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## 1997 THESIS ABSTRACTS CC

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### **LOGISTICAL IMPLICATIONS OF OPERATIONAL MANEUVER FROM THE SEA**

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**Master of Science in Operations Research-March 1997**

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The U.S. Marine Corps concept for the projection of naval power ashore is Operational Maneuver from the Sea (OMFTS). OMFTS calls for movement of Marines from ships at sea directly to objectives deep inland without requiring a pause to build-up combat power on the beach. Support for ground forces is expected to come from the sea and be delivered primarily by air. This demands that sea-based logistics assets remain sufficiently close to shore to allow air assets to conduct resupply operations directly to the battlefield. The implication of this is that Navy ships may sacrifice operational and perhaps tactical mobility while sustaining the Marine operation.

This thesis determines the distance from the coastline sea-based Combat Service Support (CSS) assets will be able to maintain and still support operations of a given magnitude, and how tactically constrained Navy ships will be in order to support this concept of expeditionary warfare. It focuses on the time-distance-weight/volume relationships involved, and takes into account characteristics of the resupply assets, such as aircraft availability, capacity, method of employment, and the effects of combat attrition. Three methods of employing a Marine Expeditionary Unit are studied, ranging from a traditional force mix to the use of small infestation teams. The analysis shows that the available CSS assets will not support a traditional ground force mix at the distances envisioned, but will support the use of small teams. To fully realize OMFTS and still allow ships to maintain the desired standoff from shore will require a shift to more lethal Marine forces with much smaller logistical demands. Until such a force is feasible, the Navy should plan on providing support to Marines from close to shore.

### **GLOBAL BROADCAST SERVICE FOR THE EXPEDITIONARY WARRIOR**

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The battlefield has changed tremendously during the past decade due to major technical innovations. These changes have resulted in a requirement for high-speed, multimedia communications and greater bandwidth capabilities. Global Broadcast Service (GBS) technology is a military application of the commercial system Direct TV and is one way the military can address the need for greater bandwidth. Many of the two-way systems in the MILSATCOM architecture could be relieved of their burden by use of GBS. This thesis focuses on the Marine Corps and how its decision-makers can integrate GBS into the existing communications architecture. This is illustrated by using a Marine Expeditionary Unit as an example. This technology meets the warfighters need to have a high data rate, high volume information transfer available. Crucial to the successful integration of GBS into the communications architecture is ensuring that the MEU command ships, and other amphibious vessels in the Amphibious Ready Group, are equipped with the GBS receive suites during MEUs workup and deployment cycle. Finally, command and control issues are discussed and how GBS can expedite the decision making process.

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### **JOINT DEPLOYABLE INTELLIGENCE SUPPORT SYSTEM (JDISS) COMMUNICATIONS AND IMAGERY APPLICATION GUIDE FOR NEW USERS**

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**LtCol Tim Phillips, U.S. Marine Corps Representative**

**Dan C. Boger, Command, Control, and Communications Academic Group**

The purpose of this thesis is to provide a Joint Deployable Intelligence Support System (JDISS) Communication and Imagery Application Guide for New Users. These two applications, together, are the core of the JDISS program. Both applications were examined to identify functions and processes that are difficult to understand as well as functions and processes that lack sufficient instructions for new users. The supporting JDISS Desktop and Utilities applications were added to provide the knowledge base required for the new user to use the Application Guide as a stand-alone document. Other JDISS applications, such as Office Tools, Email, Intelink, etc., are not included due, in part, to a common thread with other programs that the new user should already be familiar with, but mostly due to thefor interoperability (JBOC, 1996). Therefore, this detailed, step-by-step JDISS Communication and Imagery Application Guide for New Users was developed and designed to help future JDISS users world wide.

adequate help instructions readily available within the JDISS main desktop help function.

