NPS-LM-18-019

ACQUISITION RESEARCH PROGRAM
SPONSORED REPORT SERIES

Assessment of Logistics Effectiveness for Expeditionary Units

December 2017

LCDR Dana Reeves, USN

LT Stephen Baker, USN

Thesis Advisors: Uday Apte, Distinguished Professor, NPS
Keenan Yoho, Professor, Rollins College

Graduate School of Business & Public Policy

Naval Postgraduate School

The research presented in this report was supported by the Acquisition Research Program of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

To request defense acquisition research, to become a research sponsor, or to print additional copies of reports, please contact any of the staff listed on the Acquisition Research Program website (www.acquisitionresearch.net).

ABSTRACT

The purpose of this MBA project is to provide a critical review of Naval Expeditionary Combat Command (NECC) logistics support processes. By tracing the MK-16 underwater breathing apparatus, a critical piece of hardware to the NECC explosive ordnance disposal (EOD) mission, through the complicated expeditionary logistics (EXLOG) supply chain, this report highlights areas of friction across various supply processes. These include inefficiencies related to IT network connectivity, redundancies in human data input processes, and shortcomings in the overall IT infrastructure, to include financial improvement and audit readiness (FIAR) compliance. Specifically, NECC inventory and logistics refers to the materials, equipment, activities, and resources needed to properly adhere to doctrine and execute required mission tasking. A review of current inventory and logistics processes provides a baseline and affords the opportunity to apply IT improvement recommendations, enabling a more robust quantitative analysis of EXLOG data.

THIS PAGE INTENTIONALLY LEFT BLANK

ABOUT THE AUTHORS

LCDR Dana Reeves is a native of Warren, MI, and completed his undergraduate studies at Walsh College in Troy, MI, in 2000 with a degree in Finance. He was commissioned via Officer Candidate School (OCS) in 2004, earned his wings of gold as a Naval Flight Officer, then selected to the E-2C Hawkeye. He has accumulated over 1,400 flight hours over 13 years of service, including two WESTPAC deployments with Carrier Airborne Early Warning Squadron (VAW) 113, an FRS Instructor tour (VAW-120), and a CVW staff tour with Carrier Air Wing Eleven (CVW-11), prior to arriving at NPS. He married his wife Danielle in November 2004, and they have two children, Addison (10) and Casey (9). After graduation in December 2017, LCDR Reeves will report to the Naval Surface and Mine Warfighting Development Center (NSMWDC) in San Diego, CA, to serve as a Department Head and Air Defense subject matter expert.

LT Stephen Baker is a native of Winter Park, FL**,** and completed his undergraduate studies at the United States Naval Academy in Annapolis, MD in 2010 with a Bachelor's of Science degree in Ocean Engineering. He was commissioned a submarine officer and served aboard USS *Alaska* (GOLD) (SSBN 732) where he earned his prestigious "gold dolphins" or submarine officer qualification. Prior to attending NPS LT Baker earned a Master's Degree in Engineering Management from Old Dominion University in Norfolk, VA. In his previous tour, LT Baker transitioned to the Civil Engineer Corps and served as Facilities, Engineering, and Acquisition Director (FEAD) at Public Works Department, Mayport, FL, and managed many construction projects as construction manager. He married his wife, Veronica, in October 2011, and they have three children, Camila (5), Gabriela (3), and Cesar (1). Upon graduation in December 2017, LT Baker will serve as company commander at Amphibious Construction Battalion Two in Little Creek, VA.

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

For their assistance in completing this project, the authors express their gratitude to the following individuals and organizations:

- CAPT Richard Wilhelm, COMNECC N41
- CDR Albert Hornyak, CO EODESU ONE
- CDR Robert Mazzarella, CO EODESU TWO
- LCDR Mark Letourneau, XO EODESU ONE
- LCDR Bill Williams, XO EODESU TWO
- LT Crette Hendricks, Warehouse/PGI Supply Officer EODESU TWO
- LT Jay Jensen, N4 Supply Officer EODESU TWO
- LT Stephen Koye, Warehouse/PGI Supply Officer EODESU ONE
- LT Gary Morosi, TOA Officer EODESU TWO
- LTJG Greg Cummins, Warehouse/PGI Supply Officer EODESU TWO
- CWO2 Christopher Stearns, Underwater DH EODESU TWO
- CMDCM Bradley Rosenak, Command Master Chief EODESU ONE
- EODCS Roy Sedano, Materiel LCPO EODESU ONE
- LSCS SherryAnn Stevenson, Supply LCPO EODESU ONE
- EOD1 Jamie Harris, Master Diver EODESU TWO
- Mr. Anthony Hayden, COMNECC N412
- Mr. Don Murray, Diving Life Support Systems Manager EODGRU TWO
- Mr. Steve Reed, COMFLTFORCOM N414 USFF

We also thank our project advisors, Professors Uday Apte and Keenan Yoho, for their direction and guidance. Professor Apte and Professor Yoho are humble and a wealth of knowledge for any student interested in the logistics and project management fields of study. This project is a direct reflection of their time, patience, and effort in helping graduate students become successful through the completion of the MBA project.

Thank you to our families for supporting us with motivation and encouragement throughout this challenging MBA project. Their steadfast devotion allowed our undivided attention and commitment to the project.

A humble thank you is extended to the Acquisition Research Program (ARP) and their team for providing generous travel funding and editorial support, and the administrative guidance that helped foster success along the way. At every step in the research process, the entire ARP team, including RADM Greene (Ret.), Professor Keith Snider, Karey Shaffer, and Nadia Greer, are focused on student success.

We acknowledge and thank those helpful staff at the Naval Postgraduate School and Dudley Knox Library for assisting in the completion of this MBA project for editing and publishing.

Finally, as graduate students at NPS, we fully recognize that our success is directly proportional to the hard work and dedicated effort of the many NPS staff and we are grateful to be a part of the rich tradition of NPS graduates.

NPS-LM-18-019

ACQUISITION RESEARCH PROGRAM
SPONSORED REPORT SERIES

Assessment of Logistics Effectiveness for Expeditionary Units

December 2017

LCDR Dana Reeves, USN

LT Stephen Baker, USN

Thesis Advisors: Uday Apte, Distinguished Professor, NPS
Keenan Yoho, Professor, Rollins College

Graduate School of Business & Public Policy

Naval Postgraduate School

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

ADCON	Administrative Control
AFSOC	Air Force Special Operations Command
ARG	Amphibious Readiness Group
AO	Area of Operation
AOR	Area of Responsibility
APL	Allowance Parts List
APSR	Accountable Property System of Record
ATFP	Anti-Terrorism Force Protection
AUC	Average Unit Cost
C2	Command and Control
CA	Civil Affairs
CAGE	Commercial and Government Entity code
CESE	Civil Engineer Supporting Equipment
CFO	Chief Financial Officer
CJSOTF	Combined Joint Special Operations Task Force
CNO	Chief of Naval Operations
CO	Commanding Officer
COA	Course of Action
COG	Navy Cognizance Code
COMCAM	Combat Camera
COMNECC	Commander, Navy Expeditionary Combat Command
CONOPS	Concept of Operations
CONUS	Continental United States
COSAL	Consolidated Shipboard Allowance Listing
CPI	Continuous Process Improvement
CS	Combat Support
CSG	Carrier Strike Group
CSS	Combat Service Support
CTF	Combined Task Force
DETS	Detachments

DOD	Department of Defense
DON	Department of Navy
DLR	Depot Level Repair
ECRC	Expeditionary Combat Readiness Center
ELO	Expeditionary Logistics Overhaul
EOD	Explosive Ordnance Disposal
EODESU	Explosive Ordnance Disposal Expeditionary Support Unit
EODMU	Explosive Ordnance Disposal Mobile Unit
ESD	Expeditionary Support Departments
ESE	Expeditionary Support Elements
ESG	Expeditionary Strike Group
ESU	Expeditionary Support Units
ETC	Expeditionary Training Command
FADL	Flyaway Dive Locker
FARC	Flyaway Recompression Chamber
FIAR	Financial Improvement and Audit Readiness
FRTP	Fleet Readiness Training Plan
FTN	Force Tracking Number
FY	Fiscal Year
GCPC	Government Commercial Purchase Card
GS	General Schedule
GWOT	Global War on Terrorism
HADR	Humanitarian Assistance and Disaster Relief
HN	Host Nation
HVA	High Value Asset
HUMINT	Human Intelligence
IA	Individual Augmentee
IED	Improvised Explosive Device

IET	Intelligence Exploitation Team
ILO	Integrated Logistics Overhaul
IO	Information Operations
ISIC	Immediate Superior in Command
ISU	Internal Airlift/Helicopter Slingable Container Unit
IT	Information Technology
JEB	Joint Expeditionary Base
JEBLCFS	Joint Expeditionary Base Little Creek–Fort Story
JCF	Joint Force Commander
JLOTS	Joint Logistics over the Shore
JO	Junior Officer
JSOC	Joint Special Operations Command
KIA	Killed in Action
LOGSU	Logistics and Support Units
LSC	Logistics Specialists Chief
MARSOC	Marine Corps Forces Special Operations Command
MCM	Mine Countermeasures
MCT	Mobile Communications Team
MDSU	Mobile Diving and Salvage Unit
MEU	Marine Expeditionary Unit
N4	Naval Logistics Department
NRC	National Research Council
NAVCENT	U.S. Naval Forces Central Command
NAVELSG	Navy Expeditionary Logistics Support Group
NAVSOC	U.S. Naval Special Warfare Command
NCF	Naval Construction Forces
NECC	Navy Expeditionary Combat Command
NEF	Navy Expeditionary Forces

NIIN	National Item Identification Number
NMCI	Navy/Marine Corps Intranet
NPS	Naval Postgraduate School
NSN	National Stock Number
NSW	Naval Special Warfare Command
NSWC	Naval Special Warfare Center
O-6	Captain (USN)
O-5	Commander (USN)
O-4	Lieutenant Commander (USN)
O-3	Lieutenant (USN)
OARS	Online Assessment Reporting System
OCO	Overseas Contingencies Operations
OMFTS	Operational Maneuver from the Sea
OMMS	Organizational Maintenance Management System
ONR	Office of Naval Research
OPCON	Operational Control
OPSEC	Operational Security
OPTEMPO	Operational Tempo
OSK	Operational Support Kit
PGI	Personal Gear Issue
RC	Reserve Component
RCRP	Readiness and Cost Reporting Program
RHIB	Rigid-Hull Inflatable Boats
RIP/TOA	Relief in Place/Transfer of Authority
RIVGRU	Riverine Group
RTVN	Real Time Value Network
SAR	Search and Rescue
SATCOM	Satellite Communications
SBT	Special Boat Teams

SCUBA	Self-Contained Underwater Breathing Apparatus
Seabees	Naval Construction Battalions
SEAL	Sea Air and Land
SMU	Special Mission Unit
SOCPAC	Special Operations Command Pacific
SOF	Special Operations Forces
SOP	Standard Operating Procedure
SOW	Scope of Work
SPECOPS	Special Operations
SUPP-O	Supply Officer
TEU	Training and Evaluation Unit
TOA	Table of Allowances
TYCOM	Type Commander
UBA	Underwater Breathing Apparatus
USMC	United States Marine Corps
USAFRICOM	United States Africa Command
USCENTCOM	United States Central Command
USEUCOM	United States European Command
USSOCOM	United States Special Operations Command
WASP	Wedge Advanced Software Product

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND

Since the devastating attacks on the World Trade Center on September 11, 2001, the United States has been at war with an enemy determined to end the Western way of life. Prior to the war in the mountains and oil fields of the Middle East, the Navy was almost solely focused on victory of war at sea. The Navy remains focused on sea power and control of the seas, but the mission has expanded and the enemy is not as significant a threat from the seas as they are from the terrain of the mountains and cyberworld. In addition to the constant threat from state actors and their significant advances in maritime sea power such as quiet diesel-electric submarines and other naval assets, a constant, major concern to be addressed is from inland terrain where naval gunfire and air support will play the major role versus battleship engagements on the high seas.

As with any new entity, engagement, or process, there are increased fiscal requirements to be burdened. The increased need for expeditionary forces to be engaged in long-term overseas operations proportionally increases the fiscal strain already felt by the Department of Defense (DOD). The DOD does not expect or foresee any reduction in the mission requirement. Therefore, either more resources must be provided to the DOD, or tighter planning and increased efficiency must be squeezed from existing forces and their current logistics operations.

Strong research and analysis on how to more efficiently operate the Naval Expeditionary Combat Command (NECC) is imperative to keeping those forces engaged in the fight because the demand for their support and presence appears only to be increasing. To centralize logistics and gain efficiencies, the NECC conceived the Explosive Ordnance Disposal Expeditionary Supply Units (EODESUs). The EOD community is one of the member communities of the NECC but makes up a relatively smaller portion of the NECC, roughly 10% (Naval Expeditionary Combat Command [NECC], 2014). Nevertheless, EOD has a very specialized mission that sets it apart and requires tailored equipment and logistics support, which ultimately came to a head with the development of EODESU.

B. RESEARCH FOCUS QUESTIONS

This MBA project was originally conceptualized in response to in response to a previous MBA project done by three students at the Naval Postgraduate School (NPS; Kundra, Brown, & Donaldson, 2014). Prior to Kundra et al., research on expeditionary logistics (EXLOG) was not relevant to EODESU since the command had not yet been formed as it was established in 2008. Ultimately, our goal was to investigate and research EXLOG, find where there may be inefficiencies or opportunities to improve the logistics and supply chain efforts, apply various techniques for improvement. Upon agreeing to investigate the proposed research question provided by EODESU TWO, we decided to focus on the MK-16 Underwater Breathing Apparatus (UBA), due to availability and access to data. The MK-16 is an electronically controlled, closed-circuit, mixed-gas, constant partial-pressure UBA. There are various subsystems to the MK-16 that require multiple component parts. There are multiple replacement parts and necessary maintenance procedures, and thus, the complex logistics behind the operation of the MK-16 UBA. This topic is covered in the case study chapter of this report.

As the research progressed and travel was conducted to EODESU TWO in Little Creek, Virginia, and EODESU ONE in San Diego, California, it became more apparent that the logistics and complexity of the MK-16 was not the greatest threat to the ESUs because the MK-16 is supported via Consolidated Shipboard Allowance Listing (COSAL). The real threat and challenge for the ESUs was the Table of Allowances (TOA) equipment and Personal Gear Issue (PGI). These EOD-specific groups of gear and equipment were not part of the regular Navy supply system and therefore required special consideration. TOA and PGI became the primary interest during the two visits, although not the original intent. As the ESU construct continues to mature, a portion of this research should remain dedicated to capturing changes, if any, to the business model. Also, because data availability is still limited, meaningful quantitative research was also necessarily scaled back in an attempt to focus on an available subset for further analysis. With those concepts in mind, we seek to define, answer, and clarify issues such as the following:

- NECC command structure and changes
- Current roles and responsibilities of EODESUs

- Overview of supply chain for expeditionary customers
- Financial Improvement and Audit Readiness (FIAR)
- Status of prior EXLOG process recommendations
- Recommendations for EXLOG process improvement

C. RESEARCH PLAN

The NECC developed EODESUs to control logistics and maintenance functions so the EOD teams would not be burdened with logistics and support activities and could better focus on their primary mission of being EOD technicians. We thoroughly reviewed the previous MBA project by Kundra et al. (2014) and participated in classroom discussions with our advisor, which helped us to generally understand that while there were difficulties performing EXLOG, the framework was in place and functional to conduct EXLOG.

Given the relatively brief existence of EODESUs and the difficulty in obtaining the information we were ultimately seeking, our research required combining pieces of data and a broader understanding of the EODESUs, as well as their particular processes for conducting EXLOG.

D. SCOPE

The scope of this report is limited to EODESU ONE and TWO, and select supported commands and their operations. With this report, we seek to provide an overview of current EODESU operations and then compare and contrast the two units in terms of routine processes to highlight any differences that may help or hinder either of the units. Given the focus on EOD operations, specifically MCM, it is appropriate to select items from the supply chain that illustrate a core mission set. In this case, underwater MCM is a role fulfilled only by Navy EOD, the MK-16 UBA will serve to show a system and its movement through EODESU supply and logistics. This research focuses on the MK-16 UBA logistics and supply chain operations as an example of current EODESU EXLOG processes. The unit contains numerous subsystem components that help illustrate how parts are categorized as urgent, depot-level repair (DLR), and non-DLR within the supply chain, based on various repair or replacement requests.

The information used to generate this report and make critical assessments came from site visits at the two EODESU headquarters and data exchanges over email and telephone conversations. Site visits consisted of pre-arranged command briefs, delivered by front office and supporting personnel, with question-and-answer session. This was followed by a limited tour of warehouse facilities and opportunities to interact with other supply and logistics personnel. Also, the NECC assisted as the parent organization and provided detailed demand history data for the EOD units, as well as a site visit while our team was conducting research in Little Creek. Visiting both locations offered an opportunity to compare the sites and to note any process differences unavailable to prior researchers. Additionally, we sought to trace an actual subset of inventory items (MK-16 UBA system) from within the existing EXLOG supply chain, in an effort to provide a real-world common thread to trace through the supply process, as well as to highlight a roadmap for further analysis, as better data become available in the future.

E. PURPOSE AND BENEFITS

This report can be read as an independent study and assessment of the logistics and supply chain business practices of the EODESUs; it builds upon Kundra et al.'s (2014) exploratory analysis. Our intention is to contribute to the efficient and effective execution of EXLOG at EODESUs when this report is viewed in combination with similar studies. This report contains both critical opinions and recommendations based on available data, as well as acknowledgements of outstanding performance and unexpected success for such a young organization. With the continued growth of and research into EODESU commands, a basic level of knowledge and experience will naturally develop. However, this external analysis that focuses on specific processes should serve to uncover areas of inefficiency and provide opportunities for sound suggestions for improvement.

F. LIMITATIONS OF RESEARCH

The nature of the myriad NECC supply chain options, coupled with lack of readily accessible, detailed historical records, drove a focus toward a "common thread" from which to analyze the supply process. Our research team focused largely on one specific item so our findings may not be generalizable to all items in the EOD inventory. While this common thread, the MK-16 UBA, has some readily available supply history, it is limited, and only represents an example of COSAL-supported materiel. It is our opinion that TOA and special-purchase items represent the greatest area for efficiency gains. Yet, due to the inconsistent nature of these types of purchases, coupled with an inefficient information technology (IT) infrastructure, it is extremely challenging to capture any potential gains, until better data become available. As forthcoming IT upgrades are implemented, a wealth of historical data should soon become available, enabling a more robust analysis and more actionable information.

