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NAVAL EXPEDITIONARY COMBAT COMMAND (NECC) EXPEDITIONARY MAINTENANCE FACILITY IN BAHRAIN: A COST BENEFIT ANALYSIS (CBA)

December 2018

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Naval Expeditionary Combat Command (NECC) forces deploy to Bahrain in support of ongoing operations in the 5th Fleet Area of Responsibility, attached to Commander Task Force 56 (CTF 56). The largest of these deployers are Naval Construction Battalions (Seabee), Explosive Ordnance Disposal (EOD), and Coastal Riverine Group (CRG). Each of these deploy with Construction Mechanics (CM), Enginemen (EN), Logistic Specialists (LSs), and other supporting military operational specialties to support and maintain common equipment in the execution of their missions. Therefore, the purpose of this project is to conduct a preliminary cost benefit analysis (CBA) to evaluate the feasibility and attractiveness of establishing an Expeditionary Maintenance and Logistics Facility in Bahrain. This facility will support Seabees, CRG, EOD, and other deployed NECC forces while reducing costs and improving efficiencies by pooling maintenance activities.

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ABSTRACT

Naval Expeditionary Combat Command (NECC) forces deploy to Bahrain in support of ongoing operations in the 5th Fleet Area of Responsibility, attached to Commander Task Force 56 (CTF 56). The largest of these deployers are Naval Construction Battalions (Seabee), Explosive Ordnance Disposal (EOD), and Coastal Riverine Group (CRG). Each of these deploy with Construction Mechanics (CM), Enginemen (EN), Logistic Specialists (LSs), and other supporting military operational specialties to support and maintain common equipment in the execution of their missions. Therefore, the purpose of this project is to conduct a preliminary cost benefit analysis (CBA) to evaluate the feasibility and attractiveness of establishing an Expeditionary Maintenance and Logistics Facility in Bahrain. This facility will support Seabees, CRG, EOD, and other deployed NECC forces while reducing costs and improving efficiencies by pooling maintenance activities.

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

ADCON	Administrative Control
AO	Area of Operations
AOR	Area of Responsibility
APL	Allowance Parts List
C2	Command and Control
CA	Civil Affairs
CBA	Cost–Benefit Analysis
CCB	Coastal Command Boat
CESE	Civil Engineer Supporting Equipment
CJSOTF	Combined Joint Special Operation Task Force
CM	Construction Mechanic
CNO	Chief of Naval Operations
CO	Commanding Officer
COA	Course of Action
COMCAM	Combat Camera
COMNECC	Commander, Navy Expeditionary Combat Command
CONUS	Continental United States
CPI	Continuous Process Improvement
CS	Combat Support
CRF	Coastal Riverine Force
CRG	Coastal Riverine Group
CTF 56	Commander Task Force 56
DETS	Detachments
DoD	Department of Defense
DoN	Department of Navy
DTS	Defense Transportation System
ECRC	Expeditionary Combat Readiness Center
EOD	Explosive Ordnance Disposal
EODESU	Explosive Ordnance Disposal Expeditionary Support Unit
EODMU	Explosive Ordnance Disposal Mobile Unit
EN	Engineman
ESU	Expeditionary Support Unit
ETC	Expeditionary Training Command
EXLOG	Expeditionary Logistics
FIAR	Financial Improvement and Audit Readiness
FY	Fiscal Year
GWOT	Global War on Terrorism

HADR	Humanitarian Assistance and Disaster Relief
HN	Host Nation
HVA	High Value Asset
IA	Individual Augmentee
IED	Improvised Explosive Device
IET	Intelligence Exploitation Team
ISIC	Immediate Superior in Command
IT	Information Technology
LS	Logistics Specialist
MIP	Maintenance Index Page
MM	Machinist Mate
MRC	Maintenance Requirement Card
N4	Naval Logistics Department
NAVCENT	U.S. Naval Forces Central Command
NAVELSG	Navy Expeditionary Logistics Support Group
NAVSOC	U.S. Naval Special Warfare Command
NCF	Naval Construction Force
NECC	Navy Expeditionary Combat Command
NEF	Navy Expeditionary Forces
NEIC	Naval Expeditionary Intelligence Command
NOLSC	Naval Operations Logistics Support Center
NPS	Naval Postgraduate School
0-6	Captain (USN)
0-5	Commander (USN)
0-4	Lieutenant Commander (USN)
0-3	Lieutenant (USN)
OMFTS	Operational Maneuver from the Sea
OMMS	Organizational Maintenance Management System
OPCON	Operational Control
PGI	Personal Gear Issue
PMS	Planned Maintenance System
RC	Reserve Component
RCRP	Readiness and Cost Reporting Program
RHIB	Rigid-Hull Inflatable Boat
RIP/TOA	Relief in Place/Transfer of Authority
RIVGRU	Riverine Group
SABAR	Service-Craft and Boat Accounting Report
SKED	Preventive Maintenance Schedule Tracking Software
SOF	Special Operations Forces
SOP	Standard Operating Procedure

SPECOPS	Special Operations
SUPPO	Supply Officer
TAD	Temporarily Assigned Duty
TEU	Training and Evaluation Unit
TOA	Table of Allowances
TYCOM	Type Commander
USN	United States Navy
USCENTCOM	United States Central Command
3M	Maintenance Material Management
3MC	Maintenance Material Management Coordinator

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I. INTRODUCTION

A. BACKGROUND

Navy Expeditionary Combat Command (NECC) serves as the Type Commander (TYCOM) for the Navy's Expeditionary Forces (NEF). While NECC is a relatively new command, NEF has been around since World War II and earlier. In January 2006, the chief of naval operations (CNO) established NECC to centrally manage NEF. NECC's mission is to "man, train, equip and sustain NEF in order to execute combat, combat support, and combat service support missions across the full spectrum of naval, joint, and combined operations, which enable access from the sea and freedom of action throughout the sea-to-shore and inland operating environments" (B. Garbert, personal communication, September 26, 2018). NECC was established "to provide a single advocate for this group of related military capabilities which will operate together when deployed and have related missions. To better align their man train and equip process. To realize economy of scale by consolidating headquarters and centralizing the equipping function. To improve operationally from commonality of training" (B. Garbert, personal communication, September 26, 2018).

CTF 56 is a forward-deployed Echelon IV command that exercises operational and tactical command of forces assigned. CTF 56 gained relevance in Operation Enduring Freedom and Operation Iraqi Freedom and has stayed relevant with the ongoing operations in the region. The importance of CTF 56 can be seen in how it contributes to NEF operations as they execute the maritime strategy under NAVCENT in the 5th Fleet Area of Responsibility (AOR) delivering the NEF's competencies and its unique warfighting capabilities within the AOR when conducting contingency operations. Also, CTF 56 serves as the lead planner for coalition forces delivering NEF capabilities supporting theater missions. During crisis response, CTF 56 commands and controls tailored task groups comprised of some or all of the capabilities inherent in the deployed CTG 56.X elements through Adaptive Force Packages. Many of the lessons learned at CTF 56 have paved the way for other CTF and CTG across the globe employing NEF assets (R. Cullinan, personal communication, 2018).

Many within the NECC community have speculated that the maintenance landscape at CTF 56 could benefit from having a combined maintenance facility within the geographic area of the largest CTF 56 supporting units, more than likely at or around Naval Support Activity One (NSA 1) or Naval Support Activity Two (NSA 2), supporting both Civil Engineer Supporting Equipment (CESE) and Service-Craft and Boat Accounting Report (SABAR) maintenance. This facility could be manned by either personnel with permanent change of station (PCS) orders and temporarily assigned duty (TAD) orders. The permanent personnel would be attached to CTF 56 supporting their maintenance along with the rotating units supporting the overall Task Force's maintenance with TAD personnel from the deployed units. All personnel would be conducting maintenance on a variety of equipment within their skill sets mutually supporting maintenance requirements across CTF 56.

B. RESEARCH FOCUS QUESTION

The question we address in this research is as follows: Is there a net benefit for NECC to combine maintenance support efforts in Bahrain for deployed forces? We conduct high-level preliminary analyses of a defined scope to assess maintenance consolidation viability to see if further, more detailed analyses are advisable.

