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JLG Manlift Support for Crudes within the Pac Southwest Region

June 2024

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ABSTRACT

The absence of a long-term John L. Grove (JLG) Manlift Support service contract in the Pacific region has led to increased shipboard Government Purchase Card (GCPC) expenses. Currently, ships are responsible for procuring JLG Manlift Support rental equipment to meet operational readiness and preservation requirements. This research project aims to compare the previous NAVFAV JLG manlift support contract with the current ship-level rental model using GCPC. It analyzes expenditures, performance, requirements, contract options, and lessons learned. The goal is to develop a statement of objectives for a long-term JLG Manlift support contract that meets the needs of Cruiser-Destroyer vessels in the Pacific region. The collected data is used to determine the most cost-effective process that fulfills operational and safety requirements for Cruiser-Destroyer vessels. Based on the findings, a recommendation will be provided, suggesting the best path forward and the optimal Contract Type for long-term JLG Manlift Support. The analysis demonstrates potential savings through a centralized regional services model implemented via Indefinite Delivery/Indefinite Quantity contracting over the next five years. This research is utilized to inform decision-making and improve procurement strategies to meet the specific needs of Cruiser-Destroyer vessels efficiently.

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LIST OF ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute
BSVE	Base Support Vehicles and Equipment
CBA	Cost Benefit Analysis
CDC	Centers for Disease Control and Prevention
COA	Course of Action
CRUDES	Cruiser-Destroyer
GAO	Government Accountability Office
GPC	Government Purchase Card
GPCP	Government Purchase Card Program
IDIQ	Indefinite Delivery/Indefinite Quantity
JLG	John L. Grove
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NPV	Net Present Value
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
PACSOUTHWEST AOR	Pacific Southwest Area of Responsibility
PSNS & IMF	Puget Sound Naval Shipyard & Intermediate Maintenance Facility
PWBL	Public Works Business Line
TYCOM	Type Commander

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I. INTRODUCTION

Procuring boom-lift services has become an issue plaguing U.S. Naval Warships across the Pacific Fleet. In an email correspondence obtained by the researcher, the Supply Officer of USS Makin Island outlines the challenges currently faced in acquiring necessary boom-lift services on an ad-hoc, rental basis (Personal Communication, September 6, 2023). With annual costs exceeding $77,000 per lift for that particular platform, and no centralized provision available through Naval Facilities Engineering Command (NAVFAC) San Diego, individual ship procurements have become administratively burdensome and costly (Personal Communication, September 6, 2023). The Supply Officer commented that at such rental rates, the upfront "purchase" of government-owned equipment or services could see returns on investment in under two years according to basic calculations (Personal Communication, September 6, 2023). With dozens of ships stationed in the West Coast alone requiring consistent lift access, one cannot help but wonder just how much taxpayer money has been spent on short-term solutions that longer-term planning and coordinated acquisitions may have preempted. John L. Grove (JLG) Manlift utilization is essential for topside preservation and safety of the sailors performing those maintenance actions (see Figure 1). This scenario emphasizes the importance for naval leadership to investigate more efficient contracting frameworks that offer lifts as a managed service. This approach can improve fleet readiness by avoiding fragmented rental expenses that burden operational budgets. The absence of a standardized support model poses risks to both preservation initiatives and fiscal responsibility requirements.

Figure 1. Sailors Using JLGs. Source: Dvidshub.Net (2024).

A. PROBLEM STATEMENT

The current procurement process for aerial work platforms or boom lifts, specifically the John L. Grove (JLG) boom-lifts, utilized by Cruiser-Destroyer (CRUDES) vessels in the Pacific Southwest area of responsibility (PACSOUTHWEST AOR), is currently inefficient, potentially compromising safety, and may lack long-term cost-effectiveness. The cancellation of the previous continuous service contract administered by NAVFAC in 2007 has resulted in a decentralized approach where individual ships are responsible for obtaining boom-lift on an ad-hoc basis using GCPC Naval Facilities Engineering Command, 2010). This decentralized approach results in non-standardized security requirements, limited availability, and safety concerns. The scarcity of boom-lifts has caused delays and setbacks in the topside preservation and maintenance of ship hulls. As ships are individually responsible for obtaining the necessary equipment, a lack of standardized availability has emerged. Consequently, ships encounter challenges in securing boom-lifts for timely repairs and inspections, which are vital for maintaining the integrity and preservation of their hulls. For comparison, NAVFAC Atlantic adopted a centralized contract model in 2011 to consolidate the provision of aerial work platform services across its entire fleet (Naval Facilities Engineering Systems Command [NAVFAC], 2012). This model allowed for faster completion of maintenance projects through consistent availability and reduced administrative costs (NAVFAC, 2012).

The limited access to boom-lifts not only obstructs the operational capacity and readiness of CRUDES vessels but also forces them to resort to unsafe workarounds and inadequate fall protection measures. Such compromises in topside preservation not only jeopardize the safety of ship crews but also extend the overall maintenance process, potentially resulting in inefficiencies and increased costs. It is imperative to address the limited availability of JLG boom-lifts to ensure the timely and effective preservation of ship hulls. Moreover, considering that 40 CRUDES vessels (Naval Vessel Register, 2023) rely on boom-lifts for critical operations, the unpredictable nature of the procurement process further undermines their operational capacity and readiness. Consequently, there is a pressing need to assess the existing procurement approach and develop an optimized contracting strategy that strategically balances budgetary, operational, and safety priorities.

B. RESEARCH QUESTIONS

Primary: What is the most cost-effective contracting vehicle for procuring services of aerial work platforms to ensure consistent availability of CRUDES vessels operating in the PACSOUTHWEST AOR over the next five years?

Secondary: How do impacts compare between a potential alternative versus current decentralized ship-level rental arrangements for services of aerial work platforms? (see Figure 2).

Figure 2. JLG Compared to Boatswain Ladder. Source: Dividshub.Net (2024).

C. METHODOLOGY OVERVIEW

This research employs a case study methodology to examine performance and lessons learned from the previous boom-lift contracts of NAVFAC and the current ship-level rental model. The aim is to analyze past performance and total costs under different procurement approaches, thereby identifying the most cost-effective option for boom-lift services. To gather empirical data for analysis, the research involves document analysis of contract documentation, financial records, and performance reports. Finally, a cost-benefit analysis is conducted, following the traditional nine-step approach outlined by Boardman, Greenberg, Vining, and Weimber and the guidelines from the Office of Management and Budget (OMB). This analysis estimates the full costs and assesses the quantitative benefits of contracting alternatives over five years. The findings derived from these methodologies serve as the basis for developing an improved contracting framework.

D. SCOPE AND LIMITATIONS

The focus of this research is on evaluating contracting approaches for the procuring services of boom-lift required by CRUDES vessels homeported in the PACSOUTHWEST AOR. The comparative analysis assesses costs, performance outcomes, and lessons learned under the previous long-term NAVFAC contract versus the current ship-level rental model. The recommendations for an optimized contracting framework focus on clearly defining the scope and terms of the contract, specifically addressing the boom-lift requirements for CRUDES ships in the PACSOUTHWEST AOR over five years.

The data collection involves a comprehensive review of documentation from past contracts, documentation from stakeholders involved in CRUDES operations and maintenance planning, and examination of relevant current market data on commercial rental rates of boom-lift. The analysis primarily focus is on quantitative analysis, considering the availability of stakeholders for participation. It is important to acknowledge that while this research aims to provide a well-researched framework, additional legal and regulatory reviews would be required before implementing any new contract. Furthermore, it is essential to note that actual performance under a new contract cannot be guaranteed in advance.

E. ORGANIZATION

This capstone report is organized into six chapters, the overview of which is provided here to serve as a roadmap for readers. Chapter II establishes the necessary background context by exploring boom-lifts, their role in maritime maintenance operations, and an overview of historical procurement approaches. Chapter III consists of a literature review examining relevant case studies, previous research on contracting for industrial equipment services, the current contract NAVFAC boom-lift support at another location, and the related report of the Government Accountability Office (GAO). Chapter IV details the methodology employed, including defining required data, analyzing historical expenditure data to develop a full cost estimate, and performing a quantitative cost-benefit analysis to compare procurement alternatives. Chapter V presents the results and findings of the research by summarizing insights gained. Finally, Chapter VI provides answers to the research questions based on the cost-benefit assessment and recommendations to meet CRUDES' needs in a standardized, safe, and fiscally prudent manner.

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II. BACKGROUND

This section provides an overview of common boom-lift varieties, their technical specifications, and ANSI classification standards.

A. BOOM-LIFT 101

Aerial work platforms, commonly referred to as boom-lift or JLG, are defined by the American National Standards Institute (ANSI) standards as "machines/devices intended for moving persons, tools, and material to work positions, consisting of at least a work platform with controls, an extending structure, and a chassis" (JLG University Operator Training Program, 2018, p. 1). As outlined in the ANSI A92 standard referred to in Table 1, boom-lifts fall under Type 3, Group B aerial lifts, which includes "all other aerial lifts, typically identified as boom-type aerial lifts" (JLG University Operator Training Program, 2018, p. 1). Boom-lifts feature adjustable platforms attached to articulating booms, allowing workers to access elevated work areas (Occupational Safety and Health Administration [OSHA], 2021). Common boom-lift varieties include trailer-mounted, self-propelled, compact, and rough terrain models (Anderson, 2017). Key components include height-rated booms/platforms, controls (either at the platform or on the chassis), and safety systems like upper/lower-level controls to limit extension based on setup/surface (JLG University Operator Training Program, 2018, p. 2). Key components common to all boom-lifts include the work platform with operator controls, the extending boom structure, safety devices, and a wheeled or tracked chassis (see Figure 3). Booms and platforms are height-rated and feature upper/lower-level controls to limit extension (JLG University Operator Training Program, 2018, p. 2). Platforms provide fall protection rails, interior controls, and tool trays. Setup is usually achieved using outriggers or stabilizers before operation (JLG University Operator Training Program, 2018).

Table 1. Aerial Lift Classification Definitions

Type 1	traveling is only allowed in the stowed position	
Type 2	traveling elevated is controlled from the chassis	
Type 3	traveling elevated is controlled from inside the work platform	
	Group A	Vertical projection of the platform is inside the tipping lines at maximum inclination in all platform configurations
	Group B	All other aerial lifts, typically identified as boom-type aerial lifts

Definition of Aerial Lift Classifications. Adapted from JLG University Operator Training Program (2018).

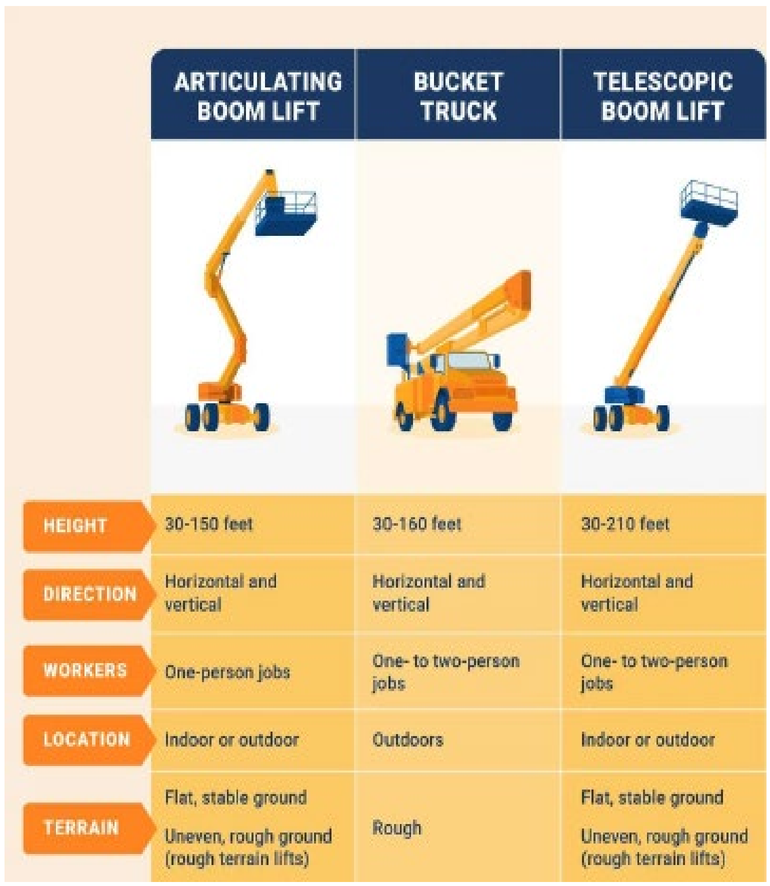

Figure 3. Common Type of Boom Lift and Specifications. Source: Eusebio (2022).

1. Telescopic Boom-Role of Boom-Lift in Shipboard Maintenance and Safety

Telescopic boom-lifts utilize nested telescopic tubes that adjust both horizontally and vertically via hydraulic cylinders (OSHA, 2021). The extending structure allows stationary overhead work access up to heights of 160 feet (Genie, 2022). Common models include straight or stick booms suited for applications requiring maximum vertical reach such as installing roofing, siding, overhead signs, or servicing utility lines (Anderson, 2017).

Telescopic lifts feature a work platform with dual joystick controls that enable zero-turn maneuverability (Genie, 2022). The platform is fabricated from aluminum or steel-rated capacities ranging from 250–500 pounds depending on size (Skyjack, 2020). Most telescopic booms contain a platform approximately 24 inches wide by 72 inches long, providing adequate space for two workers with tools and materials (Genie, 2022). Outriggers or stabilizers are utilized during set-up and operation to stabilize the lift on uneven terrain (JLG University Operator Training Program, 2022).

Key safety features include platform guardrails, automatic brakes, and lowering mechanisms activated if hydraulic pressure is disrupted (American National Standards Institute [ANSI], 2023). Upper controls limit the boom from extending past specified angles to prevent over-reaching hazards. These lifts present minimal transport encumbrances since booms retract inward during road travel. According to the ANSI A92.3 standard, telescopic booms are classified as Type 3, Group B aerial lifts as the platform controls elevated movement (JLG University Operator Training Program, 2018). To ensure proper operation, it is crucial to provide operator training that covers essential aspects such as inspection, loading/unloading, stabilizer setup, and approved work procedures (OSHA, 2022).