G. LITERATURE REVIEW

This report is not the first report to be critical or to engage the EXLOG community regarding processes or logistics. Prior to agreeing to generate an MBA project report about EXLOG, our team reviewed a prior thesis report, Kundra et al. (2014), to create a general understanding and seek specific avenues of research that may be particularly interesting before we commenced our research. From our research focus questions and areas of interest, our research team extracted the topics of use and interest from the prior thesis report and expanded upon them in this report. A distinct difference between this thesis report and Kundra et al. (2014) is that the previous report focused on Special Operations (SPECOPS) including EOD and Sea, Air, and Land (SEAL) forces. This report aims to analyze the EODESU commands on the East and West Coasts and determine where areas for improvement exist and highlight differences between the two commands' structure and organization.

In our review of the prior thesis reports, the Kundra et al. (2014) thesis was most similar to ours in its research ideas. This thesis project focused on the expeditionary teams conducting EXLOG but was broader in scope and included Naval Special Warfare (NSW). While our thesis aims to advance to understanding and analysis of EXLOG, our team's primary mission was to analyze EODESU and not any other commands. The Kundra et al. (2014) thesis was useful and aided in citing a source for comparison of EODESU EXLOG operations to NSW logistics operations but lacked information to assist in specific EODESU investigation. Although we found minimal direct correlation with Kundra et al. (2014), there were several overlapping themes that remained present in our research that are further discussed in this report. This implies that while the other team did not necessarily focus on the exact same research topic, EXLOG is similar enough throughout the Navy that findings in one area of research are likely to resemble those found elsewhere, and potentially there is a solution for improvement that will apply to multiple end-users.

The United States Marine Corps (USMC) describes EXLOG as

> the ability to rapidly develop the responsive and agile architecture necessary to support and sustain operations in austere environments or in those lacking in robust infrastructure, frequently on short notice, and where operational requirements may dictate the dispersal of forces across a large geographic area. (U.S. Marine Corps, 2015)

The USMC has historically prided itself on its amphibious roots and ability to conduct expeditionary operations. It was useful, therefore, to review USMC doctrine for comparative analysis, but the differences in USMC expeditionary doctrine and Navy Expeditionary Forces (NEF) doctrine is too great for proper comparison.

In addition to reviewing further USMC expeditionary material, our team reviewed other thesis reports and scoured the NECC webpages for additional information to clearly define what EXLOG truly is. While the main goal of our research was to critically assess EODESU EXLOG operations and find areas for improvements, there was no significant research already done specifically focusing on EODESU, given the length of time the command has had to mature.

A prior study by the National Research Council (NRC) under Department of the Navy (DON) contract N00014-96-D-0169/0001, which was issued by the Office of Naval Research (ONR), was one of the most in-depth studies regarding EXLOG and was highly useful to our literature review for this report (Committee on Naval Expeditionary Logistics, 1999). The study aimed to

> 1. evaluate the packaging, sealift, and distribution network and identify critical nodes and operations that affect timely insertion of fuels, ammunition, water, medical supplies, food, vehicles, and maintenance parts and tool blocks;
> 2. determine specific changes required to relieve these critical nodes and support forces ashore, from assault through follow-on echelonment; and
> 3. present implementable changes to existing support systems, and suggest the development of innovative new systems and technologies to land and sustain dispersed units from the shoreline to 200 miles inland. (Committee on Naval Expeditionary Logistics, 1999)

The core mission of Naval EXLOG is the movement of naval forces and the sustainment of their operations in a broad array of environments (Committee on Naval Expeditionary Logistics, 1999). Our research team aimed to couple this definition of EXLOG with our research focus of identifying a unit that routinely performs EXLOG and is crucial to a specific end-user so that we could critically analyze their performance and provide recommendations for enhanced end-user experience and EXLOG performance.

One of the main focus areas of this stated study was the concept of Operational Maneuvers from the Sea (OMFTS), which was a relatively new concept and doctrine where the Navy and USMC aimed to expand EXLOG operations from sea to well inland, up to 400 miles (Committee on Naval Expeditionary Logistics, 1999). This new concept stretched previous ideas of what EXLOG and amphibious operations would become in the future. History is proof that the concept became reality, and EXLOG, as well as amphibious operations, are conducted nearly all over the world with few to no bounds.

The OMFTS doctrine was infant at the time and included both Navy and USMC operations. The doctrine was useful to our research and very comprehensive but also contained significantly more information and non-relevant data than we needed for our specific research topic. The OMFTS doctrine contained little discussion of EOD operations, and at the time of the study, the EODESU commands had not been stood up. The OMFTS study ultimately was unable to specifically answer the questions it sought to answer but did recommend further analysis and that OMFTS be allowed to mature and generate data to attempt to a follow-on study that could provide more concrete answers using actual data.

Another report used during review and preparation for our research was a thesis report completed by an NPS graduate student, *Naval Expeditionary Logistics: A Handbook for Complementing and Supporting Land Forces* (Applegate, 2006). This report mainly supported consolidating and analyzing existing EXLOG literature and procedures. The report was critical of Navy history and tradition for supporting seagoing ships, submarines, and aviation, while lacking emphasis for expeditionary combat forces (Applegate, 2006). There is a lack of guidance and doctrine to support the Naval Expeditionary Forces (NEF) while the traditional units receive outstanding financial, logistical, and general support. Through interviews and investigation, the report determined that many documents and publications regarding EXLOG and NEF in general were community-specific because they were community-generated (Applegate, 2006). There is a lack of naval doctrine and joint doctrinal understanding of the NEF due to a lack of emphasis by the traditional Navy for the NEF. The Navy's lack of emphasis created a scenario in which multiple concepts existed for what the NEF was intended to be. Future operations and coordinated exercises became more difficult due to the lack of clarity of the NEF mission. Applegate made recommendations for how to improve joint operations and knowledge of EXLOG and NEF but with a specific focus on USCENTCOM AOR.

A third NPS thesis report was used during research and background investigation by our research team. *Logistics Support of Naval Expeditionary Units* by Nilsen, Tessier, Lugo, and Perez (2004) is useful to gain an understanding of the NAVCENT EXLOG system of operations. This report assessed NAVCENT logistics related to supported NEF units (Nilsen et al., 2004). Units such as the Seabees, NSW, and EOD receive EXLOG support through various entities; Nilsen et al. (2004) evaluated existing theater capabilities and determined whether they were compatible with the existing requirements of the supported expeditionary units. A common theme in reports critical of the federal government, and in particular, the DOD, is that inefficiency is abundant. The same was found to be true at NAVCENT regarding its logistics system of operations (Nilsen et al., 2004). There are sufficient resources to execute the required missions in nearly all DOD theaters, but in many cases, there is a lack of system operation or execution of the resources. The Nilsen et al. (2004) report considered what factors increased demand or strained the existing logistical system and whether the capabilities were in place to flex and remain supportive of the NEF units, specifically in the USCENTCOM AOR but focusing on NAVCENT logistics chain. The team yielded the common response seen with DOD systems: adequate but inefficient. The report provided a strong recommendation for improvement via simple steps such as increased integration, awareness, and doctrinal understanding (Nilsen et al., 2004).

EXLOG is a relatively seasoned process with young operators. Researching previous reports and papers related to the topic revealed that EXLOG is vast and encompasses many areas of study; therefore, each one of the reports specifically focused on a different area but anchored its research around EXLOG. Common to each report is the understanding that EXLOG is the execution of amphibious operations with sustained military action farther and farther inland beyond the capability of conventional Navy forces. Our thesis report aims to extract pieces of information from the previous reports and studies that specifically relate to EXLOG and the EOD units as well as EODESU. In this report, we focus on building upon the existing body of knowledge of EXLOG and add to it by examining specific examples and studying actual units with historical data. Historical data and case study analysis is a departure from much of the existing literature, as is our focus on EODESU, which did not even exist prior to some of the previous reports and studies. This report also briefly details how constraints and limited resources provided to the EODESU hinder or add to already existing inefficiency and where small changes or additional resources could make large improvements.

THIS PAGE INTENTIONALLY LEFT BLANK

II. NAVY EXPEDITIONARY FORCES

This section provides a broad overview of the entirety of the Navy's expeditionary forces. Also included, is the leadership hierarchy, description of subordinate units, and force distribution and location information.

A. NAVY EXPEDITIONARY COMBAT COMMAND ORGANIZATION

The NECC is the Navy's expert command regarding expeditionary logistics and operations. The NECC exists to man, train, equip, and sustain the Naval Expeditionary Forces for operations to bridge the gap from operations at sea to sea–land joint operations. While NECC the command is relatively new, stood up by the Chief of Naval Operations (CNO) in January 2006, NEF is old. The NECC is composed of various subordinate entities that are their own respective commands that deliver the unique capabilities the NECC offers to U.S. and allied forces in the expeditionary realm (see Figure 1).

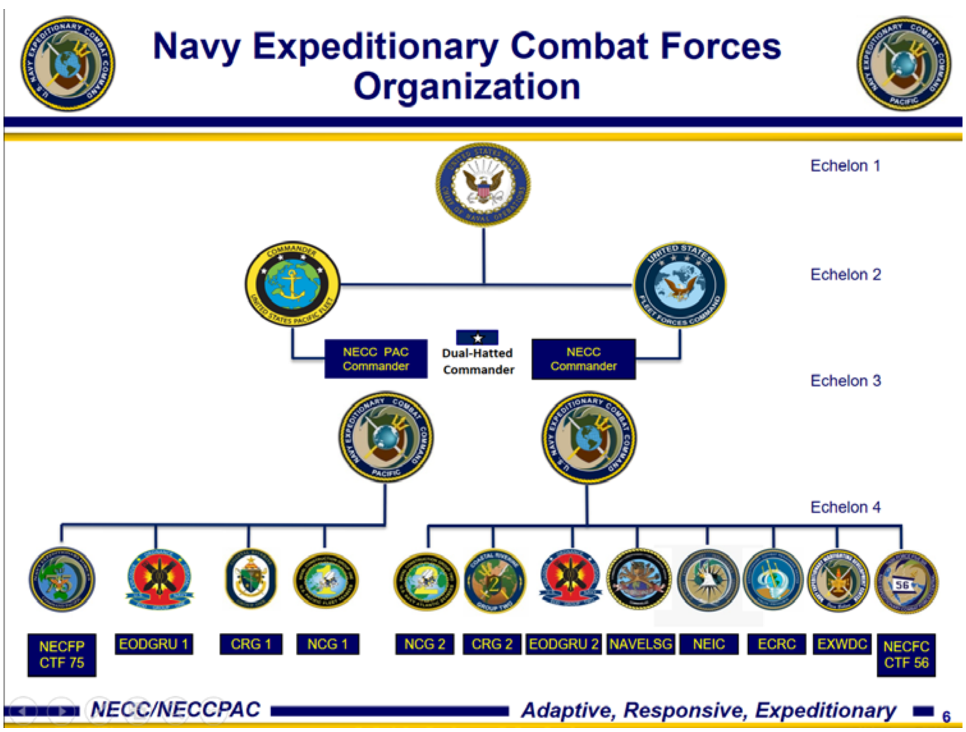


Figure 1. NECC Organization Structure. Source: NECC (2014).

When it was stood up, the NECC became a type commander (TYCOM) and falls in line below U.S. Fleet Forces Command like any other TYCOM. In an effort to support the West Coast NECC forces with greater proximity, the Navy Expeditionary Combat Command Pacific (NECCPAC) was established, but it is important to note that the commander, NECC (COMNECC) dual-hats as commander, NECCPAC (COMNECCPAC).

B. NAVY EXPEDITIONARY COMBAT COMMAND MISSIONS

The NECC is the command organization for the entire Navy Expeditionary Forces. The NECC is based out of Little Creek, Virginia, and has operational control (OPCON) and administrative control (ADCON) over a highly trained and diverse mix of forces. The NECC is required to master and remain masters of many mission sets that are unique and very challenging (see Figure 2).

Figure 2. NECC Mission. Source: NECC (2014).

The NECC's ability to execute this highly capable yet unique mission set comes from comprising itself of the various expeditionary expert commands.

(1) Combined Task Force 56, 68, and 75

Combined task forces (CTFs) are aligned with overseas fleets in order to expeditiously take the fight to the enemy. NEF supports the CTFs and their commanders who are focused on a unique theater perspective of the fight. These CTFs integrate the conventional forces with expeditionary forces capabilities to support the mission. It is important to note that these CTFs are aligned under the forward fleets but each was stood up because of the great value added with having an expeditionary element as part of their respective commands (Naval Expeditionary Combat Command [NECC], n.d.).

(2) Coastal Riverine Force

Focused ashore, at sea, and in the waters of harbors, rivers, bays, and littorals, the Coastal Riverine Force (CRF) conducts maritime security operations to secure the safe operations and navigations of these water systems (NECC, n.d.).

(3) Explosive Ordnance Disposal

The Explosive Ordnance Disposal (EOD) is the Navy's technical expert in locating, identifying, rendering safe, and explosively detonating foreign and domestic ordnance. Ordnance includes conventional, nuclear, biological, chemical, underwater, and improvised types of devices. The ability to control and dispose of these various types of dangerous devices enables access for Carrier Strike Groups (CSGs), Expeditionary Strike Groups (ESGs), mine countermeasures (MCMs), Naval Special Warfare, and Army Special Forces (SF) (NECC, n.d.).

(4) Naval Construction Forces Seabees

The Naval Construction Forces (NCF) Seabees have had a rich history since WWII as the military's premier combat construction fighting force. For providing combat engineering support to naval operating forces, the Seabees are invaluable and an asset with their ability to construct airfields and repair air and sea ports, roads, bridges, and bunkers. In addition, the

NCF executes underwater construction to survey, restore, and repair maritime infrastructure of ports and harbors (NECC, n.d.).

(5) Navy Expeditionary Intelligence Command

Based out of Dam Neck, Virginia, the Intelligence Exploitation Team (IET) comprises small teams focused on executing HUMINT and tactical expeditionary analysis to give friendly forces freedom of movement, access to waterborne lines of communication, and denial of enemy sanctuaries (NECC, n.d.).

(6) Navy Expeditionary War-Fighting Development Center

The Navy Expeditionary War-Fighting Development Center (NEXWDC) is the youngest command within the NECC and was stood up in 2015 to equip NECC forces with doctrine and procedures that are congruent in ethos and constantly improving (NECC, n.d.).

(7) Navy Expeditionary Logistics Support Group

The Navy Expeditionary Logistics Support Group (NAVELSG) directly supports combatant commanders (COCOM) for logistics capabilities and equipment such as fuels, cargo handling, freight distribution, warehouse operations, and ordnance reporting and handling. There is only one active component battalion, along with 10 reserve units, for NAVELSG. Therefore, a constant focus on proficiency and execution ensures that joint logistics over the shore (JLOTS) and humanitarian assistance and disaster relief (HA/DR) missions are successful (NECC, n.d.).

(8) Navy Expeditionary Combat Readiness

The Navy Expeditionary Combat Readiness (ECRC) provides support to the Overseas Contingency Operations (OCO) teams, in particular those who are serving as Individual Augmentee (IA), mobilized active and reservists, or a supporting ad hoc unit. As well, ECRC stays alert to new and emerging assignments that deviate from traditional overseas assignments (NECC, n.d.).

C. NECC DISTRIBUTION

A highly capable yet unique force such as the NECC requires various experts of multiple specialties. The force breakdown of the NECC describes the units that report to the NECC in order to make the mission areas a possibility (see Figure 3).

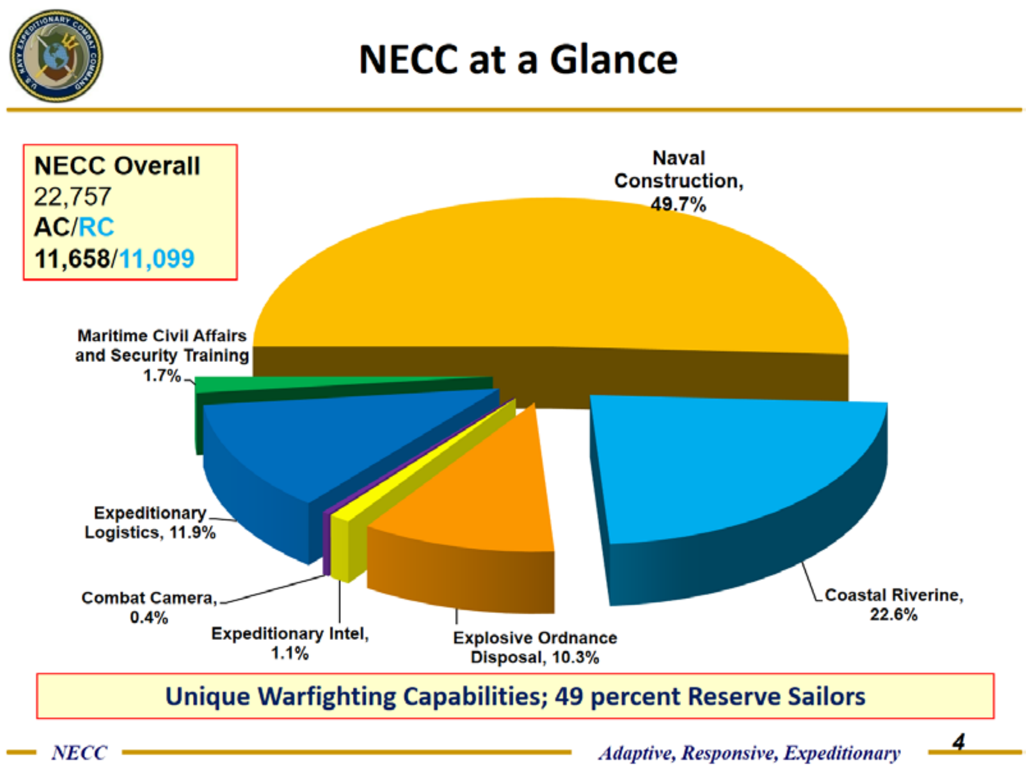


Figure 3. NECC Force Breakdown. Source: NECC (2014).

One of the largest challenges faced by the NECC is that much of its mission area does not easily fall within the traditional Navy mission of dominance at sea and executing shipboard operations on the open ocean. The NECC has a unique requirement with very specialized gear and troops where they make use of the traditional Navy shipboard operations but continue further onto land and in areas where ship and submarine can no longer be effective. Along with the unique mission are the continental United States (CONUS) headquarters and training sites that must be stood up, maintained, and utilized in order to make EXLOG missions a reality.