We identify the current operations across CTF 56 and assess Planned Maintenance System (PMS) requirements for deployed equipment and the maintenance personnel manning at each unit to see whether a centralized maintenance facility at CTF 56 would generate a net benefit across NECC's deployed forces.

C. RESEARCH PLAN

The creation of an Expeditionary Support Unit (ESU) at a forward task force where multiple NECC units would deploy or be homeported had been discussed within the NECC community; part of that plan would include a combined maintenance facility. This plan was the inspiration of our project. Those within the NECC community requested that we look at CTF 56 because most of NECC's different mission sets support the mission there. In this research, we investigate whether there is a net benefit to combining maintenance in

a central facility that supports all of the NECC forces under CTF 56, by looking at the commonality of equipment and their PMS requirements.

The NECC organizations that make up CTF 56 each have their own equipment and maintenance personnel that they deploy with and maintain in theater. For this report, we take a look at the preventive maintenance requirements listed on the Maintenance Requirement Cards (MRC) for the primary gear and equipment in Bahrain including the maritime assets. We also look at all attached maintenance personnel who are responsible for doing the required PMS checks for the gear and equipment and review the combined man-hour costs associated with each of the tasks. We are not collecting corrective maintenance data except for a general assessment of corrective maintenance versus preventive maintenance, analyzing observed time spent by the maintenance personnel at each unit. After the data is collected, we conduct a preliminary assessment of the possible efficiencies and benefits of combining the maintenance efforts and personnel under one cohesive maintenance structure for all deployed NECC units under CTF 56.

An ESU provides logistics support for EOD both at home and while deployed. They provide the following functions: armory, communication support, personal gear issue, medical support, CESE and SABAR maintenance and support, shipping and receiving, and movement of gear and equipment.

Additionally, we highlight the constant Remain in Place and Transfer of Authority (RIP/TOA) of supporting units and equipment that is ongoing within CTF 56 and acknowledge that the numbers of maintenance personnel and equipment may change with each deployment. We also look at where those units are physically located as well as where they conduct maintenance within Bahrain. The data does not include corrective maintenance actions or time spent on other command obligations outside of preventive maintenance.

We utilize data collected from units presently supporting CTF 56 to compare the equipment PMS man-hours to the maintenance personnel man-hours, to answer our primary research question: Is there a net benefit for NECC to combine maintenance support efforts in Bahrain for deployed forces?

D. SCOPE

This report encompasses all the subordinate commands and detachments under CTF 56 in Bahrain, namely Explosive Ordnance Disposal (EOD/56.1), Naval Construction Force (NCF/56.2), Navy Expeditionary Logistics Support Group (NAVELSG/56.3), Army Civil Affairs (56.4), Role 3 medical facility (56.5), Expeditionary Combat Readiness Center (ECRC/56.6), Coastal Riverine Force (CRF/56.7), Naval Expeditionary Intelligence Command (NEIC/56.9) and Embarked Security and Intelligence Teams (ESIT/56.11). Our analysis is focused on all PMS maintenance requirements and associated equipment that each unit maintains at the various facilities in Bahrain. We then compare and contrast all similar equipment, the number of maintenance-qualified personnel, the location of the facilities where maintenance is done, and the associated PMS requirements and schedules for each piece of similar equipment between the organizations. We do not include any leased or contracted vehicles or equipment that have maintenance included in the lease or contract.

E. PURPOSE AND BENEFITS

In this report, we analyze available data to see whether there are identifiable efficiencies that can be gained for the requisite PMS maintenance requirements and qualified maintenance personnel at the CTF 56 units in Bahrain. The purpose is to determine whether there would be any benefits for the organization as a whole if the deployed forces were to consolidate all maintenance activities under one centrally located sustainment facility instead of all units doing their own maintenance requirements separately in different locations.

F. LIMITATIONS OF RESEARCH

Since the implementation of CTF 56, each of the supporting units has for the most part operated independently, relying on their deployed organic maintenance and contracted support to conduct maintenance while deployed in support of CTF 56. With so many units conducting RIP/TOA, most of the mission equipment remains in theater as replacement forces come and go approximately every six months, resulting in a lack of continuous, sequential maintenance records that could be used for analysis. Additionally, there are

differences in how units log corrective maintenance, so we focus on preventive maintenance utilizing the Preventive Maintenance Schedule Tracking Software's (SKED's) scheduled maintenance boards and PMS cards. With so many separate systems using different means to track and display data, we are also not able to assess the historical data of these units. This report is an initial assessment of the overall maintenance efforts at the CTF 56 units in Bahrain, so there are numerous data elements and detailed information that do not fall within the scope of this report. For the maintenance personnel at the individual units, we are able only to evaluate the workload based on itemized PMS requirements for the equipment attached to them. We are not able to look at all other job and maintenance requirements the units are tasked with, such as incidental corrective maintenance, daily job assignments, meetings, and watch-standing. Because we are looking only at the similarity of equipment in this research, we are not able to evaluate the cost of setting up a sustainment facility or determine whether space is available in Bahrain for this type of structure.

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II. LITERATURE REVIEW

A. NAVAL POSTGRADUATE SCHOOL MBA PROJECTS

The NPS MBA project report by Reeves and Baker (2017) is focused on the expeditionary units under the Naval Expeditionary Combat Command, which are also operationally attached to CTF 56 in Bahrain. While we are focused on maintenance activity support for expeditionary forces, this report is not the first to look at logistics for expeditionary forces or Expeditionary Logistics (EXLOG). We looked at previous research reports that have focused on EXLOG and reviewed some of the research methods and logistics frameworks they utilized to find areas that we may be able to build upon. One of the research reports we looked at concerning EXLOG was Reeves and Baker (2017), because it was the most recent MBA project we found on the subject and it dealt with most of the same subordinate commands under NECC. While we found this topic and command structure to be the most similar to our own, the Reeves and Baker (2017) report focuses primarily on Explosive Ordnance Disposal (EOD) ESU commands and how the EXLOG and supply chain processes work at these commands in support of the MK-16 Under-Water Breathing Apparatus (UBA) for Navy EOD. While this report was very thorough and describes the NECC structure very well, the overall research method and focus was mainly on the EOD and how the MK-16 UBA is supported throughout the supply chain.

Another Naval Postgraduate School (NPS) MBA project report also focused on the EXLOG aspects of EOD, but these students looked at Naval Special Warfare Command (NSW) logistics framework as well when they conducted their research (Kundra, Brown, & Donaldson, 2014). While this report is very thorough and laid out many different aspects of the overall supply chain, within EOD and NSW, it did not focus on maintenance efforts for expeditionary equipment or the manning involved (Kundra et al., 2014). Because of this, we were not able to utilize the same research methods, and the supply efforts they discussed are outside of our research focus.

An older MBA project looked at improving EXLOG support in the Naval Central Command (NAVCENT) Area of Responsibility (AOR; Perez, Nilsen, Tessier, & Lugo,

2004). They discussed the support for Operation Iraqi Freedom operations in Iraq as already having a decent framework for logistics support, and the students wanted to expand similar support efforts for the expeditionary units throughout the rest of the AOR, primarily in Bahrain. This project was established by the Naval Operational Logistics Support Center (NOLSC) to establish a support system for independently operating expeditionary units that were not supported by the primary theater logistics structure (Perez et al., 2004). The expeditionary units in theater were primarily supported by CTF 53 during this time frame, along with a few other units, for all of their requirements. Because of the amount of time that has passed since this report was written and because many commands and capabilities have been created since its publishing, such as CTF 56, we were not able to use most of the findings from Perez et al. (2004). The efforts to support the individual expeditionary units are still valued much the same way today, but the framework and supporting units are not valid for our purposes.

