Private Shipyard Contracting Agility to Improve Fleet Operational Availability

Mason Beninger, BA, CTFL, ITIL, Joseph M. Bradley, PhD, PE, Kaitlynn M. Castelle, PhD, PMP, CSM, Sanjeev Gupta

Abstract

Naval Sea Systems Command (NAVSEA) faces challenges in reforming shipyard contracting strategies to support the critical need of improving naval fleet availability. Operational Fleet material availability is reduced when actors of the "NAVSEA production system" operate in conflicting roles, regarding monitoring of quality, schedule, costs, and other strategic needs. Addressing the conditions of ship repair and modernization requires increased system-wide alignment to improve delivery performance, cost, and throughput. Increased agility in procurement and acquisition is explored as a strategy for improving requirements flexibility, data records sharing, management of risk at appropriate levels, and policy collaboration. This paper proposes strategies to increase alignment between NAVSEA and private shipyards, supported by an analytical, evidence-based approach.

Introduction

NAVSEA downsizing in the 1990s and a shift in industry-led acquisition strategies are often cited as major contributors to increased cycle time (Keane et al., 2018). Increasingly complex modern warships with their rapidly evolving advanced propulsion and weapon systems, sensors and radars, and specialized materials for strength, stealth, and acoustics, among other major advancements, also have made it difficult to strategize modernization and repair for increasing operational availability (Barrett, 2011).

Modern depot maintenance periods (also known as "availabilities" involve more preparation, resources, coordination, and personnel competence than ever before. Despite efforts to plan availabilities in accordance to prescribed maintenance identified in Class Maintenance Plans (CMP), Technical Foundation Papers, and as directed by the Chief of Naval Operations (CNO) (OPNAV N431, 2010; Riposo et al., 2017), significant deviations from established baselines have become the new normal. A 2018 RAND study on accounting for growth in ship maintenance accounts revealed that in nearly every category of maintenance organized by ship work line item number (SWLIN), roughly around one third of the total work performed during availabilities was unplanned, and thus a significant proportion of work done was discovered during the availability (Martin et al., 2018).

S2S Work Package Formulation Process

The ship-to-shore work formulation process (Figure 1, a detailed in Chapter 7 of *JFMM*) lends itself to critical analysis and is of recent Navy interest because of the numerous opportunities for the best case scenario to not to play out because of the many layers, steps, and complex decisions required in creation of work packages. In Step 1, the initial work package is triggered first by ship personnel generating a causality report that is then categorized from least impactful on ship operations to profoundly critical where there is a danger to the ship or personnel. On the IS side, the causality reports are transferred from the ship-based system for recording and transferred to the shore-based Regional Maintenance Automated Information System (RMAIS). After insertion into the shore-based system, the causality report is considered a work candidate.

The work candidates run through a three-tier validation process where different teams review each work item to determine validity (Step 2). Once the candidates are vetted, a screening and brokering process organize, decomposes, analyzes, re-categorizes, and compiles into "brokered" work items. The screening process tries to group work items into logical associations, such as their relation specific sections, or certain types of work, to increase efficiency and time savings during the execution of the work. Following the work brokering, additional project information is added, such as working hour estimations and cost estimates. The additional information becomes the basis for a Letter of Authorization (LOA) to address the brokered items (Step 3).

