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Leveraging Contracting Strategies with Private Shipyards for Increasing Naval Fleet Operational Availability

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Abstract

A major rethink of NAVSEA's shipyard contracting strategy is required to support the critical need of improving our naval fleet availability. Operational Fleet material availability is reduced when various parts of the "NAVSEA production system" operate at cross-purposes. By increasing alignment between major players (i.e., NAVSEA and the private shipyards), major improvements in delivery performance, cost, and even throughput can be realized. Developing strategies and specific actions to do so is a rich field given the current state of the system. We take an analytical as well as evidence-based approach to propose strategies that can be successful given the peculiar conditions of ship repair and modernization.

Introduction

The Chief of Naval Operations (CNO) availability relies on multiple commands and supporting activities of external organizations to ensure successful planning and execution of naval vessel depot-level maintenance activities, including repair and modernization of the propulsion, electric, and auxiliary plans, and structural repairs, as directed by the CNO and scheduled according to the ship's maintenance plan (Office of the Chief of Naval Operations [OPNAV] N431, 2010; Riposo et al., 2017). Naval Sea Systems Command (NAVSEA) Contracting Directorate, as the lead technical authority, is responsible for establishing performance standards for the accomplishment of all maintenance and modernization during availability periods and ensuring commands and private companies contracted perform repairs and modernization within the authorized scope of work (Caprio & Leszcynski, 2012).

The initial Availability Work Package (AWP) consists of known maintenance actions and ship alterations to be completed during the availability period and identified by the ship crew, NAVSEA, and other supporting engineering commands. During the planning phase, additional work items identified by the crew during work discovery periods are added to the AWP, with oversight and assistance from fleet support pre-availability testing and ship deficiency identification. The final AWP contains planned and unplanned maintenance and planned modernization, as well as other work based on known or expected ship material condition.

The depot maintenance availability schedule considers the nature of the work defined in the AWP as well as the projected private or public shipyard capacity. Ships inducted for maintenance availability must adhere to tight schedules to return to the fleet or otherwise receive authorization to increase deployment length, or defer or reduce ship maintenance. Lengthened operational cycles and deployments, deferred and unplanned maintenance, and the age of the fleet have contributed to the backlog of fleet maintenance availabilities (Riposo et al., 2017). When ship maintenance availability experiences schedule growth to restore capability, training is shortened, eliminated, or deferred, also exacerbating fleet readiness (GAO, 2017).

The backlog of scheduled maintenance activities at the shipyards continues to increase, including “oversight of private-sector activities under the purview of the shipyard, continuous maintenance activity, ship alterations, nuclear equipment disposal, fleet maintenance availabilities, Nuclear Regional Maintenance Department activities, fleet technical support, availability planning activities, and process activities” (Riposo et al., 2017, p. xv). Both public and private shipyards face a number of interrelated challenges maintaining the fleet’s operational availability cost and schedule performance due to unanticipated work requirements, workload-to-capacity mismatch, and workload fluctuations. Given the challenges the Navy and public shipyards face in maintaining the fleet, the case can be made that opportunity exists for leveraging contracting strategies with private shipyards to improve fleet availability. It is no secret that NAVSEA’s relationships with private shipyards is critical to fleet availability, yet is often at odds with the shipyard contracting strategy. Misalignment between NAVSEA and private shipyards greatly impacts cost, schedule, and performance, and thus is a major area of interest.

Consider the following challenges of improving operational availability:

- Procurement of maintenance, repair, and overhaul (MRO) services differs from the procurement of most standard products. Production cycle times are much longer, and volume orders of magnitude lower. Low volume, high variety production complicates assessment of delivery performance as the ship repair and maintenance scope problems are often not known at the time that a contract is signed (Verma & Ghadmode, 2004).
- Uncertainty of ship maintenance and repair operations (MRO) and subsequent target costs mean firm-fixed price contracts that do not allow for scope increase for underestimated or unexpected work and result in delays due to long contract modification cycles associated with approval required for work items, such as issuing required changes to job orders or to address omission of work (SUBMEPP Commander, n.d.).
- Planning for availability to complete expected work, as far out as two years before the start of the availability, makes it impossible to foresee the magnitude of unexpected scope creep that will be identified when problems arise during the execution phase and how initially planned schedules of work will be impacted (Caprio & Leszcynski, 2012). It is also difficult to maintain the requisite infrastructure and necessary workforce capacity under this uncertainty (Buckley, 2015; Martin et al., 2017).
- When projects run behind schedule from delayed work, the amount of available overtime to accelerate completion is limited, and the lead-time necessary for outsourcing of labor with adequate skills and training is significant (Riposo et al., 2017).

- Investments in manpower and infrastructure required to support fleet availability needs are causing private shipyards to demand long-term contracts and Navy incentives (GAO, 2010).

These challenges are not new. Similar challenges affect all capital projects that rely on third party providers, including infrastructure, energy, and healthcare. In this paper, we will present an analysis of observed conflicts in the problem situation, associated assumptions arising in our current system to challenge, and how to do so, with supporting evidence from various system actors. These challenges can be consolidated as a core dilemma for NAVSEA to focus holistic resolution efforts and promote more synergistic contracts between NAVSEA and private shipyards. The research explores critical questions that address appropriate compensation to private shipyards for business and operational risk while improving fleet availability and reducing overall costs for NAVSEA.

Literature Review

Early in this project, the authors became aware of the different history stories and the need to examine a longer span of time than simply beginning at the transition from MS-MO to MAC-MO contract vehicles. Thus, we examine a wider swath of the ship maintenance processes, a review of ship maintenance contract history, human capital management, infrastructure investment, quality assurance and oversight and competition in the ship repair industry. This literature review will examine historical contracting strategies with shipbuilders and contextual aspects of the ship maintenance and repair landscape, including apparent conflicts and misalignment, preventing a more productive naval ship maintenance industry.