In much the same way as when Applegate (2006) wrote about EXLOG, the learning process for logistics specialists and Navy supply officers is "on-the-job and frequently on-the-fly" (Applegate, 2006, p. 2) training. The latest addition of the COMNECC 4400 has done the best job so far to give the disparate organization under NECC a common logistics document with overarching guidance to guide those conducting EXLOG. Although Applegate (2006) does not go into the maintenance functions of a deployed unit, he does lay out themes one should consider when conducting expeditionary maintenance. Most of the publications cited in his original report have been updated or revised; there continues to be a lack of consolidated guidance that can only be addressed with time and experience conducting naval operations in austere environments (Applegate, 2006)

B. NAVY PUBLICATIONS

For our research on the maintenance processes utilized by the Navy for CESE, the Naval Facilities Engineering Command (NAVFAC) P-480 manual on the Management of Expeditionary Equipment contained detailed information for the type of equipment within our report. The manual includes information on the different maintenance facilities and the general capabilities at each level of facility maintenance for organizational, intermediate,

and depot-level requirements. Organizational level is for basic maintenance requirements; the type of repairs increase in difficulty level and skill approaching depot-level maintenance, which is done by service depots, authorized agents, or NAVFAC-designated overhaul points (DOP; Naval Facilities Engineering Command [NAVFAC], 2016). Organizational-level maintenance is the focus of our research report, as it is the lowest maintenance level and lays out the maintenance requirements that fall within the capability of the units, which is consistent with the deployed forces in Bahrain. The P-480 also lists specific equipment maintenance requirement actions that are to be performed on each piece of CESE gear belonging to the organization that is listed in our data analysis. These items fall within the PMS guidelines to provide commands with the tools to plan, schedule, and control preventive maintenance within their organization (NAVFAC, 2016). Two of these tools are the Maintenance Index Page (MIP) and the Maintenance Requirement Card (MRC), which both were developed to provide at least the minimum of preventive maintenance procedures to keep equipment within specifications to ensure longevity and control life-cycle cost. These procedures make up a large part of the PMS data that was helpful in our research.

The manual goes into property book accountability and reporting procedures for Financial Accountability and Audit Readiness (FIAR) inspections, so that each command can track and try to meet the goals of the Department of Defense (DoD) strategic management plan of better financial management practices to better respond to the warfighter needs in the future (NAVFAC, 2016). While not an in-depth publication for everything needed for repairs and maintenance of CESE equipment, it does tell the user where to find other necessary procedures listed in separate manuals and publications for reference.

C. CONDUCTING COST ESTIMATES, COST–BENEFIT ANALYSIS, COST COMPARISONS, AND ANALYSIS OF ALTERNATIVES

Commander Ures (2014) authored the report an independent cost estimate and analysis of alternatives for basing in West Africa conducted by the Naval Center for Cost Analysis requested by U.S. Special Operations Command (SOCOM). From the direction of the National Defense Strategy through Defense Strategic Guidance and down to SOF

2020, SOCOM is charged with fostering trust with U.S. allies through quicker response to crisis by a more persistent presence through forward basing. In the analysis, four sizing options were taken into account, supporting force sizes ranging from 20 to 643 personnel. No specific sites were selected for the West African camps, so Dakar, Senegal; the Republic of Djibouti; Morocco; and Manda Bay, Kenya, were reference sites used to create the most accurate assessment. The requirements for the facilities were established through collaborative interaction with stakeholders and assessments of other U.S. bases throughout Africa. Additionally, current policy guidance and information from building subject matter experts were included in the analysis. The analysis calculated the initial investment and annual recurring costs and then broke them down to per person costs for each of the four different-sized bases.

The report's purpose was to answer SOCOM's question: What base size (micro, small, medium, large) offers the best value to satisfy the requirement for an ongoing security presence in the region? To answer the question, Ures (2014) conducted cost estimates, cost–benefit analyses (CBAs), cost comparisons, and analyses of alternatives. For the costing information, they compiled data from the region and made a few assumptions that were articulated in the study. The cost estimate was done to validate the best size of the base. The CBA was conducted to assess whether equipment should be forward deployed or shipped in with the unit during each rotation. The cost comparison was conducted on deploying troops from Europe or continental United States to West Africa. Ures (2014) then crunched the numbers in Excel and came to a well-founded conclusion. For the analysis of alternatives, he looked at having the personnel live on the economy either in commercial lodging or leased housing or flats, with a smaller secure working area.

As he accounted for construction and sustainment costs for the facility, Ures (2014) used many DoD, Army, and Navy facilities documents/doctrines to support his claims on how the facility would be constructed, as well as the various project rates and ultimate costs incurred during the projects. Again, he supported his claim with sound reasoning and evidence relating back to the directives. He also acknowledged that there was no pricing guidance for a live-fire shoot house, so data from similar facilities were used.

Area cost factors was another area where Ures (2014) used Unified Facilities Criteria (UCF) to start from a pricing baseline and then made well-reasoned assumptions and provided evidence from a U.S. Embassy project in the western region of Africa as well as data from Camp Lemonnier, Djibouti (CLDJ). Again he provided a range of costs and settled on a comprehensive estimate through sound reasoning and supporting evidence.

Ures (2014) accounted for design and build construction burdens required by the UCF and again spelled out and accounted for the additions of the different percentages that are added to all construction projects to pay for planning, supervision, inspection, and overhead, as well as required contingency funding for OCONUS projects. These percentages were called out in the write-up and did not just show up in the spreadsheet. At the end of the write up, a bulleted list provides the cost estimating ground rules and cost estimating assumptions, giving the reader a firm understanding of where the study came from and where it was headed. Finally, in his summary, Ures (2014) shows the cost comparison of initial investments, recurring costs, and total cost in relation to the different sized bases. He reiterates the assumptions and reasoning of the cost data, as well as analysis of TAD and transportation costs if personnel stay on the economy in commercial lodging or leased housing. The structure of this report was beneficial in constructing our research project (Ures, 2014).

D. CONSOLIDATION AND CENTRALIZATION UTILIZING A CBA

When researching pooling methods for logistics efficiencies, we looked at another article that explains how the U.S. Army distributed medical supplies for combat operations in Iraq and Afghanistan over a 10-year period (Wesler et al., 2012). The researchers discusses how medical supplies are distributed through their own distribution network that is separate from how they receive things such as fuel, ammunition, and other such items. The research question in the article is whether or not consolidating the medical supplies in places like Qatar or Germany where they currently operate out of is more efficient as far as lower cost and better performance than operating in other locations where the United States has depots. The researchers looked at these two locations in comparison to shipping items from the United States or from depots in Kuwait. RAND Arroyo Center was asked

to conduct an analysis to find out which locations would work best if we were to change to consolidating medical supplies for further distribution. The methodology utilized is a CBA to decide whether changing operations from the current status quo is necessary or whether that change would just end up costing more money and lead to a degradation in service.

Without cost data, we cannot use the same analysis metrics that were used by RAND, but the conclusion of the report however is a powerful reminder that the status quo may in fact be the best option even if it has its faults.

The RAND study is based on the criteria of Performance and Cost. For a certain location to qualify as an alternative to how U.S Forces currently operate, the option had to meet or exceed current delivery timelines. To measure this, the researchers measured each segment in the supply chain from ordering, to processing the order, to shipping and receiving, just to name a few in the overall process. Each location was then considered from a cost analysis standpoint and whether any new options were more cost effective. This would include transportation cost, labor cost, and material construction cost if the U.S. needed to increase inventory stocks or the primary focus was changed to Iraq or Afghanistan.

The conclusions in the report broke down each location and whether there were realized cost savings according to the decision criteria. The first location discussed was the United States and a Direct Vendor Delivery method of supporting directly from a vendor's location and then shipping to Iraq or Afghanistan. Understandably this led to worse performance. The outcome was a 28-day lead time compared to 10 days for current medical supplies. Because of this, no other consideration was given, as it did not meet the first criteria looked at. Kuwait was the next location discussed in the context of determining whether the depots in Qatar should be relocated there. With the current focus on Afghanistan, any cost savings with this model were wiped out, and none of the other data supported Kuwait as having better, much less equal performance. Increasing stockpiles in Qatar was the next option looked at, as it would have at least a 20% increase in performance improvement on current inventories. However, the increase in the labor force required to handle that amount as well as the construction cost to add a significant amount of material to make the performance numbers that much better would increase cost overall, eliminating

Qatar as an option. The last option looked at was consolidating material in Germany, which would have an increase in performance similar to consolidating in Qatar. This ended up being the preferred option as it would have the highest cost reduction of $1–3 million annually. This option of increased performance and cost reduction does assume that Germany increases operations from five to seven days a week, which would increase cost, but by how much would depend on a military or local national workforce. A valuable takeaway from this article is to realize that it may not require a massive shift in how things are done to make a difference and achieve the objectives; it may just be a simple tweak in a few spots that have the most benefit. The end result may be discovering that the way things are currently being done is the most effective for now, especially if how the theater of operations will look like in the future is unknown (Wesler et al., 2012).