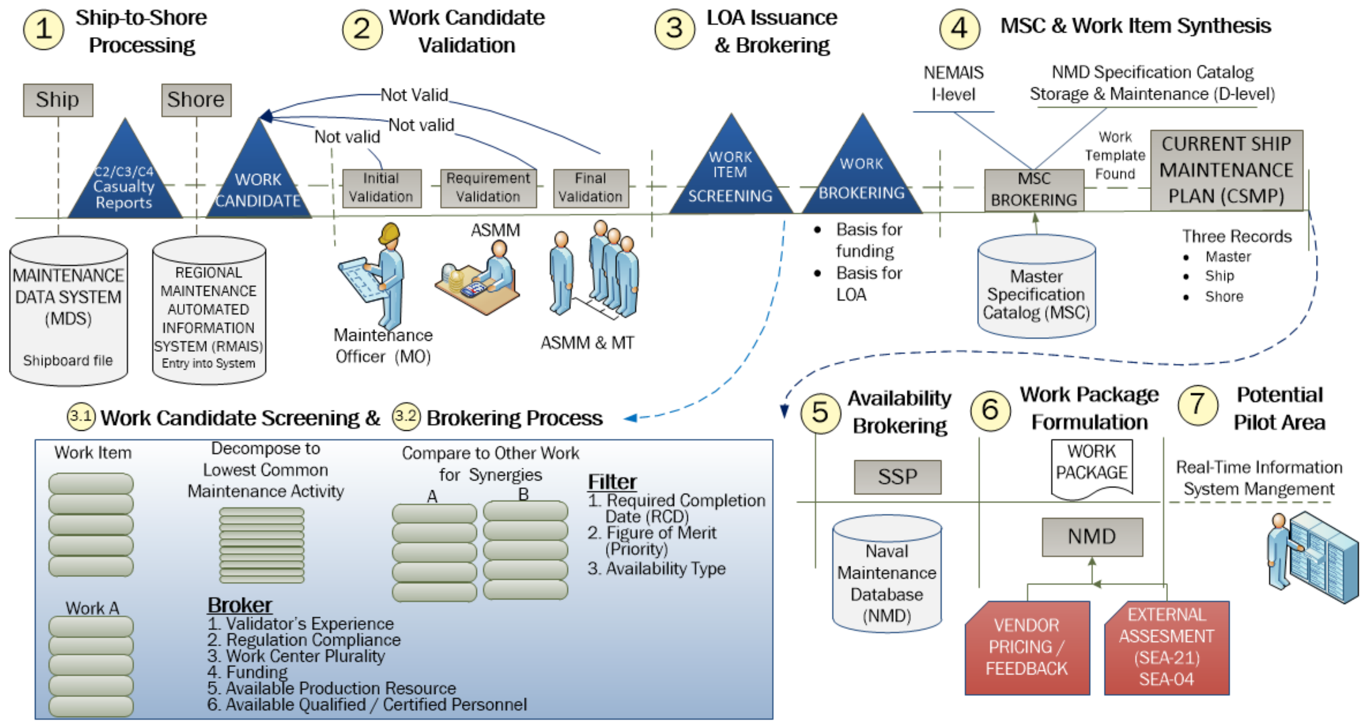

Figure 1: NAVSEA Ship-to-Work Package Simple Overview

An initial Availability Work Package (AWP) consists of identified ship deficiency information, known maintenance actions, and ship alterations planned for completion during availability, as identified by the ship crew during a discovery period, NAVSEA, and other supporting engineering commands. In Step 4, the synthesized work items (from ship) are compared to the brokered work item (from shore) to an appropriate item within the master specification catalog (MSC), which serves as template repository for standard repair item requirement verbiage. The goal is to reduce ambiguity, reduce processing times, and reduce the need to make changes during an availability execution. If a match is found, the matched item is inserted into the Current Ship Maintenance Plan (CSMP). Among many data sources and databases, the CSMP serves as a record of deferred, planned, and completed work item repairs (CNRMC, 2013). The CSMP exists in three locations; on-ship, on-shore, and a master version.

Next, the availability is brokered or scheduled to the correct type of availability (intermediate or depot), for example, deferment of work items to D-level if a specific capability or level of effort is required, or schedule in I-level. The Ship Specification Package (SSP) created for all CNO directed availabilities and lives within the Naval Maintenance Database IT system. The SSP is designed for the planning activity to map work items to budgeting funds based on milestones relational to the time from the creation of the work package, to contract award, to availability execution start date (Step 5).

Overlapping from the SSP, the work package is formulated in NMD (Step 6), where NAVSEA activities and industrial partners can input project and engineering data into the work package. Finally, the work package is sent to third-party planners and contracting to begin the contracting process. Finalized AWPs consist of planned and unplanned maintenance as well as any other work based on known or expected ship material condition.