The JDISS program was developed to ensure that each of the U.S. Services and Agencies had an integrated intelligence system, and one that would provide a common data standard permitting interoperability both intra-service and inter-service. The Joint Staff, Director of Intelligence (J2), has highlighted JDISS in joint doctrine as the principal intelligence component

### **THE INTEGRATION OF SITUATIONAL AWARENESS BEACON WITH REPLY (SABER) WITH THE ENHANCED POSITION LOCATION REPORTING SYSTEM (EPLRS)**

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In 1992, the Joint Requirements Oversight Council validated a combat identification mission need statement. In support of the requirement for system interoperability, this thesis proposes a concept of operations for integrating two systems, Situational Awareness Beacon with Reply (SABER) and the Enhanced Position Location Reporting System (EPLRS).

SABER is a program initiated by Naval Space Command to provide real-time combat identification (CID) to the tactical user. It uses UHF satellite communications technology in conjunction with the Global Positioning System (GPS) to provide positioning information for up to 500 users.

EPLRS is a situational awareness program used extensively by the U.S. Army to support tactical battlefield operations. In addition to providing automatic friendly identification of EPLRS-equipped units, it has a communications capability that allows for the passage of intelligence and targeting data, messages, and status reports. However, EPLRS operates in a line-of-sight mode only and uses military grid reference coordinates vice GPS for positional information.

The integration of SABER and EPLRS has the potential to serve a major role in the armed services' common goal of reduced fratricide. This thesis gives a detailed description of both systems, examines their individual capabilities and limitations, discusses the ways in which the two systems complement each other, and provides a recommended integrated concept of operations.

**WEAPONS OF MASS DESTRUCTION AND TERRORISM:  
PROLIFERATION BY NON-STATE ACTORS**

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Executive Order No.12938 signed by President Clinton on November 14, 1994 declared a national emergency with respect to the unusual and extraordinary threat that proliferation of weapons of mass destruction (those weapons categorized as nuclear, chemical, or biological) poses to the national security, foreign policy, and economy of the United States.

In the wake of the Cold War, a new world disorder seems to be emerging wherein the legitimacy of many states is being challenged from within by increasing non-state calls for self-determination from the likes of religious cults, hate groups, isolationist movements, ethnic groups, and revivalist movements. These movements often prey on the insecurities of the population, offering to fill psychological, social, political, or religious security needs of those who would join them. Religious oriented groups appear to share a common ideology which rejects existing social, economic, and political structure demanding a drastic revision of the world—a world where they become the authoritarian, dominant influence. These are the Post-Modern Terrorists who possess a “ripeness” to threaten use of weapons of mass destruction.

This study presents an argument suggesting that terrorist groups operating under the veneer of religion are truly the most likely candidates to threaten use of weapons of mass destruction in a mass casualty causing terrorist act.

**ANALYSIS OF TRANSFERRING U.S. NAVY PERRY CLASS FRIGATES TO  
TURKEY AND ISSUES RAISED DURING THE PROCESS**

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**Master of Science in Management-March 1997**

**Advisors: Orin Marvel, Command, Control, and Communications Academic Group  
Keith Snider, Department of Systems Management**

This thesis analyzes the process used to transfer U.S. Navy Perry class frigates to Turkey and issues raised during this transfer process. Up to the final step, this transfer was representative of most U.S. military equipment transfers. The relations between allied countries depend heavily on the mutual support they provide to each other. Strong relations create strong mutual support, or vice versa. Although the FMS/FML process is a very effective process for ship transfers, political issues must never be underestimated. As the Cold War came to an end, the mutual threat had changed, affecting alliances and rephrasing the causes of their existence. The effect of this change has caused more domestic oriented policies to predominate within a country's political system.

Although this policy change didn't cause procedural changes in regulations and rules, the application of the decisions given and approved by the highest executive and legislative branch authorities are now more subjective and seem unpredictable. Long-term and continuous repetition of this behavior could cause negative impact on alliances.

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### **COUNTER-ORGANIZATION TARGETING: A THEORETICAL FRAMEWORK FOR ANALYSIS**

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**Master of Arts in National Security Affairs-December 1996  
and**

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**Second Reader: Terry D. Johnson, Department of National Security Affairs**

The purpose of this thesis is to present and substantiate a theory of counter-organization targeting. This thesis achieves this objective by creating and testing a framework for analysis which blends the principles of organization theory with classic counterinsurgency theory. The goal of this framework is to provide an analytical tool for operational-level targeting of adversary organizations during war, conflict, and stability and support operations.

