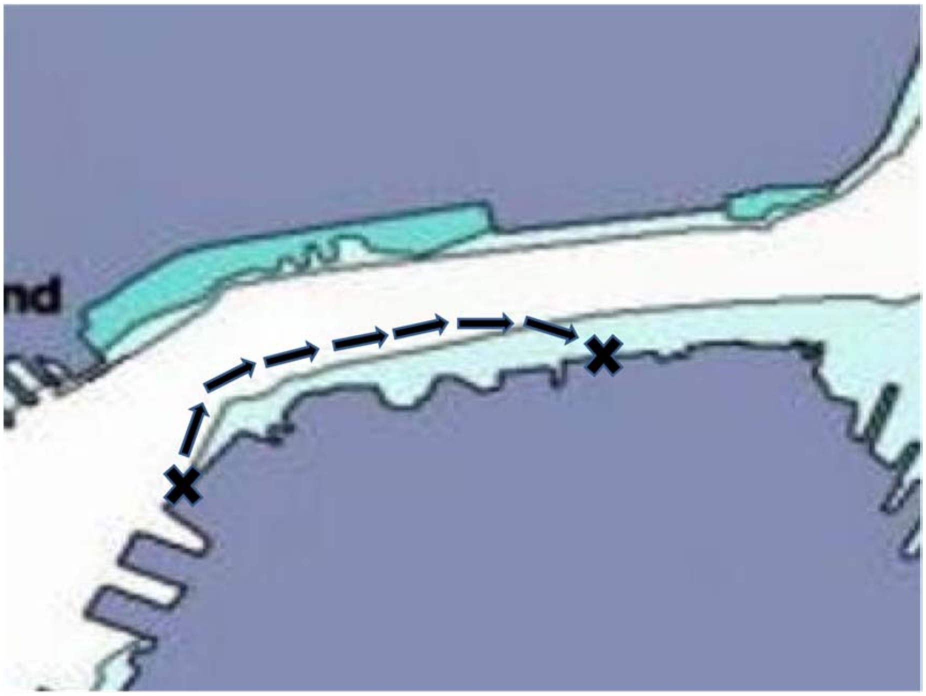


Figure 29. Mission Two Participant Harbor Chart

Figure 30. Mission Three Participant Harbor Chart

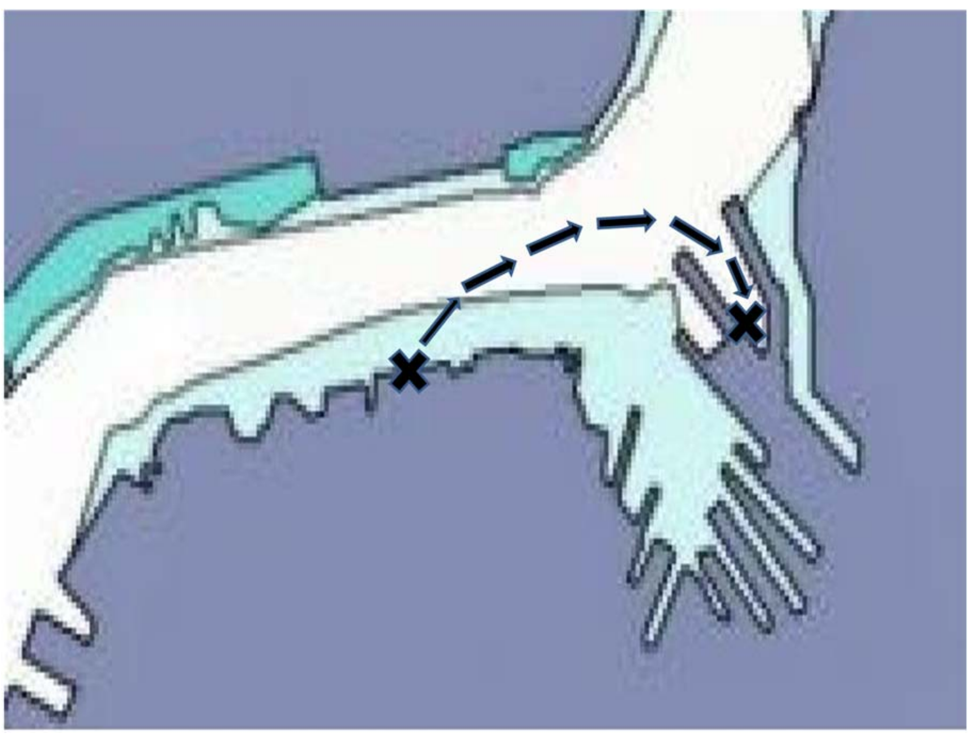
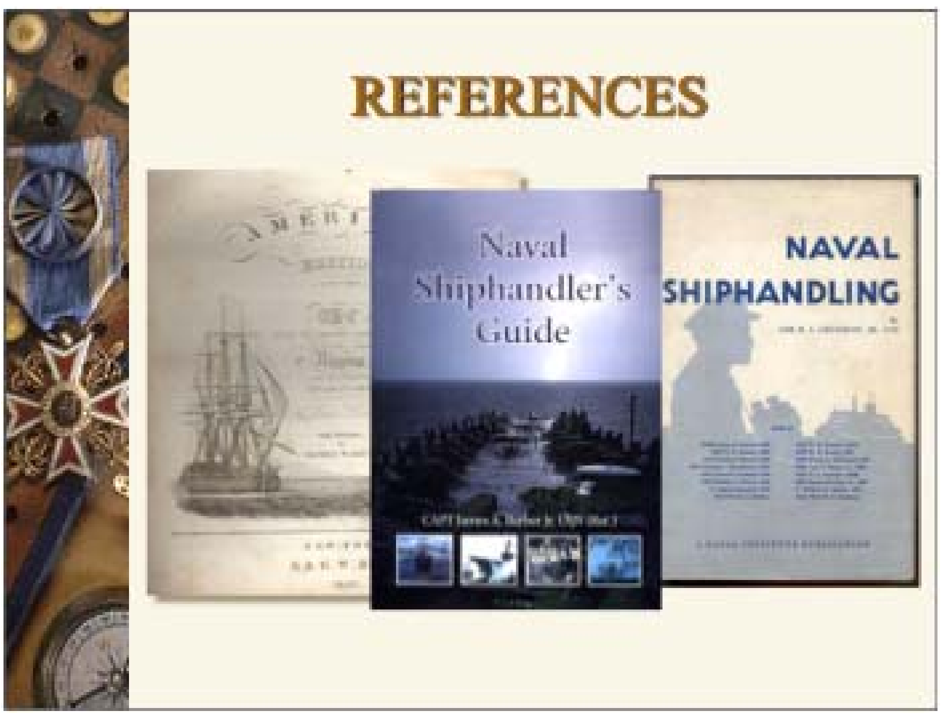
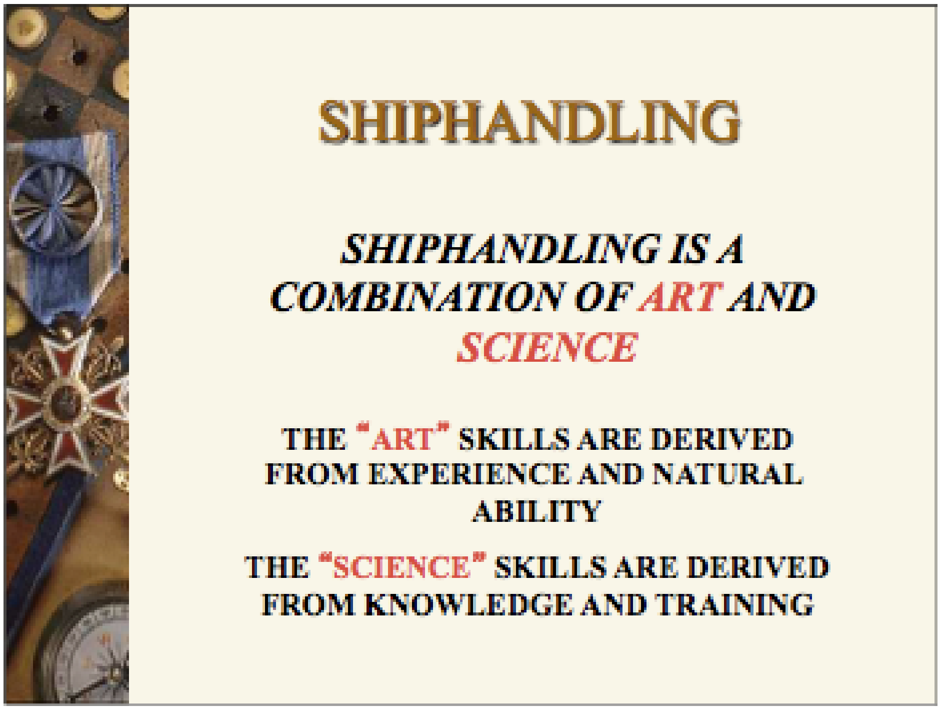


Figure 31. Mission Four Participant Harbor Chart

2. SWOS STUDENT LECTURE REFERENCE MATERIALS




SHIPHANDLING
SHIPHANDLING IS A COMBINATION OF ART AND SCIENCE
THE "ART" SKILLS ARE DERIVED FROM EXPERIENCE AND NATURAL ABILITY
THE "SCIENCE" SKILLS ARE DERIVED FROM KNOWLEDGE AND TRAINING

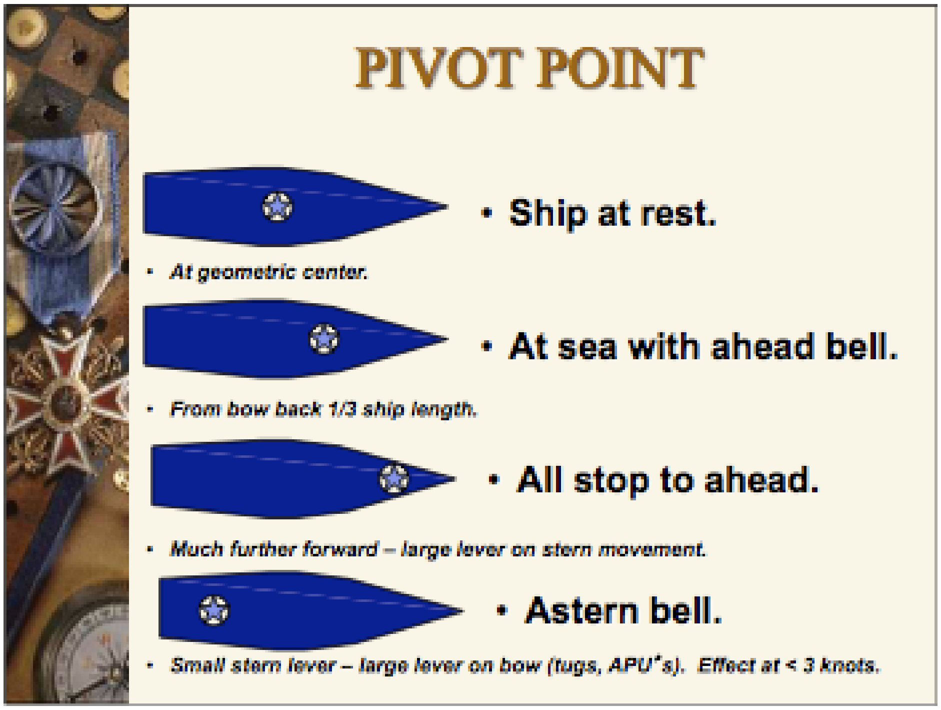

SHIPHANDLING TERMINOLOGY

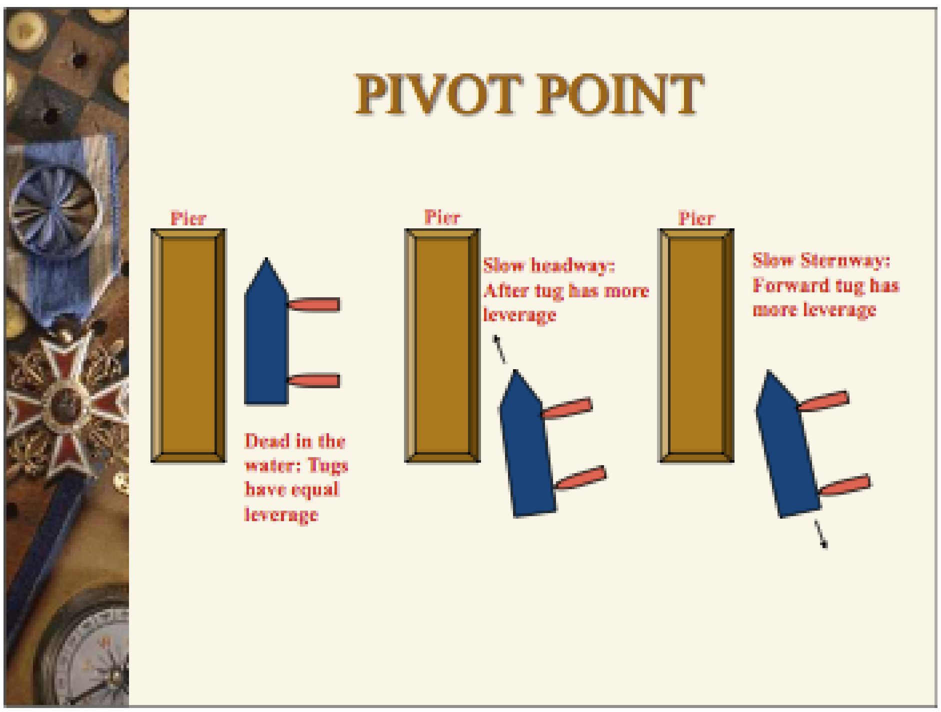
SQUAT

- The hull of a ship sinks as the ship increases speed. The bow will begin to rise and the stern will begin to sink.
- It is amplified by shallow water and results in large wakes. Harbor speed limits are designed to prevent ships from squatting and generating destructive wakes.

PIVOT POINT

- The point about which a ship rotates is called the pivot point. The position of the pivot point moves forward with headway, and aft with sternway.


PIVOT POINT
• Ship at rest.
• At geometric center.
• At sea with ahead bell.
• From bow back 1/3 ship length.
• All stop to ahead.
• Much further forward – large lever on stern movement.
• Astern bell.
• Small stern lever – large lever on bow (tugs, APU's). Effect at < 3 knots.


PIVOT POINT
Pier
Dead in the water: Tugs have equal leverage
Pier
Slow headway: After tug has more leverage
Pier
Slow Sternway: Forward tug has more leverage

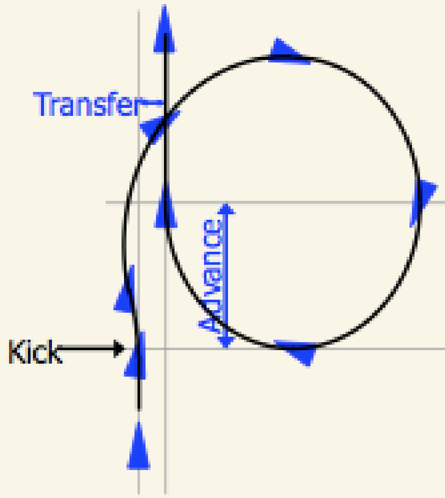
TWIST

- A spiral curve or turn resulting from side force and torque, usually brought about by ordering one engine ahead and the other engine back, with rudder placed in the direction of the twist
  - Standard command used to place a clockwise (starboard) twist
    - Right full rudder
    - Port engine ahead 1/3
    - Starboard engine back 1/3

SHIPHANDLING CHARACTERISTICS

- Several characteristics must be understood to become a competent shiphandler:
  - Advance
  - Transfer
  - Tactical diameter
  - Turning circle

ADVANCE AND TRANSFER

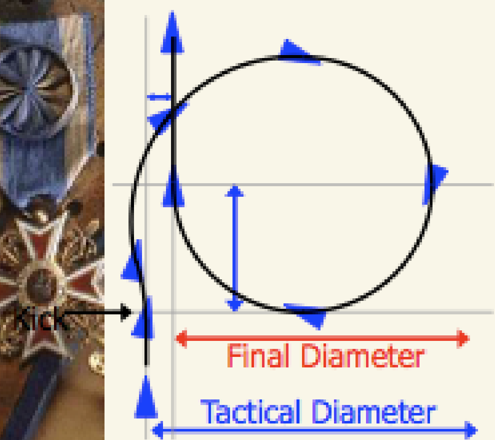


- **Advance**
  - Distance gained toward the direction of the original course after the rudder is put over.
- **Transfer**
  - Distance gained perpendicular to the original course after the rudder is put over.

TACTICAL DIAMETER

- The distance traveled perpendicular to the original course when a ship is turned to a reciprocal course. The tactical diameter distance is measured from the time the rudder is put over.
  - Tactical diameter is a function of ship's speed and applied rudder angle. The two types of Tactical Diameter include:
    - Standard Tactical Diameter (Standard Rudder)
    - Reduced Tactical Diameter (Full Rudder)

TURNING CIRCLE



- A ship's turning circle is the path followed by the ship's pivot point when making a 360° turn. Its diameter varies with rudder angle and speed. With constant rudder angle, an increase in speed results in an increased turning circle. Very low speeds (those approaching bare steerageway) also increase the turning circle because of reduced rudder effect.

TACTICAL CHARACTERISTICS FOLDER

- The ship's Tactical Characteristics folder is a document, usually an appendix to the Standing Orders, that lists the ship's design and handling characteristics. The information contained in this folder is invaluable to a new Conning Officer. Some of the design and handling information found in this folder includes:
  - Location and number of screws/rudders
  - Length, beam, height of the ship
  - Location of pivot point
  - Acceleration and deceleration tables
  - Advance and transfer tables
  - Ship' s navigational draft
  - Turn diagrams for various speeds and rudder angles

TWIST

- A spiral curve or turn resulting from side force and torque, usually brought about by ordering one engine ahead and the other engine back, with rudder placed in the direction of the twist
  - Standard command used to place a clockwise (starboard) twist
    - Right full rudder
    - Port engine ahead 1/3
    - Starboard engine back 1/3

SHIPHANDLING FORCES

INERTIA AND MOMENTUM

- *INERTIA*: Inertia is the quality of motion that causes a ship to resist a change in motion. "A force exerted on a ship will result in motion after inertia has been overcome."
- *MOMENTUM*: "Generally, we consider momentum as the motion of a ship at the time we no longer want it, especially when we have taken action to obtain the opposite effect. . . . Momentum is the quality of motion measured by the product of mass & velocity."

Hooyer - Behavior and Handling of Ships

INERTIA AND MOMENTUM

- *INERTIA*: "The motion that doesn't happen when we put the bell on!"
- *MOMENTUM*: "The motion that's still there after we took the bell off!"

