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Husbanding Service Provider Price Analysis Factors

June 2021

LCDR Austin W. Gage, USN
LCDR Luis C. Escobar, USN
LCDR Bradford R. Sturgis Jr., USN

Thesis Advisors: Dr. Geraldo Ferrer, Professor
Dr. Robert F. Mortlock, Professor

Graduate School of Defense Management

Naval Postgraduate School

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Prepared for the Naval Postgraduate School, Monterey, CA 93943.

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ABSTRACT

Since 2015, the Navy acquisition community has undergone significant changes to oversight policies and contracting methods for husbanding services. The changes were imposed because of one of the largest corruption scandals in U.S. Navy history. The rapid effects of these changes have not been thoroughly analyzed. In this thesis, there is data from the last 5 years totaling over 6,000 husbanding service contracts and port visits. The authors analyzed this data to determine if the current process is having an adversefinancial impact, including the financial impact of short-notice port visits, contractor competition, and the length of solicitation. They used a cross-tabulation methodology to determine if short-notice port visits' request submissions have a financial impact on the cost of husbanding services. The authors also used cross-tabulation to determine if the length of solicitation time makes a difference in the daily average cost. They used cost indexing to quantifiably determine if contractor competition affected the price of husbanding contracts. After a thorough quantitative analysis, the authors determined that the current oversight policies and contracting methods do not have an adverse financial impact on the husbanding service process. Navy leadership must continue refining procedures to reduce processing time while increasing audit compliance.

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ABOUT THE AUTHORS

LCDR Sturgis is a Philadelphia native and was commissioned in the Navy through Officer Candidate School in 2009 as a Supply Corps Officer after 8 years of enlisted service. He holds a Bachelor of Science in Business Management from the University of Phoenix, and a Master of Arts in Procurement & Acquisition Management from Webster University. His operational tours include serving as the Assistant Supply Officer onboard USS SAMPSON (DDG 102) in San Diego, California, and Supply Officer onboard USS MICHAEL MURPHY (DDG 112) in Pearl Harbor, Hawaii. His previous shore tours include Contract Negotiator at Office of Special Projects (OSP) in Washington, D.C.; Joint Transportation Staff Officer in the Strategy, Capabilities, Policy, & Logistics (J5/J4) directorate at United States Transportation Command; and Transportation Plans Officer in the Movement Integration (G38) directorate for Surface Deployment & Distribution Command (SDDC) at Scott AFB, Illinois. In his follow-on tour, he will serve as the Assistant Supply Officer onboard USS ESSEX (LHD 2) in San Diego, California.

LCDR Gage graduated from Old Dominion University in 2006 and was commissioned in August of 2008, after completing Officer Candidate School at Newport, R.I. He then attended the Navy Supply Corps School at Athens, GA. Gage's tours include USS ARLEIGH BURKE (DDG 51), STRIKE FIGHTER SQUADRON 106 (VFA-106), USS GEORGE WASHINGTON (CVN 73), USS RONALD REAGAN (CVN 76) and UNITED STATES SEVENTH FLEET (7th Fleet). LCDR Gage is the 2016 recipient of the Vice Admiral Robert F. Batchelder Award presented to Supply Corps officers who have made significant contributions to the supply readiness of the U.S. Navy's operating forces. LCDR Gage's next duty station will be COMMANDER NAVAL AIRFORCES PACIFIC (CNAP) in San Diego, California.

LCDR Escobar is from Gurnee, Illinois. He graduated from Robert Morris University in 2007 with a bachelor's degree in Business Administration and was commissioned in the Navy in 2010 after completing Officer Candidate School. His

operational tours include Assistant Supply Officer onboard USS PINCKNEY (DDG 91) in San Diego, CA and Supply Officers onboard USS NEW ORLEANS (LPD 18) in San Diego. His previous shore tours include Navy Acquisition and Contracting Officer (NACO) intern at Naval Sea Systems Command (NAVSEA) in Washington, D.C., and Fleet Liaison Officer at Fleet Logistic Center (FLC) Sigonella detachment in Naples, Italy. In his follow-on tour, he will be assigned to Allied Joint Forces Command Southern Europe in Naples, Italy.

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LIST OF ACRONYMS AND ABBREVIATIONS

BSC	Business Support Center
COR	Contracting Officer's Representative
DFAS	Defense Financial Accounting Service
DOD	Department of Defense
ELIN	Exhibit Line-Item Number
FAR	Federal Acquisition Regulation
FASA	Federal Acquisition Streamlining Act
FLC	Fleet Logistics Center
FY	Fiscal Year
GAO	Government Accountability Office
GDMA	Glenn Defense Marine Agency
HSP	Husbanding Service Provider
IDIQ	Indefinite Delivery Indefinite Quantity
KO	Contracting Officer
LOGREQ	Logistic Requirement
MAC	Multiple Award Contract
NAVSUP	Naval Supply Systems Command
OPNAV	Office of the Chief of Naval Operations
OSBP	Off-Ship Bill Pay
RTOP	Request for Task Order Proposal
SECNAV	Secretary of the Navy
SLR	Standardized Logistics Requirement
TYCOM	Type Commander
WAWF	Wide Area Workflow

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EXECUTIVE SUMMARY

The Navy acquisition community has been mired in corruption and scandal, which culminated with the Glenn Defense Marine Asia (GDMA) "Fat Leonard" scandal. In the wake of the scandal, the Navy inspector general (IG) conducted an audit on the Navy's internal controls and procedures. Their findings led to significant changes in oversight policy, including new instructions and contracting methods. Naval Supply Systems Command (NAVSUP) directed the implementation of Off-Ship Bill Pay (OSBP) and the Multiple Award Contract (MAC) in 2015. The pressure to be audit-compliant meant rapid changes; the effects of these changes have not been thoroughly analyzed. A quantitative analysis was needed to identify the financial and service impacts of the implemented changes. Data from the last 5 years were gathered from the Husbanding Service Provider Portal (HSPortal), an online repository that catalogs details about each port visit, including cost and processing time. This research focuses on the 5th, 6th, and 7th Fleets, as these are the most active areas of responsibility (AORs) with the most annual port visits. The thesis research questions are centered around the policy changes' effects on flexibility, competition, and cost. The first question discussed short-notice port visits. The instruction prescribes that a vessel should give a port 30-day notification before that ship arrives. Short-notice port visits occur when that time period is truncated. It is generally believed that if the notification period is shortened, it will drive up the cost of the port visit, as Husbanding Service Provider (HSP) contractors would have less time to respond and prepare for arrival. The second question evaluated the effect of competition in ports on the cost of services. The MAC Indefinite Delivery Indefinite Quantity (IDIQ) prescreens available HSP contractors and puts them into a bidding pool. When a contract is solicited, each contractor gets an opportunity to bid. Some ports naturally have more competition than others. The authors examined the effect of cost on ports with competitive environments versus those with non-competitive environments. Lastly, the authors evaluated the impact of solicitation time on the cost to verify if there is a price advantage in allowing more time for contractors to submit their bids.

Cross-tabulation methodology was used to determine if short-notice port visit request submissions had a financial impact on the cost of husbanding services. By using cross-tabulation, the authors were able to separate the data by fleet and make quantitative comparisons among ship class type, logistic requirement submission timelines, and average daily cost. The authors used cost indexing to quantifiably determine if contractor completion affected the price of husbanding contracts. By cost indexing, the authors could normalize the data to create a consistent and comparable data set. Data normalization allowed the authors to index the cost data series to a common starting point, which facilitated the comparison of cost data between fiscal years and port locations, and across all fleets. The adjustment of actual cost data to a more uniform basis enabled the authors to reduce the dispersion of the data points, provide consistency, and increase the number of data points that could be compared, which reduced variance in the data.

Upon concluding the cross-tabulation analysis of short-notice port visit requests, the results showed that short-notice port visit logistic requirement (LOGREQ) submissions have no financial impact on husbanding services received. This illustrates that there is no correlation between cost and submission timeline. Different results were found after comparing competitive and non-competitive periods using cost indexing, in that competition did impact cost. After analyzing the cost data, the researchers concluded that competition has affected husbanding contract costs and that the Navy should expect to have higher contract costs in locations where there is only one monopolist providing husbanding contracts.

The authors determined that the implemented changes had a positive effect on the HSP process. OSBP and the HSPortal have provided detailed oversight and accountability. More competition in the MAC IDIQ drives the price down and establishes a relationship with contractors. Even in a short-fused or emergent port visit, the pricing is not affected due to the competition within the MAC IDIQ. Whenever possible, the pool of contractors needs to be expanded so that more ports benefit from competition. Additionally, the authors determined that the amount of time a bid spends being solicited does not affect the average daily cost. It would be reasonable to assume that the longer a bid spends on the open market, the more the price would decrease, as this would give more time for competition and for all prospective bidders to propose their bids. The data does not support that line of

thinking. The data implies that there is no correlation between price and the length solicitation period. Whether the bid is on the market for 1 or 15 days, the average daily price stays near a baseline. After a thorough quantitative analysis, the authors have determined that the current oversight policies and contracting methods do not have an adverse financial impact on the husbanding service process. Navy leadership must continue refining procedures to reduce processing time while increasing audit compliance.

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I. INTRODUCTION

Husbanding Service Providers (HSPs) provide U.S. naval vessels of all platforms with all logistical requirements throughout port visits worldwide. In 2015, HSPs underwent a tremendous change in the wake of the Glenn Defense Marine Asia (GDMA) scandal (sometimes referred to as the Fat Leonard scandal). The GDMA scandal was a widescale corruption and national security breach that involved high-ranking U.S. Navy officials and the contractor GDMA, a firm headed by Leonard Francis (Whitlock, 2016). The investigation is still ongoing and has led to the arrest of 33 people connected with the scandal (Whitlock, 2016). Navy Supply Systems Command (NAVSUP) directed the implementation of several programs to ensure the HSP program's audit compliance. Two of these programs, Off-Ship Bill Pay (OSBP) and the Multiple Award Contract (MAC), were instituted in Fiscal Year (FY) 2016, drastically changing contracting operations. While these changes have provided some improvement, the HSP environment has shifted without definitive research identifying financial and service impacts of the implemented changes.

Husbanding services procedures have changed significantly since 2015, with the implementation of OSBP and MAC procedures. Prior to the current process, ships had little oversight and guidance in executing husbanding services. The current process involves added key players to validate and approve various steps to ensure audit readiness and accountability. The goal of this research was to identify the factors that affect the cost of Navy husbanding services. The effect of added management, the increased number of people involved, and the added bureaucracy on husbanding services remain a concern but are not included in the research. In general, this research validates current factors' influence on cost. This leads us to the following questions:

Research Question 1: Are short-fuse port visits causing an increase in costs?
Research Question 2: What is the effect of competition on cost?
Research Question 3: Does the length of solicitation time affect cost?

The researchers used an enterprise-wide cost effectiveness analysis to compare costs across all Navy ports using historical HSP data since implementation in 2015. Data

was collected from the Husbanding Service Provider Portal (HSPortal), a repository for all U.S. Navy port visit data. In the conclusion of this project, the researchers evaluated certain factors and their effect on cost to the Navy Supply Systems Command (NAVSUP) Fleet Logistics Center (FLC) Sigonella detachment in Naples, Italy. The researchers utilized data that included locations, dates, vendors, contract numbers, and ship types from a global database that records all husbanding service contracts and their contract line items. The data is a comprehensive list that provides detailed, port-specific information. The researchers exported all port visit data from October 2015 to April 2020. With the data from the HSPortal, the researchers used cross-tabular analysis to filter context across multiple relationships to determine the effects of logistics request lead-times for husbanding services in relation to the overall costs.

A. PURPOSE

The purpose of this research is to validate the impact certain factors have on the cost of a husbanding contract. To do so, the authors analyzed the financial impact of late LOGREQ submissions, contractor competition, and bid solicitation time. The methodology of this work was cross-tabulation and cost indexing normalization.

In accordance with current Department of Defense (DOD) policy, the HSP program is designed to "codify a repeatable, holistic process that is independent of person, provides clear governance, and has checks and balances with an inspection and feedback process" (Office of the Chief of Naval Operations, 2020, p. 1). Public trust was broken following the GDMA scandal, and the Navy has sought to course-correct through transparency and standard operating procedures, as seen with the OSBP and the new MAC strategy. Additionally, oversight meetings at the fleet level were implemented in coordination with contracting officials at FLC (Office of the Chief of Naval Operations, 2020). As a result of these oversight conditions, the process to plan, execute, and reconcile a port visit has become stringent and time-consuming, as based on the personal observations of sailors onboard the ship, FLC, and fleet staff involved in the HSP process (Office of the Chief of Naval Operations, 2020).

B. SCOPE AND LIMITATIONS

This study aims to compare port visit costs against the LOGREQ submissions' timeliness and port competition using historical HSP data since its implementation in FY2016 (October 1, 2015–September 30, 2016). All data for this analysis was gathered from the HSPortal website. The data used is limited to the U.S. Navy 5th, 6th, and 7th Fleet AOR beginning in FY2016 and ending in FY2019. The data used is based on HSP services that were paid for by the U.S. Navy to multiple contractors.

Figure 1 shows the Navy's numbered fleets' geographical locations and the number of port visits within each fleet area of operation during FY2019.

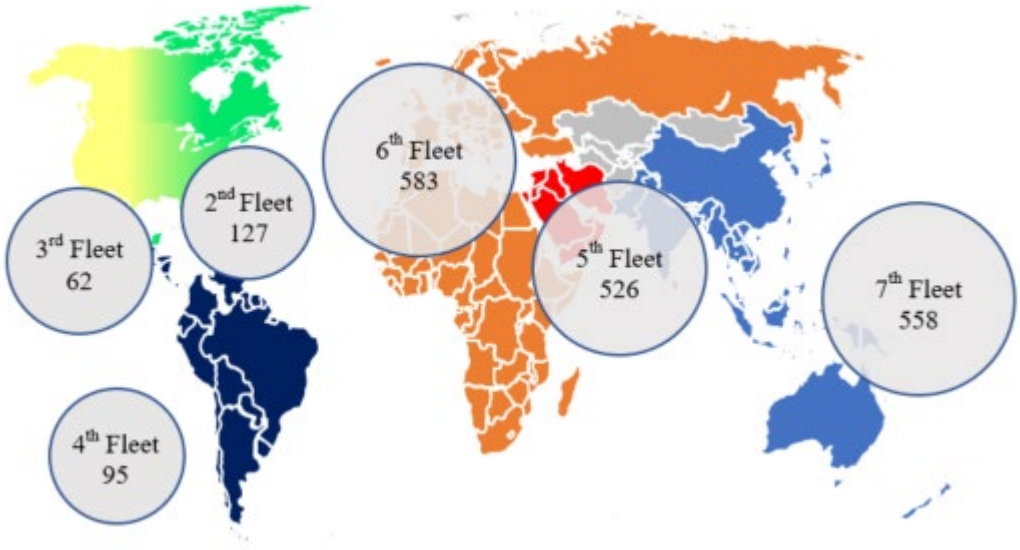

Figure 1. Numbered fleets by geographical locations. Adapted from NAVSUP (2020).

