IMPACT OF SATELLITE INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE ON MODERN NAVAL OPERATIONS

A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE
General Studies

by

PAUL A. COLON, LCDR, US NAVY
B.S., United States Naval Academy, Annapolis, MD, 2007

Fort Leavenworth, Kansas
2018

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 instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this 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 Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**			
1. REPORT DATE *(DD-MM-YYYY)* 15-06-2018	**2. REPORT TYPE** Master's Thesis		**3. DATES COVERED** *(From - To)* AUG 2017 – JUN 2018
4. TITLE AND SUBTITLE Impact of Satellite Intelligence, Surveillance and Reconnaissance on Modern Naval Operations			**5a. CONTRACT NUMBER**
			5b. GRANT NUMBER
			5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) LCDR Paul A. Colon, US Navy			**5d. PROJECT NUMBER**
			5e. TASK NUMBER
			5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD Fort Leavenworth, KS 66027-2301			**8. PERFORMING ORG REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)			**10. SPONSOR/MONITOR'S ACRONYM(S)**
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution is Unlimited			
13. SUPPLEMENTARY NOTES			
14. ABSTRACT The use of organic Intelligence, Surveillance, and Reconnaissance (ISR) assets is pervasive in historic and modern naval operations with platforms ranging from airborne, shipborne, subsurface, and organic ISR assets providing valuable situational awareness to naval commanders. The distinct difference between historic and modern carrier strike group deployments is the advent of satellite ISR. Satellite technological advancements give current naval commanders an unprecedented level of global awareness and connectivity; even in the current age of near-peer adversaries. The focus of this study is to determine if afloat availability of satellite ISR, a technology that is relatively new, fundamentally changed naval operations. The research will determine the standard ISR/operations relationship before afloat satellite ISR availability, what capabilities were available once promulgated to afloat units, and resulting naval doctrinal shifts. Once the data is observed or obtained, a comparative analysis will occur to determine deltas in naval operations before and after the afloat ISR shift.			
15. SUBJECT TERMS Intelligence, Surveillance, Reconnaissance, Satellite, Naval Doctrine, Naval Operations, Naval Policy			

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. PHONE NUMBER** *(include area code)*
(U)	(U)	(U)	(U)	69	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

Name of Candidate: LCDR Paul A. Colon, US Navy

Thesis Title: Impact of Satellite Intelligence, Surveillance and Reconnaissance on Modern Naval Operations

Approved by:

_______________________________________, Thesis Committee Chair
CDR David Stebbins, M.S.

_______________________________________, Member
Phillip G. Pattee, Ph.D.

_______________________________________, Member
LCDR David Yocum, M.M.A.S.

Accepted this 12th day of June 2018 by:

_______________________________________, Director, Graduate Degree Programs
Robert F. Baumann, Ph.D.

ABSTRACT

IMPACT OF SATELLITE INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE ON MODERN NAVAL OPERATIONS, by LCDR Paul A. Colon, US Navy, 69 pages.

The use of organic Intelligence, Surveillance, and Reconnaissance (ISR) assets is pervasive in historic and modern naval operations with platforms ranging from airborne, shipborne, subsurface, and organic ISR assets providing valuable situational awareness to naval commanders. The distinct difference between historic and modern carrier strike group deployments is the advent of satellite ISR. Satellite technological advancements give current naval commanders an unprecedented level of global awareness and connectivity; even in the current age of near-peer adversaries.

The focus of this study is to determine if afloat availability of satellite ISR, a technology that is relatively new, fundamentally changed naval operations. The research will determine the standard ISR/operations relationship before afloat satellite ISR availability, what capabilities were available once promulgated to afloat units, and resulting naval doctrinal shifts. Once observed or obtained, a comparative analysis will occur to determine deltas in naval operations before and after the afloat ISR shift.

ACKNOWLEDGMENTS

I would like to thank the members of my thesis committee at the US Army Command and General Staff College (CGSC). The thoughtful direction of LCDR Dave Yocum was invaluable to my progress in drafting my thesis and organizing my thoughts. Dr. Phillip Pattee's insight into scholarly research aided my progress and allowed me to properly focus my methodology and truly learn the art of research. In addition, I'd like to thank CDR Dave Stebbins for being a stout voice throughout this process and bringing his knowledge of naval operations to bear as a litmus test for my analysis and conclusions. I would also like to thank the instructors and students of Staff Group 9A at CGSC. Their dedication to my individual development allowed me to have the courage to pursue this thesis and maintain my focus throughout the entire process.

I want to especially thank my family for their steadfast devotion and loving care throughout my time here at CGSC. I would not have been able to complete this thesis without the constant attention and encouragement from my wife Angelique. She has dedicated much more than I deserve to my individual advancement and development as an officer, husband and father. I would like to dedicate this thesis to my son Adrian as I hope to always have the joy and wonder in life that he has.

TABLE OF CONTENTS

Page

ABSTRACT iv

ACKNOWLEDGMENTS v

TABLE OF CONTENTS vi

ACRONYMS viii

ILLUSTRATIONS x

TABLES xi

CHAPTER 1 INTRODUCTION 1

Assumptions 4
Limitations 4

CHAPTER 2 LITERATURE REVIEW 6

Literature Pertaining to the History of Naval ISR 7
Literature Specific to Satellite ISR Technology, Capability and Policy 10
Literature Analyzing the Impact of Technology on Naval Operations and Doctrine ... 12
Literature that Extrapolates Historic Trends into Current Naval Operations 13
Common Themes in Existing Literature 14
Significance of Thesis in Relation to Existing Literature 16

CHAPTER 3 RESEARCH METHODOLOGY 17

CHAPTER 4 ANALYSIS 22

Satellite ISR: US Government Necessity 22
US Navy: ISR History 24
US Navy: Satellite ISR Availability 29
Budgetary Concerns 30
The Watchfloor 36
Transformation or Revolution 40
Modern Linkage 41

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS 47

Revisiting the Research Questions 50
Conclusions 54
Recommendations 55

Areas of Further Research 56

BIBLIOGRAPHY 58

ACRONYMS

A2AD	Anti-Access, Area Denial
BuAer	Bureau of Aeronautics
C4	Command, Control, Communications, Computers
CIA	Central Intelligence Agency
CNO	Chief of Naval Operations
CNO-IP	Chief of Naval Operations Intelligence Plot
CVN	Nuclear Aircraft Carrier
DOD	Department of Defense
DSARC	Defense System Acquisition Review Committee
ELINT	Electronic Intelligence
GRAB	Global Radiation and Background
HF/DF	High Frequency Direction Finding
HULTEC	Hull-to-Emitter Correlation
IS	Intelligence Specialist
ISR	Intelligence, Surveillance and Reconnaissance.
NIPS	Naval Intelligence Processing System
NRL	Naval Research Laboratory
OpNav	Office of the Chief of Naval Operations
OPINTEL	Operational Intelligence
OSIS	Ocean Surveillance Information System
PT	Photographic Intelligenceman
RMA	Revolution in Military Affairs
RORSAT	Radar Ocean Reconnaissance Satellite

SOSUS	Sound Surveillance System

ILLUSTRATIONS

Page

Figure 1. US Navy Differences Due to Satellite ISR Availability Afloat..........................19

Figure 2. PARCAE Multiple Payload Dispenser Drawing, 1970.....................................35

Figure 3. 2011 IS Manning Data..39

Figure 4. Data over Time Graph 45

TABLES

Page

Table 1. GRAB, POPPY and PARCAE Launches 33

Table 2. 1973 Naval Intelligence Manning...38

Table 3. The US Navy's Understanding of Soviet Naval Strategy, 1978-91 42

CHAPTER 1

INTRODUCTION

> (There are) many aspects of space and space technology . . . which can be helpful to all people as the United States proceeds with its peaceful program in space science and exploration. Every person has the opportunity to share through understanding in the adventures which lie ahead. This statement [of the President's Science Advisory Committee] makes clear the opportunities which a developing space technology can provide to extend man's knowledge of the earth, the solar system, and the universe. These opportunities reinforce my conviction that we and other nations have a great responsibility to promote the peaceful use of space and to utilize the new knowledge obtainable from space science and technology for the benefit of all mankind.
>
> — Dwight D. Eisenhower, *Introduction to Outer Space*

Current naval operations rely heavily on space resources. A large majority of space resources are devoted to the ingestion of intelligence and intelligence related data. Assets organic to afloat units limited intelligence collection before the advent of satellite Intelligence, Surveillance, and Reconnaissance (ISR). These afloat units were augmented by intelligence centers ashore and through intelligence sharing efforts from allies. With the advent of technologies surrounding space exploration and exploitation, the US Navy was beneficially positioned at the forefront of adjusting to new policy, threats and operational intelligence need. The Navy has a long history of utilizing adversaries' data to gain an edge in executing missions at sea. Throughout this history, much of the data collected was limited by the technology available. After World War II, advances in technology and the presentation of new adversaries, supercharged the organic ISR capability of units afloat. However, the technologies were limited to the organic capability of individual military platforms. Global tensions pushed for exploitation of the space domain which ignited the space race. Due to advances in the ability to reach this new domain, the issue of their application at the Department of Defense pushed the services, particularly the Navy, into technological revolutions and technological transitions to satisfy the demand.

Application of data collected by sensors in space at the operational level forced significant change within the US Navy and its fleet. Although the general execution of operations seems to have only changed slightly, many fundamental changes occurred at the unit level with respect to the naval intelligence community writ large. Exploration of the changes within this community of the Navy will allow for the thorough understanding of the impacts of satellite ISR by drawing a correlation between the parts and their influence on the whole. Understanding the timeline of the genesis of satellite ISR and its implementation in the fleet is essential to comprehending the initial impacts of space-based ISR on naval operations. By setting up the timelines, juxtaposed to US policy and global pressures, one will attempt to classify the specific differences between naval operations before and after the availability of satellite ISR at the fleet level.

To comprehend the differences, however, one must understand the scope of the genesis of space-based ISR and the facets of its materialization within the US intelligence community. The US Navy's intelligence community has a distinct symbiotic relationship with the national intelligence community and the policies that affect it. Exploring this relationship and the general history of ISR around the time of satellite ISR availability, establishes the foundation for researching the proposed delta between naval operations before and after the materialization of this new technology. Furthermore, the political climate surrounding this period will provide amplification and explain the supposed culture shift from the terrestrial and tangible to the atmospheric horizon.

The focus of this study is to determine if afloat availability of satellite ISR, a technology that is relatively new, fundamentally changed naval operations. The research will determine the standard ISR/operations relationship before afloat satellite ISR availability, what capabilities were available once promulgated to afloat units, and resulting naval doctrinal shifts. Once the data is observed or obtained, a comparative analysis will occur to determine deltas in naval operations before and after the afloat ISR shift.

This thesis addresses the question: Did the advent of afloat satellite ISR availability fundamentally change naval operations? The problem question requires answering the following:

1. When did the US Navy field the first satellite ISR products afloat?
2. How were satellite products processed, exploited, and disseminated?
3. How did the US Navy conduct afloat ISR before the availability of satellite ISR?
4. What were the defined subsets of operations afloat before satellite availability?
5. What were the defined subsets of operations afloat after satellite availability?; How did the satellite products affect the individual subsets?
6. What drove satellite ISR availability afloat? Technology, threat, or both?
7. What types of products/capability became available with satellite ISR?
8. Are the differences in naval operations from the initial availability of satellite ISR to present usage of satellite ISR centered on technology or threat?