SHIPHANDLING FORCES

CONTROLLABLE:

- PROPELLER
- RUDDER
- BOW/STERN THRUSTERS
- ANCHORS
- TUGS
- MOORING LINES

SEMI-CONTROLLABLE:

- SHALLOW WATER EFFECTS
- BANK CUSHION/SUCTION
- PASSING SHIP EFFECTS

UNCONTROLLABLE:

- WIND
- CURRENT

PROPELLERS

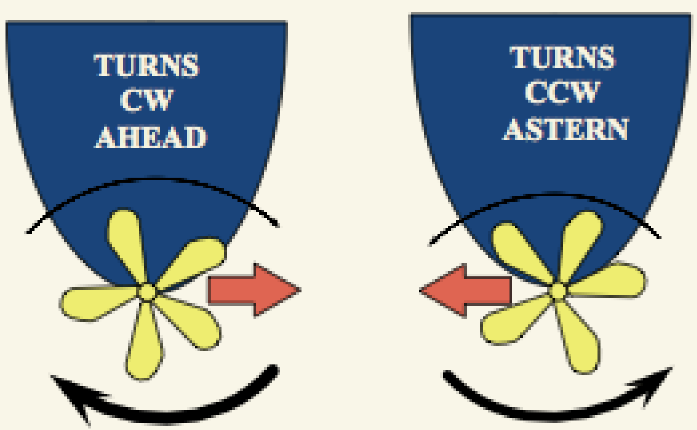
- Propellers or screws consist of multiple blades that are rotated by the main engine shafting. Propellers move ships through the water a certain distance with each rotation. This distance is a function of the pitch and/or rotation rate (rpm) of the blades. Types of propellers include Fixed Blade and Controllable Reversible Pitch (CRP).

FIXED BLADE PROPELLER

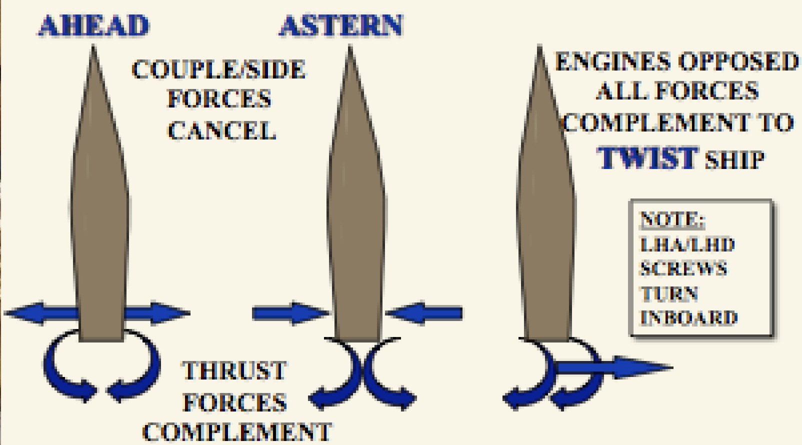
- A ship's speed through the water is a function of the fixed blade pitch and the shaft rotation rate.
- When a fixed blade screw is rotated in one direction the ship will move forward, when reversed, the ship will move backward.

SINGLE PROPELLER

Fixed Pitch

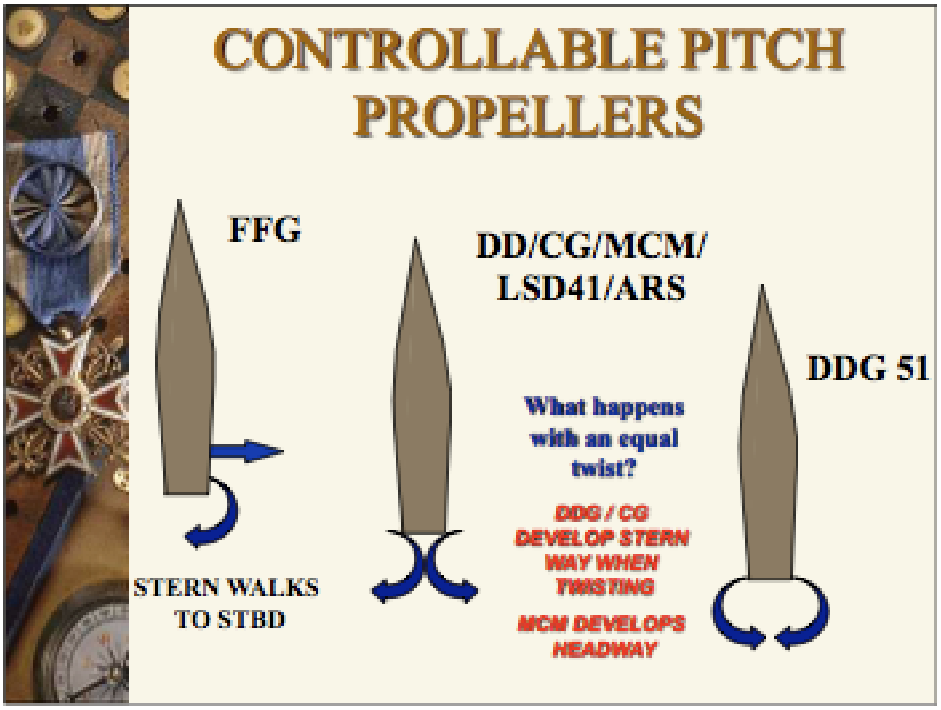


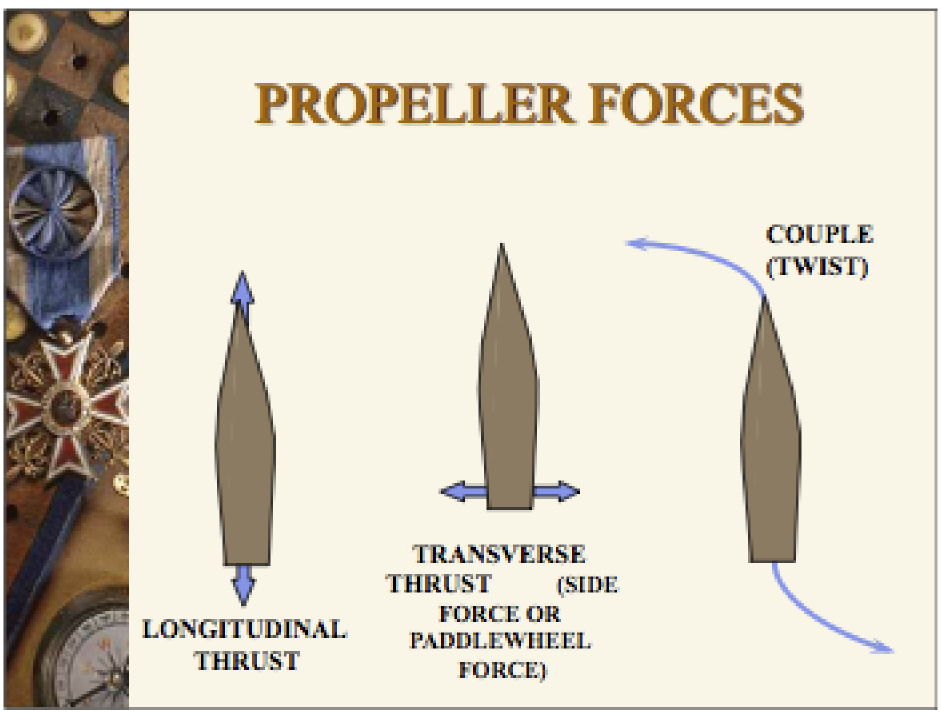
TWIN / QUAD
Fixed Pitch



CONTROLLABLE REVERSIBLE PITCH

- Propellers on which the blade pitch (angle of blade) can be changed are called Controllable Reversible Pitch (CRP)
- Ship's speed and direction through the water are a function of both shaft rotation rate and ordered screw pitch.
- The direction of shaft rotation is always the same, even when backing.


CONTROLLABLE PITCH PROPELLERS
FFG
DD/CG/MCM/ LSD41/ARS
DDG 51
What happens with an equal twist?
DDG / CG DEVELOP STERN WAY WHEN TWISTING
MCM DEVELOPS HEADWAY
STERN WALKS TO STBD


PROPELLER FORCES
COUPLE (TWIST)
LONGITUDINAL THRUST
TRANSVERSE THRUST (SIDE FORCE OR PADDLEWHEEL FORCE)

SIDE FORCE

- When a screw rotates, a side force is produced which will cause the ship's stern to move either to starboard or to port. If a ship is slowly moving astern, movement is best controlled by the side forces produced by the propeller.
- Clockwise rotation of the screw produces a side force which moves the stern to starboard. Counterclockwise rotation of the screw produces a side force which moves the stern to port.

Single screw ships will always experience a side force which may have the potential to limit the maneuvering capabilities.

TWIN SCREW

- Twin screw ships are designed so that the shafts and screws rotate in opposite directions so that side forces are cancelled out.
- On fixed-pitch ships, if the engines are opposed, then side forces will complement each other and the ship will twist.

MOORING LINES

- Lines are used next to a pier to control/assist ship positioning.
- Each line has a specific name, indicating location, direction, and purpose

BREAST or SPRING = depending on use of line

FWD or AFTER = direction in which line leads from ship

BOW or QTR = point of vessel from which line tends

MOORING LINES

1 - Bow line

2 - After bow spring line

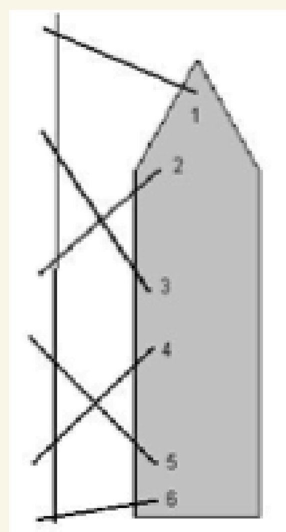
3 - Forward bow spring line

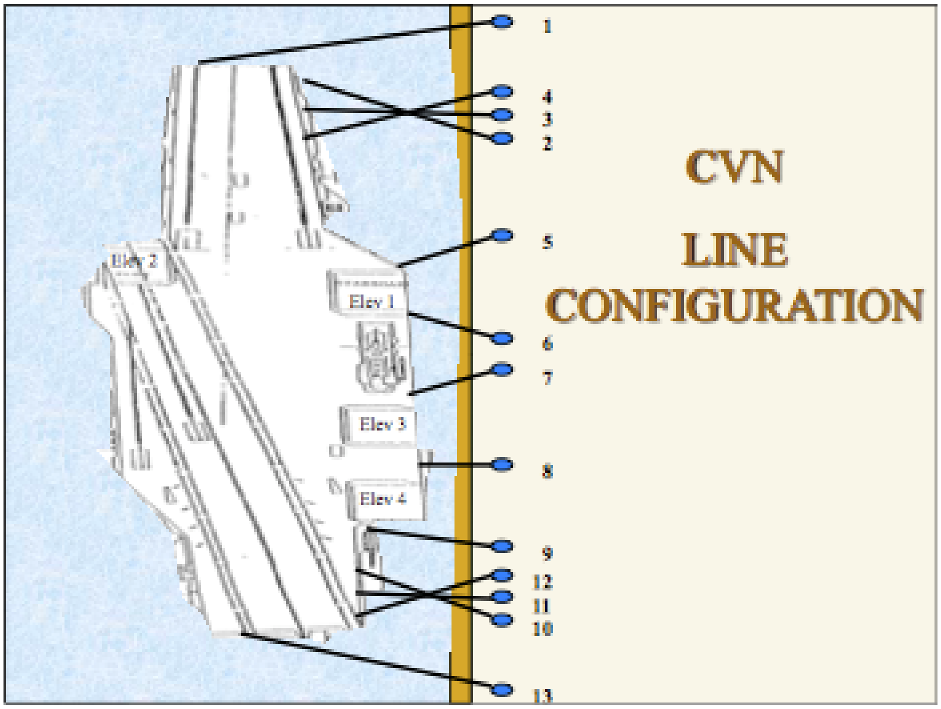
(No number) - Breast line

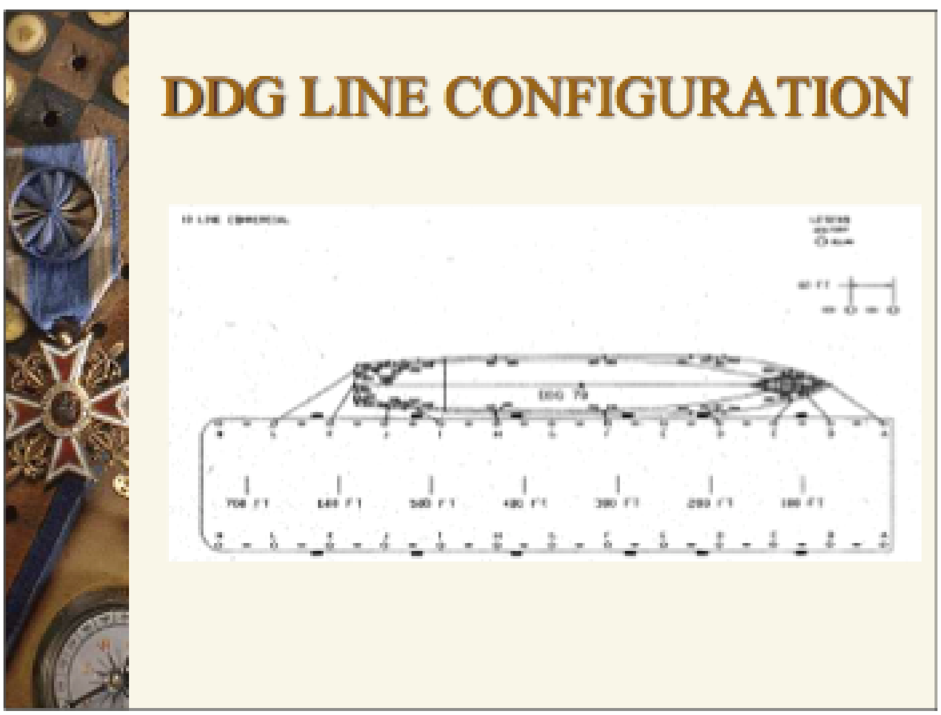
4 - After quarter spring line

5 - Forward quarter spring line

6 - Stern line




CVN
LINE
CONFIGURATION
1
4
3
2
5
6
7
8
9
12
11
10
13
Elev 2
Elev 1
Elev 3
Elev 4

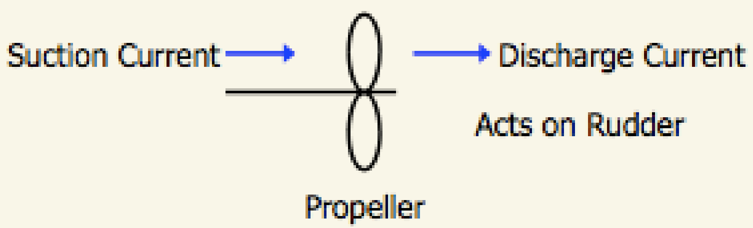

DDG LINE CONFIGURATION

LINE COMMANDS

Command	Meaning
Pass one (or number one)	Send line number one line over to the pier. Place the eye over the bollard or cleat but do not take a strain.
Slack (slack off) the bow line	Pay out bow line, allowing it to form an easy bight.
Take a strain on one (or number one)	Put number one line under tension.
Take in the slack on three (or number three)	Heave in on number three line, but do not take a strain.
Ease three	Pay out number three line enough to remove most of the tension.
Avast heaving	Stop heaving (taking in).
Check three	Hold number three line, but not to the breaking point, let the line slip as necessary.
Hold two	Take enough turns so that number two line will not slip.
Double up and secure	Run additional lines, or bights of lines, as needed, to make the mooring secure.
Single up	Take in all lines except a single standing part to each station, preparatory to getting underway.
Stand by your lines	Man the lines, ready to cast off our moor.
Take in one (or number one)	Retrieve line number one after it has been cast off.
Up behind	Cease hauling on the line and slack it quickly.

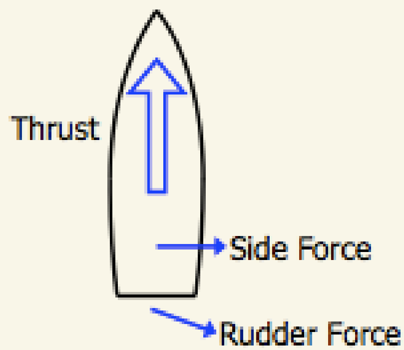
SCREW CURRENT

- Consists of two parts
  - *Suction Current* - going into the propeller
  - *Discharge Current* (Prop Wash)- comes out of the propeller



PROPELLERS AND RUDDERS

- Primary means for controlling the stern

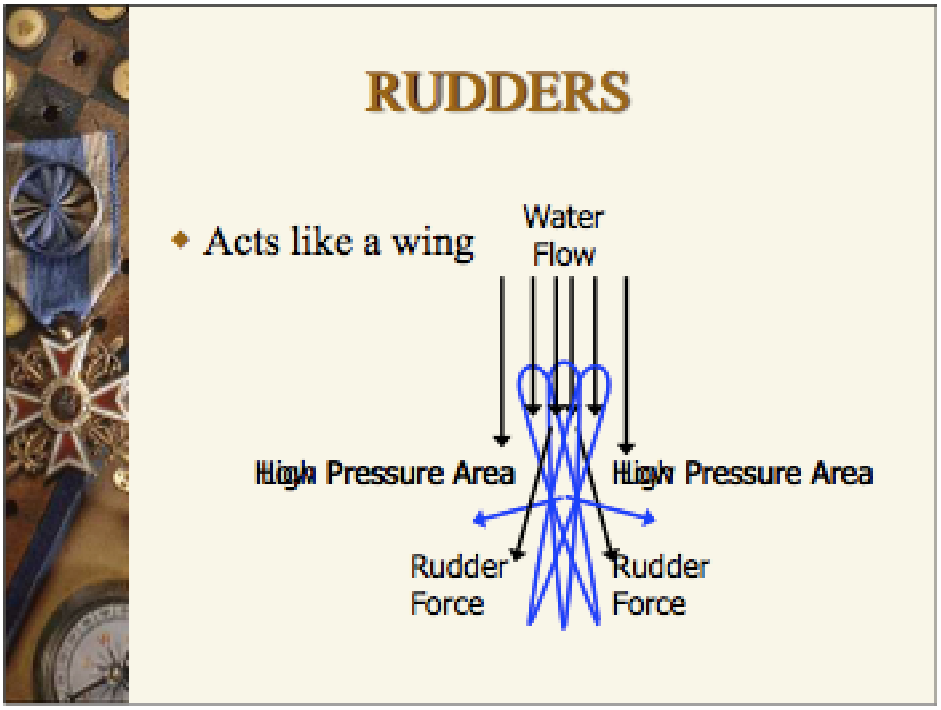


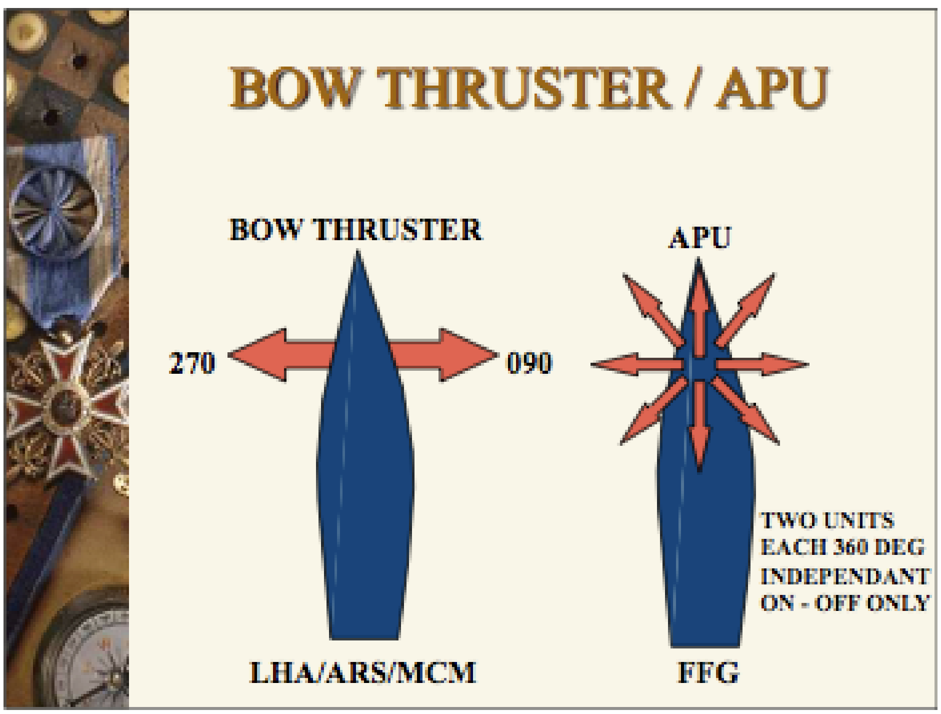
RUDDERS

- Effectiveness based on speed vs rudder angle
  - Ship's turning rate proportional to rudder angle magnitude and ship's speed
  - "bare steerageway" - minimum speed at which rudder is still effective (2-3 kts)