In this study, the researchers did not take into consideration the quality of services or performance factors; they only analyzed the costs. The researchers also did not specify any contractors' names or the task orders that were awarded to avoid disseminating any sensitive or restricted information. All information provided within this analysis is public knowledge, with no limits on the dissemination of the results or findings.

C. THESIS ORGANIZATION

The chapters of this thesis are organized as follows: Chapter II provides background information relevant to understanding the culture and management controls that existed prior to OSBP and the MAC strategy and briefly examines the changes made in recent years. Chapter III presents findings from literature reviews of relevant texts. Chapter IV describes the methodology, data, and statistical findings used to conduct the analysis. Chapter V provides the analysis and interpretation of the researchers' findings. Finally, Chapter VI provides conclusions and recommendations for further research.

II. BACKGROUND

Following the GDMA scandal, the secretary of the Navy (SECNAV) requested an inspector general (IG) audit of the Husbanding Service Provider Program; the report's stated goals were "to identify internal control weaknesses within the Navy's husbanding and port services process" (Navy Audit Service, 2014, p. 1). The audit highlighted major flaws in terms of auditability and lack of proper oversight.

Figure 2 shows the funding obligated by the fleets for port visits. The research focuses on the 5th, 6th, and 7th Fleets because they make up 82% of all obligated port visit funding.

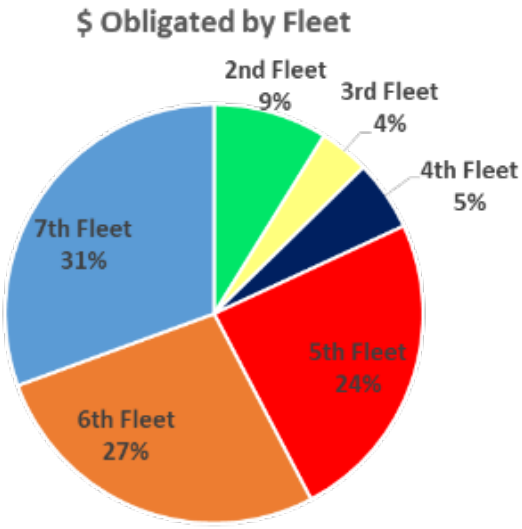

Figure 2. Funding obligation by fleet. Adapted from NAVSUP (2019).

Each year, the Navy spends approximately $120 million on port visits (NAVSUP, 2020). These port visits serve as opportunities for much-needed replenishments, provide a chance for leadership to interface with allies and partner nations, boost national defense, and improve quality of life for embarked service members. According to Office of the Chief of Naval Operations (OPNAV) Instruction 4400.11, the planning and execution of port visits are a mix of "organic, host nation, and contractor support" (Office of the Chief of Naval Operations, 2020, p. 1). Prior to 2015, port visit contracts were based on a single-

award contract (SAC). Under this contract vehicle, each individual port visit was negotiated, and ships were required to pay all invoices and payments via U.S. Treasury checks with limited oversight. Since 2015, the Navy has shifted its operations to a new husbanding service acquisition strategy, the MAC Indefinite Delivery Indefinite Quantity (IDIQ). The OPNAV instruction also puts forth a new strategy that involves OSBP, HSPortal, and oversight functions.

The following definitions and programs should be understood to fully comprehend the data presented within the research. OPNAV Instruction 4400.11 classifies these programs as key to the HSP process.

A. MULTIPLE AWARD CONTRACT INDEFINITE DELIVERY INDEFINITE QUANTITY

According to Federal Acquisition Regulation (FAR) Part 16.5, IDIQ is a contract vehicle that the government uses when it does not know the future services that will be required during a fixed period of time (FAR 16.5, 2020). The regulation also states that the current contract being used for HSP is a MAC IDIQ. This means that multiple competing contractors have been awarded the base contract. In addition, the FAR states that the IDIQ provides the Navy a method to issue orders on each port visit it wishes to execute. The MAC contract is meant to lower the cost of services by utilizing competition. The offeror with the lowest price technically acceptable offer will be awarded the order.

The MAC IDIQ process begins when the supporting FLC receives a logistic requirement (LOGREQ) from the requesting ship (Office of the Chief of Naval Operations, 2020). The LOGREQ contains the required husbanding services needed in port. Once the ship has drafted its LOGREQ, it is sent to the Contracting Officer's Representative (COR) for verification. Once the COR validates the LOGREQ, the ship sends the LOGREQ via official naval message to the Fleet Logistics Center (FLC) Contracting Shop (code 200). Ships use a standardized global LOGREQ based upon their ship class and required type of visit (moored or anchored). FLC contracting specialists and CORs were not a part of the husbanding services prior to the use of MAC IDIQ. The FLC coordinates with the CORs for requirements and the Type Commanders (TYCOMs) for funding. This provides oversight by which husbanding service providers and services are verified.

B. OFF-SHIP BILL PAY

OSBP serves as the method of payment for husbanding service providers and vendors. It removes the financial accountability from the ship to the corresponding FLC code 200 (Office of the Chief of Naval Operations, 2020). The FLC secures funding from TYCOM post verification. Payments are processed from the Defense Financial Accounting Service (DFAS) directly to the husbanding service provider, removing the need for treasury checks and large cash payments.

The OSBP process and MAC strategy involve many key players, validators, and approvers that must be in place for audit readiness and accountability (Office of the Chief of Naval Operations, 2020). Once the port visit is complete, the HSP submits its final invoice to the FLC and supporting ship for verification. A three-way match is conducted by the COR using the task order award, Department of Defense Form 250 (DD 250), and vendor invoice. Once the verification is complete, the verified documents are uploaded to Wide Area Workflow (WAWF), a payment capability with modules providing additional visibility into the Navy's business process (Defense Logistics Agency, 2020).

It has been said that the current process lacks automation, has multiple inputs, and is adversely affecting cost (Ott, 2019). Additionally, it was assumed that late LOGREQ submissions and the lengthy OSBP process execution were negatively affecting the cost of HSP services, but evidence of the actual financial impacts was unknown.

C. DATA REPOSITORY

In the summer of 2018, the Naval Supply Systems (NAVSUP) Business Support Center (BSC) instituted the HSPortal to track planning and oversee port visit information (Thornton, 2018). The database relies heavily on information technology to catalog and analyze contracts, lines of accounting, standard LOGREQs, that applies to husbanding policy (Thornton, 2018). The portal is a repository of contract information that can be used to plan future port visits, as it contains pricing, location, and historical records. HSPortal serves as an audit trail and oversight function, allowing a high degree of visibility down to the individual vessel or port location.

D. OVERSIGHT MECHANISMS

The success of the HSP process is contingent on having effective oversight mechanisms in place to ensure proper coordination and direction of the HSP business processes for acquiring husbanding services during port visits. The individuals who provide oversight are charged with facilitating a repeatable, all-inclusive process that is impartial of any one person and provides clear governance. The new HSP process has checks and balances, unlike the previous process.

Figure 3 is an illustration from the NAVSUP FLC Naples Pre-Deployment Brief and is a depiction of the prior HSP process that used the SAC method to acquire husbanding services from the requirements generation through husbanding service execution and payment. This method was used until October 1, 2015, when the Navy switched to the current HSP program.

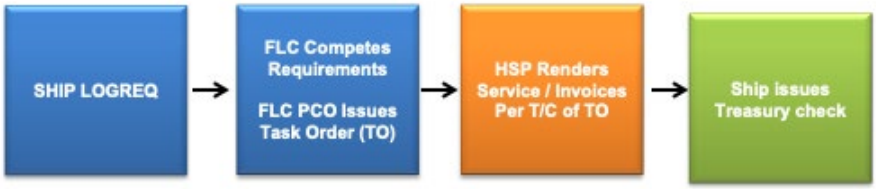

Figure 3. Husbanding service provider process prior to FY15. Adapted from NAVSUP (2019).

Figure 4 is an illustration from the NAVSUP FLC Naples Pre-Deployment Brief and is a depiction of the current HSP process that uses the MAC IDIQ and OSBP. This demonstrates the separation of functions, auditability standards, and oversight implemented to ensure compliance with the Department of the Navy business process for acquiring husbanding services during port visits per OPNAV Instruction 4400.11.

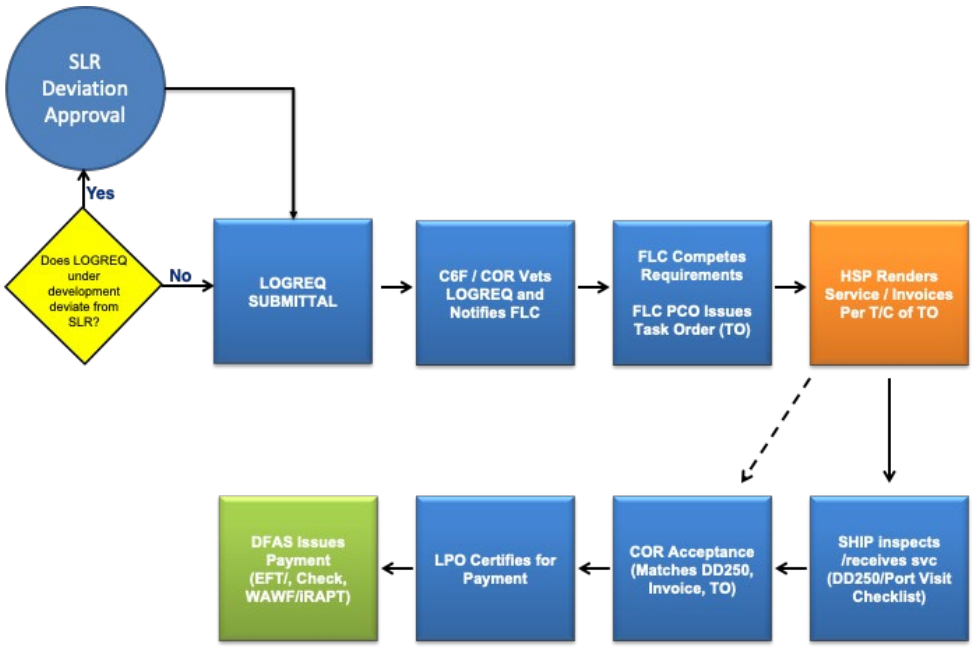

Figure 4. Husbanding service provider process FY 2015–present. Adapted from NAVSUP (2019).

OPNAV Instruction 4400.11 delineates the various personnel that have critical roles within the HSP process. These personnel include the customer submitting the requests, the fleet staff reviewing the requests, and the FLC staff processing the contract requirements. According to the NAVSUP Global MAC brief, the key stakeholders within the process are as follows:

1. **Supply Officer (SUPPO):** Port visit husbanding services requirements are originated by the ship's SUPPO, who acts as the logistics representative and sole point of contact for the husbanding agent on all husbanding requirements for the ship. Once the port visit requirement is known, the SUPPO will draft a LOGREQ and send it to the COR for review.

2. **Contracting Officer Representative (COR):** CORs play a critical role in the HSP process by ensuring contractors meet the commitment as negotiated. CORs are typically government civilians who are headquartered at the numbered fleet commands. They are usually experts on the geographical area in which they are assigned and develop expertise on the HSPs in that AOR. They work closely with the contracting officers (KOs) and SUPPOs. CORs are responsible for monitoring and overseeing

the administration of husbanding contracts within their specific AORs. They also ensure that the LOGREQ submitted by the SUPPO is within the previously approved standards by comparing it to the standardized LOGREQ. If the requirement deviates, then they request that the SUPPO submit a deviation request.

3. **Contracting Officer (KO):** KOs working at the designated FLC are responsible for executing the requirements for husbanding services. The KO requests proposals and verifies the proposals are in line with the contract. The KO also ensures performance of all the necessary actions for executing the husbanding service contract and ensures compliance with the terms and conditions.

4. **Type Commander (TYCOM):** The training and proficiency of units and SUPPOs regarding port visit management is the responsibility of the TYCOMs. Each TYCOM ensures that funding for a ship's port visit is centrally located. After each port visit, the TYCOMs validate all port visit documents to issue the final payment to the contractor.

If a deployed unit desires to exceed contract line-item quantities or has a requirement not currently on the Global Standardized Logistic Requirement (SLR), the unit must submit a deviation request to the Numbered Fleet Command (NFC), which is subject to the approval of the assistant chief of staff for logistics (N4). The N4 has the authority to approve deviations up to certain thresholds depending upon the respective TYCOM. If the request exceeds the prescribed thresholds, then the N4 has to coordinate with the TYCOM to ensure funding is available. When the request is below the threshold, the process for approval is generally a quick 48-hour turnaround time. More scrutiny and time are added when the thresholds are exceeded. This information is captured in the HSPortal. Past deviation requests should be reviewed by CORs in the planning stages of a port visit.

E. NAVY'S STANDARD LOGISTICS REQUIREMENTS LACK STANDARD SYSTEMS AND PROCESSES

To help standardize its husbanding program, the Navy created HSPortal as the official repository for all HSP data. The HSPortal database is comprehensive and contains

HSP information pulled from multiple sources to be viewed, stored, and analyzed in one place. OPNAV 4400.11 mandates the use of HSPortal for HSP stakeholders for requirement development and as a data entry repository. Currently, the SLR templates can be downloaded from HSPortal and are separated by ship class and mooring type.

The Naval Audit Service report N2019-0013 highlighted how the Navy's requirement system lacks proper standardization and processes to ensure ship personnel did not request and pay for services not required or even necessary. The audit focused on procedure after October 1, 2016, and found that the SLR templates failed to identify port-specific requirements and listed some possible requirements as "omit if not required" (Naval Audit Service, 2019, p. 3). The report views the lack of specific port requirement guidance as an issue because the SLR template is relied on by ship personnel for direction on ordering goods and services when visiting new and unfamiliar ports. The report stated that quantities and types of requirements change for each port, and the capabilities for the port may or may not require additional services. However, the report found that the current HSP process enables all items on SLR template to be ordered by ships, irrespective of their actual need. Specifically, the report discovered the Navy unnecessarily purchased $60,000 in oil boom services for a ship's port visit. The report stated that the needless purchase was a result of the lack of port-specific requirements within the SLR ordering process and that unless the Navy changes its system, these unwanted purchases will continue to occur.

The SLR process also lacks consistent methodologies for determining maximum allowable limits for quantities, as found by the Naval Audit Service report N2019-0013. The report discovered that the Navy allows each NFC the ability to generate its own maximum allowable limits for ports within its area of operation. Specifically, the report found that one NFC used the highest quantity historically ordered, while another used the average of all historical orders. The report viewed the inconsistent methodology for determining quantity limits across the fleet as a problem because ships are at greater risk of ordering unnecessary items and excessive quantities.

The Navy has made great progress in improving the HSP requirements generation and approval process since the original Naval Audit Service report N2014-0048 was issued in September 2014. However, the progress and corrective actions were not enough. The

Naval Audit Service report N2019-0013 recommended to U.S. Fleet Forces Command, U.S. Pacific Fleet, and NFCs to revise the SLR process to ensure consistency with requirements and that they accurately reflect the needed goods and services for the ship. The report also recommended that the Navy include port-specific requirements within the SLR process to be used across all NFCs and for these requirements to be updated as needed.