Assumptions

The underlying assumption of this thesis is that the US Navy will continue to conduct ISR afloat. Subsequently, that ISR will be conducted through the ingestion of collection from space-based sensors. Furthermore, the US Navy will continue to deploy in carrier strike groups and current configurations to carry out naval operations. Any deviation from deployment configurations outside of carrier strike groups are those prescribed in existing doctrine. Furthermore, this research assumes satellite ISR had significant impacts to military affairs due to the advent of the space program. Consequently, records of this assumed revolution are maintained in documents of the US Navy and are readily available.

Limitations

The study will assess satellite ISR's impact to modern naval operations. It will compare, contrast, and asses satellite ISR as a revolution in military affairs (RMA) as it pertains to ISRs application afloat in the US Navy. The study will, within limited scope, extrapolate the afloat RMA to current naval operations. The study will not elaborate or determine the impact or evolution of any other forms of ISR outside of satellite ISR unless strictly used to establish a baseline for the RMA. Due to the scope of the subject, analysis will be conducted on naval operations between the time periods of the early 1970s to early 2000s. Any data from periods prior to or after the scope of analysis is meant to provide pretext for historic analysis and context for conclusions.

Where applicable, the thesis will address naval operations impacts due to satellite ISR in the present. These impacts will specifically tie into the core discussions surrounding national policy, global threats, naval manning, training, and equipment to draw parallels within the scope of the study. The study and its results could be used as a baseline for professional military education regarding current and future naval intelligence officers. The results could also help developers of naval doctrine and tactics understand previous methods for ISR and operations to refine tactics in a denied operational environment.

Finally, although this study is limited to unclassified documents, classification and release markings may preclude a complete analysis as some current and historic naval operations documents may be marked "For Official Use Only" or remain classified. Greater accuracy could be provided with the use of classified documents especially when drawing correlations between current afloat collection methods and methods within the scope of research, however, the intent of this study is to provide discussion readily available for public release and widest dissemination.

CHAPTER 2

LITERATURE REVIEW

> Sir Walter Raleigh declared in the early 17th century that "whoever commands the sea, commands the trade; whosoever commands the trade of the world commands the riches of the world, and consequently the world itself." This principle is as true today as when uttered, and its effect will continue as long as ships traverse the seas.
>
> —Chester Nimitz, *Employment of Naval Forces: "Who Commands Sea—Commands Trade"*

The purpose of this literature review is to conduct an overview of unclassified, public domain sources pertaining to the issue of satellite ISR availability afloat in the US Navy. The intent of the research is to determine if the advent of satellite ISR fundamentally changed modern naval operations. It will define naval operations before the availability of afloat satellite ISR and compare the delta with afloat operations using satellite ISR. Furthermore, the research will touch on the historical foundations of satellite ISR, the naval intelligence community and naval operations to contextualize the impact of afloat satellite ISR availability. Literature will be broken into the following categories: literature pertaining to the history of naval ISR; literature specific to satellite ISR technology, capability and policy; literature analyzing the impact of technology on naval operations and doctrine; and literature that extrapolates historic trends into current naval operations.

This chapter will detail writings and publications from the CIA used to annotate the historic baselines for satellite ISR capability. Further historic detail will be added from analysis of government documents outlining naval operations and naval strategy with respect to implementation of satellite ISR capability. Histories will be bolstered by scholarly books and articles describing implementation and acquisition of satellite ISR in the Navy and DoD writ large. Other sourced material is gathered from individuals with professional expertise in the field of intelligence, scholars published at higher education institutions, and individuals with technical expertise in satellite remote sensing. Analysis of the sources will be conducted in chapter 4 given the methodology in chapter 3.

Literature Pertaining to the History of Naval ISR

The first set of literature represents a broad set of writing that details and chronicles the history and evolution of naval ISR. The importance of understanding this subset of writing is essential to understanding the trends in and motivations of ISR that led to the eventual implementation and operationalization of satellite ISR, and its subsequent availability afloat. Much of this literature is contained in books authored by individuals with first hand expertise in the fields of intelligence and operations within the US Navy.

The main source for historic trends of ISR in the US Navy is Norman Friedman's *Network-Centric Warfare: How Navies Learned to Fight Smarter through Three World Wars*.[1] Friedman lays out the historic premise of the need for information, the means in which it is collected, and the methods used to fit the needs of the warfighter in the Navy. The underlying focus of his book is to refine network-centric warfare into its basic form which he determines is "picture-centric warfare."[2] Friedman states, "The main factors are

[1] Norman Friedman, *Network-Centric Warfare: How Navies Learned to Fight Smarter Through Three World Wars* (Annapolis, MD: Naval Institute Press, 2009).

[2] Ibid., ix.

the area involved, the size of the forces, the variety of the objects in the operational area, and the pace of operations . . . [picture-centric warfare is] a kind of warfare based on using a more-or-less real-time picture of what is happening."[3] He goes on to extrapolate this idea as one that is inherent to navies due to the nature of wide areas covered by small, dispersed forces. Furthermore, Friedman goes on to expand on the idea of the picture by stating that its measure of success is whether the data is sufficient to present a usable picture of reality and, if so, it inherently changes the style in which a navy fights.[4]

Friedman starts his history of naval ISR by delving into the genesis of ocean surveillance in World War I during the radio era. During this time, he shows how this type of surveillance bolstered command of the fleet post-1918 by plotting data points associated with information shared over radio waves. He extends his premise for creating a picture by showing the benefits of exploiting radar supplemented by the existing use of radio. This extrapolation begins to show a historic trend of successive technologies presenting a more refined means to help the warfighter visualize the warfighting domain. Subsequently, Friedman presents the beginnings of a netted Navy through the expanded exploitation of the electromagnetic spectrum. The Navy, in turn, began to operate with systems that provided subsets of automation due to the influx of data from the previous methods exploitation.

Finally, Friedman outlines the means for ocean surveillance after 1945. This chapter essentially presents the naval ISR shift afloat from organic and terrestrial-based

---

[3] Friedman, *Network-Centric Warfare*, x.

[4] Ibid.

sensors to the use of space-based ISR assets. In his description, he outlines the initial concepts for ISR satellites, some of the policy and budgetary issues associated with acquisition, and much of the fallout that occurred after satellite ISR was available afloat. His research is essential to conceptualizing the delta between the US Navy before and after the advent of space-based ISR afloat.

The second main source for historic trends is *The Admiral's Advantage: US Navy Operational Intelligence in World War II and the Cold War.*[5] In this text, Christopher Ford and David Rosenberg outline the origins of Operational Intelligence (OPINTEL) in the US Navy via information presented due to Cold War declassification. More important to this study, they present data on naval intelligence in the 1960s and present the foundation for the Ocean Surveillance Information System (OSIS), one of the first automated intelligence systems available during the satellite age. Furthermore, the source presents the impacts of increased data on OSIS and the subsequent organizational changes within the naval intelligence community.

Ford and Rosenberg identified some of the main changes associated with increased data availability include the increase of reach-back organizations, changes to afloat intelligence staffing aboard naval vessels, and the creation of the Intelligence Specialist enlisted rate to augment analysis ashore and afloat. This data is essential in understanding the context of the impact of space-based ISR when correlated with other historic data.

---

[5] Christopher Ford and David Rosenberg, *The Admiral's Advantage: US Navy Operational Intelligence in World War II and the Cold War* (Annapolis, MD: Naval Institute Press, 2005).

Other sources such as Robert Buderi's *Naval Innovation in the 21st Century*[6] and The National Research Council's *Navy Needs in Space for Providing Future Capabilities*[7] expand on the historic trends of ISR in the US Navy. Much of the history relevant to the study focuses on time periods from the early 1960s to the end of the Cold War. This period includes key changes in US policy and technology pertaining to the advent of satellite ISR capability availability afloat.

Literature Specific to Satellite ISR Technology, Capability and Policy

The second set of literature represents a broad set of writing that details and chronicles the evolution of satellite ISR. The importance of understanding this subset of writing is essential to understanding the trends in and motivations of satellite ISR development that led to the eventual implementation and operationalization afloat. Most of this literature is contained in books and scholarly journals authored by individuals with first hand expertise in the fields of satellite ISR, naval operations, and US policy.

The first major source contributing to understanding satellite ISR technology is the Central Intelligence Agency's *Corona: America's First Satellite Program.*[8] This publication provides the foundation for understanding the genesis of satellite ISR technology and its availability at the national level. It underpins the importance of space-

[6] Robert Buderi, *Naval Innovation for the 21st Century* (Annapolis, MD: Naval Institute Press, 2013).

[7] National Research Council, *Navy's Needs in Space for Providing Future Capabilities* (Washington, DC: The National Academies Press, 2005).

[8] Kevin Ruffner, *Corona: America's First Satellite Program* (Washington, DC: Center for the Study of Intelligence, Central Intelligence Agency, 1999).

based sensing to augment existing US terrestrial capability and the limitations associated with collection on manned platforms. Furthermore, *Corona* elaborates on the neccessity of satellite ISR given the geopolitical and threat environments in the 1960s. This understanding allows the research to flow seamlessly into the policy aspects surrounding the need for satellite ISR technology.

The policy baseline allows the research to establish a foundation upon which space-based ISR is formed and promulgated from the national perspective to the individual services. One of the essential elements involved in this foundational understanding is correlating national policy, national threats, and budgets to satellite technology. To do this, a thorough understanding of the evolution of US global strategy, as it pertained to the geopolitical environment, is needed. In previous sources, key dates in the study in the 1960s and 1970s allow for the focus on policy and strategy around the genesis of satellite ISR technology.

Secondary sources of: Rose's *Power at Sea: A Violent Peace 1946-2006,*[9] Hattendorf and King's *The Evolution of the US Navy's Maritime Strategy,*[10] Pierce's *Warfighting and Disruptive Technologies: Disguising Innovation,*[11] and Fourest's *Satellite Imagery: From acquisition principles to processing of optical images for*

[9] Lisle A. Rose, *Power at Sea: A Violent Peace 1946-2006* (Columbia, MO: University of Missouri Press, 2007).

[10] John B. Hattendorf and Ernest J. King, *The Evolution of the US Navy's Maritime Strategy* (Newport, RI: Naval War College, 2004).

[11] Terry C. Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation* (New York, NY: Frank Cass, 2004).

observing the Earth[12] allow the research to round out the details surrounding the policies in the period of research and analysis. These sources present a picture of the US National mindset as it pertained to global threats and the subsequent actions the Navy took to address them. These naval actions were codified in strategy and doctrine that evolved over time and highlighted the technologies associted with that doctrinal evolution. Furthermore, this literature on the nature of space-based sensing was essential to understanding the hurdles associated with developing, fielding, operating and exploiting the capability of satellite collection capability.

Literature Analyzing the Impact of Technology on Naval Operations and Doctrine

The third set of literature represents a broad set of writing that details the impact of technology on naval operations and doctrine. This literature is the essential stepping stone to analysis of ISR related research, policy and doctrine research and the measure by which they effect the naval service. Most of this literature is contained in books and scholarly journals authored by individuals with first hand expertise in the fields of naval operations, and military technology.