Large rudder angle = low speed

Small rudder angle = fast speed

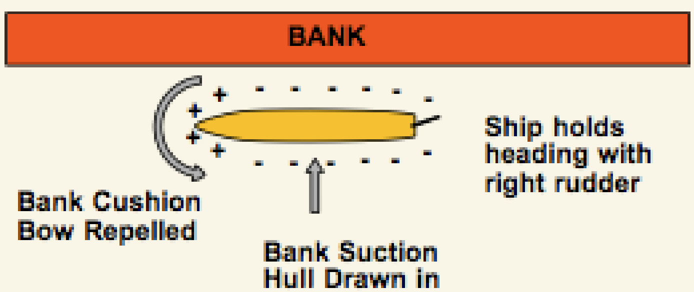

RUDDERS
Acts like a wing
Water Flow
High/Low Pressure Area
High/Low Pressure Area
Rudder Force
Rudder Force


BOW THRUSTER / APU
BOW THRUSTER
270
090
LHA/ARS/MCM
APU
TWO UNITS
EACH 360 DEG
INDEPENDANT
ON - OFF ONLY
FFG

NARROW CHANNELS

- Proceed at slow speed keeping near middle of channel to avoid the following:
  - Bank cushion - wedge of water between ship and bank builds up forcing bow out sharply
  - Bank suction - decrease of water level near quarter due to suction of screw to bank = draws stern closer
  - Act together to cause sheer twds opposite bank
- Avoid overtaking/passing in this situation

BANK CUSHION / SUCTION



SHALLOW WATER EFFECTS

- Ship increases speed, it starts to sink lower in the water
  - Distinct bow and stern waves are formed
  - Water level amidships becomes lower that the surrounding water
  - Bow starts to rise and stern sinks = Squatting
  - Wake can cause damage to shore structures, anchored boats, moored boats

SHALLOW WATER EFFECTS ON SHIP MANEUVERING

	DEEP WATER	SHALLOW WATER
TURNING CIRCLE DIAMETER	ABOUT 3X SHIP'S LENGTH	CAN DOUBLE
RATE OF TURN	GREATER	LESS
SPEED LOSS IN TURNS	GREATER	LESS
ASTERN ENGINE EFFECTIVENESS	GREATER	LESS
COASTING DISTANCE	LESS	GREATER
DIRECTIONAL STABILITY	LESS	GREATER

SHALLOW WATER ALSO INFLUENCES UNDER KEEL CLEARENCE BY INCREASES IN:

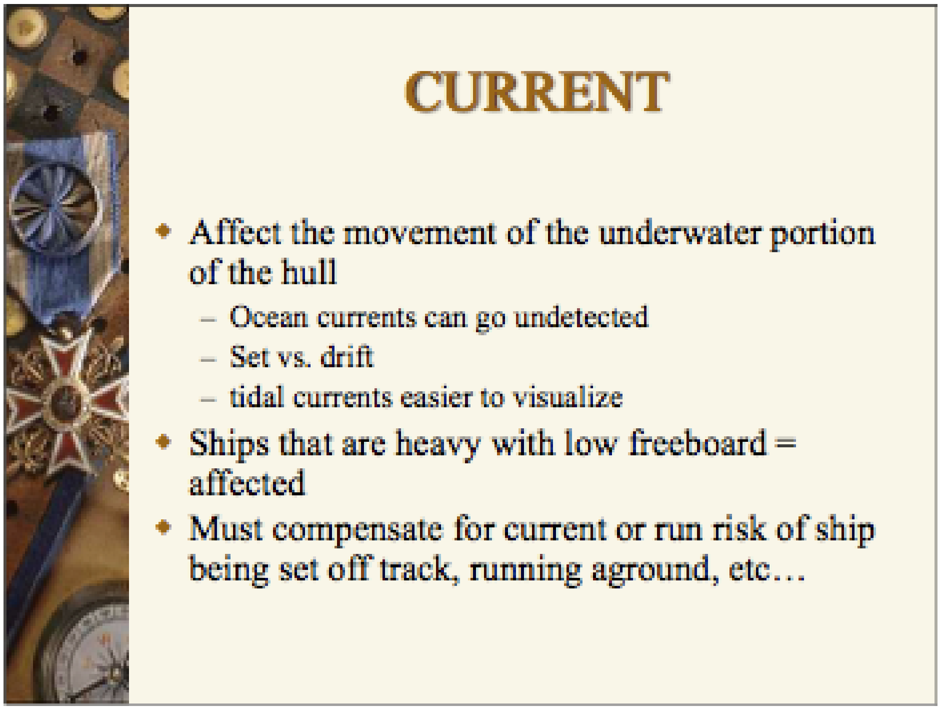
SINKAGE (INCREASE IN DRAFT AS SHIP'S SPEED INCREASES) AND SQUAT (INCREASE IN DRAFT BY BOW OR STERN AS SHIP'S SPEED INCREASES

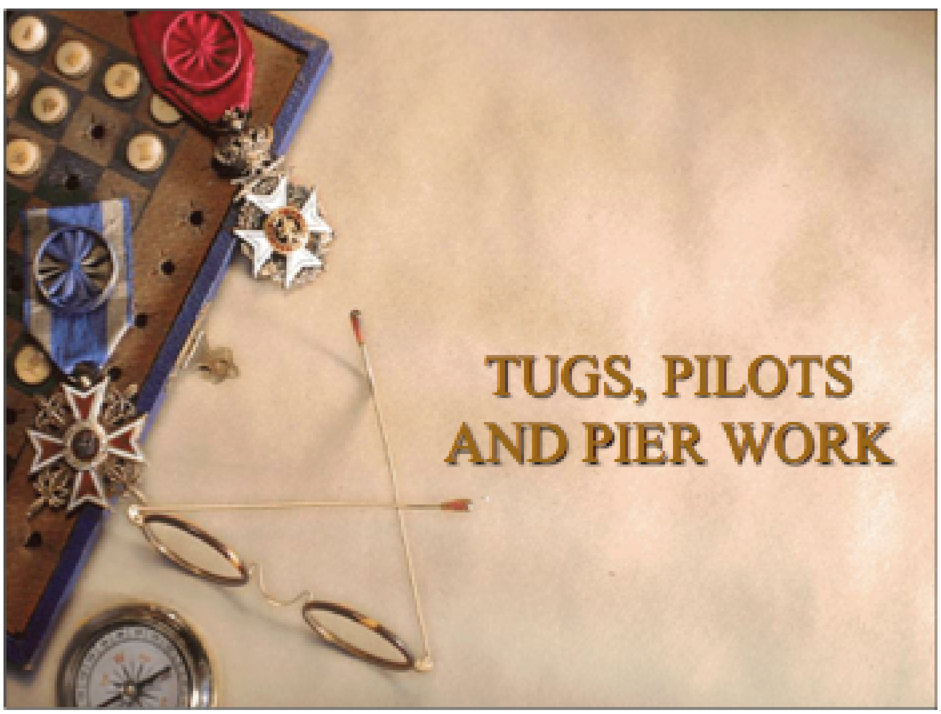
WIND

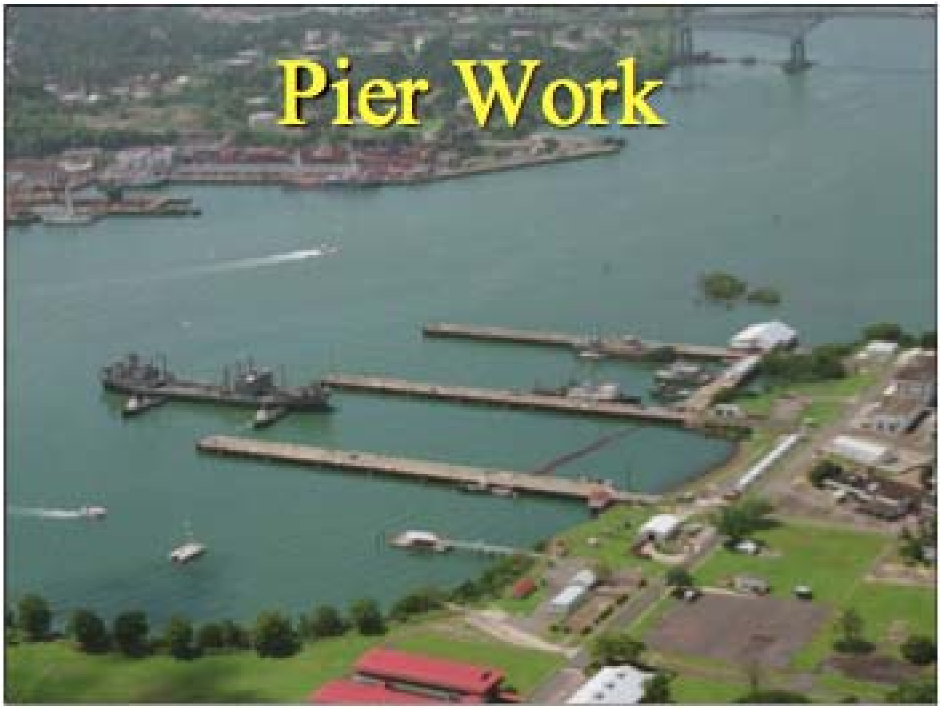
- **Freeboard:** the vertical distance from the waterline to the weatherdeck.
- **Sail area:** the entire surface area of a ship above the waterline that wind acts upon.
- Wind will have a greater affect a ship with a high freeboard

GENERAL RULES CONCERNING WINDS

- A ship's bow will seek the wind under headway
- A ship will broadside to the wind if it is not making way
- A single screw ship will normally back into the wind
- Wind usually has more effect on a light ship than a loaded one
- The effects of one knot of current will roughly equal 30 knots of wind, but this will vary with ship's draft and sail area
- As wind speed increases the force increases exponentially


CURRENT
Affect the movement of the underwater portion of the hull
– Ocean currents can go undetected
– Set vs. drift
– tidal currents easier to visualize
Ships that are heavy with low freeboard = affected
Must compensate for current or run risk of ship being set off track, running aground, etc…


TUGS, PILOTS AND PIER WORK

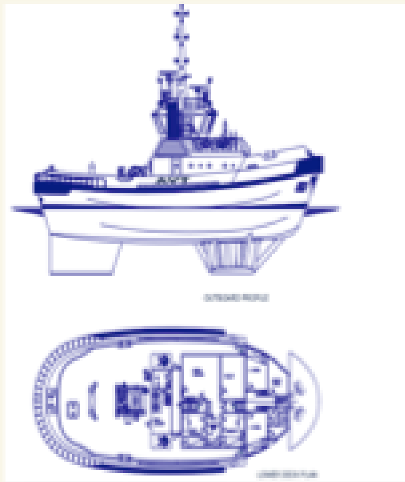

Pier Work


Tugs
Types
Single Screw.
Typical YTB (old Navy tug).
Older – Slower.
Lack of Maneuverability.
Shift make-up for different tasks.
Quarter Line.
YTB 831


Tugs
Types
Twin Screw.
Greatly Improves Maneuverability.
Twist.
More Power.
Kort Nozzle


Tugs
Types
Z-Drive Tractor Tug.
Steer 360 degrees.
2K SHP/unit.
"Large APUs".
Responsive.
Ship speed below 3kts.

TUGS



- Voith – Schneider.
  - Cycloidal Propeller (MHC class).
  - "Eggbeater" Design.
  - Quick Response.
  - Handle Higher Speeds.

TUG POWER

- USN measures tug power in Horsepower.
- Civilians measure power in Tons of Bollard Pull (BP).
  - 100 Horsepower = 1 Ton Bollard Pull (2500 HP = 25 Tons BP).
- Review LOGREQ response for tug power (20 TonsBP; 30 TonsBP+).
- Visually confirm type.

TUGS

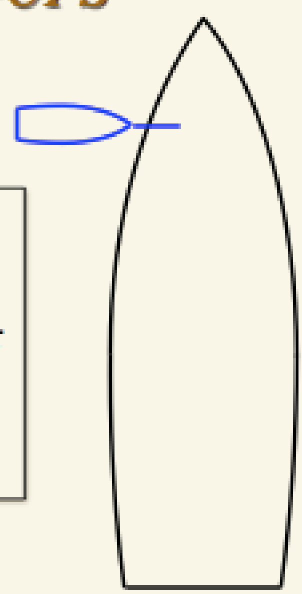
Commands

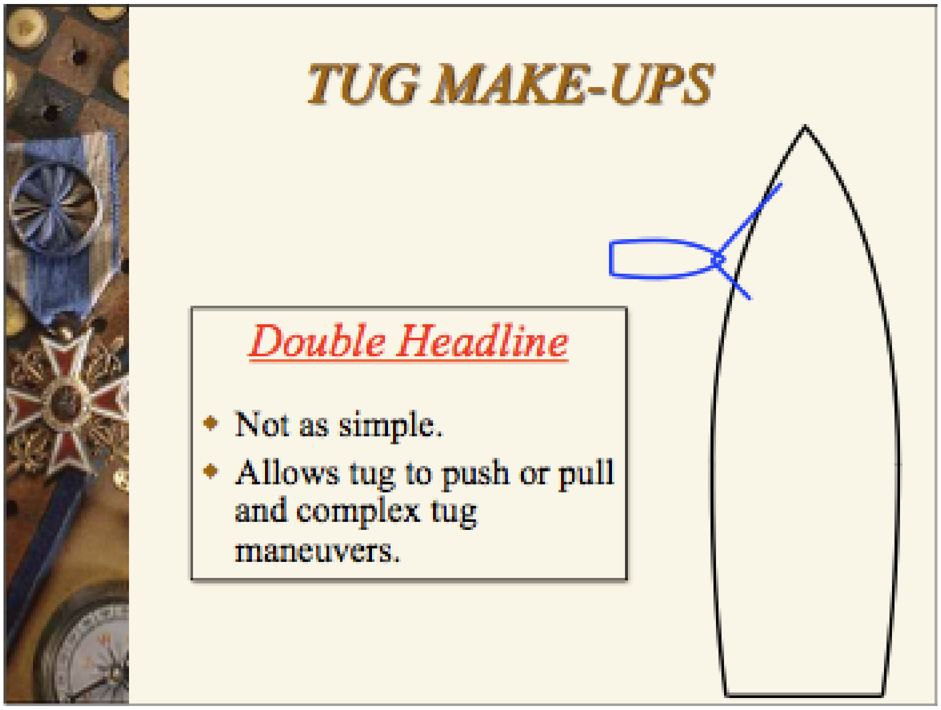
- Tractor Tugs
  - Pin to the Pier (3%)
  - Dead Slow (10%)
  - Easy (25%)
  - Half (60%)
  - Full (100%)
  - Direction.
    - Toward
    - Away
- Outside of homeport-discuss with pilot.

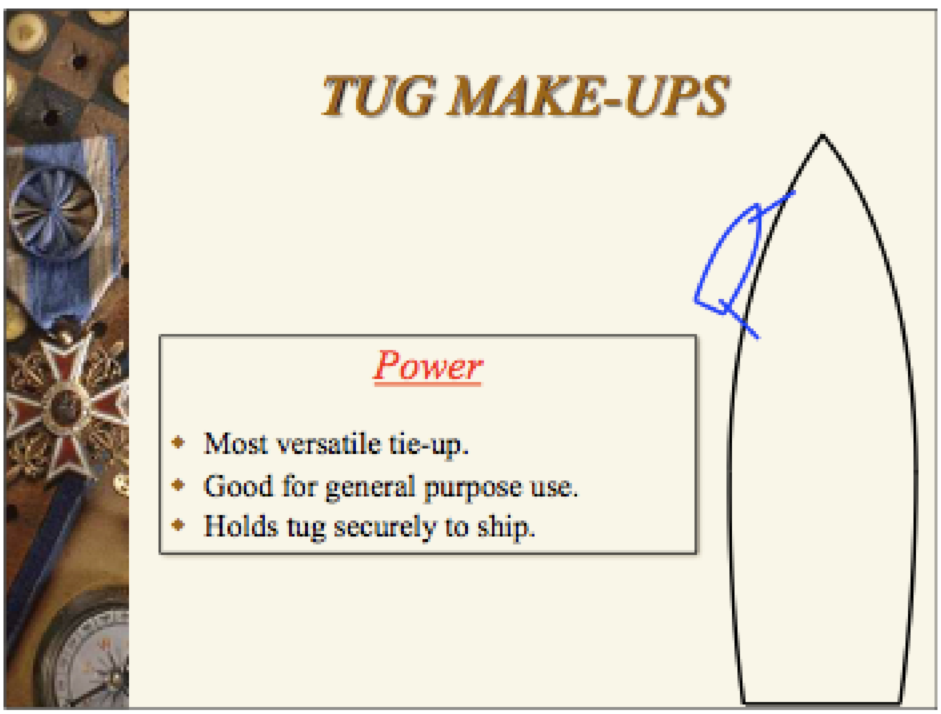
TUG MAKE-UPS

Single Headline

- Simplest Tie-up.
- Best to allow tug to push or pull only.
- Not good if complex tug maneuvers required.




TUG MAKE-UPS
Double Headline
Not as simple.
Allows tug to push or pull and complex tug maneuvers.


TUG MAKE-UPS
Power
Most versatile tie-up.
Good for general purpose use.
Holds tug securely to ship.

PILOTAGE

- Pilot's presence onboard does not relieve the CO from responsibility for navigation or ship handling, except for . . .
  - Panama canal
  - Dead stick move by order of Base Commander
  - Dry dock (sill)

QUESTIONS?

3. SWOS STANDARD COMMANDS LECTURE

Standard Commands

NS-2

1

Objectives

- Terminal Objective:
  - Understand the importance and proper use of standard commands to Conn the ship.
- Enabling Objectives:
  - State the meaning of standard commands to the Helm and Lee Helm.
  - State the purpose of issuing formatted standard commands and explain the necessity for utilizing exact phraseology for standard commands.
  - State the sequence of a helm order.

2

Standard Commands

- In general, standard commands must be loud and clear so that various watch standers may respond appropriately
- Standard commands follow a basic format which helps to avoid confusion and ambiguity
- There are four parts to a standard command
  - Command : "Right standard rudder, steady course 000."
  - Reply: "Right standard rudder, steady course 000, aye sir."
  - Report: "My rudder is right standard, coming to course 000 sir."
  - Acknowledge: "Very well."

  - Report: "Steady course 000, checking course 002, sir."
  - Acknowledge: "Very well."