This study analyzes the historical precedents of counter-organization targeting to demonstrate its viability as a necessary condition for success in counterinsurgency campaigns. Additionally, by applying the framework against an unresolved case, this study validates its applicability against a broader spectrum of the operational continuum. As a result, this thesis offers an innovative framework allowing for a logical and common sense approach to observing, assessing, targeting, and interdicting adversary organizations

### **COBRA BRASS FOR BATTLESPACE CHARACTERIZATION AND BATTLE DAMAGE ASSESSMENT (U)**

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Battlespace characterization and battle damage assessment are important to the warfighter and must be a part of the strike planning. The Cobra Brass research and development sensor has the capability to provide information the warfighter can use to aid in his decision making. Navy TENCAP is using Cobra Brass in an operational mode to test the feasibility of operationally tasking this type of sensor. This thesis educates the warfighter on the Cobra Brass family of sensors, investigates the utility of Cobra Brass for battlespace characterization and battle damage assessment, and develops a concept of operations for the non-imaging infrared sensors presently deployed and for future such sensors.

### **DESIGN AND DEVELOPMENT OF THE SCENARIO FOR THE SECOND NPS A2C2 EXPERIMENT**

**James F. Drake-Lieutenant Commander, United States Navy  
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The Adaptive Architectures for Command and Control (A2C2) project is a research effort sponsored by the Office of Naval Research to explore adaptation in command and control structures. The project's second experiment builds on the first experiment. It studies the interaction between task structure and organization structure. This thesis builds on the work of previous theses by Michael Bergin and Scott Higgins. It describes a process for developing military operational scenarios within a task structure context. First, the author conducts a literature review, which defines the dimensions of task structure

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applicable to this project, and describes how changes in one dimension might affect other dimensions. Then a method for developing scenarios in accordance with a predetermined structure and visualizing tasks is described, including a task structure diagram and a description of a task design process using the diagram and the dimensions previously delineated. The author then applies the task design process by developing two scenarios for the second NPS A2C2 experiment that differ across one dimension of task structure, coordination requirements. Finally, a description of the experiment is given, including discussion of operationalization of scenarios and organization structures, and lessons learned from the experiment with regard to scenario design.

### **COMMUNICATION MODULATION SIMULATORS: AN ASSESSMENT**

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**Donald van Z. Wadsworth, Command, Control and Communications Academic Group**

The military drawdown and budget cutbacks have created a greater emphasis on shorter, faster, and cheaper ways to do the mission. Modulation simulators have become a critical component in the evaluation and testing, and integration of new network, communications, and command and control technologies and applications.

This thesis evaluates five current commercial-off-the-shelf products: OPNET Modeler by MIL 3 Inc.; COMNET III designed by CACI Products Company; Extend by Imagine That Inc.; Workbench created by Scientific Engineering Software Inc.; and G2 from the Gensym Corporation. Each of the products is evaluated using twenty-five primary evaluation criteria. The evaluations include current costs, completeness, user interface, and post analysis support methods, and they describe the basic features and distinctive characteristics of each product.

The capabilities of the products are compared, providing the reader with the knowledge to make an informed product selection based on the user's needs. A matrix of the products and the evaluation criteria provides a quick overview of the analysis.

### **MODELING THE COMBAT POWER POTENTIAL OF MARINE CORPS CLOSE AIR SUPPORT**

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**B.A., Santa Clara University, 1981**

**M.A., Harvard University-June 1984**

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**Second Reader: Wayne P. Hughes, Department of Operations Research**

This thesis proposes a numerical measure of the combat power potential of U.S. Marine Corps close air support (CAS) aircraft. The combat power potential of a weapon system is defined as the rate at which the system could deliver lethal fire to any point on the battlefield, accounting for particular and relevant battlefield and enemy characteristics. This measure is expressed in units of "kills-per-minute," where each point is hypothesized to have an infinite supply of instantaneously replaced targets.

The collection of these values (i.e., kills-per-minute for each battlefield point) is suitable for display as a "combat potential surface," overlaid on a battlefield map. In this thesis, points of higher potential are keyed to brighter colors (e.g., red, yellow, orange). The end result is a battlefield visualization tool to assist commanders and staffs in CAS planning.