The main source within this body of research is Friedman's *The Navy after the Cold War: Progress without revolution.*[13] This text presents a unique view on the study

[12] Sébastien Fourest, *Satellite Imagery : From Acquisition Principles to Processing of Optical Images for Observing the Earth* (Toulouse: Cépaduès Éditions, 2012).

[13] Benjamin Friedman, "The Navy after the Cold War: Progress without revolution," in *US Military Innovation since the Cold War*, eds. Harvey Sapolsky, Benjamin Friedman, and Brendan Rittenhouse Green (New York, NY: Routledge, 2009), 29.

of technologic evolution and the purported revolutions within the US Navy. Furthermore, the source provides some answers to key research questions contained in this body of work allowing the analysis in chapter 4 to further focus and refine the premise behind the source's findings and adapt them into the conclusions associated with this body's primary research question.

Literature that Extrapolates Historic Trends into Current Naval Operations

The final set of literature consists of journals, government documents and studies depicting current naval doctrine and strategy and addressing previous strategies, their histories, and the related technologies including Erwin's *Intelligence Surveillance, and Reconnaissance (ISR) Acquisition: Issues for Congress,*[14] Crothers, Lanphear, Garino, Konyha, and Byrne's *Intelligence: US Space-Based Intelligence, Surveillance, and Reconnaissance,*[15] England, Clark, and Jones' *Naval Transformation Roadmap: Power and Access... From the Sea, A Cooperative Strategy for 21st Century Seapower,*[16] and

[14] Marshall Erwin, *Intelligence Surveillance, and Reconnaissance (ISR) Acquisition: Issues for Congress,* Congressional Research Service Report for Congress (Washington, DC: Library of Congress, 2013).

[15] Maj Brian Crothers, Maj Jeff Lanphear, Maj Brian Garino, Maj Paul P. Konyha III, and Maj Edward P. Byrne, "Intelligence: US Space-Based Intelligence, Surveillance, and Reconnaissance," in *AU-18 Space Primer* (Maxwell Air Force Base, AL: Air University Press, 2009), 167-181.

[16] Gordon England, Vern Clark, and James L. Jones, *Naval Transformation Roadmap: Power and Access... From the Sea* (Washington, DC: Office of the Chief of Naval Operations, 2004).

Rand's *Data_Flood: Helping the Navy Address the Rising Tide of Sensor Information.*[17] This literature aids the study in presenting current issues as they pertain to the core of the research questions allowing for the proper application of analysis and thought to the conclusions and recommendations presented in this body of work. Much of this literature is contained in scholarly journals and supplemental government documents specific to the fields of naval doctrine, strategy, operations, and associated technology.

Common Themes in Existing Literature

There were several common themes in literature pertaining to the topic of this thesis given the specific nature of the technology and the means in which its use is applied to the military. The first theme deals with personnel. Throughout most of the literature the human element is essential in every aspect of the evolution and implementation of satellite ISR afloat. From the policy maker shifts in multiple administrations to the naval personnel involved in the acquisitions process, there are multiple elements of the human aspect of space-based sensing that are pervasive in the body of research. Furthermore, the human aspect of personnel analyzing the data collected by satellite ISR and the warfighters they support are key aspect of the human element themes in the existing literature.

The second theme common to existing literature is budgetary concerns. Despite the perceived necessity for satellite ISR from either a national or naval perspective, one commonality throughout the existing literature from 1960 to present is the debate around

[17] Isaac R. Porche III, Bradley Wilson, Erin-Elizabeth Johnson, Shane Tierney, and Evan Saltzman, *Data_Flood: Helping the Navy Address the Rising Tide of Sensor Information* (Santa Monica, CA: RAND National Defense Research Institute, 2014).

budgetary concerns associated with domestic economic issues and defense spending. Budgetary factors were a huge factor in swaying the growth of the US Navy in the period of research specifically as it pertains to the acquisition of new technologies including satellite ISR. Despite the supposed inevitability of space-based ISR availability, hardline budgetary austerity presented significant roadblocks to innovation even in the face of perceived global and national need and lobbying for increased spending on behalf of the US military.

The third theme common to all the existing literature is the specific threat of the Soviet Union. Given the period of research this theme is to be expected. However, the nature in which the theme of the Soviet threat is presented in the research depicts a much more pervasive presence throughout the existing literature. Every single degree of analysis or inference maintains a tone linking to the ominous shadow that was associated with the threat of the Soviet Union.[18] Although the Soviet Union fell in the early 1990s, the lasting impact of the threats associated with the former state exist in the current elements of national power of the Russian Federation. In turn, literature delving into the modern naval strategy of the 21st century maintains themes associated with the threats from the former Soviet Union.[19]

[18] Edward C. Keefer, *Harold Brown: Offsetting the Soviet Military Challenge 1977-1981* (Washington, DC: Historical Office: Office of the Secretary of Defense, 2017), 217.

[19] United States Naval Institute, "A Cooperative Strategy for 21st Century Seapower," *Proceedings* 141, no. 4 (2015): 4.

Significance of Thesis in Relation to Existing Literature

Upon review of existing literature, the significance of this study is twofold considering the implications of the analysis and conclusions. First, the existing literature never explicitly links satellite ISR technology and the specific impacts it had on the US Navy. Much of the existing literature touches on the importance of the technology, its acquisition and the functions effected nationally. However, as it pertains to the US navy specifically, much must be inferred or correlated to fully answer the question of impact. Secondly, there is much debate on the future structure of the US Navy given the advent of the Anti-Access, Area Denial (A2AD) problem set. This study, its conclusion, and recommendations provide valuable insight into the means and methods the US Navy could use to address the issue of A2AD. By understanding the path, we chose to take to gain the advantage over our adversaries, we can comprehend the implications of executing operations in a satellite ISR limited or denied environment.

CHAPTER 3

RESEARCH METHODOLOGY

> By taking the time to educate ourselves on our history and the people who shaped this nation, we can more fully appreciate the ideals set down by the founders . . . It's a reminder that our work is to sustain freedom and ensure that rights and liberty belong to all our citizens.
>
> —Admiral Michelle J. Howard,
> "What does Black History Month Mean to You?"

Innovations in ISR capability have undoubtedly changed the course of military operations with the sheer influx in data available to the warfighter and the decision maker. Multiple researchers and scholars have answered the question of the impacts ISR has had on military operations and the effects of ISR have been demonstrated with victory over adversaries. These victories range from the tangible victory on the battlefield to the impacts on warfighting theory and doctrine. Studies have focused on the holistic impacts of ISR innovation, however the study of individual capability impacts vary. This thesis intends to focus on evaluating the impact of space-based ISR availability onboard ships and its specific impact on naval operations.

The research methodology in this study relies upon sources primarily focused on the historical maneuverings of the US government and its pursuit of satellite ISR capability. Additionally, the study relies on research of foundational, scholarly sources that provide the understanding of ISR in the space domain as well as US government documentation and policy that explains the nuance of the need for satellite ISR from a whole-of-government and naval perspective.

Although this study does not use individual speeches and interviews from human subjects, it does infer individual opinions of key individuals from historic documents and government records. Furthermore, the data from historic documents and government records provides the information to analyze quantitative and qualitative data for a rounded perspective on key policy decisions, budgetary concerns, naval requirements, as well as global threat trends and geopolitics. No new data was produced in the execution of this study. Although a disadvantage, the core of the study revolves around the pretext of satellite ISR and the advent of its availability afloat. All data researched is used to extrapolate and reinforce findings, conclusions, and recommendations.

The study and its results could be used in the professional military education of current and future naval intelligence officers. The results could also be used in the development of naval doctrine and tactics, using understanding of previous methods for ISR/operations to refine tactics for a denied operational environment. The latter has been debated significantly as demonstrated in recent naval policy and guidance. Although the due diligence has been done to address current shortfalls in a denied environment, the importance of understanding the historic trials within the service that led to the denial seem to be overlooked or glossed over. By understanding the impacts of space-based ISR on naval operations, one can appreciate its shortfalls and deduce any correlation to the current state of naval affairs and shortfalls therein. Also, and more importantly, the study reinforces the importance of understanding military history and its application to current military thought. Understanding the history of tools regularly used by naval intelligence analysts will allow for a wider range of thought as to their application with respect to support for the warfighters and the decision makers which will be the larger application of the study.

This study is unique in that it addresses a comparison of naval operations at a key event in naval intelligence: the advent of space-based ISR afloat. The US Navy had conducted ISR via every means available leading up to the advent of satellite ISR. Studies of naval operations, some referenced in this document, either focus on external factors or all-source intelligence approaches to ensure naval operational end states. Very few studies provide a deep dive into the advent of satellite ISR afloat and its impacts on naval operations. Previous studies touch on space-based collection to explain the history of the naval intelligence community. While the holistic approaches do imply certain data, points relating to the significance of satellite ISR, they only do so in providing the evidence as a stepping stone for discussion of the evolution of naval intelligence. This study expands on the topic of space-based ISR and infers the nuance needed to explain the overall significance of space collection and its application to naval operations.

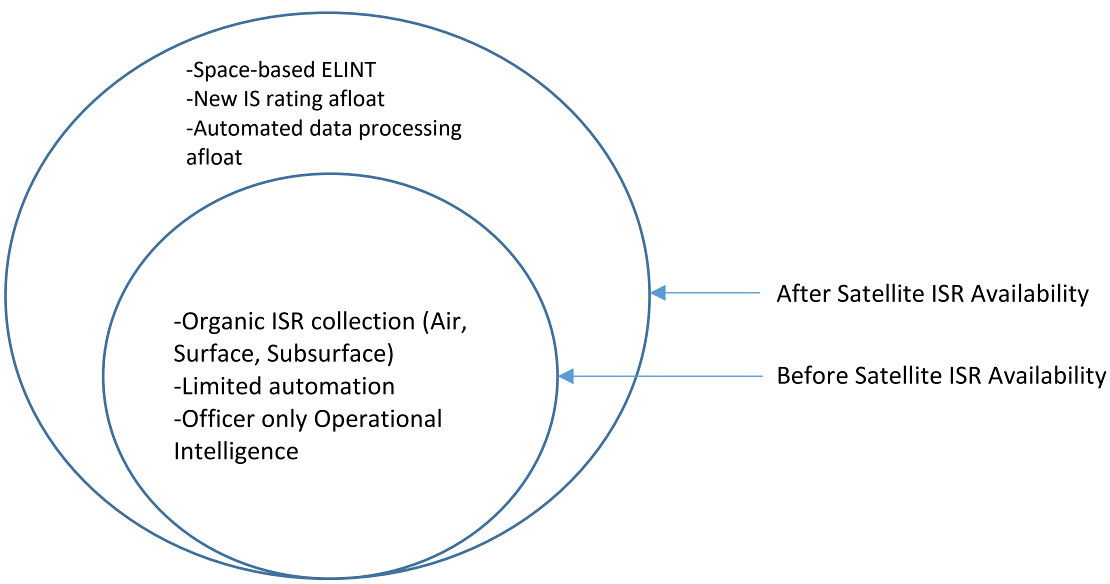


Figure 1. US Navy Differences Due to Satellite ISR Availability Afloat

Source: Created by author.

To limit the scope of the study, the focus of research will focus on the specific introduction of satellite ISR afloat and compare naval operations before and after its introduction. Quantitative measures will involve metrics specific to funding as well as types of collection platforms available and methods employed. These data point will be correlated with quantitative measures germane to policy, threats, and geopolitics. In turn, analysis will be conducted on naval operations between in the early 1970s to the early 2000s to determine the standard ISR/operations relationship before afloat satellite ISR availability, what capabilities were available once promulgated to afloat units, and resulting naval doctrinal shifts.