History of Private Sector Contracting Strategies With the Navy

NAVSEA awards approximately $24 billion in contracts annually for new construction ships and submarines, ship repair, major weapon systems, and support services (GAO, 2013). Of this, approximately $4 billion is spent annually for depot-level maintenance contracts, much of which is for repair of the nuclear fleet, performed at the four public shipyards in Norfolk (NNSY), Portsmouth (PNSY), Puget Sound (PSNSY), and Pearl Harbor (PHNSY; Riposo et al., 2008). A variety of contract fixed-price and cost reimbursement contracts are utilized, depending on the amount of responsibility each party assumes for the costs of performance risk, when risk is assumed, as well as the timing and amount of incentives offered to the contractor for achieving work at or above a specified standard (Buckley, 2015). Traditionally, cost reimbursement contracts have placed enormous risk on the government in the event that private shipyards are unable to deliver the ship on time and within budget (GAO, 2013).

Until 2004, all Chief of Naval Operations (CNO) maintenance availabilities were conducted under single-ship, firm-fixed contracts written on a ship-by-ship basis and limited by the amount of available funding for scheduled maintenance. This strategy demonstrated excessive cost growth and conflicting objectives between the Navy and industry contractors, both of which were detrimental to fostering a collaborative government-industry partnership (Duncan & Hartl, 2015).

In 2004, Multi Ship Multi Option (MSMO) contracting replaced the old system with hopes of building long-term relationships with contractors, investment in their workforce and facility modernization, and a more reliable, predictable MRO industrial base. The single, five-year contracts reimbursed all allocable, allowable, and reasonable costs expended by the contractors, plus provided the opportunity to earn an extra fee for exceptional management and technical performance. This improved collaboration and ownership, yet required close management to ensure efficiency and cost performance, which the Navy was not adequately resourced to properly provide (Duncan & Hartl, 2015).

In 2010, the Navy concluded that the surface ship force readiness was below acceptable levels, in addition to other issues about cost and schedule performance, leading it to replace MSMO with a new contracting strategy for ship repair, known as Multiple Award Contract, Multi Order (MAC-MO; GAO-17-54, 2016). According to the GAO 2016 report, several lessons were learned from pilot maintenance periods to support modification of contract processes to allow for longer planning windows to finalize work requirements for more stable requirements and pricing (GAO-17-54, 2016). MAC-MO also incorporated the input of commercial ship operators that benefit from a larger competition base (Duncan & Hartl, 2015).

In 2013, MAC-MO was officially implemented. Despite the Navy's initial optimism, cost overruns, delays in completing availabilities, and emergent maintenance issues remain a common problem in ship maintenance contracts. In the National Defense Authorization Act (NDAA) of 2019, the Committee on Armed Services House of Representatives expressed skepticism of the Navy's MAC-MO mechanism as a single-best contracting approach. Its sentiments resonate with the issues identified in the GAO report issued in 2016 (GAO-17-54) that identified apparent delays in renegotiating contracts while vessels sit idle in the yard and third party planning contractors' negligence in obtaining long lead time materials when needed. Utilization of MAC-MO in the maintenance industry implies an increased stakeholder base and a lack of systemic interfacing, which is at odds with federal internal control standards' mandate to evaluate risk responses and progress toward program objectives (GAO-17-54, 2016).

The National Defense Authorization Act (NDAA) of 2019 directed the Comptroller to produce a report to better understand the necessary adjustments to the current ship maintenance and repair process, in particular, assessment of

1. the Navy's execution of the MAC-MO strategy as it compares to the
2. previous Multi-Ship, Multi-Option strategy, with particular emphasis on cost, lost operational days, and on-time completion;
3. the effectiveness of third-party planners in the MAC-MO strategy, including their performance in developing stable, well-defined requirements during advance planning;
4. the adequacy of the Navy's structure for contract oversight;
5. the stability and viability of the ship repair industrial base, including private industry's capacity to recruit and retain critically skilled workers and maintain safe and efficient facilities; and
6. the advantages, disadvantages, or key differences between the MAC-MO and Multi-Ship, Multi-Option strategy depending on the location where the work will be performed.

(NDAA, 2019, p. 91)

Strategizing modernization and repair to quickly increase fleet operational ability as seen in previous eras is no longer possible due to the complexity of modern warships, which are equipped with rapidly evolving advanced propulsion and weapon systems, sensors and radars, and specialized materials for strength, stealth, and acoustics, among other major advancements (Barrett, 2011). The downsizing of NAVSEA in the 1990s and a shift in industry-led acquisition strategies are cited as major contributors to increased cycle time

(Keane et al., 2018). Availabilities now require more preparation, resources, coordination, and competence than ever before.

Shipyard inability to meet the Navy's demand with the current system will be explored in the next several sections, with emphasis on key aspects of the contractual relationship between the Navy and shipyards and the challenges each face.

Human Capital Management

Contract cost is comprised of four main categories: labor, material, contractor overhead, and Navy-furnished equipment, all of which are the responsibility of the Navy (GAO, 2005). A major area of budgeted costs is allocated for contractor labor, including labor hours for production, engineering and other direct support, and costs based on labor hours and the workers' labor rates (GAO, 2005). The 50/50 rule, formally known as 10 U.S.C. § 2466, requires that at least half of all Navy maintenance work be performed at a public depot, meaning shipyards are required to spend a minimum of 50% of all funding received for depot maintenance organically by their permanent workforce (Riposo et al., 2008; Porter, 2016). This limits the amount of money the private sector can receive, although typically much more than 50% is allocated to public shipyards: The average reported workforce composition in 2007 was largely government personnel (NNSY: 90%, PHNSY: 86%, PNSY: 77%, and PSNSY: 86%; Riposo et al., 2008), and more recent data continues to report around 70% (Moore, 2015).

Navy policy requires that depot maintenance be performed in a ship's homeport when possible, based on available internal capacity; otherwise the work may be solicited for open competition in the private sector. Nuclear ship repair also traditionally is allocated to the public shipyards as regulations require public depots to maintain core capabilities. While the intent is to keep the government yards operating at near capacity and to capitalize on efficiencies and other sunken facility costs and overhead, the large volume of business allocated to the public yards has detrimental effects on the ship repair industry as a whole, especially in times of imbalance between shipyard workload and capacity.