III. LITERATURE REVIEW

It is impossible to discuss the policy changes to the HSP program without understanding the contextual and cultural shifts within the Navy after the fallout from the GDMA scandal. Widespread corruption in the 7th Fleet exhibited a breakdown in ethical leadership and sound policy. While much discussion has centered around the prosecution of the individuals responsible for this breach in trust, there was also a need to correct the policies that made the corruption possible. According to a *Washington Post* investigative report, the GDMA scandal broke in 2013 when federal investigators arrested Leonard Francis, the head of GDMA, in San Diego (Whitlock, 2016). Francis complied with investigators and pleaded guilty to bribery and falsifying invoices to steal more than $35 million. He successfully ran his scheme for over a decade (Whitlock, 2016). Charges have been filed against over 30 people, and at least 20 have pleaded guilty (LaGrone, 2019). As a result of the scandal, then–Secretary of the Navy (SECNAV) Ray Mabus ordered an audit of the HSP. The Naval Audit Service report N2014-0048, *Navy Husbanding and Port Services Contracts*, was an objective yet scathing account of the failures in the HSP process. The overall program had few internal controls, and key personnel, such as SUPPOs, lacked appropriate training on their roles and responsibilities. The audit found that not only had GDMA exploited these weaknesses for monetary gain, but the process was vulnerable to be exploited by other HSPs (Moran, 2016). SECNAV correctly saw that a change in culture and policy was needed to reinforce the ethical standards. Key findings from articles, instructions, previous theses, and the naval audits are highlighted in the remainder of this section.

A. PREVIOUS RESEARCH ON THE TOPIC OF HUSBANDING SERVICE PROVIDERS

Analysis of the Multiple Award Contracting Strategy on U.S. Government Husbanding Service Provider (HSP) Prices, the most recent thesis on this topic at the Naval Postgraduate School (NPS), was published in 2020 (Kiengsiri et al., 2020). The research focused on comparing the MAC to the SAC IDIQ. That study sought to compare quantitative data to see if the MAC was, in fact, a more economical contracting vehicle than the traditional SAC. The authors used a series of regression analyses to directly compare port visits from

before and after the change in 2016. Pricing information was retrieved from HSPortal, the same database used for this thesis. Individual contract line items were compared to see how costs fluctuated over time. While some line items increased in cost, the total cost of port visits declined. The study covered a three-year period and determined that the MAC was the more economical contracting method (Kiengsiri et al., 2020).

Kiengsiri et al. (2020) did not look at the effect of last-minute port visit planning, sometimes called "short-fuse" port visits, where requirements are developed and then a task order is submitted for bid in a matter of days as opposed to the recommended 30-day lead-time. It was assumed that, if a requirement was produced late, the cost would greatly increase, as HSPs would have less time to source the requirements. Additionally, changes in schedule and operational factors can limit the planning horizon. The research also did not assess competition among contractors inside the MAC. Short-fuse port visits can limit the competitive nature of the MAC, given that a narrow window to compete the task order will naturally exclude some HSPs from submitting a bid.

Another NPS thesis, *Worldwide Husbanding Process Improvement: Comparative Analysis of Multiple Contracting Methodologies*, was published in 2007 (Gundemir et al., 2007). The research focused on forecasting and simulating expenses for future budgets. The Gundemir et al. (2007) thesis predates the MAC and therefore only focuses on the previous SAC type. What is significant about this research is that it was conducted during the timeframe of the Fat Leonard scandal, but the researchers saw a need to define "a flat-rate, low-variability, well-defined and constant set of requirements [that] minimizes risk and price fluctuations" (Gundemir et al., 2007, p. 55). When Navy leadership realized that logistic requirements needed to be flexible and should be grouped by geographic location, they introduced what was to be known as the Standardized LOGREQ (Office of the Chief of Naval Operations, 2020). The standardized LOGREQ was created using historical data and subject matter expertise so that there was no ambiguity on the services a ship would need in port. Each numbered fleet was responsible for setting the standardized LOGREQ for its region, and the MACs were aligned to the region therein. The most recent naval audit has inspired a broad desire to consolidate the regional MACs into one global MAC now that each ship type has its own global LOGREQ that captures its port service needs.

The MAC contract strategy was previously utilized by the Navy. In 2015, a thesis by NPS students titled *Multiple Award, Multiple Order Contracts—The Future of Navy Surface Maintenance Procurement* examined maintenance contracts for surface vessels (Duncan & Hartl, 2015). Duncan and Hartl compared the MAC to the SAC in a similar fashion as the group in 2020, but in the context of maintenance. Their emphasis was on creeping requirements that caused the work package to grow, causing an increase in costs. They determined that the MAC was more effective in curbing these costs and led to better on-time completion. While this was a good example of the MAC strategy in practice, there is a difference in the nature of the two programs; specifically, a maintenance contract focuses on an end product. A task is assigned and has specific measurable items that either meet the requirement or do not meet the requirement. Conversely, HSP contracts tend to focus on services. There are certain material products that must be delivered in order for the contractor to fulfill the contract obligation, but there is a qualitative component that is harder to measure. Contract fulfillment for port visits is more subjective than it is for maintenance. This study was useful for its initial fielding of the MAC strategy but should be caveated by the difference therein.

B. CRITICAL REVIEW OF PRIOR NAVAL SERVICE AUDITS

Prior to the MAC implementation, a key weakness in the HSP program was the requirements generation and approval process, as outlined in the Naval Audit Service report N2014-0048 (Naval Audit Service, 2014). The audit report was conducted at the request of secretary of the SECNAV in response to the fraudulent activities conducted by GDMA contractors and Navy officials. The report focused on identifying "internal control weaknesses within the Navy's husbanding and port services processes" (Naval Audit Service, 2014, p. 40)

In response to the Naval Audit Service report N2014-0048, the Navy issued a new policy, OPNAV Instruction 4400.11, *Husbanding Service Provider Program Policy*, dated June 2, 2016 (Office of the Chief of Naval Operations, 2020). OPNAV 4400.11 was drafted and issued to be the Navy's comprehensive policy for standardizing the HSP Program process across the Department of the Navy. The instruction addressed the following problem areas that were highlighted in the Naval Audit Service report N2014-0048:

- Authorities
- Responsibilities
- Requirement generation and approval
- Ordering
- Surveillance
- Receipt and acceptance
- Invoicing and payment (Office of the Chief of Naval Operations, 2020)

In addressing specific issues regarding the requirements generation and approval process, OPNAV 4400.11 corrective actions included

- Providing increased control over the requirement generation and approval process for ships by creating a SLR template and review process
- Removing the ordering authority from ships for HSP supplies and services and shifting the authority to NAVSUP FLCs and their KOs, who were more trained in executing task orders
- Appointing CORs to oversee delivery of HSP contracts, goods, and services for increased task order surveillance
- Providing additional examination of HSP goods and service payments by implementing the OSBP process
- Establishing program managers to oversee the daily execution of the HSP program at U.S. Fleet Forces (USFF) and U.S. Pacific Fleet (PACFLT) type commands (Office of the Chief of Naval Operations, 2020)

These actions are evidence the Navy made progress in correcting issues regarding requirements generation and approval. However, the Naval Audit Service (2019) conducted and issued the follow-up Audit Report N2019-0013 in June 2019 that showed significant weaknesses remained.

Naval Audit Service report N2019-0013 found that the Navy's SLR templates and deviation "process were not standardized across the Numbered Fleet Commands" (NFCs; Naval Audit Service, 2019). Additionally, the report found that the SLR templates lacked the "necessary internal controls needed to ensure that only goods and services required were ordered by shipboard personnel "(NFCs: Naval Audit Service, 2019). Specifically, the report highlighted how the SLR templates failed to accurately estimate the ships' actual needs, did not take into consideration port-specific requirements, and did not use any quantitative data, statistical analysis, or any consistent methodologies to determine maximum allowable limits on volumetric services, such as trash, water, or waste.

Audit Report N2019-0013 further showed that the deviation process failed to maintain proper segregation of duties, approving authorities did not always set the appropriate levels, and proper documentation was not maintained. The report stressed how these weaknesses continued to expose the Navy to unnecessary ordering, undue influences, and the fraud, waste, abuse, and mismanagement of the GDMA scandal.

C. SUMMARY

The articles, instructions, and previous research discussed in this chapter provided historical context and exhibited gaps in the understanding of an ever-changing environment. Fiscal transparency and repeatable process clarity has been a long-term goal of the Navy and the wider DOD (H.R. 5687, 1990). It is imperative for the Navy to be a good steward of public funds and to maintain the highest ethical standards. This can be achieved through sound policy and quality training that is informed by empirical evidence and judgment.

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IV. DATA AND METHODOLOGY

This chapter covers the methodology of data aggregation, cleaning, and analysis used to answer the three research questions of this thesis.

A. COST EFFECTS OF SHORT-NOTICE PORT VISITS

Based on the NAVSUP FLC Sigonella research directive, this project explored the financial impact of short-notice port visit LOGREQ submissions on the cost of services. Given that husbanding agents have less time to resource the services provided, the researchers expected that the later the LOGREQ was submitted, the higher the cost would be. This section describes the methodology the researchers used to analyze the data.

1. Source of Data

Per HSPortal, the U.S. Navy conducted 5,892 port visits in the 5th, 6th, and 7th Fleets from October 1, 2015, to April 30, 2020. The HSPortal is an online repository of U.S. Navy port visits worldwide that stores husbanding service data. The data used for this project is considered unclassified and was downloaded directly from HSPortal. The COR, KO, and ship SUPPO from the respective fleets are responsible for adequately submitting, verifying, and validating that the cost data are accurately inputted in the HSPortal. This data creates the groundwork for the price comparison between on-time and late submissions of a LOGREQ. The researchers analyzed and scrubbed the data for accuracy.

2. Data Sample

The initial sample contained 5,892 port visits that were executed over the 4-year period. The researchers utilized the specific data from HSPortal for this analysis: ship type, fleet, port location, total port visit cost, arrival date, departure date, and LOGREQ received date. Each data element downloaded from HSPortal is described in Table 1. Next, the researchers grouped all ship types into six different ship classes as defined in Table 2.

Table 1. Summary and description of required data elements

DATA ELEMENT	DESCRIPTION
SHIP TYPE	Hull type of a ship
FLEET	Numbered fleet where the port visit was executed
TOTAL PVST COST	All-inclusive costs of husbanding services for port visit
ARRIVAL DATE	Date the port visit started
DEPARTURE DATE	Date the port visit ended
LOGREQ RECEIVED DATE	Date LOGREQ was submitted to COR from the ship

Table 2. Ship classes and descriptions of ship types

SHIP CLASS	DESCRIPTION OF SHIP TYPE
AMPHIB	Dock Landing Ship (LSD) Landing Platform/Dock (LPD)
CRUDES	Guided Missile Destroyer (DDG) Guided Missile Cruiser (CG)
LARGE DECK	Landing Helicopter Assault (LHA) Landing Helicopter Dock (LHD) Aircraft Carrier (CVN)
MSC SHIPS	Afloat Forward Staging Base (AFSB) Submarine Tender (T-AS) Command Ship (LCC) Hospital Ship (T-AH) Dry Cargo/Ammunition Ship (T-AKE) Underway Replenishment Oiler (T-AO) Fast Combat Support Vessel (T-AOE) Cable Laying/Repair (T-ARC) Rescue/Salvage Ship (T-ARS) Fleet Ocean Tugs (T-ATF) Expeditionary Fast Transport Vessel (T-EPF) Expeditionary Mobile Base (T-ESB)
SMALL CRAFT	Littoral Combat Ship (LCS) Mine Countermeasure (MCM) Coastal Patrol (PC)
SUBMARINES	Fast Attack (SSN) Ballistic Missile (SSBN) Guided Missile (SSGN)

After data was reviewed and categorized into ship classes, the number of days for each port visit was calculated. This was done by calculating the departure date and subtracting the arrival date. Next, the daily cost was calculated by taking the total port visit cost and dividing it by the port visit's number of days. Since there were many data points per ship class, this was the best method of getting a comparable data point across all port visits for the project. All ship visits vary in the number and types of services they receive. The researchers were able to establish a baseline by taking the average of each. Finally, the researchers calculated the number of days from the port visit that the ship submitted the LOGREQ. This was done by taking the ship's port visit arrival date and subtracting the LOGREQ received date. After establishing the baseline data, the researchers then began to scrub the data. The methodology utilized is described in the following section.

3. DATA SCRUBBING

Data scrubbing is a critical step before performing an analysis. Excluding inaccurate or incomplete data improved the data sample's quality and improved confidence in findings on the effect of late LOGREQ submissions on costs. The following three steps were used to clean the data:

a. Step 1: Exclude canceled port visits and transits

The first step in scrubbing the data involved excluding all canceled port visits, zero cost, and transits. The canceled port visits did not reflect full and accurate pricing since port visits either had a zero charge or just a cancellation fee. A transit port visit occurs when the vessel is going through a strait and requires additional support from shore installations to safely navigate. The transits only consist of a tug fee, which would not be a valid data point to be averaged into port visits that consisted of full services. Neither one of these exclusions would provide an accurate daily cost to be averaged with executed port visits. Using the "sort" function in Excel, the researchers identified and removed all canceled port visits and transits. A total of 392 data points were removed from the complete database list of 5,892 port visits. Of these, 156 port visits were removed because they were listed as canceled or as transit, representing 39.8% of all port visits excluded.

b. *Step 2: Exclude port visits with missing data elements*

The second step in data scrubbing involved excluding all port visits with missing or invalid required data elements such as LOGREQ received dates, ship type, arrival date, departure date, or port visit total. These data fields were required for each port visit to identify the effect of late LOGREQ submissions on average daily costs. The researchers used the "sort" function in each of the categories to find any missing data. Out of 392 port visits that were removed from the data, 137 port visits were removed due to missing data. Exclusion due to missing elements represented 34.9% of all excluded port visits.

c. *Step 3: Exclude outliers utilizing the empirical rule*

The final step in data scrubbing is to identify and remove all outliers. An outlier is a data point that is unlikely to occur within a random sample. Keeping outliers in the dataset can skew the results by minimizing or maximizing the estimation. Outliers can be caused for multiple reasons. For example, a contractor may know they are the only HSP capable of providing services at that time, and the contractor could price all items at the highest price allowable per the contract, which leads to an inflated port visit cost. Outliers could also be caused by human error in data entry into the HSPortal database.

The researchers calculated the standardized value of daily cost per port visit within each ship class using a Normal distribution to identify outliers. Once the sample size is greater than 30, the distribution becomes bell-shaped, resembling a Normal distribution (Lumen Candela, 2020). Each ship class group in the researchers dataset met the sample size criteria. Utilizing the empirical rule means that 99% of the data from the dataset will fall within plus or minus three standard deviations of the mean. Anything outside this would be considered an outlier from a normal distribution; they would either be extremely small or large values, and, therefore, the researchers considered them to be outliers. The process for removing extreme values established the legitimacy of the daily costs pulled from the HSPortal and increased the accuracy of findings. Of the total of 392 port visits removed from the dataset, 99 port visits were removed using this method (representing 25.3% of all excluded port visits).