No single agency is responsible for the state of the fleet and the availability planning and execution cycle. Successful planning and execution of these availabilities rely on coordinating efforts of multiple commands and supporting activities of external organizations, yet more often than not, unplanned work arises and prescribed maintenance is deferred to meet mission objectives by returning to the fleet and make room for other ships. Combined with the reality of lengthened operational cycles and deployments for an aging fleet and prior sequestration, the result is a significant backlog of maintenance availability work. Reducing this availability backlog without improved processes or an increase in capacity in private yards continues to be a major challenge for the Navy (Martin et al., 2018).

Data Management Impact on Availability Planning

In this section, we discuss business processes that affect naval fleet availability are examined; availability contract change management and contract data requirement list (CDRL) data management.

A contract data requirement list is a "is a list of authorized data requirements for a specific procurement that forms part of a contract. The CDRL provides a contractual method to direct the contractor to prepare and deliver data that meets specific approval and acceptance criteria. The CDRL is the standard format for identifying potential data requirements in a solicitation, and deliverable data requirements in a contract" (DAU, 2017, n.p.). Deliverables defined in a Contract Data Requirement List (CDRL) provide the government a mechanism to understand actual costs for negotiations on future performance-based logistics (PBL) contracts (Ewer, 2015). Both on-shore contract administration and executive level surface ship availability planning are challenged by the management of CDRL data; in fact, the governance of CDRL data as whole plagues many government programs besides MRO, including construction. As an example, consider the oversight demands of the CVN 79/80 construction program at Newport News Shipbuilding, where voluminous amounts of CDRL data are obtained on a weekly basis, consuming resources to track, reducing the ability to properly align and maintain monitoring of the program.

> "Too many metrics make it difficult to manage and may also work at cross purposes to each other. Also, data must be available for the metric. There have been occasions where metrics were required as part of an arrangement without the ability to collect the data to determine performance against the metric" (ASD (L&MR) 2014, 114).

Accessible, manageable data in a useable form is necessary to manage current and future contracts, yet procurement of data via Statement of Work are often unused, rendering the CDRL package and Procurement Initiation Document (PID) of little value since they are interrelated (Adams, 2016). Excessive manpower spent managing spreadsheets hardly inspires human innovation; in fact, it is wasteful and degrading, especially when data collected and subsequent program office analyses for cost and schedule estimation are not managed properly, as will be discussed in this paper's case studies. Program offices need to involve the right people and appropriate data management tools to streamline their business processes of developing work packages to solicit proposals, or otherwise suffer from the hampering of the well-intentioned contracting system and policy (Adams, 2016).

As a best practice identified in the GAO's Cost Estimating and Assessment Guide, cost estimate data should be realistic and timely: without accurate and updated data, changes are difficult to analyze, estimated future costs are unreliable, and decision makers are given insufficient information for planning and assessing alternatives (GAO-17-575, 2017).

Business arrangements are challenged when 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. There is conflict in retaining/permitting a robust ship repair industry while delivering repairs at the lowest price. 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.

Different organizations have different goals for procuring and collecting data. Analyzing these situations from an IS/system engineering perspective, to propagate effective contracting strategies from the policymakers to industry, a concerted effort is required to standardize and streamline the flow and agility of data records between the NAVSEA production system.

A cursory look at CDRL management illustrates an important fact; the contract compliance structure generates administrative burdens not only on NAVSEA "production system" but also the contractors. The CDRL process is a case in point: it imposes a major challenge for improving private shipyard contracting processes due to the volumes amount of data generated from contractors that must be managed. A CDRL, among the various types of data, could ask a contractor to report on status of a work item, project schedule updates, labor hours, and progress reports. Given the long lead times, the USN is expecting delivery of CVN-81 in 2032 (Eckstein, 2019), each individual carrier project generates a consistent flow of CDRL data. The format can range from common office formats and PDF to XML envelopes. Anecdotally, in the case of spreadsheets, the data flow from the contractors can range from daily, weekly, or monthly data dumps. A single sheet could potentially contain 25 unique columns with 10,000 rows, just for one week. This process of managing the incoming data occurs for the duration of construction project.

