MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

AN ASSESSMENT OF SUBMARINE APPROACH OFFICER DECISION-MAKING AND ITS IMPLICATIONS FOR COMMAND WORKSTATION DESIGN
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U.S. Navy Submarine Approach Officers (AO) use tactical skills acquired from years at sea and a seemingly natural panache to accurately determine an enemy submarine's bearing, range, course, and speed. This thesis investigates the effects of AO demographic differences and combat system employment methodologies on the ability to develop a timely and accurate firing solution. Employing a low-resolution submarine combat simulator, approximately 10 percent of the total pool of AOs were taken through two of four pre-scripted initial contact scenarios. The AOs were instructed to execute each scenario until they perceive that an accurate solution is obtained on the enemy submarine. The demographic differences of geographic location, ship type, and duty type are the top three traits that distinguish between success and failure. Further data analysis reveals differences in the information utilization of the simulator between successful and unsuccessful operators. Additionally, utilizing a survey administered to the subjects and basic display design principles, a notional command workstation for the next generation of submarine is developed. The conclusions of this research provide insight into the cognitive modeling, training, and selection of AOs, as well as adding to the growing body of work in the design of military decision support systems.

DoD KEY TECHNOLOGY AREAS: Human Systems Interface, Manpower, Personnel, and Training, Surface/Under Surface Vehicles – Ships and Watercraft

KEYWORDS: Submarines, Human Factors, Cognitive Task Analysis, Displays, Decision-Making, Expert vs. Novice Performance

MODELS FOR COMPARING AIR-ONLY AND SEA/AIR TRANSPORTATION OF WARTIME DEPLOYMENT CARGO
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When faced with an overseas contingency, efficiencies may be gained by using ships in conjunction with aircraft to transport military cargo from the Continental United States (CONUS) to an overseas Port of Debarkation (POD). This thesis evaluates a proposal to load air-transportable cargo aboard vessels at CONUS seaports and to ship that cargo to an appropriately located sea-air-interface (SAI) for further transport by air to the final POD. This bi-modal approach is profoundly different from the current uni-modal paradigm where cargo loaded on a given platform at the port of embarkation continues on the same platform to the POD. Two mixed-integer programming models compare the incumbent and candidate transportation paradigms. The models are formulated in the General Algebraic Modeling System (GAMS) and run on a desktop PC. Solutions for a typical set of overseas airlift-only cargo requirements are obtained in less than one minute for both the air-only and bi-modal models. This research

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concludes that the bi-modal paradigm is less efficient than the uni-modal paradigm with respect to lift asset utilization and timeliness of deliveries, but may have merit as supplemental transportation to alleviate the backlog of surge cargo in the early phase of a conflict. For instance, by pre-positioning cargo at the SAIs, we are able to reduce the aircraft inventory required to execute our Time-Phased Force and Deployment Database from 44 to 30.

DoD KEY TECHNOLOGY AREAS: Modeling and Simulation, Other (Transportation, Airlift, Sealift, Logistics)

KEYWORDS: Optimization, Mixed-Integer Programming, Time-Phased Networks, Multi-Commodity Flow Networks, General Algebraic Modeling System (GAMS)