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III. NAVY EXPEDITIONARY FORCES

The following information provides an overview of the Central Command (CENTCOM), Commander 5th Fleet (5th FLT), Navy Forces Central Command (NAVCENT), NECC, and Command Task Force 56 (CTF 56) force structures and a brief explanation of each subordinate unit's mission for the organization.

A. NAVY EXPEDITIONARY COMBAT COMMAND ORGANIZATIONAL STRUCTURE

NECC is the headquarters for all United States Navy (USN) expeditionary combat forces around the world, as shown in Figure 1. It provides combat service support and is directly involved in combat operations in numerous sea and land operating environments. The NECC's primary "mission is to organize, man, train, and equip expeditionary combat forces" (NECC, n.d.). that will deploy with the Navy or that are attached to a Joint Task Forces Combat Service Support (NECC, n.d.).

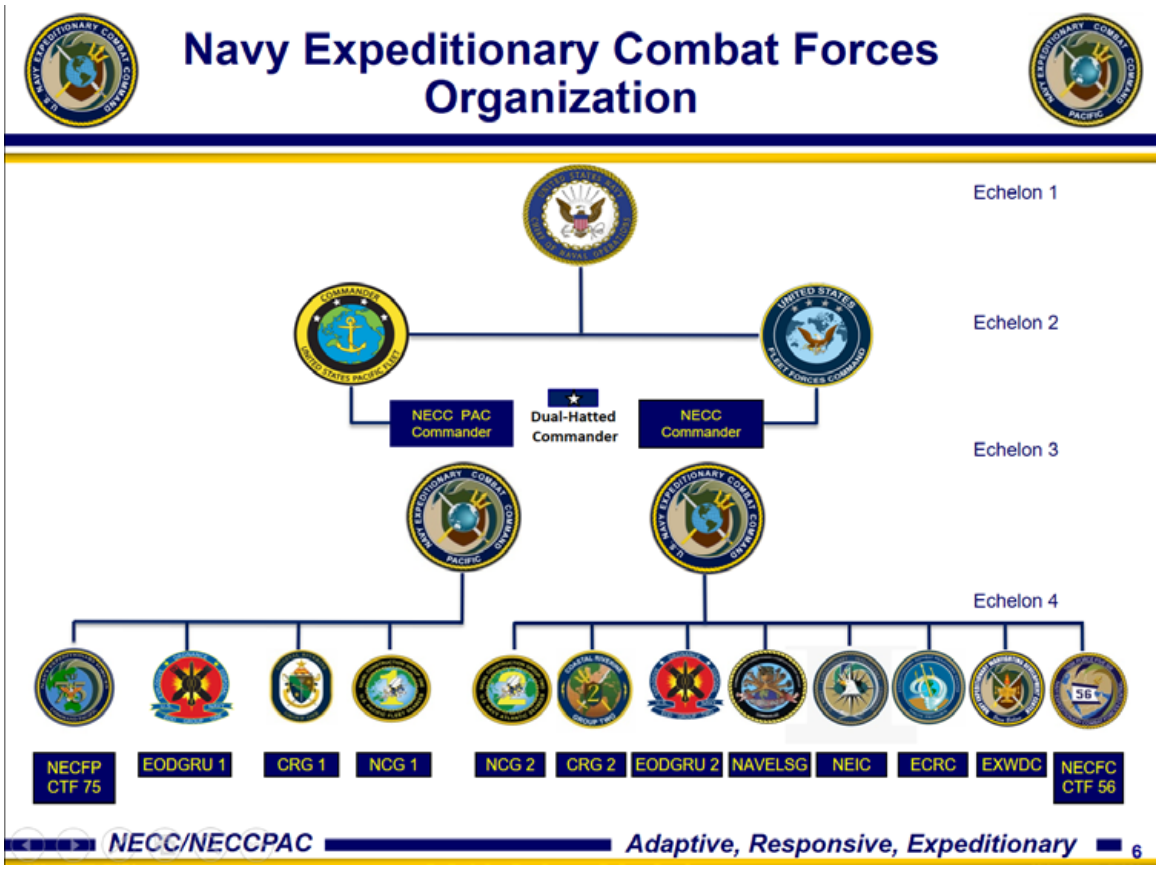

Figure 1. Organizational Structure of NECC. Source: B. Garbert, personal communication, September 26, 2018.

B. COMBINED NECC/CTF 56 SUPPORTED ORGANIZATIONS IN BAHRAIN

NECC maintains administrative command (ADCON) of the units as they deploy to CTF 56 continually even after they enter the theater. Central Command (CENTCOM) is the Combatant Commander responsible for all the operations conducted within the AOR. Under CENTCOM, the U.S. Navy 5th Fleet/NAVCENT are responsible for all U.S. and coalition naval assets within CENTCOM. CTF 56 falls under 5th Fleet/NAVCENT for both ADCON and operational control (OPCON). When NECC forces such as CRF, EOD, and NCF deploy to CENTCOM, they fall under CTF 56 for OPCON, and for their remaining time in theater they take all direction from CTF 56. The relationship between the COCOM, NECC, and CTF 56 can be seen in Figure 2. An illustration of how CTF 56

is support by NECC and NECCPAC through its subordinate commands that deploy from NECC and NECCPAC can be seen in Figure 3.

Figure 2. Command Relationship between COCOMs, NECC/NECCPAC, and CTFs. Source: R. Cullinan, personal communication, September 5, 2018.

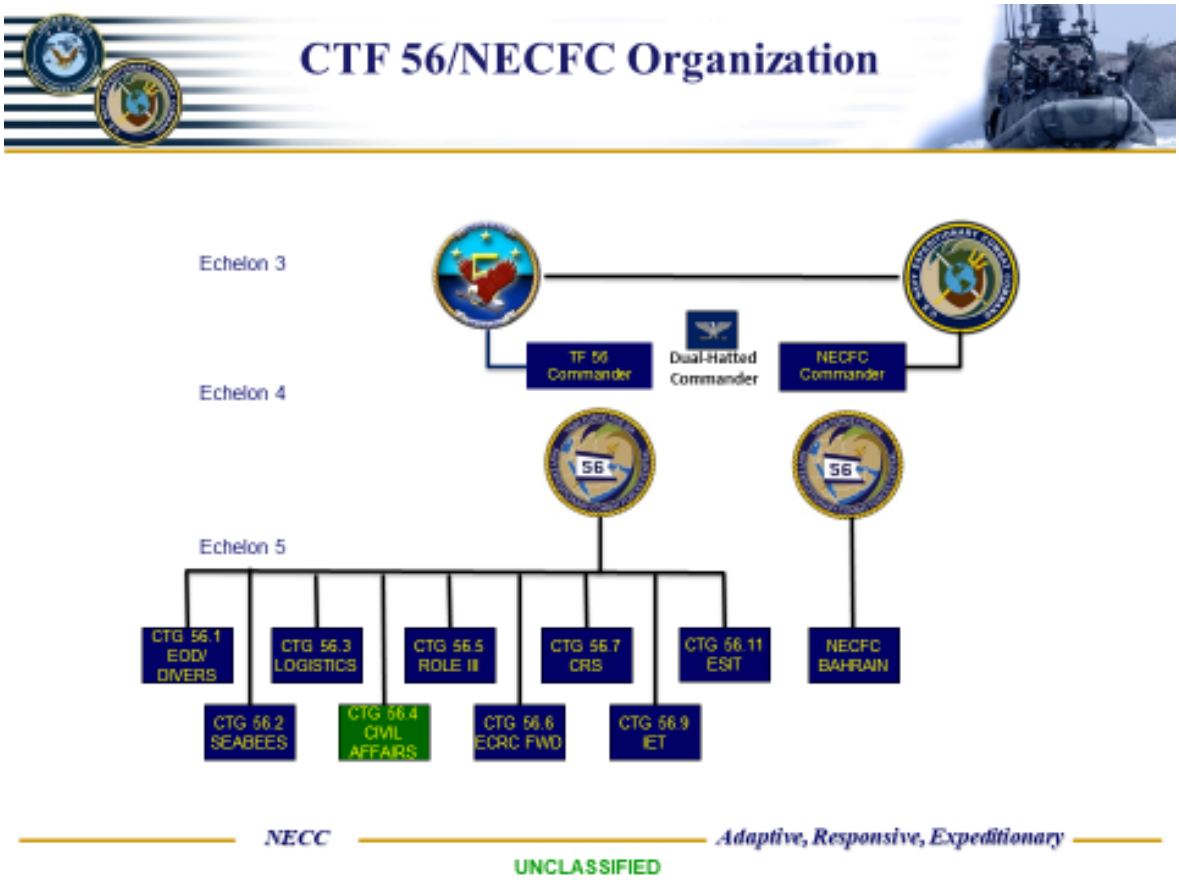

Figure 3. Organizational Chart of Commands under CTF 56. Source: R. Cullinan, personal communication, September 5, 2018.