4. CROSS-TABULATION

The researchers excluded 392 port visits from the data sample based on the three steps for scrubbing the data. After data scrubbing, only 5,500 port visits remained. The researchers used the cross-tabulation method in Excel via a pivot table to identify the effect that a LOGREQ has on price. The researchers used six data elements in this model, listed in Table 1. The researchers split all ship types into six ship classes, listed in Table 2. Each group was separated into seven LOGREQ submission timeline ranges, from 0 to 30 and above in increments of 5 days. All port visit entries were then categorized into each of those ranges.

The first cross-tabulation model (Model 1) consisted of two tables. The first table showed the average daily cost for each ship class for the 5th, 6th, and 7th Fleets (aggregate). The second table counted the number of port visits contributing to the values in the first table. The two tables in Model 2 allocated the information in Model 1 to the 5th, 6th, and 7th Fleets, but independently.

B. IMPACT OF CONTRACTOR COMPETITION ON COST

According to the Government Accountability Office (GAO; 2010), competitive contracts can save taxpayer dollars, improve the performance of contractors, and reduce fraud. In this section of the research, the researchers sought to validate whether contractor competition has an impact on the cost of HSP task orders. The intent was to evaluate the port visit data, filtering out irrelevant or incomplete elements, and focus on the most accurate data entries that could be used unilaterally across all contractors to effectively validate cost savings.

1. Competition and Solicitation Procedures

As U.S. deficits continue to grow and defense budgets continue to shrink, government agencies have placed a greater focus on competitive contracting, as seen with the 2015 initiative of Better Buying Power (BBP) 3.0 (Office of the Under Secretary of Defense for Acqiusition, Technology, and Logistics [OUSD(AT&L)], 2015). BBP 3.0's aim is to achieve dominant capabilities through cost consciousness, professionalism, and

technical excellence (OUSD[AT&L], 2015). Specifically, BBP 3.0 focuses on the following eight areas:

- Achieve affordable programs
- Achieve dominant capabilities while controlling life-cycle costs
- Incentivize productivity in industry and government
- Incentivize innovation in industry and government
- Eliminate unproductive processes and bureaucracy
- Promote effective competition
- Improve tradecraft in acquisition of services
- Improve professionalism of total acquisition workforce (OUSD[AT&L], 2015)

Each of these focus areas is equally important. However, this section focuses on the impact that effective competition can have on contracting for husbanding services.

Within government procurement, competition is defined as the government determining from whom to procure goods and services (Nash et al., 2013). The competitive process is conducted through solicitations and entertaining offers from multiple competitors, comparing them, and accepting one based on the offer's value to the agency (Nash et al., 2013). The governing document for competitive procurement within the federal government is the Competition in Contracting Act (CICA) of 1984 (2011). Any federal procurement contract that is not specifically authorized by a particular statute is subject to the guidelines of CICA (2011). One of the most prominent guidelines outlined by CICA (2011) is the requirement that agencies conducting procurement for goods and services shall be entered into after "full and open competition through the use of competitive procedures" (para. 2).

A decade after CICA (2011) was passed, the Federal Acquisition Streamlining Act (FASA) of 1994 was passed to simplify competitive contracting (GAO, 2010). FASA established a preference for MAC strategies that utilized task order and delivery order (TO/DO) contracts (CICA, 2011). MAC is the same strategy utilized to contract the Navy's husbanding services. Although the MAC itself is subject to CICA, TO/DO contracts are not (GAO, 2010). However, FASA requires agencies using MACs to provide contractors

"a fair opportunity to be considered" when TO/DO contracts are issued in excess of $3,000, unless

- The agency's need for the services or property is of such unusual urgency that providing such opportunity to all such contractors would result in unacceptable delays in fulfilling that need;
- Only one such contractor can provide the services or property required at the level of quality required because the services or property ordered are unique or highly specialized;
- The task or delivery order should be issued on a sole-source basis in the interest of economy and efficiency because it is a logical follow-on to a task or delivery order already issued on a competitive basis; or
- It is necessary to place the order with a particular contractor in order to satisfy a minimum guarantee (CICA, 2014).

Because Navy ships sometimes pull into remote and less-populated ports, finding husbanding support can be challenging. The lack of organic resources creates an environment where there is only one viable husbanding service provider, forcing Navy contracting officials to issue the TO/DO contract without the benefit of other competitive proposals to make an accurate cost decision. Before this study, the cost impact regarding the lack of contractor competition was unknown and worthy of further analysis.

2. Sources of Data

Refer to paragraph A.3, Steps 1 through 3, for the same procedures to source and scrub the data sources. The same scrubbed data source used to address the first research question, which contained 5,500 port visits from the 5th, 6th, and 7th Fleets between October 1, 2015 and April 30, 2020, was used for the second question.

3. Additional Data Scrubbing

There was a slight refinement in the data to better accommodate price analysis. Ports with 10 or fewer visits were classified as outliers and were removed, and only normal port visits were included. Ports not frequently visited fail to provide sufficient evidence for competition criteria. Other event types, such as brief stops for fuel (BSF) or brief stops for provisions (BSP), were removed to only analyze actual port visits. In total, 930 port visits were removed from the additional data scrubbing, leaving a remainder of 4,570 port visits to be analyzed.

4. Methodology

The researchers used cost indexing to normalize the data and create a consistent and comparable data set. The methodology allowed cost normalization of the data series to have a common starting point, which facilitated the comparison of cost data between fiscal years and port locations, and across all fleets. The adjustment of actual cost data to a more uniform basis has two benefits: (a) it reduces the dispersion of the data points and provides consistency, and (b) it increases the number of data points that can be compared, which smooths out the data set.

To index the cost data, the values had to be adjusted to equal each other in a given starting period in terms of their relative value compared to a base quantity. The conventional starting value of 100 was used with the base quantity being the cost data at the fleet level. Each value was normalized from the starting value of 100. Port index values are relative to the fleet and represent percent change above or below the fleet's average cost data. Contractor index values are relative to the port and represent percent change above or below the port's average cost data. Table 3 illustrates the indexing and normalization methodology used to compare relative values of contractor costs to those of the port and port costs at the fleet level.

Table 3. Cost index example of Port Gaeta of 6th Fleet in FY 2019

FY 2019

FLT/Port/CTR	Daily Cost (avg)	Index	
6th Fleet	**$12,964**	**100**	Relative to fleet average
Gaeta	**$17,387**	**134**	
Global Defense Logistics (GDL)	$24,249	139	Relative to port average
Multinational Logistics Services (MLS)	$19,832	114	
Shipping Consultants Associated (SCA)	$12,591	72	

Port visit average daily costs were used as the base value. The average daily cost was calculated by dividing the total cost of the port visit by the total length (in days) of the port visit. Port index values reflect the relation of port costs to the fleet's average. To determine if contractor competition has an impact on contract costs, non-competitive port index data was compared with competitive port index data.

Table 4. Subic Bay contract cost and index values for FY 2016 and FY 2017

	FY 2016		FY 2017	
FLT/Port/CTR	**Daily Cost (avg)**	**Index**	**Daily Cost (avg)**	**Index**
7th Fleet	**$16,530**	**100**	**$11,804**	**100**
Subic Bay	$13,614	**82**	**$5,989**	**51**
Inchcape Shipping Services	$0	0	$8,912	149
Multinational Logistics Services	$13,614	100	$5,282	88
Parsh Marine	$0	0	$8,959	150
Parsh Marine Philippines	$0	0	$6,099	102
Seaway Filipinas Logistics	$0	0	$4,289	72

The researchers used a fiscal year as the period in which to classify if a port was competitive or non-competitive. For example, Subic Bay in FY 2016 is one period. Contracts won by a single contractor in a given port during a fiscal year indicated a non-competitive period. Conversely, contracts won by multiple contractors during a fiscal year indicated a competitive period. The data was analyzed over 5 fiscal years (2016 through 2020), totaling 170 periods across the 34 ports. Of the 170 periods, eight (4.7%) had zero contracts executed during the period. Non-competitive periods totaled 65 (38.2%), and competitive periods totaled 97 (57.1%).

C. IMPACT OF SOLICITATION PERIOD ON AVERAGE DAILY COST

The third research question centers around the value-added step of solicitation. Specifically, does the length of solicitation time make a difference in the daily average cost? It is hypothesized that the more time contractors have to bid, the more proposals would be submitted with greater price fidelity. The HSP Process is broken up into distinct parts in which a stakeholder has a specific role and task to perform. HSPortal records these actions and time stamps them when the port visit proceeds from step to step. The accuracy and completeness of data entry has gotten progressively better since the program's implementation in 2015. Mandatory compliance was instituted on October 1, 2017, with the start of FY 2018. After that point, the data is significantly more accurate. For this reason, the researchers focused on the data set beginning on October 1, 2017. The steps are defined as follows:

1. Logistic Requirement to Code 200

The first major step in the process is setting the requirements for a port visit, which is done through a LOGREQ. Once approved by the Commanding Officer, the message is sent to the AOR's requisite FLC, where a COR vets the requirements to ensure compliance with standard requests and fleet guidance. There is dialogue back and forth to the ship to capture all needs. Once the COR is satisfied, the message is sent to the KO. This step is initiated with the LOGREQ date time group Date and concluded with the Sent to Code 200 date in the HSPortal.

2. Code 200 to Request for Task Order Proposal Issue

The KO works with the Code 200 shop at the requisite FLC. Once the KO receives the requirements, the KO puts those into a contract format called a Request for Task Order Proposal (RTOP). The KO works with the assigned COR to ensure all requirements are listed as the vessel intends. Once the RTOP is constructed, it is sent to the vendors within the MAC for solicitation and bid proposals.

3. Solicitation Period: Request for Task Order Proposal Issue to Request for Task Order Proposal Due Date

The solicitation period is a key step in the process and is the basis for Research Question 3: Is the amount of time given to vendors sufficient to receive the best price? Would the Navy benefit from lengthening or curtailing this period? Once the RTOP is complete, it is sent to a market of HSPs that can bid on the contract. The MAC includes a pool of prescreened HSPs that are qualified to provide services to U.S. naval warships. The KO tries to provide sufficient time for the HSPs to bid in order to allow for robust competition. There is a specified due date when the RTOP is issued because there are still several steps to complete prior to ship arrival.

4. Evaluation: Request for Task Order Proposal Due Date to Task Order Award

Another key step is the evaluation period. Once the HSPs have submitted their proposals, the KO reviews them to ensure the requirements are met and selects the offer with the lowest price technically acceptable.

5. Task Order Award to Arrival

Once the KO has selected the HSP, a task order is drafted. This is the official contract between the U.S. government and the HSP. Once everything is signed, the HSP begins to prepare for the vessel's arrival to the port. Again, the KO wants to give the HSP as much time as possible to prepare. This can be a stressful step, as there is limited time for the HSP and its subcontractors to have all requirements ready for the vessel's arrival at the port. At the conclusion of this step, the vessel arrives in the port. If the contract is not in place by the time the vessel arrives, then the service will not be available to meet the ship's needs. The port visit may be delayed or canceled, which could impact the mission of the ship or affect the readiness.

6. Port Visit: Arrival to Departure

This step records when the vessel arrives in port and when it departs. Upon arrival, the HSP provides the requested services. Some augmentation and modification can be made if required, but this is predominantly an execution phase.

7. Departure to Task Order Complete

At the end of the port visit, there are many documents that are required to be completed. A three-way match of the HSP Contractor Invoice, the Material Inspection and Receiving Report (DD Form 250), and the Port Visit Checklist (PVCL) must be conducted and be free of discrepancies before payment can be issued. Every contract line item is reviewed and accounted for, and the KO will address any disputes or contractual challenges to the HSP. This is also an opportunity for the ship's company to record comments on the quality of services rendered. The ship's company ensures that all services are met and are within an agreeable standard. Once the task order is complete, the process for payment begins. Applicable paperwork is sent to DFAS to be administered.

8. Data Scrub

As previously mentioned, the dataset contained entries with data omissions and inconsistencies. The researchers scrubbed the data to remove theses errors in a different

procedure than previously described to address research question 3. The following steps were taken to scrub the raw data from HSPortal for errors:

Step 1. The raw data for port visits from FY 2018–FY 2020 were compiled. The data started on October 1, 2017, and concluded April 30, 2020. The initial data set consisted of 3,864 port visit entries.

Step 2. Canceled and $0 port visits were removed from the data. The researchers removed 1,055 entries, leaving 2,810 port visit entries.

Step 3. "Bad data" is defined as date omission or dates that should have been but were not chronological (e.g., LOGREQ submission after port arrival). The researchers identified the rows with "good" data. All other rows of data were omitted in the analysis, leaving only the "good" data. First, the researchers determined the number of days each step took by comparing successive steps. The entire HSP Process is sequential, so each step can only begin once the predecessor has been completed. Next, the HSP process time was calculated by comparing the LOGREQ release date to the vessel's arrival-in-port date. This serves as the denominator when calculating the solicitation time percentage. Finally, each step was placed in chronological order, and the duration of each step (in days) was calculated. The data entries that resulted in negative durations were determined to be "bad" and were removed from the data set. Of all entries, 1,247 were removed. This left 1,563 port visit entries.

Step 4. The researchers calculated the percentage of time that the solicitation period lasted compared to the total pre-port-visit arrival time using the simple formula of solicitation days/time to port visit. This figure was used as a normalized measure of solicitation time.

Step 5. The scope of this analysis was to compare normal port visits; therefore, line items in the data set labeled as Straits Transits, Dry Dock Visits, Ammunition On/Offloads, BSF, and BSP were not good examples on which to base the port visit analysis. As a result, they were removed from the data set. Removing Ammunition On/Offloads subtracted an additional 35 line items from the dataset. Dry Docks removed 15 entries, BSF removed 60 entries, and BSP removed 85 entries. The new total was 1,368 port visits.

Step 6. Port visits with uncommonly long solicitation periods (greater than 15 days) were removed from the data set. This resulted in 42 entries being removed. The size of the resulting dataset was 1,326 entries.

Step 7. Port visits with solicitation periods of 0 days were removed because this was either an emergent request or an error in the data set. A total of 119 line items were removed, resulting in the final data set of 1,207 port visits.

9. Methodology

For this research question, the solicitation period was compared to the average daily cost of the port visit. The researchers used a cross-tabulation method in Excel via a pivot table to demonstrate the effect that the solicitation period had on cost. Scatter plots were used to graphically display the information. Two models were used to compare the results. The first model measured solicitation period as the number of days, and the second model measured solicitation period as a percentage of the pre-arrival HSP process time. The ratio is defined as the number of days the proposal was in solicitation time divided by the number of days in the pre-arrival process (shown in Equation 1).

$$Soliciation\ Ratio = \frac{RTOP\ Due\ Date - RTOP\ Issue\ Date}{LOGREQ\ submission\ date - Port\ arrival\ date} \qquad (1)$$

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V. DATA ANALYSIS AND RESULTS

A. COST EFFECTS OF SHORT-NOTICE PORT VISITS

Chapter IV, Section A, included an explanation of where the data was sourced, what was excluded, and the strategy used in the four cross-tabulation models created using the pivot table function in Excel, which analyzed a total of 5,500 port visits. The researchers understood that the fleet utilizes the standardized LOGREQ when pulling into port. Each ship type should, in theory, request the same services. The researchers knew that some visits have deviations due to ships' needs and the period of the stay. The researchers assumed that the best way to normalize the data was to take the daily average costs, separate them by ship class, and split them into specific time ranges. The specific time ranges refer to the timeliness of LOGREQ submissions and are in increments of 5 days. As mentioned previously, outliers were removed. The MAC IDIQ captures only Husbanding Services; if other services are needed, those are contracted via a separate contract. Due to the information in the dataset, quality and customer satisfaction were not taken into consideration in this analysis.