As a general rule, data procured by the government should be carefully selected for the intended future use in managing the contract and program, or by designating it as accessible or as an option for availability, rather than required (Kendall, 2016). Unfortunately, project teams are inundated with data that requires more time structuring and formatting the CDRL data rather than analyzing trends to make accurate assessments. Reporting and presenting an accurate snapshot of the project is critical for all Carrier Program stakeholders, yet constrained by the challenges in the managing program office to regulate, format, analyze, and report on the progress within a timely manner.

The Problem Situation, unresolved by MSMO or MAC-MO

In 2004, Multi-Ship Multi-Option (MSMO) contracting replaced the traditional system of single-ship, firm-fixed contracts, written on a ship-by-ship basis, which limited the amount of available funding for scheduled maintenance, experienced excessive cost growth, and were detrimental to collaborative Navy-industry partnerships (Duncan & Hartl, 2015). The hope was to restore relations through investment in workforce and facility modernization, with a more reliable, predictable MRO industrial base. The multi-ship, five-year contracts offered reimbursement of all allocable, allowable, and reasonable costs expended by the contractors, plus a possible incentive. While improving collaboration and ownership, the Navy was not adequately resourced to properly monitor efficiency and cost performance (Duncan & Hartl, 2015).

By 2010, unacceptable surface ship force readiness and cost and schedule performance issues led to the decision to replace MSMO with Multiple Award Contract, Multi Order (MAC-MO) (GAO-17-54, 2016). In 2013, MAC-MO was officially implemented. Despite the Navy's research and pilot maintenance periods, the initial optimism was quickly faced with cost overruns, delays in completing availabilities, and emergent maintenance issues, a common problem in ship maintenance contracts (GAO-17-54, 2016). The lack foresight and preparation to manage the increased stakeholder base address the lack of systemic interfacing necessary for MAC-MO while meetings federal internal control standards which mandate evaluation of risk responses and progress toward program objectives. MAC-MO contracting has also 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).

In general, the nature of maintenance, repair, and overhaul (MRO) services are low volume, high variety production services often accompanied with previously unidentified work, complicating assessment of contract delivery performance (Verma & Ghadmode, 2004). Castelle et al. (2019) extracted the following set of additional system-generated challenges unresolved by trials of historical contracting strategies:

- Insufficient planning time between request for proposal and need to begin the availability (contract award), impacting both short uncertainty due to quality of work packages that often require changes upon execution (Martin, 2017).
- Underestimated or unexpected work bottle-necked by the contract modification cycle to approve job order changes (*JFMM*, 2017).
- Behind-schedule projects limited by the amount of available overtime to accelerate completion and challenged by necessary lead times to outsource adequate labor of labor (Riposo et al., 2017).
- Reduced confidence in future demand to make long-term capital investments for requisite infrastructure and necessary workforce capacity (Buckley, 2015; Martin et al., 2017), causing private shipyards to demand long-term contracts as well as incentives (GAO-10-686, 2010).
- Vastly limited qualified yards that are also reliant on the Navy to remain in business, enabling quality deficiencies and performance variances as the Navy has an interest in sustaining their limited shipbuilding base.

The *National Defense Authorization Act (NDAA)* of 2019 directed the Comptroller to produce an assessment of (1) Navy's execution of MAC-MO versus MSMO strategy, impacts on cost and schedule performance; (2) effectiveness of third party planner ability to develop stable requirements in advance planning; (3) adequacy of Navy's structure for contract oversight; (4) 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 (5) advantages, disadvantages, or differences in strategies depending on location of performed work.