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### **AN EFFECTIVENESS STUDY FOR PRIORITIZATION ALGORITHMS IN A COMMUNICATIONS NODE MODEL FOR THE COPERNICUS TACTICAL DATA INFORMATION EXCHANGE SYSTEMS (TADIXS)**

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The U.S. Navy has published its vision of the future in Command, Control, Communications, Computers and Intelligence (C41): Copernicus. Copernicus takes advantage of new technology and attempts to answer the demand for larger amounts of more timely information. Despite the advances in technology, new transmission methods and increased bandwidth, the U.S. Navy still does not have all the communications throughput that it desires. The author examines message prioritization algorithms as a way of making more efficient use of scarce communications resources. Through a simple communication node model and two algorithms, it is statistically proven that prioritization algorithms can improve the efficiency of a communication system.

### **A COMPARATIVE STUDY OF CIVIL-MILITARY OPERATIONS PERSPECTIVES AS THEY APPLY TO PEACE SUPPORT OPERATIONS**

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**Chris Layne, Command, Control, and Communications Academic Group**

**James C. McNaughton, Defense Language Institute**

The post-Cold War world has been marked by the United Nation's approval and participation in the intervention into the affairs of sovereign states, often labeling them: Peace Support Operations (PSOs). While American interventions have been studied in terms of chain of command, firepower and rules of engagement problems, Civil-Military Operations (CMO) have not been analyzed in a comparative fashion. Given that future interventions are likely to occur, it is the responsibility of policy analysts and leaders to consider both the costs and benefits of democratic enlargement and the applicability of current CMO doctrine. To do this, tools are needed. This study provides three such tools.

First, case studies on the U.S. interventions in Somalia and Haiti provide a view of some of the questions and problems involved with intervening in the affairs of states for humanitarian or democratic enlargement issues. Second, the study pits contending theories against each other to see if one does a better job of explaining/predicting outcomes. Finally, the study provides recommendations on the implications of democratic enlargement, including the need for a Department of Defense, Department of State and civilian relief organization synchronization in regard to the military's requirement to: 1) intervene; 2) stabilize the situation; and 3) extract itself so that other agencies may consolidate democracy.

### **THE ARMY TACTICAL COMMAND AND CONTROL SYSTEM**

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**Lt Col John H. Gibson, Command, Control, and Communications Academic Group**

This thesis is a summary of the capabilities of the Army Tactical Command and Control System (ATCCS) and the guiding Command, Control, Communications, Computers and Intelligence (C41) documents as they apply to the ATCCS. Its pur-

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pose is to strengthen the knowledge base of Army officers entering the Joint C41 curriculum by providing a summary of Joint and Army C4 doctrine and guidance as it applies to ATCCS.

ATCCS is the Army's primary Command and Control (C2) system at echelons corps and below. ATCCS consists of five smaller systems, each a Battlefield Functional Area Control System (BFACS) controlling seven Battlefield Functional Areas (BFA). The five BFACS are the Maneuver Control System (MCS), the Advanced Field Artillery Tactical Data System (AFATDS), the Forward Area Air Defense Command, Control and Intelligence System (FAAD C21), the Combat Service Support Control System (CSSCS), and the All Source Analysis System (ASAS).

A clear strategy for the functional design of ATCCS is supported by three documents. Related to and supportive of each other, the three documents are Joint Pub 6-0, Doctrine for Command, Control, Communications and Computer Systems Support to Joint Operations; The Army Enterprise Strategy consisting of The Vision and The Implementation Plan; and Army Field Manual 100-5, Operations. This thesis draws threads of continuity from joint doctrine through Army guidance into implementation in ATCCS.

### **A STUDY OF NATIONAL RECONNAISSANCE OFFICE'S (NRO) FUTURE COMMUNICATIONS ARCHITECTURE (U)**

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The National Reconnaissance Office (NRO) has identified much higher data rate requirements for future national systems. The goal of this thesis is to provide a possible alternate solution that would utilize crosslink technology developed for the Iridium Mobile Satellite System combined with existing and emerging laser communications technology. In addition to many other advantages over RF communications, laser communications can fulfill the extremely high data requirements of the future NRO systems. This technology could be a part of a new satellite constellation that can provide single and double global coverage in Stage I and Stage II, respectfully, of the satellite constellation design.