The authors utilized Model 1 to determine if LOGREQ submission timelines affect port visit costs at the fleet level. Table 5 is a cross-tabulation table that shows the average daily cost per ship class arranged with the number of days prior to the port visit from when the LOGREQ was submitted versus the average daily price by ship class, broken down by fleet. A heatmap was applied to each column by individual fleet, with green being lower cost and red being higher cost. The results showed no pattern related to cost based on the number of days the LOGREQ was submitted prior to port visit ranges for each class type, illustrating that there is no evidence of correlation between cost and submission timeline. The researchers then combined the three fleets to see if more data would change the results.

Table 5. LOGREQ submission vs. average daily cost by the 5th, 6th, and 7th Fleets (10/01/2015 – 04/30/2020)

DAYS TO PVST	AMPHIB	CRUDES	LARGE DECK	MSC SHIPS	SMALL CRAFTS	SUBMARINES
5th Fleet						
0-5	$20,582	$22,668	$47,377	$11,447	$2,310	$32,435
5-10	$26,818	$20,728	$66,248	$12,779	$3,656	$19,286
10-15	$37,292	$19,090	$109,945	$11,854	$5,337	$5,319
15-20	$36,113	$18,834	$162,383	$15,906	$4,844	$4,250
20-25	$25,738	$14,252	$79,911	$14,919	$8,567	$10,253
25-30	$36,608	$23,885	$74,207	$14,005	$7,169	$60,491
>30		$12,792	$57,660	$11,520	$12,193	$20,536
6th Fleet						
0-5	$26,648	$15,140	$52,511	$11,137		$3,916
5-10	$27,316	$14,674	$315,197	$11,905		$7,892
10-15	$19,055	$16,964	$73,203	$13,747		$6,470
15-20	$30,287	$17,241	$290,320	$11,362		$13,789
20-25	$12,335	$16,755	$191,202	$11,440		$9,878
25-30	$31,489	$18,325	$137,566	$13,391		$11,291
>30	$39,693	$17,801	$159,812	$15,337		$10,980
7th Fleet						
0-5	$11,384	$12,593	$43,460	$11,185	$14,528	$4,053
5-10	$27,456	$21,071	$70,411	$10,541	$14,254	$19,581
10-15	$19,969	$18,217	$30,176	$8,055	$9,950	$17,260
15-20	$4,018	$14,484	$107,374	$8,605		$2,450
20-25	$13,833	$19,784	$84,230	$8,396	$9,755	$9,907
25-30	$22,955	$19,796	$126,290	$10,243	$13,272	$14,469
>30	$31,498	$21,762	$100,235	$11,522	$14,312	$23,241

To give a better visual illustration of the cross-tabulation of Model 1 shown in Table 5, a line graph was produced (see Figure 5). The line graph shows the same data in a different form, again showing that there is no consistent correlation between the daily cost and LOGREQ submission timeline when broken down by fleet.

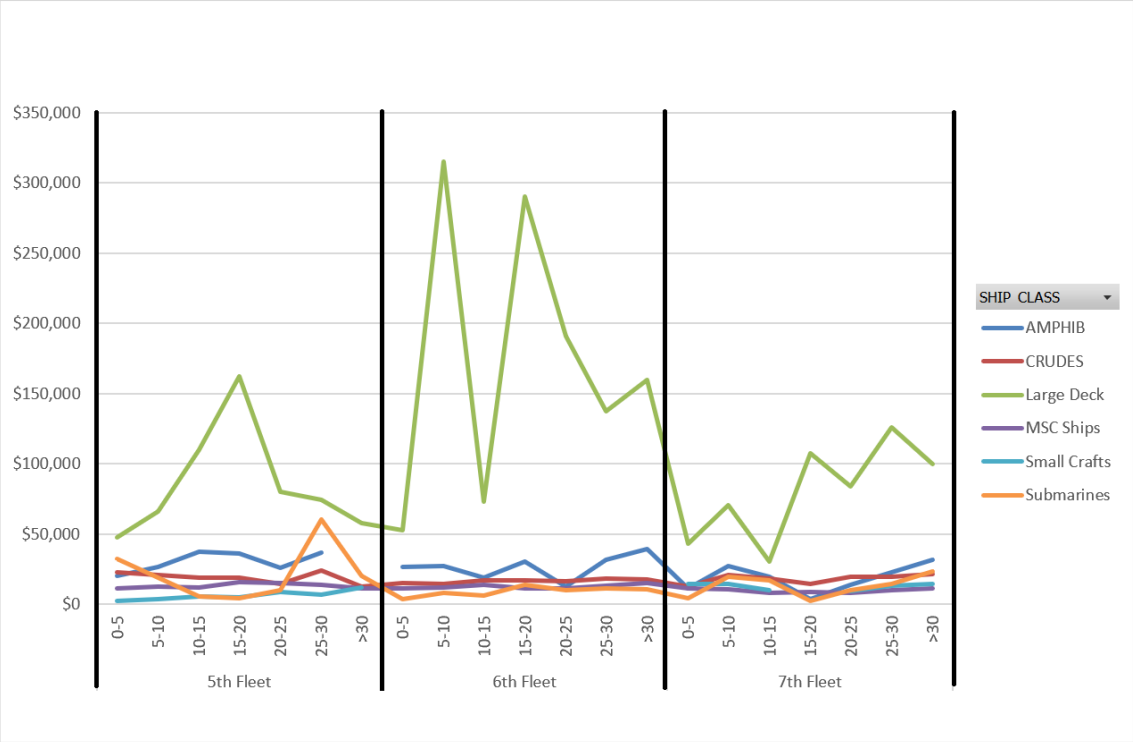

Figure 5. LOGREQ submission timeline vs. average daily cost by ship class for 5th, 6th, and 7th Fleets

Table 6 is a cross-tabulation table that shows the aggregate data from Table 5. The researchers combined the 5th, 6th, and 7th Fleets to further test Research Question 1, resulting in a consistent lack of evidence supporting correlation between the LOGREQ submission timeline and the average daily cost. A heatmap was applied to each column, with green being the lower cost and red being the higher cost, which showed that there is no evidence of correlation.

Table 6. LOGREQ submission vs. average daily cost for the 5th, 6th, and 7th Fleets combined (10/01/2015 – 04/30/2020)

DAYS TO PVST	AMPHIB	CRUDES	LARGE DECK	MSC SHIPS	SMALL CRAFTS	SUBMARINES
0-5	$21,821	$16,491	$47,620	$11,268	$3,877	$4,801
5-10	$27,207	$19,617	$72,290	$11,680	$4,087	$13,316
10-15	$24,324	$17,734	$92,917	$12,217	$5,603	$7,321
15-20	$26,739	$17,407	$154,965	$12,427	$4,844	$12,325
20-25	$16,185	$17,066	$121,166	$11,635	$8,651	$9,904
25-30	$30,155	$19,337	$105,648	$12,362	$9,494	$13,018
>30	$34,974	$18,533	$105,150	$12,935	$14,039	$13,583

To give an alternative visual illustration of the cross-tabulation Model 1 in Table 6, a line graph was produced (shown in Figure 6). The line graph shows the same data, again illustrating that there is no evidence of correlation between the daily cost and LOGREQ submission timeline for the 5th, 6th, and 7th Fleets combined.

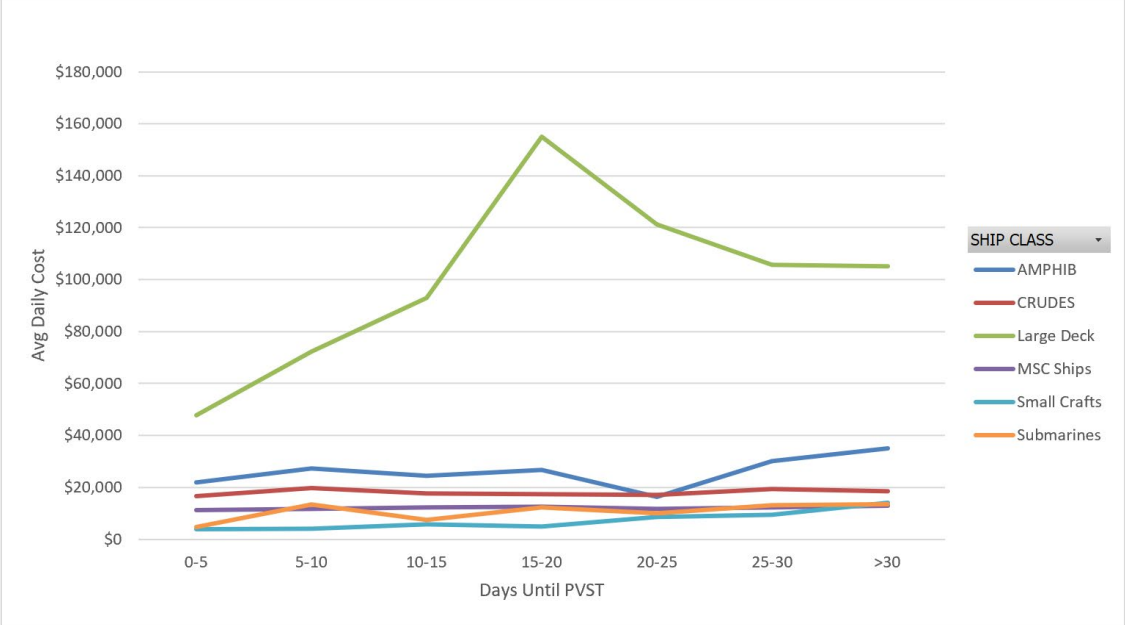

Figure 6. LOGREQ submission timeline vs. average daily cost by ship class for the 5th, 6th, and 7th Fleets (combined)

Table 7 is a cross-tabulation table that illustrates the number of port visits that occurred in the categories in Table 5, broken down by fleet. This shows the number of port visit entries averaged per each cross-tabulation cell of data. It is interesting that most submissions are in the 5-to-10–day mark for both the 5th and 7th Fleets, but there was no evidence of correlation between the price and the LOGREQ submission timeline. A heatmap was applied to each column by fleet, with green being the higher number of visits and red being the lower, which shows that there are more data points in the 5-to-10–day mark in the 5th and 7th Fleets, but still no evidence of correlation.

Table 7. Number of port visits by LOGREQ submission timeline for the 5th, 6th, and 7th Fleets

DAYS TO PVST	AMPHIB	CRUDES	LARGE DECK	MSC SHIPS	SMALL CRAFTS	SUBMARINES	GRAND TOTAL
⊟5th Fleet	59	219	58	929	919	29	2213
0-5	2	17	3	67	34	1	124
5-10	39	120	29	481	755	21	1445
10-15	5	22	6	79	49	1	162
15-20	5	29	1	87	51	1	174
20-25	3	10	5	75	13	2	108
25-30	5	13	8	92	13	1	132
>30		8	6	48	4	2	68
⊟6th Fleet	79	459	21	825		252	1636
0-5	7	46	1	62		27	143
5-10	19	82	1	124		67	293
10-15	9	45	2	133		21	210
15-20	6	38	1	112		19	176
20-25	5	58	4	100		27	194
25-30	19	72	4	158		30	283
>30	14	118	8	136		61	337
⊟7th Fleet	94	308	80	1027	76	66	1651
0-5	3	11	1	47	5	5	72
5-10	53	187	36	489	32	38	835
10-15	4	10	1	42	3	2	62
15-20	3	12	3	48		2	68
20-25	4	17	2	70	1	1	95
25-30	8	30	6	148	8	3	203
>30	19	41	31	183	27	15	316
Grand Total	232	986	159	2781	995	347	5500

Figure 7 illustrates the same information from Table 7 in the form of a line graph. This shows a significant number of port visits with the LOGREQ submitted in the 5-to-10–day mark for the 5th and 7th Fleets, but again, there is no correlation between the price and the LOGREQ submission timeline.

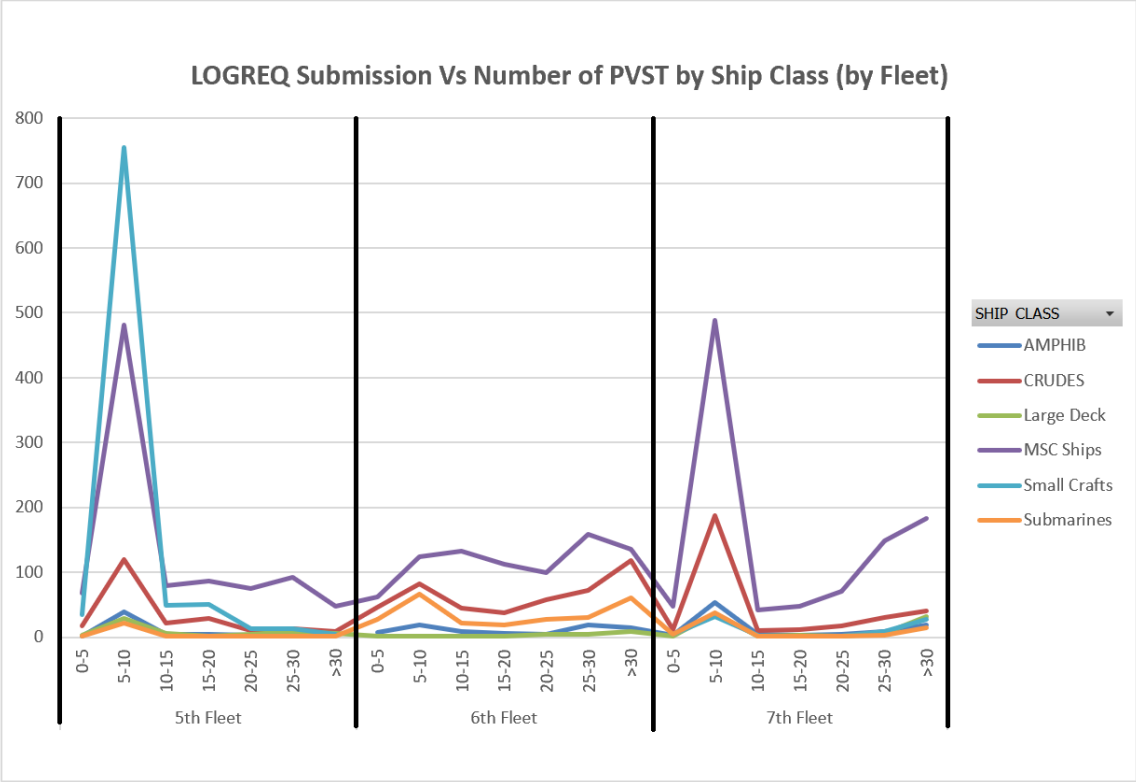

Figure 7. LOGREQ submission timeline vs. number of port visits by ship class for the 5th, 6th, and 7th Fleets

Table 8 is a cross-tabulation table that shows Table 7's data combined. This illustrates the number of port visits that occurred in the same categories as Table 6 to see the amount of data that visually calculated the figures. As shown in Table 8, the majority of the submissions are in the 5-to-10–day range (consistent with the 5th and 7th Fleets). A heatmap was applied to each column, with green being the higher number of visits and red being the lower, which shows that there are more data points between the 5-to-10 mark.