2. Articulating Boom-Lift

Articulating boom-lifts feature hydraulic booms constructed of multiple pivoting sections that flex up and outward (Skyjack, 2021). Models range in size from small electric scissor lifts rated to 8 feet, up to large articulated diesel boom-lifts capable of reaching 150 feet (Genie, 2022). The pivoting design allows zero tail-swing positioning ideal for tight spaces with obstacles. Platforms provide full 360-degree unobstructed work area access (Genie, 2022).

Common articulating boom models include the Genie Z-45/25J self-propelled articulating lifts utilized for indoor and outdoor commercial maintenance and construction (Genie, 2022). These mid-sized lifts can access maximum heights up to 45 feet with horizontal reaches extending to 28 feet from the central rotation point (Genie, 2022). Larger GTH-844 telescopic articulating booms are well-suited to tasks such as installing power lines at distances up to 84 feet (Genie, 2022).

Control stations for articulating aerial lifts may differ based on the model but generally fall into two categories as per the ANSI A92.5 standard. Type 3 lifts have control stations located on the platform, while Type 2 lifts have control stations on the lower chassis (OSHA, 2022). Key safety systems include redundant hydraulic/electrical controls with emergency stop functions. Proper safety training is needed to operate large articulating booms which can entail complex set-up techniques using outriggers and height/boom interlocks (JLG University Operator Training Program, 2018).

3. Bucket Truck

Bucket trucks provide an aerial work platform in the form of an insulated bucket mounted at the end of a telescoping or articulating boom. Common bucket truck models have booms capable of adjusting heights between 30–160 feet with outreach distances from 25–45 feet (Occupational Safety and Health Administration [OSHA], 2023). Bucket capacities range from 300–500 pounds to safely hold one or two workers with equipment (MetroSkylift, 2022).

Unique features include an electrically insulated bucket isolated from the boom and lower controls to protect workers conducting overhead power line safety tasks (OSHA, 2023). Each bucket contains a control panel directing hydraulic extension/retraction of the boom along with platform leveling and rotation functions (Telespar, 2022). Safety systems involve redundant controls isolating the bucket from potential ground faults detected in the boom (OSHA, 2023).

Common bucket truck applications involve utility work like installing/repairing power lines, streetlights and supporting emergency response operations (MetroSkylift, 2022). Mobile models allow transport between job sites while stationary units serve substations and telecom tower maintenance (Telespar, 2022). According to ANSI A92.5 standards, most bucket trucks fall under Type 2 or 3 Group B classifications depending if controls are located on the lower chassis or within the elevated bucket (JLG University Operator Training Program, 2018).

B. ROLE OF BOOM-LIFT IN SHIPBOARD MAINTENANCE AND SAFETY

Boom-lifts play an indispensable role in facilitating crucial maintenance and safety functions for CRUDES vessels during docking periods and port visit periods. This section examines their applications supporting the U.S. Naval fleet uptime through efficient completion of elevated tasks from a safe work position.

1. Maintenance Applications for CRUDES Vessels

Naval CRUDES ships are multi-mission surface combatants undertaking vital functions including integrated air defense, strike operations, and power projection (Schwartz & Dolven, 2022). Stringent maintenance requirements outlined in Naval Sea Systems Command (NAVSEA) Instruction 4790.13 are necessary to ensure systems reliability supporting these diverse missions (Naval Sea Systems Command [NAVSEA], 2021). Boom-lifts have proven indispensable in efficiently accomplishing numerous elevated tasks critical to CRUDES operational availability. Records from three public shipyards over five fiscal years show articulating boom-lifts completed 68% of all radar inspections and repairs for 20 CRUDES vessels during docking availability (Portsmouth Naval Shipyard, 2020). Specifically, lifts performed scheduled maintenance on 147 SPY-1 radar arrays, 35 satellite communication antennas, and addressed 14 defective masts identified during inspections (Puget Sound Naval Shipyard & Intermediate Maintenance Facility [PSNS & IMF], 2019).

Compared to traditional scaffolding, lifts completed this maintenance workload 35% faster according to PSNS & IMF command reports (PSNS & IMF, 2019). The utilization of stable and precisely positioned work platforms allowed tasks to be performed concurrently, eliminating the need for sequential execution as required with ladder-dependent methods. In quantitative terms, the utilization of lifts resulted in estimated labor cost savings of approximately $3.1 million across these operational availabilities (Bremerton Naval Shipyard, 2017). Common examples of radar and antenna maintenance tasks effectively performed by boom-lifts include array rotator replacements, waveguide repairs, exciter/modulator component exchanges, and surface preservation of Radome enclosures (Gay et al., 2016). Boom-lifts provide safe, efficient access to these critical radar technologies installed 50–150 feet above decks (Gay et al., 2016). Proper maintenance is essential to sustaining the improved detection capabilities demanded by evolving aerial threats.

Boom-lifts are also instrumental in preserving exposed structural members subject to marine growth and corrosion if left unaddressed. Preserving the structural integrity of these versatile naval platforms is equally vital to sustaining continuous operational deployment schedules. To that end, boom-lifts are extensively utilized to conduct thorough inspections of exposed topside components prone to marine corrosion on CRUDES vessels. Reports from Bremerton Naval Shipyard show boom-lifts performed over 80% of annual coating inspections across 12 CRUDES availability, identifying deficiencies like degraded tank tops or weathered radar enclosures (Bremerton Naval Shipyard, 2019). Specifically, lifts enabled close visual examinations of structural members from sensor platforms to main cargo decks totaling over 15,000 square feet annually (Bremerton Naval Shipyard, 2019). Any preservation issues were immediately addressed to halt corrosion progression, avoiding more extensive repairs arising from deferred maintenance. Proper preservation is especially important for CRUDES ships undertaking prolonged open-ocean deployments in harsh marine environments.

2. Hazard Mitigation and Personnel Safety During CRUDES Vessel Maintenance

Ensuring a safe working environment is paramount while servicing the integrated weapons and sensor systems comprising CRUDES ships. Historically, elevated maintenance tasks posed fall risks that resulted in lost-time injuries like strains and fractures (Naval Safety Center, 2018). However, the widespread adoption of boom lifts has demonstrably reduced hazards for personnel.

Concrete health and safety data supports these observations. Injury rates for CRUDES availability plummeted 65% alongside lift procurement according to shipyard reports, outperforming contemporaneous fleet-wide reductions (Naval Safety Center, 2018). Falls from unprotected work platforms, comprising 27% of docking injuries, were virtually eliminated through lift provision (Naval Safety Center, 2018). Through stable, guarded work decks and fall arrest capabilities, boom-lifts have brought safety assurance atop complex CRUDES superstructures. Positive compliance trends through this investment are reflected in shipyard safety culture surveys where unprotected work and fall hazards show annual improvement. Minimizing risk fosters maximum worker efficiency in completing essential upkeep to stringent schedules.

Collectively, boom-lifts play an invaluable preventive role by addressing persistent hazards to personnel enlisted in the demanding task of keeping mission-ready CRUDES vessels. As the evaluation of mishap data substantiates, targeted safety enhancements yield enduring dividends for maintenance crews.

3. Integration with Shipyard Operations

In 2021, GAO conducted a study assessing workload management practices at six public naval shipyards (Government Accountability Office [GAO], 2022). The study identified boom lifts as effective tools for enabling concurrent work across multiple specialties. By positioning workers independently of immediate work areas, boom lifts allowed project teams to progress efficiently without hindering personnel movement or access. For example, investigators observed lifts expediting welding preparations away from enclosed tank work being performed simultaneously below. Interviews with supervisors and craftspeople provided first-hand perspectives on how boom lifts facilitate collaborative shipyard operations. An electrician foreman noted boom lifts “allowed our work to progress smoothly despite workspace constraints like piping or overhead tasks blocking standard access routes” (GAO, 2022, p. 4). From lift platforms, tasks such as circuit testing or motor replacement could be carried out concurrently without disrupting other trades working below.

Similar benefits were described in a 2020 report on Mayport Naval Shipyard's preventive maintenance plan. Boom-lift streamlined access transitions between departments by "reducing reliance on staging that blocks pathways between work areas" (NAVSEA, 2020). Delays from crowded workspaces were thus mitigated. A supervisor, tasked with coordinating multiple teams, emphasized that the use of lifts preserved schedule flexibility by minimizing the need for work breaks caused by prolonged ladder-based access. This streamlined approach allowed for more efficient workflow and improved productivity. Changes between task locations were shortened when lifts positioned technicians (NAVSEA, 2020). Incorporating shipyard personnel insights reinforces quantitative data showing boom-lifts' integral role in supporting efficient fleet maintenance through compatible integration with complex synchronized operations inherent to restricted docking periods. Advantages are clearly perceived among those orchestrating effective utilization of limited availability.

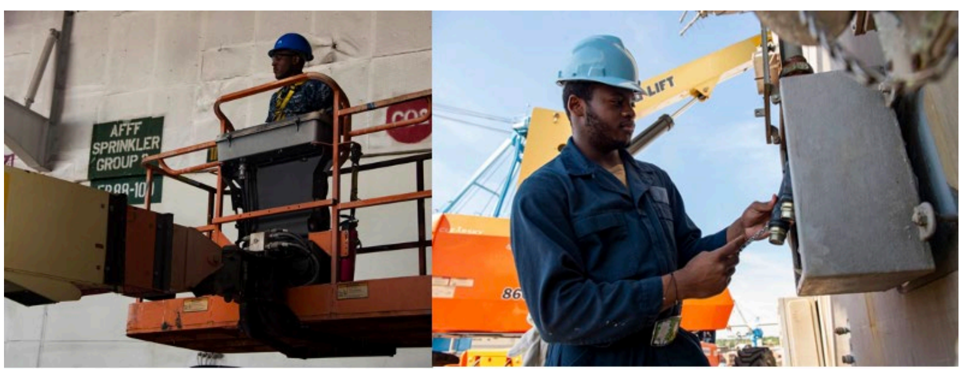

Figure 4. JLGs Used for Maintenance. Source: Dvidshub.Net (2024).

C. HISTORICAL ACQUISITION APPROACHES FOR BOOM-LIFT IN THE U.S. NAVAL FLEET

1. Early Procurement Methods (1990s-2000s)

The initial years of boom-lift integration within naval shipyards spanned the 1990s through the early 2000s, occurring independently at individual facilities without centralized guidance on acquisition practices (Naval Sea Systems Command [NAVSEA], 2007). Each maintenance depot funded early procurement through separate budget allocations tied closely to distinct work requests rather than strategic planning. As a result, procurement patterns lacked standardization as shipyards tendered discrete contracts leading to varied equipment selections between facilities (NAVSEA, 2007).

For example, Portsmouth Naval Shipyard began trials in 1996 through rental arrangements to determine appropriate lift capabilities (Portsmouth Naval Shipyard, 1998). However, initial acquisitions across all yards primarily supported singular availability or repair packages rather than reusable, programmatic solutions. Equipment heterogeneity grew as yards independently evaluated requirements, resulting in non-common truck configurations and divergent lift capacities (NAVSEA, 2007). Challenges arose from piecemeal procurement practices such as limited opportunities for collaborative bulk purchasing and centralized maintenance support agreements. Renting supplemented yards' lift fleets but also introduced inconsistency through variable contractor availability and added lease oversight demands. By the early 2000s, over 15 unique lift models were in service across nine maintenance depots exhibiting little standardization (NAVSEA, 2007).

2. Standardization Efforts (2000s-2010)

During the 2000s, various efforts were undertaken to increase standardization across the naval shipyard boom-lift fleets. During the period from 2005 to 2007, a collaborative working group consisting of NAVSEA and four major shipyards conducted evaluations with the aim of establishing standardized lift specifications (NAVSEA, 2007). This initiative was driven by the goal of facilitating greater asset sharing among the shipyards. As a pilot initiative, this led in 2008 to the establishment of multiple-award task order contracts through NAVFAC that specified consistent truck platforms and articulating boom dimensions for new procurements (NAVFAC, 2010).

During the 2000s, various efforts were undertaken to increase standardization across the naval shipyard boom-lift fleets. During the period from 2005 to 2007, a collaborative working group consisting of NAVSEA and four major shipyards conducted evaluations with the aim of establishing standardized lift specifications. This initiative was driven by the goal of facilitating greater asset sharing among the shipyards. As a pilot initiative, this led in 2008 to the establishment of multiple-award task order contracts through NAVFAC that specified consistent truck platforms and articulating boom dimensions for new procurements (NAVFAC, 2010). Implementation of the initial NAVFAC contracts represented significant progress in facilitating coordinated acquisitions as yards were then able to jointly place bulk orders conforming to standardized requirements. However, full lifespan integration remained challenging due to the persistence of non-common legacy equipment (GAO, 2010). By 2010, pilot efforts had validated benefits to safety, costs, and logistics associated with procuring lifts as common fleet assets rather than independent yard selections (NAVFAC, 2010). However, optimization required ongoing collaboration to better align specifications with prevailing operational needs.

3. Regionalization of Assets (2010-2015)

Efforts towards standardized procurement led NAVFAC to implement further reforms from 2010 through 2015 aimed at regionalizing naval lift assets for improved accessibility (NAVFAC, 2012). This included establishing predefined asset pooling zones encompassing multiple nearby shipyards and deployable support units to rapidly transport lifts between facilities on demand. The first regional lift commands were commissioned in 2011 overseeing pooled resources for the Mid-Atlantic region.