3

Commands to the Helm

- Basic format for a helm order has three parts
  - Direction of Rudder
    - Right or left
  - Amount of Rudder
    - Number of degrees
  - Course to Steer
    - Given in degrees

4

Special Steering Commands

- Course change is 10 degrees or less
  - "Come left/right, steer course . . ."
- Course change is greater than 10 degrees
  - "Right standard rudder, steady on course . . ."
- Increase or decrease the amount of rudder
  - "Increase/ease your rudder to . . ."
- Steady as she goes
  - Helmsman will steady on the course in which the ship's head was pointing at the time the order was given
- Meet her
  - Helmsman will put on opposite rudder to check but not stop the swing of the ship; followed by a course.

5

Special Steering Commands

- Shift your rudder
  - Equal and opposite of ordered rudder
- Rudder amidships
  - Reduces rudder angle to zero
- How's your rudder
  - Exact angle of the rudder at that moment
- Mark your head
  - Exact heading of the ship at that moment

6

Special Steering Commands

- Mind your helm
  - Warning to the helmsman to steer more exactly
- Steer nothing to the left or right of _______
  - Used for close maneuvering situations
- Steady as you go
  - Command to the helmsman when it is desired to steady the ship on the exact heading when the order is given

7

Conning Officer Tips for Standard Commands

- In general, the amount of rudder given for a course change should not exceed the number of degrees in the course change
- Conning Officer must oversee the helmsman through the entire turn
- Avoid giving too many commands or giving too few commands
- Always look in the direction that you are turning before you give the command to turn

8

Commands to the Lee Helm (Fixed-Pitch Propeller)

- Basic format for a lee helm order has four parts
  - Engine desired
    - Port, starboard, all
  - Direction desired
    - Ahead or back
  - Amount Bell/Speed
    - 1/3, 2/3, etc,
  - Revolutions desired
    - "Indicate" and the three digit RPM desired

9

Commands to the Lee Helm (Controllable-Pitch Propeller)

- Basic format for a lee helm order has four parts
  - Engine desired
    - Port, starboard, all
  - Direction desired
    - Ahead or back
  - Amount Bell/Speed
    - 1/3, 2/3, etc,
  - Speed desired
    - Say speed as a number "fifteen knots"

10

Special Commands and Reports

- Backing Bells
- Using revolutions
  - Station keeping
  - Handling Alongside
  - Restricted maneuvering
  - "Indicate __% Pitch Port/STBD shaft"
    - Used on Diesel or GT ships
  - "Indicate 999 revolutions for Maneuvering Combos"
    - Used only on Steam ships
- Emergency
  - Helmsman will indicate three times in rapid succession
- How are my engines
- Bow Thrusters
  - Right or left, 1-10

11

Summary

- STATE the meaning of standard commands to the Helm and Lee Helm
- STATE the purpose of issuing formatted standard commands and explain the necessity for utilizing exact phraseology for standard commands
- STATE the sequence of a helm order

12

Review

- What is the purpose for using a Standard Command?
- What are four parts of a Standard Command?
- If a course change is less than 10 degrees, what order is given?
- What will the helmsman do when the order "Meet her" is given?
- Name two tips that the conning officer should follow when giving a standard command.
- What is the purpose of using "Indicate 999 revolutions for maneuvering combinations"?

13

Standard Commands Handout Exercise

14

Questions?

15

4. PARTICIPANT IN-BRIEF

The participant in brief was conducted using a checklist in order to standardize the process for all involved. This insured that from the moment of entry into the classroom by the participant until the start of the scenario, no participant was provided any additional guidance or information that had not been available to others.

Participant In-brief

1) Complete Informed Consent form

2) Complete demographic survey

3) ShipSim Extremes Coast Guard Cutter characteristics

4) Discuss material on dry erase board [Available in class presentations]

   - Proper order of conning commands
   - Helm Orders and corresponding Rudder Positions
   - Engine Orders and corresponding Bells
   - Propeller Walk effect
   - Twisting the ship
   - Harbor speed restrictions (scenario 2 & 4 = 10 knots)

5) Show available printouts and reference materials

   - SWOS Standard Commands lecture (NS-2)
   - SWOS Shiphandling Fundamentals lecture
   - Barber’s Naval Shiphandler’s Guide
   - SWOS COVE Standard Commands reference sheet from binder

6) Discuss mouse operation with student

   - Zoom (In / Out)
   - Pan (Left / Right / Up / Down)

7) Ask student if they have any questions about material covered (steps 3 through 6)

8) Start scenarios

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APPENDIX B. CLASSROOM FACILITY SETUP

WHITE BOARD:

Engines (Ahead)

1/3- approximately 5 knots

2/3- approximately 10 knots

Standard- approximately 15 knots

Full- approximately 20 knots

Flank- approximately 30 knots

(Back) 1/3, 2/3, standard, full, emergency

The students were reminded that the backing bells were not for a specific speed, and could not be ordered as an Ahead bell. An example from the SWOS lecture was provided for the students- “All Engines Ahead 2/3 for 8 knots.” Rudder orders were then covered:

Rudder Amidships (0 degrees)

(Left/ Right)

Order rudder by degrees 1 – 30

Standard (15 degrees)

Full (30 degrees)

Hard (35 degrees)

Below the breakdown an example was given that was also in the SWOS lecture. “Right Standard Rudder, steady on course 000”

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APPENDIX C. RECRUITING TOOLS AND DOCUMENTS

The Sea of Simulation

An Analysis of Game Based Shiphandling Software in Support of the Surface Warfare Officer Training Continuum.

[ENTER DATE OF RECRUITMENT HERE]

Participation is voluntary. Your participation will support Naval Postgraduate School thesis research.

Researchers: LT Ben Bernard and LT Ethan Reber

Please contact us if you want to volunteer! [redacted] [redacted]

Naval Postgraduate School
Consent to Participate in Research

Introduction. You are invited to participate in a research study entitled:
"The Sea Of Simulation: An Analysis of Game Based Shiphandling Simulation Software in Support of the Surface Warfare Officer Training Continuum"

Purpose. The purpose of this study is to discover the effect on student COVE performance when exposed to game based simulation prior to OCS SWO Intro COVE training. The study will statistically determine whether game based simulation has any effect on overall COVE training effectiveness.

Procedures. This study will require up to 24 volunteers. Each volunteer will be asked to fill out a demographic questionnaire. The researchers will provide participants with game based shiphandling simulation scenarios after students receive the SWO Intro Shiphandling lecture and before they have been given COVE training. The participant will perform Conning Officer standard verbal commands and the researcher will act as the console operator/ helmsman. The treatment will occur over a period of two days. On each day, participants will be given a practice simulation scenario of 10 minutes as a warm up to their respective task scenario. In the subsequent task scenario, the participant will consecutively get underway from, and moor the ship to a pier. Each scenario will have measures to increase difficulty that will be the same for each participant. The researchers will not offer training to the group. Participants will be provided with Conning Officer standard commands as given in the SWOS COVE instructor handbook and can have their notes as reference material. The simulation treatment scenario is designed to last a total of one hour and 30 minutes over two days, the COVE evaluation will last one hour. The treatment given to participants will not interfere with the OCS SWO Intro course of instruction. Upon completion of SWO Intro COVE training, a qualified COVE instructor will evaluate the participants individually after working hours utilizing a modified CRESST Conning Officer Shiphandling Assessment form. The COVE evaluation scenario will be getting underway from, and mooring to, a pier. Upon completion of the COVE evaluation the participants will be asked to complete a post-study demographic survey using Survey Monkey. There is no cost to participate in this research study.

Voluntary Nature of the Study. Your participation in this study is strictly voluntary. Participants must have vision correctable to 20/20 and must not be colorblind. There is no cost to participate. If you choose to participate you can change your mind at any time and withdraw from the study. You will not be penalized in any way or lose any benefits to which you would otherwise be entitled if you choose not to participate in this study or to withdraw. The alternative to participating in this research is not to participate in this research. Participation or non-participation in this research study will have no effect on academic standing.

Potential Risks and Discomforts. The potential risks of participating in this study are:

Data mismanagement; personal demographics will be collected and there is minimal risk data could be lost.

There is minimal risk that a participant who unsuccessfully completes the game based tasking may have feelings of inadequacy or lower confidence.

The student may experience some simulator motion sickness. Participants will be immediately removed from the study if he or she has signs of motion sickness.

Anticipated Benefits.

There is no direct benefit to the participants.

Possible Fleet Training benefits:
Using a game based shiphandling simulation software package may make training in the Conning Officer Virtual Environment (COVE) more effective. The game based simulation could potentially be used fleet-wide in preparation for available simulator time. The software could also provide a way to remain current for those shiphandlers that have not been able to practice an evolution for an extended period of time. Lastly, the simulation could provide a wardroom with a proven visual tool that can be used to walk through evolutions with ship drivers and bridge teams.

Compensation for Participation.
No tangible compensation will be given.

Confidentiality & Privacy Act. Any information that is obtained during this study will be kept confidential to the full extent permitted by law. All efforts, within reason, will be made to keep your personal information in your research record confidential but total confidentiality cannot be guaranteed. Participant information will be scanned to PDF and stored on the secure Naval Postgraduate School server. Hard copy's will be destroyed after scanning to PDF. *(The last four digits of a participant's telephone number will be recorded as an identification number. ID numbers will be used to keep track of student scores and will be used to pair the results. Age and years of service will also be recorded but will only be associated with identification number.)*

Points of Contact. If you have any questions or comments about the research, or you experience an injury or have questions about any discomforts that you experience while taking part in this study please contact the Principal Investigator, CDR Joe Sullivan, USN [redacted] Questions about your rights as a research subject or any other concerns may be addressed to the Navy Postgraduate School IRB Chair, CAPT John Schmidt, USN, [redacted]

Statement of Consent. I have read the information provided above. I have been given the opportunity to ask questions and all the questions have been answered to my satisfaction. I have been provided a copy of this form for my records and I agree to participate in this study. I understand that by agreeing to participate in this research and signing this form, I do not waive any of my legal rights.

______________________________   _______________
Participant's Signature   Date

______________________________   _______________
Researcher's Signature   Date

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OCT 0 7 2011
EXPIRES
MAR 3 0 2012

Demographic survey

ID# (last four digits of your telephone #):_______

1. Do you play video games on computers (e.g., PC/MAC)?

2. Have you ever played simulation video games on your computer?

3. If the answer to previous question is "Yes", have any of the computer simulations been related to naval or commercial shiphandling?

4. If you have played video games on your computer as described in question 3, what amount of time would you say you have contributed to the game in the last 6 months?(e.g., hours, days, weeks, months, etc.)

5. What amount of time have you spent playing simulations other than those related to question 3? (e.g., hours, days, weeks, months, etc.)

6. What amount of time have you spent playing any video game on a computer in the last 6 months (non-console, Xbox, PS3)? (e.g., hours, days, weeks, months, etc.)

7. What level of shiphandling experience do you have? E.g. recreational, military, commercial (Please include shipboard qualifications or any commercial simulation time like COVE or Full Mission Bridge)

8. Do you have sailing experience?

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APPROVED
OCT 0 7 2011
EXPIRES
MAR 3 0 2012

STANDARD COMMANDS

NOTE: THE STANDARD COMMANDS LISTED ARE FOR THE COVE's VOICE RECOGNITION SYSTEM AND ARE NOT INTENDED TO BE A STANDARD FOR THE FLEET

SECTION 1 (HELM)

Command	Reply	Report	Acknowledgement
"Right full rudder."	"Right full rudder, aye, sir/ma'am"	"My rudder is right full sir/ma'am. No course given"	"Very Well"

The helmsman should report which course the ship is passing every ten degrees until either told to "Belay your headings" or until told to steady on a course.

For course changes greater than 10 degrees:

Command	Reply	Report	Acknowledgement
"Left 10 degrees rudder, steady course 298"	"Left 10 degrees rudder, steady on course 298 aye, sir/ma'am"	"My rudder is left 10 degrees, coming to course 298, ... Steady on course 298 checking course XXX"	"Very Well"

For course changes less than 10 degrees:

Command	Reply	Report	Acknowledgement
"Come right, steer course 224"	"Come right, steer course 224, aye, sir/ma'am"	" My rudder is right (5, 10, 15, 20, 30) degrees coming to course 224... Steady on course 224, checking course XXX"	"Very Well"

For an increase in rudder angle:

Command	Reply	Report	Acknowledgement
"Increase your rudder to right full, steady course 270"	"Increase my rudder to right full, steady on course 270, aye, sir/ma'am"	"My rudder is right 30 degrees coming to course 270....Steady on course 270, checking course XXX"	"Very Well"

For an decrease in rudder angle:

Command	Reply	Report	Acknowledgement
"Ease your rudder to right/ left standard, steady course 270,	"Ease my rudder to right/left standard, steady on course 270, aye,	"My rudder is right/left standard steadying on course 270.... Steady on course 270 checking course XXX"	"Very Well"

IF THE CONNING OFFICER DOES NOT PASS "VERY WELL", THE COMPUTER SHOULD CONTINUE TO PASS THE LAST REPORT UNTIL THE CONNING OFFICER ACKNOWLEDGES WITH "VERY WELL".

"Shift your rudder" - The command given to go from the previously ordered position of the rudder to the opposite direction, an equal amount.

Command	Reply	Report	Acknowledgement
"Shift Your Rudder"	"Shift My Rudder, Aye "	"My rudder is right/left XX degrees, No course given"	"Very well"

"Meet her" - The command given to immediately put on opposite, not necessarily equal, rudder to check, but not stop, the swing of the ship.

Command	Reply	Report	Acknowledgement
"Meet her"	"Meet her aye, Sir/Ma'am"	N/A	"Very Well"

"Rudder Amidships" - The command given to reduce the rudder angle to 0

Command	Reply	Report	Acknowledgement
"Rudder Amidships"	"Rudder Amidships, Aye"	"My rudder is amidships.... no course given"	"Very Well"

"Steady as she goes" - The command given to steady on course/ship's head at the moment the command is given.

Command	Reply	Report	Acknowledgement
"Steady as she goes"	"Steady as she goes, Aye Sir/Ma'am. steady on course XXX"	"My rudder is left or right XX degrees coming to course XXX.... steady on course XXX"	"Very Well"

"Mind your helm" - The command given to ensure that the helmsman does not allow the ship to drift off course.

Command	Reply	Report	Acknowledgement
"Mind your helm"	"Mind My helm . Aye Sir/Ma'am	N/A	"Very Well"

"Mark your head" - The command given to have the helmsman report the exact heading of the ship at the moment.

Command	Reply	Report	Acknowledgement
"Mark your head"	"Mark my head . Aye Sir/Ma'am"	"My head is XXX"	"Very Well"

"Belay your headings" -Command given to silence heading reports. Command is used in conjunction with orders which do not contain a specific course.

Command	Reply	Report	Acknowledgement
"Belay your headings"	"Belay my headings aye Sir/Ma'am	N/A	"Very Well"

FOR MHCs CONNING COMMANDS ARE DIFFERENT DUE TO THE FACT THAT MHCs DO NOT HAVE RUDDERS. FOR MHC'S FOLLOWING TYPES OF STANDARD COMMANDS ARE USED.

MHC

Command	Reply	Report	Acknowledgement
Left/Right XX (0-90) Degrees helm Steady on course 270	Left/Right XX (0-90) degrees helm Steady on course 270 aye Sir/Ma'am	My helm is Left/Right XX (0-90) degrees coming to course 270 ... Steady on course 270	"Very Well"

IN THE CASE OF EACH OF THESE COMMANDS, THE COMPUTER SHOULD REPEAT BACK THE ORDER FOLLOWED BY "AYE SIR/MA'AM" (i.e. Mark your head, Aye Sir). THE CONNING OFFICER SHOULD CONCLUDE THE EXCHANGE BY SAYING "VERY WELL". IF VERY WELL IS NOT PASSED, THE COMPUTER SHOULD REPEAT THE LAST REPORT UNTIL THE CONNING OFFICER ACKNOWLEDGES WITH "VERY WELL".

11

SECTION 2 (LEEHELM)

ALL COMMANDS SHOULD HAVE :
AHEAD/ BACK/ STOP/ 1/3, 2/3, STANDARD, FULL, FLANK, FLANK1, FLANK2, FLANK 3 AND ABILITY TO WORK PORT AND STBD LEEHELM INDIVIDUALLY EXCEPT THE FFG and LCC

AOE

Command	Reply	Report	Acknowledgement
"All engines ahead XXX Indicate XXX RPMs for XXX kts."	"All engines ahead XXX Indicate XXX Revolutions or XXX kts, aye, Sir/Ma'am"	"All engines are ahead XXX Indicating XXX Revolutions for XXX kts"	"Very Well"

CVN

Command	Reply	Report	Acknowledgement
All engines ahead XXX Indicate XXX Revolutions	All engines ahead XXX Indicate XXX Revolutions	All engines are ahead XXX Indicating XXX Revolutions	"Very Well"

CG

Command	Reply	Report	Acknowledgement
All engines ahead XXX For XXX kts	All engines ahead XXX for XXX kts aye, Sir/Ma'am	All engines are ahead XXX for XXX kts.	"Very Well"

DDG

Command	Reply	Report	Acknowledgement
All engines ahead XXX For XXX kts	All engines ahead XXX for XXX kts aye, Sir/Ma'am	All engines are ahead XXX for XXX kts.	"Very Well"

DD

Command	Reply	Report	Acknowledgement
All engines ahead XXX For XXX kts	All engines ahead XXX for XXX kts aye, Sir/Ma'am	All engines are ahead XXX for XXX kts.	"Very Well"

MCM
For MCM's and MHC's 1/3, 2/3, STD, etc, do not apply. Individual engine orders can be given as STBD AHEAD 2, PORT BACK 2

Command	Reply	Report	Acknowledgement
All ahead XX (1-10)	All ahead XX aye, Sir/Ma'am	All engines are ahead XXX, Sir/Ma'am	"Very Well"

MCM BOW THRUSTER COMMANDS

Command	Reply	Report	Acknowledgement
Thruster Port 25	Thruster Port 25, Aye Sir/Ma'am	My thruster is Port 25	"Very Well"

* THRUSTER COMMANDS ARE STBD/PORT THEN 25, 50, 75, 100. (The thruster "water ejector" ports are fixed so the numbers correspond to percent of thrust NOT a direction as with APUs. THRUST CONTINUES UNTIL ORDERED "STOP".