Table 8. Number of port visits by LOGREQ submission timeline for the 5th, 6th, and 7th Fleets (combined)

DAYS TO PVST	AMPHIB	CRUDES	LARGE DECK	MSC SHIPS	SMALL CRAFTS	SUBMARINES	GRAND TOTAL
0-5	12	74	5	176	39	33	339
5-10	111	389	66	1094	787	126	2573
10-15	18	77	9	254	52	24	434
15-20	14	79	5	247	51	22	418
20-25	12	85	11	245	14	30	397
25-30	32	115	18	398	21	34	618
>30	33	167	45	367	31	78	721
Grand Total	232	986	159	2781	995	347	5500

Figure 8 illustrates the same information from Table 8 in the form of a line graph. This again shows a significant number of port visits with the LOGREQ submitted between the 5-to-10-day mark, as was expected when combining the three fleets.

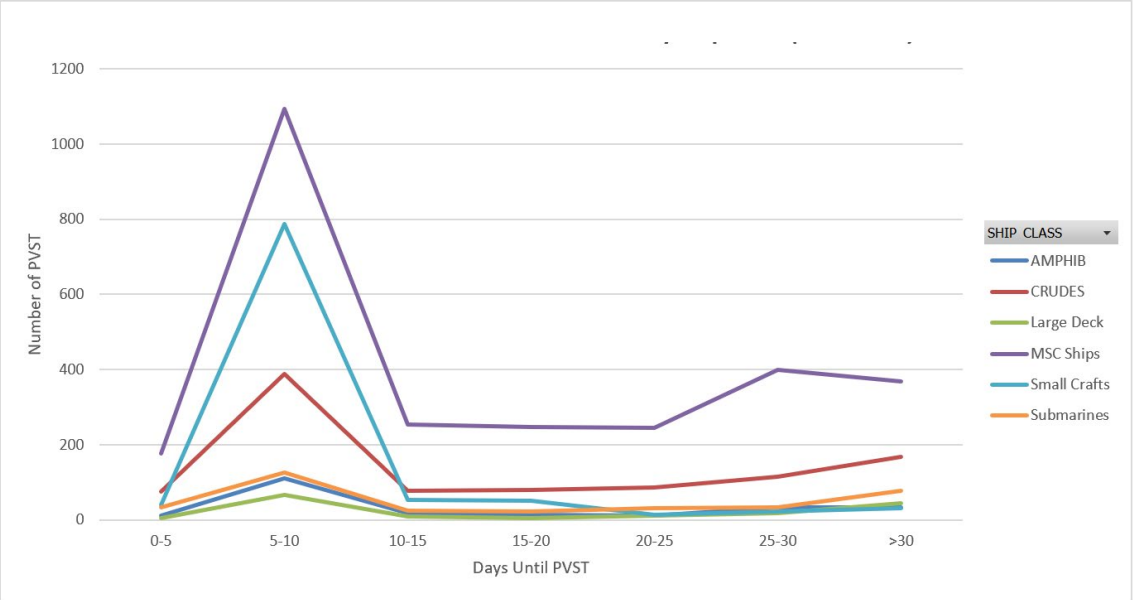

Figure 8. LOGREQ submission timeline vs. number of port visits by ship class for the 5th, 6th, and 7th Fleets (combined)

B. IMPACT OF CONTRACTOR COMPETITION ON COST

To answer the second research question, the researchers sought to identify the effect of competition on cost. The researchers analyzed a total of 4,570 port visits, comprised of 34 port locations across the 5th, 6th, and 7th Fleets. Based on the port visit cost data, there is evidence to suggest that the Navy should expect to have higher contract costs in locations where there is only one contractor competing for husbanding contracts.

For non-competitive periods, the average daily costs index across all fleets was 154, ranging from 16 to 356, or 89% below to 131% above average. Therefore, port locations where there was only one contractor competing for husbanding contracts between October 1, 2015, and April 30, 2020, experienced average daily costs that were 54% higher than the fleet average. Table 9 reflects the ports across the fleets and their respective port indexes for non-competitive periods. For non-competitive periods, the port with the lowest index was Tromso, located in the 6th Fleet, with a port index of 16. Al Duqm in the 5th Fleet had

the highest port index at 356. The standard deviation among the non-competitive period indexes is 91.3.

Table 9. Port indexes of average daily costs, non-competitive periods

Fleet	Port	Non-Competitive Period Index
5th	Abu Dhabi	144
5th	Al Duqm	356
5th	Aqaba (Port of Aqaba)	275
5th	Doha	135
5th	Fujairah	192
5th	Jebel Ali	98
5th	Khalifa Bin Salman Port	201
5th	Mina Salman	27
5th	Muscat (Port Sultan Qaboos)	152
5th	Salalah	183
5th	Sitra	92
6th	Augusta Bay	104
6th	Brest	54
6th	Djibouti	110
6th	Faslane	45
6th	Gaeta	-
6th	Haakensvern	130
6th	Haifa	263
6th	Lisbon	204
6th	Lochstriven	82
6th	Piraeus	268
6th	Port Victoria	82
6th	Souda Bay	-
6th	Tromso	16
7th	Changi Naval Base	-
7th	Chinhae	87
7th	Manila	315
7th	Phuket	311
7th	Pusan (Busan)	206
7th	Sasebo	80
7th	Sattahip	213

Fleet	Port	Non-Competitive Period Index
7th	Sembawang	-
7th	Subic Bay	82
7th	Yokosuka	99

Summary Statistics

Lowest Index	16
Highest Index	356
Average Index	154
Standard Deviation	91.3

Indexes for ports with two or more husbanding providers bidding for contracts during a fiscal year were much lower than they were for non-competitive periods. The smallest indexes were seen in periods with two or more husbanding providers bidding for contracts. On average, ports during competitive periods had a cost index of 118, which is 66% lower than ports during periods with no competition. Table 10 reflects the ports across the fleets and their respective port indexes for competitive periods. For competitive periods, the port with the lowest index was Mina Salman, located in the 5th Fleet, with a port index of 19. Manila in the 7th Fleet had the highest port index at 314. The standard deviation among the non-competitive period indexes was 68.9.

Table 10. Port indexes of average daily costs, competitive periods

Fleet	Port	Competitive Period Index
5th	Abu Dhabi	67
5th	Al Duqm	206
5th	Aqaba (Port of Aqaba)	-
5th	Doha	124
5th	Fujairah	182
5th	Jebel Ali	64
5th	Khalifa Bin Salman Port	115
5th	Mina Salman	19
5th	Muscat (Port Sultan Qaboos)	107
5th	Salalah	87
5th	Sitra	-

Fleet	Port	Competitive Period Index
6th	Augusta Bay	118
6th	Brest	77
6th	Djibouti	99
6th	Faslane	40
6th	Gaeta	127
6th	Haakensvern	160
6th	Haifa	146
6th	Lisbon	239
6th	Lochstriven	86
6th	Piraeus	89
6th	Port Victoria	40
6th	Souda Bay	81
6th	Tromso	65
7th	Changi Naval Base	204
7th	Chinhae	70
7th	Manila	314
7th	Phuket	239
7th	Pusan (Busan)	208
7th	Sasebo	82
7th	Sattahip	128
7th	Sembawang	49
7th	Subic Bay	58
7th	Yokosuka	94

Summary Statistics

Lowest Index	19
Highest Index	314
Average Index	118
Standard Deviation	68.9

Among the three fleets, non-competitive periods in 7th Fleet were the highest, averaging 174 compared to 169 and 123 for the 5th and 6th Fleets, respectively. This means that ports in 7th Fleet that have only one husbanding provider bidding on a contract have historically experienced average daily costs to be 74% above the fleet average for husbanding services. The reason the 7th Fleet has the highest average indexes in both the competitive and non-competitive periods is unclear. The 7th Fleet has had fewer non-

competitive periods (15) than any other, which, based on research, should reduce cost. The 7th Fleet AOR also has the second largest number of competitive periods (34). A large cost driver might be that key services, such as pilots, tugs, and utility services (e.g., potable water, sewage, and electric power), are less available than in the 5th and 6th Fleets, which increases costs.

Table 11 reflects selected ports in the 7th Fleet AOR and their respective port indexes for competitive and non-competitive periods. The port with the lowest index was Sembawang during a competitive period, with a port index of 49. Manila during a non-competitive period had the highest port index at 315. The average port indexes for 7th Fleet were 145 for competitive periods and 174 for non-competitive periods.

Table 11. Port indexes of average daily costs, 7th Fleet

7th Fleet Ports	Competitive Period Index	Non-Competitive Period Index
Changi Naval Base	204	-
Chinhae	70	87
Manila	314	315
Phuket	239	311
Pusan (Busan)	208	206
Sasebo	82	80
Sattahip	128	213
Sembawang	49	-
Subic Bay	58	82
Yokosuka	94	99
Summary Statistics		
Lowest Index	49	80
Highest Index	314	315
Average Index	145	174
Standard Deviation	90.8	101.1

Table 12 shows a breakdown of the number of competitive and non-competitive periods for each port. For 7th Fleet, there are more competitive periods (34) than non-competitive periods (15). Most of the non-competitive periods occurred during FY 2016.

Table 12. Period summary for 7th Fleet port competition

7th Fleet	FY 16	FY 17	FY 18	FY 19	FY 20	C	N	X
Changi Naval Base	C	C	C	C	C	**5**	**0**	**0**
Chinhae	N	N	C	C	C	**3**	**2**	**0**
Manila	N	C	C	N	X	**2**	**2**	**1**
Phuket	N	C	C	C	C	**4**	**1**	**0**
Pusan (Busan)	N	N	C	C	N	**2**	**3**	**0**
Sasebo	N	N	N	C	C	**2**	**3**	**0**
Sattahip	N	C	C	C	C	**4**	**1**	**0**
Sembawang	C	C	C	C	C	**5**	**0**	**0**
Subic Bay	N	C	C	C	C	**4**	**1**	**0**
Yokosuka	N	N	C	C	C	**3**	**2**	**0**
% Competitive ports	**20%**	**60%**	**90%**	**90%**	**80%**	**34**	**15**	**1**

C = Competitive
N = Non-Competitive
X = No Contracts

The fleet with the smallest indexes was 6th Fleet utilizing competitive ports, with an average index of 105, compared to 108 and 145 for the 5th and 7th Fleets, respectively. Therefore, port locations where there are two or more husbanding providers competing for contracts experienced average daily costs that were 66% lower than port locations with only one competing contractor.

Table 13 reflects selected ports in the 6th Fleet AOR and their respective port indexes for competitive and non-competitive periods. During a non-competitive period, Tromso recorded the lowest port index at 16. Piraeus had the highest port index at 268, which also occurred during a non-competitive period. The average port indexes for 6th Fleet were 105 for competitive periods and 123 for non-competitive periods.

Table 13. Port indexes of average daily costs, 6th Fleet

6th Fleet Ports	Competitive Period Index	Non-Competitive Period Index
Augusta Bay	118	104
Brest	77	54
Djibouti	99	110
Faslane	40	45

6th Fleet Ports	Competitive Period Index	Non-Competitive Period Index
Gaeta	127	-
Haakensvern	160	130
Haifa	146	263
Lisbon	239	204
Lochstriven	86	82
Piraeus	89	268
Port Victoria	40	82
Souda Bay	81	-
Tromso	65	16
Summary Statistics		
Lowest Index	40	16
Highest Index	239	268
Average Index	105	123
Standard Deviation	54.3	85.7

Table 14 shows a breakdown of the number of competitive and non-competitive periods for each port. For the 6th Fleet, there are more competitive periods (34) than non-competitive periods (15). All periods in FY 2016 were non-competitive.

Table 14. Period summary for 6th Fleet

6th Fleet	FY 16	FY 17	FY 18	FY 19	FY 20	C	N	X
Augusta Bay	N	C	C	C	C	**4**	**1**	**0**
Brest	N	N	C	N	N	**1**	**4**	**0**
Djibouti	N	C	C	C	C	**4**	**1**	**0**
Faslane	N	C	C	C	C	**4**	**1**	**0**
Gaeta	X	C	C	C	C	**4**	**0**	**1**
Haakensvern	N	C	C	C	C	**4**	**1**	**0**
Haifa	N	N	C	C	N	**2**	**3**	**0**
Lisbon	N	C	C	C	C	**4**	**1**	**0**
Lochstriven	X	N	C	C	N	**2**	**2**	**1**
Piraeus	N	C	C	C	C	**4**	**1**	**0**
Port Victoria	N	C	C	C	N	**3**	**2**	**0**
Souda Bay	X	C	C	C	C	**4**	**0**	**1**
Tromso	N	C	C	C	C	**4**	**1**	**0**
% Competitive ports	**0%**	**77%**	**100%**	**92%**	**69%**	**44**	**18**	**3**

6th Fleet	FY 16	FY 17	FY 18	FY 19	FY 20	C	N	X

C = Competitive
N = Non-Competitive
X = No Contracts

Table 15 reflects selected ports in the 5th Fleet AOR and their respective port indexes for competitive and non-competitive periods. The port with the lowest index, which occurred during a competitive period, was Mina Salman, with a port index of 19. Al Duqm had the highest port index at 356, which occurred during a non-competitive period. The average port indexes for the 5th Fleet were 108 for competitive periods and 169 for non-competitive periods.

Table 15. Port indexes of average daily costs, 5th Fleet

5th Fleet Ports	Competitive Period Index	Non-Competitive Period Index
Abu Dhabi	67	144
Al Duqm	206	356
Aqaba (Port of Aqaba)	-	275
Doha	124	135
Fujairah	182	192
Jebel Ali	64	98
Khalifa Bin Salman Port	115	201
Mina Salman	19	27
Muscat (Port Sultan Qaboos)	107	152
Salalah	87	183
Sitra	-	92
Summary Statistics		
Lowest Index	19	27
Highest Index	206	356
Average Index	108	169
Standard Deviation	58.6	90.1

Table 16 breaks down the number of competitive and non-competitive periods for each port. For the 5th Fleet, there are more non-competitive periods (31) than competitive periods (20). All periods in FY 2016 and FY 2017 were non-competitive.