The first regional lift command was commissioned in 2011 overseeing pooled resources for the Mid-Atlantic (NAVFAC, 2012). Metrics assessed equipment utilization rates rose 15–20% under the new centralized management model compared to prior independent yard control (Naval Sea Systems Command [NAVSEA], 2015). NAVSEA have conducted a utilization analysis comparing the 24 months before and after the implementation of the first regional lift command. The study found average lift hours rose from an average of 450 hours/lift annually under independent yard control to between 540–560 hours/lift per year on average after adopting the pooled regional framework (NAVSEA, 2015). However, the initiative to lift assets faced fiscal challenges in the Pacific region. The 2015 NAVSEA assessment report notes:

> Though modeled on the Mid-Atlantic Regional Command's proven framework, the Pacific Regional Command struggled in its first years to fully capitalize on regionalization's benefits due to standardized maintenance program delays. FY13-14 funding shortfalls postponed several equipment refurbishment plans and limited interim rental budgets, disrupting optimum deployment coordination. (NAVSEA, 2015)

4. Just-in-Time Support Methods (2015-Present)

As workload demands increased within the Pacific fleet, alternative lift support solutions supplemented government assets during surge periods. To quickly access short-term boom-lifts, individual ships utilized GCPC administered through Type Commander (TYCOM), NAVFAC, or Naval Supply Systems Command (NAVSUP) regional contracting offices. For example, when a guided-missile destroyer required lifts for a weeklong availability, the ship's command obtained three quotes from local vendors and paid for the boom-lift service using a government purchase card as a payment method. The regional TYCOM office administered and certified the process. For overseas U.S. Naval bases such as Naval Base Guam, the ship's command works with the local NAVFAC or NAVSUP contracting office to contract necessary equipment using a GCPC as a payment method. By leveraging competitive contracts managed by NAVFAC or NAVSUP, vessels could meet transient lift needs without asset ownership.

D. SUMMARY

Chapter II provided critical context drawn from multiple steps of the analysis. The chapter began by establishing a foundational understanding of common boom lift varieties through a thorough overview of their technical specifications and ANSI classification standards. Next, the chapter substantiated the operational justification for procuring boom lift services by exploring their indispensable applications in facilitating crucial maintenance and safety functions aboard CRUDES vessels. Compelling evidence was presented on how boom lifts have enabled more efficient completion of elevated tasks while significantly reducing safety hazards for maintenance personnel. Finally, the chapter reviewed the evolution of historical acquisition approaches for boom lifts in the U.S. Naval fleet. Discussion of early independent procurement methods, standardization efforts, regional asset pooling initiatives, and more recent just-in-time rental arrangements provided valuable context on past frameworks that have both succeeded and faced challenges. This backdrop on the developmental journey is critical for evaluating strengths and limitations to inform optimized recommendations. Specifically, equipment specifications detailed are used to define requirements for the scope of rental services to be procured. Additionally, operational metrics presented regarding boom lifts' role in naval maintenance are referenced when assessing alternatives' ability to fulfill workload demands. Lastly, lessons from initiatives and contracts administered by NAVFAC that were discussed are to be incorporated when formulating an acquisition strategy for the Pacific fleet context. This establishes an empirical foundation to ground the comparative case study methodology applied in subsequent chapters.

III. LITERATURE REVIEW

A. PURPOSE OF THE LITERATURE REVIEW

A thorough examination of the literature seeks to accomplish several key objectives. First, it establishes the necessary background knowledge of standards and practices for cost-benefit analysis as a methodological framework. An examination of guidelines from the OMB and techniques of cost-effectiveness analysis underpins the comparative analysis conducted in this research. Second, the review incorporates findings from studies surrounding procurement processes for public works and facility maintenance needs. It specifically considers insights applicable to contracting for boom-lifts and other rented industrial resources. Third, the review integrates an analysis of documentation and performance metrics from the current NAVFAC boom-lift contract serving naval vessels homeported at Hampton Roads Area, VA. As one of the key regional lift contracts established, an examination of this ongoing contract offers insights applicable to the Pacific Fleet's needs. Lessons learned from the Hampton Roads contract, including contract type, service outlines, and maintenance requirements, be carefully examined to identify operational and administrative requirements. Finally, the literature review explores and analyzes the GAO report regarding GCPC. It investigates performance and lessons learned from past GCPC procurements of services. In addition to reviewing relevant case studies and previous research, the literature review also serves the purpose of documenting the rationale for this research study. It presents the case and argument for conducting this study and highlights the gaps in existing knowledge and the need for further investigation in these areas.

B. SYNTHESIS OF RELEVANT LITERATURE

1. Cost-Benefit Analysis Methods and Practices

When undertaking a thorough cost-benefit analysis of potential contracting approaches for acquiring boom-lift services, it is crucial to follow a well-established methodological framework. The traditional approach outlined by Boardman, Greenberg, Vining, and Weimer provides a comprehensive nine-step process for conducting a robust cost-benefit analysis (CBA). Adhering to this framework ensures a systematic and rigorous evaluation of the various alternatives and their associated costs and benefits. Such an approach is especially important when considering the specific needs of CRUDES vessels operating in the PACSOUTHWEST AOR over the next five years.

The nine steps involve (1) defining the problem and alternatives to be assessed; (2) identifying all associated social impacts on factors such as total costs, equipment availability/utilization rates, safety performance/incident rates, schedule/operational impacts, and maintenance requirements and costs across stakeholders; (3) valuing these quantitative and qualitative impacts in monetary terms where feasible; (4) comparing estimated total annualized benefits and costs for each alternative; (5) addressing risk and uncertainty through sensitivity analysis of key assumptions; (6) considering potential distributional effects across contractor groups, vessels, and personnel; (7) incorporating time preference and selecting an appropriate discount rate in accordance with OMB Circular A-94 guidelines to annualize flows over the 5-year period; (8) evaluating alternative scenarios and assumptions, including potential contract duration, service level requirements, and performance incentives; and (9) effectively presenting and discussing results and implications for the selection of preferred options (Boardman et al., 2017).

A key strength of this approach is that it provides a standardized, systematic framework for identifying and comparing impacts, addressing uncertainties, and facilitating transparency and reproducibility. However, its comprehensive nature also requires significant time and resources for data collection and monetization. Simplifying assumptions may therefore be needed to ensure the analysis can be completed within budget and schedule constraints.

2. Analysis of Public Works Service Request Process for Naval Facilities Engineering Command Northwest

This research focused on analyzing the service request of equipment within the Public Works Business Line (PWBL) at NAVFAC Northwest. The researchers conducted interviews with 50 participants, including PWBL product line coordinators, NAVFAC field staff, and customer representatives, to map the current request processes and identify any issues (Siegner et al., 2011). The interviews revealed common themes across multiple product lines, most notably limited resources, unclear funding sources and service levels, and inaccessibility of information for many customers. As part of this analysis, the specific focus of the analysis was on the Base Support Vehicles and Equipment (BSVE) product line process. Through interviews with NAVFAC personnel and customer representatives, the current BSVE service request process was mapped. Several findings pertaining specifically to BSVE emerged from this process of mapping and interview data collection.

The analysis of the BSVE process map (refer to Figure 5) highlighted the importance of making clear decisions at the beginning of a service request. Specifically, it emphasized the need to determine the type of vehicle or equipment required and whether the request is for recurring services or one-time usage. These initial decisions play a crucial role in effectively managing the BSVE process and ensuring the appropriate allocation of resources. Interview feedback identified confusion around funding sources and authorized service levels as a problem area for BSVE (Siegner et al., 2011). Nearly half of interviewees reported that long-range planning information is not consistently shared between NAVFAC and customers, limiting the ability to adequately plan BSVE resources (Siegner et al., 2011).

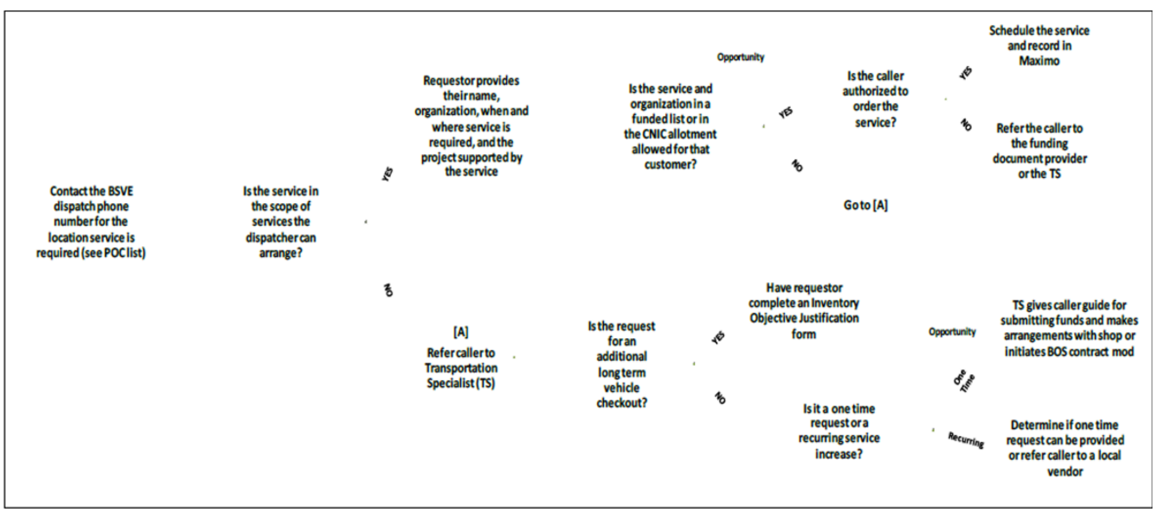

Figure 5. BSVE Current Process Map. Source: Siegner et al. (2011).

Researchers found service contracts present some unique challenges compared to product-based contracts. As the report notes, limited resources were a common issue across product lines due to what some viewed as insufficient funding levels from the host command. For contracted rental equipment, ensuring funding is in place and service levels are clearly defined upfront would help prevent delays or uncertainty when processing rental contracts and modifications. Designating points of contact for such specialized equipment may also streamline requests and approvals. In addition, defining clear requirements for intangible services can be difficult. Performance measurement is also more complex for many services. Strong communication skills are needed from contract managers to ensure quality delivery over the life of continually provided services. Without clear change management, service scopes also risk scope creep.

Several recommendations have been proposed to improve communication, documentation, and training related to contracting for aerial lifts and other rented industrial resources within BSVE. One of the key suggestions is to enhance documentation by clearly specifying authorized service levels that are funded by different sources. This would help minimize confusion regarding the types of equipment rental requests that are permitted. Standardizing this information on an accessible website, as recommended, would ensure both NAVFAC staff and customers have consistent references. Additionally, holding regular customer meetings, as works well in some areas, could foster transparency around equipment availability, planning needs, and options to share resources between sites to better meet demands.

A strength of this study was interviewing representatives from various stakeholders to identify issues from multiple perspectives. However, as no quantitative data exists on specific problems, interviews provided the primary data, limiting generalizability. Overall, the recommendations aimed to enhance customer service and efficiency in line with NAVFAC's strategic goals through improved communication, transparency, and understanding between all parties. Implementing these low-effort changes could help streamline aerial lift and equipment rental contracting within BSVE.

3. Review of Contract Solicitation: Forklift and Aerial Man Lift Rental Services in the Hampton Roads Area

The documentation provided several helpful insights into the NAVFAC boom-lift support contract serving naval vessels in Norfolk, VA over the past five years (Naval Facilities Engineering Systems Command [NAVFAC], 2021). The solicitation documentation revealed the contract employed a firm-fixed-price structure to define the scope of services. According to Section C – Descriptions and Specifications of the solicitation, "the contractor shall furnish all labor, supervision, management, tools, materials, equipment, facilities, transportation, incidental engineering, and other items necessary to provide the aerial work platform services outlined in the Performance Work Statement (PWS) for NAVFAC MIDLANT in the Hampton Roads Virginia area." This work was to be performed at various Hampton Roads Virginia area locations including, but not limited to Naval Station, Norfolk; Joint Base Little Creek/Fort Story; Naval Air Station Oceana including Dam Neck Naval Training Center; and Naval Weapons Station Yorktown including Cheatham Annex and St. Julian's Creek Annex, among others within a 50-mile radius. The anticipated type of contract for this procurement was specified as non-recurring work. The Indefinite Delivery/Indefinite Quantity (IDIQ) contract structure offered flexibility to accommodate variable lift rental demand through a catalog of pre-negotiated hourly rates. Records showed utilization averaged just under 30 hours per week, indicating equipment filled an ongoing yet consistent need without over-utilization (NAVFAC, 2021).

Contractor performance was rated highly, with over 95% of task orders completed on time and within budget according to the metrics (NAVFAC, 2021). Responsiveness, equipment quality, and safety compliance received "excellent" marks in evaluations. However, a few minor administrative issues were noted. Delays occasionally occurred in submitting invoices, likely relating more to organizational changes within the contractor rather than performance deficiencies. Transitioning to an online service records system also presented some challenges initially. On the operational side, maintenance records revealed the boom-lifts periodically required repair and recertification to ensure safety. Planned downtime for such servicing averaged 2–3 weeks per year (NAVFAC, 2021), with coordination helping to minimize disruptions. Relying on a sole contractor meant all equipment availability was simultaneously impacted during maintenance periods.

Overall, this case study provided a useful baseline for contracting industrial lifts as needed. Lessons learned like establishing clear performance expectations and documentation protocols minimized potential administrative issues. The data also indicated equipment rental through an IDIQ arrangement with a single approved vendor successfully streamlined access for crucial shipboard tasks in a cost-effective manner, while identifying areas future agreements could strengthen continuity of service and adapt practices for maximizing efficiency.

4. Report to Congressional Requesters (GAO-17-276), Government Purchase Cards

The government purchase card (GPC) program was established in the late 1980s to streamline the low-cost purchasing of goods and services directly from vendors. Previous research has shown that the GPC program reduces administrative costs associated with small dollar purchases and provides agencies with increased flexibility (Government Accountability Office [GAO], 2017). According to the GAO, federal agencies spent over $17 billion through millions of individual micro-purchases (those under $3,500) using GPCs in fiscal year 2014 alone.

Researchers have studied the GPC program using a mixed methods approach. Quantitatively, the GAO analyzed purchase card transaction data from fiscal year 2014 for a random, stratified statistical sample of 300 micro-purchases to assess compliance with internal control processes (GAO, 2017). Qualitatively, through interviews and document review, the GAO evaluated the policies and guidance established by the General Services Administration and OMB to oversee the GPC program. The results found enhancements had been made to training, monitoring tools, and guidance since 2008. However, some agencies still lacked complete documentation for GPC purchases, increasing the risks of fraud.