Figure 4 shows the logistics difficulties that are associated with performing EXLOG. The units are spread out across CONUS, and there are OCONUS operations that require logistics support. Operationally, each one of these units may be engaged in a different mission set requiring specific equipment and materials to be supplied. Therefore, the NECC must be supply savvy as well as technically independent to be able to know the mission's technical requirements as well as how to provide the support via the Navy's available supply and logistics delivery options

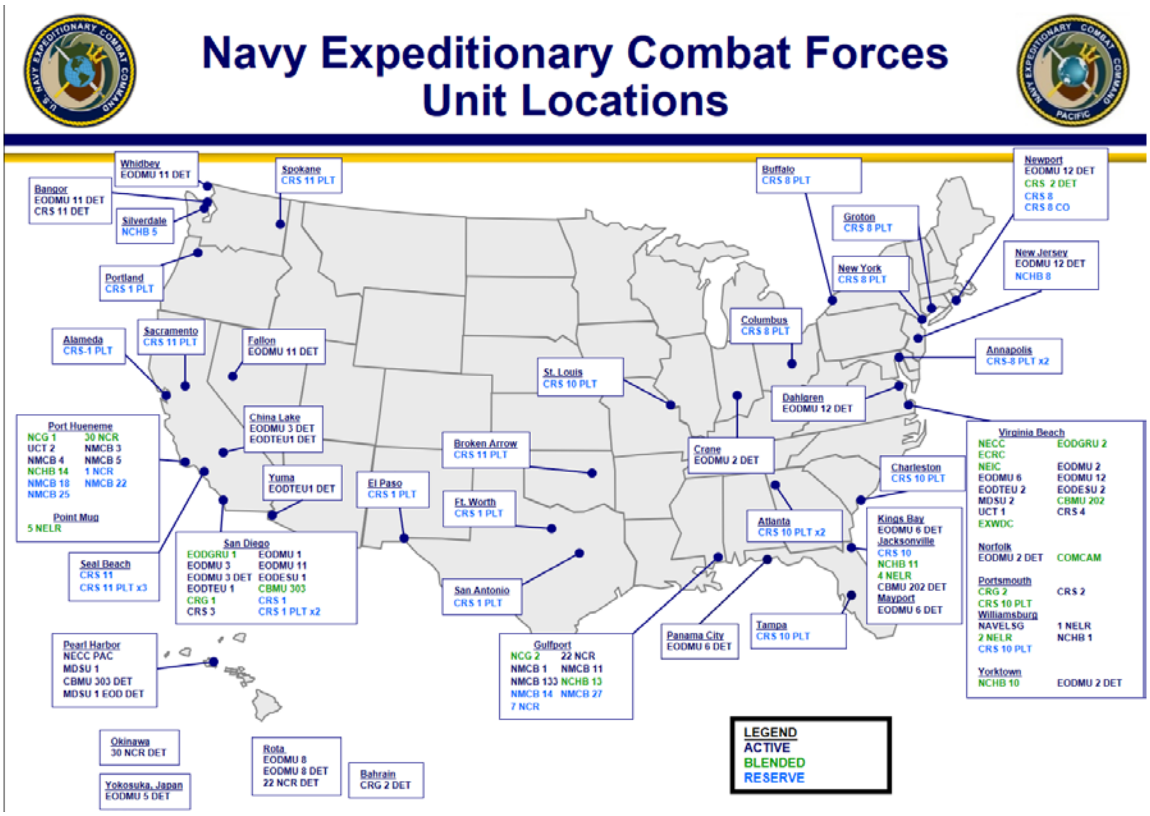


Figure 4. NECC Locations. Source: NECC (2014).

D. NAVAL EXPLOSIVE ORDNANCE DISPOSAL (EOD)

EOD is a history-rich, proud community that serves alongside many SPECOPS forces, as well as traditional Navy mission communities such as ships and submarines. The EOD technicians are required to risk their lives to perform complex, technical defusing of mines, bombs, and improvised explosive devices (IED) and must be physically fit, superior swimmers and athletes. EOD technicians undergo rigorous schoolhouse training prior to arriving at their commands and then complete operationally challenging tours filled with deployments and stressful workups due to the operational tempo (OPTEMPO). The EOD community comprises officers and enlisted as shown in Figure 5.

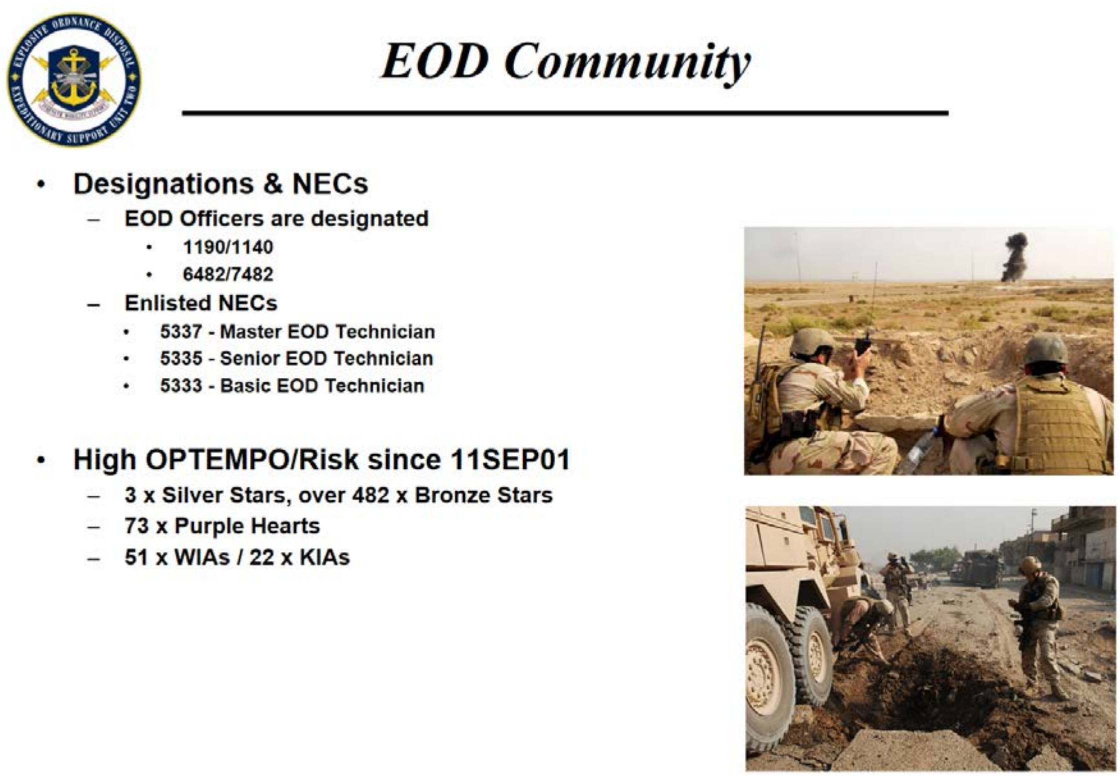


Figure 5. EOD Community. Source: EODESU TWO (2017a).

1. EOD Group

EOD Group One based in San Diego, California, and EOD Group Two based in Little Creek, Virginia, are the two U.S.-based EOD elements. Each EOD group has five battalions and various shore detachments, platoons, and companies within them. The group provides specially trained, combat ready, highly mobile EOD forces to support CSGs, amphibious ready group (ARG)/Marine Expeditionary Units (MEUs), MCM task forces and groups, NSW forces, Army SF, Military Sealift Command, unified theater commanders, CONUS Navy Region commander, and Homeland Defense and Contingency Operations. Figures 6 and 7 show the EOD Group command organization along with the respective commanding officer (CO) ranks.

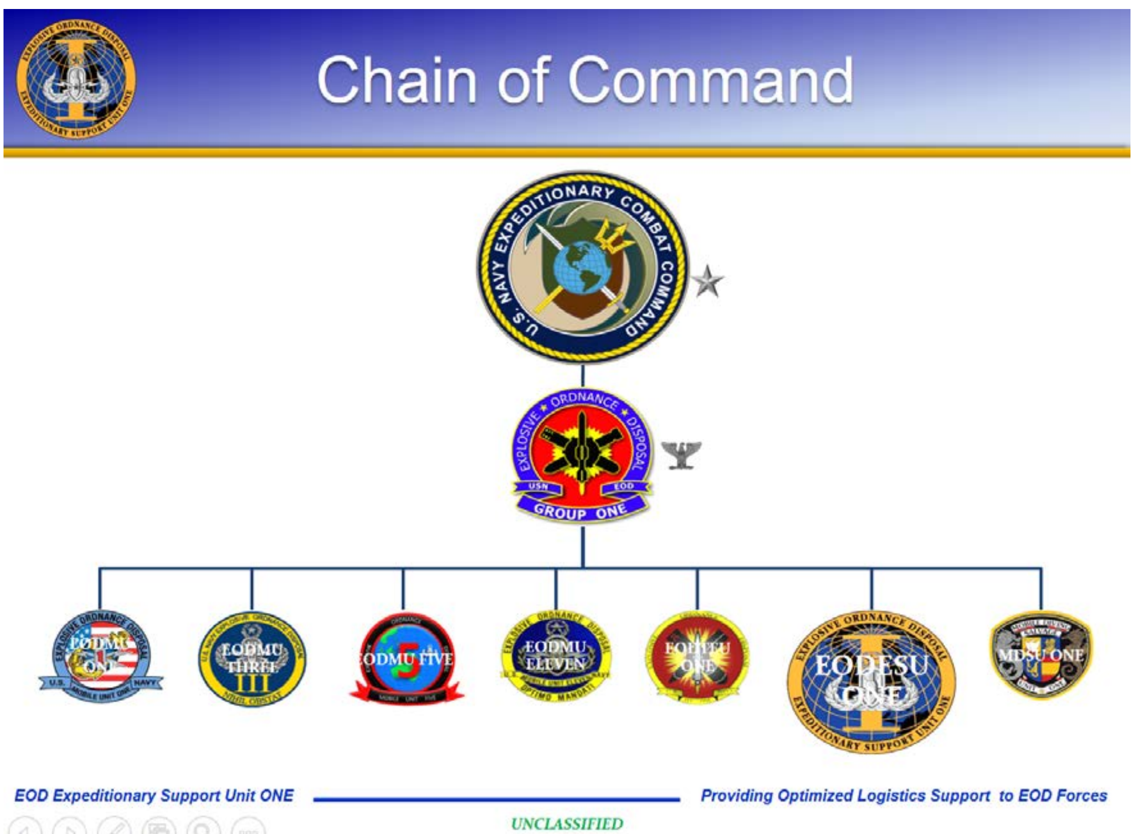


Figure 6. EOD Group One Chain of Command. Source: EODESU ONE (2017).

Figure 7. EOD Group Two Chain of Command. Source: EODESU TWO (2017b).

2. EOD Training and Evaluation Units

EOD Training and Evaluation Units (TEUs) One and Two have similar geographical basing locations as the corresponding groups. The TEUs specialize and become advanced trainers in order to provide advance training and certification to all of the diving and salvage companies.

3. EOD Mobile Diving and Salvage Units

EOD Mobile Diving and Salvage Units (MDSUs) are the world's premier diving forces for salvage. These highly trained EOD technicians perform expeditionary diving and salvage, support conventional combat units, execute mine countermeasures support, and complete other mission sets. One of the important pieces of gear for these teams is the MK-16 UBA, which is highlighted later in the report. These teams are highly mobile and rapidly deployable with highly technical equipment requiring precise logistics and preparation.

4. EOD Expeditionary Support Units

EOD Expeditionary Support Units (ESUs) One and Two also follow the same geographical structure as their fellow expeditionary forces. EODESU provides optimized logistics support to the EOD forces through financial, supply chain, and logistics management as well as operational planning and global force support. In an effort to allow EOD forces to focus on warfighting efforts and their primary mission, the EODESU primary mission is to provide total logistics support to the warfighter.

ESU was established in 2008. While it was created to help centralize and improve efficiency for the EOD teams, it was created under a zero-growth mentality and therefore cannibalized its members from within the EOD teams. Zero-growth inception of a unit that is as crucial as the ESUs shows that anything is possible, but lasting detrimental effects are felt when done improperly. Increased funding and personnel, as well as new and different training for the ESU members, are required to ensure the climate and thinking are new and improved compared to their EOD brethren, or else really there is no change other than creating a new organization.

E. EOD EXPEDITIONARY SUPPORT UNITS

Prior to EODESU, EXLOG was performed by the teams in parallel, with stressful OPTEMPOs and very dangerous deployments stacked one after the other. The purpose of the ESUs was to relieve the mobile units of logistics and maintenance duties so they could focus on their demanding operational duties. Also, the ESUs would be staffed with logistics and maintenance experts in order to perform those functions more efficiently and with increased precision, ultimately improving the value for the Navy and the result provided to the warfighter.

While ESU commands are not tasked with executing any of the highly technical and versatile missions the EOD teams are tasked with, they are tasked with equipping those teams with the proper gear and equipment to successfully execute the mission. In order to know what is required and understand the details necessary to complete these difficult missions, the ESU must be knowledgeable about the EOD mission and experts in logistics and supply chain management. EOD teams are stationed and deployed worldwide (see Figure

8). Managing distances alone is a task worthy of only superior logisticians, but also navigating the bureaucracy when spending government money requires the ESU teams to be savvy supply experts.

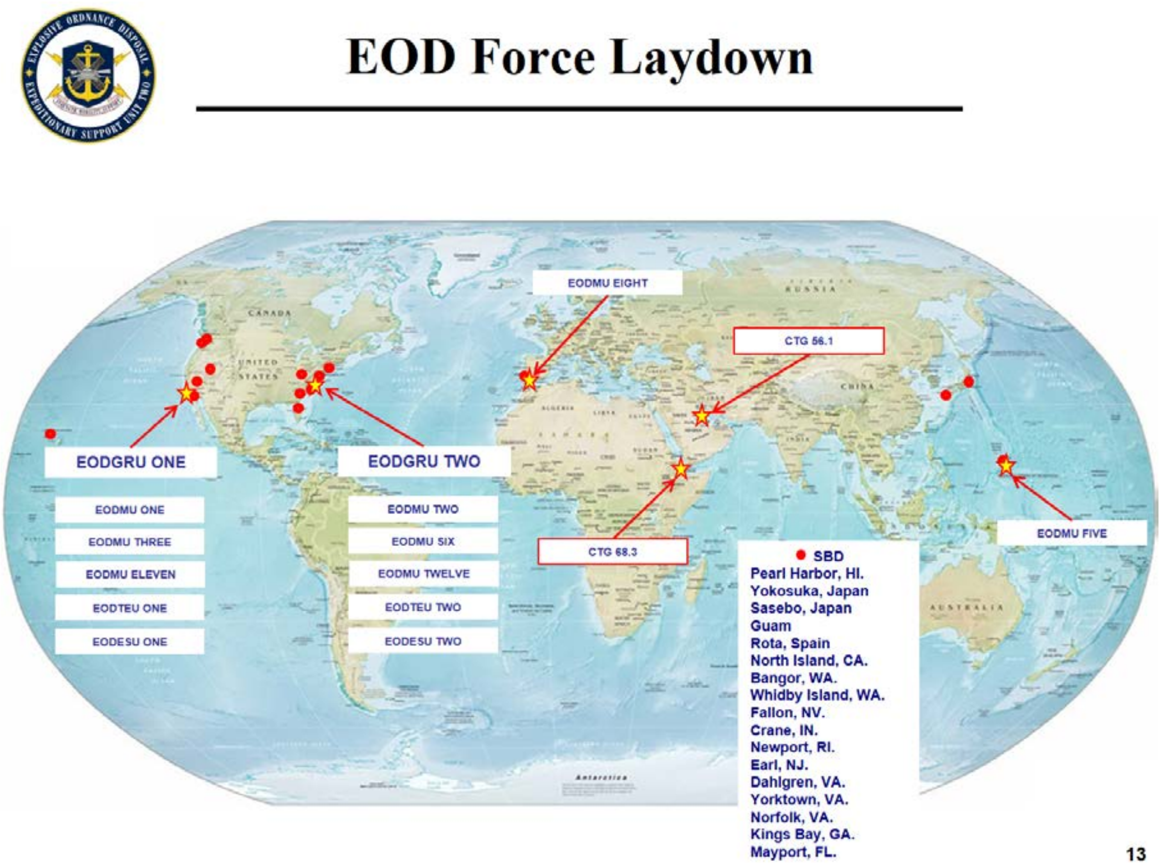


Figure 8. EOD Force Laydown. Source: EODESU TWO (2017a).

1. EODESU ONE

EODESU ONE is located on the West Coast, aboard Naval Amphibious Base Coronado, California, a great deal further away from NECC headquarters. Figure 9 illustrates the organizational structure of the command.

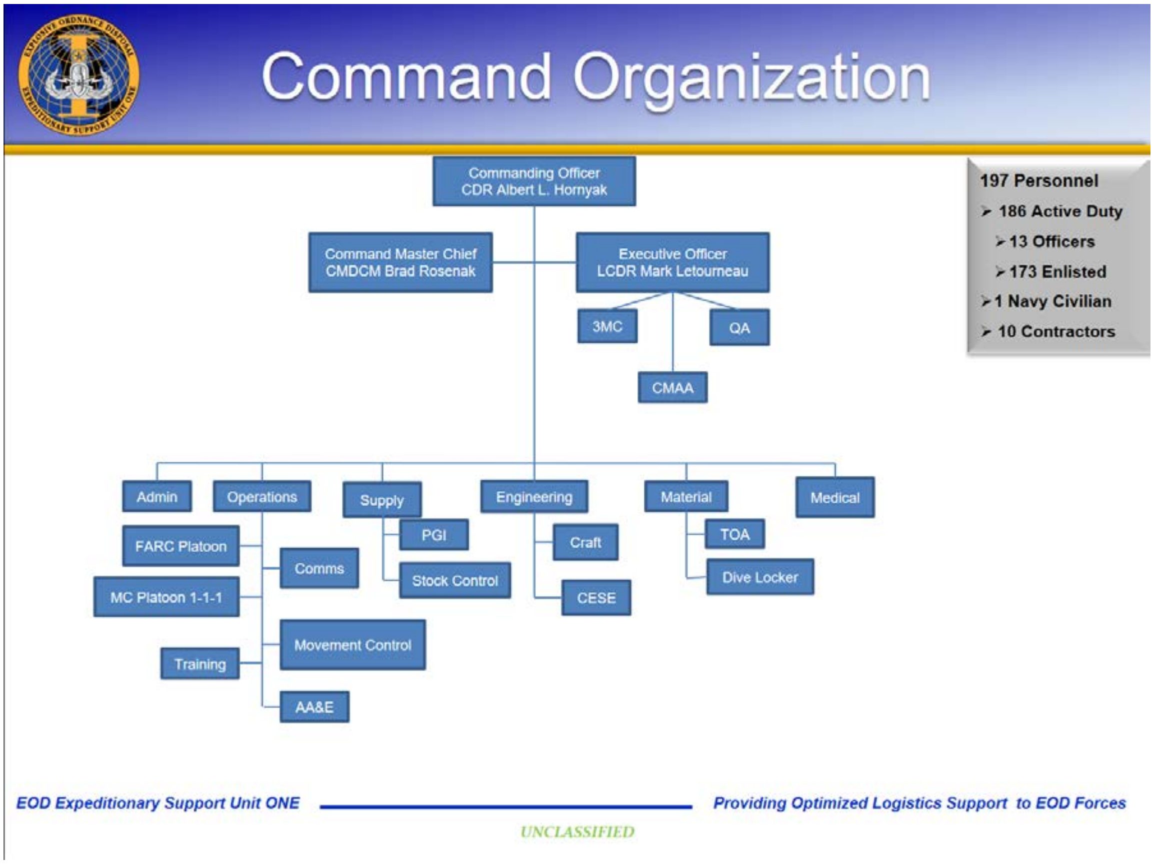


Figure 9. EODESU ONE Command Organization. Source: EODESU ONE (2017).