Even though the total shipyard workforce is growing, overall workforce productivity has decreased for several reasons. Inexperienced workers often replace experienced ones and represent a large portion of the total workforce: As of 2016, 32% of data on the public shipyard employees had fewer than five years of experience (GAO, 2017). To put this in perspective, personnel with one year of experience, on average, are historically only 25% as productive as those with seven years of experience and achieve approximately one-third the productivity as those with four years of experience, if given accelerated training (Riposo et al., 2017). Shipyards are limited in their ability to hire and train the numbers of people required to replace lost productivity to meet near-term peak demands that are rarely accurately forecasted, budgeted, and resourced.

Depot-level maintenance is forecasted and budgeted by the number of man-days required two years ahead of execution. Year after year, the budgeted amounts for maintenance and repair are consistently below what is ultimately required to perform the work, due to increased operational cycles, unidentified maintenance, unplanned events, and age of the fleet, which also contributes to unplanned maintenance. It is difficult to maintain the necessary workforce capacity when incorrect assumptions from the past surface into the present reality. Take for example, the evolution of the Ohio-Class Maintenance Plan, which was revised to reflect a 13% increase in the required man-days of maintenance over the life of each boat, from the 2004 estimate of approximately 406,000 man-days to the 2007 estimate of 459,000 man-days (Riposo et al., 2017). For a fleet of 18 boats, this means almost one million added man-days. In addition, the estimated time to perform the mid-life engineered refueling overhaul (ERO) was revised from 28 to 33 months (Riposo et al., 2017).

Even with experienced personnel, there remains the learning curve associated with new work services, such as CVN inactivation and support for the new generation ships; the Ford-class CVNs and the Virginia-class submarines also contribute to delays. Peak workloads and under-capacity arising from discrepancy in work packages, evolving maintenance plans, design and engineering issues, inadequate planning and scheduling, production process layout, and training continue to fall on the shoulders of the public shipyard workforce (Moore, 1996). These issues require cautious mitigation strategies, yet are not given adequate consideration in forecasting, budgeting, and contracting. Mitigation for future challenges and risks of boat shortage involves looking at how human capital and workforce planning are managed, as well as looking beyond productivity as the driver of unacceptable performance data.

Infrastructure Investment

Shipyard ability to perform repair, maintenance, and modernization depends on the extent of the available facilities and the complexity of the maintenance requirements. Contracted private shipyards must possess a Master Ship Repair Agreement (MSRA) granted by NAVSEA to perform all aspects of naval shipboard work, from minor to complex repairs and alterations. This certification demonstrates a depot's facilities, management, organization and production capabilities to repair steel, aluminum, and fiberglass hulled vessels for desired capacities. Shipyards are granted MSRA based on the ability to produce integrated (rather than individual) work packages for structural, electrical, electronics, machinery and piping work, installation, integration, and testing (Navy Regional Maintenance Center [NRMC], 2015). Shipyards are also assessed on their competence and understanding of the complex nature of machinery and systems and their ability to subcontract out and provide oversight for work not directly performed (NRMC, 2015).

High capital investment in critical infrastructure is required to maintain specialized equipment, cranes, and drydocks able to accommodate vessels of specified dimensions, rigging equipment, and various shops for structural shop fitting, machinery, piping, electrical equipment and electronics, welding/NDT, sheet metal, insulation, and painting (NRMC, 2015). Many repair activities must be performed in a drydock, such as hull inspection and repair and removal of marine growth. Larger ships, such as the DDG-51, the CG-47, and the LCS-2, are limited to the drydocks to which they may be assigned, exacerbating the already saturated supply of available drydocks, especially on the East Coast, where smaller ships may consume the submarine and carrier docks as a last resort in the future (Martin et al., 2017). The ability of the Navy's public shipyards to support the Navy's readiness needs is continually challenged by capability and capacity constraints in an environment in which public shipyards are in degraded and neglected condition.

Facilities and associated maintenance are contractor overhead expenses (GAO, 2005). For the private sector, decisions to invest are influenced by whether or not properly-structured incentives are provided to increase investment in critical infrastructure to support the needs of the future fleet (Martin et al., 2017). For that reason, the supply of drydocks available for depot maintenance are largely subject to government influence through decision making to invest in public shipyards (Martin et al., 2017). It has been suggested that the government needs to do more to directly support the domestic ship maintenance industry, given the forecast of reduced defense spending and lack of partnerships with commercial shipyards (Moore, 2015).

Quality Assurance and Oversight

Although the Navy and leading commercial buyers agree that quality is the responsibility of the contractor, the Navy routinely accepts ships not meeting quality criteria that are later addressed following delivery, resulting in increased costs and disruption to availability (GAO, 2013). Accepting ships with known deficiencies can interfere with the command maintenance plan for other maintenance and repair activities, as well as upgrades and crew training.

This issue is far less common for the commercial ship industry, where risks to quality belong to the contractor, as does the premium paid to transfer this risk (GAO, 2013). The payment structure in commercial ship buying is also structured to enforce timely correction of deficiencies. Instead, the commercial shipyards are expected to deliver a defect-free (or nearly so) vessel at delivery and are incentivized to provide timely correction of deficiencies by contract and payment structure (GAO, 2013). In contrast, the Navy typically assigns less cost risk to contractor quality problems under cost-reimbursement and fixed-price incentive contracts and pays a significantly larger proportion of the total cost upfront.

Commercial shipyards producing and maintaining oil production storage and offloading vehicles, large cruise ships, gas carriers, and offshore oil drilling ships and the buyers they serve operate in an environment vastly different from the Navy in terms of oversight and quality assurance. Commercial firms are substantially more effective in resolving quality deficiencies before delivery of ships, potentially by their differences in practice that could benefit the Navy, including (GAO, 2013)

- contracting approaches that place cost risk associated with addressing quality problems on the shipbuilder,
- incentives for timely resolution of problems,
- oversight processes with clear lines of accountability, and
- emphasis on observing in-process work.