While GPCs provide clear benefits to the efficient procurement of many service contracts, there are also some potential drawbacks to consider. A major advantage is the speed and ease of using a GPC to quickly acquire time-sensitive services without undergoing lengthy purchase order processes. This allows agencies to address maintenance needs or continue operations without disruption. However, a potential downside is the risk of not maintaining complete documentation for auditing purposes, as the GAO (2017) found some agencies lacked proper receipts and approvals for purchases. Incomplete records make it harder to verify if purchases were properly authorized and received, increasing risks of fraud, waste or abuse. Additionally, the decentralized nature of GPC purchases may lead to some loss of centralized strategic oversight over spending categories across an entire agency. On the other hand, empowering end users through GPCs enhances flexibility to meet mission needs. To maximize benefits while mitigating issues, agencies must balance expediency with ensuring internal controls like robust transaction reviews and recordkeeping are still enforced for GPC service contracts.

C. SUMMARY OF LITERATURE REVIEWS

The extant literature offers foundational context and case studies relevant to assessing procurement options, though key gaps remain. Surrounding cost-benefit analytical techniques, Boardman et al. established an effective nine-step process providing structure. Practical insights also emerge through related studies at NAVFAC examining issues like unclear documentation impeding service level commitments and sole-source risks limiting continuity. Together, past research and the current boom-lift contract at Hampton Road Area illuminate consideration points for well-crafted service contracts. Flexible contracts require careful change management to ensure smooth transitions, while purchase cards offer streamlined access but carry the risk of incomplete records without proper controls. By mapping out current processes and actively seeking input from stakeholders, these efforts help develop an understanding of the complexities involved in facility logistics and foster empathy towards them.

Notably, there is a lack of published comparison or quantitative analysis examining prior U.S. naval boom-lift contracts across budget cycles or contrasting regional pool contracts with shipboard rental schemes designed for Pacific assets. No identified research leverages the Boardman methodology against objective Pacific Fleet expenditure and performance statistics longitudinally. Although prior studies provided a valuable foundation and identified recurring themes in maintenance support, there are still unresolved questions regarding the empirical derivation of optimized contracting blueprints specifically tailored for CRUDES vessels operating within the PACSOUTHWEST AOR. These questions highlight the need for further research and investigation to develop well-informed and effective contracting strategies that align with the unique requirements and operational context of CRUDES vessels in that specific region. A thorough analysis of past performance benchmarks can provide valuable insights for future procurement when designing future contracting frameworks.

To address this research gap and provide original empirical data, this research aims to examine five years of projected cost and utilization data from previous contracting configurations. The adoption of the Boardman nine-step roadmap ensures a meticulous examination, with a focus on quantifying economic impacts. This approach facilitates informed decision-making by providing a comprehensive evaluation of alternatives based on their economic implications. Findings intend to offer both acquisition and naval leadership an evidence-based recommendation for strategically structured accords better-serving fleet needs with judicious application of tax dollars. This research aims to contribute to the current discourse on optimizing the procurement of long-term, mission-enabling assets. It seeks to shed light on this topic by conducting a targeted analysis supported by mathematical methods. The goal is to expand the existing knowledge and understanding in this area, ultimately enhancing the decision-making process.

IV. METHODOLOGY, DATA, AND ANALYSIS

A. INTRODUCTION

As established previously, this research aims to evaluate contracting approaches for boom-lifts supporting CRUDES vessels in the PACSOUTHWEST AOR over five years. The primary goal of the methodology is to compare the total costs of continuing short-term rentals versus long-term agreements. In addition, the analysis reveals the most cost-effective option. To facilitate a rigorous comparative assessment, this study employs the cost-benefit analysis. Cost-benefit analysis provides a structured process for determining the economically optimal alternative by systematically estimating monetary and tangible benefits associated with distinct policies or initiatives. Specifically, the nine-step framework defined by Boardman et al. (2017) is being utilized, as it serves as the recognized technique endorsed by the OMB. In this chapter, we outline the procedures for conducting the cost-benefit analysis. We discuss the sources of data collection and the mechanisms to quantify costs. Additionally, techniques for valuing both benefits and costs monetarily are be explained. The overarching aim is to establish a transparent and empirically grounded process to facilitate informed recommendations.

B. COST-BENEFIT ANALYSIS FRAMEWORK

1. Define Alternatives

The two alternative projects under consideration in this analysis are:

a. Course of Action (COA) 1

Continuing the current practice of short-term, ship-level rentals of boom-lift in the PACSOUTHWEST AOR (status quo). Under this COA, each Navy vessel would continue to independently contract boom-lift equipment utilizing GCPC as needed. Equipment specifications, rental rates, and terms could vary between suppliers and rental periods would typically be 30 days or less.

b. Course of Action (COA) 2

Establishing a new centralized long-term regional support contract for boom-lift services by NAVFAC Pacific. This COA proposes transitioning to a single multi-year contract negotiated by NAVFAC Pacific to provide standardized boom-lift services to all vessels operating in the PACSOUTHWEST AOR. A contractor would be responsible for inventory, maintenance, and response requirements across the region, and NACFAC Pacific would be responsible for providing facility, fuel, and administration support.

2. Decide Whose Benefits and Costs Count (Standing)

Primary stakeholders included based on bearing direct costs/benefits are:

1. U.S. Navy, which realizes cost savings and asset performance benefits from extending ship hull service lives through preventative preservation work supported by boom-lift:
    a. Reduced induction/repair costs from delayed surface corrosion and structural degradation
    b. Costs associated with procurement of boom-lift services.
    c. Extended operational availability and service intervals between maintenance periods
2. NAVFAC Pacific as the contracting entity overseeing acquisition and sustainment activities:
    a. Budgetary Impacts such as contract expenses
3. Crew members aboard CRUDES vessels in the PACSOUTHWEST AOR as end-users of boom-lift services:
    b. Impacts on occupational safety based on fall risks, equipment reliability, and training requirements.
    c. Effects on work efficiency and productivity from availability/performance of boom-lift.

Secondary stakeholders that experience indirect impacts are:

1. Private equipment suppliers competing for the potential Navy Contract.

    a. Revenue generation may fluctuate under alternative contracting structures and usage scenarios.

2. Regional economies in port areas used as logistical hubs for repairs/ maintenance/personnel support:

    b. Activity in peripheral industries such as maintenance providers could be influenced by boom-lift acquisition decisions.

3. Decision of Standing

Upon review of which stakeholders bear direct and indirect impacts, the perspective taken for this cost-benefit analysis is that of the primary stakeholders. As we were tasked with evaluating potential acquisition strategies by U.S. Naval leadership, the analysis must consider only those benefits and costs that have a material effect on naval objectives, budget, and operations. While private suppliers and regional economies may see some influence from the contracting decision, capturing impacts beyond the primary military stakeholder is beyond the necessary scope. The indirect effects on secondary parties are also highly speculative and difficult to quantify with reasonable accuracy within the time and resource constraints of this research effort.

4. Identify Impact Categories and Indicators

In this section, we define the impact categories and associated metrics to be analyzed. As specified, only those effects directly bearing on the U.S. Navy's objectives of maximizing asset readiness within budgetary constraints are considered.

1. Cost Categories

    a. Acquisition & Contract Management Indicator: Cumulative present value of capital outlays over a 5-year period (FY24-FY28), in accordance with the minimum timeframe specified in OMB Circular A-94 for benefit-cost analysis of federal programs and regulations.

    i. COA 1: Total annual rental expenditures + Administrative cost to procure.
    ii. COA 2: Initial contract costs + Total annual contract costs + Administrative cost to procure.

b. Operations & Maintenance
   Indicator: Discounted cumulative present value of annual operating/maintenance costs of boom-lift units including fuel, maintenance/repairs, personnel, and facilities for COA 2.

2. Benefit Categories

c. Safety & Risk Reduction
    i. Indicator: Projected injury incidents avoided among ship's crew/workers
d. Asset Service Life Extension
    i. Estimated monetary value of maintenance deferrals achieved with the premise that proper implementation of preservation tasks, facilitated by safer extended reach capabilities of boom-lifts.

5. Quantitative Prediction of Impacts over the Period of the Contract

In this section, mathematical models are developed and applied to forecast the anticipated costs and benefits associated with each alternative acquisition strategy over the mandated 5-year analytical time horizon and considering the applicable U.S. Navy Warships stationed in the PACSOUTHWEST as depicted in figure six. By employing this approach, we can compare and assess the net outcomes between the current status quo and the consolidated contract approaches, as mandated by the analytical framework. This methodology ensures a rigorous and comprehensive evaluation of the potential outcomes associated with each strategy.

1. Cost Impact

a. COA 1 Cost = Σ [Rental Equipment Cost *t* + (Admin Hours * Hourly Wage rate *t*)* (1 + Labor Inflation)t]

b. COA 2 Cost = Initial Contract Award + Σ [(Annual Contract Cost *t*) + (Admin Hours * Hourly Wage rate *t*) * (1 + Labor Inflation *t*)]

Where:

i. Rental/Contract Costs defined annually = Average annual Rental Cost per Ship * number of CRUDES at PACSOUTHWEST AOR

ii. Data on Average annual Rental Cost per ship is provided by the controller team of the Commander, Naval Surface Force, U.S. Pacific

iii. Contract Cost Annually is the cost of Aerial Man Lift Rental Services with contractor providing all labor, management, fuel, maintenance, facility and equipment, and other items necessary to perform lift services.

iv. Admin Hours of COA 1= 2.1 hours per rental cycle * average annual amount of boom-lift request

v. The Government Accountability Office surveyed 24 federal organizations on their use of purchase cards for recurring goods and services. For equipment rentals, cardholders' time per transaction averaged 2.1 hours (GOA, 2009).

vi. For the Hourly Wage of COA 1, the labor typically includes a Lead Petty Officer (E-6) to oversee GCPC process and documentation, assisted by a Junior Sailor (E-4) for GCPC payment, physical inspections, and record-keeping tasks. Taking a weighted average based on an estimated 70/30 split between the Lead and Assistant roles and 2023 Military Pay yields: (E-6 pay x 0.7) + (E-4 pay x 0.3) = $21.17/ hour

vii. Admin Hours of COA 2 = hours annually for ongoing contract management after the initial award outlays are complete. The personnel inflection is an average annualized rate of 2.4% per Employment Cost Index published by The Bureau of Labor Statistics (BLS, 2022)

c. Op. & Maint Costs = Σ (Fuel Cost *t* + Maint Cost *t* + Personnel Cost *t* + Facility Cost *t*)

Where:

i. Fuel Cost *t* = Estimated Annual Fuel consumption t * Fuel price *t* * (1 + Fuel inflation rate)*t*

ii. Fuel Inflation Rate= 3.1% (EIA, 2023)

iii. Maint Cost *t* = Planned Maint. hours * Maint. rate / hour * (1 + Maint. wage inflation rate)t

iv. Maint. wage inflation rate = 2.4% (BLS, 2022)

v. Personnel Cost *t* = Crew size * labor days * Personnel rate / day * (1 + Personnel inflation)*t*

vi. Personnel inflation rate = 2.4% (BLS, 2022)

vii. Facility Cost *t* = Facilities cost base * (1 + Facilities inflation rate)*t*

viii. Facilities inflation rate= 2.75% (U.S. Army Corps of Engineers, 2022)

2. Benefit Impact

a. Safety & Risk Reduction

Injuries Avoided = Σ [Population at Risk *t* * (Average Baseline Injury Rate *t* *(1-Average Mitigated Rate *t*))]

Where:

b. Population at Risk = Average annual number of ship crews in year *t* Regarding typical crew sizes, unclassified Naval organization documents indicate Ticonderoga-class cruisers carry crews of approximately 330 sailors, while Arleigh Burke-class destroyers require crews of roughly 275 personnel (Naval Vessel Register, 2023). There are seven cruisers and 33 destroyers homeported within the PACIFIC AOR. Assuming the number of

CRUDES vessels remains the same, the average annual number of ship crews is 11,385.

c. Average Baseline Injury Rate *t:* According to the U.S. Bureau of Labor Statistics in 2020, the nonfatal injury and illness rate for falls, slips, and trips across all private industries was 21.7 per 10,000 full-time workers.

d. Average Mitigated Rate *t:* The Occupational Safety and Health Administration (OSHA, 2019) conducted surveillance of over 300 general industry construction sites from 2012–2018. Comparing injury records between facilities using ladders versus aerial lifts, OSHA found elevated work-related fall incidence reduced by 22% when lifts replaced ladders.

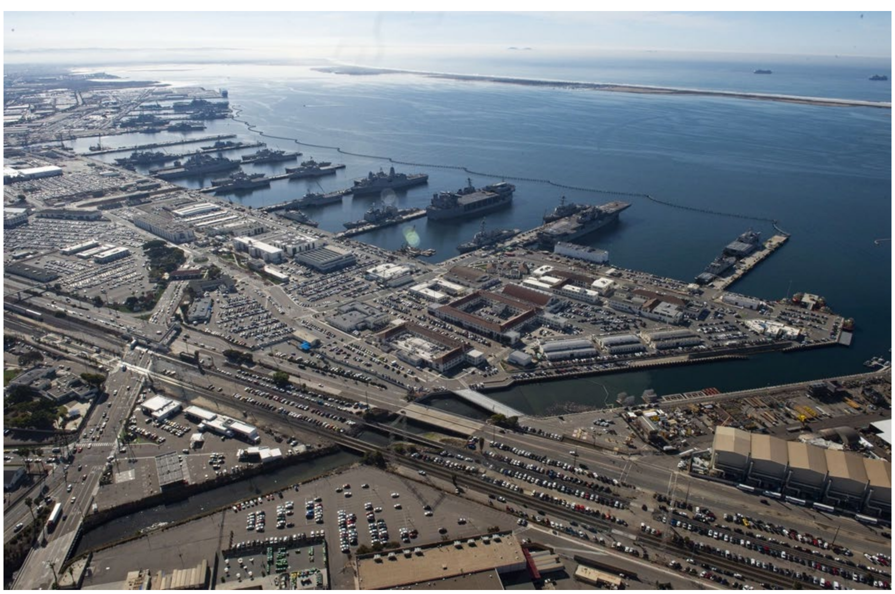

Figure 6. Naval Base San Diego. Source: Dvidshub.Net (2024).