This study excludes other forms of ISR and their individual impacts on naval operations. Some evidence of other collection methods that were precursors to or results of space-based ISR will be used to frame and provide context for the primary research question. Furthermore, this study will not explain the impacts of other space-based capability in the realm of command, control, communication and computers outside of their direct relation to space-based ISR. These direct relationships will only be included if they are a direct or secondary result of the advent of satellite ISR afloat. However, as with the related ISR capabilities, C4 capabilities will only be referenced to frame and provide context for the primary research question.

An argument exists that shows opposing views on the evolution or revolution of naval operations within the scope of the case researched. This argument fits into the larger focus of the study by providing an existing, scholarly measure for innovation within the Navy. Use of the data to determine the viability of the individual schools of thought, innovation versus technological revolution, will provide a means for determining the impacts of satellite ISR availability afloat. Any data available to address the debate regarding the primary research question will be considered to provide a whole-of-research conclusion and aid in eliminating bias.

This research methodology should provide the foundations for an unbiased approach to the factors surrounding the impacts of satellite ISR on naval operations. Addressing secondary questions will provide for foundational understanding of the problem statement. Furthermore, proof, or disproof, of the primary question is dependent upon answering secondary questions. Resultant conclusions of this study should be reasonably unbiased, based on complete analysis of the researched case. Through this approach, any recommendations provided will be concise and within the bounds of the evidenced conclusion.

CHAPTER 4

ANALYSIS

Satellite ISR: US Government Necessity

> From its start in the late 1950s until its retirement in 1972, CORONA (in its several versions) both proved valuable in itself and set the stage for the satellite programs that followed it. For the first time US policymakers had encompassing coverage of the Soviet Union and China that was both timely and accurate. Since the 1960s a significant percentage of finished intelligence, intelligence reports sent to policymakers, has been largely derived from reconnaissance satellites. Satellite imagery is used for a variety of analytical purposes from assessing military strength to estimating the size of grain production. Far and away its greatest utility, however, has been to monitor the deployment of Soviet strategic forces and to verify compliance with arms control agreements.[20]

The CORONA project amplified the US appetite for satellite ISR as it pertained to the Soviet threat. Limits on existing ISR capability revolved around requiring manned platforms to execute deep collection in contested adversary territory. This capability rested predominantly on the U2 spy plane program and the processing, exploitation and dissemination of the data collected. Manned aircraft have inherent limits based on the operator and the dwell time over the target due to fuel. These restrictions were not limited to the CIA in the 1960s however. The operational reach of manned military ISR platforms extended only as far as the onboard fuel could reach within the limits of the operator. The threat of being shot down also contributed to risk within overt and covert collection. In turn, long-range aviation collection platforms ran the risk of escalation due to the tensions surrounding the Cold War.

> This was a time when it was still extraordinarily difficult to gather information by any other means from "denied areas" including the Soviet Union, Communist China, and their allies. The need for intelligence about Soviet strategic weapon

[20] Ruffner, xiii.

> systems and bases dramatically increased after 1 May 1960, when the Soviets shot down an American U-2 aircraft and captured its CIA pilot, Francis Gary Powers.[21]

All these factors, including the appetite for preemptive data on the adversary, led politics and policy within the US to search for less risky technology. The search for a less risky form of collection was not necessarily a result of trial and error of different technologies and experimentation, it was more so in the lane of an aversion to escalation with the Soviets. Therefore, the US, like its adversaries, pursued satellite ISR capability to exploit the space domain undetected. CORONA faced many issues early in the program. The United States government and contracting agencies dealt with numerous shortfalls in the testing and evaluation of technology for launch and recovery of delivery vehicles. Any new technology and subsequent experimentation runs the risk of failure. The satellite ISR program, however, came with significant shortfalls. These shortfalls involved high cost associated with rocket body failures as special manufacturing processes were needed for not only the delivery vehicle, but also the payloads, miniaturization and data link technology for the delivery of collected information to terrestrial exploitation centers. Furthermore, the adversarial build-up of soviet technology and equipment forced the US satellite program offices to strive to overcome the initial adversities. Through the trial and error, policy makers needed to be convinced of the significance of satellite ISR juxtaposed to existing capability. "The answer lay in the overwhelming intelligence needs of the period. The initial planning of CORONA began at a time when we did not know how many BEAR and BISON aircraft the Soviets had,

[21] Ruffner, xiii.

whether they were introducing a new and far more advanced long-range bomber than the BISON, or whether they had largely skipped the build-up of a manned bomber force in favor of missiles."[22]

The threat and associated intelligence gaps have long been the main reason for the pursuit and introduction of new sensor technology. Intelligence gaps, based on current capability and need, force the intelligence community to leverage existing intelligence capacity for a means to supplement existing collection capacity. The CORONA project of the 1960s embodied this process of expanding capability to meet the need.

> In the preparation of the National Intelligence Estimate on guided missiles in the fall of 1959, the various intelligence agencies held widely diverse views on Soviet missile strength, Nineteen Sixty ushered in an election year in which the missile gap had become a grave political issue, and the President was scheduled to meet with Soviet leaders that spring without, it appeared, the benefit of hard intelligence data. The U-2 had improved our knowledge of the Soviet Union, but it could not provide area coverage and the answers to the critical questions, and it was increasingly becoming less an intelligence asset than a political liability. It was judged to be only a matter of time until one was shot down, with the program coming to an end as an almost certain consequence.[23]

US Navy: ISR History

The Navy, since the dawn of World War II, vied for the application of naval air power as an extension of its operational reach. Aside from being forward observers for naval gunnery, naval aircraft served as forward reconnaissance platforms to extend the eyes of the commander beyond previous constraints. This extension of what a commander could see was so valuable, the aircraft carrier was defined as a multi-role platform in World War II and was staged to become the centerpiece of naval operations

[22] Ruffner, 20.

[23] Ibid.

in the historic surface and air domains. Furthermore, the US Navy leveraged the unlikelihood of attribution of submarines in the subsurface domain to also extend the operational reach of its commanders. Technology upgrades to ships and aircraft, however, could only do so much to address the issues previously faced by the U2 spy plane. Adversary surface to air threats increased the risk to maritime patrol aircraft and compounded seaborne ISR operational reach limitations on a global scale. The US Navy relied heavily on High Frequency Direction Finding (HF/DF) capability, just like the Soviets, for surface ocean surveillance.[24]

HF/DF was a capability in which energy from the electromagnetic spectrum was ingested by a receiver, processed via computer algorithm, and correlated to a line of bearing (or direction) relative to the location of the vessel collecting the data. Furthermore, the line of bearing could be correlated to other bearing lines from multiple units afloat or ashore to potentially triangulate or fix the source of the energy to a specific location. The energy ingested was typically relegated, based on capability of the receiver, to Radio Frequencies or frequencies typically associated with high frequency communications emitters. The fidelity of the fix or location is based on multiple variables but relative accuracy is typically catalyzed by the total number of HF/DF receivers collecting and the angles between the lines of bearing from the source vessel to the receivers.

This capability was linked to ground stations in various areas of operation to provide updates to ships afloat for tracking merchant and threat traffic on the open ocean.

---

[24] Friedman, *Network-Centric Warfare*, 177.

The premise of the collect revolved around the reliance of soviet vessels on HF radio to broadcast orders for fleet patrols and maneuver. This electronic intelligence was bolstered by the availability of undersea surveillance capability allowing naval intelligence analysts to fuse data and assess enemy movement and track correlation. Although the DF capability along with the Sound Surveillance System (SOSUS) nets bolstered existing organic ISR capability (aircraft etc.), DF data and collection were limited by the availability of ground stations. The navy, in turn, installed CLASSIC OUTBOARD to its vessels and linked them with allied nation DF vessels.[25] CLASSIC OUTBOARD was the first DF system created and installed on US Navy ships. The system had a compliment of collection antennas that ingested low, medium and high frequency RF data for afloat processing and exploitation. However, the intelligence was limited to what the underway vessels encountered and the DF afloat technology did little to negate the risk of contact with the enemy.

Though there were issues with airborne ISR assets, their impact on naval operations cannot be understated. Furthermore, the impact of advocates of naval aviation bolstered the overall effectiveness and operational reach of aviation as an organic ISR platform. One could argue that carrier aviation, in its current form, is a direct result of the constant innovation by William Moffett. William A. Moffett, an advocate of US Navy aviation, had a major impact on innovation through policy, doctrine, and culture before World War II. Moffett created a lasting impact on the Navy during the interwar period and effectively focused the force into its current configuration.

---

[25] Friedman, *Network-Centric Warfare,* 179.

William Moffett furthered successful naval aviation doctrine emboldening technological and experimental advances. Early in his career, he used personal experience in gunnery to push naval aviation as an asset to long range fires and recon. While in command of the USS *Mississippi,* Moffett was witness to the impact of aviation assets to supplement operational reach. In December of 1918, he installed the capability to launch scout planes and by summers end in 1920, his ship achieved "scores so high that they almost equaled those of all the other battleships combined."[26] This evidence enthralled Moffett to persevere with naval aviation experimentation based on concurrent and future endeavors. William Sims conducted one of the concurrent emboldening efforts. In 1918, Sims as the president of the Naval War College, began adapting tactical war games that "contributed substantially to the development of ideas about how to employ the aircraft carrier."[27] These findings became the foundation for an evidence-driven institutional process empowering Moffett's ambition and furthering naval aviation employment and carried over well into the later years of his career.

Eventually, Moffett's influence as the head of the Bureau of Aeronautics (BuAer) allowed him to impact naval aviation doctrine, naval and national policy, and naval culture at all levels of war. He was able to leverage the gains of fellow naval aviation influencers, Sims and Reeves, to eventually make the aircraft carrier the center piece of naval operations. The successes of the institutional process he witnessed from his early

[26] Williamson Murray and Barry Watts, "Military Innovation in Peacetime," in *Military Innovation in the Interwar Period,* eds. Williamson Murray and Allan R. Millett (Cambridge: Cambridge University Press, 1996), 393.

[27] Ibid., 392.

years culminated in the test and evaluation of the *USS Langley*. As BuAer, his technological pushes specific to airframe capability allowed for naval air parity with land-based fighters and influenced carrier operations and their execution on *Langley*. Moffett committed to air-cooled engines and high-wing-loaded aircraft with the performance to engage land-based fighters and the capacity to perform successful dive bomb maneuver.[28] Fleet exercises were the culmination of focused efforts by Moffett and his organization's interdependence with Newport and the general board, an advisory board in the US Navy resembling a general staff. He appointed John Reeves as the commanding officer of the *Langley* after observing his successes in simulation at the Naval War College. Reeves went on to apply his academic findings to tactical experimentation and, through coordination of empirical data through Newport, tipped the scale fully in favor of carrier aviation and subsequent fleet exercises.[29] The expertise of Reeves, with the technological influence of Moffett allowed for spectacular innovation including the rapid launch and recovery of aircraft which led to the foundations in which modern carrier flight operations are executed. The slight modification to launch and recovery times caused a dramatic shift in the overall compliment of total aircraft availability in the *Langley* airwing. Therefore, "Moffett . . . capitalized on Reeves' success to generate support…that allowed BuAer to pursue specialized aircraft – rather than multipurpose aircraft."[30]

[28] Murray and Watts, 395.