EODESU ONE has a clear chain of command noted by its command organization chart. The command organization chart accounts for its billets that are necessary as well as those that are vacant. Vacant billets can be a challenge for force management and work distribution, with the responsibility lying with the executive officer (XO).

2. EODESU TWO

EODESU TWO is located on the East Coast of the United States, aboard Joint Expeditionary Base, Little Creek, Virginia. Located on the same base is COMNECC, which reduces administrative logistics and funding delays, due to proximity. Figure 10 illustrates the organizational structure of the command.

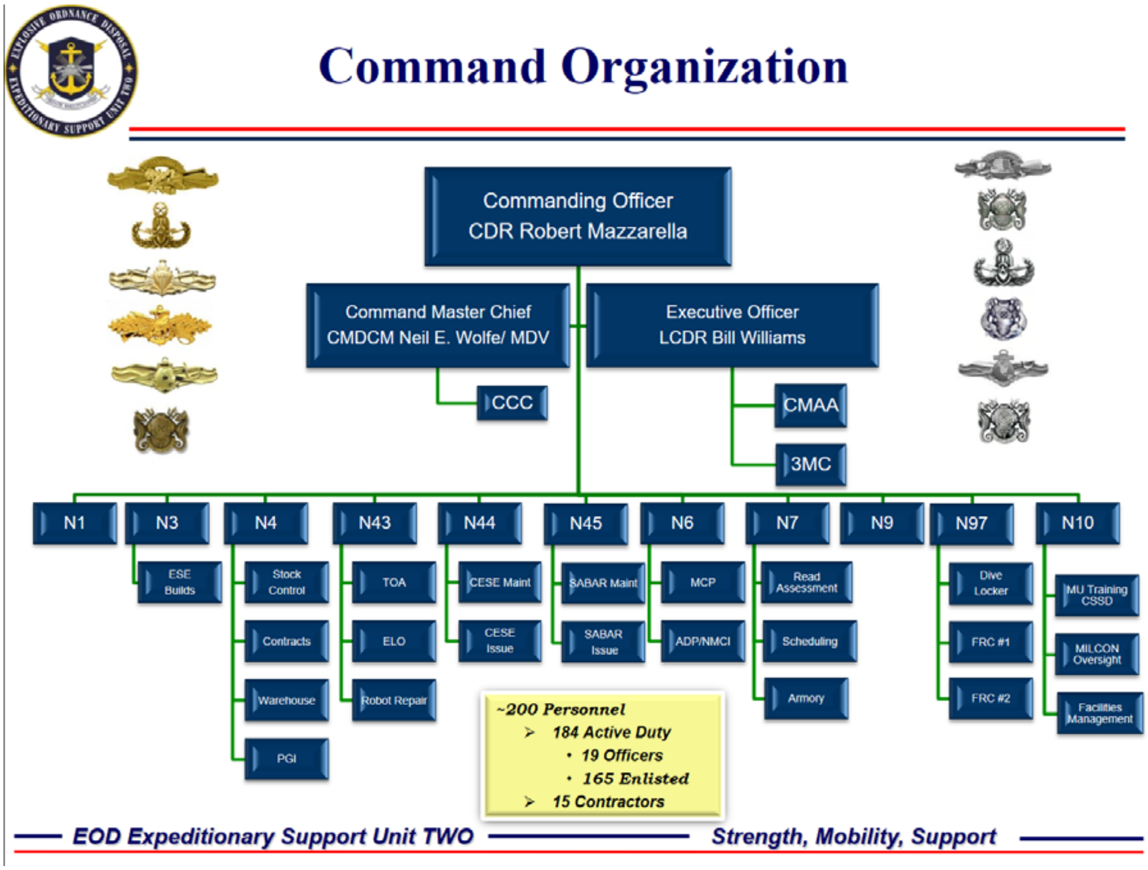


Figure 10. EODESU TWO Command Organization. Source: EODESU TWO (2017b).

EODESU TWO has a very detailed command structure with each billet listed for delegating responsibility, although each billet may not actually be filled all the time due to manning limitations.

3. EODESU ONE versus EODESU TWO

With roughly the same number of members, the two commands were stood up at the same time with the intent of one providing ESU services for the East Coast and OCONUS responsibilities belonging to the East Coast teams, and the West Coast unit providing the same but for the opposite coast.

EODESU ONE is required to surpass additional levels of scrutiny or administrative tasking in order to achieve the same effect as its counterparts due to the establishment of NECCPAC. The same CO heads both the NECC and NECCPAC; therefore, the additional staff and personnel that comprise the NECCPAC are supposed to focus solely on Pacific ESU operations to help control logistics. Likely, the NECCPAC was established to help bridge the distance gap between EODESU ONE and its parent command, the NECC, as well as provide a sort of Immediate Superior in Command (ISIC) locally to help resolve issues that may arise.

Largely, the processes are similar at the two facilities. Both currently operate with the same supply and inventory IT systems, which are somewhat dated but still functional. EODESU TWO handles all logistics and maintenance support for its supported units, while, in regard to the MK-16, EODESU ONE maintains the older style of leaving the MK-16 maintenance and logistics management primarily with the supported unit. This difference is primarily due to the difference in demand requirements between the two units. EODESU TWO must support a greater demand across multiple units for MK-16 service and supply, and therefore has determined that it is more efficient to maintain control at a higher echelon.

EODESU TWO utilizes a general schedule (GS) government employee to be the MK-16 expert. The GS civilian in this position, Mr. Don Murray, works locally at the ESU in Little Creek and is a constant employee who, unlike his military counterparts, does not transfer every two to three years with a new set of orders. Murray's stability allows EODESU TWO to have a stability and history with the program, as well as inherent knowledge regarding the system and its respective logistics that does not leave the command.

III. EODESU SUPPLY

A. THE BASICS

The ESU units supply their teams as part of the services they provide. While the process by which the individual units perform this function may be slightly different, relatively the same outcome is delivered. The organizations receiving ESU support receive TOA, PGI, COSAL, and non-COSAL supported supply parts, expeditionary logistics overhaul (ELO), and general logistics and supply chain support. ELO sounds similar to the integrated logistics overhaul (ILO) process aboard ships but is specifically for expeditionary forces where they identify the gear needed to be repaired, reconditioned, or replaced. Each ESU is equipped with an O-4 Navy supply officer (SUPP-O) because the supply community is composed of the Navy's experts in working with the supply systems. Also, ESU commanding officers (COs) are SUPP-Os so they can be integrated in the working knowledge of the ESU supply mission. The XO of the units is an EOD technician in order to provide the technical expertise of the warfighter and counter-balance the CO to ensure the ESU mission is achieved by supplying the units with what is required by the most efficient and practical means possible.

One of the greatest challenges for the ESU teams, if not *the* largest, is the multiple operating systems they use to track gear, equipment, and parts. ESU has a requirement to store information on an Accountable Property System of Record (APSR) system. ESU uses WASP, RCRP, R-Supply, and DPAS systems to track and store information regarding PGI, TOA, COSAL, and other material. WASP, RCRP, R-Supply, and DPAS are four distinctly different IT systems each used to organize the same information. In some cases, the information is actually the same, and duplicate efforts are being made to track and store transactions because of a fear of inaccuracies. ESU will track a transaction in WASP and manually enter the same information in RCRP.

Supply parts are received from vendors at the ESUs and automatically confirmed in R-Supply. Subsequently, the ESU member manually enters the same information that was just confirmed in R-Supply into WASP because the ESU teams use WASP as their internal inventory management system.

B. SUPPLY PROCESS

Supported commands come through ESU at various points in the Fleet Readiness Training Plan (FRTP) cycle. Individual members will report initially to receive PGI; they are responsible to care for and account for this PGI upon their transfer from the unit. This PGI issue is the personal gear given to each uniformed member of a unit and includes uniforms, undershirts, socks, and other items that require some specificity to a member's body and measurements. Also, units will report to the ESU to receive ELO where the team will receive a loadout of gear required for their FRTP. Many times, the gear is standardized with spares and non-necessary items, which makes for an easier process at the ESU, but a more difficult historical demand tracker at the upper echelons. This EOD-specific gear issued at ELO is referred to as TOA and can be items such as inflatable boats and generators or also even specific wetsuits. The teams will keep this gear from initiation of the FRTP to return post-deployment. Many times, there may be items missing or destroyed as part of the training, mission, or accidental loss, all requiring proper documentation and reconciliation.

A damaged piece of gear can be replaced with a ready spare that was issued with the TOA, but if done properly, the damaged piece of gear would be accounted for in the Organizational Maintenance Management System (OMMS) and therefore tracked for repair and replacement. OMMS is yet another Navy IT system used by ESU to track and document work. Many times, the ELO process comes with Operational Support Kits (OSK) where the teams will replace broken or damaged items with ones from the OSK but not properly account for that transaction. Therefore, no demand history is created for future planning purposes or estimating usage rates of specific pieces of gear.

RCRP is the Navy's APSR, but internally, the ESUs also use WASP because it is an in-house system that they created and manage independent of external input. Therefore, there is a higher level of confidence in the accuracy of the information, although it is unusable during a data call where information is required to be provided to higher echelon commands.

DPAS is another DOD-required IT system that tracks property valued over $5,000 and other sensitive items as directed (i.e., difficult to replace, prone to theft). These listed systems each require a significant amount of manual data input, with similar data often repeated across the multiple systems.

1. PGI

Personal Gear Issue (PGI) is issued to all members reporting to expeditionary units (units belonging to the NECC). Other NECC commands also issue PGI such as the Seabees and Riverine forces, but they use a similar system and distribute from within their respective locations. Some PGI gear may not be held in the local warehouses if it is general enough that most of the NECC uses it and can be more efficiently stored centrally, but even in those cases, we found that ESU junior officers (JOs) in charge of PGI would store that gear to avoid delays in acquiring it or issuing it to needing forces.

The PGI issue process is done at one of the two unit headquarter warehouses where PGI is stored. The members will arrive and report to either a JO EOD technician or JO SUPP-O depending on which ESU is being examined. There is benefit to having knowledge from both the operator and the supply mind, but we did not find that this difference in JO in charge of PGI was cause for significant inefficiency or unaccountability.

PGI is community-specific gear that is not standard issue to the greater Navy, so there is an argument that an EOD technician should be in charge of knowing what is being issued because they are the expert on the gear. But there is an inefficiency in having to retrain someone to do the job of a SUPP-O solely because he is knowledgeable on PGI.

2. TOA

The Table of Allowances (TOA) consists of specific gear, equipment, systems, and materiel related to expeditionary missions. TOA gear represents a challenge to cost savings efforts, due to the constantly changing nature of expeditionary missions. This is non-standard gear allowed or allotted to the expeditionary teams based on their missions, and most Navy personnel would not know how to use it. The TOA provides guidance for initial outfitting and planning for future demand to baseline what is required in the units and allow readiness reporting with an understood baseline (NAVFAC, 2016). TOA allowance comes from higher-level decision-makers working with operational-level experts to understand the missions and requirements to be successful. Example of items issued as TOA to the EOD technicians via ESU are cable power twist locks, jacking level equipment, water pumps, generator systems, and floor tents. Some of EOD-issue TOA is used elsewhere within the

NECC and potentially other communities within the Navy, but that does not change that its function can be EOD-specific and is allotted as part of the TOA to be issued via the ESU.

3. COSAL

The Consolidated Shipboard Allowance Listing (COSAL) is a document listing items that the ship should carry onboard. The COSAL contains nomenclature, operating characteristics, technical manuals, and equipment descriptions as described in allowance parts lists (APL) and allowance equipage lists (AEL). AEL is a standard Navy term and therefore includes the term *ship*, but refers to items that a command, whether it be sea- or shore-based, should support (U.S. Navy, 2014). The maintenance and upkeep of the ship or command's COSAL is usually delegated to the SUPP-O, adding to the heavy fiscal and logistical responsibility already assumed.

4. GEAR RETURN

Upon completion of the mission, training, or cycle, the gear that was not specifically provided to be kept by the member is returned and inventoried. The gear return process is more than simply stacking and counting specific clothing articles or ammunition boxes. Given the EOD mission, many times the gear is able to be returned, but in a heavily damaged state or potentially even unusable. Therefore, ESU inspectors must know what separates returned, quality gear, from gear requiring depot-level repair (DLR) or minor maintenance.

In addition to assessment and inventory of existing gear, ESU is required to properly document missing and damaged gear that is beyond repair. DD Form 200 is the Navy's form for financial liability investigation, the process that is initiated by submitting a DD Form 200. The Navy must determine, based on DD Form 200, the reason the equipment was lost or damaged and who should be responsible, if anyone, for the cost to repair or replace. DD Form 200 is required per DOD Directive 7200.11 for lost DOD-controlled property. It is a form that is filled out electronically, but ultimately it is kept hardcopy and entered into the ESU IT systems manually. ESU members are required to physically search archived DD Form 200s when they need to find information (see Figure 11).

Figure 11. EODESU TWO Member Inspecting Hardcopy DD Form 200

DD Form 1149 is another DOD directive form required when shipping through certain seaports or airports. The DD 1149 is specifically known as the Requisition and Invoice/Shipping Document to verify what was issued against the electronic records in WASP. This hardcopy document is also manually entered into systems and kept hardcopy for storage or later use when searching for information. Figure 12 shows the storage cabinet used to house old DD 1149s that may be needed later. There is a large collection of files at EODESU TWO of forms that are necessary to conduct business but are only stored hardcopy.

NEF personnel are expected to execute highly dangerous and technically challenging missions while on deployment, but in addition they are required to account for very expensive gear and equipment. DD Forms are meant to account for gear and equipment but in the midst of deployment, training, or even war, the accountability for actually following through with administrative burdens such as DD Forms is not necessarily thorough, and when the forms are completed, they can pile up very quickly. Potentially, in some cases, units have so much administrative paperwork when they return from deployment that it is either too much to be controlled, did not get filled out properly, or did not get filled out at all, so that they must rely on memory or recount the reasons for which gear and equipment is being administratively documented for instead of physically turned in.

Figure 12. DD Form 1149 Filing Cabinet

IV. CASE STUDY: EODESU TWO MK-16 UBA

The following chapter is a case study based on site visits at the two EODESU headquarters and research regarding one highly critical piece of equipment EODESU supports. Mainly, the scenario described revolves around EODESU TWO and one of their supported units which utilizes the MK-16. Specifically, this case study will focus on one unit type, an EOD Mobile Unit (EODMU), in particular one of its Mine Countermeasures (MCM) platoons, which is a primary end-user of the MK-16. This case study starts with a description of the MK-16 equipment. It then follows a MCM platoon throughout the deployment cycle to capture various steps in the EOD supply chain. This will provide realistic insight into the ongoing mission and logistics operations of EODESU and the EODMU MCM platoon. The MK-16 is a heavily utilized piece of gear with many subcomponents. A focus on this particular item allows for analysis of multiple replenishment methods in use at EODESU TWO. EODESU is still developing as a command but plays a significant role in supporting EOD units. Therefore, there is great value in learning and tracking the processes by which EODESU supports the MK-16 for a MCM platoon.

EOD OPTEMPO has been fast and steady since approximately 2011 with three EOD technicians earning the Silver Star medal, nearly 500 earning the Bronze Star, and sadly, over 20 killed in action (EODESU TWO, 2017a). The EOD mission has no end in sight and if anything, only an increase in OPTEMPO. Therefore, it is prudent and beneficial for NECC, EODESU, and the EODMUs to understand the process in place performed to support all pieces of equipment, but detailed via the study of the MK-16 at EODMU TWELVE MCM Platoon 1201.

A. MK-16 SYSTEM OVERVIEW

> Navy EOD is the only Service EOD that is manned, trained, and equipped to perform underwater render safe procedures and conduct EOD dive operations. Navy EOD dive operations have unique logistics, personnel, and mobility support requirements, in addition to any potential hazardous material requirements associated with diving equipment and/or gases. (Chairman of the Joint Chiefs of Staff, 2016, appendix G-5)

Given the unique demand the EOD community fulfills in conducting underwater EOD operations, it seems most appropriate to use the MK-16 UBA as a representative hardware sample in order to illustrate the various facets of the EXLOG supply process.

The MK-16 MOD 1 is an electronically-controlled, closed-circuit, mixed-gas, constant partial-pressure UBA (Harwood, 1980). It is comprised primarily of four main subsystems: the housing (which contains the gas tanks, recirculation filter, and electronics), the pneumatic system (gas canisters which hold various gas mixtures, depending on the mission), the electronics (which monitor and regulate gas mixtures and provide system status information to the diver), and the recirculation system (which allows for recirculation of the diver's exhalation gases through a special filtration process, enabling the recycling of gases). Gas recycling greatly extends the duration of the dive, as well as limits the bubbling of waste gases to the surface, reducing detection of dive activity (Harwood, 1980).

Typical EOD mission sets include MCM, salvage diving, ship's hull diving, search and rescue (SAR) operations, and other necessary diving missions ordered to be completed. With such a variety of technically challenging and highly dangerous diving missions, EOD technicians are trained to perform and be successful at nearly any diving mission. The MK-16, therefore, is a common piece of equipment used in the EOD teams, and all EOD technicians are well-versed in its use and capabilities.

The MK-16 was developed to reduce magnetic and acoustic signatures emitted by diving EOD technicians. The mission of EOD technicians is one that is highly technical, diverse, and dangerous. Under such tense work conditions, a superior diving suit is required that allows full range of motion but still provides protection from the natural and enemy hazards present in the area of operation (AO). The MK-16 breathing medium is maintained at a predetermined partial pressure of oxygen (PO2) which is monitored by sensors and controls to ensure diver safety (Harwood, 1980). The reason divers are required to maintain a safe level of oxygen and are monitored so heavily is that depending on the mission, they may use more or less oxygen and cannot follow a standard timetable for bottom time.

Along with the MK-16, other essential diver's equipment includes a knife, hook knife, strobe, smoke or flare, thermal protection, fins, and potentially a weapon as required (EODESU TWO, 2017c). The knife has many uses but one of its main uses is to help free a trapped diver from any number of hazards. The MK-16 equipment must withstand these conditions and not puncture, disconnect, or break easily. Strobes, smoke, and flares are essential safety gear for EOD technicians because at the depths required of some of the EOD missions, there is absolutely no natural visibility and those pieces of equipment could prove to be life-saving. A weapon is a necessity depending on the mission and AO in which the dive will take place; this is a harsh reminder that the mission is not a recreational dive but instead highly important and dangerous. Thermal protection is a necessity due to the water temperature experienced. Naturally, the thermocline is the reduction in water temperature based on increasing depth (Bergman, 2011). Ninety percent of the total volume of the deep ocean's water is found below the thermocline, and it averages around 32 to 37.5 degrees Fahrenheit (Bergman, 2011). While the EOD mission may not necessarily reach the ocean's deepest depths, the reduction in water temperature is most severe at the EOD operating depths. The MK-16 and other equipment are required to operate in the constantly changing water temperature based on the mission's depth requirements.