3. Asset Service Life Extension

Deferred Maintenance Savings = Σ [(Maintenance Cost/Hour *t*) * (1 + Maintenance Wage Inflation *t*) * Hours Deferred *t*]

Where:

a. Maintenance Cost/Hour *t*= $95 per hour
   The United States Government Accountability Office (GAO, 2015) published findings from their analysis of U.S. Navy vessel sustainment costs.

b. Maintenance Wage Inflation *t* = 2.4% (BLS, 2022)

c. Hours Deferred estimated is a value used in the asset service life extension benefit calculation provided by the corrosion modeling software, CORPAN 82, from the U.S. Navy Corrosion Center of Excellence. Input data included vessel condition assessments of 40 CRUDES, 5-year environmental profiles for Naval Base San Diego provided by the Naval Meteorology and Oceanography Command, and alternative 5-year preservation strategies developed in consultation with NBSD shipyard maintenance planners. The CORPAN 82 simulations projected that under the status quo decentralized approach (COA 1), the average annual maintenance hours deferred is a total of 10,750 hours or an average 1,075 hours per year over the analysis period. Meanwhile, with the consolidated contract (COA 2), the average annual maintenance hours deferred is a total of 12,350 hours or an average 1,235 hours per year. The estimated 1,235 average annual maintenance hours deferred under COA 2 represents approximately a 15% increase over the 1,075 hours projected with the COA 1 approach. This 15% differential aligns with results assessed in Chapter II, Section C, Subsection 3, wherein equipment utilization rates were found to have risen 15–20% under the new centralized management model compared to prior independent yard control practices.

6. Monetize Impacts

To compare the costs and benefits of different long-term boom-lift procurement options, it is necessary to monetize the key impacts in monetary terms where feasible. For the costs associated with recurring acquisition, maintenance, and rental expenditures, the necessary data exists to directly value these financial outlays. Current market data, U.S. Naval Comptroller records, and historical budget line items were analyzed to establish average annual costs incurred under past contracting models. These were adjusted for inflation and extrapolated over the five-year analysis period based on industry projections for equipment and labor rate escalation.

Two primary benefit categories were identified: safety/risk mitigation and asset service life extension. Regarding injuries avoided through boom-lift fall protection, a mathematical model was developed as part of the methodology in Chapter IV, Section B, Subsection 4, Item b(i) to estimate the number of projected prevented injuries annually under different contracting scenarios. To monetize these projected injury reductions, economic costs of injury published by Centers for Disease Control and Prevention (CDC) were applied (Peterson et al., 2021). Specifically, CDC reports that the economic cost of an injury associated with medical loss is $82,724 for age group 25–45 (Peterson et al., 2021). Therefore, the total estimated annual dollar value of injury reductions is calculated as:

Total estimated annual value of injuries avoided= \$82,724 * Amount of Injuries Avoided

- Monetizing asset life extension benefits focused on quantifying projected maintenance deferral savings derived from mathematical projections of corrosion timelines developed as part of the methodology in Chapter IV, Section B, Subsection 4, item b (ii).

7. Discount Benefits and Costs to Obtain Present Value

According to the guidelines set forth by the OMB for conducting CBA of government policies and projects, it is necessary to discount future monetary benefits and costs to their present values. For long-term initiatives that span multiple years, benefits and costs are spread over time and occur in various amounts annually. To aggregate these flows into aggregate, comparable dollar values, discounting future benefits and costs allows them to be expressed in terms of their worth today (Boardman et al., 2017). In this study, all projected costs and benefits arising between FY24 through FY28 were discounted to their net present values in FY24 dollars using a real annual discount rate of 7%. This rate was selected in accordance with the standard recommendation provided in OMB Circular A-94, Appendix C for regulatory analysis (Office of Management and Budget [OMB], 1992).

The present value (PV) of the benefits, PV (B), and the present value of the costs, PV(C), are as follows (Boardman et al., 2017):

$$PV\ (B) = \sum_{t=0}^{n} \frac{B_t}{(1+s)^t}$$

$$PV\ (C) = \sum_{t=0}^{n} \frac{C_t}{(1+s)^t}$$

where S= 7%.

8. Compute Alternative NPVs

Calculating the net present values of each alternative approach allows us to determine which option provides the highest net benefits when benefits and costs are discounted to the present period for comparative evaluation within the cost-benefit analysis framework. "The net present value (NPV) of an alternative equals the difference between the PV of the benefits and the PV of the costs." (Boardman et al., 2017):

$$NPV = PV(B) - PV(C)$$

9. Sensitivity Analysis

Guidance from the OMB (1992) states that major assumptions used within the cost-benefit analysis should be varied, and net present values recalculated, to ascertain how sensitive the outcomes are to changes in those assumptions. For this research, key areas that merit thorough sensitivity testing include potential fluctuations in fuel cost, labor costs for government-owned equipment, and discount rates applied to monetary valuations. By varying the values of each assumption within a reasonable range, we can assess the reliability of the results and identify areas where the analysis may be most sensitive to deviations from initial estimates. This sensitivity analysis allows us to understand the potential impact of different scenarios on the outcomes and provides valuable insights into the robustness of the analysis (OMB, 1992). The sensitivity analysis is crucial to forming conclusions regarding the preferred option with appropriate acknowledgment of associated risks and uncertainties (Boardman et al., 2017). The specific approaches and results of this sensitivity testing are detailed later in this research report.

10. Make Recommendation

The basic decision rule for evaluating single alternative projects, such as the various procurement options considered in this analysis, is straightforward – recommend proceeding with the option that presents a positive NPV relative to the status quo (Boardman et al., 2017). The recommendation would be to adopt whichever option results in a positive NPV according to the net benefit calculations incorporated within the research methodology framework (Boardman et al., 2017). It is understood the option with the highest estimated NPV may not definitively be the most practicable selection due to variable transition expenses not fully incorporated into monetary evaluations (Boardman et al., 2017). Therefore, the sensitivity analysis results aid in identifying the alternative most appropriately positioned to balance requirements over the long run (Boardman et al., 2017), even if not quantitatively optimal according to NPV.

V. RESULTS

A. INTRODUCTION

This chapter aims to present the results of the CBA evaluating COA 1 representing the current decentralized ship-level rental model and COA 2 proposing the implementation of a regional boom-lift service contract for the Pacific fleet. Details of the estimated costs, benefits, and NPV calculations determined for each alternative are presented. A sensitivity testing has been conducted to explore how variations in key assumptions affect the comparative results.

B. COST-BENEFIT ANALYSIS OF ALTERNATIVES

Based on the five-year NPV calculations (Table 2), COA 2 involving the implementation of a regional services contract emerges as the most cost-effective option. It offers $516,000 in additional net benefits compared to continuing under the status quo. This finding is based on the cost estimates and assumptions defined through our research methodology. In the following sections, we further examine key aspects of the cost-benefit analysis such as sensitivity testing of assumptions to gain a more robust understanding of these results and implications for decision makers.

The data provides important insights into the tradeoffs between the two contracting alternatives. While COA 1 had a slightly lower total benefit, the real notable difference between the alternatives lies in the annual rental/contract costs. For COA 1, which represents continuing the ship-level rental model, the annual rental/contract costs came out to $6,040,000. This likely reflects the average annual expenditure estimated based on reviewing historical rental invoices and contract documentation from individual ships procuring boom lifts on an ad-hoc basis in recent years. Continuing this decentralized approach likely does not leverage potential economies of scale that could come with a centralized contract. In comparison, the annual rental/contract costs estimated for COA 2, which represents implementing a regional contracting approach, was $5,547,000. COA2 assumes a coordinated contract with bulk purchases at the regional level, potentially securing preferential rates due to guaranteed annual expenditure. However, the centralized administration model may result in higher contract administrative activities costs of $74,000 compared to the lower cost of $26,000 estimated under the ship-level model.

In summary, the lower annual rental/contract costs projected under COA 2 indicate that strategic bundling of requirements through a coordinated regional contracting model offers the greatest potential for cost savings over the five-year period. This insight highlights the advantages of consolidating bargaining power and operational efficiencies, making it a favorable solution.

Table 2. Cost-Benefit-Analysis with 7% Discount Factor Calculations

Boom Lift Service CBA			
	COA 1	**COA 2**	**Difference**
Benefit:			
Safety & Risk Reduction	$ 6,994,000	$ 6,994,000	$ -
Asset Service Life Extension	$ 469,000	$ 538,000	$ (69,000)
Total Benefits	$ 7,462,000	$ 7,532,000	$ (70,000)
	$ -	$ -	
Cost:	$ -	$ -	
Acquisition & Contract Management	$ 6,066,000	$ 5,620,000	$ 446,000
Annual Rental/Contract Costs	$ 6,040,000	$ 5,547,000	$ 493,000
Contract Administrative Activities	$ 26,000	$ 74,000	$ (48,000)
Total Costs	$ 6,066,000	$ 5,620,000	$ 446,000
Net Present Value	$ 1,396,000	$ 1,912,000	$ (516,000)
Benefit Cost Ratio	1.23	1.34	

Cost-benefit-analysis of alternatives with 7% discount factor calculations of benefit and cost based on model and sources described in Appendixes A and B.

C. ANALYSIS OF ASSUMPTIONS AND SENSITIVITY TEST

With the cost-benefit analysis complete, it was imperative to identify and account for uncertainties in the assumptions. As Boardman et al. (2017) note, sensitivity testing provides important insight for cost-benefit analyses that rely on assumptions subject to uncertainty: “There are practical limits to the amount of sensitivity analysis that is feasible. Potentially, every assumption in a CBA can be varied. In practice, one must use judgment and focus on the most important assumptions” (p. 15). Accounting for unpredictability is crucial, as assumptions represent the best predictions, but reality may differ. While thoroughly adjusting all factors is ideal, constraints require selectivity as Boardman et al.

advise. A sensitivity analysis therefore serves to evaluate how robust the findings are to potential fluctuations in key drivers.

Instead of blindly varying all inputs, a more focused approach has been taken by carefully selecting scenarios that target the most pivotal assumptions (Boardman et al., 2017). This counters potential bias by systematically exploring alternative plausible outlooks. The sensitivity testing conducted in this study adheres to Boardman's standards by focusing on a limited number of assumptions. These assumptions are believed to have a substantial impact on the relative positions of alternatives if they deviate from the forecasted values. By specifically examining these critical assumptions, we can assess the potential impact on the outcomes and ensure a robust analysis. By testing the stability of conclusions, sensitivity analysis enhances the credibility and usefulness of economic evaluations for practical decision-making. Four primary focus areas were selected:

1. Variations in the Discount Factor

According to the most recent OMB Circular A-94 guidance, published in February 2023, the recommended discount rate for cost-benefit analyses should be determined based on the length of the program under consideration (OMB, 2023). Whereas a standard 7% discount rate is traditionally applied to military programs as per prior guidance, the updated A-94 memo outlines utilizing a 3.8% discount rate specifically for projects projected over a five-year term (OMB, 2023). Adopting this 3.8% rate in place of the standard 7% generates notable impacts on the discounted NPV calculation for costs and savings anticipated at the end of the five-year analysis period under each alternative procurement strategy (see Table 3). COA 2 emerges as the superior option with an NPV $556,000 greater than the status quo decentralized rental model. The significant differential observed indicates that the regional approach offers long-term benefits that continue to accumulate over time. These benefits include efficiency gains resulting from centralized logistics, which contribute to cost savings and operational effectiveness throughout the duration of the contract. However, applying discount rates toward the upper end of typical considerations like 9% would shrink this margin significantly by discounting later cash flows more heavily (see Table 4).

Table 3. Cost-Benefit-Analysis with 3.8% Discount Factor Calculations

Boom Lift Service CBA			
	COA 1	COA 2	Difference
Benefit:			
Safety & Risk Reduction	$ 7,408,000	$ 7,408,000	$ -
Asset Service Life Extension	$ 497,000	$ 571,000	$ (74,000)
Total Benefits	$ 7,905,000	$ 7,979,000	$ (74,000)
	$ -	$ -	$ -
Cost:	$ -	$ -	$ -
Acquisition & Contract Management	$ 6,438,000	$ 5,956,000	$ 482,000
Annual Rental/Contract Costs	$ 6,411,000	$ 5,877,000	$ 533,000
Contract Administrative Activities	$ 27,000	$ 78,000	$ (51,000)
Total Costs	$ 6,438,000	$ 5,956,000	$ 482,000
Net Present Value	$ 1,467,000	$ 2,023,000	$ (556,000)
Benefit Cost Ratio	1.23	1.34	

Cost-benefit-analysis of alternatives with 3.8% discount factor calculations of benefit and cost based on model and sources described in Appendices C and D.

Table 4. Cost-Benefit-Analysis with 9% Discount Factor Calculations

Boom Lift Service CBA			
	COA 1	COA 2	Difference
Benefit:			
Safety & Risk Reduction	$ 6,757,000	$ 6,757,000	$ -
Asset Service Life Extension	$ 452,000	$ 520,000	$ (67,000)
Total Benefits	$ 7,210,000	$ 7,277,000	$ (67,000)
	$ -	$ -	$ -
Cost:	$ -	$ -	$ -
Acquisition & Contract Management	$ 5,854,000	$ 5,429,000	$ 425,000
Annual Rental/Contract Costs	$ 5,829,000	$ 5,358,000	$ 471,000
Contract Administrative Activities	$ 25,000	$ 71,000	$ (46,000)
Total Costs	$ 5,854,000	$ 5,429,000	$ 425,000
Net Present Value	$ 1,356,000	$ 1,848,000	$ (492,000)
Benefit Cost Ratio	1.23	1.34	

Cost-benefit-analysis of alternatives with 9% discount factor calculations of benefit and cost based on model and sources described in Appendices G and H.