[29] Ibid., 402.

[30] Ibid.

From what we can see from the interwar period with naval aviation and the advent of the Cold War with electronic warfare collection, the modus operandi for the US Navy was to successfully find ways to increase operational reach for the warfighter, through the collection of data, to present an advantage over the adversary. Given the operating environment presented by the Soviet Union, the US Navy was poised to take the next step in applying new technologies to gain leverage over a near-peer adversary.

US Navy: Satellite ISR Availability

Satellite ISR came into fruition in the mid to late 1960s. "The US Navy became interested in radar satellites as early as 1964 . . . and first publicly discussed ocean surveillance from space in the context of the abortive Manned Orbiting Laboratory."[31] As previously stated, by this time the US Naval Research Laboratory (NRL) had built the Global Radiation and Background (GRAB), the first US reconnaissance satellite. The US Navy, interested in the advancements by NRL, decided to conduct a phased approach to dedicated naval space systems. The first phase consisted of a passive satellite and the second being an active radar satellite code named CLASSIC WIZARD and CLIPPER BOW respectively. Although the Soviets already had satellite surveillance technology fielded in space, NRL advancements placed the US a step above its major adversary. NRL's ISR satellites avoided satellite-borne processing by sending raw data down to ground stations continuously rather than processing the data on the vehicle and dumping the collected data periodically.[32] This raw data allowed for track correlation and

---

[31] Friedman, *Network-Centric Warfare*, 178.

[32] Ibid.

eventually paved the way for hull-to-emitter correlation or HULTEC. The Navy's satellite program formally began in 1974 and with pressure from policy makers, CLIPPER BOW was fully funded in the 1976 FYDP.[33] The initial premise of the CLIPPER BOW/CLASSIC WIZARD combo revolved around how the platforms would be tasked and how collection was prioritized. Because of the limits on the onboard sensors and their inability to scan the entire ocean, CLIPPER BOW had to be cued, possibly by organic/terrestrial ELINT, via control centers. The ultimate plan was to have the active sensor tasked by ships afloat or fleet commanders.[34]

Budgetary Concerns

Before continuing into expansion of space ISR in the Navy, it is prudent to discuss the policies and budget considerations surrounding it. "The fiscal year 1979 Department of Defense budget provided the first real opportunity for Secretary of Defense Harold Brown and President Jimmy Carter to transform their public positions of defense spending into significant action."[35] This was an understatement to say the least. With the Navy, Army and Air Force all vying for budget increases, the White House and Pentagon had to balance domestic, global, and defense policies while not significantly surrendering to fiscally conservative austerity and potentially the Soviet Union threat. The Navy thought it had an ally in the in the White House; President Carter was an alumnus from Annapolis and served in the Navy. However, the Navy had good reason to

[33] Friedman, *Network-Centric Warfare*, 179.

[34] Ibid.

[35] Keefer, 226.

be anxious. The Soviet threat caused the president to focus on conventional warfare in Europe which had an air of favoritism for the Army. Furthermore, the president's record on naval funding waivered from favorable as he viewed the FY 1978 naval five-year development plan as wasteful and chaotic.[36] CLIPPER BOW was slated for full operational capability around this time. "By 1978 plans called for launching the first satellite in FY83 and the second in FY84. A draft Navy Decision Coordinating Paper was circulated within OpNav in early 1978, and a Defense System Acquisition Review Committee (DSARC) II review approving full development was expected in the third quarter of FY79."[37] The president vetoed the FY 1979 Defense Authorization bill passed by the senate and his veto was supported by the House of Representatives. The resulting budget process juxtaposed priorities of a global navy that could combat the Soviet Union and project power versus a smaller force designed to support sea lane defense. This issue became a referendum on the future of the Navy.[38] The Naval War College in Newport, RI reiterated this notion. Through in-depth study of naval capability versus the Soviet threat, analysts concluded the Navy in its current configuration could not sustain protracted conflict with the Soviets in the Mediterranean or the Barents especially given the previously mentioned chaotic and wasteful budget execution. Scholars from Newport and

[36] Keefer, 227.

[37] Friedman, *Network-Centric Warfare*, 179.

[38] Keefer, 231.

analysts in Washington concluded that a smaller navy would be detrimental to national security and was compiled in a report called "Sea Plan 2000."[39]

Sea Plan 2000 stated:

> In a major war, the destruction of the Soviet fleet and denial to the Soviets of access to any ocean is a basic objective. This requires the close coordination of surface, submarine and sea-based air assets in an aggressive naval campaign. Denying the Soviets access to the oceans provides the allies with post-hostility negotiation leverage. The ability to achieve this objective has a significant impact on the attainment of other important objectives, e.g., maintenance of important sea lines of communication and support for allies.[40]

This was harsh language in contrast to policy from the president. President Carter campaigned on reducing budget ceilings while congressmen focused on expanding the military. Proponents of CLIPPER BOW argued that without the capability, the United States lacked any equivalent to the Soviet Radar Ocean Reconnaissance Satellite (RORSAT).[41] Although there were speedbumps in the budget process predominantly surrounding building a new CVN, a budget was eventually passed. However, despite the pseudo victory for Sea Plan 2000 in the funding for a new CVN and additional naval capabilities, the Navy took losses in the approval process in the Marine Corps as well as the intelligence community. CLIPPER BOW never materialized. In 1978, the U.S senate arms Services Committee stated CLIPPER BOW would duplicate existing capability

---

[39] Keefer, 233.

[40] Hattendorf and King, 15-16.

[41] Friedman, *Network-Centric Warfare*, 179.

existing in the Army despite assurances of its unique capability by the Navy.[42] In turn, the Navy was left with CLASSIC WIZARD.

As previously stated, there were prerequisites to the Navy's CLASSIC WIZARD program. The most well-known prerequisite is the GRAB satellite developed to passively collect electronic intelligence. This capability forced the US government to heavily invest in space-based collection capability which led to the POPPY launches. POPPY was the intermediate electronic intelligence satellite program co-developed by the National Reconnaissance Office and the Naval Research Laboratory. Initial findings show that the purpose of POPPY was to prove the ability to launch multiple payloads into orbit with a shared intent and mission. Poppy provided the foundation for the next iteration of space-based collection satellites specifically dedicated to and funded by the US Navy which was PARCAE or CLASSIC WIZARD.[43]

Table 1. GRAB, POPPY and PARCAE Launches

Date	Vehicle	Launch Site	Mission	Remarks
GRAB				
22 Jun 1960	Thor Able Star	CC	GRAB 1	
30 Nov 1960	Thor Able Star	CC		Failure
29 Jun 1961	Thor Able Star	CC	GRAB 2	
24 Jan 1962	Thor Able Star	CC		Failure
26 Apr 1962	Scout	NMFPA		Failure
POPPY				
13 Dec 1962	Thor Agena D	VAFB	POPPY 1	
15 Jun 1963	Thor Agena D	VAFB	POPPY 2	
1 Jan 1964	TAT Agena D	VAFB	POPPY 3	
9 Mar 1965	Thor Agena D	VAFB	POPPY 4	

[42] Friedman, *Network-Centric Warfare*, 179.

[43] Dwayne Day, "Above the Clouds: The White Cloud Ocean Surveillance Satellites," The Space Review, April 13, 2009, accessed April 10, 2018, http://www.thespacereview.com/article/1351/1.

31 May 1967	Thor Agena D	VAFB	POPPY 5	
30 Sep 1969	Thorad Agena D	VAFB	POPPY 6	
14 Dec 1971	Thorad Agena D	VAFB	POPPY 7	
PARCAE				
14 Dec 1971	Thorad Agena D	VAFB		
30 Apr 1976	Atlas F	VAFB	PARCAE 1	
8 Dec 1977	Atlas F	VAFB	PARCAE 2	
3 Mar 1980	Atlas F	VAFB	PARCAE 3	
9 Dec 1980	Atlas E	VAFB		Failure
9 Feb 1983	Atlas H	VAFB	PARCAE 4	
9 Jun 1983	Atlas H	VAFB	PARCAE 5	
5 Feb 1984	Atlas H	VAFB	PARCAE 6	
9 Feb 1986	Atlas H	VAFB	PARCAE 7	USA 15, 16, 17, 18
15 May 1987	Atlas H	VAFB	PARCAE 8	USA 22, 23, 24, 26

Source: Dwayne Day, "Above the Clouds: The White Cloud Ocean Surveillance Satellites," The Space Review, April 13, 2009, accessed April 10, 2018, http://www.thespacereview.com/article/1351/1.

CLASSIC WIZARD, also known as WHITE CLOUD and PARCAE, was first launched on board a Thor-Agena on 14 December 1971.[44] The project consisted of three satellites. These satellites would detect an emitter, pass the tracking data to each satellite, and an algorithm would use time differences between the three to triangulate the direction of the collected target.[45] The differences in time were essentially rudimentary doppler shift calculations. These calculations are not unlike the premise behind the HF/DF direction correlation. Ingested energy was put into an algorithm based on the relative location of the collector to calculate the direction of the source. In the case of a satellite, specific equations pertaining to orbital physics are also used in the algorithm to determine the direction and location of the source of emitted energy.

[44] Friedman, *Network-Centric Warfare*, 179.

[45] Ibid.

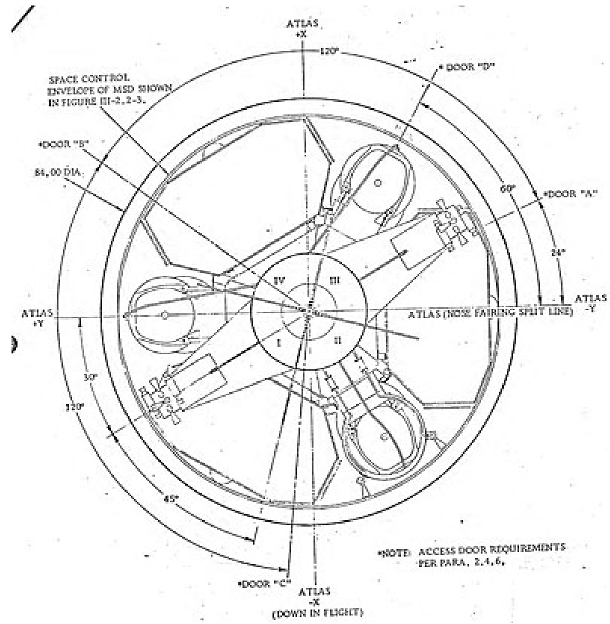


Figure 2. PARCAE Multiple Payload Dispenser Drawing, 1970

Source: Dwayne Day, "Above the Clouds: The White Cloud Ocean Surveillance Satellites," The Space Review, April 13, 2009, accessed April 10, 2018, http://www.thespacereview.com/article/1351/1.

> To make use of the WHITE CLOUD output, the Navy mounted the hull-to-emitter correlation (HULTEC) radar fingerprinting project. It became possible to confirm that the same ship was detected on two separate satellite passes. On that basis, a track could be measured and ship position projected ahead. A track vector analysis capability (i.e., the ability to deduce the direction of a ship's course from a series of satellite sightings) was developed for OSIS specifically to exploit such data.[46]

For the first time, the Navy was conducting ocean surveillance from space with little to no attribution. The attribution factor plays a significant role in afloat ISR, providing the collector the ability to detect without attribution. Impacts of CLASSIC WIZARD were

[46] Friedman, *Network-Centric Warfare*, 179-180.

pervasive in the US Navy and essentially served as the tipping point for evolved exploitation and dissemination.