### **MULTIATTRIBUTE UTILITY ANALYSIS OF NON-SATELLITE COMMUNICATIONS (U)**

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There is a growing awareness of U.S. overhead reconnaissance capabilities throughout the world today. In the last twenty years various entities have revealed portions of the U.S. overhead coverage and capability. Operation Desert Shield/Desert Storm served to underscore both the U.S. reliance on overhead collection and the robustness of this architecture. Additionally, there has been an effort to downgrade the classification of overhead intelligence products. While this provides additional intelligence to U.S. forces, allies, and coalition partners, it also provides a greater understanding of previously sensitive national programs to a wider audience.

Today there are many countries who have or are developing denial and deception programs. These countries may easily obtain information about U.S. overhead capabilities through a variety of means. Some countries may exploit overhead system vulnerabilities in order to enhance their own denial and deception programs.

With multiattribute utility analysis, a model was created with which one can evaluate overhead systems designed to thwart foreign exploitation. Through this model one way will be demonstrated in which U.S. overhead security may be maintained while still providing broad support to U.S. forces.

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### **AN OPERATIONAL OVERVIEW OF NATIONAL SIGINT COLLECTION (U)**

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National SIGINT collection remains both a national and fleet level priority. As such, a basic understanding of these collection systems is given emphasis at the Naval Postgraduate School for curriculums such as Space Systems Operations, Space Systems Engineering, and Information Warfare. Yet no one document or reference contains all relevant material for instruction of the subject, as taught at NPS. Also, most references do not present the material in a format readily assimilated by students with little or no experience in related fields.

This thesis is intended to produce a document which will provide an operational overview of all relevant national SIGINT collection systems. The primary product of this thesis is a hard copy paper which could be used both as a source for professors and as a reference for students studying national SIGINT collection. Operational usefulness, communications paths, and system differences are the primary topics of the paper. All topics will be researched with an operational, vice technical, consideration.

Additionally, a version of this operational overview has been placed on the INTELINK secure network. In the form of a web page (not unlike web pages found on the World Wide Web/Internet), the thesis then becomes a user-interactive learning tool. Users can visit the site, download relevant information, then follow hypertext links to related sites such as mission offices or reporting sites.

### **DIRECT BROADCAST TECHNOLOGY IN BOSNIA: ITS IMPACT ON THE DECISION-MAKING PROCESS AND JOINT ENDEAVOR OPERATIONS**

**Robert D. Morrill-Captain, United States Air Force**

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**Gary R. Porter, Command, Control, and Communications Academic Group**

During Desert Storm a serious shortfall was identified in the communications architecture and its ability to effectively provide high-bandwidth information to meet the demands of the operation. In response to this shortfall, the Department of Defense (DoD) is pursuing the exploitation of commercial Direct Broadcast Satellite (DBS) technology and its ability to broadcast video and data at high rates to small, affordable, and portable terminals. The Global Broadcast Service (GBS) was initiated to ultimately provide this military direct broadcast capability.

A precursor to GBS, the Joint Broadcast Service (JBS), was begun as an Advanced Concept Technology Demonstration (ACTD). It is now leveraging DBS technology to support Operation Joint Endeavor. This thesis describes how the JBS works, what types of information are sent over the JBS, the complete process of information distribution, and the impact the JBS has had on Operation Joint Endeavor and the associated operational decision making process.

The JBS system has, at least in part, answered the joint warfighter's need for an improved high-bandwidth video and data distribution system. Although it does have force enhancement capabilities, the lack of familiarity, information management, and trust of the system have limited its effectiveness in Operation Joint Endeavor.