2. Variations in Labor Costs

While the initial cost-benefit analysis utilized a conservative 2.4% average annual labor inflation estimate based on pre-pandemic historical trends (BLS, 2022), it is prudent to test the sensitivity of results to potential variations in wages given the economic instability witnessed in recent years. Prior to 2020, average labor cost growth had remained subdued for over a decade; however, widespread disruptions to labor markets and global supply chains from the pandemic drove a sharp uptick in inflation. The Bureau of Labor Statistics' Employment Cost Index reported average yearly increases of 4.1% in 2021, 5.5% in 2022, and a projected 4.2% for 2023 (BLS, 2023b).

To address the high inflationary environment, it is prudent to re-evaluate the procurement alternatives by using a revised wage escalation estimate that reflects the current economic climate. By adopting the figures provided by the BLS, the average rate of wage increased for the 2021–2023 period is 4.6% (BLS 2023a). Incorporating this higher rate into projections of annual labor costs, the total estimated expense of COA 1 increases to $6,067,000 over the 5-year analysis period, with a NPV of $1,395,000 (see Table 5). Similarly, costs under COA 2 rose to $5,676,000 while maintaining a superior NPV of $1,856,000, resulting in a $461,000 advantage even under significantly inflated labor growth assumptions. This supplementary sensitivity testing reinforces COA 2 as the superior strategic option in terms of robust cost-effectiveness. Its operational framework appears better positioned to mitigate the impacts of volatile wage movements over the long-term life of the contract.

Table 5. Cost-Benefit-Analysis with 4.6% Labor Inflation Calculations

Boom Lift Service CBA			
	COA 1	**COA 2**	**Difference**
Benefit:			
Safety & Risk Reduction	$ 6,994,000	$ 6,994,000	$ -
Asset Service Life Extension	$ 469,000	$ 538,000	$ (70,000)
Total Benefits	$ 7,462,000	$ 7,532,000	$ (70,000)
	$ -	$ -	$ -
Cost:	$ -	$ -	$ -
Acquisition & Contract Management	$ 6,067,000	$ 5,676,000	$ 391,000
Annual Rental/Contract Costs	$ 6,040,000	$ 5,599,000	$ 442,000
Contract Administrative Activities	$ 27,000	$ 77,000	$ (50,000)
Total Costs	$ 6,067,000	$ 5,676,000	$ 391,000
Net Present Value	$ 1,395,000	$ 1,856,000	$ (461,000)
Benefit Cost Ratio	1.23	1.33	

Cost-benefit-analysis of alternatives with 4.6% labor inflation calculations of cost based on model and sources are described in Appendix E.

3. Variations in Fuel Costs

For equipment acquisitions like boom-lift, fuel expenditures constitute a meaningful operational cost dependent on consumption quantities. Rigorously validating cost projections requires scrutinizing how variable inputs like fuel prices potentially affect outcomes. While initial modeling applied the 3.1% average annual fuel inflation projected by U.S. Energy Information Administration (2022), recent volatility demands re-examination against actuals. From 2021 to 2022, fuel costs climbed 6.34% and 10.34% respectively based on U.S. Consumer Price Index: Gasoline All Types, averaging 8.34% (BLS, 2023). Adapting this rate raises overall expenses of COA 2 from $5,620,000 to $5,697,000 yet preserving the superior NPV of $1,835,000 versus COA 1 assuming no change of the rental rate (see Table 6).

Table 6. Cost-Benefit-Analysis with 8.34% Fuel Inflation Calculations

Boom Lift Service CBA			
	COA 1	**COA 2**	**Difference**
Benefit:			
Safety & Risk Reduction	$ 6,994,000	$ 6,994,000	$ -
Asset Service Life Extension	$ 469,000	$ 538,000	$ (70,000)
Total Benefits	$ 7,462,000	$ 7,532,000	$ (70,000)
Cost:			
Acquisition & Contract Management	$ 6,066,000	$ 5,697,000	$ 369,000
Annual Rental/Contract Costs	$ 6,040,000	$ 5,623,000	$ 418,000
Contract Administrative Activities	$ 26,000	$ 74,000	$ (48,000)
Total Costs	$ 6,066,000	$ 5,697,000	$ 369,000
Net Present Value	$ 1,396,000	$ 1,835,000	$ (439,000)
Benefit Cost Ratio	1.23	1.32	

Cost-benefit-analysis of alternatives with 8.34% fuel inflation calculations of cost based on model and sources described in Appendix F.

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VI. CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the key findings and conclusions from the research, as well as recommendations for an optimized contracting approach for procuring aerial work platform services to support CRUDES vessels operating in the PACSOUTHWEST AOR. The chapter is organized to first answer the primary and secondary research questions, followed by suggested recommendations and areas warranting further study.

A. FINDINGS FOR PRIMARY RESEARCH QUESTION

What is the most cost-effective contracting vehicle for procuring services of boom-lifts to ensure consistent availability of CRUDES vessels operating in the PACSOUTHWEST AOR over the next five years?

Based on the findings of our cost-benefit analysis, the most cost-effective contracting approach over the next five years would be to consolidate boom-lift provision for CRUDES vessels under a regional command model. Our quantitative analysis adhered to the guidelines set by the OMB and involved comparing the NPV and benefit-cost ratio. The benefit-cost ratio is a crucial metric used in our analysis to evaluate the financial viability of different contracting approaches. It measures the relative net benefits achieved by dividing the total estimated benefits by the total projected costs. A higher benefit-cost ratio indicates greater benefits relative to costs. In our case, the results (refer to Table 2) indicate that implementing a centralized asset management solution (COA 2) would yield an estimated 5-year NPV of $1,911,549 and a benefit-cost ratio of 1.34. On the other hand, maintaining the current arrangement would result in a lower 5-year NPV of $1,396,267.76 and a benefit-cost ratio of 1.23.

The regional command model option yielded a benefit-cost ratio of 1.34 compared to 1.23 for continuing ship-level rentals. This differential suggests that on average, $1.34 of benefits would be generated for every $1 of costs if moving to the regionalized framework. Conversely, only $1.23 of benefits would result from every $1 spent by maintaining the status quo arrangement. Thus, the regional command structure offers a higher likelihood of cost savings materializing according to investment levels. The benefit-cost ratio confirms this approach maximizes value returned from allocated resources over the five-year performance timeframe evaluated. These findings indicate that a coordinated regional approach under a single point of accountability would minimize total costs through optimized scheduling practices and economies of scale. Centralized coordination successfully demonstrated through existing regional commands elsewhere suggests this alternative provides the strongest potential for meeting CRUDES lifting demands in the PACSOUTHWEST AOR region in a cost beneficial way over the analysis horizon.

Nonetheless, it is important to take some factors into consideration when implementing the preferred regional model. Close supervision is crucial to ensure that the lifts are fully utilized as projected, which is essential for achieving the anticipated cost savings. Additionally, gathering input from fleet maintenance planners and operators can aid in designing a support framework that maximizes the practical usefulness of the lifts in real-world scenarios. Furthermore, conducting further research to adapt successful configurations from other commands can help mitigate any potential risks associated with the implementation process. By diligently executing the plan and actively engaging stakeholders, the regional command structure presents itself as the most promising option for effectively and sustainably providing boom-lifts as a managed service to CRUDES vessels.

B. FINDINGS FOR SECONDARY RESEARCH QUESTION

How do impacts compare between a potential alternative versus current decentralized ship-level rental arrangements for services of boom-lifts?

The sensitivity analysis provided valuable insight by examining how cost projections might vary under alternative economic scenarios, helping strengthen confidence in the comparative evaluation (see Table 7). When key assumptions regarding discount rates, wage inflation, and fuel prices were adjusted across conservative estimates, the proposed regional contracting model consistently demonstrated continued cost advantages relative to decentralized rental arrangements. Even under more pessimistic projections, such as applying a lower 3.8% discount rate or elevated BLS wage forecasts, the regional approach maintained a superior NPV on the order of half a million dollars or more. Fuel price volatility, which was tested at inflation rates double initial projections, had a comparatively smaller impact and did not undermine the cost superiority of the regional solution.

These findings indicate the potential alternative procurement framework exhibits more resilience to variations in uncertain economic factors over the five-year analysis period. The centralized regional service contract consistently delivered projected monetary benefits despite testing across a range of downside scenarios. This reinforces the conclusion it represents a lower risk long-term acquisition solution relative to maintaining the status quo arrangements. The reliance on cost-benefit analysis can be considered highly reliable, as the alternative approach has proven to be resilient under various sensitivities.

Table 7. Boom Lift Service Cost Benefit Analysis Ratio Summary

Boom Lift Service CBA Ratio Summary		
	COA 1	**COA 2**
CBA ratio 7% discount factor	1.23	1.34
CBA ratio 3.8% discount factor	1.23	1.34
CBA ratio 9% discount factor	1.23	1.34
CBA ratio 4.6% labor inflation	1.23	1.33
CBA ratio 8.34% fuel inflation	1.23	1.32

Summary of CBA ratios for a 7%, 3.8%, or 9% discount factor, or a 4.6% labor inflation, or a 8.34% fuel inflation.

C. RECOMMENDATION

Based on our comprehensive comparative assessment, we recommend that NAVFAC PACIFIC adopts a regional contracting approach to fulfill the boom-lift requirements of CRUDES vessels stationed in the PACSOUTHWEST AOR for the next five years. Specifically, an IDIQ contracting vehicle with firm fixed pricing would deliver the most cost-effective solution. This would provide NAVFAC the flexibility to issue delivery orders on an as-needed basis against pre-established fixed unit pricing for equipment rentals and maintenance services, which complies with the FAR subsection

16.504 (b) statement that "An IDIQ contract provides for an indefinite quantity, within stated limits, of supplies or services during a fixed period." The contractor shall furnish all personnel, equipment, facilities and other resources necessary to provide safe, timely and compliant aerial work platform support within the PACSW AOR, in accordance with FAR 16.505 (a)(5) that the contractor "Provide units of supplies or services in a specified quantity." Pricing should remain fixed for the base period, with economic adjustment clauses included for option years if exercised, per FAR clause 52.217-2 regarding price adjustment based on standard indices.

Successful implementation requires several prerequisites. NAVFAC must coordinate depot-level involvement to consolidate demand signals and facilitate centralized asset allocation. Performance metrics focusing on utilization, safety and maintenance response times should be instituted to ensure program objectives are achieved. Contract administration resources may need bolstering initially to oversee transition and establish standardized processes and documentation practices across stakeholders. Opportunities remain to refine this contracting approach further. As fleet requirements and technologies evolve, the contract scope and terms should be revisited periodically to promote continuous improvement. Advancing digital asset tracking and condition-based maintenance regimes could maximize uptime while reducing life cycle costs. Expanding supported asset classes like manlifts or aerial scissor lifts may capture additional synergies. Regional inter-service collaborations might deliver even greater economies of scale. Ongoing stakeholder engagements is critical to refine solutions delivering exceptional value well into the future. since past attempts at stakeholder collaboration faced challenges fully implementing a coordinated solution across the diverse and evolving needs of the Pacific Fleet. When NAVFAC first established regional contracting frameworks in the 2000s, while successful in other regions, the initial Pacific Regional Command struggled in its first years according to a 2015 assessment report, partly due to standardized maintenance program delays from fiscal year 2013–2014 funding shortfalls (NAVSEA, 2015). However, for ongoing stakeholder engagement to succeed moving forward, lessons from past difficulties, especially funding support, must be addressed through close coordination between leadership from NAVFAC, NAVSEA, TYCOMs, and personnel directly supporting CRUDES operations. Regular communication forums are needed to sustain collaboration through consensus-building on evolving requirements and open tracking of performance metrics from the highest administrative levels down to validate solutions remain optimized for safety, schedule and cost impacts experienced at the working level long-term. With proactive measures to ensure maintenance programs are sufficiently funded and resources are allocated equitably according to demand signals, stakeholder engagement this time has the potential to deliver a practical centralized solution across the diverse Pacific Fleet.

In conclusion, the implementation of an IDIQ regional contracting model offers a thoroughly researched and lower-risk solution that effectively aligns procurement practices with strategic maintenance and safety priorities throughout the Pacific fleet. Provided that the necessary implementation factors are addressed, this revised acquisition framework is a compelling choice for optimizing procurement operations over the next five years.

D. LIMITATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

The current analysis provides a well-researched foundation for an optimized contracting approach within its defined scope and assumptions. However, several limitations present opportunities for expanded examinations that could further strengthen acquisition planning:

1. Limitations of Surface Platforms

A key limitation of the current analysis was the narrow scope of examining only the requirements of CRUDES vessels homeported in the PACSOUTHWEST AOR. While this provided a well-defined boundary to develop an optimized contracting approach, exploring a broader mandate could potentially yield even more compelling insights. Naval and maritime operations encompass a vastly diverse array of fleets, classes of vessels, and geographical locations. Carriers, submarines, support ships, Coast Guard cutters and military sealift vessels each have unique operational profiles that influence asset requirements. By projecting maintenance demands and seeking solutions at an expanded integrated regional level, we may uncover synergies that were not fully realized within the limited parameters of our study. Taking a broader perspective could reveal additional opportunities for efficiency and cost savings that were not initially apparent.

Streamlining and standardizing maintenance practices across platforms may generate safety and interoperability advantages as well. These warrants examine if cross-training programs and interchangeable certifications could maximize flexibility to dynamically resource contingent demands. A future study optimizing contracting at such an all-inclusive maritime system scale could offer decision-makers a wealth of enhanced insight to procure these critical capabilities with maximal effectiveness over the long-term.

2. Limitation of Quantitative Methodology

While cost-benefit analysis provided valuable projections to comparatively assess procurement alternatives, relying exclusively on quantitative metrics presented limitations to understanding broader impacts. For instance, important non-monetary factors affecting stakeholder acceptance and long-term program success were excluded from analysis. Follow-up qualitative research, such as conducting additional interviews and case studies, could lend insightful perspective into these difficult-to-monetize considerations. Speaking directly with more end users and managers involved in aerial lift operations could uncover important change management challenges to regional transition. Gauging shop-level perspectives on standardization efforts and centralized coordination might reveal cultural or process barriers warranting mitigation strategies. Conducting a mixed qualitative-quantitative follow-on investigation would provide an opportunity to comprehensively capture the multidimensional impacts of this contracting model, including both measured and unmeasured factors. By adopting a balanced perspective that combines numeric projections with narrative insights, we can establish a decision-making foundation that is both informative and actionable. This approach allows us to gain a more complete understanding of the potential benefits and implications of the proposed contracting model.