The Watchfloor

As previously stated, much of the necessity for advances in ISR spawned from the Soviet threat. The Soviets placed great emphasis on tracking and interdicting US carriers and submarines before they could come within range of launching an attack.[47] In turn, the Navy had new and emergent threats to track. "In these urgent needs lay the seeds of the worldwide Ocean Surveillance Information System (OSIS) that the US Navy gradually constructed and made operational by the early 1970s."[48] With these threats the intelligence community saw an influx of different types of INTs and, with respect to satellites, a dramatic need to fuse this data to provide a holistic operational picture. OSIS, in turn, leveraged the imagery provided by the CORONA project, SIGINT provided by the GRAB satellite and subsequently CLASSIC WIZARD.

> All in all, the volume of information "inputs" to the emerging Ocean Surveillance Information System was growing exponentially . . . The sophisticated operational concept of the admiralty's OIC had now been fully revived and was being played out with the benefit of everything that modern technology could offer.[49]

Although most of the fusion and analysis was being conducted ashore, there was a distinct need to project this capability forward on vessels. Driven by the need for an afloat capability to collect various items of tactical information and to process, analyze,

---

[47] Ford and Rosenberg, *The Admiral's Advantage*, 41.

[48] Ibid.

[49] Ibid., 47.

and correlate the information for near real-time use by the operating forces, the Naval Intelligence Processing System (NIPS) was developed.[50] The Navy dove into a highspeed development and integrating evolution that involved creating, not only automated means to execute OPINTEL, but infrastructure upgrades poised to provide commanders ashore with rapid access to analyst data. High-speed data links were installed connecting the Office of Naval Intelligence, CNO-IP at the Pentagon, as well as multiple, inter-service intelligence centers.[51] Furthermore, the Navy pursued the same methods afloat. These methods resulted not out of sheer want, but out of need due to the exploding information burdens of intelligence analysis during the 1960s and helped create powerful incentives to develop near-real-time information exchange with ships at sea.[52] One former DNI stated:

> One of the reasons we became so proficient at OPINTEL as early as we did – and other [US military] services did not – was because of the physical nature of our flagships…The fact is, most of our numbered flagships back in the 1960s could accommodate an Intel staff of about five people. As new sources of information became available – overhead [imagery], SIGINT, acoustic information, or whatever – it quickly became apparent that five people on board the ship with limited communications ability cannot keep up with the picture. So, we had to devise a system that can take all of this data, put it together, boil it down to critical information required by the Fleet, and then send that out in a single thread to this heavy cruiser.[53]

The navy saw many changes in its automation due to the increase of data. One of the major impacts to the navy was in personnel. Because of the advent of OSIS, the Navy

---

[50] Ford and Rosenberg, *The Admiral's Advantage*, 46.

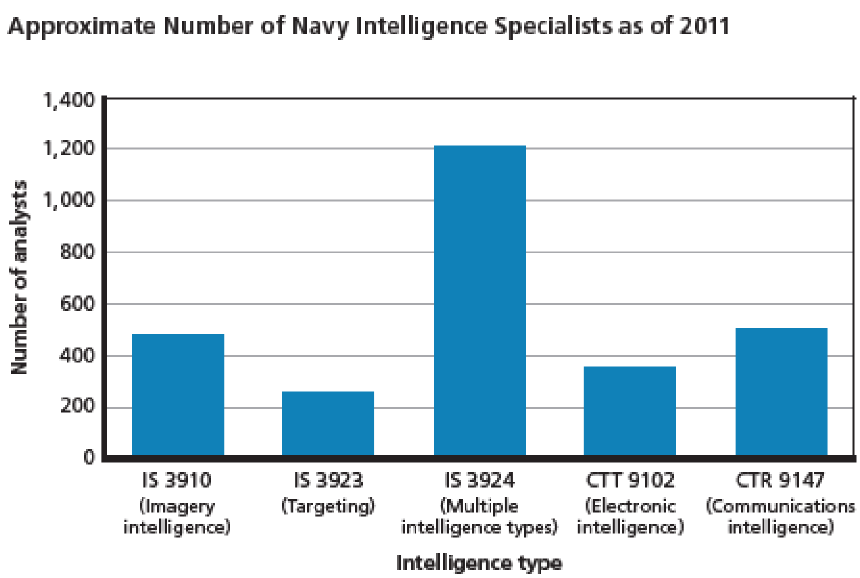
[51] Ibid., 48.

[52] Ibid., 47.

[53] Ibid.

recognized a well-groomed intelligence cade was imperative to the successful execution of intelligence in support of the warfighter. As a result, the service created the OPINTEL career path for intelligence officers and, in 1975, established the Intelligence Specialist (IS) rating.[54] The following table and chart show the intelligence manning numbers compared to the a relatively recent data pull from 2011:

Table 2. 1973 Naval Intelligence Manning



Source: Naval Personnel Research and Development Laboratory, *Occupational Analysis of Photographic Intelligenceman (PT) and Related NECs,* Special Report (Washington, DC: Bureau of Naval Personnel, 1973), 7.

[54] Ford and Rosenberg, *The Admiral's Advantage*, 72.

PHOTOGRAPHIC INTELLIGENCEMAN (PT)

Paygrades	On Board Navy-Wide	Sample Population	Percentages
E-9	7	5	71
F-8	8	5	63
E-7	53	28	53
E-6	122	66	54
E-5	152	76	50
E-4	133	88	66
E-3	82	29	35
TOTALS	557	297	53

NAVAL INTELLIGENCE CLERK (YN-2505)

Paygrades	On Board Navy-Wide	Sample Population	Percentages
E-9	11	5	45
E-8	46	29	63
E-7	170	106	62
E-6	269	180	67
E-5	120	84	70
E-4	53	42	79
E-3	24	21	88
TOTALS	693	467	67

Figure 3. 2011 IS Manning Data

Source: Isaac R. Porche III, Bradley Wilson, Erin-Elizabeth Johnson, Shane Tierney, and Evan Saltzman, *Data_Flood: Helping the Navy Address the Rising Tide of Sensor Information* (Santa Monica, CA: RAND National Defense Research Institute, 2014).

From its inception, the IS rating was roughly 1200 personnel assuming all Intelligence Clerks transitioned to the IS rating with PT manning. When compared to the manning assessment from 2011, the IS rating only increased by approximately 900 personnel over the course of 36 years.

OSIS effectively created a world-wide view for the Navy's operating environment. The US Navy could not have imagined the "forward leaning" and offensively oriented "Maritime Strategy" of the 1980s without OSIS and, naval intelligence, effectively pioneered the concept of "network-centric warfare"; a concept which would become a major focus of strategic and operational planning in the US military two decades later.[55]

[55] Ford and Rosenberg, *The Admiral's Advantage*, 73.

Transformation or Revolution

There are many schools of thought surrounding the evolution of the US Navy. Some argue the service has undergone a revolution due to advances in technology, threat, policy and global operating environment. These theorists purport a distinct transition in naval operations as a direct result of the operating environment. In turn, the service has transcended previously inadequate methods and reorganized into a new age of naval operations. Other theorists, however, argue the converse. These belligerents state that the Navy has, in fact, undergone significant change but not changed the basis for which it operates. This theory of transformation expands on technological revolutions and transitions in operations at sea. However, the core doctrinal principles of maritime warfare, they argue, have not changed. The basis of this argument revolves around innovation. Because the advent of new technology, and the means in which it is employed, offer little to expand on the core principles of naval operations. "In the post-Cold War Navy, there has been plentiful progress because of technologies, and several significant organizational shifts, but little innovation. Despite considerable change – upgraded and retired platforms, new communications systems – the Navy largely retains its Cold War mix of missions within its three dominant communities: carrier-based aviation, surface ships, and submarines."[56] The premise of these arguments, however, revolve around the end of the Cold War and naval operations in the present.

[56] Friedman, "The Navy after the Cold War," 29.

Modern Linkage

There have been commonalities in themes throughout the research and analysis. The most pervasive theme from the 1960s to present is the Soviet/Russian threat. Early in the nascent stages of satellite ISR technology, the US government focused on the near-peer threats associated with the Soviet Union. To this day, these threats still exist with slight modification.

Table 3. The US Navy's Understanding of Soviet Naval Strategy, 1978-91

1978 Assessment	1985 Assessment	1991 Assessment
Office of the Chief of Naval Operations (CNO), US Department of the Navy, *Understanding Soviet Naval Developments* (3d edn, January 1978).	Office of the CNO, US Department of the Navy, *Understanding Soviet Naval Developments* (5th edn, 1985).	Office of the CNO, US Department of the Navy, *Understanding Soviet Naval Developments* (6th edn, July 1991).
'[T]he Soviets are firm believers in the old adage that "the best defense is a good offense".'	The Soviet Navy is 'for the first time in its history… capable of conducting hostile and aggressive operations if it should desire'. It has become 'a modern, oceangoing, "blue water" Navy… increasingly capable of accomplishing the full range of naval tasks. … The Soviets are employing their Navy in much the same way as the United States, Great Britain and other naval powers…..'	The principal Soviet Navy wartime role is strategic strike. The top priority for non-SSBN forces, therefore, is to provide SSBN forces with 'combat stability' by protecting them against attack.
The Soviet Navy is focusing increasingly upon fighting a long, conventional conflict with NATO, and is increasingly 'challenging the United States in all aspects of maritime activity'.	Nevertheless, the Navy's top two missions are strategic offense and strategic defense. In the defensive mission, great emphasis is placed upon countering NATO anti-submarine warfare in order to protect Soviet ballistic missile submarines (SSBNs). The aim is to 'exercise their own type of sea control and hence to provide maritime security for their submarines… particularly in those waters considered critical by the Soviet leadership'.	To this end, SSBNs are increasingly deployed in 'bastions' surrounded by layered anti-submarine and anti-ship defenses.

Table 1 (*continued*)

1978 Assessment	1985 Assessment	1991 Assessment
'[T]he Soviets are employing their navy in much the same way as the United States and Great Britain,. . . [and the Navy can now] perform most of the traditional functions of a naval power in waters distant from the Soviet Union.'	SLOC interdiction has long been a mission of the Soviet Navy, but it is only the fourth of the five main Soviet Navy missions.	The priority mission for the Soviet Atlantic and Pacific Fleets is to ensure SSBN survival and keep US carrier battle groups as far as possible from the Soviet homeland.
Interdicting NATO Sea Lines of Communication (SLOCs) is 'one of the most important of the Navy's missions'.		In time of war, much of the Atlantic and Pacific Fleets would be devoted to the protection of SSBN bastions. The main mission of most Soviet Navy forces, therefore, is primarily defensive.
		Interdicting SLOCs is low-priority mission. The only forces that would be available for this in wartime would be those not needed for higher-priority missions such as protecting SSBN 'bastions'.

Source: Christopher Ford and David Rosenberg, "The Naval Intelligence Underpinnings of Reagan's Maritime Strategy," *Journal of Strategic Studies* 28, no. 2 (2005): 379-409.