Given these varied mission environments and operating conditions, the MK-16 is required to withstand density, pressure, salinity, hot or cold-water conditions, and high usage rates due to a high OPTEMPO being experienced by the EOD teams. At first glance, the MK-16 suite appears to be nothing more than a UBA in a large black carrying box, but upon further investigation, we found that there are numerous pieces that are required for such a sensitive, yet capable system. Subsequent to a physical observation of the MK-16 hardware, we began to review the demand history for repair parts requests that were logged at EODESU TWO, and saw that it was equally challenging and littered with various nomenclatures, APLs, quantities, and so on.

Table 1 shows a sample adapted from a detailed quarterly order report for the MK-16 MOD 1 UBA by EODESU TWO. The national item identification number (NIIN) is the nine-digit identification number associated with the parts that can be used to search within a national database for the item. The NIIN comprises the last nine digits of the thirteen-digit national stock number (NSN), not used to sort data in Table 1. The NSN is helpful to the federal government in sorting large inventories of items and starts as a larger thirteen-digit number, which is then subdivided for further tracking and filtering of the data. The part number is a specific label associated with the item generated from within and helps to place the item in a category of inventory. The federal supply class (FSC) is the numeric categorizer that is part of the larger thirteen-digit NSN. The four-digit FSC and the nine-digit NIIN comprise the thirteen-digit NSN. The navy cognizance code (COG) is a two-letter symbol that identifies the inventory manager who manages a specific category of material. The last column is the commercial and government entity (CAGE) code which is an individual identification assigned to government and defense agencies that help identify specific storage facility sites within a given location.

Table 1. MK-16 Quarterly Order Report. Adapted from J. Cazares (personal communication, December 12, 2017).

# Checks	SPIN	Nomenclature	NIIN	Category	Part Number	COG	FSC	CAGE
53	02826	Gloves, disposable, nitrile, 8 mil	014478217	Misc	8005XL	9B	8415	62528
40	00366	Detergent, general purpose	002829699	Materials	MIL-D-16791	9Q	7930	81349
39	02271	Flashlight	002993035	Tools	6230-00-299-3035	9Q	6230	80244
35	00754	Leak test compound	006211820	Materials	MIL-PRF-25567	9G	6850	81349
31	01550	Grease, aircraft and instrument	009618995	Materials	MIL-G-27617	9G	9150	81349
30	03199	Mirror, inspection	006186902	Tools	GGG-M-350	9Q	5120	81348
24	00419	Faceshield, industrial	005422048	Misc	A-A-1770	9Q	4240	58536
24	01998	Wrench set, crowfoot, ratcheting	002930013	Tools		9Q	5120	
24	02274	Pail, utility, plastic, 3 GL	002461097	Misc	7240-00-246-1097	9Q	7240	0HFR0
24	09460	Aural protector, sound	000222946	Misc		9G	4240	
24	10273	Brushes, nylon		Materials				
24	10832	Extraction tool kit, O-ring	016030826	Tools	BRASS EXTRACTION KIT		5331	02697
21	10324	Grease, aircraft and instrument	014419016	Materials	CHRISTO-LUBE 111		9150	OJDR3
15	00123	Wrench, torque	DDENDUM	Tools		GP	TE A	
15	01210	Scriber, machinist's	002217063	Tools	5120-00-221-7063	9Q	5120	80244
15	01459	Wrench, adjustable	002643796	Tools	A-A-2344	9Q	5120	58536
15	02086	Gloves, chemical and oil protective	011479540	Misc	MIL-G-87066	9D	8415	81349
15	02279	Rule, steel, machinist's	009718827	Tools	5210-00-971-8827	9Q	5210	80244
15	10314	Strap wrench	LLLCC1787	Tools	OEM6413		5120	1JEK9
7	12147	Parts kit, EOD	014667354	Parts	6914771		1386	53711
6	01707	Screwdriver set, jeweler's, swivel	002888739	Tools	GGG-S-1808	9Q	5120	81348
6	10856	Valve, check	014128291	Parts	B16145-1		4820	1W506
3	01605	Wrench, open end	001848548	Tools	MIL-W-19928	9Q	5120	81349
3	03494	Wrench, open end	001877123	Tools		9Q	5120	
3	10853	Cap, protective	010818282	Misc	M5501/3-4		5340	81349
3	10855	Plug, protective	008041238	Misc	M5501/2-4		5340	81349
2	00063	Applicator, disposable	012346838	Materials	6515012346838	9B	6515	3Y857
1	00152	Brush, acid swabbing	005142417	Materials	A-A-289	9Q	7920	58536
1	01359	Tape, pressure sensitive adhesive	005824772	Materials	PPP-T-0097	9Q	7510	81348
1	01445	Wrench set, box & open	001487917	Tools	A-A-1358	9Q	5120	58536
1	01900	Caps, valve, protective cyl		Misc				
1	10866	O-ring	014460720	Parts	6914770-18		5330	53711

Table 1 is abbreviated, and some of the column features were redacted due to necessity, but there are multiple orders for various repair tools, parts, manuals, lubricants, and others. This gear is very specialized and comes with strenuous testing requirements prior to being accepted into the supply system and placed in one of the warehouses for later issuing. Many of the items such as O-rings, inspection mirrors, or even flashlights might seem to be non-essential for an EOD UBA, but they are in fact specific to the UBA. The inspection mirrors are required to have certain characteristics that allow the EOD technicians at EODESU TWO performing maintenance on the MK-16s to inspect the necessary crevices. The O-rings are required to undergo specific testing to ensure suitability prior to replacement or use in one of the MK-16 rigs. The O-rings are vital pieces of equipment for safety and for ensuring that the rig is properly fitted and sealed to withstand the AO conditions previously described.

Recently, EODESU TWO has experienced difficulty with the T-bit valve for the mouthpiece attachment. The MK-16 has many accessories required to support the operation, not simply the UBA, but the additional components are required for mission success. Specific testing was not completed on nearly all of the valves being shipped to the units as repair parts. The pieces require an oxygen-free environment for testing, along with other stringent requirements that were not completed; therefore, as they arrive, the valves are required to be specially tested and separated based on pass-or-fail criteria. This was an unexpected challenge that is being faced by dive locker personnel. Those valves that fail are required to be sent to be repaired, increasing the logistics burden on EODESU TWO. Also, this limits a crucial piece of the complete MK-16 assembly, reducing the readiness of the teams, which are already heavily utilized with the current mission tasking.

EODESU TWO has a team of maintainers as well as a GS civilian employee who account for and maintain the MK-16 system inventory. The GS civilian employee is known as the resident expert on the system. The benefit to having a civilian expert versus a military member is that ideally, the civilian will remain the expert point of contact for a longer period of time, providing a long-term persistent presence opposite the routine rotations of assigned active duty personnel, and therefore ensuring retention of critical corporate knowledge regarding program supply and maintenance history. The issue with the mouthpiece is being closely tracked by the diving life support systems manager and the EOD technicians, to ensure that they remain able to execute their support mission of the EOD teams and outfit them with operable MK-16 UBAs, but also to mitigate any potential safety risks by ensuring that no diver is exposed to a faulty mouthpiece or any other piece of gear that is not properly inspected and ready for use in an operational environment.

Table 2 provides a list of highly critical parts associated with the MK-16 according to EODESU TWO Supply Department and their respective demand history over a 12-month period, specifically at the ESU echelon IV level. It can be noted that O-rings are the fastest moving parts, along with batteries that are used to support or operate the MK-16 UBA system. O-rings are highly critical to the safe operation of the MK-16 and are in high demand.

Table 2. [Bahrain] Pre-stage DLA List. Adapted from J. Jensen (personal communication September 8, 2017).

			EODESU TWO	DLR/urgent
NOMENCLATURE	**NIN / PART NUMBER**	**Each**	12 month demand	NON-DLR
Battery, Secondary 1.5 volt	013552524/6195925	50	456	fast mover
Sensor Assembly (O2)	015298960/6915278	20	247	fast mover
O-Ring	014469109/6914770-26	30	209	fast mover
O-Ring	014128292/6914770-5	30	140	fast mover
Battery Assembly, Primary	015299000/6915242	10	80	fast mover
Sensor Connector Assembly	014125483/6196183	10	78	fast mover
Blowout Disk	014118386/B16189-1	30	70	fast mover
Battery Adaptor	014830397/6914774	8	69	fast mover
O-Ring Kit	014667354/6914771	10	58	NON-DLR
Switch Assembly	015299003/6914831-1	8	49	fast mover
O-Ring	014460718/6914770-7	50	38	fast mover
MouthPiece	013047142/6195947	8	34	NON-DLR
PWB Gain Adjust	014212726/6195785	3	29	NON-DLR
O-Ring	014460719/6914770-15	30	20	fast mover
O-Ring	014460716/6914770-16	30	16	fast mover
Fuse	0148380396/6914775	10	13	fast mover
Cover, Assembly	012999780/6196126	2	9	NON-DLR
O-Ring, Inner	013710463/6914770-11	8	8	NON-DLR
O-Ring, Outer	013710464/6914770-12	8	8	NON-DLR
Holder, Primary Display	014128315/6196090	10	7	fast mover
Filter, inline	012983005/6195857	5	5	NON-DLR
Support Base Assembly	012959268/6195979	2	5	NON-DLR
Threaded Retainer	013000091/6195791	3	4	NON-DLR
Primary Electronic Assembly (DLR)	015305593/6914802	3	3	DLR
Display, Secondary (DLR)	012970920/6196066	3	3	DLR
Valve Diluent (DLR)	012970901/6196012	3	3	DLR
Valve, Oxygen (DLR)	012975977/6196011	3	3	DLR
Primary Display Assembly	012970949/6196140	3	3	NON-DLR
Hose, High-Pressure	013641719/6196161	3	3	NON-DLR
Nut, Secondary Display	012970890/6196072	3	3	NON-DLR
Canister Assembly, Complete	012975994/6196095	3	3	NON-DLR
Center Section Assembly (DLR)	012965892/6195797	2	2	DLR
Gauge Assembly O2 HP	012970965/6196159	2	2	NON-DLR
Gauge Assembly Diluent HP	013651719/6196160	2	2	NON-DLR
Cable Assembly, Secondary Display	012970902/6196017	2	2	NON-DLR
Cable Assembly, Primary Display	012970903/6196019	2	2	NON-DLR
Cable Assembly, Scrubber	014128287/6196018	2	2	NON-DLR
Cabble Assembly, O2 Addition	012970904/6196020	2	2	NON-DLR
O-Ring	014460715/6914770-2	30	0	fast mover
Cap, Secondary Display	013970985/6196073	3	0	NON-DLR
Oxygen addition valve (DLR)	01297596/6196153	2	0	DLR

The OMMS system is used to track the MK-16; therefore, NECC is able to gather data and track trends regarding specific units or equipment in order to determine the most efficient method to perform EXLOG. NECC is an echelon III command and is able to group subordinate commands to determine trends regarding specific items, like the MK-16. NECC utilizes an Online Assessment Reporting System (OARS) to capture overall demand history, cost, unit demand, command type, and a number of other filterable categories. The pre-stage MK-16 list, presented in Table 3, was captured via OARS data, and a four-year demand history, as well as average unit cost (AUC), was determined.

Table 3. Four-Year OARS Demand History and Average Unit Cost

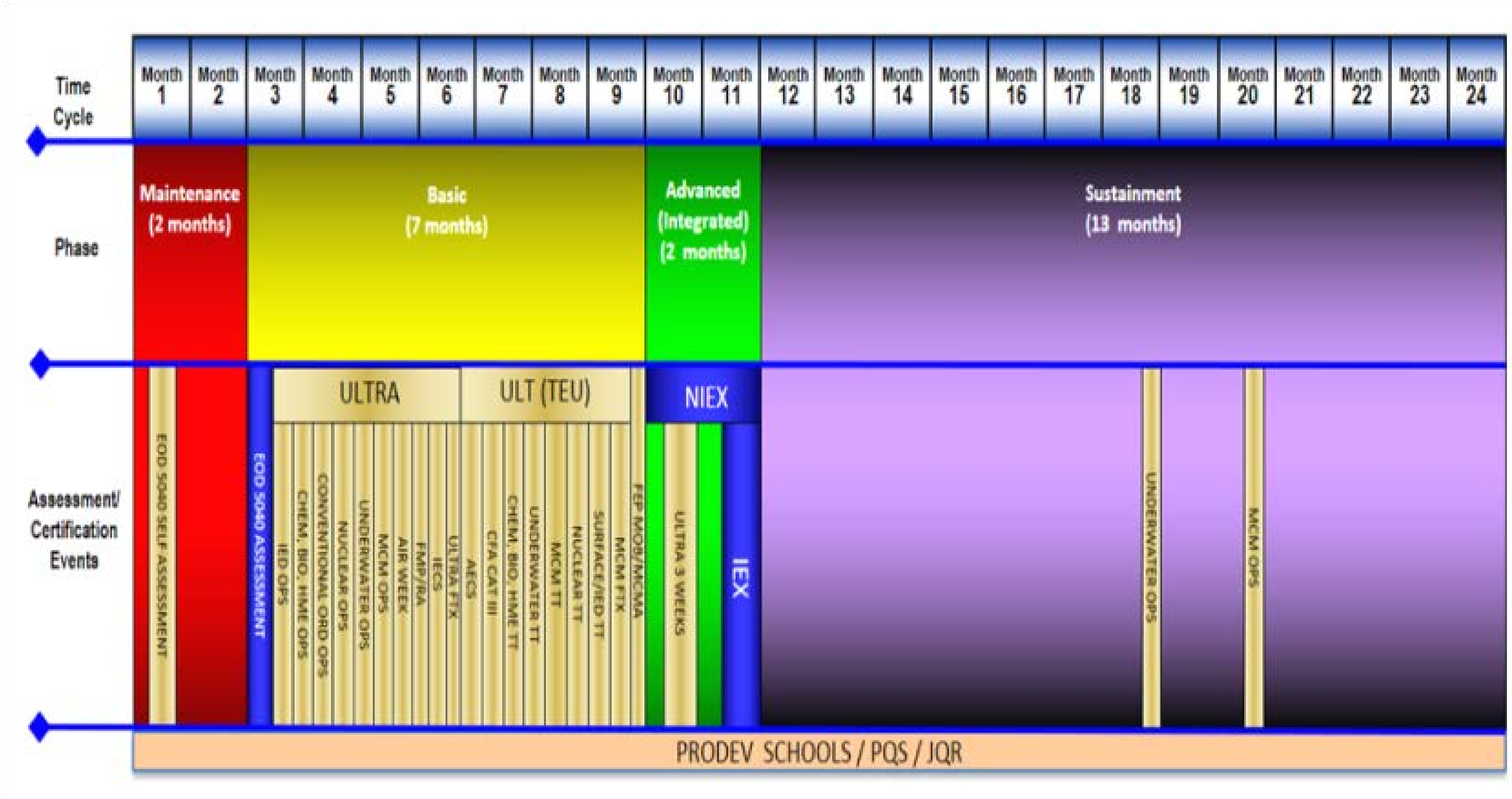
NOMENCLATURE	NIN / PART NUMBER	Each	EODESU TWO 12 month demand	4 year OARS demand	Avg Unit Cost ($)	DLR/urgent NON-DLR
Battery, Secondary 1.5 volt	013552524/6195925	50	456	1613	$ 17.62	fast mover
Sensor Assembly (O2)	015298960/6915278	20	247	1084	$ 197.41	fast mover
O-Ring	014469109/6914770-26	30	209	1263	$ 1.00	fast mover
O-Ring	014128292/6914770-5	30	140	140	$ 6.00	fast mover
Battery Assembly, Primary	015299000/6915242	10	80	310	$ 78.81	fast mover
Sensor Connector Assembly	014125483/6196183	10	78	126	$ 32.92	fast mover
Blowout Disk	014118386/B16189-1	30	70	134	$ 57.87	fast mover
Battery Adaptor	014830397/6914774	8	69	207	$ 16.23	fast mover
O-Ring Kit	014667354/6914771	10	58	233	$ 38.31	NON-DLR
Switch Assembly	015299003/6914831-1	8	49	132	$ 136.40	fast mover
O-Ring	014460718/6914770-7	50	38	64	$ 3.00	fast mover
MouthPiece	013047142/6195947	8	34	84	$ 568.48	NON-DLR
PWB Gain Adjust	014212726/6195785	3	29	88	$ 499.78	NON-DLR
O-Ring	014460719/6914770-15	30	20	108	$ 8.00	fast mover
O-Ring	014460716/6914770-16	30	16	27	$ 6.00	fast mover
Fuse	0148380396/6914775	10	13	15	$ 4.00	fast mover
Cover, Assembly	012999780/6196126	2	9	34	$ 820.85	NON-DLR
O-Ring, Inner	013710463/6914770-11	8	8	4	$ 8.00	NON-DLR
O-Ring, Outer	013710464/6914770-12	8	8	1	$ 3.00	NON-DLR
Holder, Primary Display	014128315/6196090	10	7	65	$ 62.70	fast mover
Filter, inline	012983005/6195857	5	5	93	$ 265.42	NON-DLR
Support Base Assembly	012959268/6195979	2	5	19	$ 50.07	NON-DLR
Threaded Retainer	013000091/6195791	3	4	11	$ 40.80	NON-DLR
Primary Electronic Assembly (DLR)	015305593/6914802	3	3	83	$ 1,540.92	DLR
Display, Secondary (DLR)	012970920/6196066	3	3	63	$ 8,436.71	DLR
Valve Diluent (DLR)	012970901/6196012	3	3	130	$ 1,507.80	DLR
Valve, Oxygen (DLR)	012975977/6196011	3	3	34	$ 1,289.88	DLR
Primary Display Assembly	012970949/6196140	3	3	46	$ 1,664.24	NON-DLR
Hose, High-Pressure	013641719/6196161	3	3	41	$ 448.88	NON-DLR
Nut, Secondary Display	012970890/6196072	3	3	1	$ 57.00	NON-DLR
Canister Assembly, Complete	012975994/6196095	3	3	3	$ 831.00	NON-DLR
Center Section Assembly (DLR)	012965892/6195797	2	2	22	$ 13,764.05	DLR
Gauge Assembly O2 HP	012970965/6196159	2	2	22	$ 764.09	NON-DLR
Gauge Assembly Diluent HP	013651719/6196160	2	2	9	$ 578.00	NON-DLR
Cable Assembly, Secondary Display	012970902/6196017	2	2	29	$ 1,426.46	NON-DLR
Cable Assembly, Primary Display	012970903/6196019	2	2	35	$ 1,433.57	NON-DLR
Cable Assembly, Scrubber	014128287/6196018	2	2	15	$ 1,335.90	NON-DLR
Cabble Assembly, O2 Addition	012970904/6196020	2	2	9	$ 1,907.20	NON-DLR
O-Ring	014460715/6914770-2	30	0	1322	$ 1.80	fast mover
Cap, Secondary Display	013970985/6196073	3	0	21	$ 113.14	NON-DLR
Oxygen addition valve (DLR)	01297596/6196153	2	0	5	$ 8,650.80	DLR

B. SCENARIO

The following scenario focuses on one of the EODESU TWO supported units that utilize the MK-16, as well as other gear provided by EODESU TWO. Specifically, this case study focuses on one particular type, an EOD Mobile Unit (EODMU), along with one of its Mine Countermeasures (MCM) platoons, which is a primary end-user of the MK-16. The EODMU is a critical EOD element, and serves as a prime example based on the variety, complexity, and volume of mission sets to which they are assigned. The four East Coast teams are supported by EODESU TWO, and all are based out of the same base in Little Creek, Virginia (EODESU TWO, 2017). This scenario follows one of the supported East Coast mobile units, EODMU TWELVE, through its training cycle, deployment, and ultimate return to home base. Specifics focus on EXLOG activity in support of the MK-16 throughout the entire process, to understand the procedures currently in use, to reconcile supply-related activity, from pre- through post-deployment.