Table 16. Period summary for the 5th Fleet

5th Fleet	FY 16	FY 17	FY 18	FY 19	FY 20	C	N	X
Abu Dhabi	N	N	X	N	C	**1**	**3**	**1**
Al Duqm	N	N	C	C	C	**3**	**2**	**0**
Aqaba (Port of Aqaba)	N	N	N	N	N	**0**	**5**	**0**
Doha	X	N	C	C	X	**2**	**1**	**2**
Fujairah	N	N	N	C	C	**2**	**3**	**0**
Jebel Ali	N	N	C	C	C	**3**	**2**	**0**
Khalifa Bin Salman Port	N	N	C	C	C	**3**	**2**	**0**
Mina Salman	N	N	C	C	C	**3**	**2**	**0**
Muscat (Port Sultan Qaboos)	N	N	N	C	N	**1**	**4**	**0**
Salalah	N	N	N	C	C	**2**	**3**	**0**
Sitra	N	N	N	N	X	**0**	**4**	**1**
% Competitive ports	**0%**	**0%**	**45.4%**	**72.7%**	**63.6%**	**20**	**31**	**4**

C = Competitive
N = Non-Competitive
X = No Contracts

One noticeable observation is that in the port summary for all of the fleets, there is a gradual increase in competitive periods from FY 2016 to FY 2020. The increase in competition can be contributed to the effectiveness of the MAC IDIQ acquisition strategy.

C. IMPACT OF SOLICITATION TIME ON AVERAGE DAILY COST

Model 1 determined that the length of solicitation time does influence the average daily cost of a port visit. Table 17 shows the cross-tabular examination that illustrates that the number of days compared to the cost is seemingly random. While there is some correlation between average daily cost and the number of solicitation days, the researchers are confident that the solicitation period in days cannot be a determining factor in average daily cost. To determine the strength of the correlation, the researchers examined the R^2 value. An R^2 value of 1 is a perfect correlation, while a value of 0 shows no correlation at all. The left-hand column of Table 17 details the number of solicitation days for port visits by ship class. The averages by solicitation day are in the right-hand column, and the

averages by ship class are on the bottom row. A heatmap was applied to the average daily cost column by the number of days solicited and to the average daily cost row by the ship classes, green being lower cost and red being higher cost, which shows that there is no evidence of correlation.

Table 17. Average daily cost by solicitation days and ship class

	AMPHIB		CRUDES		LARGE DECK		MSC		SMALL CRAFT		SUBMARINES		AVERAGE	
Solicitation Days	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev
1	$20,696	$10,569	$16,108	$12,278	$47,932	$27,395	$13,895	$13,672	$9,983	$7,862	$23,501	$22,472	$15,614	$14,942
2	$30,883	$14,211	$14,627	$14,585	$118,320	$92,399	$14,305	$16,102	$17,478	$23,691	$20,980	$15,139	$18,058	$24,306
3	$20,949	$8,869	$13,620	$7,944	$72,299	$54,049	$11,527	$10,508	$9,052	$7,520	$26,454	$25,570	$14,305	$17,429
4	$26,436	$15,067	$15,369	$11,989	$133,081	$136,174	$14,228	$12,864	$14,454	$13,390	$15,075	$12,133	$17,800	$27,533
5	$22,632	$10,580	$18,107	$12,120	$138,256	$69,766	$11,491	$11,433	$14,645	$7,735	$19,523	$20,843	$18,421	$29,668
6	$28,731	$16,121	$22,958	$29,024	$197,409	$165,848	$15,078	$15,256	$14,725	$8,205	$20,581	$13,166	$26,460	$55,341
7	$57,713	$47,620	$18,717	$14,080	$112,143	$85,583	$15,940	$16,891	$26,294	$30,670	$8,828	$6,343	$25,198	$37,260
8	$20,904	$8,242	$18,754	$9,408	$69,026	N/A	$12,891	$12,514	$13,221	$9,393	$3,498	N/A	$15,149	$13,729
9	$26,009	N/A	$45,668	$47,685	$52,034	N/A	$10,501	$9,090	$13,410	$5,150	N/A	N/A	$19,007	$20,485
10	$29,292	N/A	$21,910	$26,559	N/A	N/A	$18,093	$23,592	$19,807	$2,556	N/A	N/A	$19,289	$22,115
11	$39,070	$39,553	$17,737	$2,337	N/A	N/A	$6,840	$5,336	$10,179	N/A	$16,171	N/A	$12,047	$14,548
12	$49,070	N/A	$20,334	$4,561	$230,344	N/A	$19,041	$18,252	N/A	N/A	N/A	N/A	$29,702	$47,023
13	N/A	N/A	$5,276	N/A	N/A	N/A	$16,973	$12,909	N/A	N/A	$5,699	N/A	$15,764	$12,699
14	N/A	N/A	$12,924	N/A	N/A	N/A	$10,190	$6,038	$12,426	$1,552	$21,979	$17,813	$12,558	$8,152
15	$28,041	N/A	N/A	N/A	N/A	N/A	$13,466	$12,812	N/A	N/A	$833	N/A	$13,744	$13,090
Average	$29,305	$19,583	$17,423	$15,441	$122,241	$103,243	$13,685	$13,933	$13,973	$14,427	$19,577	$17,774	$18,792	$30,236

Overall, the researchers compared 1,207 port visits to yield the totals in Table 18. Table 18 shows the number of port visits by ship class and the number of days the bid was in the solicitation period. The totals in the right-hand column are across all ship classes by the length of the solicitation period, and the totals at the bottom represent the number of port visits each ship class made.

Table 18. Number of port visits by ship class and solicitation days

SOLICITATION DAYS	AMPHIB	CRUDES	LARGE DECK	MSC	SMALL CRAFT	SUBMARINES	AVERAGE
1	7	35	4	102	18	12	178
2	10	28	3	92	14	7	154
3	4	24	5	104	16	6	159
4	7	21	3	90	6	5	132
5	3	36	6	101	6	2	154
6	9	21	7	85	13	4	139
7	4	31	8	63	7	3	116
8	3	8	1	34	6	1	53
9	1	2	1	9	3		16
10	1	4		18	2		25
11	2	2		13	1	1	19
12	1	3	1	18			23
13		1		17		1	19
14		1		8	2	2	13
15	1			5		1	7
Grand Total	**53**	**217**	**39**	**759**	**94**	**45**	**1207**

Graphically, the relationship between average daily cost and the solicitation days is shown in Figure 9. The graph shows a relatively straight trendline across the number of solicitation days, showing that the number of days in solicitation doesn't appear to have an effect on cost. The graph in Figure 9 has an R^2 value of 0.009. This is a very low R^2 value and led the researchers to believe that the average cost is not affected by the solicitation days. Based on the slope of the trendline, it could be said that the average daily cost decreases by approximately $110 for each day of solicitation, but the R^2 is so low that it is difficult to assume any correlation.

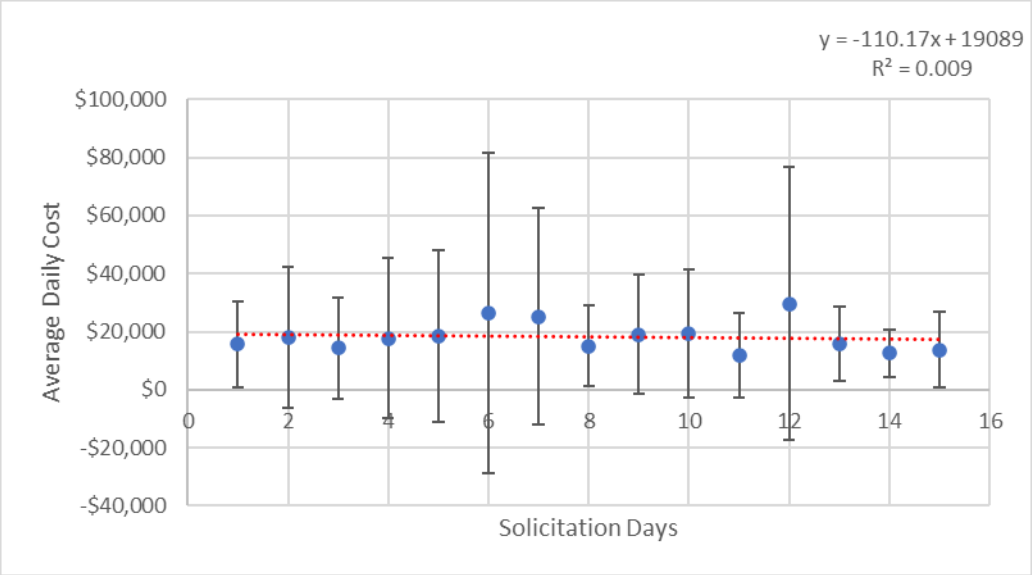

Figure 9. Average daily cost vs. solicitation days

Figures 10 through 15 display the correlation by ship class. The error bars show the range of variability in the data and represent where there is uncertainty. Most have an R^2 value close to zero, meaning there is no evidence of correlation; however, the Submarines ship class has the strongest correlation at 0.3585. Figure 15 shows there are only five data points with over 10 days for submarines. It is hard to render a result based on sparse data.

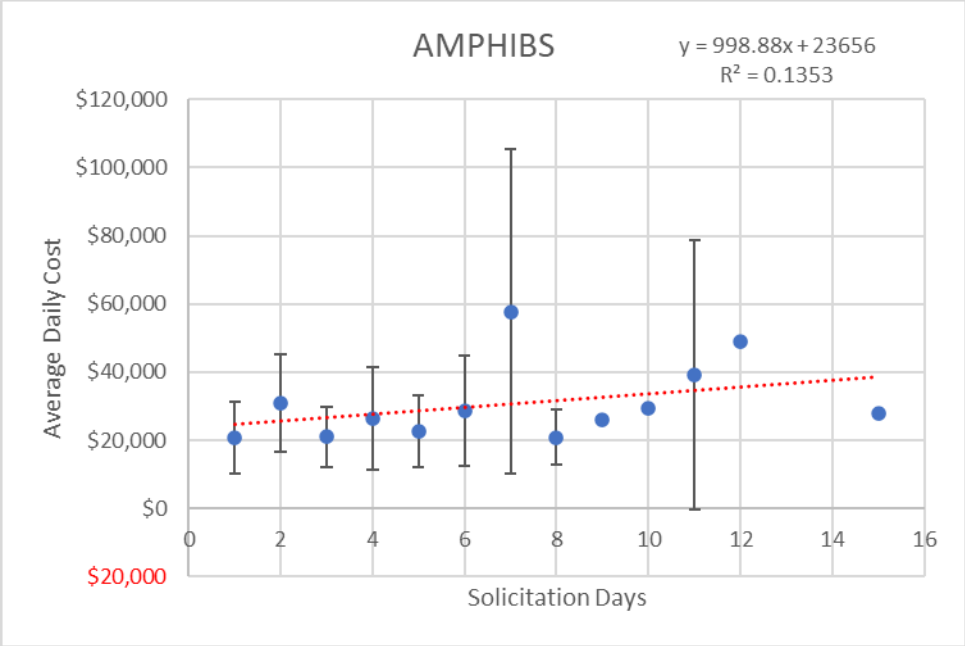

Figure 10. Correlation of cost and the number of solicitation days for the ship class AMPHIBS

Amphibious ships have a R^2 value of 0.13. This value is closer to zero than one, thus there is no evidence of correlation.

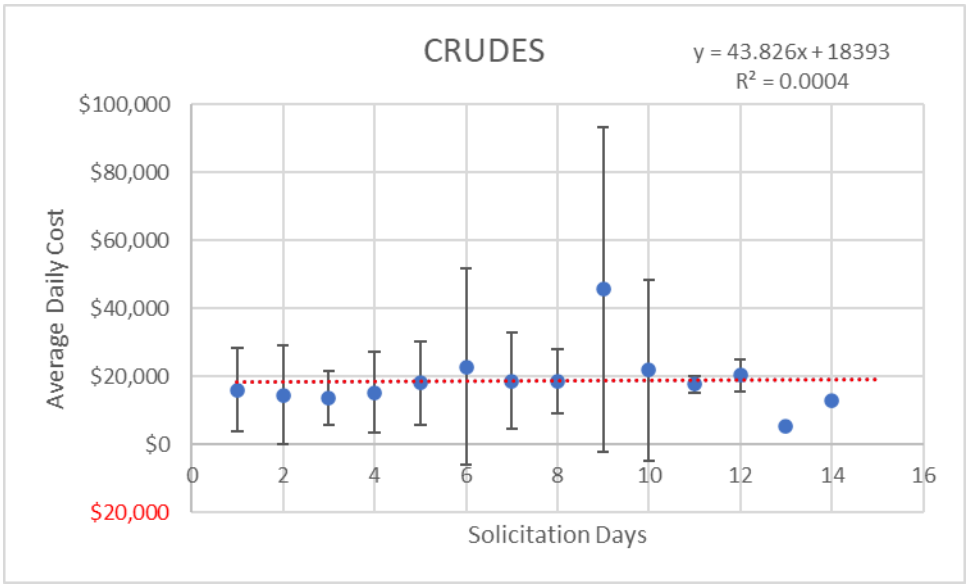

Figure 11. CRUDES

Cruisers and Destroyers have a R^2 value of 0.0004 therefore there is no evidence of correlation.

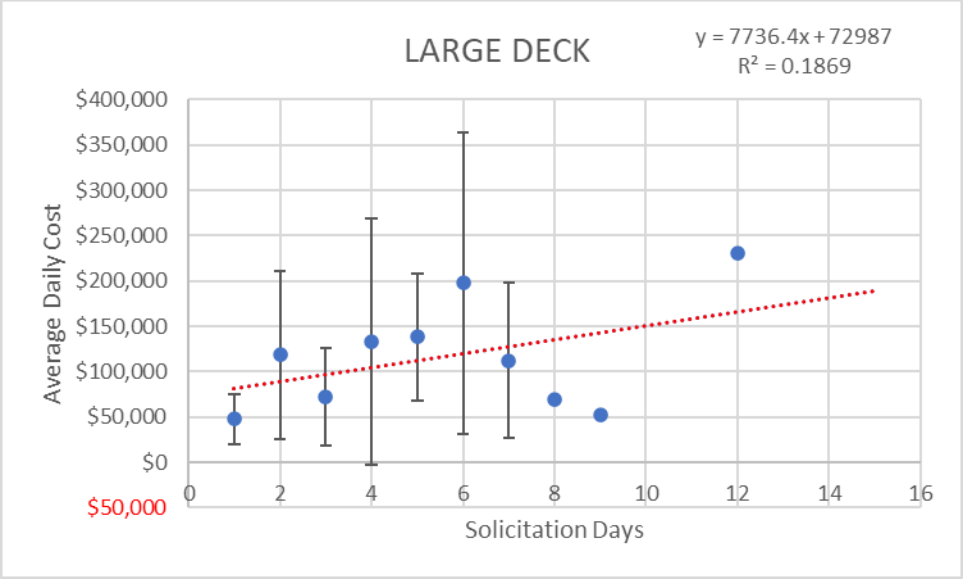

Figure 12. LARGE DECK

Large Deck ships have a R^2 value of 0.1869. This is higher than some of the other ship classes but is still far closer to zero than one, thus there is no evidence of correlation.