FFG

Command	Reply	Report	Acknowledgement
All engines ahead XXX For XXX kts	All engines ahead XXX for XXX kts aye, Sir/Ma'am	All engines are ahead XXX for XXX kts.	"Very Well"

FFG APU COMMANDS:

Command	Reply	Report	Acknowledgement
"Start Port and Stbd APU"	"Start Port and STBD APU aye, Sir/Ma'am	Port/Stbd APU is started"	"Very Well"
"Stop PORT and STBD APU"	"Stop PORT and STBD APU, Aye Sir/Ma'am	"PORT and STBD APU is Stopped"	"Very Well"
"Train Port and Stbd APU's 130"	"Train Port and Stbd APU's 130, Aye Sir/Ma'am"	"Port and Stbd APUs are trained 130"	"Very Well"
"Port/STBD APU Stop"	Port/STBD APU Stop, Aye Sir/Ma'am"	"Port and STBD APU are stopped"	"Very Well"

LSD

Command	Reply	Report	Acknowledgement
All engines ahead XXX For XXX kts	All engines ahead XXX for XXX kts aye, Sir/Ma'am	All engines are ahead XXX for XXX kts.	"Very Well"

SOMETIMES IT IS NECESSARY TO CONTROL SPEED MORE EXACTLY THROUGH THE USE OF PITCH ALONE. THESE ORDERS ARE USED SPECIFICALLY WHEN MANEUVERING NEXT TO A PIER, BOUY OR OTHER SHIP (i.e. UNREP)

FOR CHANGES TO BOTH PORT AND STARBORD TOGETHER:

Command	Reply	Report	Acknowledgement
Indicate 4 percent pitch	Indicate 4 percent pitch AYE, Sir/Ma'am	Indicating 4 percent pitch	"Very Well"

FOR INDIVIDUAL ENGINE ORDERS:

Command	Reply	Report	Acknowledgement
PORT/STBD Ahead/Back 4 Percent Pitch	PORT/STBD Ahead/Back 4 Percent pitch AYE, Sir/ Ma'am	PORT/STBD is Ahead/Back Indicating 4 Percent pitch	"Very Well"

LHA

Command	Reply	Report	Acknowledgement
All engines ahead XX for XX kts.	All engines ahead XX for XX kts Aye, Sir/Ma'am	Main control answers, All engines ahead XX for XX kts Aye, Sir/Ma'am	"Very Well"

LHA BOW THRUSTER COMMANDS: (given at 50, 75, or 100 percent)

Command	Reply	Report	Acknowledgement
Thrust left/right 75%	Thrust left/right 75% aye, Sir/Ma'am	Thruster is right 75%	Very Well

LHD/LPD/LCC

Command	Reply	Report	Acknowledgement
Indicate XXX Revolutions	indicate XXX Revolutions	Main control answers Indicating XXX	"Very Well"

12

COVE Eval.

Appendix A. CRESST Evaluation Sheet

STANDARD SURFACE FORCE SHIPHANDLING ASSESSMENT SHEET (Rev 03 Mar 2011)

Rank / Name/Team:____________________ Date:__________

Ship:____________________ Evaluator: ____________________

Evolutions / PQS Line Items:

- ☐ Conn the ship underway from a Pier (302.2.21)
- ☐ Conn the ship during a mooring evolution (302.2.20)
- ☐ Conn the ship in a river, estuary, or channel (302.3.12)
- ☐ Conn during an UNREP approach (302.2.31), alongside during an UNREP evolution (302.2.30), or during an UNREP breakaway (302.2.32)
- ☐ Conn the ship during a multi-ship tactical maneuvering exercises (302.2.36)
- ☐ Conn the ship to recover an actual or simulated man overboard (302.2.57)
- ☐ Conn the ship through an anchoring evolution (302.2.27) or underway from anchorage (302.2.28)
- ☐ Other: ____________________

Level of Performance: ☐ Basic ☐ Intermediate ☐ Advanced (See Table 1-Tasks, Standards, Conditions)

Skill Areas and Tasks (See Table 2 for Task Description)		UNSAT (0)	Requires Improvement (1)	Meets Standards (2)	Proficient (3)	N/A
SITUATIONAL AWARENESS (15%)						
• Environmental Factors	5	0	5	10	15	
• Ship Activities / Plant Configuration	5	0	5	10	15	
• Contact Situation	5	0	5	10	15	NA
DECISION MAKING (15%)						
• Assess, Prioritize, and Act	8	0	8	16	24	
• Operate under stress / Emergencies	7	0	7	14	21	
MANEUVER (60%)						
• Margins of Safety maintained	10	0	10	20	30	
• Rules of the Road Application	10	0	10	20	40	NA
• Use of Rudder, Propulsion, and Tugs	25	0	25	50	75	
• Anticipates & Evaluates Ship responsiveness	10	0	10	20	30	
• Standard Commands	5	0	5	10	15	
COMMUNICATION (10%)						
• BRM/Internal & watch team communication	10	0	10	20	30	NA
Total SCORE:						

Optional NA

Comments:

____

____

____

____

____

Panis, Rikki (CIV)

From:	Reber, Ethan (LT)
Sent:	Wednesday, September 14, 2011 2:14 PM
To:	Panis, Rikki (CIV)
Cc:	Bernard, Benjamin (LT)
Subject:	Revised IRB App & Exit Survey blurb
Attachments:	Bernard_Reber_IRB-Application.pdf

Rikki,

Please see attached our IRB application with the recommended changes to Block 23.

Please see below for exit survey e-mail blurb:

Dear Study Participant,

We would like to take this opportunity to thank you for your willingness to support our Naval Postgraduate School thesis research and your valuable contributions to our efforts!

As discussed during the initial recruitment phase and again on the Informed Consent form, we are now requesting your voluntary completion of an online exit survey.

The survey is available through the following URL: **INSERT SURVEYMONKEY URL HERE**

To complete the survey you will need the 4 digit identification number selected by you on your first day of study participation and about 15 minutes of your time. This number is most likely the last four digits of a telephone number you are familiar with, but if you no longer have access to this number, please contact LT Ben Bernard at bjbernar@nps.edu and we will establish a temporary identification number for you to access the online content.

The survey will attempt to gather your opinions on the shiphandling tool you were exposed to and its perceived utility to you and the Navy. Completion of this survey is voluntary and, in the event you feel the question(s) to be invasive or of a personal nature, need not be completed in its entirety.

Once again, we would like to thank you and wish you the best of luck in the Fleet!

Respectfully,

LT Ben Bernard, USN
LT Ethan Reber, USN

V/R,
Ethan

LT Ethan Reber, USN
Student MOVES Institute http://www.movesinstitute.org/
Graduate School of Operational & Information Sciences
Naval Postgraduate School
[redacted]

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MAR 3 0 2012

1

this one on survey monkey

Post- study Demographic Survey

ID# (last four digits of your telephone #):_______

1. Did you have any problems seeing the tool clearly?
   (hard to see) 1 2 3 4 5 (easy to see)

2. How easy was the tool to understand and apply?
   (hard) 1 2 3 4 5 (easy)

3. Did the tool hinder learning or practice?
   (none) 1 2 3 4 5 (extremely)

4. Did the training tool help you apply training given in the SWOS shiphandling lectures?
   (not at all) 1 2 3 4 5 (very much)

5. How well did tool help you in the SWOS Intro COVE training sessions?
   (not at all) 1 2 3 4 5 (very much)

6. What specifically helped you?
   (not at all) 1 2 3 4 5 (very much)

7. If you had this tool to take with you to the fleet how likely would it be that you continue to use it to train or practice?
   (not at all) 1 2 3 4 5 (often)

8. How likely would it be that you would recommend this tool to a friend or shipmate for training or practice?
   (none) 1 2 3 4 5 (everyone)

9. How likely would it be that you would use this tool to prepare for simulated shiphandling evolutions (i.e. COVE, Full Mission Bridge, NSST)?
   (not at all) 1 2 3 4 5 (often)

10. How likely would it be that you would you use this tool to prepare for "live" shiphandling evolutions?
    (not at all) 1 2 3 4 5 (often)

11. Did you feel frustrated while using the tool? If so, please explain.

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APPROVED
OCT 0 7 2011
EXPIRES
MAR 3 0 2012

12. What recommendations would you give for improvement of the tool or its application to training?

13. What was your opinion of the training tool you used?

14. What are some things you thought the tool lacked?

15. Did you experience any problems with the supplemental information given while using the tool? (e.g. "cheat sheets" or worksheets)

16. Are there any other recommendations you can give (when not actually driving a ship) that will help future shipdrivers train or practice shiphandling skills?

The Sea of Simulation

An Analysis of Game Based Shiphandling Simulation Software in Support of the Surface Warfare Officer Training Continuum

831-656-7582
http://movesinstitute.org

Disclosure

- This is a research study performed by Naval Postgraduate Students.
- The research is being performed for thesis work required in an NPS Master's Degree program.
- Participation is voluntary and will not have any effect on your academic standing.
- Participation is anonymous. No one in your chain of command will know whether you have chosen to participate or have chosen not to participate.

831-656-7582
http://movesinstitute.org

Background

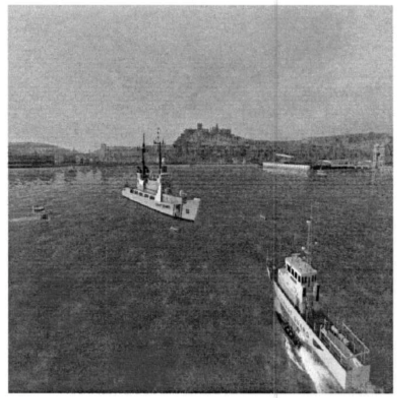
- There is no low cost, readily accessible shiphandling resource to fill the gap between seminar style shipboard training and the higher fidelity simulations currently available to Naval Officers.
- COVE / FMB usage restrictive

Current Training Resources

- Shipboard / Classroom Seminar
- Kongsberg NSST Desktop
- Conning Officer Virtual Environment
- Full Mission Bridge
  - IMO certified models available
- Real World Shiphandling

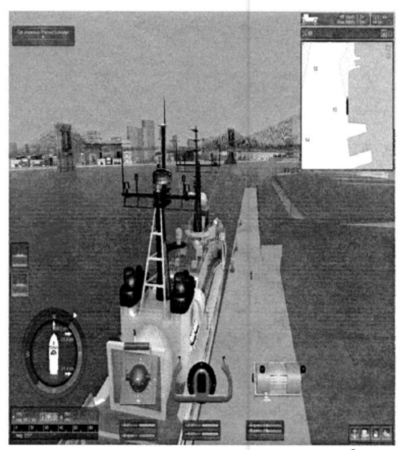
ShipSim Extremes

- Developed by VSTEP
  - Nautis (Task Group level)
- Not designed for training, but lent well to task scenarios
- Robust Mission Editor allowed development at the evolution level
- Networked play ability



Scenarios volunteers will participate in

- 2 practice scenarios and 2 Task scenarios of increasing difficulty
- Focus on core competency of getting a ship underway and maneuvering for a subsequent pier landing
- Parallel landing
- 90 degree landing with obstructions



9/14/2011

6

Scenario Design

- Three days of participation
- Two days (After normal working hours)
  - 2 sessions of 10 minute practice scenario followed by 15 minute Task scenario
  - Task scenario ends once first mooring line is over or 15 minutes expires
  - Short break between tasks
- Third day (after hours on last day of COVE)
  - 45 minute evaluation scenario
- Post-study online survey

Hypothesis

- Students who use game based shiphandling simulations to practice tasks covered in classroom shiphandling theory, prior to higher level simulation use (e.g., Conning Officer Virtual Environment (COVE), Full Mission Bridge (FMB)), will result in a higher level of performance in those tasks than those not currently using game based shiphandling simulation

Proposed Research Study

- Goal is to get at least 18 participants over three sessions
- Participants will receive test treatments over two sessions
- Research study will be conducted on a not to interfere basis with OCS SWO Intro classes.
- At the end of the normal COVE course of instruction a 45 minute evaluated session will be held after hours to gather data

Expected Results

- We think using simulation prior to COVE will maximize effective COVE time.
  - Providing a game based simulation for practiceof shiphandling theory could shorten familiarization time, make COVE training more immediately effective, and help students immerse more readily.
  - Saying conning commands out loud and seeing the ship respond will allow quicker memorization and result in more beneficial application during higher level simulation.
  - Visually identifying navigation buoys, piers, and other navigation aids will help student to recognize these features in higher level simulation.

Possible benefits

- There is no direct benefit to participants.
- A tool for students to use for independent Study prior to COVE, potentially resulting in reduction in COVE and FMB time to acquire proficiency.
- A tool to be used by Wardrooms to visually rehearse evolutions.
- A tool for officers who have not had recent bridge time to maintain proficiency.
- A training tool for the JO/ CO shipboard training continuum.
- A demonstration tool for CO's to check shiphandling acumen or as a gateway toward eligibility for live evolutions (direct observation or score reporting).

Restrictions

- Correctable 20/20 vision is required
- Participants must not be colorblind
- Motion sickness

Questions?

If you are interested in volunteering please contact LT Bernard[redacted]or LT Ethan Reber by lunchtime tomorrow.

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APPENDIX D. CRESST STANDARD SURFACE FORCE SHIPHANDLING ASSESSMENT

A. COSA CRESST SSFSAS

STANDARD SURFACE FORCE SHIPHANDLING ASSESSMENT SHEET (Rev 03 Mar 2011)

Rank / Name/Team:______________________________ Date:______________

Ship:______________________________ Evaluator: ______________________________

Evolutions / PQS Line Items:

- ☐ Conn the ship underway from a Pier (302.2.21)
- ☐ Conn the ship during a mooring evolution (302.2.20)
- ☐ Conn the ship in a river, estuary, or channel (302.3.12)
- ☐ Conn during an UNREP approach (302.2.31), alongside during an UNREP evolution (302.2.30), or during an UNREP breakaway (302.2.32)
- ☐ Conn the ship during a multi-ship tactical maneuvering exercises (302.2.36)
- ☐ Conn the ship to recover an actual or simulated man overboard (302.2.57)
- ☐ Conn the ship through an anchoring evolution (302.2.27) or underway from anchorage (302.2.28)
- ☐ Other: ______________________________

Level of Performance: ☐ Basic ☐ Intermediate ☐ Advanced (See Table 1-Tasks, Standards, Conditions)

Skill Areas and Tasks (See Table 2 for Task Description)		UNSAT (0)	Requires Improvement (1)	Meets Standards (2)	Proficient (3)	N/A
SITUATIONAL AWARENESS (15%) • Environmental Factors	5	0	5	10	15	
• Ship Activities / Plant Configuration	5	0	5	10	15	
• Contact Situation	5	0	5	10	15	
DECISION MAKING (15%) • Assess, Prioritize, and Act	8	0	8	16	24	
• Operate under stress / Emergencies	7	0	7	14	21	
MANEUVER (60%) • Margins of Safety maintained	10	0	10	20	30	
• Rules of the Road Application	10	0	10	20	30	
• Use of Rudder, Propulsion, and Tugs	25	0	25	50	75	
• Anticipates & Evaluates Ship responsiveness	10	0	10	20	30	
• Standard Commands	5	0	5	10	15	
COMMUNICATION (10%) • BRM/Internal & watch team communication	10	0	10	20	30	
Total SCORE:						

Comments:

____

____

____

____

____

Shiphandling Skill Assessment

Background: Developing a *Seaman's Eye* and shiphandling proficiency requires an understanding of basic maneuvering principles, developing situational awareness and frequent practice. This assessment tool is designed to measure the extent to which Basic, Intermediate, and Advanced level mariners have perfected their shiphandling skills. In all cases, shiphandling tasks and standards of performance are the same from Basic to Advanced levels. What distinguishes performance of beginners from that of experts is the ability to perform those same tasks successfully under ever more demanding conditions. This tool is one option Commanding Officers may use to judge the proficiency of their conning officers. Scoring may be done manually on paper grade sheets or on a PC tablet with Shiphandling Skill Assessment software installed.

Directions:

1. On the grade sheet identify the Evolution being evaluated.

2. From Table 1, (the attached Excel Spread Sheet) identify the level of performance being evaluated (Basic, Intermediate, Advanced). Level of performance is a function of the difficulty of the Conditions (handling the ship in challenging environments, among high traffic density, and facing equipment casualties and emergencies, etc.). The tasks and standards are the same from Apprentice through Master, the conditions become more demanding with increased levels of performance. Note: In graded trainer/simulator scenarios, the conditions can be easily controlled, but not at sea. At-sea evaluators must apply judgment as to the level of difficulty or complexity of the conditions to assign the Basic, Intermediate, Advanced Master level of performance based on the prevailing conditions at the time. Not all the indicated conditions in Table 1 will be present in all evolutions at sea or in a trainer.

3. Monitor the conning officer's performance in each of the eleven (11) skill tasks listed on the grade sheet to determine the skill level achieved, from Unsatisfactory to Proficient and circle the level achieved for each task. Table 2 describes the tasks for standardized interpretation.
   a. **UNSAT** = little to no skill or knowledge demonstrated.
   b. **Needs Improvement** = sufficientknowledgeorskilldemonstratedbutinsufficienttomeetminimum expectations. Additional training and practice required.
   c. **Meets Standard** = adequate skill or knowledge demonstrated to perform the task.
   d. **Proficient** = EXCELLENT skill and knowledge demonstrated.

4. Tally all points awarded.

Weighting: The Shiphandling Assessment is based on evaluation in four (4) major skill areas, each weighted according to its relative importance: Situational Awareness 15%, Decision-making 15%, Maneuver 60%, and Communication 10%.

Skill Levels: Based on the individual's performance, increasing value is assigned for each of the skills listed in the grading table: 0 – Unsatisfactory, 1 X – Needs Improvement, 2 X – Meets Standards, and 3 X – Proficient.

Score Calculation: Scoring is based on a 300 point scale (maximum number of points available). The overall score is calculated by adding the individual task point values for each of the four (4) skill areas under the UNSAT, Needs Improvement, Meets Standards, and Proficient columns. These benchmarks assume all 11 skill tasks on the assessment sheet are graded. If one or more skills are not applicable and marked "N/A", the final grade must be adjusted accordingly and the grade calculated based on the total points available. Note: Shiphandling software automatically calculates the conning officer's grade as performance is entered.

Automatic Failing Grade; Allision with an object (pier, buoy), collision with another vessel, running aground, violating the Rules of the Road or accumulating one or more grades of UNSAT on any task will result in an automatic failure for the event.