> Russian military modernization, the illegal seizure of Crimea, and ongoing military aggression in Ukraine underscore the importance of our commitments to European security and stability. NATO members can ensure the continued viability of the alliance by maintaining their commitment to the naval forces that provide security for the European maritime theater.[57]

[57] United States Naval Institute, "A Cooperative Strategy for 21st Century Seapower," 4.

These understandings of threats, however, are not the only issues that the modern Navy must face with respect to creating and advocating space-based ISR. One of the major elements facing the Navy, since the advent of satellite ISR, has been the increased amount of data. In previous sections, analysis has correlated the possible increase of naval personnel to the advent of new collection capability based on the creation on the IS rating in 1975 and the installation of data processing capability afloat around the same time. In turn, one can surmise, the cause of said correlation is the increase in data collected. Subsequently, the increase in personnel is relative to the increase in data. "Navy analysts are struggling with the timely consumption and accurate integration of big data, and we expect their challenges to grow as the Navy fields new and additional ISR platforms. Common wisdom among analysts themselves is that they spend 80 percent of their time looking for the right data and only 20 percent of their time looking at the right data."[58]

[58] Isaac R. Porche III, Bradley Wilson, Erin-Elizabeth Johnson, Shane Tierney, and Evan Saltzman, *Data_Flood: Helping the Navy Address the Rising Tide of Sensor Information* (Santa Monica, CA: RAND National Defense Research Institute, 2014), 20.

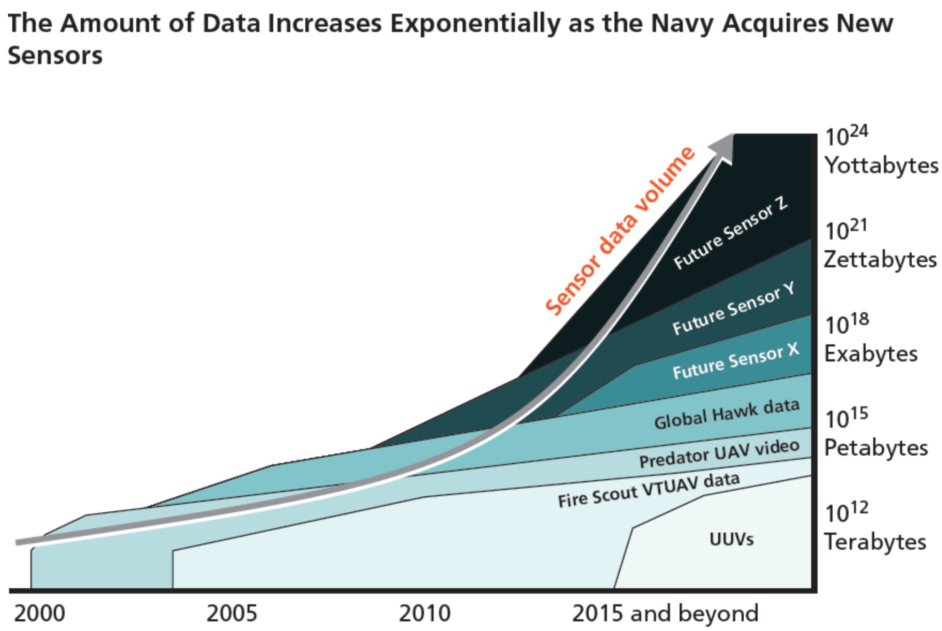


Figure 4. Data over Time Graph

Source: Isaac R. Porche III, Bradley Wilson, Erin-Elizabeth Johnson, Shane Tierney, and Evan Saltzman, *Data_Flood: Helping the Navy Address the Rising Tide of Sensor Information* (Santa Monica, CA: RAND National Defense Research Institute, 2014), 5.

Although the above chart depicts current and future data sets, the premise of the issue has existed since the Navy started to exploit data for the warfighter. The US Navy developed automation capability early in the stages of the analog and digital ages. In fact, automation capability was developed due to the prescient need for exploitation of new data sets for the warfighters and decision makers. The increases in personnel afloat could only do so much to sate the need for data and, although they were likely a direct result of new technology, the trendlines of human capacity and data increases seem to be diverging at an exponential rate. In turn, the advent of new collection technology afloat i.e. satellite ISR, possibly has had an unpredictable inadequate trend affecting the individual analyst and warfighter capability to gain leverage over the adversary. This trend is presented by the constant increase in data based on the distinct intelligence needs due to global threats juxtaposed to a comparatively flat trend line of intelligence personnel increase from 1975 to the 2011.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Although satellite ISR has provided great advances for the naval service, the impact of satellite ISR availability has not fundamentally changed operations in the US Navy. The US Navy has conducted ISR of the adversary since its inception but as technology advanced, the eventuality of space-based ISR availability afloat was a given. The US Navy had the tall order of refining its intelligence practices and apparatus to take advantage of the new data presented by this emergent technology. Furthermore, individuals within the intelligence community had to understand the limits of naval intelligence before the advent of satellite ISR to successfully implement change within the service. Through this understanding, naval leadership was able to understand and operationalize the data from space-based sensors and bolster existing naval ISR capability. Finally, although there were marked advantages from having satellite ISR products afloat, the modern-day US Navy is facing issues that may show marked cause and effect from technological innovation to the increase of intelligence data and its subsequent, overwhelming presence in the face of existing naval intelligence manning. Despite the lack of change to the core of operations in the US Navy, the availability of satellite ISR products afloat had significant impact on the naval intelligence apparatus and, in turn, helped shape and modernize naval operations into its current form.

Understanding the adversary goes together with military operations throughout history and the US Navy is no exception. The US Navy truly exercised its use of adversary data, through collection and analysis, during the interwar period and throughout World War II. Some of the main avenues of acquiring this data was through the exploitation of the radio frequencies by using direction finding technology, the collection of specific electronic data, and the exploitation of the expanded operational reach of aircraft. All these types of collection occurred from both the operational need due to the threats presented and the advance of technology. In the case of advancements within the intelligence community, threat and technology are not mutually exclusive. They tend to have a symbiotic relationship that is most readily evidenced by the events of the Cold War and the advent of satellite ISR. The US Government was faced with a Soviet threat that was rapidly advancing military-related technology. One of the main advances leveraged by the Soviet Union was in the space domain. Although the US Government was dabbling in this domain, the emergent Soviet threat catalyzed technological advancements with the sole purpose of gaining an operational advantage for the United States. The CIA made the initial dive into space-based sensing to supplement the more hazardous manned ISR missions and in turn engendered a sense of urgency in the US military. In turn, the NRL placed the US Navy at the forefront of leveraging the space domain with the purpose of conducting ISR.

Getting an asset into space was only the first step for the US Navy, however. The service had to figure out a way to process, exploit, and disseminate the data collected by space-based sensors for operational use afloat. The Navy understood this problem from both a data and a personnel aspect. First, the increase in data had to be stored and processed which led the service to create new automation tools ashore. These tools eventually made their way for test and implementation afloat and provided underway commanders with some of the first satellite ISR products for use in operations. However, the existing manning could not keep up with the flow of data. The naval intelligence community expanded its capability by creating the IS rate with a focus on operational intelligence. These two course corrections made by the US Navy, with the advent of satellite ISR availability afloat, allowed the service to truly leverage the capability of space-based sensing in support of operations at sea during the Cold War and the early onset of satellite ISR.

The two advances above were not the only forcing functions of satellite ISR availability afloat, the US Navy also faced the same issues that plagued the CIA during the Cold War. Although the US Navy could maintain a forward presence close to the enemy, the existing ISR capability proved too dangerous given the necessity for proximity to the enemy. US policy makers not only wanted to maintain an operational edge over the Soviets, but also wanted to stem any change of escalation. This interesting juxtaposition of want and need, within US policy, effected global and domestic policy, military doctrine, and congressional appropriations and authorizations. The US Navy, among the other services, were stuck between proving demonstrative need for new technology and shortcomings with existing authorizations. The navy persevered and received approval for the first, dedicated, military ISR satellite. With its demonstrated success and value, the navy was able to continue to evolve and fund change within the naval intelligence community.

Many of the evolutions within the US Navy, with respect to satellite ISR technology may seem proactive. However, the resultant fundamental changes within the naval intelligence community are reactionary. The early onset, demonstrated, need for satellite ISR availability afloat showed the proactive nature of not only the naval service but the US government approach to increased operational capacity in the in the face of the Soviet threat. The same cannot be said about the subsequent, internal, shifts within the naval intelligence apparatus. The US Navy did not fully comprehend the volume of data from the resultant new space-based collection asset and the capacity afloat and ashore to exploit the new data set. Furthermore, the service could not comprehend the supplemental manning needed to conduct analysis for eventual production in support of naval operations at sea. This same action and reaction can be extrapolated to today's naval intelligence force. Given the increased need for situational awareness for commanders and the subsequent technological advances produced to aid in attaining the increased situational awareness, the current naval intelligence analyst is being flooded with data. Given this fact, the modern US Navy will likely face a point of reaction to curb the stress on the service's existing intelligence capacity.

There have been significant changes to the naval intelligence function given the advent of satellite ISR availability afloat. Despite these changes, the foundation of US Navy operations afloat has remained relatively the same since the inception of the air, surface, and subsurface warfighting domains. The trend of change effecting modern naval operations has yet to be seen though the scope of this research, however, the nuanced effects of technological advancement do present a substantial impact to the supporting and related functions of the US Navy's operations afloat.

Revisiting the Research Questions

To address the primary research question, it is essential to answer the eight secondary research questions within the scope of the research. These questions are as follows: 1. When did the US Navy field the first satellite ISR products afloat? 2. How were satellite products processed, exploited, and disseminated? 3. How did the US Navy conduct afloat ISR before the availability of satellite ISR? 4. What were the defined subsets of operations afloat before satellite availability? 5. What were the defined subsets of operations afloat after satellite availability? 5a. How did the satellite products affect the individual subsets? 6. What caused the satellite ISR availability afloat? Technology, threat, or both? 7. What types of products/capability became available with satellite ISR? And 8. Are the differences in naval operations from the initial availability of satellite ISR to present systems centered on technology or threat?

The first two research questions revolve around the advent of the passive ELINT collection system named CLASSIC WIZARD. In the late 1970s, the US Navy fielded the passive collection system with the premise of supplementing existing organic ELINT collection afloat. The data was collected by the space-based sensor, exploited by shore-based analysts and disseminated via ground station to ships afloat. Subsequent evolutions of exploitation capability afloat, in the form of automated information systems, allowed vessels to receive and fuse space-based and terrestrial data by afloat analysts.

Before the advent of space-based ISR, the Navy maintained a robust means for organic collection of data. Since the interwar period, the US Navy refined the organic airborne ISR capability to extend the operational reach of ship-based warfighters. Also, the US Navy took advantage of the electromagnetic spectrum to collect and share data faster and create a common operating picture for the decision maker. Decision makers and high-level leadership, in turn, codified naval operations into three main domains: surface, subsurface and air. These three subsets, having existed together for the Navy since the Interwar period, have lasted well into the present state of naval operations, strategy and doctrine. These subsets remain, for the most part, unchanged. The only changes to the subsets are the nature in which individual units operate within them and how they are seemingly inter-related and define one another. This inter-relationship is the only main “change” from historic definitions, but only to the extent that the mutual support between the three was less robust as displayed in the analysis of ISR history.