In 2007, Supervisors of Shipbuilding, Conversion, and Repair, Puget Sound (NAVSEA's SUPSHIP Command), as the responsible authority for procurement and administration of new construction and ship repair contracts with private sector shipyards, drew to light the lack of resources needed to improve quality as identified in quality assurance inspections. In 2009, the Back to Basics effort was initiated. The program identified key quality assurance goals and developed a means to help SUPSHIP improve communication with program offices to enhance quality assurance and oversight. NAVSEA also introduced many standardized operating procedures across SUPSHIP's locations. The GAO found significant variation in SUPSHIP locations with respect to commercial practices, like the use of design drawings and random inspections, as the Navy had not defined the role they should play (GAO, 2013).

Designated classification societies surveying to monitor rules, regulations, and statutory requirements are often incorporated in commercial shipbuilding contracts to provide a robust oversight process, provide engineering services for the development and testing of new technologies, and provide technical assistance to reduce potential risks to quality such as by attending and witnessing inspections (GAO, 2013). Leading commercial ship owners reported that these services are never used as a substitute for their own oversight and quality assurance processes, as their rules may not consider their buyer-specific technical requirements.

SUPSHIP's quality assurance department is closest to the work being performed, but has limited influence on the shipbuilder and on early contracting decisions made early with respect to quality (GAO, 2013). As of 2013, a standardized quality performance standard, proposed by SUPSHIP, had not been incorporated in any shipbuilding contract (GAO, 2013). At the time of the report, the Navy had shared its intent to establish a quality team within the NAVSEA Logistics, Maintenance and Industrial Operations Directorate (previously NAVSEA 07, now 04) to promote attention to quality assurance; however, the roles, responsibilities, and authorities of the team had not been defined. The GAO suggested that the hypothetical team, if given sufficient authority and tasked with elevating SUPSHIP quality assurance concerns throughout the acquisition process, may be conducive to enhancing contractor performance and contract requirements for managing quality. It was indicated that diffused responsibility for quality in the Navy program offices, NAVSEA, SUPSHIP, INSURV, and others may be due to distraction from or supersession of competing roles and distraction with concerns for monitoring schedule, costs, or other strategic needs (GAO, 2013).

In the NDAA of 2019, the Committee directed the Under Secretary of Defense for Acquisition and Sustainment to provide a briefing by December 1, 2018, on the feasibility of the DoD's Superior Supplier Incentive Program, designed to provide contract incentives for superior contractor performance in terms of cost, schedule, performance, quality, and responsiveness (NDAA, 2019, p. 192). Previously, the Secretary of Defense was directed to conduct a review of the extent to which sustainment matters are considered in decisions related to the requirements, acquisition, cost estimating, and programming and budgeting processes for major defense acquisition programs (NDAA, 2017). The report was to include an assessment of private sector best practices in assessing and reducing sustainment costs over the lifecycle of complex systems and the organic industrial base's capabilities, capacity, and resource constraints as required by the materiel commands (NDAA, 2017). The story of how these lessons will be used to inform decisions to modify contracting policy to shape the future of defense procurement is not yet known and is constrained by intricate complexities in the relationship between the Navy and its industrial base, as discussed in the next section.

Competition

Contracting relationships also have implications for the competition within the environment. Besides the key differences between commercial and defense shipbuilding oversight and operating practices, there are also some differing contextual factors worth noting, especially with respect to competition. Measures taken for ensuring quality to protect reputation are critical to remain viable in the commercial shipbuilder's competitive environment; thus, they are pressured to meet contracted delivery dates and deliver on schedule.

The Navy's shipbuilding industrial base is vastly limited in comparison to the number of qualified commercial shipbuilders, that are also reliant on the Navy to remain in business. This codependency enables quality deficiencies and performance variances as the Navy has an interest in sustaining its limited shipbuilding base.

MAC-MO contracting has been criticized by former MSMO contract holders for introducing competition and uncertainty that could result in decisions to reduce their workforce and facilities (GAO-17-54, 2016). The previous strategy did not require the MSRA certification for noncomplex availabilities. As of March 2016, it was unclear how NAVSEA would handle the assignment of noncomplex availabilities to smaller businesses without the certification, as no indefinite delivery, indefinite quantity (IDIQ) contracts had yet been granted (GAO-17-54, 2016).

Horns of a Dilemma: Analyzing Ship Availability Contract Performance Using Goldratt's Conflict Cloud

This section discusses the current state of knowledge with respect to what has been reported as challenges in the current system, the needs of the Navy and private shipyards in addressing these challenges, and how the approaches to address needs and overcome challenges create seemingly intractable dilemmas.

Dr. Eli Goldratt, inventor of the Theory of Constraints, argued that complex systemic problems can be analyzed by understanding the dilemma that is preventing organizations from solving those problems. These dilemmas, he posited, are caused by trying to satisfy two valid underlying needs that are both necessary to achieve the overall goal but seem to conflict with each other. He suggested that instead of compromising on either of the needs, organizations should resolve the dilemma by identifying and challenging various assumptions that put those needs in conflict.

The Conflict Cloud, popularized by Dr. Goldratt, offers a way to approach complex problems through uncovering the perceived sources of the problem, examining them from the perspective of conflicts between the sources and mitigations, and then surfacing the unspoken assumptions. It is this step, the surfacing of unspoken assumptions, that frequently provides a path to a breakthrough change in the conditions and an improvement in the situation. The conflicts are often represented in a specific way, called a conflict cloud. A generic conflict cloud follows, adapted from Smith (1999 Figure 1).