1. Pre-deployment

Preparation for any deployment begins with a codified training cycle, or FRTP. Concurrent with the deployment schedule assigned to EODMU TWELVE, MCM Platoon 1201 undergoes a FRTP cycle like most other Navy units. The purpose of this process is to train, equip, and certify unit mission preparedness. In this process, a given unit executes a number of standard and customized training evolutions to meet the expected mission requirements during deployments. The FRTP for a MCM platoon is a tightly packed schedule of events lasting roughly eleven months prior to deployment. Figure 13 below illustrates the planned readiness cycle for a MCM platoon. The timeline, in months is depicted along the top, with the FRTP ('workup' cycle) consuming months 1 thru 11. The other 13 months represents sustainment, or, in other words, their availability for operational deployment following training certification. FRTP consists of various milestones, including inspections, evaluations, training, and exercises. Each one of these events helps to build unit skill and cohesion, starting with basic, individualized training, and working toward more advanced, integrated training with external units. The process is designed to prepare the unit for the upcoming deployment based on available intelligence data (Intel) gathered prior to heading into theater. This same Intel is what EOSESU TWO uses to prepare supply and logistics support. EODESU TWO outfits the units during ELO and issues all of the required gear aside from what has already been issued for the team to be successful on deployment. Once on deployment, the various units assigned to EODMU TWELVE separate into detachments (DETS) or smaller units. Therefore, the unit must be prepared for all possible missions and have sufficient gear and personnel to complete the necessary tasking that may arise.



Note. EOD MCM PLTs are trained to locate, identify, neutralize, recover, exploit, and dispose of underwater ordnance that impedes dominant maneuver. MCM PLTs are capable of operating independently and provide diving and demolition support, intelligence collection, aircraft and ordnance recovery, range clearance and underwater clearance, shore detachment augmentation, riverine operations, CNO project support, and contingency and special operational support as tasked. Normal manning includes eight personnel.

Figure 13. EOD MCM Platoon Readiness Cycle. Source EODTEU TWO (2017).

Prior to deployment, MCM Platoon 1201 must certify ready via successful completion of the FRTP requirements. Prior to FRTP, the platoon receives expeditionary logistics overhaul (ELO) from EODESU TWO and begins workups. Part of the workups include successful completion of the requirements of the Training and Evaluation Unit (TEU). TEU does not completely oversee the FRTP process for the platoon, but is influential and will provide training, classes, study materials and equipment, and some evaluation for how the unit performs against the various elements of the deployment they are likely to face.

TEU will directly issue some duplicate equipment that is required during training. This prevents the EODMU from utilizing primary issue equipment, which avoids potential damage or loss to mission-essential gear, which in some cases could delay deployment or reduce mission capabilities of the unit. The TEU has its own supply of gear that it accounts for and purchases via EODESU TWO to support the unit training and evaluation process. ESU controls the budget used by TEU to purchase their course gear, which they acquire via DOD e-mall, GSA Advantage, GSA Leasing Support vendors, prime vendors, or other legal government sources of acquisition. The gear issued by TEU is generally the same as what was issued by ESU but slight variation is possible. Ultimately it is very familiar, and the EODMU will receive adequate training. Figure 14 shows a general outline of what is expected of an EODMU going through the training phase, prior to deployment. This graphic amplifies the FRTP (eleven months of training) portion of Figure 13, detailing the sequence of events that helps transition an EOD unit from individual stand-alone operations, to joint interoperability.

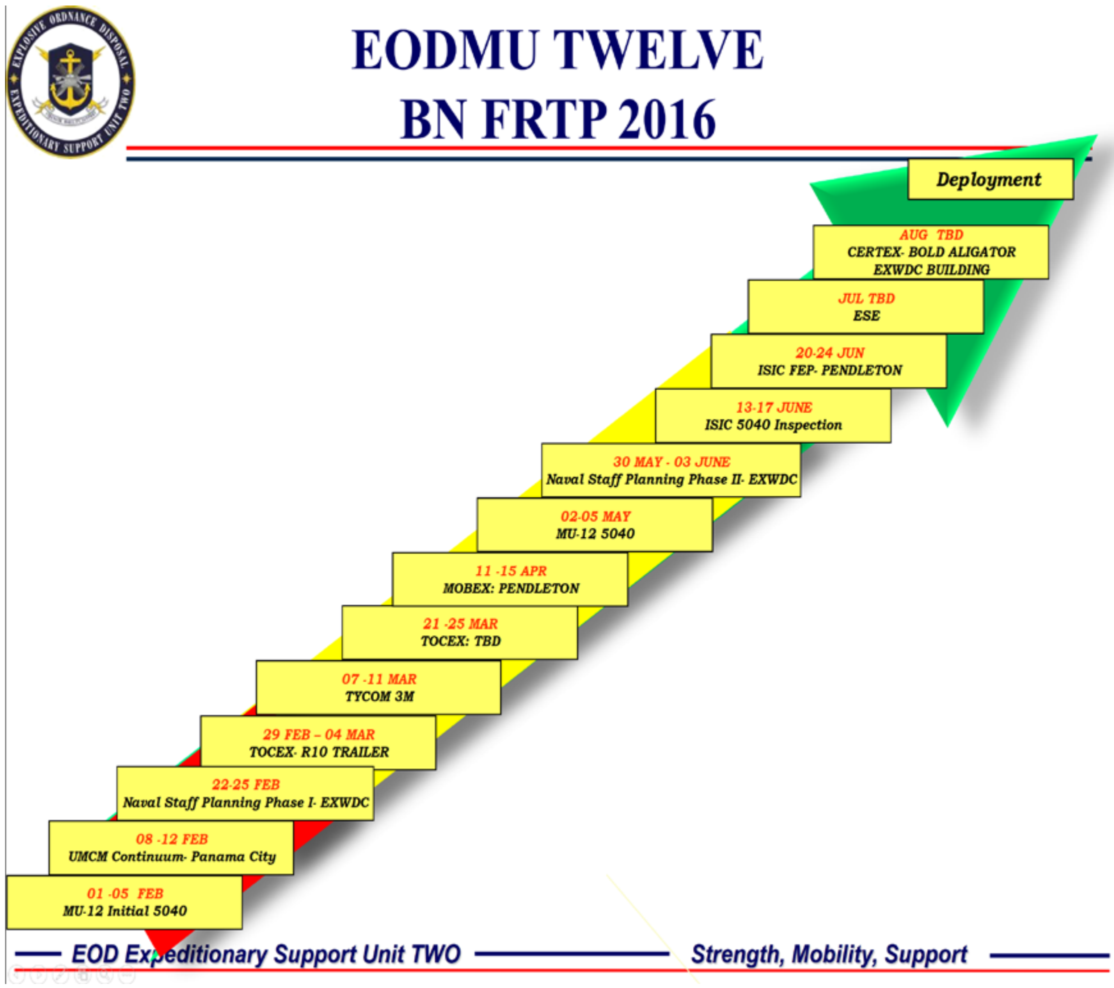


Figure 14. EODMU FRTP. Source: EODESU TWO (2017b).

Throughout the training cycle, MCM Platoon 1201 is traveling, preparing for deployment, and executing necessary pre-deployment tasking. Platoon 1201 is required to account for their gear and issued allowances throughout the entire FRTP process, as well as when they finally deploy and utilize the equipment. One of the major pieces of equipment generally used, or at least accompanied, on all missions is the MK-16 UBA. Aside from certain landlocked missions, the MK-16 is required and generally is part of ELO because tasking and mission requirements can change at the last minute prior to deployment and even once on deployment.

EODESU TWO has five commodity categories in its supply structure; EOD, Robotics, Communications, Combat Services Support, and Underwater. Underwater commodity, just as it sounds, consists of items related to SCUBA, Fly-away Recompression Chamber (FARC), and the MK-16. EOD and Robotics are managed by N43, which is currently an EOD lieutenant due to his operational expertise at fielding the unique requests associated with the specialized TOA gear related to these commodities. This arrangement is unique, in that unlike the communications and combat services commodities, an EOD-trained officer is holding this supply position. The underwater commodities, including MK-16, are managed by N97. This department is referred to as the dive locker and is currently headed by a Chief Warrant Officer Two (CWO2). MK-16 is handled through OMMS, which allows ESU and the EODMU to track the gear and put requests in for resupply or replacement parts as needed. For MK-16, this structure is unique to the East Coast. Alternatively, at EODESU ONE, units manage this item at the echelon V level, that is to say, the individual West Coast-based mobile units support this item independent of the ESU. On the East Coast, due to greater operational demand, the dive locker within EODESU TWO handles all maintenance and support requirements for all of the supported units. It is this construct which applies to further case analysis in the following sections.

Platoon 1201, like most MCM platoons, operates under a 24-month deployment rotation. The first twelve months are for training, also referred to as “workups.” Upon completion of the workup cycle, the platoon will then be in a six-month sustainment phase. In sustainment, they are certified for operations, and thus may be deployed early if necessary. Otherwise, they will maintain their availability status until departing on a six-month deployment, which will complete the 24-month deployment cycle. This timeline is for planning purposes, which varies between units that specialize in different core missions, and may adjust occasionally for operational necessity.

a. ELO/Gear Issue

At the start of the deployment cycle, Platoon 1201 must undergo ELO, to be outfitted with the gear required for conducting training and subsequent deployment tasking. This ELO process facilitates issue of a baseline of standard gear that EODESU TWO has developed over time, based on coordination with the EODMUs and their historical tasking. Scheduled six to 12 months in advance, and based on long-term deployment rotations that are often available two years prior, Platoon 1201’s ELO will take approximately three weeks to fully transfer ownership of the thousands of required pieces of gear from the ESU to the unit. The process starts with coordination between EODESU TWO and EODMU TWELVE, to deconflict an appropriate start date, based on all units that may need similar support.

To start preparing for the ELO, EODESU TWO will designate four Internal Airlift/Helicopter Slingable Container Unit 90 (ISU 90; see Figure 15), along with a mini flyaway dive locker (FADL), for storage of all ELO gear to the platoon. At the completion of ELO, these storage units will be transferred to the unit. Before the gear may be moved from the warehouse to the storage containers, EODESU supply personnel will generate a DD 1149 listing all of the items required for transfer. Each commodity manager will be responsible for populating a DD 1149 with the appropriate items under their purview. These documents serve as the official inventory record for equipment ownership, and in the interim, also serve as an inventory checklist utilized by both ESU personnel and the platoon commander, for verifying all items transferred. The DD 1149 information must be entered in two separate systems. First, all items must be properly accounted for in the warehouse, and the IT system utilized in maintaining an accurate warehouse accounting is Wedge Advanced Software Product (WASP). WASP is a standalone warehouse management database. ESU personnel must go into WASP to update the ownership/location status of each item, as it is transferred to the storage containers. Additionally, this same supply/inventory information must be entered into the Navy's Readiness and Cost Reporting Program (RCRP), which is the approved system of record for use in official reporting up the Navy chain of command, and which is not connected to WASP. Though WASP is not an approved system of record, it is used locally for the convenience and simplicity it provides in managing the local inventory. DPAS warehouse is another inventory management system that is available to the supply community that satisfies the same requirements as WASP, but adds date entry efficiencies such as bar code scanners. EODESUs have yet to implement the new system. WASP is utilized for the majority of ELO transfer items, but not for underwater items. Due to the much smaller inventory of underwater items, the dive locker works primarily with RCRP (for ownership transfer), OMMS (for repair/maintenance), and spreadsheets (for ad hoc local tracking). Once the containers have been filled, and ESU and the platoon commander have verified the transfer, the platoon commander signs the DD 1149, accepting ownership of the containers and their contents.

Figure 15. EODESU TWO Personnel Managing ISU 90 Containers

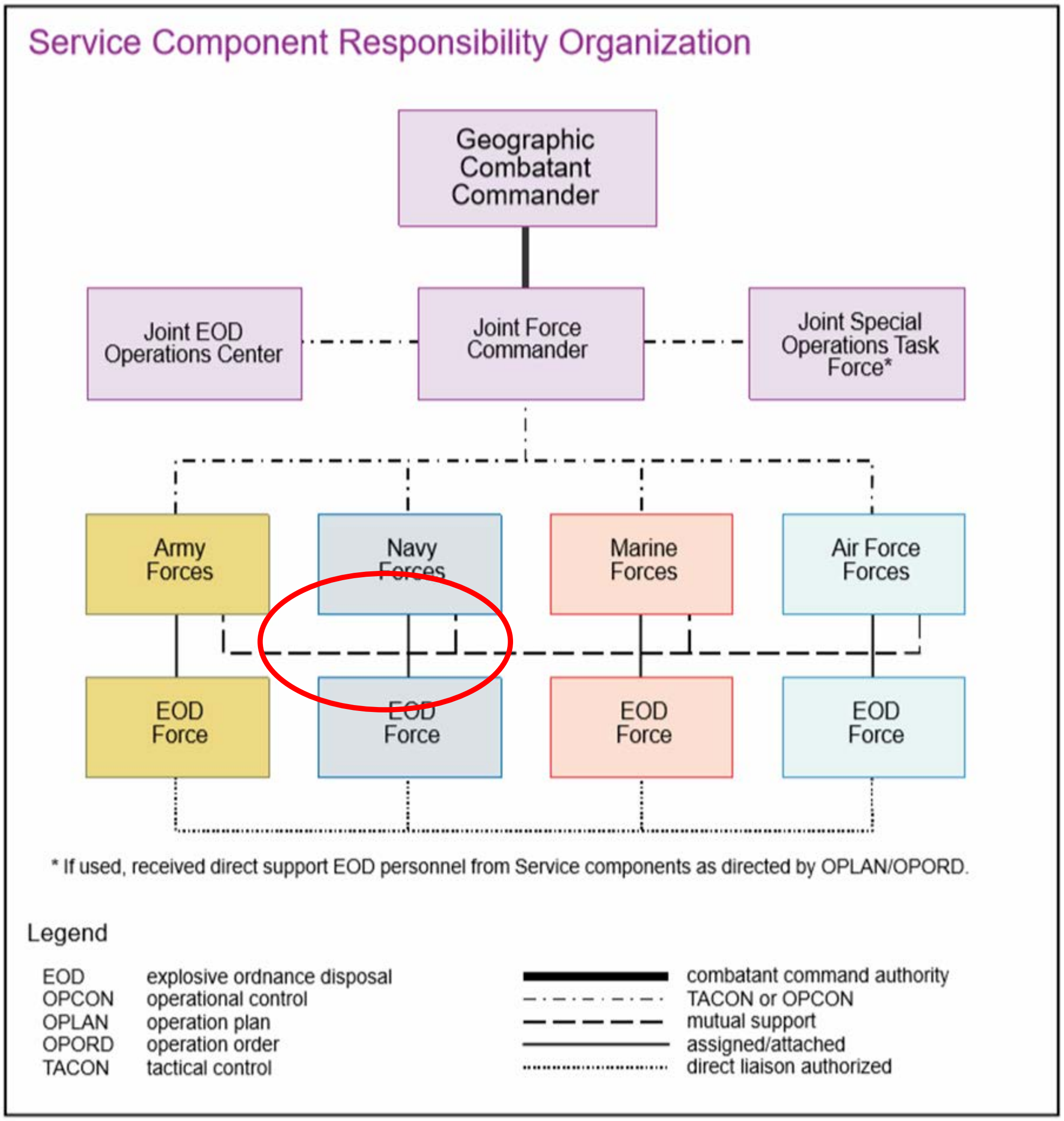
While the platoon should have received the entire complement of gear required for deployment, there may sometimes be adjustments to the process based on supply availability and community demand for limited equipment, such as the MK-16. ESU TWO manages an inventory of 89 MK-16 UBAs, to support three EODMUs, a MDSU, and the TEU (D. Murray, personal communication, August 22, 2017). The dive locker may delay issuance of the MK-16, if there is excess demand for use at the TEU in preparing other units for their own deployment schedule. There are simply not enough units to supply all operational units, and all units under training, at the same time. Operational platoons will always be prioritized, so Platoon 1201 should not be concerned that it will not deploy with necessary gear. Additionally, since MCM is a primary mission, MCM platoons will typically be outfitted at the start of workups, regardless. However, other platoons that treat MCM as a secondary mission, may suffer a delay of the complete MK-16 issue during workups, but they will be provided equipment on a short-term basis as they commence specific MK-16 training evolutions during the workup cycle, then receive the full issue prior to deployment. Since the TEU is also serviced by the dive locker, the demands of operational units may conflict somewhat with those of the training unit. As previously mentioned, there are sometimes tradeoffs, in order to ensure best distribution of limited equipment to meet operational requirements.

After about 18 months of training and sustainment, MCM Platoon 1201 will deploy. During sustainment and deployment, the process for acquiring repair and replacement equipment is an a la carte version of the ELO process, which is discussed in the following section.

2. Deployment

Upon completion of the training cycle, any training-specific gear issued by the dive locker will be returned, and any outstanding ELO gear requirements to-date, will be fulfilled by the ESU prior to departure. The unit then embarks on deployment to support real-time tasking from theater commanders, execute pre-planned missions, or operate independently, depending on theater demands. EODMU TWELVE has been tasked with conducting a dive mission, to clear a port in the Persian Gulf. This is a routine anti-terrorism/force protection (ATFP) mission, to ensure safe passage for a naval surface action group (SAG), scheduled to arrive soon. As depicted in Figure 16, EOD units will be assigned to naval forces in the region, which are under operational control of the Joint Force Commander (JFC), in this case Combined Task Force 56.1 (CTF 56.1), in Manama, Bahrain. Figure 16 illustrates a typical COCOM structure in the joint environment. This is a flexible organizational structure where units are routinely joining and departing the COCOM based on their service component and operational expertise.

Given that this was an expected mission due to planned unit rotational schedules, they are fully equipped to send one of their MCM platoons to respond to the task.