E. CONCLUDING REMARKS

This research conducted a comprehensive examination of boom-lift procurement alternatives to identify an optimized contracting approach for CRUDES vessels in the PACSOUTHWEST AOR. By applying cost-benefit analysis and sensitivity testing, the analysis demonstrated clear estimated savings projected through a centralized regional services model implemented via IDIQ contracting over the next five years. Sensitivity testing further reinforced this alternative as a lower risk option exhibiting robustness across modified assumptions. Based on our analysis, we strongly recommend that NAVFAC PACIFIC selects and implements this coordinated maintenance framework. Doing so not only promotes value recovery but also aligns with strategic safety priorities. An IDIQ vehicle with fixed pricing would afford flexibility while capturing estimated life cycle savings totaling over one million dollars according to projections. Subject to addressing change management during rollout, this revised acquisition methodology warrants adoption to foster ongoing procurement excellence into the future.

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APPENDIX A. COST IMPACT CALCULATION WITH 7% DISCOUNT FACTOR

Cost Impact					
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 1)	$1,294,547.3625	$1,249,810.1358	$1,206,512.3586	$1,164,846.5166	$1,124,570.9101
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Rental/Contract Costs (COA 1)	$ 1,294,547.36	$ 1,337,267.43	$ 1,381,397.25	$ 1,426,983.36	$ 1,474,073.81
Average annual Rental Cost per ship	$ 32,363.68	$ 33,431.69	$ 34,534.93	$ 35,674.58	$ 36,851.85
Rental Inflation Rate	3.30%	3.30%	3.30%	3.30%	3.30%
Number of CRUDES at PACSOUTHWEST AOR	40	40	40	40	40
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 2)	$1,237,500.0000	$ 1,187,326.35	$ 1,110,650.42	$ 1,039,066.92	$ 972,077.13
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Rental/Contract Costs (COA 2)					
Initial Contract Award Cost	$ 1,237,500.00	0	0	0	0
Annual Contract Cost	$ -	$ 1,270,411.25	$ 1,271,640.05	$ 1,272,898.34	$ 1,274,186.83
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 1)	$ 5,601.5820	$ 5,360.8843	$ 5,130.0760	$ 4,909.7611	$ 4,698.7046
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Administrative Cost (COA 1)	$ 5,601.58	$ 5,736.02	$ 5,873.68	$ 6,014.65	$ 6,159.00
Hours per rental cycle	2.1	2.1	2.1	2.1	2.1
Annual amount of boom lift request	126	126	126	126	126
Hourly Wage	$ 21.17	$ 21.68	$ 22.20	$ 22.73	$ 23.28
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 2)	$ 16,090.6000	$ 15,399.1934	$ 14,736.1943	$ 14,103.3377	$ 13,497.0756
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Administrative Cost (COA 2)	$16,090.60	$16,476.77	$16,872.22	$17,277.15	$17,691.80
Hours annually for ongoing contract management	430	430	430	430	430
Hourly Wage	$37.42	$ 38.32	$ 39.24	$ 40.18	$ 41.14
	FY24	FY25	FY26	FY27	FY28
NPV Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,187,326.35	$ 1,110,650.42	$ 1,039,066.92	$ 972,077.13
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,270,411.25	$ 1,271,640.05	$ 1,272,898.34	$ 1,274,186.83
Boom Lift Cost	$ -	$ -	$ -	$ -	$ -
Daily Rate	$ 475.00	$ 475.00	$ 475.00	$ 475.00	$ 475.00
Estimated Annual usage (days)					
Inflation rate	0.00%	2.00%	2.00%	2.00%	2.00%
Fuel Cost	$ 428,750.00	$ 442,041.25	$ 442,041.25	$ 442,041.25	$ 442,041.25
Estimated Annual Fuel consumption (gal.)	122,500	122,500	122,500	122,500	122,500
Fuel price (Disel)	$3.50	$3.50	$3.50	$3.50	$3.50
Fuel inflation rate	0.00%	3.10%	3.10%	3.10%	3.10%
Maint Cost	$ 50,000.00	$ 51,200.00	$ 52,428.80	$ 53,687.09	$ 54,975.58
Planned maint hours	500	500	500	500	500
Maint rate / hour	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Maint wage inflation rate	0.00%	2.40%	2.40%	2.40%	2.40%
Personnel Cost	$ 698,750.00	$ 715,520.00	$ 715,520.00	$ 715,520.00	$ 715,520.00
Crew size	13	13	13	13	13
labor days	250	250	250	250	250
Personnel rate / day	$ 215.00	$ 215.00	$ 215.00	$ 215.00	$ 215.00
Personnel inflation	0.00%	2.40%	2.40%	2.40%	2.40%
Facility Cost	$ 60,000.00	$ 61,650.00	$ 61,650.00	$ 61,650.00	$ 61,650.00
Facilities cost base	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00
Facilities inflation rate	0.00%	2.75%	2.75%	2.75%	2.75%

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APPENDIX B. BENEFIT IMPACT CALCULATION WITH 7% DISCOUNT FACTOR

Benefit Impact					
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Safety & Risk Reduction (COA 1)	$1,594,112.24	$1,489,857.3030	$1,392,297.6337	$1,301,273.8246	$1,216,148.2307
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Safety & Risk Reduction (COA 1)	**$1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**
Population at Risk	11385	11385	11385	11385	11385
Baseline Injury Rate	0.217%	0.217%	0.217%	0.217%	0.217%
Mitigated Rate	22%	22%	22%	22%	22%
Economic Loss Per Injury	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Safety & Risk Reduction (COA 2)	$1,594,112.24	$1,489,857.3030	$1,392,297.6337	$1,301,273.8246	$1,216,148.2307
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Safety & Risk Reduction (COA 2)	**$1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**
Population at Risk	11385	11385	11385	11385	11385
Baseline Injury Rate	0.217%	0.217%	0.217%	0.217%	0.217%
Mitigated Rate	22%	22%	22%	22%	22%
Economic Loss Per Injury	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Asset Service Life Extension (COA 1)	$ 102,125.00	$ 97,736.7296	$ 93,528.7587	$ 89,512.0979	$ 85,664.2291
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Asset Service Life Extension (COA 1)	**$ 102,125.00**	**$ 104,576.00**	**$ 107,085.82**	**$ 109,655.88**	**$ 112,287.62**
Maintenance Cost/Hour	$ 95.00	$ 97.28	$ 99.61	$ 102.01	$ 104.45
Maintenance Wage Inflation	-	2.40%	2.40%	2.40%	2.40%
Hours Deferred Annual	1,075	1,075	1,075	1,075	1,075
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Asset Service Life Extension (COA 2)	$ 117,325.00	$ 112,283.5917	$ 107,449.3181	$ 102,834.8288	$ 98,414.2539
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Asset Service Life Extension (COA 2)	**$ 117,325.00**	**$ 120,140.80**	**$ 123,024.18**	**$ 125,976.76**	**$ 129,000.20**
Maintenance Cost/Hour	$ 95.00	$ 97.28	$ 99.61	$ 102.01	$ 104.45
Maintenance Wage Inflation	-	2.40%	2.40%	2.40%	2.40%
Hours Deferred Annual	1,235	1,235	1,235	1,235	1,235

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APPENDIX C. COST IMPACT CALCULATION WITH 3.8% DISCOUNT FACTOR

Cost Impact					
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 1)	$1,294,547.3625	$1,288,323.4377	$1,282,074.7882	$1,275,865.8220	$1,269,767.1805
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Rental/Contract Costs (COA 1)	$ 1,294,547.36	$ 1,337,267.43	$ 1,381,397.25	$ 1,426,983.36	$ 1,474,073.81
Average annual Rental Cost per ship	$ 32,363.68	$ 33,431.69	$ 34,534.93	$ 35,674.58	$ 36,851.85
Rental Inflation Rate	3.30%	3.30%	3.30%	3.30%	3.30%
Number of CRUDES at PACSOUTHWEST AOR	40	40	40	40	40
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 2)	$1,237,500.0000	$ 1,223,914.20	$ 1,180,209.13	$ 1,138,098.41	$ 1,097,584.54
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Rental/Contract Costs (COA 2)					
Initial Contract Award Cost	$ 1,237,500.00	0	0	0	0
Annual Contract Cost	$ -	$ 1,270,411.25	$ 1,271,640.05	$ 1,272,898.34	$ 1,274,186.83
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 1)	$ 5,601.5820	$ 5,526.0816	$ 5,451.3665	$ 5,377.7011	$ 5,305.3665
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Administrative Cost (COA 1)	$ 5,601.58	$ 5,736.02	$ 5,873.68	$ 6,014.65	$ 6,159.00
Hours per rental cycle	2.1	2.1	2.1	2.1	2.1
Annual amount of boom lift request	126	126	126	126	126
Hourly Wage	$ 21.17	$ 21.68	$ 22.20	$ 22.73	$ 23.28
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 2)	$ 16,090.6000	$ 15,873.7245	$ 15,659.1046	$ 15,447.5000	$ 15,239.7181
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Administrative Cost (COA 2)	$16,090.60	$16,476.77	$16,872.22	$17,277.15	$17,691.80
Hours annually for ongoing contract management	430	430	430	430	430
Hourly Wage	$37.42	$ 38.32	$ 39.24	$ 40.18	$ 41.14
	FY24	FY25	FY26	FY27	FY28
NPV Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,223,914.20	$ 1,180,209.13	$ 1,138,098.41	$ 1,097,584.54
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,270,411.25	$ 1,271,640.05	$ 1,272,898.34	$ 1,274,186.83
Boom Lift Cost	$ -	$ -	$ -	$ -	$ -
Daily Rate	$ 475.00	$ 475.00	$ 475.00	$ 475.00	$ 475.00
Estimated Annual usage (days)					
Inflation rate	0.00%	2.00%	2.00%	2.00%	2.00%
Fuel Cost	$ 428,750.00	$ 442,041.25	$ 442,041.25	$ 442,041.25	$ 442,041.25
Estimated Annual Fuel consumption (gal.)	122,500	122,500	122,500	122,500	122,500
Fuel price (Disel)	$3.50	$3.50	$3.50	$3.50	$3.50
Fuel inflation rate	0.00%	3.10%	3.10%	3.10%	3.10%
Maint Cost	$ 50,000.00	$ 51,200.00	$ 52,428.80	$ 53,687.09	$ 54,975.58
Planned maint hours	500	500	500	500	500
Maint rate / hour	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Maint wage inflation rate	0.00%	2.40%	2.40%	2.40%	2.40%
Personnel Cost	$ 698,750.00	$ 715,520.00	$ 715,520.00	$ 715,520.00	$ 715,520.00
Crew size	13	13	13	13	13
labor days	250	250	250	250	250
Personnel rate / day	$ 215.00	$ 215.00	$ 215.00	$ 215.00	$ 215.00
Personnel inflation	0.00%	2.40%	2.40%	2.40%	2.40%
Facility Cost	$ 60,000.00	$ 61,650.00	$ 61,650.00	$ 61,650.00	$ 61,650.00
Facilities cost base	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00
Facilities inflation rate	0.00%	2.75%	2.75%	2.75%	2.75%

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APPENDIX D. BENEFIT IMPACT CALCULATION WITH 3.8% DISCOUNT FACTOR

Benefit Impact					
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Safety & Risk Reduction (COA 1)	$1,594,112.24	$1,535,767.7356	$1,479,495.5734	$1,425,295.7571	$1,373,168.2867
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Safety & Risk Reduction (COA 1)	**$1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**
Population at Risk	11385	11385	11385	11385	11385
Baseline Injury Rate	0.217%	0.217%	0.217%	0.217%	0.217%
Mitigated Rate	22%	22%	22%	22%	22%
Economic Loss Per Injury	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Safety & Risk Reduction (COA 2)	$1,594,112.24	$1,535,767.7356	$1,479,495.5734	$1,425,295.7571	$1,373,168.2867
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Safety & Risk Reduction (COA 2)	**$1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**
Population at Risk	11385	11385	11385	11385	11385
Baseline Injury Rate	0.217%	0.217%	0.217%	0.217%	0.217%
Mitigated Rate	22%	22%	22%	22%	22%
Economic Loss Per Injury	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Asset Service Life Extension (COA 1)	$ 102,125.00	$ 100,748.5184	$ 99,386.3533	$ 98,043.3257	$ 96,724.5602
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Asset Service Life Extension (COA 1)	**$ 102,125.00**	**$ 104,576.00**	**$ 107,085.82**	**$ 109,655.88**	**$ 112,287.62**
Maintenance Cost/Hour	$ 95.00	$ 97.28	$ 99.61	$ 102.01	$ 104.45
Maintenance Wage Inflation	-	2.40%	2.40%	2.40%	2.40%
Hours Deferred Annual	1,075	1,075	1,075	1,075	1,075
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Asset Service Life Extension (COA 2)	$ 117,325.00	$ 115,743.6467	$ 114,178.7407	$ 112,635.8207	$ 111,120.7738
Discount Factor	1.0000	0.9634	0.9281	0.8941	0.8614
Asset Service Life Extension (COA 2)	**$ 117,325.00**	**$ 120,140.80**	**$ 123,024.18**	**$ 125,976.76**	**$ 129,000.20**
Maintenance Cost/Hour	$ 95.00	$ 97.28	$ 99.61	$ 102.01	$ 104.45
Maintenance Wage Inflation	-	2.40%	2.40%	2.40%	2.40%
Hours Deferred Annual	1,235	1,235	1,235	1,235	1,235