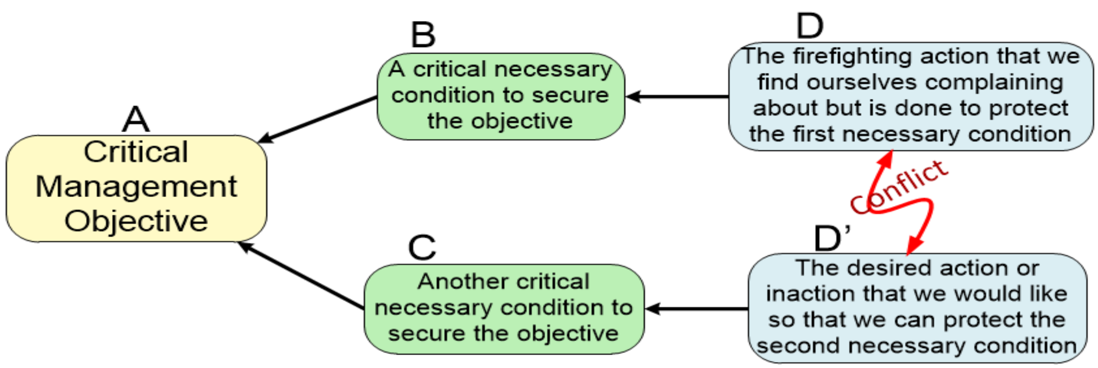

Figure 1. Generic Conflict Cloud
(Adapted from Smith, 1999)

Beginning on the left-most box of Figure 1 the presumed common goal is presented. The next two boxes to the right (B and C) present two apparent needs that must be accomplished to achieve the goal. The final two boxes (D and D') present two wants that must be accomplished to meet the needs. These two wants are often in opposition with each other, by mutual exclusion or due to resource contention (Andersen & Gupta, 2013). Conflict within the context of naval ship maintenance and modernization presents challenges to confront the current system and identify strategies to improve contractual relationships between NAVSEA and private shipyards.

We use the conflict cloud as a starting point to engage participants from an outsider perspective of the current landscape of the relationship between the Navy and private shipyards. From our perspective as experienced practitioners and with contextual evidence as framed in the literature review, we generated the "prototype" conflict cloud shown in Figure 2.

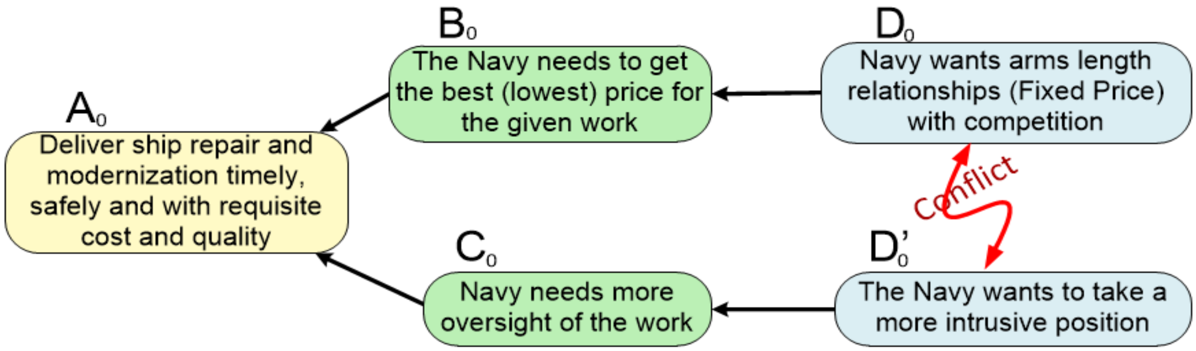

Figure 2. Initial Conflict Cloud Perspective

This conflict cloud was used as an entry point into semi-structured interviews, as discussed in the Research Approach section. In this example, the conflict is an internal one for the Navy, but also crosses organizational boundaries. The goal of the authors was to first identify a conflict from an external perspective, with the hope of identifying other conflicts, to be able to refine the initial interpretation of underlying conflict and articulation of the stakeholders' competing needs. The Three Cloud approach (Smith, 1999) facilitated this effort by guiding exploration of additional conflict themes that emerge in the analysis. By exposing additional conflict and assumptions, this approach supports communication among stakeholders with competing objectives without creating resistance as assumptions are surfaced. It also supports continuous improvement by analysis of the reinforcing loop where perception of an inability to change current processes is embedded.

Research Approach

Methodology

Taking a systems-based approach, we aimed to develop a rich picture from various perspectives by asking the following questions:

1. Does the perspective of the conflict as articulated make sense?
2. How would you resolve the conflict you see?
3. Do you have anecdotes that you would be willing to share?
4. What most frustrates you about the current situation?

A phenomenological research design involves a researcher's inquiry into the lived experiences of individuals about a phenomenon as described by participants (Creswell, 2013), in this case, challenges in aligning the goals of NAVSEA and private shipyards. A group of 30 individuals were solicited for input based on their experience and perspective and invited to participate in semi-structured interviews lasting from 30 to 60 minutes. Ten respondents representing both industry and the Navy responded, and eight individuals were interviewed or provided significant responses. The respondents included representation from a variety of MSRs, as well as both current and former Navy officials responsible for the execution of both the former and current contract strategies.

In order to encourage open responses, the respondents have been granted anonymity, and some discussions of the responses may be altered to prevent specific language from being used to identify the specific respondents. Responses to the questions and other input relevant to the topic were documented from each interview and processed in the analysis.

Interview Results

The respondents were remarkably open about the current situation and their individual and organization's role in the history that led to today's situation. The overwhelming fraction of respondents began by addressing their own shortfalls rather than seeking to cast blame on a different participant. Thus, quotes included,

> "We lost over half our contracting officers, and thought that was okay, and we could not replace them anyway."
>
> "The MSMO contracts assumed that our performance would improve over the contract, and to be honest, it did not."

Beginning with these comments to set the stage, we explored the circumstances around the previous contracting strategy and how it did not lead to the desired results of improving availability performance with delivery times that met the Fleet's needs. Comments here focused on the following:

- Understanding of the ship's material condition was poor.
- The ability to respond to emergent material problems was highly variable.
    - One maintainer was able to persuade the board to purchase repair parts that were expected to be consumed over several availabilities; however, this was not adopted broadly, and the accuracy of forecasts varied.
- Not all participants (Navy and industry) understood the business.
- Simplicity was favored.
- Availability costs were higher than budgeted. A variety of reasons were provided:
    - Unlike carrier or submarine programs, the engineering planning activity had been disestablished under BRAC, thus dissolving the capability to maintain class maintenance plans centrally.
    - Regional or even single port engineers could use different approaches to maintain their ships.
    - Poor cost control—loss of experienced personnel on the government side exacerbated this factor.