1. EXPLOSIVE ORDNANCE DISPOSAL 56.1

EOD technicians are the Navy's experts in rendering safe explosive devices, including improvised explosive devices; unexploded ordnance; mines; chemical, biological, radiological munitions; and any other munition that requires disposal. They deploy with Special Operations Forces (SOF) on land and sea to support SOF operators. They are both parachute- and diver-qualified, a unique combination compared to other military branches' EOD technicians. Additionally, they are trained in underwater salvage and can perform clearance operations in sea lanes and harbors. Mobile Diving and Salvage Units fall under the purview of EOD Groups, and they specialize in search-and-recovery operations underwater, clearing navigation hazards in harbors, and performing minor underwater ship repairs (NECC, n.d.).

2. NAVAL CONSTRUCTION FORCE SEABEES 56.2

NECC's Naval Construction Force (NCF) battalions—known as Seabees—provide a full range of construction capabilities that can be utilized in any civilian or hostile combat zone. They can adapt to almost any mission requirement to build bridges, roads, expeditionary camps, aircraft runways, and medical or port facilities, just to name a few. Seabees deploy to aid in preparation and recovery during humanitarian relief operations and nation-building projects in disaster-prone areas all over the world (NECC, n.d.).

3. NAVY EXPEDITIONARY LOGISTICS SUPPORT GROUP 56.3

The Naval Expeditionary Logistics Support Group (NAVELSG) is an operational reserve command responsible for EXLOG support to deployed forces at sea and ashore, air and surface cargo handling missions, fuel distribution, ordnance handling, contingency contracting capabilities, custom inspections, and postal services. The group organizes, trains, and equips active and reserve forces that are ready to support any number of operational requirements, including responding to humanitarian relief efforts and enabling Marine Prepositioning Forces (MPF) and Joint Logistics Over the Shore (JLOTS) activities (NECC, n.d.).

4. U.S. ARMY CIVIL AFFAIRS 56.4

The U.S. Army Civil Affairs (USA CAT) conducts targeted civil affairs operations supporting national objectives that shape the NAVCENT operational environment. They are capable of conducting civil affairs (CA) planning with host nation governments and militaries to build long-term stabilization and to coordinate and manage interagency partners. They help strengthen U.S. and coalition partner relationships, enhance civil defense capabilities and legitimize partner nation governments to their populations. CA assets provide foreign humanitarian assistance (FHA) with food, water, shelter, and medical support (R. Cullinan, personal communication, September 5, 2018).

5. NATO ROLE 3 MMU, AFGHANISTAN 56.5

CTF 56 supports a North Atlantic Treaty Organization (NATO) Role 3 Multinational Medical Unit (MMU) combat trauma hospital in Afghanistan that serves

U.S. forces, coalition forces, and host nation citizens wounded in the region. The facility is set up to do a full assortment of lifesaving surgical stabilizations and comes with an intensive care unit and ward-size holding capacity. It is staffed by medical professionals consisting of doctors, nurses, and corpsmen trained in numerous medical specialties (R. Cullinan, personal communication, September 5, 2018).

6. EXPEDITIONARY COMBAT READINESS COMMAND 56.6

The Navy Expeditionary Combat Readiness Center (ECRC) mobilizes Navy Individual Augmentees (IA) and Navy Reserve Forces in support of Overseas Contingency Operations. As the administrative parent command for IA sailors, ECRC coordinates the training requirements for deploying assets; interfaces with Navy component commanders about support requirements; and provides reception, staging, onward movement, and integration (RSOI) in the area of operations (NECC, n.d.).

7. COASTAL RIVERINE FORCE 56.7

The primary mission of Coastal Riverine Forces (CRF) is maritime security operations defending high-value assets, coastal and inland ports and harbors, and vital maritime infrastructure. CRF utilizes various medium-size patrol boats, ranging from 25 to 85 feet, to perform maritime security operations in the littorals, operating in rivers, bays, and harbors. CRF can secure vital maritime infrastructure to support an amphibious landing or protect energy infrastructure, supporting trade and ensuring regional stability. Additionally, riverine units are trained to conduct surveillance, reconnaissance, and river patrols to interdict smugglers of weapons and drugs. They also conduct High Value Asset (HVA) escort around the globe (R. Cullinan, personal communication, September 5, 2018).

8. NAVY EXPEDITIONARY INTELLIGENCE COMMAND 56.9

The Navy Expeditionary Intelligence Command (NEIC) forces are a capable and ready force that responds rapidly to irregular warfare intelligence requirements. They supply timely relevant intelligence information to expeditionary warfighters to restrict the enemy freedom of movement, deny them sanctuary, or the use of maritime lines of communication so the NEF forces can find, fix, and destroy enemy assets (NECC, n.d.).

9. EMBARKED SECURITY AND INTELLIGENCE TEAMS 56.11

Embarked Security and Intelligence Teams (ESIT) provide underway defense and gather visual intelligence and waterside security in port aboard HVAs while operating in NAVCENT. They are a permanent Forward Deployed Naval Force (FDNF) supporting several different operations under both CTF 56 and CTF 53 for Military Sealift Command (MSC) vessels that operate in theater (R. Cullinan, personal communication, September 5, 2018).

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IV. CTF 56 MAINTENANCE

In this chapter, we illustrate the different maintenance processes for the unit that has organic equipment assigned and the equipment is stationed at either Naval Support Activity Two or Isa Air Base.

A. MAINTENANCE OVERVIEW

Currently, Explosive Ordnance Disposal (EOD/56.1), Naval Construction Force (NCF/56.2), Navy Expeditionary Logistics Support Group (NAVELSG/56.3), and Coastal Riverine Force (CRF/56.7) bring their own maintainers and conduct their own maintenance at their various camps on Naval Support Activity Bahrain and Isa Air Base. Commander Task Force Five-Six (CTF 56) has a small table of allowance (TOA) equipment, and they utilize NAVELSG Detachment Maintenance Material Management Coordinator (3MC) and CTF 56 logistics specialists to conduct PMS requirements. These deployment sites located on the island of Bahrain are miles apart, and local traffic patterns make movement between sites arduous. NSA Bahrain and Isa Air Base are approximately 27 miles to the south and the routes go through the heart of Manama, which can be seen in Figure 4. Preventive maintenance is conducted on the unit's equipment at the deployed location, and each unit has distinctive maintenance facility capabilities. These facilities contain tools, parts, and hazmat that the unit uses to conduct a RIP/TOA for items that were previously procured. For example, CTF 56.1,7,2 are supported from ESU ONE or ESU TWO, while Coastal Riverine Group Two N4/N43 and NCF support comes from the battalion main body in Rota, Spain. Additionally, the Preventive Maintenance Schedule Tracking Software (SKED) is not held locally, except for at CTF 56 proper, so when checks are completed, the check is entered into SKED at the home unit or main body headquarters outside of Bahrain. Currently, CTF 56 does not have any maintenance personnel assigned to it, so CTF 56 utilizes the 3MC from the deployed NAVELSG detachment to run its SKED and schedule its maintenance. Then logistics specialists from CTF 56 perform the maintenance to keep the equipment in good condition and operational.

Figure 4. Illustration of the Distance from NSA Bahrain to Isa Air Base

B. CTF 56 UNITS OVERVIEW

For the 10 units including CTF 56 that conduct the preponderance of work at NSA1, NSA 2, or Isa Air Base, we were able to obtain PMS data from only four because they were the only ones that held and maintained their own equipment. Of those four units, we discarded the data from NCF, because NCF is located on Isa Air Base and there are significant barriers to entry and exit; additionally, the travel time between units is prohibitive. The three groups that remained were EOD, CFR, and CTF 56 proper.