The major theme of threat is pervasive throughout the body of the research. The Soviet threat was essentially the genesis of the US military interest in exploitation of space for the singular focus of gaining advantage over the adversary. Furthermore, although the US strategy placed focus on space, the US Navy, via the Naval Research Laboratory, was uniquely positioned to be the front runner for developing space-based ISR directly supporting a military service.

Although there seem to be straight forward answers to most of the secondary research questions, the final two are a little more nuanced. The advent of satellite ISR afloat led to the refinement of automated processing systems and their subsequent installation on all naval vessels. Although the satellite data could not be rapidly exploited and disseminated to the warfighter afloat, the Navy lacked the foresight to understand the impact of increased data and how that increase would affect the warfighter and decision maker. Furthermore, the resultant organizational changes due to the increased data came in the form of increased afloat intelligence staffing and the creation of the Intelligence Specialist rating focused on fusion of the new data into operational intelligence all of which are seemingly reactionary to the advent of new collection technology and its subsequent impacts.

Having addressed the secondary research questions, it is now possible to address the primary research question of: Did the advent of afloat satellite ISR availability fundamentally change naval operations? Based on much of the analysis conducted in chapter 4 to answer the secondary research questions, the initial assessment of the primary research question seems rather simple. The US Navy has not expressed specific change to the means in which it conducts operations at sea. In fact, the only actual change to operations was the interrelatedness that came with the evolution of the service. These evolutions, in this study, are codified in the advent of new technologies that allow for the interconnected nature of mutually supportive warfighting. However, the answer, in its subtext, may not be so simple. The nuanced change that occurred after the advent of satellite availability afloat displays significant and lasting impacts to the means in which intelligence operations are executed afloat. Before the availability of satellite ISR afloat, the US Navy was not rapidly exploring ship-based automated information systems. In fact, the Navy was resigned to keep this analytic tool ashore. Once new collection capability presented itself, i.e. satellite ISR, an exponential increase in data occurred. This increase, as previously mentioned in the study, could have correlative effects on the need to rapidly exploit the data and present the information to the warfighter afloat. Furthermore, it is appropriate to conflate the advent of this new technology with the creation of the Intelligence Specialist rating.

The US Navy, through the existing capacity afloat, showed a distinct need to lighten the load of the existing intelligence cadre. It is plausible to liken the manning shift, purportedly focused on operational intelligence, and the advent of new collection capability afloat in the late 1970s. The US Navy identified the need for increased capacity to exploit data though these measures in the 1970s, and this same issue is plaguing the modern naval intelligence apparatus. In the more current RAND study, specific emphasis is placed on the data overload associated with meeting the increased need for analysis and its correlation to increased collection capability.

In turn, although the initial answer to the primary research question maintains the status quo as it pertains to naval operations, the nuanced change that occurred at the common points within the study show a lasting impact on the nature of intelligence support to naval operations afloat.

Conclusions

The US Navy, since the creation of carrier aviation, has remained consistent in the way it conducts operations at sea. Primarily, the Navy has focused on operations in the air, surface, and subsurface domains. Based on the avenues and need for ISR technology acquisition and the subsequent impacts on intelligence methodologies and US Navy personnel, the advent of satellite ISR afloat didn't revolutionize naval operations. However, the primary effect of the new technology did in fact revolutionize the naval intelligence function. Naval intelligence, post 1970s, was significantly different based on the advent of new collection technology. The main technological evolution that occurred in this period was space-based sensing. The lasting impact of the intelligence revolution directly effects the operations in which it supports. So, although the primary effect surmised by the research question in this thesis is negated on its face, the secondary effect of satellite technology does allow for the plausibility of significant impacts to naval operations through the revolutions in the naval intelligence function. As the common adage denotes, intelligence drives operations. If the capability and capacity to conduct intelligence increases, then it is certainly possible that the capability and capacity to conduct operations will also increase.

Recommendations

Many of the findings of analysis conducted in this research point to reactionary measures conducted by the Navy to increase the capacity for data exploitation in the advent of new collections technologies. Based on the conclusions of this research, the following recommendations should be considered.

The Navy should devise a method for addressing the capacity shortfalls associated with data-overload. One approach would be to implement increased recruitment of intelligence personnel to address the data increase due to increased collection capability. Although this method may not be cost effective, it its prudent that the Navy conduct a personnel study that addresses cost with an increased demand for analysis of raw data. Another possible approach would be to invest in further automation to conduct processing, exploitation, and dissemination with artificial intelligence. This approach, while high in initial investment, could potentially address the intelligence needs of the warfighter and the increased capacity of emergent collection technologies while maintaining or reducing the manning necessity in the Navy's intelligence enterprise.

Furthermore, the Navy must conduct thorough research on the ramifications of data overload due to the shortfalls and the impact on the A2AD problem set. If the adversary further limits the capacity of the US Navy to conduct afloat exploitation and dissemination of data, what are the potential solutions that could be attributed with leveraging and maintaining the existing capacity in a potentially denied environment.

The Navy, through this research has demonstrated that although it may be forward leaning with respect to intelligence collection technology acquisition and implementation, it maintains key deficiencies with respect to the capacity to operationalize data. The Navy has made relatively small increases to intelligence manning since 1975 but has been presented with increased need for intelligence analysis due to collection. It is prudent that the Navy conduct studies to determine the proper methods to address the key issues presented above.

Areas of Further Research

Based on the conclusions and recommendations of this study there are many areas of research that could not be addressed in this study that would provide a holistic view of ISR as it pertains to the US Navy.

First, individual studies of ISR conducted in the terrestrial domains would allow scholars to compare the significance of the individual capabilities to the primary research question of this study. Determining the key intelligence collection capability that fundamentally changed naval operations will allow scholars and historians to provide a baseline for naval intelligence and allow for the extrapolation of that data into studies on future developments in the intelligence community.

Second, research on the personnel aspect within the Navy would be beneficial to address concerns with capacity shortfalls in execution of operations afloat. Special studies conducted by the Bureau of Naval Personnel, like the study conducted in 1973 for PTs are crucial in understanding the capabilities and limitations of the personnel conducting operations afloat. Specific studies that would be beneficial to the expansion of findings within this thesis would be manning capacity issues with respect to the naval cryptologic community. Once the baseline for the core intelligence ratings is established, expanded manning studies could be conducted on the key rates within the Information Warfare Community.

Third, research on the potential impacts of satellite communications on naval operations would be beneficial to supplement this thesis. Because the scope of this study was limited to collection platforms, the gravity and implications of space-based communications were not addressed. A thorough understanding of this capability would demonstrate key linkages between the data presented in this study and the execution of operations afloat.

Finally, the Focus of this study revolved predominantly around operations afloat and the impacts of satellite ISR on sea-based naval assets. A study on the impacts of satellite ISR on ashore intelligence commands would allow for a greater understanding of satellite remote sensing in a joint environment. This research would also lead to the studies of satellite ISR on the other services within the DoD and the implications of space-based ISR with respect to the whole of the US Government.

BIBLIOGRAPHY

Baumann, Paul. *History of Remote Sensing, Satellite Imagery, Part II.* The State University of New York, 2009. Accessed October 2, 2017. http://oneonta.edu.

Buderi, Robert. *Naval Innovation for the 21st Century.* Annapolis, MD: Naval Institute Press, 2013.

Crothers, Maj Brian, Maj Jeff Lanphear, Maj Brian Garino, Maj Paul P. Konyha III, and Maj Edward P. Byrne. "Intelligence: US Space-Based Intelligence, Surveillance, and Reconnaissance." In *AU-18 Space Primer,* 167-181. Maxwell Air Force Base, AL: Air University Press, 2009.

Day, Dwayne. "Above the Clouds: The White Cloud Ocean Surveillance Satellites." The Space Review, April 13, 2009. Accessed April 10, 2018. http://www.thespacereview.com/article/1351/1.

England, Gordon, Vern Clark, and James L. Jones. *Naval Transformation Roadmap: Power and Access...From the Sea.* Washington, DC: Office of the Chief of Naval Operations, 2004.

Erwin, Marshall. *Intelligence Surveillance, and Reconnaissance (ISR) Acquisition: Issues for Congress*. Congressional Research Service Report for Congress. Washington, DC: Library of Congress, 2013.

Ford, Christopher, and David Rosenberg. *The Admiral's Advantage: US Navy Operational Intelligence in World War II and the Cold War.* Annapolis, MD: Naval Institute Press, 2005.

———. "The Naval Intelligence Underpinnings of Reagan's Maritime Strategy." *Journal of Strategic Studies* 28, no. 2 (2005): 379-409.

Fourest, Sébastien. *Satellite Imagery: From Acquisition Principles to Processing of Optical Images for Observing the Earth.* Toulouse: Cépaduès Éditions, 2012.

Friedman, Benjamin. "The Navy after the Cold War: Progress without revolution." In *US Military Innovation since the Cold War*, edited by Harvey Sapolsky, Benjamin Friedman, and Brendan Rittenhouse Green, 29. New York, NY: Routledge, 2009.

Friedman, Norman. *Network-Centric Warfare: How Navies Learned to Fight Smarter Through Three World Wars.* Annapolis, MD: Naval Institute Press, 2009.

Hattendorf, John B., and Ernest J. King. *The Evolution of the US Navy's Maritime Strategy.* Newport, RI: Naval War College, 2004.

Keefer, Edward C. *Harold Brown: Offsetting the Soviet Military Challenge 1977-1981.* Vol. 9. Washington, DC: Historical Office: Office of the Secretary of Defense, 2017.

Murray, Williamson, and Barry Watts. "Military Innovation in Peacetime." In *Millitary Innovation in the Interwar Period*, edited by Williamson Murray and Allan R. Millett, 383-405. Cambridge: Cambridge University Press, 1996.

National Research Council. *C4ISR for Future Naval Strike Groups.* Washington, DC: The National Academies Press, 2006.

———. *Navy's Needs in Space for Providing Future Capabilities.* Washington, DC: The National Academies Press, 2005.

Naval Personnel Research and Development Laboratory. *Occupational Analysis of Photographic Intelligenceman (PT) and Related NECs.* Special Report. Washington, DC: Bureau of Naval Personnel, 1973.

Pierce, Terry C. *Warfighting and Disruptive Technologies: Disguising Innovation.* New York, NY: Frank Cass, 2004.

Porche III, Isaac R., Bradley Wilson, Erin-Elizabeth Johnson, Shane Tierney, and Evan Saltzman. *Data_Flood: Helping the Navy Address the Rising Tide of Sensor Information*. Santa Monica, CA: RAND National Defense Research Institute, 2014.

Richelson, Jeffrey. *The US Intelligence Community.* Boulder, CO: Westview Press, 2016.

Rose, Lisle A. *Power at Sea: A Violent Peace 1946-2006.* Vol. 3. Columbia, MO: University of Missouri Press, 2007.

Ruffner, Kevin. *Corona: America's First Satellite Program.* Washington, DC: Center for the Study of Intelligence, Central Intelligence Agency, 1999.

Till, Geoffrey. *Seapower: A Guide for the Twenty-first Century.* New York, NY: Routledge, 2013.

Townshend, John, and Nicholas M. Short. "The Landsat Tutorial Workbook: Basics of Satellite Remote Sensing." *The Geographical Journal* 150, no. 2 (1984): 283.

United States Naval Institute. "A Cooperative Strategy for 21st Century Seapower." *Proceedings* 141, no. 4 (2015): 4.