These comments set that stage for the transition from MSMO to MAC-MO. Those respondents that covered the transition used language like

> "The cure is worse than the disease."
>
> "The current [MAC-MO] model is win-lose."

"Hey, sorry that spec was bad, but tough, use an REA[1] at the end."

Rather than dwell here, we transitioned to developing other potential conflict diagrams. Several respondents accepted the draft conflict diagram in Figure 2, suggesting minor adjustments or clarifications. Others, especially those familiar with the cloud method, presented additional conflict diagrams.

One respondent was focused on the business arrangements and the differences that arise between the Budgeted Work Package and the Actual Work Package, especially as the availability progresses and modifications are made (i.e., contract changes) to the work package (Figure 3).

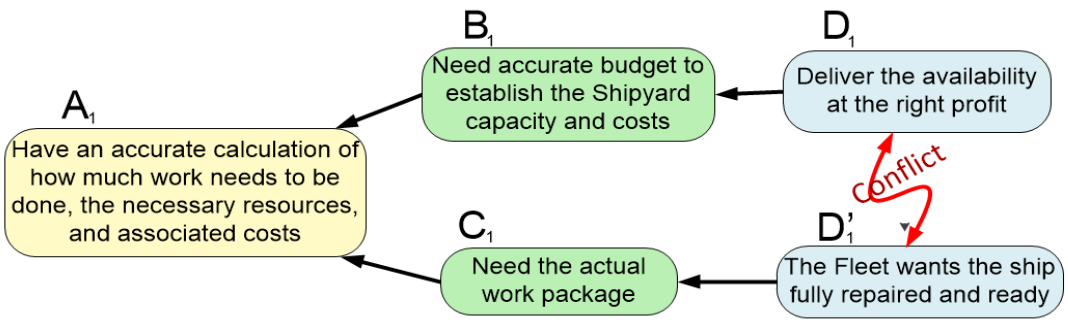

Figure 3. Conflict Cloud Focused on Work Packages

Another cloud (Figure 4) was developed from the perspectives of retaining/permitting a robust ship repair industry while delivering repairs at the lowest price.

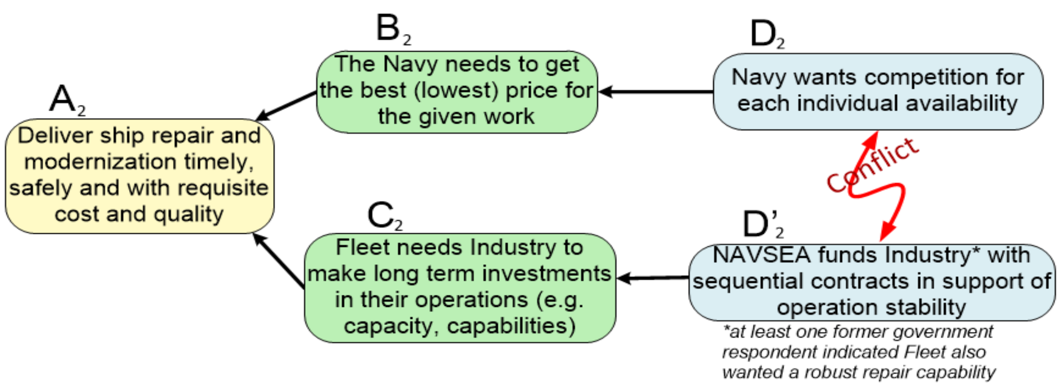

Figure 4. Conflict Cloud Focused Between Pricing and a Robust Industry

[1] REA (Request for Equitable Adjustment)—Under CFR and the FAR, a contractor can submit for an equitable adjustment to the terms of the contract item, in terms of costs, markups and time for completion.

Another respondent cast the conflict by capturing the different organizations that had different goals (Figure 5). This respondent noted that while the Fleet would like lower prices, there is a much greater emphasis at the Fleet on having operable ships that can respond to its changing needs.

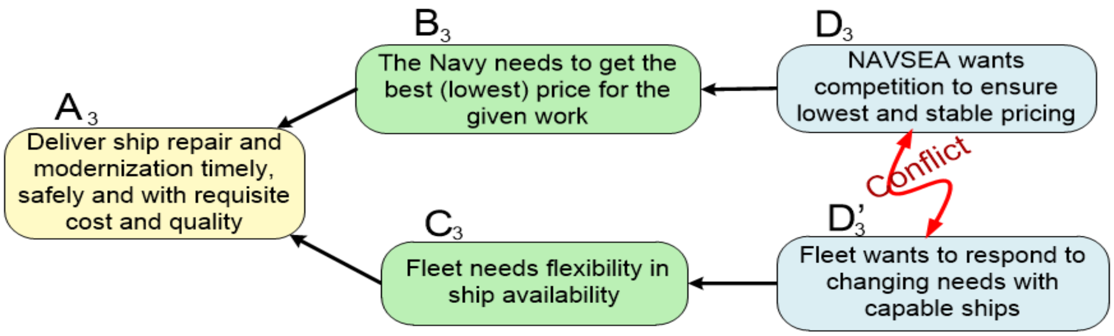

Figure 5. Conflict Cloud Focused on Pricing and Fleet Availability

The interviewees looked forward to evolution from the current contracting system, with improved strategies to facilitate a symbiotic relationship between the government and industry and the emergence of a more mutually beneficial procurement environment.

Core Conflict Cloud

The Three Cloud Approach (in this study, "Four Cloud") facilitated the exploration of additional conflict themes that emerged in the analysis. Using this approach, the core conflict was synthesized from four specific conflict clouds which, when combined, convey a fundamental issue leading to undesirable effects in the contracting environment. The core conflict cloud (Figure 6) shows refinement of previously identified conflicts and expresses two core wants (entities D_c and D'_c) that are prerequisite to satisfying opposing parties' core needs (entities B_c and C_c), both of which must be met to achieve the common goal (entity A_c).