Some of the units we looked at under CTF 56 did not have any CESE or SABAR gear and equipment attached to their units or under an assigned TOA, so these units were not considered when looking at the pooling of units under a combined maintenance effort at CTF 56. These eliminated units include Army Civil Affairs (56.4), Role 3 medical facility (56.5), Expeditionary Combat Readiness Center (ECRC/56.6), Naval Expeditionary Intelligence Command (NEIC/56.9), and Embarked Security and Intelligence Teams (ESIT/56.11). The Expeditionary Logistics Support Group Detachment conducts operations in support of CTF 56 in Bahrain at Isa Air Base. The equipment used during these logistics operations is leased from and maintained by host nation vendors.

The Naval Construction Group Detachment in Bahrain that operates under CTF 56 is located out at Isa Air Base and is operated by the Bahraini military. Isa Air Base is 27 miles away, and it usually takes over an hour with city traffic to get from Isa Air Base to NSA Bahrain. Because it is not a U.S. military base, any equipment coming on or off Isa Air Base has to receive special permission from the host nation before being moved. The Bahraini military restricts the number of military or government-contracted personnel who are granted access to the base, which is something we had to take into consideration when doing our analysis. As we analyzed the data we received from NCF, we realized that almost all of the equipment NCF uses on Isa Air Base is large, heavy-mover equipment for their primary mission, airfield repair; this is different from any of the other units under CTF 56.

C. MAINTENANCE AND SUPPLY PROCESSES

In the following sections we examine the three main supporting units under CTF 56 and examine their individual maintenance and supply processes in greater depth and detail.

1. Naval Construction Force

NCF receives logistics and SKED support from their main body located in Rota, Spain. All of the equipment at the detachment in Bahrain is owned and controlled by the NCG 2 unit that is on deployment to Rota. The bulk of the maintenance conducted in Bahrain for the NCF Detachment is PMS on large earth-moving equipment and other associated rolling stock that is deployed to Isa Air Base because they are there to conduct a particular mission set and only that mission set. Rotating units also conduct RIP/TOA approximately every six months on the NCF equipment located at Isa Air Base. All maintenance actions are coordinated through the Headquarters Element, which is located at Camp Mitchell on Naval Station Rota, Spain (J. Chambers, personal communication, 2018).

2. Explosive Ordnance Disposal

Currently the EOD Mobile Unit (MU) that is supporting CTF 56 conducts maintenance as follows. During the training phases before deployment, the EOD MU is augmented with maintenance personnel from their respective ESU to support their maintenance requirements during the workup cycle and while they are deployed. When the EOD MU deploys, they conduct a RIP/TOA in country, with the outgoing EOD MU transferring all the equipment, tools, gear, and consumables to the new unit. The current typical deployment length is six months, with approximately one week of turnover time. When the RIP/TOA is complete, the new unit is responsible for all the equipment and its maintenance, reporting back to stateside commands the status of equipment and execution of preventive maintenance. The PMS boards are sent to the deployed EOD MU via email, and the completion of the maintenance is communicated back to the supporting ESU via email. The maintenance is conducted at the EOD compound on NSA 2, in the equipment yard or the one/single maintenance high bay. There is no dedicated maintenance area

within the EOD compound. Also, many of the light trucks and SUVs are leased from or through NAVFAC, and the leased vehicles' maintenance is performed by NAVFAC or the leasing agency such as Avis.

The deployed EOD Mobile Unit (EODMU) has a unique relationship with both ESU ONE and ESU TWO because of a Memorandum of Agreement (MOA) between EOD GROUPs ONE and TWO and the split ownership of equipment/TOA that the EODMU inherits during the RIP/TOA process. According to the MOA, ESU ONE is responsible for the maintenance costs of parts, ordering, and shipping of roughly half of the equipment deployed to Bahrain in support of CTF 56, and the other half is supported through ESU TWO. This requires access to both ESU ONE and ESU TWO's Relational Supply Database (RSUPPLY) and SKED maintenance boards, as well as coordination for funding to support operations. Also, maintenance technicians must ensure that they open the jobs within the correct maintenance system and that there is nothing to prevent ordering of a component for one ESU's piece of CESE and then installing it on the other ESU's piece of CESE.

Major equipment exchanges are predominantly done during the RIP/TOA of two EODMUs to take advantage of the deploying/re-deploying unit's cargo shipment.

3. Coastal Riverine Force

CRF deployed forces reach back to CRG 2 for all maintenance support functions such as funding and tracking of maintenance. CRG 2 owns all of the TOA equipment so there is no need for an MOA between the groups like EOD has. There is a covered and climate-controlled warehouse on NSA 2 where the deployed CRS conducts boat maintenance. The SKED and ordering support are provided by CRG 2 in Little Creek, VA. CRG 2 provides all funding and logistical support, regardless of the CRS that deploy from CRG 1 or CRG 2. They handle support all levels of maintenance to include contract support for depot-level maintenance. What we refer to as Craft 6 in our research and calculations below has its own cadre of maintenance personnel that is not shared with the rest of the CRF detachment; likewise because of specialized training and the quantity of maintenance that Craft 6 requires, the rest of the maintenance personnel do not conduct maintenance on Craft 6. Most of the maintainers work on other equipment because that is where the bulk

of the maintenance is required. CRG 2 also holds contracts for vehicles leased through NAVFAC on NSA 1 to support mission and personnel movement around Bahrain. Again, major equipment exchanges are conducted during the RIP/TOA as units deploy/redeploy, which is on an approximately six-month cycle (C. Lastie, personal communication, 2018).

V. ANALYSIS AND CONCLUSION

In the below sections we illuminate our analysis and conclusion for our project.

A. CASE ANALYSIS

For the 10 units including CTF 56 that conduct most of the work at NSA1, NSA 2, or Isa Air Base, we were able to obtain PMS data from only four because they were the only ones that held and maintained their own equipment. Of those four units, we discarded NCF, because NCF is located on Isa Air Base and there are significant barriers to entry and exit; additionally, the travel time between units is prohibitive. The three groups that remained were EOD, CFR, and CTF 56 proper.

In our analysis of the current structure of maintenance operations for each command, we took into account the number of personnel conducting maintenance at the unit, multiplied by the estimated 2,000 working hours'/maintenance hours per person available per year, utilizing the standard for calculated working hours for an individual. We used 2,000 working hours, based on a 40-hour work week multiplied by 50 working weeks a year. We estimated 50 working weeks to allow for some holiday time off and time for RIP/TOA that affects working hours. We normalized our data to look at all PMS checks in a 12-month time horizon, that is, monthly checks would be multiplied by 12, and a once-every-24-months check would be multiplied by 0.5 to give us requirements in yearly maintenance hours.

We also determined that most of the units are deployed and will not be using much leave time off during this time period. The following is an example of how we did our calculations: An average EODMU deploys to CTF 56 with five maintainers, so 5 x 2000 = 10,000 maintenance hours per year. We then looked at the major pieces of CESE and SABAR PMS requirements of a 36-month time horizon and multiplied or divided the PMS hour(s) to normalize total hours per year for each check. For example, a light service support vehicle (LSSV) has 1.2 hours in monthly (1.2*12=14.4) PMS requirements, 1.5 hours in quarterly (1.5*4=6) PMS requirements, 1 hour in required semi-annual (1*2=2) PMS requirements, and 3.9 hours in annual (3.9*1=3.9) PMS requirements for a total

normalized yearly PMS requirement of 26.3 (14.4+6+2+3.9=26.3) hours per vehicle. We summed all of the yearly PMS hours for each piece of equipment at a given unit to get the total PMS hours for the unit in a year time horizon. We then divided the total units' yearly PMS hours by the total number of available maintenance hours to get a ratio to compare manning to PMS. A representation of the Excel spreadsheet can be found in Table 1.