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### **REQUIRED INFORMATION SYSTEMS KNOWLEDGE FOR NAVAL INTELLIGENCE OFFICERS**

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**Ralph Norman Channell, Department of National Security Affairs**

To be effective in most current billets, Naval Intelligence Officers must have a baseline technical knowledge of computer hardware and software, data communications, and related-systems (known collectively as Information Technology). This thesis reviews survey data of common Intelligence Officer billets ashore and afloat as well as leadership statements and doctrine. Using these sources, knowledge requirements of existing and future Intelligence Officer assignments are identified in this study, and it is clear that these requirements are not currently being satisfied through standard intelligence training methods. An outline is provided of information technology fundamentals, military and commercial telecommunications, intelligence systems, applications, and connectivity to assist with formal or self-training programs.

Intelligence Officer training and education must include more information technology and intelligence architecture. Existing intelligence courses and other non-traditional programs should be better utilized by Naval Intelligence personnel. ONI or DIA should ensure that these programs are both current and readily available to Intelligence Officers throughout their entire careers.

### **ISSUES IN SPACE LAW AND POLICY**

**Steven A. Padgett-Lieutenant Commander, United States Navy**

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**Master of Science in Systems Technology-December 1996**

**Advisor: Dan C. Boger, Command, Control, and Communications Academic Group**

**Second Reader: Carl R. Jones, Department of Systems Management**

This thesis provides a student studying space with background information and insight into selected issues that have shaped, or continue to shape, the world's approach to activities involving space. Further, the basic understanding gained through the study of these issues and their connection with international treaties and policies gives an appreciation for the regulatory side of space programs.

Some of the topics discussed are the delimitation and control of space, space debris, and the interpretation of the Anti-Ballistic Missile Treaty. Though they are often seen as issues in space law, it is shown that political considerations and decisions more often determine the outcome or path followed. Further, technical aspects and applications have seemingly usurped any laws which govern use, i.e., what can or cannot be done. Regardless, a commitment to the future use of space is as important as current operations.

This does not imply a need to quickly fill this legal void with well-meaning rules to provide structure. Rather, it is seen that certain laws do need to be created in order to ensure the continued access and use of space will not be interrupted.

### **REAL TIME INFORMATION IN THE COCKPIT MISSION UTILITY**

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**Master of Science in Space Systems Operations-September 1997**

**Advisor: Alan Ross, Navy Tactical Exploitation of National Capabilities (TENCAP) Chair**

**Second Reader: Dan Boger, Command, Control, and Communications Academic Group**

Navy TACAIR mission effectiveness requires timely responses to emerging conditions in the operational environment. Mission effectiveness is improved by increasing pilot situational awareness with Real Time Information in the Cockpit (RTIC). Exploiting updated and new information from offboard sources provides accurate targeting, increases aircraft survivability, and expands mission flexibility. The evolution of RTIC, sensor to shooter, and offboard targeting concepts are summarized through a discussion of past RTIC exercises and Advanced Concept Technology Demonstrations. Existing

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operations utilizing the Rapid Targeting System in EUCOM illustrates emerging concepts of operation. In order to assess RTIC mission utility, several TACAIR missions are analyzed for specific information requirements that RTIC can support. Measures of Effectiveness and Performance are identified and applied to a heuristic model to determine RTIC mission utility. An example is provided to illustrate the method's application. Finally, conclusions and observations are given regarding the RTIC utility methodology, on-going research initiatives, RTIC mission planning cycle impact, and areas for future studies.

### **OBJECT-ORIENTED PLAN REPRESENTATION FOR THE OMWG C2 OBJECT SCHEMA**

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**Tung Bui, Department of Systems Management**

The purpose of this thesis is to examine current Command and Control planning methods and to aid in the furtherance of the Object Model Working Group's (OMWG) Core Plan Representation. Chapter I introduces the discipline of planning and its history. Chapter II discusses the theory and practice of modern Object-Oriented modeling. The structure and conventions of object programming are covered as well as a method for information system abstraction. Chapter III covers the background of current Command and Control systems and gives a report on the OMWG efforts in creation of an Object Schema for Command and control. Chapter IV presents the author's submission for an Object-Oriented representation of the COMSUBPAC OPLAN 5050 based on the Core Plan Representation (CPR).