Note. This graphic depicts an operational Joint EOD force structure for deployed EOD units, and highlights where EODMU TWELVE would be assigned (circled area).

Figure 16. Service Component Responsibility Organization. Source: Chairman of the Joint Chiefs of Staff (2016).

This EOD MCM platoon is made up of approximately eight personnel. As part of their standard complement of gear, they were issued five MK-16 units and one operational support kit (OSK), which should be enough to handle the job. After four days of dive operations, two of the MK-16 units are in need of servicing. Several O-rings need replacement and one of the units needs an oxygen addition valve replaced. Until they are serviced, these MK-16s are not safe for use. Without them, the platoon is able to continue operations, but with only three remaining operational MK-16 systems. In order to meet the necessary pace of operations and to avoid any extended time on station, they need to get the equipment repaired. Fortunately, these items are available within the OSK. After a quick repair evolution, all MK-16 units are fully operational. This allows the platoon to meet the mission requirements as scheduled, and more importantly, this allows a follow-on naval SAG to pull into port safely and on time.

The use of parts from the OSK, along with a subsequent replenishment request from the platoon, create a demand signal for execution back at EODESU TWO. The goal is to maintain a fully-stocked OSK, to provide some maintenance capacity on-site. With other commodities, the platoon will typically coordinate with the Expeditionary Support Element (ESE), based in Bahrain. The ESE will then route those requests through the appropriate commodity manager at ESU TWO for processing. However, in the case of underwater commodity items such as this, they will typically e-mail with dive locker personnel directly to request necessary items. From a supply standpoint, this current request will be fulfilled two different ways. The routine expendable items (the O-rings), are available immediately from the supply warehouse. The commodity manager will enter the request in OMMS, which will route the request through the chain of command for approval. Once approved, the request will go to the warehouse to tag the O-rings for distribution to Platoon 1201. The oxygen addition valve however, is considered a depot-level repair (DLR) item, and therefore is handled somewhat differently. DLR basically means that the item cannot be locally serviced, and must be sent to a dedicated repair facility. The oxygen addition valve is requested in similar fashion as the O-rings, using e-mail and an OMMS job order. However, the platoon must also send the failed part back to the ESU for exchange. The exchange part will be turned in to the depot repair facility, where it will be refurbished or discarded as unserviceable. The repair facility will provide a replacement part to ESU, likely a refurbished item from a previous repair. The dive locker at the ESU will then generate a DD 1149 to document the parts delivery, make any necessary updates required in RCRP, and ship the O-rings and oxygen addition valve out to Platoon 1201. Upon receipt, the platoon has a DD 1149 for their records, and the OSK is back to full operational status. This process will occur repeatedly throughout the deployment, to facilitate repair and replacement activity on the MK 16.

3. Post-deployment

When authorized, following relief by an oncoming mobile unit, the staff and subordinate units of EODMU TWELVE will then conduct a pass-down, to convey critical up-to-date mission information and lessons-learned to the oncoming unit, along with any necessary turnover of equipment or personnel, prior to returning to Little Creek. Some equipment will be handed over to the oncoming unit, and as such, will remain in theater. This type of equipment designated for Relief in Place/Transfer of Authority (RIP/TOA) facilitates efficiency by avoiding unnecessary transit of some common gear, to and from Little Creek. Underwater commodity items, such as the MK-16, are not treated as RIP/TOA, and will physically move in conjunction with Platoon 1201.

Upon return, Platoon 1201 will follow up with EODESU TWO, to conduct all necessary equipment turn-in, along with associated documentation processes. The purpose of this effort is to reconcile supply-related activity that occurred throughout deployment and close out any outstanding logistics support requirements.

Just as when the platoon received initial gear issue, the primary process for gear return is also ELO. This involves presenting any remaining gear to the supply warehouse for reconciliation. ESU personnel will receive the gear, accept functional or repairable gear into inventory, and properly account for other equipment that is either unusable or lost. Functional gear may be cleaned and prepped for immediate redeployment, while repairable gear will be processed for repair or refurbishment before being returned to mission-capable status. ELO and associated data reconciliations to RCRP are important steps in the process for ensuring accountability for inventory levels. These steps support the ongoing financial improvement and audit readiness (FIAR) initiative across the DOD.

For TOA and PGI gear, Platoon 1201 will return to the supply warehouse at EODESU TWO, to transfer ownership of the preponderance of ELO. Again, the process takes approximately three weeks to complete. Using the original DD 1149 document from ELO issue, along with accumulated DD 1149s generated throughout deployment for parts orders, the platoon commander will work with ESU personnel to inventory all returned items. All equipment will be designated as mission-capable, serviceable, unserviceable, or missing. After accounting for all items, ESU personnel will return to WASP and RCRP for appropriate electronic transfer of ownership. In the case of unserviceable or missing items, a form DD 200 must be generated, to account for the loss. It is the responsibility of Platoon 1201 to generate the DD 200 and route it through their chain of command for review. A copy will be provided to EODESU TWO to facilitate recordkeeping, and to ensure inventory items are appropriately removed in WASP and RCRP, to avoid overstating the value and quantity of existing inventory.

Occasionally, due to operationally constrained deployment timelines, there is pressure to expedite the ELO process between deploying and returning platoons. A solution employed by EODESU TWO is a modified ELO. Requiring a surge of personnel and a tightly coordinated schedule, this allows a returning platoon to transfer inventory directly to another platoon starting workups. This requires coordinated commitment from both platoons and ESU, and can reduce the typical three-week process down to one week.

Again, EOD is a unique community within the Navy and utilizes equipment specific to only EOD units within the Navy. Other military branches operate with their own EOD units to execute a similar mission, but only the Navy EOD utilizes the MK-16 and performs the underwater MCM mission. The MK-16 UBA seems appropriate as a representative hardware sample due its complexity and many subsystem components that are required to be tracked and moved within the Navy supply system. Fast moving and expensive DLR items are closely tracked by the EODESU SUPP-O because each item is vital to system operation. DLR inherently indicates that those items are handled in a special manner and must physically be shipped for repair, further increasing the cost or lengthening the timeline to return the system to full operational capability.

THIS PAGE INTENTIONALLY LEFT BLANK

V. ANALYSIS AND CONCLUSION

A. CASE ANALYSIS

The objective of the following section is to review several key facets of the case, to highlight certain functions within the EXLOG supply chain. Though the focus is primarily on areas of friction, discussion also covers key strengths, which may potentially be leveraged for the benefit of other related entities within NECC.

1. Data Management

How an organization manages data can make a powerful difference in day to day operational effectiveness. Several routine inefficiencies in data flow are discussed here.

a. Data Entry/Redundancy

We concur with the findings of Kundra et al. (2014) that repetitious manual data entry is a persistent issue at both EODESUs. IT systems are a useful tool and clear demonstration of how technology can improve efficiency, but ineffective implementation continues to drive inefficient procedures, resulting in wasted man-hours and reduced accuracy and effectiveness. Subordinate commands, such as EODESU, use these systems independently and locally (i.e., WASP), but rely on them heavily, and yet the software programs are not connected with the controlling commands.

Concurrent with the inefficient duplicate effort to manage two systems for the same information is the introduction of human error when manually inputting data. Much of the ESU supply process is automated and tracked electronically, but when information is required to be manually entered (i.e., WASP), this opens a significant opportunity for errors. Much of the information being input is numeric along with some drop-down menu choice options within these systems. Upon the third entry of the same information, it is highly conceivable that a number could be input incorrectly or that a rapid selection from a drop-down menu may be incorrectly chosen, resulting in the same information being input differently in two or more IT systems. Currently, some of the EODESU IT systems manage only PGI, or only TOA, while others handle both, even duplicative from those that only handle either PGI or TOA. This repetitive and ineffective use of IT systems may be more burdensome to productivity than simply maintaining a spreadsheet of all inventory and managing version control of the revised spreadsheet.

Initially, this error may not be drastic or even noticeable. It may be discovered only in the course of reconciliations, inspections, or a general review of data. A line item incorrectly input into WASP, for example, would be used internally at the warehouse by EODESU but not by NECC. If the mistake was a reduction in quantity of an item due to error in manually entry, then NECC may see what appears to be satisfactory and accurate data but EODESU may be ordering and replenishing unnecessary items resulting in a loss of time, money, space, and efficiency of the EXLOG process. Similarly, an error in RCRP regarding inventory levels may improperly under- or over-state the value of current inventory to upper echelons within DOD, contributing to larger, ongoing issues with auditability.

To compound an already complicated supply process for a young command with many demanding tenants, DPAS is another DOD-required IT system that tracks property valued over $5,000, or other sensitive items as directed (i.e., difficult to replace, prone to theft). With the multitude of required IT systems for tracking millions of dollars of gear and inventory at the ESU, as well as the addition of WASP for internal use due to convenience and security, one can see there is vast opportunity for error and inefficiency.

Improved system interoperability is the greatest course of action (COA) available that will improve overall effectiveness and efficiency of EODESU at performing EXLOG and keep the existing legacy IT systems. Working with the current available IT systems is advantageous because it does not require the purchase of new operating systems, either in the open market or creating one specifically for NECC and EODESU. With new purchases, there are acquisitions rules and regulations required to be adhered to. The Federal Acquisitions Regulations (FAR) has numerous additional requirements concerning competition, scope of work (SOW), and acquisition authority, which would place a significant time burden and additional responsibility on NECC and EODESU.

One of the initial steps before adding more IT systems or spending money to train on new equipment should be to study how the various IT systems can be made to communicate and operate between each other. Once the systems are operating and sharing data, the data then can be consolidated and made easier to track or sort. Only when the existing infrastructure is made to handle the data and information to a point where it is fully understood, and all categories of gear (PGI, TOA, COSAL) are accessible in the same system and easily sortable, should a new IT system be developed. Introducing a new system is not necessarily an immediate solution because the output cannot be controlled if the input is disorganized, that is to say, inputting inaccurate data that is unsorted to a new system will yield unsorted, inaccurate data that was produced from a new IT system.

b. Reporting Requirements

NECC has a persistent need for an effective, integrated logistics and inventory management IT solution. As a parent command of a diverse, technically challenging, and highly capable set of units, NECC must operate abreast of its units, if not ahead, in order to maintain effective control. It is plausible that, if NECC failed to receive accurate information or information that is significantly delayed, the subordinate commands could begin to operate more independently than they currently do. Reduced input from NECC is concerning given the larger mission objective of a parent command and higher echelon leadership.

As the controller of the budget being distributed to EODESU, NECC should not simply allocate budget authority to EODESU without tracking historical purchases or having an input on what is required for the command to achieve the higher-level objective. Each command has a role in supporting the greater NECC goals, but the responsibility lies with NECC to control and lead those commands through budget controls, receipt and reporting of accurate information, and general leadership so that each unit is successful.

There are several options under consideration, and likely an even greater available pool of commercially available solutions not being currently considered, for satisfactory IT systems that would improve EXLOG within NECC. Some of the IT systems not being considered may be due to cost, Navy/Marine Corps Intranet (NMCI) compatibility, or compatibility issues with existing DOD legacy systems, among other reasons. Those currently under consideration are sufficient, and once operational, can generate increased efficiency and improvement of EXLOG. It is likely that, until an efficient tool is in place, effective analysis of EODESU supply chains will remain prohibitive. It is the expectation that, once an IT solution is in place, subsequent research teams will be in a much more advantageous position to glean concise, actionable data from ESU supply history.

2. Audit Readiness

At the conclusion of Fiscal Year (FY) 2017, the DOD has yet to earn audit-ready status, contrary to the Chief Financial Officer (CFO) Act of 1990. By signing the CFO Act of 1990, President Bush required that "the government use timely, reliable, and comprehensive financial information when making decisions which have an impact on citizens' lives and livelihoods" (CFO Act, 1990). Currently, the DOD is the largest budget of the federal government, totaling $583 billion for FY 2017 (Office of Management and Budget, 2017). This total amount includes both discretionary spending and overseas contingency operations (OCO) funding. Commonly within the DOD, agencies that do not fully execute or obligate all of the funds that expire in the operating FY do not receive a larger or even equal amount the subsequent year. In the current fiscal environment, it is near unimaginable to think that $583 billion is spent each year by organizations within the DOD in a competitive fashion to ensure each entity gets at least their previous share of the money the following year.

3. Command Structure

a. EOD Officer in Charge of TOA

At EODESU, an EOD officer is in charge of managing the TOA commodity. TOA is managed via Navy and EODESU supply systems. Therefore, it is inherently a SUPP-O function, but the position is filled with capable EOD officers. Uniformed members of the military are highly capable, and commonly used to fill voids in job positions in which they may have minimal formal training or experience. Given the relative agility of an EOD JO, it should not necessarily be considered a detriment that he or she be placed in charge of supply functions within EODESU. What an EOD-trained officer may lack in supply training, they are able to make up in tactical experience. As requests for tactical gear repair or replacement are submitted, a field-experienced Officer will be capable of quickly understanding the nature of the request and bridging any communication gaps in the process. This operational knowledge translates into effective prioritization of similar requests in the event of resource availability constraints. Further, to help mitigate risks associated with limited supply experience, there are several Supply Officers within arms' reach to support. For example, at EODESU TWO, the PGI manager, a formally trained Supply Officer, works just a few steps away in the adjoining office. Overall, we do not find fault or lag in the EXLOG process due to EOD Officers filling SUPP-O positions within EODESU. In fact, this should be considered an advantage to the ESU manning construct.

b. NECCPAC

NECCPAC is an administrative organization specific to West Coast EODESU. COMNECC is dual-hatted with responsibility as COMNECC and COMNECCPAC. NECCPAC was established to advocate and help administer tasks that were burdensome to the West Coast units that related to coordinating with NECC on the East Coast. It is unclear whether the development of NECCPAC was due to reduced operating oversight given to the West Coast teams from NECC or whether there needed to be an intermediate advocate with near proximity to help promote efficiency for EODESU ONE.

Historically, and what appears to be the case with NECCPAC, is additional entities and COCs were established in good faith to help solve some existing perceived issue at the time, but added another layer of bureaucratic effort when routing from West Coast EODESU to East Coast NECC. Based on our research team's limited visit times to the East and West coast, there was not sufficient time and data to allow analysis to the impact of NECCPAC, good or bad. NECCPAC is useful and a good resource if they are allowed certain authorities that can allow operational efficiency to improve in real time. Previously, EODESU ONE was required to communicate with the East Coast on a time delay, but now with NECCPAC, they can have a close ISIC to help support efficient EXLOG operations.

4. Modified ELO

The modified ELO is generally the exception rather than the rule, but exists as an option for meeting tight operational turnaround. This can be undesirable for involved personnel, due to the increased coordination required and compressed timeline. It saves time by avoiding the process of transferring equipment ownership authority to the ESU, only to transfer the same inventory immediately back to another unit. This essentially cuts out the ESU middleman on a typical ELO transfer. However, benefits are limited since the process does nothing to alleviate required steps to replenish any serviceable, unserviceable, or missing gear. Essentially, this puts a much greater demand on ESU personnel and involved platoons, but allows for an expedited transfer to meet operational timelines.

5. MK-16 Demand History

A review of MK-16 demand history that illustrates the subsystem components that are most frequently ordered, rapidly required, and on average, are the most expensive. A twelve-month demand history of MK-16 components ordered by EODESU TWO, represented in Table 4, shows that actual ordering was significantly higher than initial estimates. In one case, there was over 1,000% difference in actual ordering compared to what EODESU TWO initially estimated. This significant difference in demand estimation requires improvement through enhanced history tracking and data analysis. Reduced lead times, reduced urgent ordering, and overall increased efficiency is a certain result of improved estimates of MK-16 component demands.

Table 4. Analysis of EODESU 12-Month Demand versus Estimate

NOMENCLATURE	NIN / PART NUMBER	Each	EODESU TWO 12 month demand	4 year OARS demand	Avg Unit Cost ($)	DLR/urgent NON-DLR	Estimate vs. Actual % delta
Battery, Secondary 1.5 volt	013552524/6195925	50	456	1613	$ 17.62	fast mover	812%
Sensor Assembly (O2)	015298960/6915278	20	247	1084	$ 197.41	fast mover	1135%
O-Ring	014469109/6914770-26	30	209	1263	$ 1.00	fast mover	597%
O-Ring	014128292/6914770-5	30	140	140	$ 6.00	fast mover	367%
Battery Assembly, Primary	015299000/6915242	10	80	310	$ 78.81	fast mover	700%
Sensor Connector Assembly	014125483/6196183	10	78	126	$ 32.92	fast mover	680%
Blowout Disk	014118386/B16189-1	30	70	134	$ 57.87	fast mover	133%
Battery Adaptor	014830397/6914774	8	69	207	$ 16.23	fast mover	763%
O-Ring Kit	014667354/6914771	10	58	233	$ 38.31	NON-DLR	480%
Switch Assembly	015299003/6914831-1	8	49	132	$ 136.40	fast mover	513%
O-Ring	014460718/6914770-7	50	38	64	$ 3.00	fast mover	-24%
MouthPiece	013047142/6195947	8	34	84	$ 568.48	NON-DLR	325%
PWB Gain Adjust	014212726/6195785	3	29	88	$ 499.78	NON-DLR	867%
O-Ring	014460719/6914770-15	30	20	108	$ 8.00	fast mover	-33%
O-Ring	014460716/6914770-16	30	16	27	$ 6.00	fast mover	-47%
Fuse	0148380396/6914775	10	13	15	$ 4.00	fast mover	30%
Cover, Assembly	012999780/6196126	2	9	34	$ 820.85	NON-DLR	350%
O-Ring, Inner	013710463/6914770-11	8	8	4	$ 8.00	NON-DLR	0%
O-Ring, Outer	013710464/6914770-12	8	8	1	$ 3.00	NON-DLR	0%
Holder, Primary Display	014128315/6196090	10	7	65	$ 62.70	fast mover	-30%
Filter, inline	012983005/6195857	5	5	93	$ 265.42	NON-DLR	0%
Support Base Assembly	012959268/6195979	2	5	19	$ 50.07	NON-DLR	150%
Threaded Retainer	013000091/6195791	3	4	11	$ 40.80	NON-DLR	33%
Primary Electronic Assembly (DLR)	015305593/6914802	3	3	83	$ 1,540.92	DLR	0%
Display, Secondary (DLR)	012970920/6196066	3	3	63	$ 8,436.71	DLR	0%
Valve Diluent (DLR)	012970901/6196012	3	3	130	$ 1,507.80	DLR	0%
Valve, Oxygen (DLR)	012975977/6196011	3	3	34	$ 1,289.88	DLR	0%
Primary Display Assembly	012970949/6196140	3	3	46	$ 1,664.24	NON-DLR	0%
Hose, High-Pressure	013641719/6196161	3	3	41	$ 448.88	NON-DLR	0%
Nut, Secondary Display	012970890/6196072	3	3	1	$ 57.00	NON-DLR	0%
Canister Assembly, Complete	012975994/6196095	3	3	3	$ 831.00	NON-DLR	0%
Center Section Assembly (DLR)	012965892/6195797	2	2	22	$ 13,764.05	DLR	0%
Gauge Assembly O2 HP	012970965/6196159	2	2	22	$ 764.09	NON-DLR	0%
Gauge Assembly Diluent HP	013651719/6196160	2	2	9	$ 578.00	NON-DLR	0%
Cable Assembly, Secondary Display	012970902/6196017	2	2	29	$ 1,426.46	NON-DLR	0%
Cable Assembly, Primary Display	012970903/6196019	2	2	35	$ 1,433.57	NON-DLR	0%
Cable Assembly, Scrubber	014128287/6196018	2	2	15	$ 1,335.90	NON-DLR	0%
Cabble Assembly, O2 Addition	012970904/6196020	2	2	9	$ 1,907.20	NON-DLR	0%
O-Ring	014460715/6914770-2	30	0	1322	$ 1.80	fast mover	-100%
Cap, Secondary Display	013970985/6196073	3	0	21	$ 113.14	NON-DLR	-100%
Oxygen addition valve (DLR)	01297596/6196153	2	0	5	$ 8,650.80	DLR	-100%

MK-16 component analysis in Table 3 shows that fast moving items, i.e. low density and high demand, were the among the components with the highest difference in estimated demand and actual demand. Urgent orders for items related to a mission critical system such as the MK-16 can be acceptable of course to ensure completion of the mission but should be minimized by sufficient inventory. Items such as batteries that are part of the system are reasonable to classify as "fast movers" due to their usage rates and relatively short usage life compared to the system as a whole. O-rings, in particular, classify as "fast movers" and are an operational and safety requirement for a full-functioning MK-16 system. As well, O-rings are the largest component of demand at EODESU TWO that is truly a MK-16 specific item. Given EODESU TWO's classification of the O-rings as "fast movers," there should be more accurate forecasting to ensure less variability in estimated versus actual demand.