For each PMS check, we took the total hours of each PMS check and multiplied it by a normalized time period to compute one year's worth of total maintenance hours adjusted per year for each piece of equipment. Calculations for each time periodicity is as follows:

- Daily PMS: total daily PMS hours multiplied by 365 days in a year equals total daily PMS hours performed in a year.
- Weekly PMS: total weekly PMS hours multiplied by 52 weeks in a year equals total weekly PMS hours performed in a year.
- Monthly PMS: total monthly PMS hours multiplied by 12 months in a year equals total monthly PMS hours performed in a year.
- Quarterly PMS: total quarterly PMS hours multiplied by 4 quarters in a year equals total quarterly PMS hours performed in a year.
- Semi-Annual PMS: total semi-annual PMS hours multiplied by 2 representing two 6-month periods in a year equals total semi-annual PMS hours performed in a year.
- Annual PMS: total annual PMS hours multiplied by 1 equals total annual PMS hours performed in a year.
- 18 Month PMS: total 18-month PMS hours multiplied by 0.75 to represent 18 months normalized to a year equals total 18-month PMS hours performed in a year.
- 24 Month PMS: total 24-month PMS hours multiplied by 0.5 to represent 24 months normalized to a year equals total 24-month PMS hours performed in a year.

- 36 Month PMS: total daily PMS hours multiplied by 0.333 to represent 36 months normalized to a year equals total 36-month PMS hours performed in a year.

Table 1. Generic Calculations for Six LSSVs

		Preventative Maintenance Scheduled Periodicity											
Equipment nomenclature	Quantity	36M	24M	18M	Annual	Semi-Annual	Quarterly	Monthly	weekly	Daily	Special	Total PMS Mhr per piece of equipment per year	Total PMS Mhr per year for the each piece of equipment per year
		0.333	0.5	0.75	1	2	4	12	52	365			
LSSV	6				3.9	1	1.5	1.2					
			0	0	3.9	2	6	14.4	0	0	0	26.3	157.8

The calculation used is as follows:

$$\frac{Unit\ total\ PMS\ Hrs}{Unit\ total\ yearly\ Maintenance\ Hrs} * 100 = \%\ Maintenance\ Hrs.PMS\ per\ year$$

Another way of looking at the ratio would be

$$\frac{Units\ total\ yearly\ Maintenance\ Hrs.}{Units\ total\ PMS\ Hrs.} = ratio\ of\ maintenance\ hrs.to\ PMS\ hrs.$$

A figure larger than 1 would indicate a surplus of maintenance hours beyond PMS requirements, and a figure smaller than 1 would indicate a deficit in maintenance hours available to conduct PMS requirements.

Additionally, we had the units determine their ratio of preventive maintenance to corrective maintenance to see if their general workload was consistent with our ratio of maintenance hours to PMS hours. The analysis of each unit follows.

1. EOD Analysis

Because of the initial availability of EOD's data, we first looked at the EODMU deployed in support of CTF 56. In our calculations, we utilized the five maintainers currently conducting maintenance at CTF 56.1. Then we estimated the total number of available man-hours that are worked for the year per person, which we estimated to be about 2,000 hours. We multiplied these two numbers together for EOD to get a total of 10,000 man-hours available based on current manning levels. Then we compared the total number of man-hours available to the total number of combined estimated hours of PMS for each piece of CESE/SABAR equipment attached to the unit. For EOD, we calculated a total yearly PMS requirement of 5,637.40 hours spread across just the larger assets of CESE and SABAR equipment at the command.

When we divided the total number of PMS hours of 5,637.40 by the total number of maintenance man-hours for all five maintainers of 10,000 hours, we came up with a ratio of 0.56, that is, 56 % of EOD's maintenance time is spent just doing PMS on the equipment.

PMS Ratio: (10,000 total man hours / 5,367.40 total PMS hours) * 100 = 56%

This ratio closely coincides with the unit's estimate that they spend about 60% of their time doing PMS and 40% doing corrective maintenance. The numbers and ratio of time spent doing maintenance and total man-hours available does not include any corrective maintenance requirements when a piece of equipment breaks down or requires replacement due to operating hours. It also does not include any other outside duties on the job such as watch station duties, Navy Knowledge Online training requirements, command physical fitness, meetings, and so forth. See the calculations in Table 2.

For operational security purposes, we have masked our data by using CESE and Craft. *CESE* refers to all land equipment, and *Craft* refers to all waterborne equipment.

Table 2. PMS Calculations for Equipment Held by EOD Forces at CTF 56. Source: SKED (2018).

		Preventative Maintenance Scheduled Periodicity																	
Equipment nomenclature	Quantity	36M	24M	18M	Annual	Semi-Annual	Quarterly	Monthly	Weekly	Daily	Special	Total PMS Mhr per piece of equipment per year	Total PMS Mhr per year for each piece of equipment per year	Total yearly PMS	EN	EM	CM	Per person Annual man hours	Total yearly Man hours	Ratio of: total yearly hours of PMS / total yearly man hours
		0.333	0.5	0.75	1	2	4	12	52	365				5637.3978	1	2	2	2000	10000	0.56373978
CESE 1*	6				3.9	1	1.5	1.2												
Total PMS Hrs			0	0	3.9	2	6	14.4	0	0	0	26.3	157.8							
CESE 2*	6				2.4	2	4.5	2.7												
Total PMS Hrs			0	0	2.4	4	18	32.4	0	0	0	56.8	340.8							
CESE 3*	2		0.5		4.2	0.5	1.5													
Total PMS Hrs			0.25	0	4.2	1	6	0	0	0	0	11.45	22.9							
CESE 4*	4				6.2	0.5	1													
Total PMS Hrs			0	0	6.2	1	4	0	0	0	0	11.2	44.8							
CESE 6	1				4.2		0.5													
Total PMS Hrs			0	0	4.2	0	2	0	0	0	0	6.2	6.2							
CESE 7	2				4		2													
Total PMS Hrs		0	0	0	4	0	8	0	0	0	0	12	24							
CESE 8	5	1			6.2	0.5	1	1.5												
Total PMS Hrs		0.333	0	0	6.2	1	4	18	0	0	0	29.533	147.665							
Craft 1	8		1	0.5	5.3	28.9	2	2.7	1											
Total PMS Hrs		0	0.5	0.375	5.3	57.8	8	32.4	52	0	0	156.375	1251							
Craft 2	13					6	1													
Total PMS Hrs		0	0	0	0	12	4	0	0	0	0	16	208							
Craft 3	16		6		39.1	9	17.2													
Total PMS Hrs		0	3	0	39.1	18	68.8	0	0	0	0	128.9	2062.4							
Craft 4	22		0.1		0.5	1	3.7	2.1												
Total PMS Hrs		0	0.05	0	0.5	2	14.8	25.2	0	0	0	42.55	936.1							
Craft 5	16	0.1					4.4	0.8												
Total PMS Hrs		0.0333	0	0	0	0	17.6	9.6	0	0	0	27.2333	435.7328							

* are similar equipment used across all tables

2. CRF Analysis

In our analysis of CRF, the number of personnel conducting maintenance at the unit was eight maintainers. Then we looked at the total number of available man-hours that are worked for the year per person, which we estimated to be about 2,000 hours. We multiplied these two numbers together for CFR to get a total of 16,000 man-hours available based on current manning levels. Then we compared the total number of man-hours available to the total number of combined estimated hours of PMS for each piece of CESE/SABAR equipment attached to the unit. For CRF, we calculated a total yearly PMS requirement of 3,124.4 hours spread across just the larger assets of CESE and SABAR equipment at the command. We break this down between separate types of SABAR equipment referenced as Craft 6 maintenance and Craft 7 with all other CESE.

For the Craft 6, we divided the total number of PMS hours of 1,225 by the total number of maintenance man-hours for all three maintainers of 6,000 hours; we came up with a ratio of 0.204, that is, 20.4% of their maintenance time is spent just doing PMS on the equipment.

PMS Ratio: (1,225 total PMS hours /6,000 total man hours) * 100 = 20.4%

Maintenance Hour Ratio: (6,000 total maintenance hours / 1,225 total PMS hours) = 4.9

The maintenance hour ratio shows us that there are 4.9 times the required hours needed to conduct PMS.

Again, for the Craft 7 and other CESE, we divided the total number of PMS hours of 1,899.25 by the total number of maintenance man-hours for all five maintainers of 10,000 hours; we came up with a ratio of 0.1899, that is, 18.99 % of Craft 7 and other maintenance time is spent just doing PMS on the equipment.