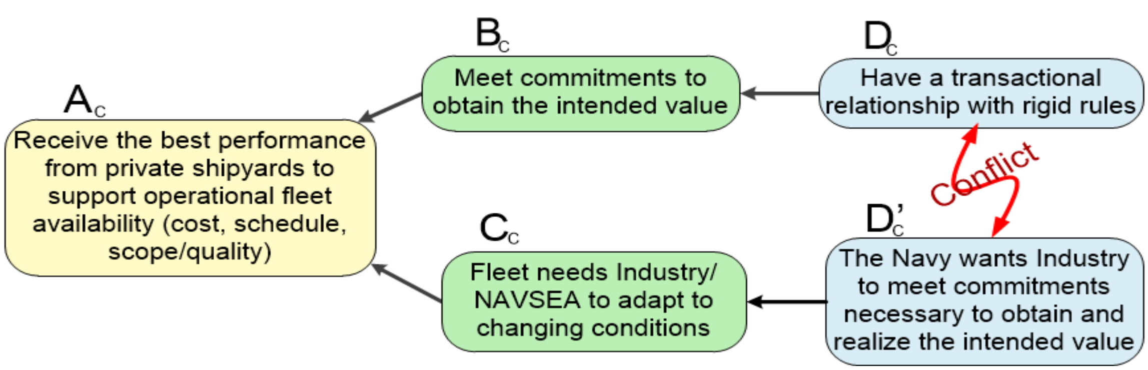

Figure 6. Core Conflict Cloud

Language Analysis

We used the transcripts of the conversations and the Qualitative Analysis tool Nvivo® to examine the language of the respondents. Nvivo® has the capability of analyzing language for similarity by the speakers. We limited the analysis to words five letters or longer and allowed synonyms (using a built-in dictionary) to group the respondents by the similarity of the words they used (Figure 7).

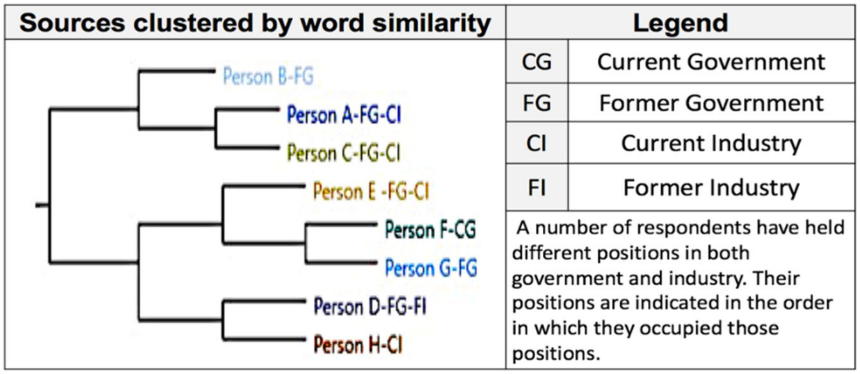

Figure 7. Respondents Clustered by Word Similarity

The groupings are not surprising. Person F worked for Person G, and E, F, and G are all close in their relative seniority within their community. Likewise, A, B and C are very close in their seniority and careers within the industry. As far as the authors know, D and H are unknown to each other, but use similar language. This analysis supports an evolving hypothesis that government and industry are not as far apart as might otherwise be expected.

A second part of the language analysis was to use another Nvivo® functionality and examine the frequency of word usage among the respondents. In this analysis, we searched the transcripts for words over five letters long and used synonyms to build a word cloud limited to the top 50 words, where the size of the font indicates the relative importance of the word. The word cloud and relative word frequency are illustrated in Figure 8.

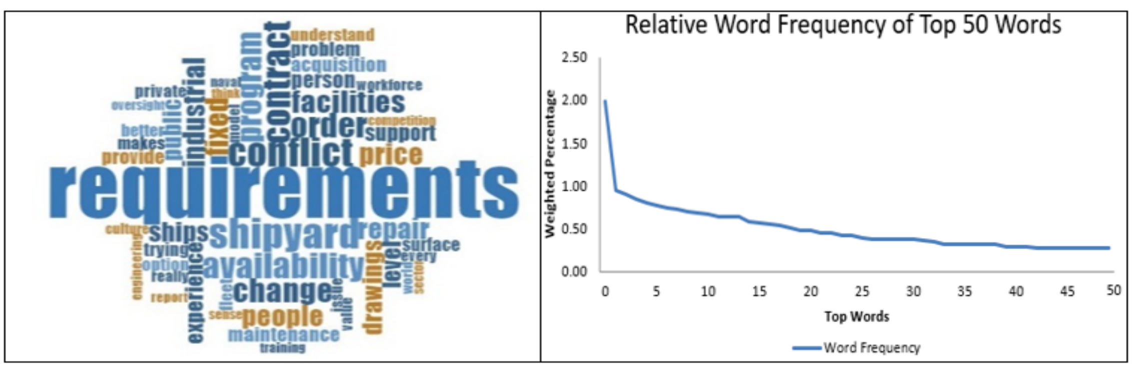

Figure 8. Word Cloud Representing Top 50 Words in Respondent Conversations and Respective Relative Word Frequency

The significant break between Word 1, "requirements," and all the other words led us to extend the search to consider the top five words used by the respondents, which are Requirements, Shipyard, Conflict, Contract and Availability (meaning either the ship repair period or the operational availability, as we did not distinguish the two dominant meanings in this industry). We elected to not to filter or censor words like "shipyard" and others commonly expected to arise, as it confirmed the focus of the respondents and was leveraged to develop recommendations.

Inductive Generation of Contracting Strategies

During the interviews, many respondents answered Question 2, "How would you break the conflict?" with recommendations (Table 1). The majority responded with one or two ideas based on the original conflict cloud, or a new cloud surfaced during the interview.