It is not entirely clear that the policy or strategy itself is the problem, but perhaps the way it was conceived given the environment, and the way is being implemented. Because contract forms specify cost reimbursable or fixed price items or by contract line item number (CLIN), each contract is unique in composition (Braxton et al., 2017). It is commonly assumed that a fixed price contract improves government contract performance by transferring risk, although "without additional mechanisms (e.g., Contract Data Requirements Lists (CDRLs)), they do not provide the information needed by the Government to understand actual costs for negotiations on future PBL contracts" (Ewer, 2015, p. 29). It is also a challenge to define and determine caveats for incentives, allocating the appropriate amount of responsibility each party will assume for 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).

Concurrent Contract Modification

The Navy has developed a unique approach to adjust a contract during ship availability rapidly. This approach is known as concurrent contract modification (CCM). In respect to fleet availability and maximizing private shipyard engagement, CCM is a method to collect, manage, and report on contract change data. This process is allowing shipyard-borne contracting and engineering teams to make unilateral and bilateral contract changes simultaneously under a single contract modification. Frequent changes include obligation and de-obligation actions, Technical Direction Letters/Technical Instructions, stop orders, administrative, and equitable adjustments.

CCM is a response to the challenge of processing constant changes during availabilities. Whether the changes originate through "conditions found the report" (CFR), unclear SWLI requirements, or fleet operational requirements forcing availability schedule to be expedited; project and contract teams on the ground need a way to process these changes, but more importantly, document and track contract changes through the availability Lifecycle. A typical medium to track on-the-ground changes is spreadsheets. A spreadsheet is a means to track, among other critical data points, changes to contract line item numbers (CLINs), sub-line item numbers (SLINs), exhibit line item numbers (ELINs), technical instructions or technical direction letters (TIs/TDLs), and task orders (TOs) as well as impacts to the schedule and resource baselines (Graham, 2018). Changes can also include new work added to a depot work package, however, the effort required for the new work is often underestimated and thus can lead to even more changes (Caprio & Leszczynski, 2012).

The labyrinth of legacy IS preventing on-the-ground-users from effectively and efficiently tracking availability changes and quickly communicating critical information to key decision makers at the fleet level. The main challenge of using collection mediums, such as spreadsheets, are version control and processing. A project team needs absolute surety that the records contained in a row of data are up-to-date, accurate, and unique. Second, the project team must process the data and use significant labor hours transferring or inputting the data to other business systems, either through automatic or manual means in some cases. As a whole, contract changes generate data that will propagate through other IS and processes. Table 1 references a sample of non-contracting information systems where the data could propagate, however, the sheer amount of IS and defined processes increases the administrative burden, but critically, fragments the data much more than needed. As a result, data integrity could be impacted and accuracy is reduced.

Table 1: Non-contracting Information Systems

Maintenance Planning & Execution	Management Support
• Advanced Industrial Management (AIM) • AIM Express (AIMXp) • Automated Radiological Controls Management Information System (ARCMIS) • Material Requirements (MRQT) • Navy Workload & Performance System (NWPS) • Project Sequencing and Scheduling (PSS) • Ship's Force Integration System (SFIS) • Shipyard Metrics (SYMET) • Supervisors' Desk (SUPDESK) • Technical Information Management (TIM)	• Automated Training Management System (ATMS) • Corporate Lessons Learned (CLL) • Laboratory Information Management System (LIMS) • Occupational Safety and Health Record Keeping System (OSHRKS) • Supplemental Administration Employee Management (SAEM)
Material Resource	**Financial Management**
• Material Access Technology (MAT) • Facilities & Equipment • Facilities and Equipment Maintenance (eFEM)	• COST • Pre & Post Payroll Processes (PPPP) • Shipyard Query Database (QDB) • Shipyard Automated Budget Reporting System (SABRS)

The implications do not support the agility of data nor operational readiness. Ramifications include delays in updating Class Standard Work Template (CSWT) in the Master Specification Catalog (MSC) or missing data for the Class Maintenance Plans (CMP). Most crucially, without an efficient means to communicate and iterate on data generated during availability, data points such as work items and Availability costs may not make into the next planning cycle for the next availability.