Performance Benchmarks: Based on the 300 point criteria, the benchmarks for individual performance are as follows. **The minimum passing score is 180.**

Proficient: 250 – 300
Meets Standards: 180 – 249
Needs Improvement: 101 – 179
Unsatisfactory: 100 or Below

APPENDIX E. RAW DEMOGRAPHIC SURVEY DATA BY QUESTION

Question 1

Do you play video games on computers (e.g., PC/MAC)?	
Participant #	Participant Response
2831	N/A
2121	No
3536	Sometimes
9758	No
6562	I have in the past
2369	No
2289	No
5194	Yes. PC and MAC
2233	Console and PC
7093	Yes
2998	Not really

Question 2

Have you ever played simulation video games on your computer?	
Participant #	Participant Response
2831	N/A
2121	No
3536	Yes
9758	No
6562	No
2369	Yes
2289	Yes
5194	Yes
2233	No
7093	Yes
2998	Yes

Question 3

If the answer to the previous question is "Yes," have any of the computer simulations been related to naval or commercial shiphandling?	
Participant #	Participant Response
2831	N/A
2121	N/A
3536	No
9758	N/A
6562	N/A
2369	No
2289	No
5194	No
2233	N/A
7093	No
2998	No

Question 4

If you have played video games on your computer as described in question 3, what amount of time would you say you have contributed to the game in last six months? (e.g., hours, days, weeks, months, etc.)	
Participant #	Participant Response
2831	N/A
2121	N/A
3536	N/A
9758	N/A
6562	N/A
2369	N/A
2289	N/A
5194	N/A
2233	N/A
7093	N/A
2998	N/A

Question 5

What amount of time have you spent playing simulations other than those related to question 3? (e.g., hours, days, weeks, months, etc.)	
Participant #	Participant Response
2831	N/A
2121	Zero
3536	Played MS Flight Simulator for about 2 months, 2–3 hours every day after class due to my job as a student researcher for NASA.
9758	N/A
6562	N/A
2369	None
2289	N/A
5194	Months
2233	None
7093	Very little, hours at most
2998	Very little

Question 6

What amount of time have you spent playing any video game on a computer in the last 6 months (non-console, Xbox, PS3)? (e.g., hours, days, weeks, months, etc.)	
Participant #	Participant Response
2831	Zero
2121	Zero
3536	2 hours
9758	Zero
6562	Zero
2369	6 hours
2289	Zero
5194	Week or so
2233	36 hours
7093	3 hours per day before OCS
2998	Zero

Question 7

What level of shiphandling experience do you have? E.g., recreational, military, commercial (Please include shipboard qualifications or any commercial simulation time like COVE or Full Mission Bridge)	
Participant #	Participant Response
2831	None
2121	Zero
3536	None
9758	None
6562	Recreational. Weekends on the lake or waterway in smaller power boats
2369	None
2289	None
5194	None
2233	None
7093	None
2998	Very Little

Question 8

Do you have sailing experience?	
Participant #	Participant Response
2831	No
2121	Zero
3536	Went sailing for the first time yesterday [Would have been 11Oct11]
9758	No
6562	No
2369	No
2289	No
5194	No
2233	No
7093	No
2998	Very Little

APPENDIX F. JMP RAW COVE DATA BY PARTICIPANT

Participant ID	Margins of Safety Maintained	Use of Rudder, Propulsion, and Tugs	Anticipates & Evaluates Ship Reponsiveness	Standard Commands	Standardized Score
1	20	25	10	10	130
2	10	50	10	15	170
3	20	50	20	10	200
4	20	25	10	10	130
5	10	50	10	10	160
6	20	50	20	15	210
7	20	50	10	10	180
8	10	50	10	10	160
9	20	50	10	10	180
10	20	50	10	10	180
11	20	50	10	10	180

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APPENDIX G. COGNITIVE TASK ANALYSIS (CTA) (FROM GRASSI, 2000)

1. HIERARCHICAL TASK ANALYSIS (HTA)

a. HTA for Getting Ship Underway from a Pier

Goals:

Ensure Ship is Ready to get underway

- Assess environmentals and ship surroundings
- Visually assess ships distance to nearest obstructions

Complete Clearing the Pier

- Receive order from CO to get underway
- Complete assessment of environmental factors
- Complete taking in all lines
- Swing stern away from pier
- Swing bow away from pier
- Complete assessment of ships movement/ position

Complete Exiting Pier Area (problem in this section of Grassi thesis)

- Ensure stern is clear of pier
- Ensure bow is clear of pier
- Ensure Bow direction matches heading of intended course
- Determine course to steer
- Order engines ahead at a 1/3 bell
- Order helmsman to steer ordered course
- Assess response of ship
- Ensure bow direction matches heading of intended course

Complete Entering the Channel

- Complete turn into channel
- Ensure ship is on correct heading
- Order engines ahead at a 2/3 bell
- Monitor intended course for surface contacts

b. HTA for Mooring Ship to a Pier

Goals:

Enter pier area

- Safely complete harbor transit
- Reduce ships speed

Complete pier approach phase

- Maneuver ship to proper approach angle with pier
- Assess environmentals and ship surroundings
- Visually assess ships distance to nearest obstructions
- Complete assessment of ships movement/ position
- Reduce speed to bare steerage way
- Assess environmentals and ship surroundings

Complete positioning and stopping

- Approach within 100 feet of pier
- Maneuver ship so mooring side is parallel to pier
- Slow to less than 1 knot Speed Over Ground
- Order over all lines

Complete maneuvering ship against pier phase

- Verify ship properly aligned with pier
- Monitor ships position and distance from pier
- Make adjustments to ships position

- Move in ship against pier
- Monitor ships position and distance from pier
- Make adjustments to ships position
- Verify ship properly against pier

2. CRITICAL CUE INVENTORY (CCI)

a. CCI for Getting Ship Underway and Mooring to a Pier

Assess enviromentals and ship surroundings

- State of water in channel
- Buoys
- Wind Indicator

Visually assess ships distance to nearest obstructions

- Separation between bow and pier
- Separation between stern and pier
- Distance to surrounding obstructions

Complete taking in all lines

- Order take in all mooring lines

Determine if engine order was executed

- Sound of engines accelerating
- Hear helmsman acknowledgement

Assess response of ship

- Change in separation between ship and pier
- Rate of swing of ships bow or stern

Assessment of Ships movement and position

- Change in separation between ship and pier
- Rate of swing of ships bow or stern

Measuring distance between ship and pier

- Open space between ships stern and pier
- Open space between ships bow and pier
- Open space between ships amidships and pier

Monitor intended course for surface contacts

- Scan horizon for other surface contacts

Verify ship aligned with pier

- Bridge wing is aligned with second bollard on pier

APPENDIX H. CRESST SHIPHANDLING TASK DESCRIPTION AND GRADING CRITERIA

Skill Area	Needs Improvement	Meets Standards	Proficient
Planning – Navigation Picture	Understands the general navigation picture, but may not familiar with specific track requirements (when turns are to be taken, location of navigation aids, etc.)	Has a solid understanding of the navigation picture, track to be followed, turns, and navigation aid location (i.e., understands the navigation plan for a harbor transit, transit to anchorage or the UNREP plan – when the ship is in waiting station, when the ship is to make its approach, is aware of when other ships are to come along side etc.)	Clearly knows the navigation picture (landmarks, navigation aids, intended course and speed changes to maintain track, courses and speeds to station), understands the environment and HOW and WHERE those forces will impact the ship's movement (i.e., knows where currents, tides, and winds will affect the ship, in what direction the ship will be pushed) and knows how to take those factors into consideration when maneuvering the ship (turning early or late , or staying right or left of track to compensate for these factors)
Planning – ORM / Contingency Plans	Understands basic actions required in the event of a casualty, but may not recognize when the situation changes or all of the actions required.	Knows what actions should be taken to address major casualties (loss of steering, man overboard, etc.) and understands that as the situation changes, different actions may be required to address casualties.	Knows what action should be taken to address major casualties, but also understands WHEN the situation changes and WHAT new response is required (i.e., knows how to address a man overboard situation while in restricted maneuvering vice open ocean). Shows evidence of planning ahead, anticipating potential problems and acting accordingly.

Figure 32. CRESST Shiphandling Task Description and Grading Criteria page one

Skill Area	Needs Improvement	Meets Standards	Proficient
Situational Awareness – Environmental Factors	Understands the various environmental factors, but may not fully understand how those forces impact the ship. May not apply sufficient rudder to turn the ship against the wind or current, allowing the ship to depart from intended track and requiring frequent rudder and speed changes to compensate.	Understands the various environmental factors that impact the movement of the ship (wind, seas, currents, etc.). Understands that on-setting wind and current may hold the ship to the pier. Has a basic understanding of what actions are required to counteract the environmental factors.	Clearly understands the environmental factors, HOW they impact the ship, and WHAT actions should be taken to counter those forces (i.e., knows to apply an additional 1 to 2 degrees of rudder while transiting to counter currents and keep the ship consistently on track or to turn early / late to comensate).
Situational Awareness – Ship Activities / Plant Configuration	Cognizant of activities taking place on the ship, but may not fully understand HOW these events might impact the ship's movement (i.e., having man aloft and how it might impact use of radars, or conducting ballasting operations in preparation for going into Lynnhaven anchorage to offload LCAC or displacement craft). Knows the ship's configuration, but may not be fully aware of plant (speed, maneuvering) limitations	Understands what other activities are taking place and HOW they impact the ship's movement (boat operations, flight quarters, etc.). Understands the plant configuration and what limitations it will place on maneuvering.	Understands what activities are taking place and HOW they may potentially impact ship's movement. Clearly understands the plant configuration and WHAT limitations it will place on maneuvering. Shows evidence of planning ahead to preclude activities or limitations from impacting ship's intended movement.

Figure 33. CRESST Shiphandling Task Description and Grading Criteria page two

Skill Area	Needs Improvement	Meets Standards	Proficient
Situational Awareness – Contact Situation	Is aware of contacts closest to the ship, but may not be cognizant of the full contact picture or all the significant contacts and HOW they may potentially impact the safe movement of the ship.	Is aware of the other contacts in the vicinity of the ship during its movements. Is able to keep the ship safely clear of contacts.	Has a solid grasp of the contact situation. Clearly understands how ship movement will impact (increase / decrease) CPAs and the contact situation, and acts accordingly. Takes avoiding action early.
Decision-Making – Assess, Prioritize, Act	Is generally able to assess the situation and identify some of the potential hazards (contacts, shoal water, etc.) that may impact the ship, but may not fully understand which hazards might impact the ship first.	Is able to assess the situation and identify some of the potential hazards that may impact the ship. Is able to recognize and establish priorities and act upon them.	Properly assesses the situation, identifies potential hazards and HOW and WHEN they might impact the ship. Determines priorities (what contacts pose the greatest hazard to ship movement), and acts decisively, taking early action to avoid potential problems (i.e., individual assesses a series of contacts, understands which one is going to cause the most concern and takes action early to increase the margin of safety by slowing down to let contacts open or maneuvering early)
Decision-Making – Operate under stress / Handle emergencies	Recognizes emergency situations, but may not be able to take appropriate action. May lose focus in keeping the ship safe when reacting to stressful situations (i.e., bumping the pier while making an approach during a gyro casualty because the individual loss focus)	Handles emergencies and maintains focus to keep the ship safe. Understands the priority of keep the ship on course and safe during casualty situations.	Effectively handles emergencies and abnormal conditions that impact ship maneuvering (loss of steering, etc). Maintains focus and keeps the ship safe in challenging and stressful situations.

Figure 34. CRESST Shiphandling Task Description and Grading Criteria page three

Skill Area	Needs Improvement	Meets Standards	Proficient
Maneuver - Margins of Safety	Follows the ship's track, but may not recognize the need to adjust course and speed to maintain a margin of safety (i.e., applies too much speed when approaching the pier, too close an approach when coming along side a replenishment ship, etc.)	Maintains the ship on track as required, but may not necessarily adjust to increase margins of safety (i.e., ensuring widest margin when passing / meeting another vessel, making a close approach on a replenishment ship)	Maintains and follows safe tracks, courses, and speeds. Tries to maintain maximum distance from hazards (shoals, other ships) when maneuvering. Is cognizant of other vessels, water depth, visibility, capability of ship, capability of tugs, and other factors, and plans accordingly. Looks ahead and anticipates potential problems.
Maneuver – Rules of the Road Application	Understands the Rules of the Road, but may not uniformly apply them (i.e., fails to properly sound 3 short blasts when operating astern propulsion when backing out of a slip, etc.)	Understands the Rules of the Road and generally applies them. Sounds proper signals when maneuvering. Generally recognizes most of the lights, day shapes, navigation aids, and sound signals when encountered.	Clearly understands the Rules of the Road and consistently applies them. Sounds proper signals when maneuvering and encountering other vessels. Recognizes lights, day shapes, navigation aids, and sound signals when encountered.
Maneuver – Use of Rudder, Propulsion, and Tugs	Is able to employ rudder and propulsion to maneuver the ship, but may not fully appreciate all the forces affecting ship's movement. Tends to over compensate when maneuvering resulting in an excessive number of engine and rudder orders to maneuver the ship. Not fully conversant in employing tugs and bow thruster / APUs.	Understands the capabilities and characteristics of the ship. Effectively employs rudder, propulsion (and tugs) to maneuver. May tend to over compensate when maneuvering resulting in a number of engine and rudder orders to maneuver / remain on track. Knows how to handle tugs and APUs / bow thruster.	Clearly understands the capa-bilities and characteristics of the ship and HOW forces effects it. Effectively employs rudder, propulsion (and tugs) to safely maneuver. Anticipates HOW the ship will respond to changes and compensates for effects. Under-stand WHEN and HOW pivot point changes. Safely and effectively employs tugs. Knows the right amount of rudder / speed required.

Figure 35. CRESST Shiphandling Task Description and Grading Criteria page four

Skill Area	Needs Improvement	Meets Standards	Proficient
Maneuver - Anticipates and evaluates ship's responsiveness	Effectively maneuvers the ship, but may not track the ship's movement (checking bridge wing, watching rudder angle indicator) or fails to check the ship's swing during maneuvering	Checks the ship's bridge wings before executing turns. Tracks and monitors the ship's movements.	Checks the ship's bridge wings before executing turns. Evaluates and monitors the responsiveness of the ship when executing maneuvers (checks the swing of the ship when turning if the bow or stern is swinging too fast, etc.). Monitors advance and transfer. Anticipates changes and how the ship will respond.
Maneuver – Standard Commands	Understands and uses standard commands, but occasionally uses plain language to communicate orders.	Properly uses standard commands in communicating orders	Clearly understands standard commands and clearly communicates orders using standard phraseology .
Communication – BRM & Internal communications	Communicates with bridge watch standers and CIC, but occasionally misses a report or fails to communicate information to watch standers	Establishes effective information flow between Conn, OOD, CIC, Navigator, and CO regarding piloting situations	Establishes smooth and effective communications within the watch team. Encourages the flow of information between watch standers.
Communication – BTB & External communications	Is able to conduct a BTB communication but needs additional experience to be proficient and conversant in its use.	Uses proper VHF procedures, makes clear and timely communications (security calls)	Conversant in the use of BTB. Makes timely and confident communications. Communicates clearly and effectively

Figure 36. CRESST Shiphandling Task Description and Grading Criteria page five

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APPENDIX I. CRESST SHIPHANDLING TASKS, STANDARDS, AND CONDITIONS

Task#	Task Description	Performance Standards	Conditions - Basic	Conditions - Intermediate	Conditions - Advanced
302.2.21	Conn the ship underway from a pier				
	(1) Lift the ship off the pier, (2) Back the ship out of the slip, and (3) Maneuver the ship fair into the channel using a twist	(1) Lead with stem to protect the screws while keeping the bow from touching the pier (to protect the sonar dome on CRUDES ships). (2) Maintain safe and controlled forward, aft, and lateral movement.	**Environment**: Calm conditions with winds less than 5 knots and no current, clear visibility; **Facilities**: one or two tug(s) made up to the bow (or bow thruster); **Contacts**: no contacts or other vessels in the slip or in the surrounding area; **Emergencies / Abnormal Conditions**: None.	**Environment**: Up to 10 knots of onsetting or off setting wind, up to 0.3 knots of onsetting or offsetting current, day or night, limited visibility ; **Facilities**: one tug made up to the bow or bow thruster; **Contacts**: one contact in the vicinity of the slip; **Emergencies**: Possibly 1 emergency situation.	**Environment**: 15 knots or greater of onsetting or offsetting wind, 0.5 knots or greater of onsetting or offsetting current, day and night, limited visibility; **Facilities**: one tug made up to the bow or bow thruster; **Contacts**: multiple contacts in the vicinity of the slip; **Emergencies**: 1 or more emergency situations.

Figure 37. CRESST Tasks, Standards, and Conditions for Conn the ship underway from a pier

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APPENDIX J. SHIP SIMULATOR EXTREMES TASK SCENARIO USAGE, DESIGN PHILOSOPHY, AND PERIPHERAL SETUP

A. SOFTWARE INSTALLATION AND ACCESS TO MISSION EDITOR

1. The Ship Simulator Extreme software is available for purchase at http://www.shipsim.com/products/shipsimulatorextremes and can be downloaded directly from the site or ordered in hard copy. Verify that the software is no earlier than v1.4 (build 1086). If this is not the case, the appropriate software patch is available at http://www.shipsim.com/downloads/updates.

2. Once the software had been installed on your Windows PC or laptop, open the program by clicking the left button of your mouse twice over the Ship Simulator Extremes icon on your Desktop or via the following path Start/All Programs/Ship Simulator Extremes/Ship Simulator Extremes. The program will go through its normal startup routine and then present the Main Menu screen (Figure 38).

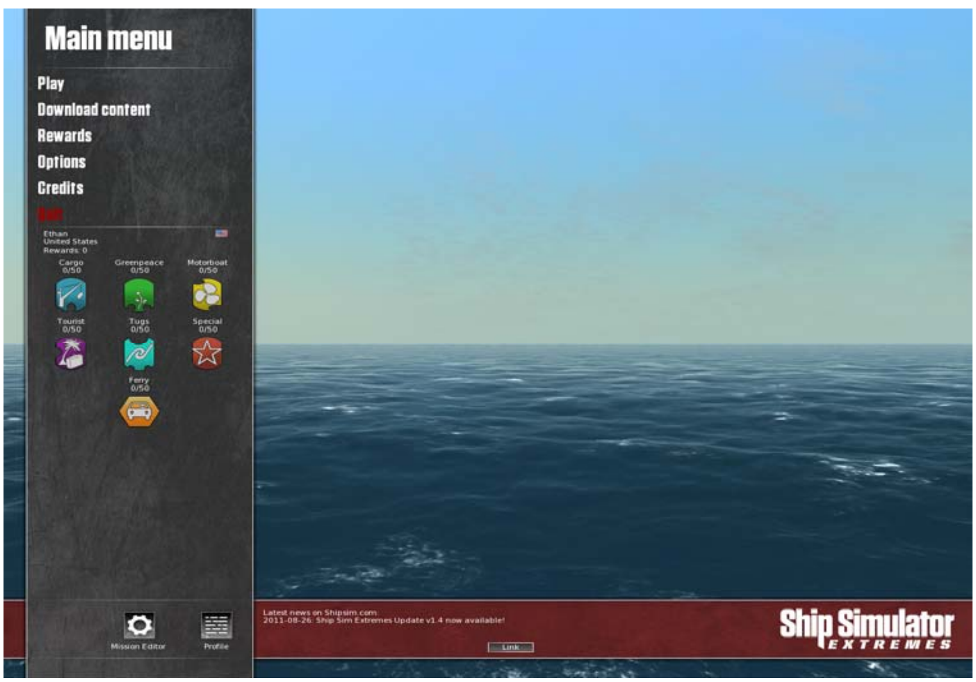

Figure 38. Ship Simulator Extremes Main Menu Screen

3. You will need to provide a name for your profile before you are allowed to proceed any further. This can be any alphanumeric sequence.

4. Left-click on the Mission Editor icon found in the lower left corner of the Main Menu Screen. This will bring you to the Mission Editor GUI (Figure 39). It is via the Mission Editor that task scenarios can be created. A helpful resource to assist in mission development, the Mission Editor Guide, is available through the following path Start/All Programs/Ship Simulator Extremes/Mission Editor Guide.

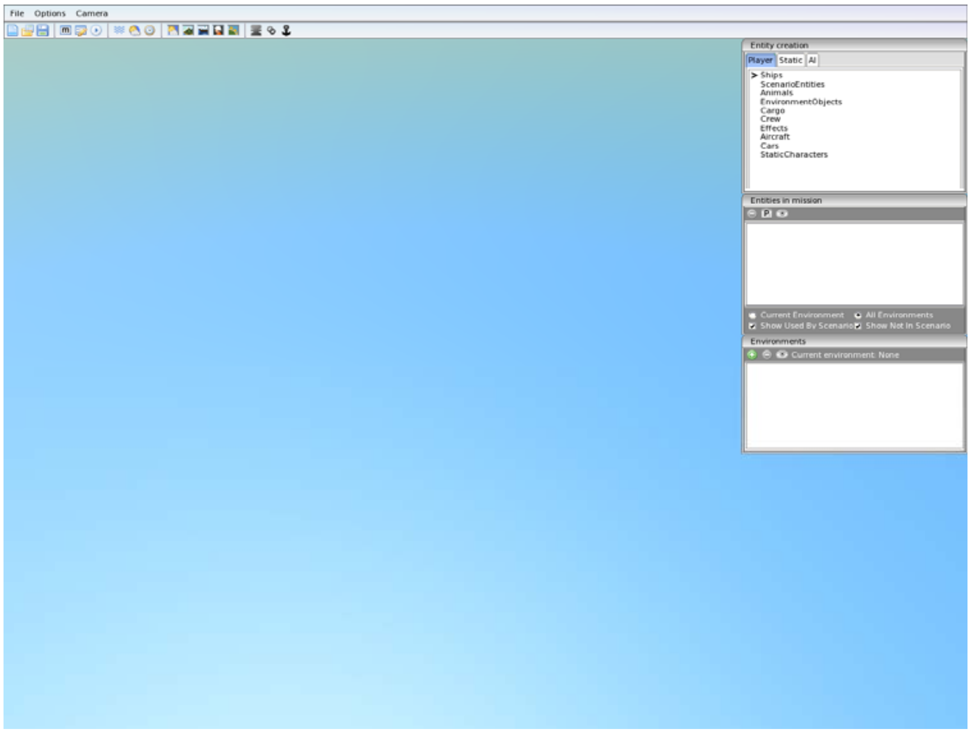

Figure 39. Ship Simulator Extremes Mission Editor GUI

B. DOWNLOADING AND INSTALLING THE TASK SCENARIO MISSION FILES

The two files that comprise a task scenario are in XML and a EN file format. The latter file type allows the game and scenario instructions to display in the English language. To download and install the task scenario mission files, perform the following steps:

1. In your Internet browser, visit http://www.movesinstitute.org/ed_student_res.html and look for the hyperlink for the downloadable thesis missions under the Sea of Simulation thesis description.