The center section assembly, classified as DLR, is the most expensive of the MK-16 system components. The average unit cost (AUC) is nearly $14,000 and in one year, EODESU TWO ordered two. Generally, Table 3 showed that DLR items had higher AUC probably due to the additional technical skill and logistics required to repair damaged items. The center section assembly, for example, is at the base of the scrubber assembly of the MK-16 UBA. Incorporated in the center section assembly are three "fast moving" O-rings. Knowledge of the MK-16 system and detailed tracking is required to provide EOD technicians with complete and usable component assemblies, therefore EODESU personnel must carefully consider items that are "fast movers" but incorporated in DLR components. This combination of EOD technical skill and Navy supply blended to create the mission of EODESU. Personnel must analytically associate mission critical items and prioritize them accordingly while understanding the systemic operation of the MK-16 and how subcomponents are used together to properly use the MK-16 UBA.

The largest demand item not classified as a "fast mover" is the O-ring kit and is a non-DLR item. With a 480% difference in estimated versus actual demand, this non-DLR item serves as an example of one needing precise estimation to avoid urgent or excessive ordering as well as more efficient warehouse inventory stocking. Fast moving and non-DLR items do not require the repair facility or "depot," therefore EODESU TWO is able to repair or replace the item and return the system to functional service more efficiently.

B. CONCLUSION

EODESU mission is complex, and the responsibility to perform EXLOG so the supported units can be successful is very high. Based on our research, we sustain the Kundra et al. (2014) study findings that the IT systems are antiquated, inefficient, and do not communicate well with other Navy IT systems. Additionally, using the MK-16 system as an example of a mission critical system and studying demand history and inventory logistics, we found that there are significant differences in estimated versus actual demand, not necessarily associated with only the MK-16 system. The inconsistency in estimated versus actual demand leads to unnecessary time and effort spent acquiring a “fast moving” items.

Tracking and managing equipment via these IT systems is a necessity given the complexity of the EOD mission and quantity of associated equipment inventory. The IT systems at the EODESUs need enhanced quality and reduced quantity in order to optimize their use. Too much reliance on knowledge of the senior members at the organization is insufficient and certainly not accurate enough to manage the gear and equipment that supplies the Navy’s premier expeditionary forces. The multiple warehouse, inventory, and logistics management IT systems each have unique capabilities but do not function well together without the laborious effort of EODESU personnel.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. RECOMMENDATIONS

A. RECOMMENDED SOLUTIONS

The following is a list of potential solutions to several of the aforementioned issues discussed in the case analysis. The following recommendations are reasonable and achievable, though some may require resources beyond that of current NECC budgetary constraints. Regardless of those cases, they will remain listed here for the record, until such time as financial resources, technology, and/or ingenuity improve so as to allow for their implementation.

1. Data Management Recommendations

Much of what is to be cited as recommendations for data management resides with the implementation of new or improved IT systems. A new, comprehensive IT system is unequivocally a cover all solution but as well, improvements to interoperability amongst legacy systems will improve the status quo. Generic improvement to IT systems will not suffice as a legitimate solution, but new solutions that reduce the total number of IT systems in operation and enhance functional capabilities are what is truly necessary.

a. Data Entry/Redundancy

If a new IT system is to be developed and introduced, it should reduce the total number of IT systems in operation by two. Reduction of operational IT systems should be in the concept of operations (CONOPS) in order for there to be effective change and enhanced simplicity for users at the EODESU level. Simply substituting one system, for another (i.e., DPAS warehouse for WASP) appears wasteful. While comparatively it may be better in some fashion than the one it is replacing (barcode input), it does little to actually improve the process or add real value.

In the development of new IT systems that reduces the total number of operational systems by at least two, the functions of those systems being replaced must still be accomplished. Therefore, there must be enhanced functional capability of the replacing IT systems compared to those being replaced because this new system must still meet the mission needs of EODESU. Significant pre-developmental group meetings must occur with input from every end user, both the command generating data as well as the command receiving it and the engineers developing the system. Communication will ultimately drive the solution to be effective and simpler or only another substitution that requires new training and initial defects to be worked out.

In the interim, a time and resource study should be conducted to better illustrate the human resource costs associated with current IT data processes. This would also provide a metric from which to measure the value of IT investments under consideration.

b. Reporting Requirements

Times and technology have changed and will continue to change; therefore, the medium through which communications occur will inevitably change, but the requirement for reporting and constant communication will not. Improved requirements communications should occur between reporting and receiving commands so that the necessities are established for what information is needed. With that information requirement, project teams can work together to develop functional systems that meet those requirements. A few considerations based on our team's research that could be useful in the development of the new IT systems to amplify reporting are DD form automation, establish a bridge of communication between DPAS warehouse and RCRP, and ensure FIAR compatibility.

> To ensure data integrity, there must be one – and only one – system of record for a given piece of property. The APSR [RCRP] is a subsidiary ledger to the financial systems general ledger and represents the transactions impacting the property. (OUSD AT&L, 2017)

Currently, there are DOD-wide efforts to improve reporting requirements, driving a desire to change legacy IT systems in a way that offers a fix to one or more known problems. DPAS warehouse is being considered for implementation at the ESUs as early as November 2017, as an interim replacement for WASP. While we support the advantages of bringing this system online for its data entry automation features (bar code readers), and its existing status as an APSR within DOD, it does too little to change the ongoing issues with effective documentation, reporting to higher echelons, and data accuracy risk. To date, a request for this program to provide automated output of DD 200 forms remains outstanding (DPAS, 2017). The DD-200 form is one of many basic, routine byproducts commonly associated with the inventory data management process (i.e. WASP/DPAS Warehouse data entries). This should be an obvious feature for inclusion in any IT solution under consideration. Automated generation of a DD-200 form would allow for quicker, simpler population of a required document, by reducing repeated data input tasks, and associated data accuracy risk due to human error. Ideally, the warehouse management tool would provide not only automated form generation as mentioned, but should also connect directly with RCRP, to provide inventory data up the chain of command without the need for re-entry of existing data in WASP.

2. Audit Readiness

NECC should ensure that new IT systems either purchased as COTS, or custom-developed, are acquired with audit readiness in mind. Another advanced solution under consideration, dubbed Naval Operational Supply System (NOSS), is the latest effort to address some of the concerns discussed here. NOSS seeks to bridge several existing supply systems (WASP, DPAS Warehouse, portions of R-Supply, etc.), but also leverages an existing system called Real-Time Value Network (RTVN), which meets FIAR compliance standards for audit reporting (Reed, 2017). To improve inventory reporting, RTVN would feature an option for end-users to create a batch file that may be exported electronically. If successful, this would address current shortcomings of redundant entry of warehouse data into the approved Navy reporting system, RCRP, and presumably allow for more timely access to inventory data at upper echelons. As EODESU seeks to implement recommendations for improved logistics, it should ensure due diligence in ensuring that any such solution implemented is appropriately aligned with DOD/FIAR audit readiness mandates.

B. RECOMMENDATIONS FOR FURTHER RESEARCH

EXLOG will continue, regardless the efficiency of any unit performing EXLOG, due to the operational demand in the current global threat scenario. Further research of EXLOG will enhance operations and seek continuous process improvement (CPI) for the communities involved which ultimately benefits the entire force. Studying specific units performing EXLOG is beneficial because it allows a detailed insight into the processes currently in use.

As expeditionary missions and related support continue to evolve, areas for improvement might only be revealed through periodic analysis of an evolving supply chain. Research into IT solutions will continue to be a recommendation, but will always be followed close behind by the financial concern. IT solutions, in general, are not cheap and are constantly evolving, and the benefit must be weighed against the cost.

1. Logistics Management Tools (IT)

While the RTVN/NOSS opportunity may finally implement the IT solution needed by the NECC community, it is simply another proposal amongst a patchwork of prior attempts (Reed, 2017). If not this, then something similar must be researched, that would address the series of limitations discussed herein. It is strongly advised that NECC avoid further implementation of temporary solutions. Those such as WASP, only serve to entrench inefficient, disconnected data processes into a supply chain already riddled with friction points. Objectives should focus on universal systems that may apply even beyond NECC, such that maximum standardization is achieved, reducing training time, and increasing fleet proficiency.

2. USMC EXLOG

Another DON organization performing EXLOG is the USMC. The USMC operates as a department within the Navy, and much of the funding is interlinked between the two organizations. There is a potential gain from specific studies of the USMC forces performing EXLOG. Amphibious operations such as EXLOG are inherently performed by the USMC and are considered one of its core missions. Most of the research done regarding EXLOG effectiveness and efficiency has revolved around NECC or other communities that operate in parallel with or for NECC, but the USMC has a significant footprint in EXLOG and there certainly could be room for improvement if studied appropriately.

The USMC has a smaller operating budget than the DON, but the percentage of their budget as a whole that is related to EXLOG is significantly higher, given its importance as one of its core missions. Therefore, there are potentially greater cost savings, ideas for implementation, or a number of other valuable solutions available through a comprehensive study of USMC EXLOG.

3. Prior, Unaddressed Research Recommendations

The following recommendations were proposed by Kundra et al. (2014). Our research team is including them here because they remain important and have yet to be addressed.

a. Reliance on Commercial Equipment and Government Purchase Card

The Kundra et al. (2014) thesis previously recommended that research be performed to enable purchase data history be more easily available via new systems or methods with a central viewing location or distribution location. This recommendation still holds true and aligns with many of the other recommendations our research team is making that are cost effective and achievable within a reasonable length of time. Data history for acquisitions, purchases, demands, repairs, and other logistics support actions should all be stored electronically via one of the many IT systems currently in place at NECC and EODESU. Ultimately, one comprehensive IT system is the goal, but until that solution is adopted, the information exists in electronic form but among many systems.

User effort, knowledge, and experience with the systems and processes is required in order to gather the required data for the research teams who perform the studies to enhance EXLOG operations. User interface and operability should not be so difficult, but current systems require that a user have working knowledge of multiple databases to simply access the data. Then, a user must understand the process for which the acquisition, order, or repair was made, in order to make relevant use of the data presented.

The Government Commercial Purchase Card (GCPC) is a tool provided by the federal government and used by many within the DOD to acquire certain items that are urgently needed and meet a required threshold. GCPC purchases are required to be tracked by nearly every supporting command; therefore, the data is available and reasonably accessible in order for it to be presented and reviewed by immediate superior in command (ISICs). With the data available and accessible, studies should be performed focusing on EODESU purchases using the GCPC to determine what items in particular are being purchased, what the associated costs are, what the primary reason for the purchase is, and importantly why the item was not already stocked or inventoried by a Navy unit since the acquisition required GCPC action with funds going outside of the federal government system.

b. *Contracting Support*

The Kundra et al. (2014) thesis previously recommended that contracting support be reviewed as a potential source of gain within EODESU. Based on the research the team did, the evidence exists that a staff GS-11 or GS-12 warranted contracting official would benefit EODESU. The unit is a revolving machine for financial transactions, and many of those are revolved around acquisitions of goods or services. NSW teams are equipped with internal contracting support allowing them to acquire the necessary goods and services within the rules and regulations of the FAR, only much faster. EODESU SUPP-Os are well versed in the FAR and have experience in dealing with contracts or administering them, but are not given contracting authority via a contracting warrant to enter into obligations on behalf of the government. This could be beneficial for items that lie outside the threshold of the government commercial purchase card (GCPC), or in those circumstances when a single-source provider is the only competition and special contracting rules are required to be followed.

Given the large amounts of money that pass through EODESU accounts regularly, investing in a full-time contracting official could help save money. Contracting officials are able to negotiate purchases, compete contracts for items that are necessary but not urgent in order to have competition drive down the cost, as well as other useful necessities that currently EODESU is required to seek outside support for. The requirements will still remain whether EODESU seeks outside support for contracting or can handle it internally, but efficiency and reduced burden for communications between different units would be gained by hiring a full-time contracting official.

c. *Logistics Training*

The Kundra et al. (2014) thesis previously recommended that logistics training be reviewed as a COA for enhancing warehouse production efficiency and expertise. Training and increased effectiveness using the IT systems is certainly a solution that will improve operations and should be considered on a routine basis. Knowledge of the systems will dissipate with limited use for certain individuals as well as with the constant military transfer rotations; personnel will change duty stations and take their level of knowledge with them. New personnel should be trained upon arrival via standard introductory training and routine training by senior leaders. A rigorous and effective qualification program should be established within the commands to ensure a baseline expertise by all users. The qualification program would give confidence to all users that the information in the IT systems is at least input or updated by qualified personnel so there would be no need for the redundant systems managing the same information. We consider this recommendation to remain valid, though implementation of a new IT solution, potentially standardized beyond just the NECC community, could reap much greater economy of effort in maintaining a well-trained supply workforce.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

Applegate, K. A. (2006). *Naval expeditionary logistics: A handbook for complementing and supporting land forces* (Master's thesis). Retrieved from https://calhoun.nps.edu/handle/10945/10147

Bergman, J. (2011, February 16). Temperature of ocean water. Retrieved from https://www.windows2universe.org/earth/Water/temp.html&edu=elem

Chairman of the Joint Chiefs of Staff. (2016). *Joint explosive ordnance disposal* (JP 3-42). Retrieved from http://www.dtic.mil/doctrine/new_pubs/jp3_42.pdf

Chief Financial Officers Act of 1990, Pub. L. No. 101-576 (1990). Retrieved from https://govinfo.library.unt.edu/npr/library/misc/cfo.html

Committee on Naval Expeditionary Logistics. (1999). *Naval expeditionary logistics: Enabling operational maneuver from the sea.* Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a413072.pdf

Federal Acquisition Regulation (FAR), 48 C.F.R. ch. 1 (2017).

Defense Property Accountability System (DPAS). (2017, March 8). Request DD Form 200. Retrieved from https://dpassupport.golearnportal.org/index.php/support/system-change-request/details/4/19940/request-dd-form-200

EODESU (Explosive Ordnance Disposal Expeditionary Supply Unit) ONE. (2017, September 18). Explosive Ordnance Disposal Expeditionary Support Unit ONE command brief [PPT]. Personal communication.

EODESU (Explosive Ordnance Disposal Expeditionary Supply Unit) TWO. (2017a, August 8). EOD_MDS overview [PPT]. Personal communication.

EODESU (Explosive Ordnance Disposal Expeditionary Supply Unit) TWO. (2017b, August 8). Explosive Ordnance Disposal Expeditionary Support Unit TWO command brief [PPT]. Personal communication.

EODESU (Explosive Ordnance Disposal Expeditionary Supply Unit) TWO. (2017c, August 8). Explosive Ordnance Disposal Expeditionary Support Unit TWO MK 16 Mod 1 brief [PPT]. Personal communication.

EODTEU (Explosive Ordnance Training and Evaluation Unit) TWO. (2017, October 25). Explosive Ordnance Training and Evaluation Unit Unit TWO FRTP Slides Final [PPT]. Personal communication.

Harwood, M.J. (1980). *MK 16 MOD 0 UBA TECHEVAL report* (Report No. 14-80). Panama City, FL: Department of the Navy, Navy Experimental Diving Unit. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a091892.pdf

Kundra S., Brown L., & Donaldson C. (2014). *Assessment of logistical support for expeditionary units* (Master's thesis). Retrieved from https://calhoun.nps.edu/bitstream/handle/10945/42666/14Jun_Kundra_Brown_Donaldson.pdf?sequence=1

Naval Expeditionary Combat Command (NECC). (2014, February 6). NECC overview brief [PPT]. Personal communication.

Naval Expeditionary Combat Command (NECC) (n.d.). NECC fact sheet. [Fact sheet]. Retrieved from http://www.public.navy.mil/NECC/Documents/NECC.pdf

Naval Facilities Engineering Command (NAVFAC). (2016). *Management of expeditionary equipment* (P-480). Retrieved from https://www.navfac.navy.mil/content/dam/navfac/Expeditionary/PDFs/NAVFAC-P480-29Jun2016.pdf

Nilsen, J., Tessier, J., Lugo, J., & Perez, R. (2004). *Logistics support of naval expeditionary units* (Master's thesis). Retrieved from https://calhoun.nps.edu/handle/10945/9911

Office of Management and Budget. (2017). *The President's budget: Agency fact sheet*. Retrieved from https://www.defense.gov/Portals/1/features/2016/0216_budget/docs/2-4-16_Consolidated_DoD_FY17_Budget_Fact_Sheet.pdf

Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. (OUSD AT&L). (n.d.). Accountable property systems of record. Retrieved November 20, 2017, from https://www.acq.osd.mil/pepolicy/accountability/accountability_APSR.html

Reed, S. (2017). *Table of allowance (TOA)/personal gear issue (PGI) concept of operations version 1* [Working paper].Norfolk, VA: U.S. Fleet Forces.

U.S. Marine Corps. (2015, April 13). Expeditionary logistics. Retrieved from https://marinecorpsconceptsandprograms.com/programs/unit-readiness/expeditionary-logistics

McNabb, M. (2014, April 9). Consolidated shipboard allowance listing (COSAL). Retrieved from http://www.public.navy.mil/surfor/lha6/Pages/COSAL.aspx

ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL
555 DYER ROAD, INGERSOLL HALL
MONTEREY, CA 93943

www.acquisitionresearch.net