In the end, the Navy "recognizes the importance of achieving accurate work specifications for maintenance availability, as inaccurate work specifications could result in contract modifications, leading to schedule delays, and cost growth…" (GAO 17-54, 2016, p. 26), a challenge that will continue to grow.

Regardless of the data residing in spreadsheets or Enterprise Wide Applications, the change data made during an availability flow through a series of legacy information systems (IS) that are not optimized for reducing the manual double entry and reformatting. For availability, there exists a series of IS that support the contracting teams on the ground. Currently, the Standard Procurement System (SPS) is the central contracting writing system, however, for contract administration, the Naval Maintenance Database is the "means for initiation changes to the contract, approving and negotiating materials, man hours and total cost" (Northrup, 2015, p. 24). Not mentioning the other IS for CDRLs, resource management, invoicing, contract and sub-contractor labor hour reporting, and host of engineering databases, contract changes all affect data living in databases outside of the contracting systems.

CCM represents a symptom a broader challenge within the Navy; how to propagate, track, and report on data throughout the organization. NAVSEA, Type Commanders, and Executive Decision Makers.

The Need for Agility and Holistic Resolution

As the backlog of scheduled maintenance activities at the shipyards continues to increase, public shipyards face a number of interrelated challenges maintaining the fleet's operational availability cost and schedule performance. While the opportunity exists for leveraging contracting strategies with private shipyards to improve fleet availability, NAVSEA's contracting strategy with private shipyards greatly impacts cost, schedule, and performance. Framing these challenges as a "system of problems" manifested from a core contracting dilemma in NAVSEA, a holistic resolution effort will be necessary to address the lack of synergy in contracts between NAVSEA and private shipyards, to be explored in this paper.

Agility in awarding contracts/tasks on time requires streamlining of Ship availability planning processes. This is particularly critical for depot level work and modernization projects, where any delay or hiccup in the "NAVSEA production system" causes surface ships availabilities to defer to the next cycle, ranging from approximately 12 to 14 months in length. Streamlining CDRL data intake, decomposition, parsing, and improving data organization enables recursive modeling, to reveal patterns and insights. Data consistency improves the efficiency of performance monitoring, contract closeout, forecast and risk analysis, and resource planning, as well as enable more sophisticated stochastic modeling, machine learning, and other advanced techniques. A standardized data model connecting all stakeholders; from the 3M system to SPS and spreadsheets to produce a quality data model is a possibility that would provide improved support for contract awards, oversights, modifications, and accountability.

Challenges in contract awards, concurrent contract modifications, cost overruns, and inconsistent data are often thought to have originated from the program office side. Many are motivated to reduce the administrative burden on program staff and open the venue to reduce the reporting burden on the contracting team. Proposals to investigate the creation of a joint Navy-Private Sector information system to flatten the reporting data in alignment with the Navy's Data Architecture may be a plausible avenue to explore in the future. However, other potentially advantageous opportunities currently exist to improve contract management strategies, particularly through agility.

Given the dynamic IT system context driven by unpredictable, externally driven changes, organizational agility implies that success is necessitated by program management and system engineers' ability to identify continued satisfactory performance, effectiveness, and efficiency in a changed circumstance (Alberts, 2011). This implies that current, accurate data is available for continued estimation of engineering change proposal impact and adapting to meet operational availability:

> "With regard to the CVN IT system context of unpredictable externally driven changes… it follows that program agility would be a desirable quality for a program team. The program manager and system engineer need to be able to quickly dispatch and inform the team, assess the impact of changes, and develop strategies for successful and timely delivery of systems to CVNs" (Porter, 2016, p. 26).

This establishes the "what" but not the "how". As stated in DoDD 5000.01, also "Evolutionary acquisition strategies are the preferred approach to satisfying operational needs." DoDD 5000.01 also established an overarching policy that states "acquisition professionals shall continuously develop and implement initiatives to streamline and improve the Defense Acquisition System. MDAs and PMs shall examine and, as appropriate, adopt innovative practices (including best commercial practices and electronic business solutions) that reduce cycle time and cost, and encourage teamwork." This policy invites promising conversations to improve our current situation.