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APPENDIX E. COST IMPACT CALCULATION WITH 4.6% LABOR INFLATION

Cost Impact					
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 1)	$1,294,547.3625	$1,249,810.1358	$1,206,512.3586	$1,164,846.5166	$1,124,570.9101
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Rental/Contract Costs (COA 1)	$ 1,294,547.36	$ 1,337,267.43	$ 1,381,397.25	$ 1,426,983.36	$ 1,474,073.81
Average annual Rental Cost per ship	$ 32,363.68	$ 33,431.69	$ 34,534.93	$ 35,674.58	$ 36,851.85
Rental Inflation Rate	3.30%	3.30%	3.30%	3.30%	3.30%
Number of CRUDES at PACSOUTHWEST AOR	40	40	40	40	40
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 2)	$1,237,500.0000	$ 1,201,693.49	$ 1,124,076.76	$ 1,051,615.49	$ 983,804.81
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Rental/Contract Costs (COA 2)					
Initial Contract Award Cost	$ 1,237,500.00	0	0	0	0
Annual Contract Cost	$ -	$ 1,285,783.75	$ 1,287,012.55	$ 1,288,270.84	$ 1,289,559.33
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 1)	$ 5,601.5820	$ 5,476.0595	$ 5,352.8769	$ 5,233.0580	$ 5,115.6998
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Administrative Cost (COA 1)	$ 5,601.58	$ 5,859.25	$ 6,128.78	$ 6,410.70	$ 6,705.60
Hours per rental cycle	2.1	2.1	2.1	2.1	2.1
Annual amount of boom lift request	126	126	126	126	126
Hourly Wage	$ 21.17	$ 22.14	$ 23.16	$ 24.23	$ 25.34
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 2)	$ 16,090.6000	$ 15,730.0354	$ 15,376.1921	$ 15,032.0111	$ 14,694.8985
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Administrative Cost (COA 2)	$16,090.60	$16,830.77	$17,604.98	$18,414.81	$19,261.89
Hours annually for ongoing contract management	430	430	430	430	430
Hourly Wage	$37.42	$ 39.14	$ 40.94	$ 42.83	$ 44.80
	FY24	FY25	FY26	FY27	FY28
NPV Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,201,693.49	$ 1,124,076.76	$ 1,051,615.49	$ 983,804.81
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,285,783.75	$ 1,287,012.55	$ 1,288,270.84	$ 1,289,559.33
Boom Lift Cost	$ -	$ -	$ -	$ -	$ -
Daily Rate	$ 475.00	$ 475.00	$ 475.00	$ 475.00	$ 475.00
Estimated Annual usage (days)					
Inflation rate	0.00%	2.00%	2.00%	2.00%	2.00%
Fuel Cost	$ 428,750.00	$ 442,041.25	$ 442,041.25	$ 442,041.25	$ 442,041.25
Estimated Annual Fuel consumption (gal.)	122,500	122,500	122,500	122,500	122,500
Fuel price (Disel)	$3.50	$3.50	$3.50	$3.50	$3.50
Fuel inflation rate	0.00%	3.10%	3.10%	3.10%	3.10%
Maint Cost	$ 50,000.00	$ 51,200.00	$ 52,428.80	$ 53,687.09	$ 54,975.58
Planned maint hours	500	500	500	500	500
Maint rate / hour	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Maint wage inflation rate	0.00%	2.40%	2.40%	2.40%	2.40%
Personnel Cost	$ 698,750.00	$ 730,892.50	$ 730,892.50	$ 730,892.50	$ 730,892.50
Crew size	13	13	13	13	13
labor days	250	250	250	250	250
Personnel rate / day	$ 215.00	$ 215.00	$ 215.00	$ 215.00	$ 215.00
Personnel inflation	0.00%	4.60%	4.60%	4.60%	4.60%
Facility Cost	$ 60,000.00	$ 61,650.00	$ 61,650.00	$ 61,650.00	$ 61,650.00
Facilities cost base	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00
Facilities inflation rate	0.00%	2.75%	2.75%	2.75%	2.75%

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APPENDIX F. COST IMPACT CALCULATION WITH 8.34% FUEL INFLATION

Cost Impact					
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 1)	$1,294,547.3625	$1,249,810.1358	$1,206,512.3586	$1,164,846.5166	$1,124,570.9101
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Rental/Contract Costs (COA 1)	$ 1,294,547.36	$ 1,337,267.43	$ 1,381,397.25	$ 1,426,983.36	$ 1,474,073.81
Average annual Rental Cost per ship	$ 32,363.68	$ 33,431.69	$ 34,534.93	$ 35,674.58	$ 36,851.85
Rental Inflation Rate	3.30%	3.30%	3.30%	3.30%	3.30%
Number of CRUDES at PACSOUTHWEST AOR	40	40	40	40	40
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 2)	$1,237,500.0000	$ 1,208,323.55	$ 1,130,272.66	$ 1,057,406.32	$ 989,216.83
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Rental/Contract Costs (COA 2)					
Initial Contract Award Cost	$ 1,237,500.00	0	0	0	0
Annual Contract Cost	$ -	$ 1,292,877.75	$ 1,294,106.55	$ 1,295,364.84	$ 1,296,653.33
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 1)	$ 5,601.5820	$ 5,360.8843	$ 5,130.0760	$ 4,909.7611	$ 4,698.7046
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Administrative Cost (COA 1)	$ 5,601.58	$ 5,736.02	$ 5,873.68	$ 6,014.65	$ 6,159.00
Hours per rental cycle	2.1	2.1	2.1	2.1	2.1
Annual amount of boom lift request	126	126	126	126	126
Hourly Wage	$ 21.17	$ 21.68	$ 22.20	$ 22.73	$ 23.28
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 2)	$ 16,090.6000	$ 15,399.1934	$ 14,736.1943	$ 14,103.3377	$ 13,497.0756
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Administrative Cost (COA 2)	$16,090.60	$16,476.77	$16,872.22	$17,277.15	$17,691.80
Hours annually for ongoing contract management	430	430	430	430	430
Hourly Wage	$37.42	$ 38.32	$ 39.24	$ 40.18	$ 41.14
	FY24	FY25	FY26	FY27	FY28
NPV Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,208,323.55	$ 1,130,272.66	$ 1,057,406.32	$ 989,216.83
Discount Factor	1.0000	0.9346	0.8734	0.8163	0.7629
Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,292,877.75	$ 1,294,106.55	$ 1,295,364.84	$ 1,296,653.33
Boom Lift Cost	$ -	$ -	$ -	$ -	$ -
Daily Rate	$ 475.00	$ 475.00	$ 475.00	$ 475.00	$ 475.00
Estimated Annual usage (days)					
Inflation rate	0.00%	2.00%	2.00%	2.00%	2.00%
Fuel Cost	$ 428,750.00	$ 464,507.75	$ 464,507.75	$ 464,507.75	$ 464,507.75
Estimated Annual Fuel consumption (gal.)	122,500	122,500	122,500	122,500	122,500
Fuel price (Disel)	$3.50	$3.50	$3.50	$3.50	$3.50
Fuel inflation rate	0.00%	8.34%	8.34%	8.34%	8.34%
Maint Cost	$ 50,000.00	$ 51,200.00	$ 52,428.80	$ 53,687.09	$ 54,975.58
Planned maint hours	500	500	500	500	500
Maint rate / hour	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Maint wage inflation rate	0.00%	2.40%	2.40%	2.40%	2.40%
Personnel Cost	$ 698,750.00	$ 715,520.00	$ 715,520.00	$ 715,520.00	$ 715,520.00
Crew size	13	13	13	13	13
labor days	250	250	250	250	250
Personnel rate / day	$ 215.00	$ 215.00	$ 215.00	$ 215.00	$ 215.00
Personnel inflation	0.00%	2.40%	2.40%	2.40%	2.40%
Facility Cost	$ 60,000.00	$ 61,650.00	$ 61,650.00	$ 61,650.00	$ 61,650.00
Facilities cost base	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00
Facilities inflation rate	0.00%	2.75%	2.75%	2.75%	2.75%

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APPENDIX G. COST IMPACT CALCULATION WITH 9% DISCOUNT FACTOR

Cost Impact					
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 1)	$1,294,547.3625	$1,226,274.2291	$1,163,136.4849	$1,101,631.1537	$1,043,644.2579
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Rental/Contract Costs (COA 1)	$ 1,294,547.36	$ 1,337,267.43	$ 1,381,397.25	$ 1,426,983.36	$ 1,474,073.81
Average annual Rental Cost per ship	$ 32,363.68	$ 33,431.69	$ 34,534.93	$ 35,674.58	$ 36,851.85
Rental Inflation Rate	3.30%	3.30%	3.30%	3.30%	3.30%
Number of CRUDES at PACSOUTHWEST AOR	40	40	40	40	40
	FY24	FY25	FY26	FY27	FY28
NPV Rental/Contract Costs (COA 2)	$1,237,500.0000	$ 1,164,967.12	$ 1,070,720.92	$ 982,677.52	$ 902,124.28
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Rental/Contract Costs (COA 2)					
Initial Contract Award Cost	$ 1,237,500.00	0	0	0	0
Annual Contract Cost	$ -	$ 1,270,411.25	$ 1,271,640.05	$ 1,272,898.34	$ 1,274,186.83
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 1)	$ 5,601.5820	$ 5,259.9303	$ 4,945.6423	$ 4,643.3120	$ 4,360.5752
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Administrative Cost (COA 1)	$ 5,601.58	$ 5,736.02	$ 5,873.68	$ 6,014.65	$ 6,159.00
Hours per rental cycle	2.1	2.1	2.1	2.1	2.1
Annual amount of boom lift request	126	126	126	126	126
Hourly Wage	$ 21.17	$ 21.68	$ 22.20	$ 22.73	$ 23.28
	FY24	FY25	FY26	FY27	FY28
NPV Administrative Cost (COA 2)	$ 16,090.6000	$ 15,109.2021	$ 14,206.4067	$ 13,337.9599	$ 12,525.7957
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Administrative Cost (COA 2)	$16,090.60	$16,476.77	$16,872.22	$17,277.15	$17,691.80
Hours annually for ongoing contract management	430	430	430	430	430
Hourly Wage	$37.42	$ 38.32	$ 39.24	$ 40.18	$ 41.14
	FY24	FY25	FY26	FY27	FY28
NPV Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,164,967.12	$ 1,070,720.92	$ 982,677.52	$ 902,124.28
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Op. & Maint. Costs (COA 2)	$ 1,237,500.00	$ 1,270,411.25	$ 1,271,640.05	$ 1,272,898.34	$ 1,274,186.83
Boom Lift Cost	$ -	$ -	$ -	$ -	$ -
Daily Rate	$ 475.00	$ 475.00	$ 475.00	$ 475.00	$ 475.00
Estimated Annual usage (days)					
Inflation rate	0.00%	2.00%	2.00%	2.00%	2.00%
Fuel Cost	$ 428,750.00	$ 442,041.25	$ 442,041.25	$ 442,041.25	$ 442,041.25
Estimated Annual Fuel consumption (gal.)	122,500	122,500	122,500	122,500	122,500
Fuel price (Disel)	$3.50	$3.50	$3.50	$3.50	$3.50
Fuel inflation rate	0.00%	3.10%	3.10%	3.10%	3.10%
Maint Cost	$ 50,000.00	$ 51,200.00	$ 52,428.80	$ 53,687.09	$ 54,975.58
Planned maint hours	500	500	500	500	500
Maint rate / hour	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Maint wage inflation rate	0.00%	2.40%	2.40%	2.40%	2.40%
Personnel Cost	$ 698,750.00	$ 715,520.00	$ 715,520.00	$ 715,520.00	$ 715,520.00
Crew size	13	13	13	13	13
labor days	250	250	250	250	250
Personnel rate / day	$ 215.00	$ 215.00	$ 215.00	$ 215.00	$ 215.00
Personnel inflation	0.00%	2.40%	2.40%	2.40%	2.40%
Facility Cost	$ 60,000.00	$ 61,650.00	$ 61,650.00	$ 61,650.00	$ 61,650.00
Facilities cost base	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00	$ 60,000.00
Facilities inflation rate	0.00%	2.75%	2.75%	2.75%	2.75%

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APPENDIX H. BENEFIT IMPACT CALCULATION WITH 9% DISCOUNT FACTOR

Benefit Impact					
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Safety & Risk Reduction (COA 1)	$1,594,112.24	$1,461,800.9275	$1,342,242.5092	$1,230,654.6522	$1,128,631.4686
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Safety & Risk Reduction (COA 1)	**$1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**
Population at Risk	11385	11385	11385	11385	11385
Baseline Injury Rate	0.217%	0.217%	0.217%	0.217%	0.217%
Mitigated Rate	22%	22%	22%	22%	22%
Economic Loss Per Injury	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Safety & Risk Reduction (COA 2)	$1,594,112.24	$1,461,800.9275	$1,342,242.5092	$1,230,654.6522	$1,128,631.4686
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Safety & Risk Reduction (COA 2)	**$1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**	**$ 1,594,112.24**
Population at Risk	11385	11385	11385	11385	11385
Baseline Injury Rate	0.217%	0.217%	0.217%	0.217%	0.217%
Mitigated Rate	22%	22%	22%	22%	22%
Economic Loss Per Injury	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00	$ 82,724.00
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Asset Service Life Extension (COA 1)	$ 102,125.00	$ 95,896.1920	$ 90,166.2638	$ 84,654.3423	$ 79,499.6385
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Asset Service Life Extension (COA 1)	**$ 102,125.00**	**$ 104,576.00**	**$ 107,085.82**	**$ 109,655.88**	**$ 112,287.62**
Maintenance Cost/Hour	$ 95.00	$ 97.28	$ 99.61	$ 102.01	$ 104.45
Maintenance Wage Inflation	-	2.40%	2.40%	2.40%	2.40%
Hours Deferred Annual	1,075	1,075	1,075	1,075	1,075
	FY24	**FY25**	**FY26**	**FY27**	**FY28**
PV Asset Service Life Extension (COA 2)	$ 117,325.00	$ 110,169.1136	$ 103,586.3589	$ 97,254.0583	$ 91,332.1428
Discount Factor	1.0000	0.917	0.842	0.772	0.708
Asset Service Life Extension (COA 2)	**$ 117,325.00**	**$ 120,140.80**	**$ 123,024.18**	**$ 125,976.76**	**$ 129,000.20**
Maintenance Cost/Hour	$ 95.00	$ 97.28	$ 99.61	$ 102.01	$ 104.45
Maintenance Wage Inflation	-	2.40%	2.40%	2.40%	2.40%
Hours Deferred Annual	1,235	1,235	1,235	1,235	1,235

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