Table 1 Participant Recommendations for Contracting Strategy Reform

Participant and Role		Recommendation(s)
A	Former Government Current Industry	Hybrid contract—some elements of fixed price, some elements of MSMO Stability and predictability are needed, but also compromise and negotiation.
B	Former Government	(none provided)
C	Former Government Current Industry	Change perspective from transactional and optimizing locally. There can be a mutually compatible, win-win approach to value the total system.
D	Former Government Former Industry	Establish a flexible reserve managed close to the waterfront to handle new work, as part of an overall reserve, to mitigate lack of scope understanding at the front end.
E	Former Government Current Industry	Change the level of trust: allow a threshold above a fixed price to prevent 30-45 day delays to execute contract changes.
F	Current Government	Develop a mechanism to have a backlog for industry to invest; renew experience in both private and government participants; look at how to allow industrial investment for horizontal building of industrial base.
G	Former Government	Contract for a level of effort each year with Option Years for good performance (similar to Naval Shipyards) to generate a backlog to sustain workforce, training, and facility improvements.
H	Current Industry	Utilize a hybrid approach of fixed price for reasonably quantifiable work, and time and materials or cost-reimbursable for the rest. Figure out how to level playing field by using pilot projects with independent teams to identify work needed, including implied but not articulated, to improve requirements analysis.

One respondent began the interview with the statement, "Everybody has a silver bullet, and there is none!" This statement provides an excellent starting point to begin defining characteristics of the solution space. Given the complexity of the problem, the total system at large must remain the focus of the solution set, with more local or detailed elements admitted to the set based on their support of the global system rather than a focus on local optimization. The solution space must also consider constraints and underlying assumptions applied from the system environment, which may not be limited to the industry side of the equation (e.g., contracting officers).

It was generally agreed by participants that well-understood work items should be contracted as fixed price elements, with different treatment for uncertain items within the contract vehicle. An existing assumption is that a contract vehicle is required to be either transactional (fixed price) or highly collaborative (cost reimbursable). An associated assumption is that a fixed price contract improves contract performance for the Navy by transferring risk. In reality, the "contract type" is applied at the contract line item number (CLIN; Braxton et al., 2017). Contract forms can distinguish cost reimbursable items and provide caveats to incentives. There also exists the potential to develop a new contract form or utilize alternative contracting mechanisms used in other defense programs, such as multi-year procurement (MYP) or block-buy contracting (BBC), which Congress permits the DoD to use for limited programs, yielding significant reduction in cost (O'Rourke & Schwartz, 2017).

At a high level, constraint-based, pipelined availability scheduling provides stability and improves shipyard ability to provide the fleet responsiveness. Using a contract that purchases capacity over a multi-year period could include features of negotiated operating (facility, or fixed costs), material fixed price cost, a cost buffer (as discussed earlier), and a combination of "over" and "under" share ratios tied to delivery performance, known as a shareline. Use of higher tier schedules is based on constraints, an obvious one being the number of available drydocks and the unwillingness of industry to invest in expanding drydock capacity.

Associated with the change in contract form, the use of a reserve (buffer) with a share of the portion allocated to the rapid resolution of straightforward, relatively simple problems would hasten the ability of the shipyard to execute work revisions when a small problem is encountered and bypass the contract modification cycle. A data records system that allows recording, sharing and reviewing of these contract changes (Graham et al., 2018) would also enhance efficiency in these situations. A share of the cost buffer can be reserved for the more significant issues that require longer timelines to resolve, and the processes should incorporate agility as well as accuracy.

Ackroyd (2018) has defined collaborative contracting as one with a focus "on the desired outcomes of greater integration and therefore collaboration of the parties to an agreement. That subset of agreements where success for one is inextricably linked with the performance of all" [emphasis in original]. The collaborative contracting approach enables two parties with different motivations to achieve a mutually beneficial outcome. ISO 44001:2017 specifies requirements for this form of contracting to effectively identify, develop, and manage collaborative business relationships within or between organizations, facilitated by an adoption of leading behaviors to reduce barriers and build consensus (Ackroyd, 2018). The uncertainty and need for collaboration in ship maintenance procurement requires a view of contract form through multiple lenses as a key enabler of value.

The set of strategies inductively generated challenges the current contracting status quo and can be used directly to improve ship availability performance. This strategy set can also be used in other DoD environments with shared industry and government governance.

Limitations, Future Research, and Conclusion

Class maintenance plans are developed under assumptions about workloads and capacity, but without a static workload demand, are based on imperfect knowledge. "Those who are involved with executing this work believe the increase in duration is a result of executing with insufficient resources," explains Riposo et al. (2017, p. xv).

Shifting to a more collaborative, hybrid contracting regime offers the potential for long-term viability of the industry with improved performance meeting the Navy's needs and is in coherence with the Agile Manifesto's core value of *collaboration over contract negotiation* (Beck et al., 2001).

Addressing the core of conflict preventing a more collaborative environment to improve a present situation requires a critical look at three separate issues, known as "the layers of resistance" in the theory of constraints: (1) "What to change?" (2) "What to change to?" and (3) "How to cause the change?" (Goldratt, 1984). Clear identification of the problem, the solution, and how to implement the solution should be understood by the agents of change to find the necessary buy-in from key stakeholders. From a governance perspective, the repeated cycling through contract strategies implies that a system is not well-regulated. Examination of possible improvements in the complex system governance structures can assist in damping the oscillations of contract policy.

Three areas limiting this study also offer the opportunity to conduct future research on collaborative contracting:

1. The research approach was inherently qualitative, although the authors recognize that recent efforts have pushed for improved data availability to explore defense contracting geometry strategies with data-driven approaches (Braxton et al., 2017).
2. The authors' contact set did not reach two critical sets of stakeholders, contracting officer and Congressional staff. An interesting extension would be to expand the set of stakeholders and engage them for insights on expanding the core conflicts. This would offer the potential for identifying more conflicts that could be used to improve the collaboration recommendations.
3. At the start of this research, the Navy's efforts to improve the surface ship maintenance construct was largely invisible to the authors. The extensive Navy efforts, including the Private Shipyard Optimization Initiative (PSO) and the Private Sector Improvement Program (PSI) are now recognized to exist but did not inform our recommendations. As such, understanding how those efforts address the core conflicts also are of research interest.

In conclusion, the authors truly appreciate the generosity and openness of those current and former participants in the surface ship community. They shared their knowledge openly and extensively. Any errors or mischaracterizations are the fault of the authors. We look forward to learning of the success in the community in this critical endeavor.

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