The pattern of continuing to fail at anticipation and responsive planning is what is to be expected in a complex political environment with rigorous rules and limited feedback loops for learning, re-strategizing, and implementing solutions, where agility is needed.

Analyzing Ship Availability Contract Performance Using Goldratt's Conflict Cloud

Dr. Eli Goldratt, inventor of the Theory of Constraints and the Conflict Cloud, argued that complex systemic problems can be analyzed by understanding the dilemma that is preventing organizations from solving those problems. According to Goldratt, dilemmas arise when two valid but contradictory needs are required to be met to achieve the shared goal. Rather than seek compromise, Goldratt suggests organizations resolve the dilemma by identifying and challenging various assumptions in the way the actors have articulated their needs and how they can be fulfilled. The surfacing of assumptions often allows adjustment of the strategy to meet needs in the fact of changing circumstances, and subsequent improvement in the situation.

Castelle et al. (2019) used the conflict cloud model (Smith, 1999) to begin with an initial conflict cloud that was refined through interview research, generating the following core conflict cloud (Figure 2) conveying a fundamental issue leading to undesirable effects in the contracting environment.

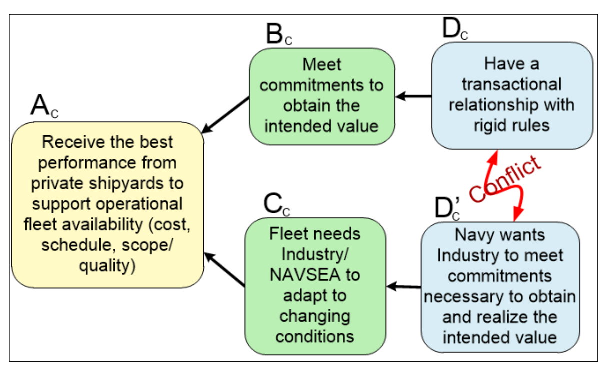

Figure 2: Core Conflict Cloud

The core conflict cloud (**Error! Reference source not found.**2) consolidated from the research's identified conflicts The two core wants (entities D_c and D'_c) are prerequisite to satisfying opposing core needs (entities B_c and C_c), although both must be met to achieve the common goal (entity A_c).

Inductive Generation of Contracting Strategies

Castelle et al. (2019) recommended further exploration of shifting from transactional contracts and detrimental local optimization to a more collaborative approach for total system value by challenging conflict-enabling assumptions. The following recommendations were provided for contracting strategy reform:

- Hybrid approach of fixed price for reasonably quantifiable work, and time and materials or cost-reimbursable for the more complex
- Improving requirements flexibility through compromise and negotiation.
- Data records sharing of pilot projects with independent teams to identify work needed, including implied but not articulated, to improve requirements analysis.
- Management of risk & change at appropriate levels (empowerment) to enable contract responsiveness, such as through flexible waterfront reserve to manage new work and mitigate lack of scope understanding at the front end.
- Increased trust by allowing a threshold above a fixed price to prevent 30-45-day delays to execute contract changes.
- Backlog mechanism for industry investment: 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.

Since its publication, we have further developed ideas for contracting strategies. Building on extracted themes, a solution space is constrained by underlying assumptions applied from the system environment, which may not be limited to the industry side of the equation. We provide another conflict cloud construct from the current data-challenged contracting environment (Figure 3):

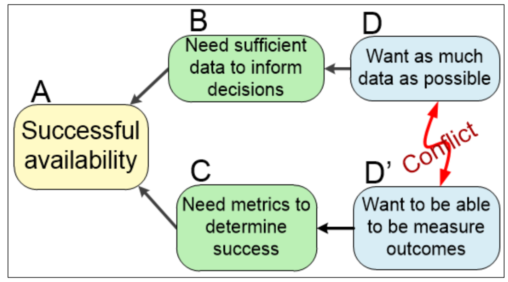

Figure 3: Interpreted Conflict

The National Institute of Standards and Technology (NIST) defines an information system as "a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information." An IS could be spreadsheets and or flat file physically passed around within a project team or an organization-wide Enterprise Resource Planning (ERP) system. The underlying theme is not the business systems, but rather the method to manage data creation and fungibility. To implement new contracting strategies and business processes, the underlying ISs supporting the organization need to be modernized to current industry practices.