2. Download the Zip file ThesisMissions.zip to your machine.

3 Extract the folder and cut and paste the eight files into the following path Documents/ShipSimExtremes Userdata/Missions.

4. Start or restart Ship Simulator Extremes for the scenario files to be recognized by the program.

5. The missions can now be accessed by left clicking “Play” then “Single Mission.”

C. SCENARIO ONE DESIGN

Task scenario one was designed to support familiarizing the student participant with the controls of the WHEC ship model as well as the task environment they would be operating in during scenarios two and four. Figure 40 displays the starting point of the Cutter model in the Mission Editor.

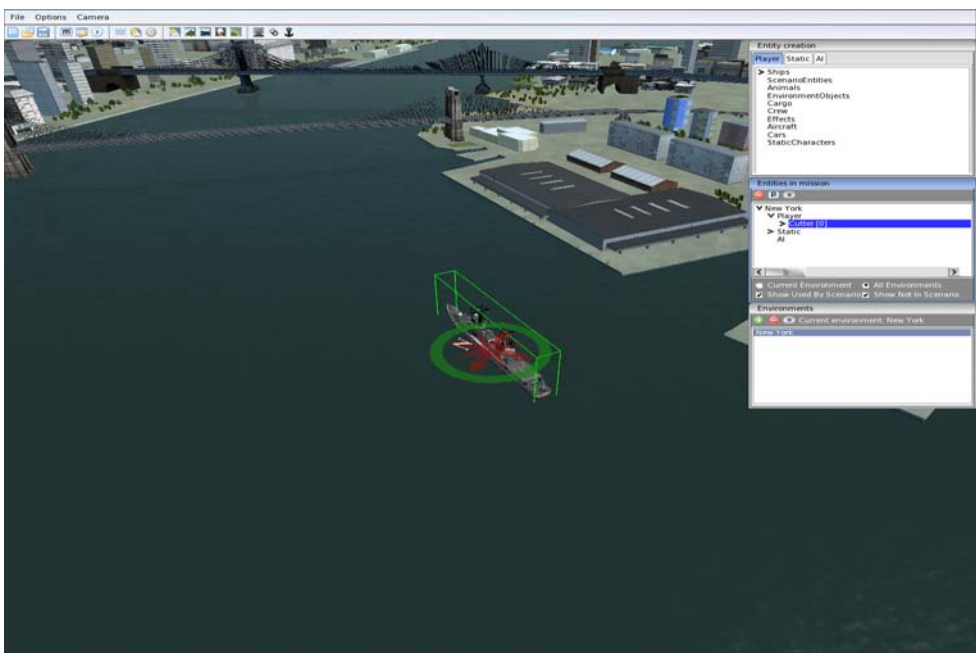

Figure 40. Cutter Starting Position Mission One

The logic chain implemented in this scenario was relatively simple and required a 15-minute countdown clock to begin counting down at the initiation of the scenario and to end the mission once the time had expired. This was accomplished using one Start Event node, three State nodes, and three trigger nodes. The logic chain is displayed in Figure 41. The StartStudentObjectiveNode1 initiated the countdown. ClearedStudentObjective1 listened for the timer to end and ended the scenario once this state was achieved.

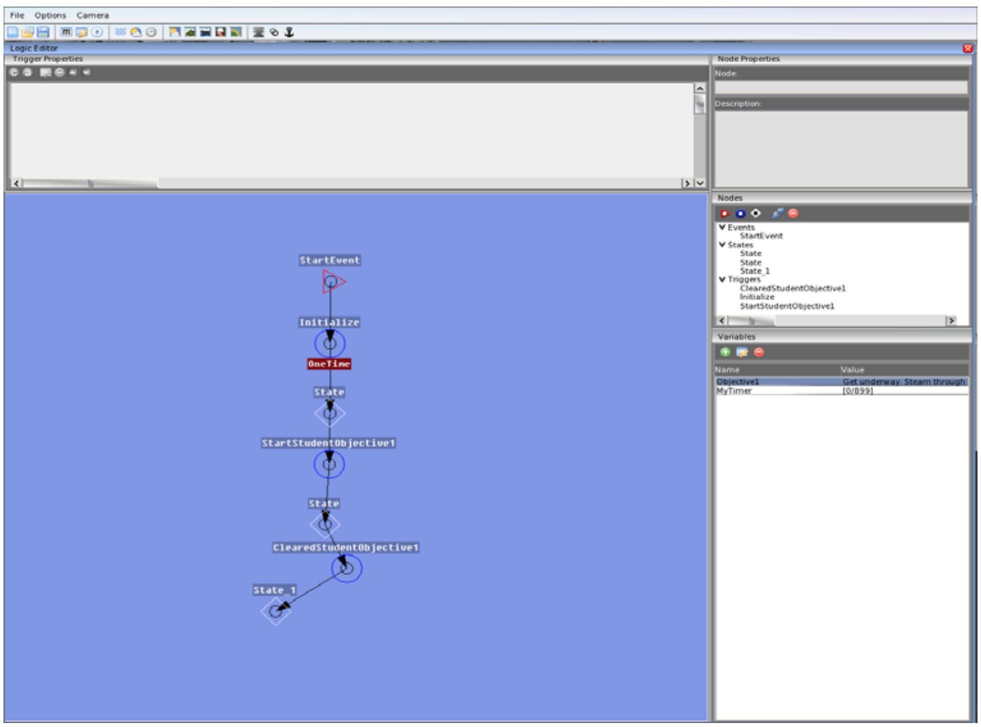

Figure 41. Task Scenario One Logic Editor Logic Chain

D. SCENARIO TWO DESIGN

Task scenario two was designed to present the student participant with the compound problem of getting the WHEC ship model underway from a pier, steaming down the river, making an approach on a pier, and successfully mooring to the pier. Environmental variables were disabled in scenario two and four to present a similar operating environment to that presented in the COVE training and evaluation sessions. Figure 42 displays the starting point of the Cutter model in the Mission Editor.

Figure 42. Cutter Starting Position Mission Two

In order to ensure the participant was not overwhelmed with instructions related to their maneuvering task, we split the information displayed to them to the beginning of the scenario and the middle, relative to distance and not time. At the midway point, the pier where the student would be tasked to moor would be visible to them. Two bridges previously obscured this pier. At this point, they would pass through an invisible waypoint, called Waypoint1SphereAreaEntity (Fig 43), which would trigger the display of their final maneuvering instructions.

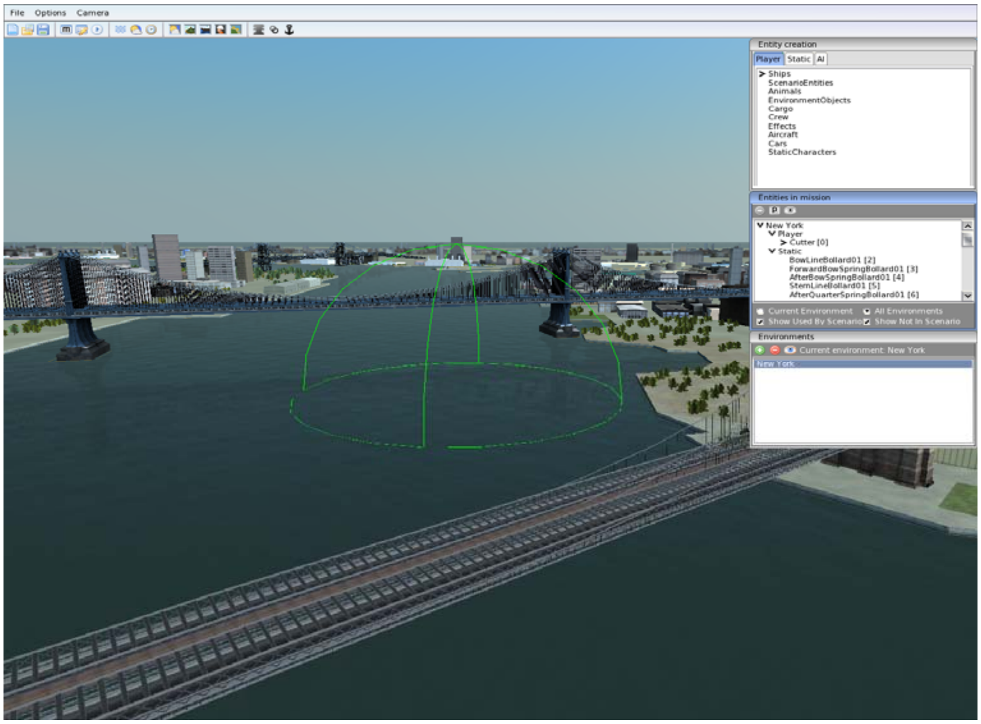

Figure 43. Mission Two Further Directions Trigger Waypoint

Figure 44 displays the six bollard-mooring configuration at the destination pier. The arrangement on the starting pier is the same. A trigger was set for the third bollard from the front, named AfterSpringBollardEnd01, which ended the scenario once mooring line number two was connected. The bollard size was increased to a value of eight to ensure visibility comparable to that of a standard bollard on a shipping pier.

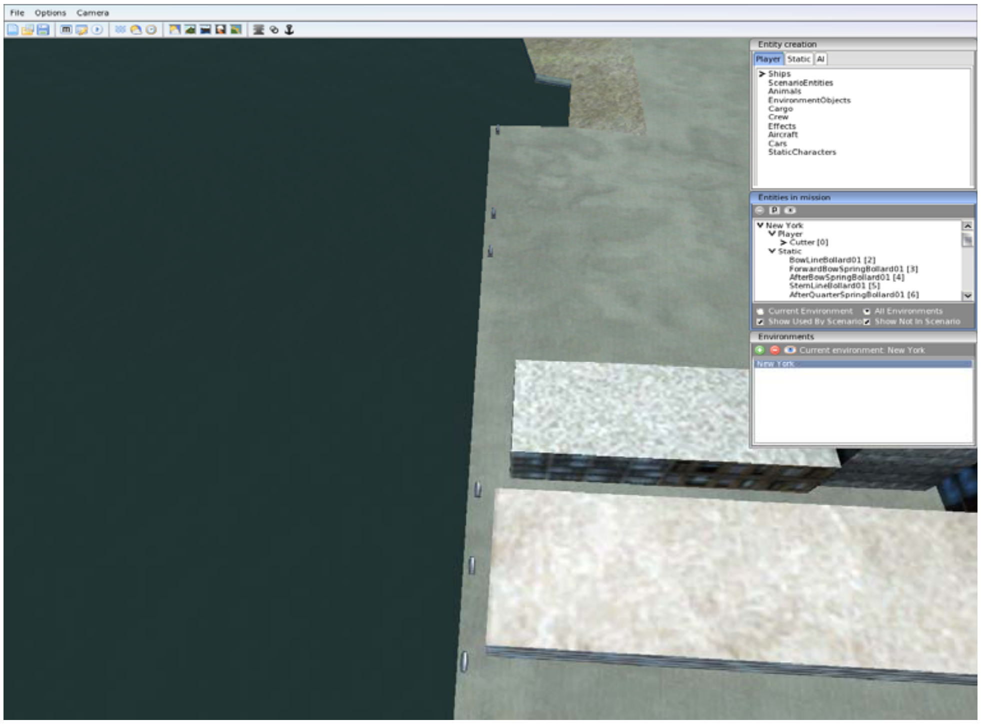

Figure 44. Mission Two End of Mission Mooring Area

The logic chain implemented in this scenario was accomplished using one Start Event node, five State nodes, and four trigger nodes. The logic chain is displayed in Figure 45. The Initialize node initiated placed the scenario into an active state and cleared a bug that initiated high winds at the start of the scenario, despite settings for winds of speed zero. StartStudentObjective1 displayed the “Captain’s Orders” on the screen and activated the waypoint sphere previously discussed. ClearedStudentObjective1 listened for the Cutter to pass through the waypoint sphere and activated a message directing the student to moor to the pier ahead once this state was achieved. The final trigger, Trigger1, ended the scenario once mooring line number two was connected to the entity AfterSpringBollardEnd01. The student could only order this if proximity to the pier was less than 100 feet and the ship’s speed was under one knot of headway or sternway

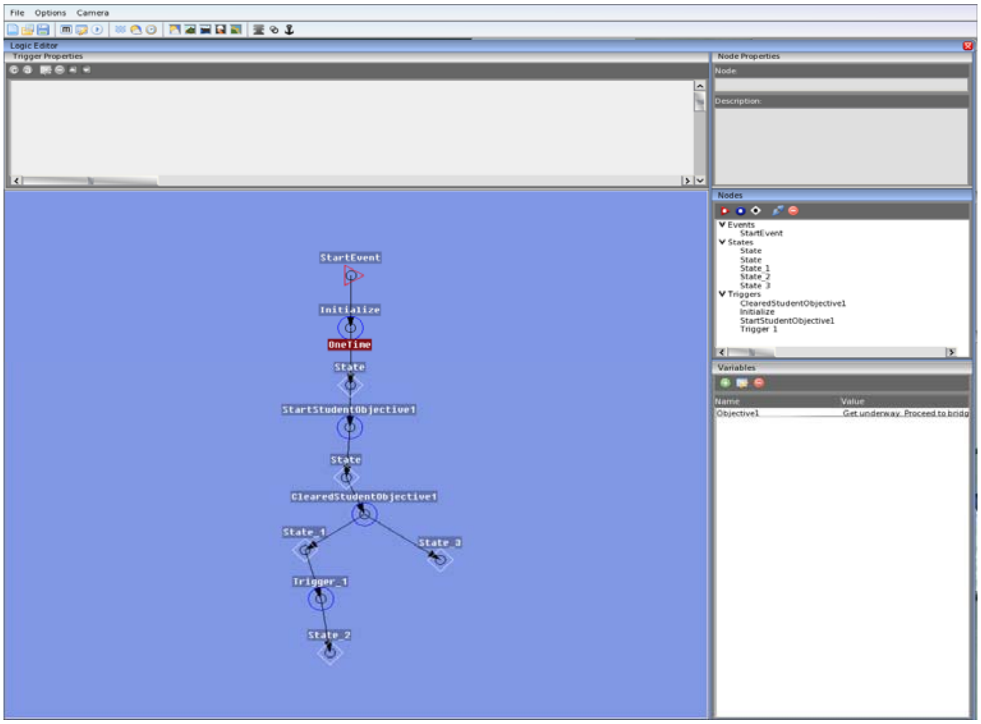

Figure 45. Task Scenario Two Logic Editor Logic Chain

E. SCENARIO THREE DESIGN

Task scenario three was designed to support the student in practicing with the controls of the WHEC ship model but started the student in a different area of the task environment and time of day than scenario one. The change of location, still within the New York map, and time of day was done to prevent the student from becoming complacent from a stale environment and was chosen from the research team's experiences in a classroom pilot study at Naval Postgraduate School. Figure 46 displays the starting point of the Cutter model in the Mission Editor.

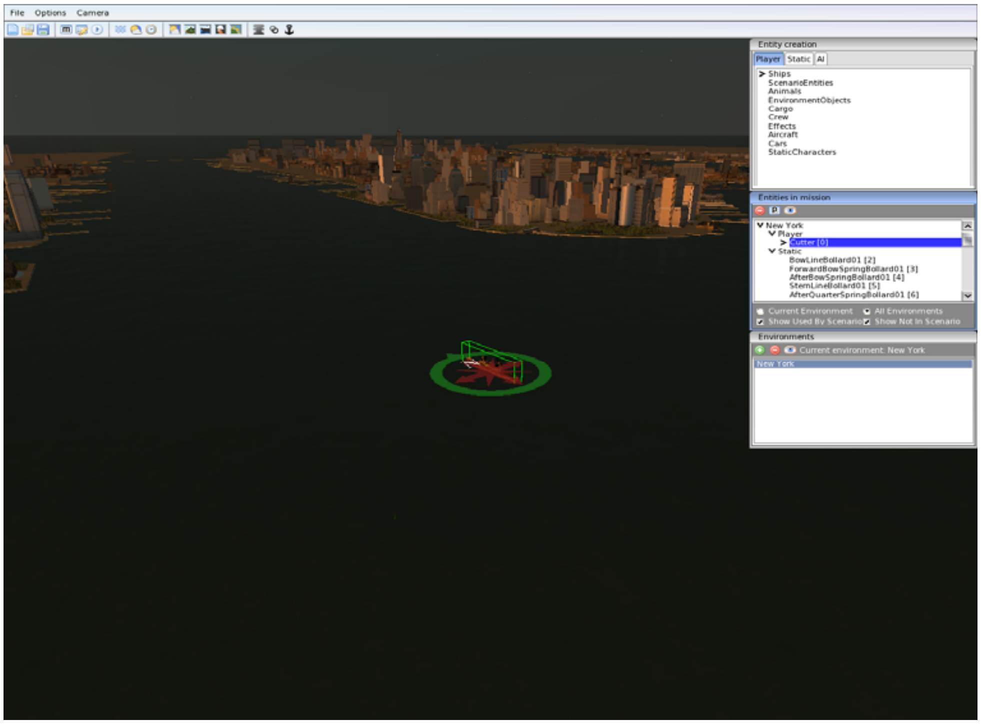

Figure 46. Cutter Starting Position Mission Three

The logic chain implemented in this scenario was the same as that utilized in task scenario one and is displayed in Figure 47. The countdown timer value was set for 15 minutes.