PMS Ratio: (1,899.25 total PMS hours /10,000 total man hours) * 100 = 18.99%

Maintenance Hour Ratio: (10,000 total maintenance hours / 1,899.25 total PMS hours) = 5.265

The maintenance hour ratio shows us that there are 5.265 times the required hours needed to conduct PMS.

This ratio closely coincides with the unit's estimate that they spend about 25% of their time doing PMS and 75% doing corrective maintenance. The numbers and ratio of time spent doing maintenance and total man-hours available does not include any corrective maintenance requirements when a piece of equipment breaks down or requires replacement due to operating hours. It also does not include any other outside duties on the job such as watch station duties, Navy Knowledge Online training requirements, command physical fitness, meetings, and so forth. The calculations are shown in Tables 3 and 4.

Table 3. PMS Calculations for General Equipment Held by CRF at CTF 56. Source: J. Wherry, personal communication, September 6, 2018.

		Preventative Maintenance Scheduled Periodicity																	
Equipment nomenclature	Quantity	36M	24M	18M	Annual	Semi-Annual	Quarterly	Monthly	Weekly	Daily	Special	Total PMS Mhr per piece of equipment per year	Total PMS Mhr per year for each piece of equipment per year	Total yearly PMS	EN	EM	CM	Per person Annual man hours	Total yearly Man hours	Ratio of: total yearly hours of PMS / total yearly man hours
		0.333	0.5	0.75	1	2	4	12	52	365				1899.25	2	2	1	2000	10000	0.189925
CESE 10	2		6		21.6	2.5	3	2.2												
Total PMS Hrs			3	0	21.6	5	12	26.4	0	0	0	68	136							
CESE 5*	1				3.3			2.7												
Total PMS Hrs			0	0	3.3	0	0	32.4	0	0	0	35.7	35.7							
Craft 7	6	1	16.3	4.1	61.5	21.4	35.3	2.6												
Total PMS Hrs		0.333	8.15	3.075	61.5	42.8	141.2	31.2	0	0	0	287.925	1727.55							
* are similar equipment used across all tables																				

Table 4. PMS Calculation for Unique Equipment Held by CRF at CTF 56. Source: J. Wherry, personal communication, September 6, 2018.

		Preventative Maintenance Scheduled Periodicity																	
Equipment nomenclature	Quantity	36M	24M	18M	Annual	Semi-Annual	Quarterly	Monthly	Weekly	Daily	Special	Total PMS Mhr per piece of equipment per year	Total PMS Mhr per year for each piece of equipment per year	Total yearly PMS	EN	EM	CM	Per person Annual man hours	Total yearly Man hours	Ratio of: total yearly hours of PMS / total yearly man hours
		0.333	0.5	0.75	1	2	4	12	52	365				1225.125	0	3	0	2000	6000	0.2041875
Craft 6	3	3	18.6	26.1	82.3	30	22.7	12.2												
Total PMS Hrs		0.999	9.3	19.575	82.3	60	90.8	146.4	0	0	0	408.375	1225.125							

3. CTF 56 HQ Analysis

We did not develop a PMS ratio for the CTF 56 Headquarters element, as it does not have dedicated maintenance personnel assigned to it. Currently, logistics specialists assigned to CTF 56 conduct PMS maintenance on the equipment assigned to CTF 56 to keep it operational. We did calculate that the addition of these duties take up approximately 8% of each of the two assigned logistics specialists' time based on the current assigned equipment; see Table 5.

Table 5. PMS Calculations for Equipment Held by CTF 56. Source: SKED (2018).

		Preventative Maintenance Scheduled Periodicity																
Equipment nomenclature	Quantity	36M	24M	18M	Annual	Semi-Annual	Quarterly	Monthly	Weekly	Daily	Special	Total PMS Mhr per piece of equipment per year	Total PMS Mhr per year for each piece of equipment per year	Total yearly PMS	CM	LS	Per person Annual man hours	Total yearly Man hours	Ratio of: total yearly hours of PMS / total yearly man hours
		0.333	0.5	0.75	1	2	4	12	52	365				336	0	2	2040	4080	0.082352941
CESE 1*	2				3.9	1	1.5	1.2											
Total PMS Hrs			0	0	3.9	2	6	14.4	0	0	0	26.3	52.6						
CESE 2*	1				2.4	2	4.5	2.7											
Total PMS Hrs			0	0	2.4	4	18	32.4	0	0	0	56.8	56.8						
CESE 3*	6		0.5		4.2	0.5	1.5												
Total PMS Hrs			0.25	0	4.2	1	6	0	0	0	0	11.45	68.7						
CESE 4*	10				6.2	0.5	1												
Total PMS Hrs			0	0	6.2	1	4	0	0	0	0	11.2	112						
CESE 5*	1				3.3			2.7											
Total PMS Hrs			0	0	3.3	0	0	32.4	0	0	0	35.7	35.7						
CESE 9	1		0.1	0.2	1.6		2.1												
Total PMS Hrs		0	0.05	0.15	1.6	0	8.4	0	0	0	0	10.2	10.2						
* are similar equipment used across all tables																			

B. CONCLUSION

After reviewing the CESE and SABAR assets at each unit, we have discovered that there is little commonality between the NECC deployed units in Bahrain. Most NECC units OPCON or TACON to CTF do not have any organic equipment in Bahrain. These units lease equipment through NAVFAC on NSA 1, and all maintenance is performed by the leasing agent. The units that do have a significant amount of equipment to be maintained are split up between two separate locations on NSA 2 (EOD and CRG) and Isa Air Base (NCG), as displayed on the map in Figure 2. These units presently do not have a formal maintenance memorandum and only limited interaction at the organizational maintenance level. With their proximity on NSA 2, inside the same security perimeter, there is an opportunity for sharing resources for greater efficiency with in CTF 56.

Additionally, the EOD and CRF units' cadre of equipment are dissimilar enough that we only found five nominal pieces of CESE common between them. The types of maintainers that deploy in support of CTF 56 share some similar skill sets that would support a mobile maintenance team that we discuss in our recommendations. Therefore, after doing our preliminary analysis, we do not see a net benefit to having a combined maintenance facility in Bahrain for deployed NECC forces supporting CTF 56 at this time.

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VI. RECOMMENDATIONS

In this chapter we provide recommendations derived from our experiences during the research process and our conclusions.

A. RECOMMENDATIONS

As stated previously, our analysis does not support a combined maintenance facility centrally located in Bahrain because of the lack of commonality of equipment and efforts. However, many of the same enlisted rates are required for conducting maintenance at each of the commands supporting CTF 56. Therefore, further research should look at a combined maintenance effort in the construct of a maintenance team at the CTF 56 level supporting units on NSA 1 and NSA 2. The maintenance team could be constructed utilizing both permanent change of station and temporarily assigned personnel. This could help normalize maintenance practices, tracking data and local knowledge and contracts, ultimately giving CTF 56 better purview of supporting units' maintenance issues so they can provide support and continuity of effort as units deploy and redeploy in and out of theater.

B. RECOMMENDATIONS FOR FURTHER RESEARCH

As stated in our research question, this is a preliminary analysis and will require an in-depth review of each of the individual units under CTF 56 to be able to better compare requirements and capabilities. Additional data can be acquired to analyze the feasibility and benefits of an ESU-type construct focusing on personal gear issue, armory, and communications equipment in Bahrain and could include the cost–benefit of a combined maintenance effort for personnel to determine whether any manning efficiencies would be gained.

Another research option to consider is a maintenance team located at CTF 56 consisting of deployed maintenance personnel on TDY orders from each supporting unit and a cadre of permanent personnel PCS to CTF 56 maintaining permanent assets in Bahrain. This maintenance team could conduct maintenance on all deployed equipment

within their military occupational specialty. Most of the PMS does not require a highly skilled technician, a sailor basically trained in their military occupational specialty can conduct the majority of PMS requirements.

Further research should include an assessment of space requirements, available land and construction costs of suitable locations for an ESU facility within Bahrain. This research will be required for a holistic view and will greatly impact any future cost–benefit analysis.

Additional research on standardizing the collection and reporting of maintenance data across CTF 56 with a repository of the data collected in a maintenance management system held at CTF 56 is recommended for better visibility. We found in our research that a variety of methods were utilized to track and report maintenance data. A single system for the collection of maintenance data would be beneficial to produce a consolidated maintenance picture.

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