### **MODELING THE EFFECTS OF TECHNOLOGICAL CHANGE ON COSTS FOR DIVERT/ATTITUDE CONTROL SYSTEMS**

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**Second Reader: Ronald L. Brown, Department of Operations Research**

The purpose of this thesis is to produce a usable Cost Estimating Relationship (CER) or Cost Model for the solid-propellant Divert/Attitude Control System (DACS) used in the Atmospheric Interceptor Technology (AIT) program kill vehicle. While developing this CER, several other areas are investigated, including technology measurement and cost estimation of systems that incorporate advanced technology. The data sample for this analysis was collected by Tecolote Research, Inc., and includes both antiballistic missile interceptor and antisatellite attitude control system data.

The analysis includes review and application of a method to measure the level of state-of-the-art of technology embodied in an attitude control system. This methodology also includes the ability to measure the advance, or extension, of that state-of-the-art proposed by a new development program.

Theoretical first unit cost estimates for the ALT DACS are developed by using existing CERs and by first measuring the level of technology to be embodied in the DACS and then building a cost model from these technology measures. The models developed by this procedure show a smaller 90% prediction interval than the 80% prediction intervals produced by the traditional CER approach.

Central to this analysis is the use of various statistical analysis techniques, primarily factor, and regression analysis. Recommendations for further research are also provided.

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### **AN INVESTIGATION OF THE EXPECTED IMPACT OF THE SPACE BASED INFRARED SYSTEM (SBIRS) ON CUEING OF NAVY THEATER BALLISTIC MISSILE DEFENSE SHIPS(U)**

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This thesis studies tactical ballistic missile (TBM) position and velocity measurement accuracy available from the current Overhead Non-Imaging Infrared (ONIR) Defense Support Program (DSP) space-based sensors, and compares this measurement accuracy with the measurement accuracy improvements expected from the Space Based Infrared System (SBIRS). SBIRS is to replace the existing space-based sensors in the near future. The analysis is motivated by a requirement to improve the lethality of AEGIS class ships performing a defended area theater ballistic missile defense (TBMD) mission or a theater-wide TBMD mission.

TBM position and velocity measurements from space-based IR sensors can be handed off to the AEGIS TBMD ship as cueing information which enables earlier acquisition of the TBM by the shipboard AN/SPY-1B/D phased array radar. Earlier acquisition can enable earlier engagement and intercept of the missile at a greater distance from the ship. An analysis of the factors that introduce ONIR space sensor measurement error to the current satellites is performed and used as a baseline for comparison with the design approach and measurement improvements offered by the SBIRS spacecraft and ground processing stations. The result is investigated within the context of lethality improvements to the AEGIS TBMD ship against TBMs of various ranges.

### **A GOAL PROGRAMMING APPROACH FOR DETERMINING THE FORCE STRUCTURE OF NAVAL SURFACE GROUPS USING THE ANALYTIC HIERARCHY PROCESS**

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A methodology for determining the force structure of naval surface groups is developed. A survey of naval surface officers is used to determine a surface ship's relative superiority over the others with respect to several factors (e.g., speed, warfare capabilities, surveillance capabilities, and fuel consumption). The Analytic Hierarchy Process (AHP) is employed to convert survey judgments into numerical preference weights. The AHP weights are then used as objective function coefficients in the mixed integer goal programming model formulations. The object of each model formulation is to select a preferred mix of ship types by minimizing the total deviation from one or more force level goals given certain system constraints such as budget, weapon requirements, and/or existing force levels.

### **A METHODOLOGY FOR AN IMAGERY VULNERABILITY ANALYSIS**

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The proliferation of high resolution commercial remote sensing satellites over the next ten years will allow potential adversary countries to possess high quality imagery which can be used for intelligence purposes against U.S. forces. This thesis first provides a functional description of each segment of an imagery system, discusses relevant concepts of Command and

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Control Warfare, and examines three existing vulnerability analysis taxonomies. The author then combines those elements of each taxonomy applicable to an imagery system with the principles of Command and Control Warfare and develops an imagery system vulnerability analysis methodology. This three-phased methodology describes how to determine the vulnerable nodes of an imagery system, provides a framework for developing ways to attack such a system, and presents a method to measure the effects of an attack on the system. Illustrations are provided to “walk “ the reader through the methodology.