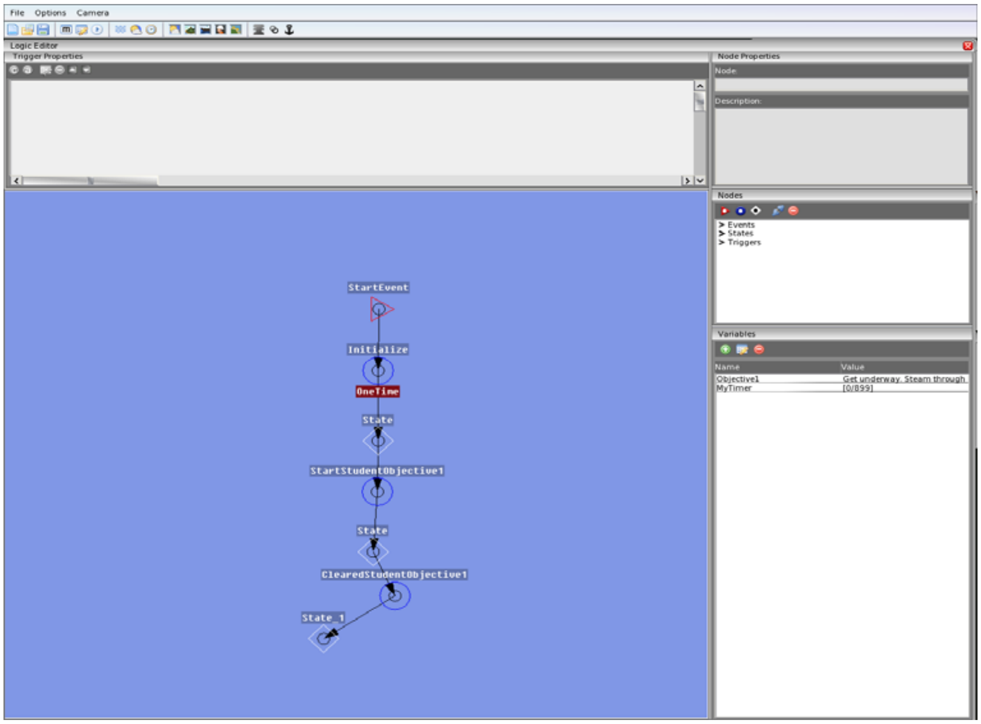

Figure 47. Task Scenario Three Logic Editor Logic Chain

F. SCENARIO FOUR DESIGN

Task scenario two was designed to present the student participant with the compound problem of getting the WHEC ship model underway from a pier, steaming down the river, making a 90-degree approach turn on a pier, and successfully mooring to the pier with obstructions in all directions. Environmental variables were disabled in scenario four to present a similar operating environment to that presented in the COVE training and evaluation sessions. Figure 48 displays the starting point of the Cutter model in the Mission Editor. The starting point for mission four is the same as the ending point from mission two.

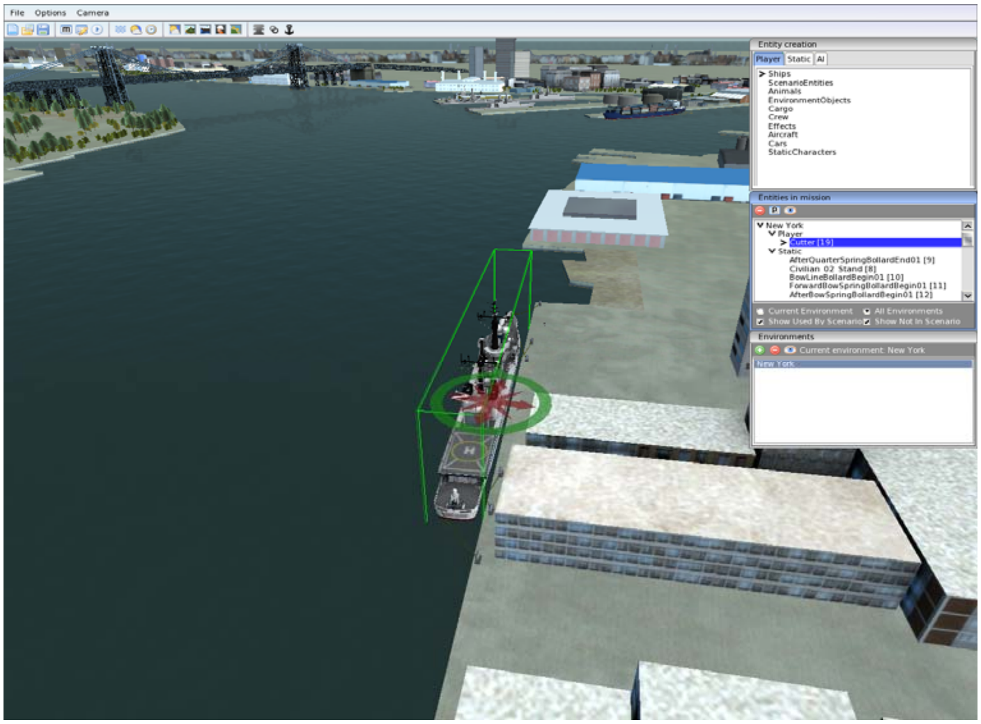

Figure 48. Cutter Starting Position Mission Four

Figure 49 displays the “navy pier” where the participant would attempt to moor. This pier arrangement is similar to that which could be seen on an actual naval pier or in the COVE. The static ships were required to be moored with lines and anchored as well to prevent a venture effect between the moving Cutter and the static warship models. The “navy pier” was clearly visible from the starting point of the mission and required no additional instructions beyond the initial “Captain’s Orders,” thus eliminating the requirement of additional triggers.

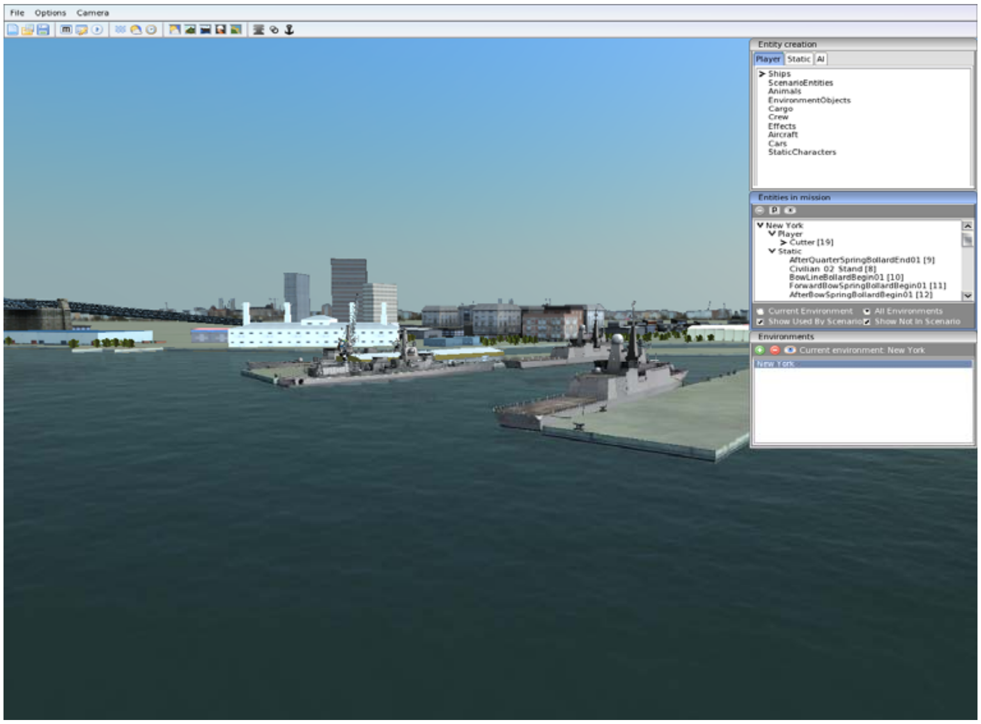

Figure 49. Mission Four Starboard Turn to Navy Pier

Figure 50 displays the six bollard-mooring configuration at the destination pier. The arrangement on the starting pier is the same. A trigger was set for the third bollard from the front, named AfterSpringBollardEnd01, which ended the scenario once mooring line number two was connected. The bollard size was increased to a value of eight to ensure visibility comparable to that of a standard bollard on a shipping pier.

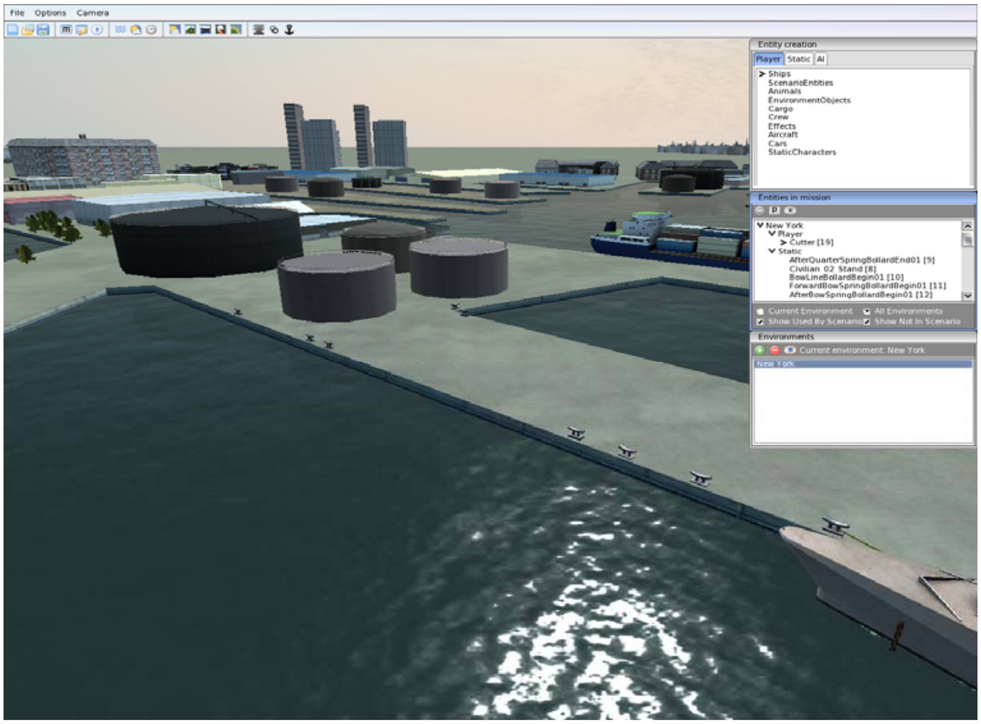

Figure 50. Mission Four End of Mission Mooring Area

The logic chain implemented in this scenario was accomplished using one Start Event node, three State nodes, and three trigger nodes. The logic chain is displayed in Figure 51. The Initialize node initiated placed the scenario into an active state and cleared a bug that initiated high winds at the start of the scenario, despite settings for winds of speed zero. StartStudentObjective1 displayed the “Captain’s Orders” on the screen. Trigger1 ended the scenario once mooring line number two was connected to the entity AfterSpringBollardEnd01. The student could only order this if proximity to the pier was less than 100 feet and the ship’s speed was under one knot of headway or sternway

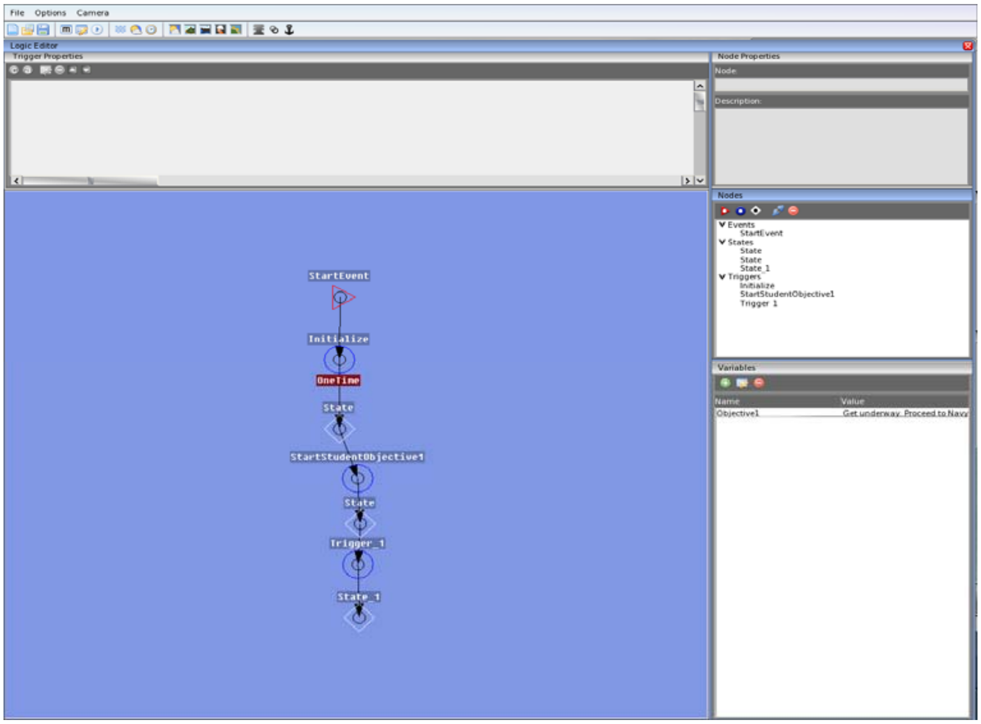

Figure 51. Task Scenario Four Logic Editor Logic Chain

G. PERIPHERAL SETUP: SHIP CONSOLE

1. The research team used a Ship Console by VR Insight (Fig 52) for simulated helmsman control inputs as directed by the student conning officer.

Figure 52. Ship Console by VR Insight

2. The Ship Console was simple to program and was well integrated with the Windows Operating System. Before programming functions to the Ship

Console in Ship Simulator Extremes, you must calibrate the tiller and throttles in Windows. To perform the calibration, plug the USB output from the Ship Console into an open USB port on your machine. The Windows Operating System will recognize the addition of a peripheral. Go to “Control Panel” then “Game Controllers” and verify that the Ship Console has been recognized as a USB pad. Select “Properties” then “Setting” and then “Calibration.” Run the “Calibration Wizard” and click “Next” until you see “X Rotation.” Move the tiller to the left maximum and then to the right maximum. Click “Next” until you see “Rudder.” Move the left lever to the forward maximum and then to the rearward maximum. Click “Next” until you see “Throttle.” Move the right lever to the forward maximum and then to the rearward maximum. Click “Next” to finish and exit the calibration process.

3. After calibrating the Ship Console you can then map the keys, tiller, and throttles in Ship Simulator Extremes. After starting Ship Simulator Extremes, click “Options” then “Controls.” Verify that the “Precision Steering” option is unchecked. From the drop down menu, choose “Interface” and update in accordance with Table 12.

Interface	**Input 2**
Show / Hide Panels	**Joy 1 Button 3**
Select Camera 1	**Joy 1 Button 16**
Select Camera 2	**Joy 1 Button 17**
Select Camera 3	**Joy 1 Button 18**
Pause	**Joy 1 Button 13**
Restart Mission	**Joy 1 Button 12**
Show / Hide Controls	**Joy 1 Button 5**
Chart Zoom In	**Joy 1 Button 10**
Chart Zoom Out	**Joy 1 Button 11**

Table 12. Interface Key Bindings

4. Next, choose “Ship Controls” from the drop down menu and update in accordance with Table 13.

Ship Controls	Input 2
Engine 1 Increase Throttle	Joy 1 Zrot Pos
Engine 1 Decrease Throttle	Joy 1 Zrot Neg
Engine 1 Reset Throttle	Joy 1 Button 7
Engine 2 Increase Throttle	Joy 1 Slider 1 Pos
Engine 2 Decrease Throttle	Joy 1 Slider 1 Neg
Engine 2 Reset Throttle	Joy 1 Button 8
Rudder 1 + 2 port / Left	Joy 1 XRot Pos
Rudder 1 + 2 starboard / Right	Joy 1 XRot Neg
Rudder 1 + 2 reset	Joy 1 Button 20

Table 13. Ship Controls Key Bindings

5. Finally, choose “Camera Controls” from the drop down menu and update in accordance with Table 14.

Camera Controls	Input 2
Camera Rotate Left	Joy 1 POV 16
Camer Rotate Right	Joy 1 POV 12
Camera Rotate Up	Joy 1 POV 10
Camera Rotate Down	Joy 1 POV 14
Camera Zoom In	Joy 1 Button 1
Camera Zoom Out	Joy 1 Button 9
Camera Reset	Joy 1 Button 2

Table 14. Camera Controls Key Bindings

H. PERIPHERAL SETUP: WIRELESS 3 BUTTON USB MOUSE

The mouse, Figure 53, required no additional setup due to Windows Plug and Play functionality. The students used the left mouse button to access the harbor chart built into the Ship Simulator Extremes task scenario. The right button, by depressing it and dragging the mouse, offered them rotational control of the camera to maneuver around the ship for optimal viewpoint. The scroll button allowed the students to zoom the camera in and out from the WHEC model as needed.

Figure 53. Microsoft Wireless Mobile Mouse 3000

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LIST OF REFERENCES

Barber, J. A. (2005). *Naval shiphandlers guide.* Annapolis: Naval Institute Press.

Bohemia International. (2006, August 9). Bohemia interactive announces United States Marine Corps (USMC) VBS2 enterprise license and development of the VBS2 virtual tool kit (VTK). Retrieved from: http://www.virtualbattlespace.com/press_usmc_vtk.htm.

Brown, B. (2010, March). *A training transfer study of simulation games*. (Master's thesis). Naval Postgraduate School).

Commander, N. S. (2007, July 1). *Surface force training manual (Comnavsurfor Instruction 3502.1D.)*. Washington, DC: Author.

Commander, N. S. (2010, Feb 19). *Navigation seamanship ship handling training (NSST) (Comnavsurfor Instruction 3505.1A.)*. Washington, DC: Author.

Green, C., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature, 423*, 534 –538*.*

Meers, D. (2011, October 1). *USN navigation seamanship shiphandling trainer.* W. Mystic: Kongsburg Maritime Simulation Inc.

Merriam-Webster. (2012). *Modality*. Retrieved from: http://www.merriam-webster.com/dictionary/modality.

Mitchell, M. L., & Jolley, J. M. (2007). *Research design explained.* Belmont, CA: Thomson Wadworth.

Morgan, R. (2011). Advanced gunnery training system. Retrieved from: http://www.peostri.army.mil/PRODUCTS/AGTS/.

NAWCTSD. (2010, March). *NSS COVE overview.* Retrieved from: FedBizOpps.gov: https://www.fbo.gov/index?tabmode=form&subtab=step1&tabid=f52aceebbe7c2e697d459becf2dbb627.

Nguyen et al., L. (2001). *Real- time virtual environment applications for military maritime training*. Orlando, FL: Naval Air Warfare Center Training Systems Division.

Peters, S., Bratt, E., & Kirschenbaum, S. (2011). *Automated support for learning in simulation: Intelligent tutoring of shiphandling.* Menlo Park, CA: Stanford University.

Prensky, M. (2000). *Digital game-based learning.* New York: McGraw-Hill.

Robson, S. (2009, January 6). Army paying $17.7M for training game. *Stars and Stripes*.

Sanchez-Vives, M. V., & Slater, M. (2005, April 25). From presence to conciousness through virtual reality. *Nature Reviews, 6,* 332–339.

Stinchfield, M. K., & Caldwell, J. C. (2011, September). *Improving military detection skills in a virtual environment: The effects of time, threat level, and tutorials.* (Master's thesis, Naval Postgraduate School).

Surface Warfare Officer School Command. (2011, 2 10). Trainers & Simulators. Retrieved from: https://www.netc.navy.mil/centers/swos/CourseInfo.aspx?ID=1

United States Navy. (2011, November 21). United states navy fact file. Retrieved

from: http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=900&ct=4

Wikipedia. (2011, December 3). High endurance cutter. Retrieved from: Wikipedia:http://en.wikipedia.org/wiki/USCG_High_Endurance_Cutter

Witmer, B. G., & Singer, M. J. (1998, June). Measuring presence in virtual environments: A presence questionnaire. *Presence, 7*(3), 225–240.

Zeltzer, D. L., & Pioch, N. J. (1996). Validation and verification of a virtual environment for training naval submarine officers. *Procedings, SPIE*.

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