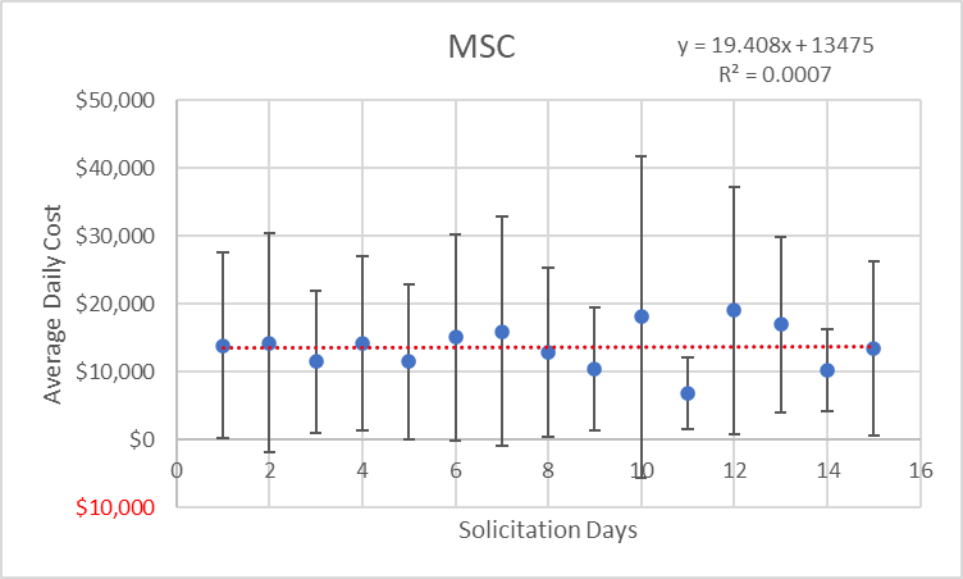

Figure 13. MSC

MSC vessels have a R^2 value of 0.0007 therefore there is no evidence of correlation.

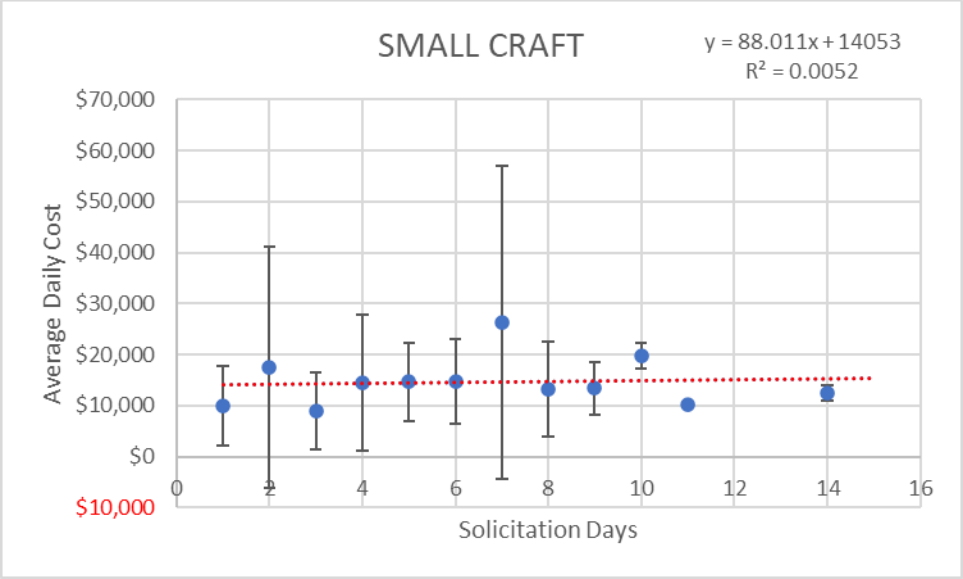

Figure 14. SMALL CRAFT

Small Crafts have a R^2 value of 0.0052 therefore there is no evidence of correlation.

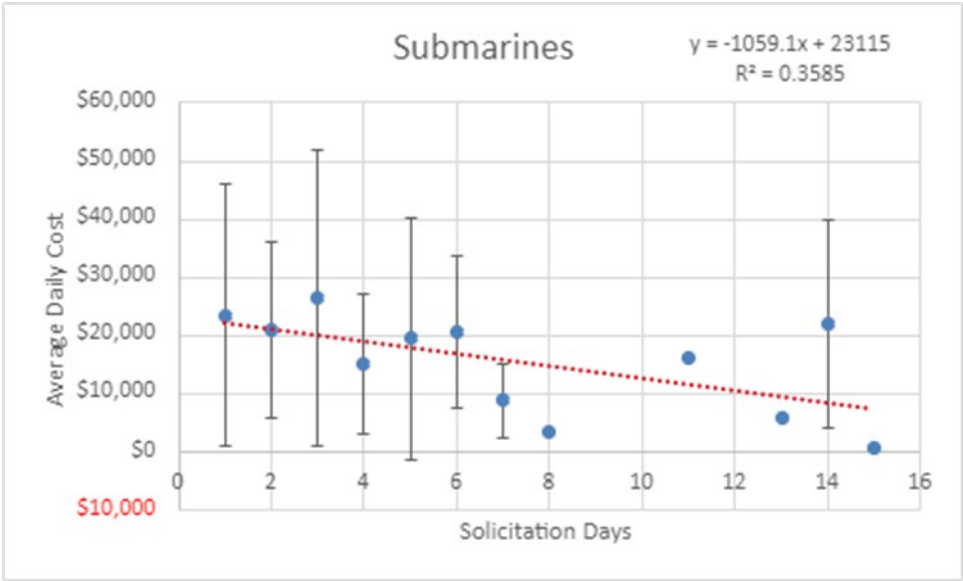

Figure 15. SUBMARINES

The submarines may have a stronger correlation due to internal operating procedures. Due to the nature of their operations, submarines send and receive fewer communications. The Submarine Group Command sends the LOGREQ on behalf of the operational unit. This streamlines the process and deviates less from the Standardized LOGREQ. By extension, the COR and KO then have less to review and approve.

Submarines are restricted by which ports they enter. They tend to visit the same locations, where they can receive maintenance and replenishment. Given the classified nature of submarine missions, foreign ports cannot offer the same services. The lack of variation in locations and processes likely contributes to a better correlation in cost.

Model 2 determined that the ratio of solicitation time had no impact on the average daily cost via the cross-tabular analysis in Table 20. Again, there are outliers with the Large Deck ship class, but most stay below $30,000. The Large Decks are always going to be of a magnitude higher than most other ships, as they support a larger crew and inherently need more services. The researchers were looking for trends, so as long as the Large Decks trended similarly, then the findings would be consistent.

Table 19. Percentage of solicitation time vs. average daily cost

	AMPHIB		CRUDES		LARGE DECK		MSC		SMALL CRAFT		SUBMARINES		AVERAGE	
Solicitation Ratio	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev	Daily Cost	Std Dev
<10%	$20,724	$14,187	$13,563	$7,807	$115,614	$173,312	$13,341	$14,442	$11,885	$7,791	$24,433	$19,311	**$18,895**	$42,038
10-20%	$26,460	$12,983	$17,871	$13,268	$123,450	$79,329	$13,767	$13,231	$12,188	$10,908	$14,896	$13,352	**$19,727**	$30,699
20-30%	$39,323	$26,070	$16,442	$14,220	$126,788	$96,880	$14,286	$15,091	$17,189	$20,630	$20,838	$26,098	**$18,831**	$26,752
30-40%	$25,789	$12,336	$17,611	$14,499	$100,687	$72,318	$12,344	$13,261	$16,715	$16,381	$24,899	$13,226	**$17,488**	$22,292
40-50%	$10,179	$1,071	$28,404	$33,024	$206,656	N/A	$15,351	$14,794	$9,108	$11,000	$10,230	$12,304	**$20,298**	$30,641
>50%	N/A	N/A	$11,433	$7,286	N/A	N/A	$12,378	$12,125	$14,840	$6,381	N/A	N/A	**$12,400**	$11,585
Average	**$29,305**	$19,583	**$17,423**	$15,441	**$122,241**	$103,243	**$13,685**	$13,933	**$13,973**	$14,427	**$19,577**	$17,774	**$18,792**	$30,236

Table 20. Number of port visits by ship class and percentage of solicitation time

ROW LABELS	AMPHIB	CRUDES	LARGE DECK	MSC	SMALL CRAFT	SUBMARINES	GRAND TOTAL
<10%	7	29	8	106	18	15	183
10-20%	14	73	19	269	33	16	424
20-30%	18	68	7	205	27	7	332
30-40%	12	28	4	89	10	4	147
40-50%	2	15	1	43	4	3	68
>50%		4		47	2		53
GRAND TOTAL	53	217	39	759	94	45	1207

Graphically, the ratio is converted into the percentage of time the bid is solicited and is then compared to the average daily cost. The trendline appears to go down slightly, but the magnitude of the trend is not significant relative to the total cost. The number of port visits with a greater than 40% solicitation period is smaller than the other categories.

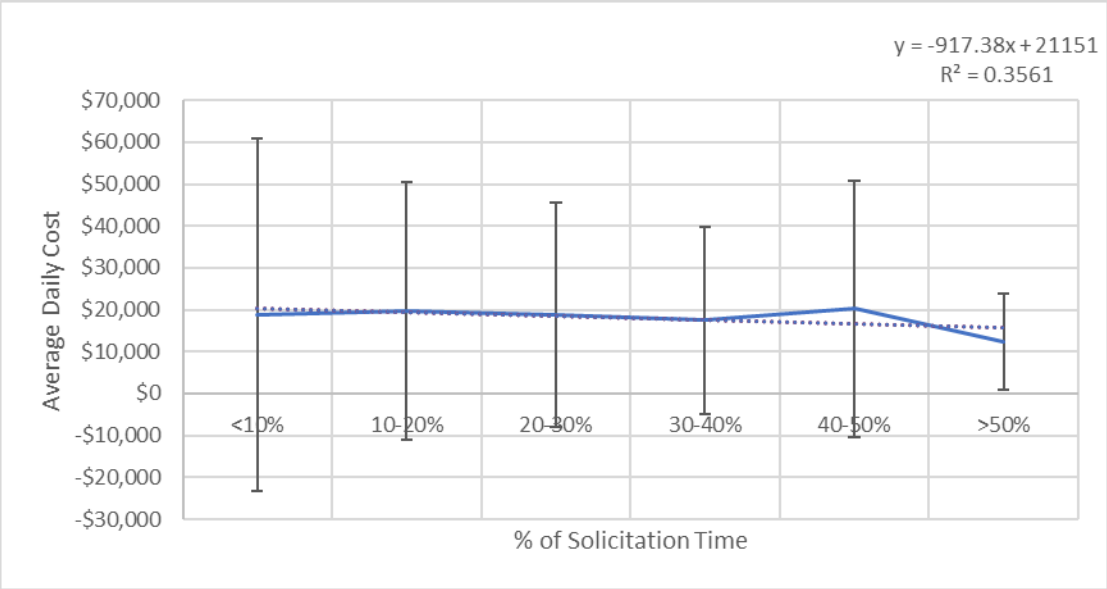

Figure 16. Percentage of solicitation time vs. average daily cost trendline

The solicitation time, whether by day or ratio, is not a good indicator of cost. Counterintuitively, the length of time—whether short or long—contractors were given in which to make offers did not appear to have a significant impact on cost. This could be because the husbanding service providers have standard pricing already available or good analytical tools in which to make rapid decisions. Some HSP contractors have their own organic assets and others need to outsource to subcontractors.

It is worth further study to examine if a contractor has organic assets changes the effect on cost or solicitation time. The finding in Research Question 3 runs parallel to the early result from Research Question 1 about short-notice port visits. There is no evidence to support that timing, either short-notice or solicitation time, increases port visit cost. KOs should not be concerned with time as a deciding factor when considering price.

VI. CONCLUSIONS AND RECOMMENDATIONS

After a thorough quantitative analysis, the authors determined that the current oversight policies and contracting methods used to procure husbanding services do not have an adverse financial impact on the husbanding service process. Various tests and extensive quantitative analysis aided the researchers in arriving at this conclusion.

Contrary to popular belief, there was no correlation between the LOGREQ submission timeline and the average daily cost of a husbanding contract. Actual data do not substantiate the idea that short-notice port visit requests increase contract costs. Over 5,000 husbanding contract data were analyzed individually at the fleet level and collectively by examining the 5th, 6th, and 7th Fleets in a combined dataset. After thoroughly testing the data, both individually and collectively, the results did not change. The results suggest that the MAC IDIQ contracting strategy utilized for husbanding services is performing as intended. The increased competition has caused HSPs to standardize and refine their services to reduce costs and remain competitive. As contractors continue to standardize their services, short-notice port visits become less significant in determining the contractors' bid prices. Because there are fewer unknowns in the services and products they can offer, contractors are less likely to artificially increase their bid price to account for unknown costs when faced with short-notice requests. The authors suspect contractors have become more efficient to remain viable options for husbanding services in an increasingly competitive landscape.

The researchers discovered in their analysis greater insight and granularity regarding how the competition impacts Navy husbanding service contracts. The fact that more competition reduces contract costs is not particularly groundbreaking. Full and open competition is a general rule in government contracting, which safeguards agencies against collusion. The insights gathered from the research shows that even with competition, there could be ports experiencing higher prices, mainly due to limited resources. One way to identify ports with limited resources is to analyze those with an average competitive period index greater than the average index of all fleets. These ports are experiencing higher prices even though competition exists, which may point to a lack of resources in such ports. Further

research is needed to conduct a deeper analysis into the resources within these ports and provide recommendations on how Navy leadership can reduce costs.

The findings in Chapter V demonstrate that the average daily price is not impacted by the amount of time the bid is solicited. This is counterintuitive, as it would be expected that the longer an offer is on the open market, the better price the government would get. Increased solicitation time should allow more contractors to bid, improving fidelity in price estimation and increasing preparation time to obtain resources from sub-contractors. This, however, is false. There is a misconception about the importance of time on cost. The data revealed that the amount of time a bid is solicited, whether in days or as a percentage of the pre-port visit arrival time, has little to no impact on the final average daily cost.

There is more work to be done on this topic of study, and internal controls would facilitate future research. The HSPortal should be fully utilized to capture data needed for continuing analysis of husbanding services in the future. The researchers threw out many data points due to discrepancies in the data. Data collection could be improved by fully automating the HSPortal system so that time-stamps automatically populate as the workflow moves through the process. The ability to make recommendations was hindered by the lack of complete and accurate data. As the HSPortal dataset increases, the data's quality should improve, allowing for a similar analysis to be conducted in the future. Those results may represent a more accurate prediction model for the solicitation period and average cost.

It is worth investigating whether the contractor is sacrificing quality when less notice is given prior to the port visit. A process analysis based on the Quality Assurance Surveillance Plan (QASP) should be conducted to determine whether the quality of services received decreases when there are fewer notification days, as described in Research Question 1.

Recent procurement scandals have shown that the government procurement process and acquisition professionals can easily fall victim to inefficiencies that can be costly in the absent of effective systems and procedures. Navy leadership must continue refining "internal controls over the management, execution, and oversight of husbanding service procedures" to reduce processing time while increasing audit compliance (Office of the Chief of Naval Operations, 2020).

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