NAVSEA faces challenges of reforming shipyard contracting strategies and Information System will only be possible through reformed processes to enable procurement agility.

How incentives and shared profit and risk are handled, as well as contract modification, in the face of uncertainty continue to be a challenge. Ackroyd (2018) describes collaborative contracting as a strategy to achieve mutually desired outcomes, even with different motivations, given leadership to reduce barriers to consensus and integration with the realization that success for either party is linked to the other and necessary for the performance of all, which is especially applicable given the limited industrial base. When looking at contracting strategy on the private shipyard side, business processes or workflows are driven by the underlying information system. To change a business process essentially means a new contracting strategy must be executed, requiring a wholesale upgrading of the information system capabilities. From the perspective of Navy IT systems that support this acquisition process, the process of transforming baseline availability work packages into Standard Procurement System (SPS) documents is a nightmare. Reforming the process requires the streamlining of data models of dozens of information systems, piece-by-piece consolidation and updates to those systems, and development of an "Acquisition Pipeline" to provide procurement agility by integrating resources to create virtual BAWPs and expedite the concurrent processes.

Alternative Strategy: Contract for Capacity

We recommend dividing the contracts between NAVSEA and the private shipyards into two general forms, applying a strategy as depicted in (Figure 4) and explained in this section.

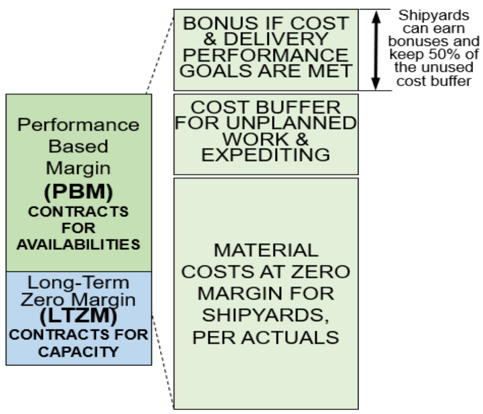

Figure 4: Proposed Contracting Strategy

Long-Term, Zero-Margin (LTZM) Contracts for Capacity

The proposed long-term contracts for capacity with zero margin would provide private shipyards enough certainty to invest in the capacity that NAVSEA needs to support demand. An important point to note: this proposed contract strategy would not transfer uncertainty from the private shipyards to NAVSEA. Since NAVSEA's capacity needs for the next many years are already known, it instead would take advantage of workload knowledge to create certainty for both parties. NAVSEA would gain assurance that required capacity would be developed, and the private shipyards would have confidence that their investment would not fail. Since these contracts would be at zero-margin, the private shipyards will still have to deliver cost and schedule performance on the individual availabilities to make a profit.

Performance-Based Margin (PBM) Contracts for Availabilities

If the shipyards deliver an availability within the desired ranges for cost and schedule, the proposed strategy for short-term contracts for availabilities with performance-determined margin would award a bonus (e.g.: 5%-10% of the total cost of an availability). A few additional important details:

1. The material costs for each availability would be covered by NAVSEA at zero-margin. That way, the shipyards are not incentivized to unnecessarily increase material costs. Moreover, the shipyards can be given leeway to order materials for unplanned items without having to go to the government for approvals every time new work is discovered; this would minimize delays caused by bottlenecks in the approval process.
2. The desired cost of an availability should include a cost buffer. This buffer can be used for labor and other operating costs associated with unplanned work, as well as for overtime and other expediting costs. Shipyards, in collaboration with the NAVSEA representative on the availability, should be free to consume this cost buffer as needed. A significant percentage (50% is recommended) of the unused buffer money will be awarded to private shipyards, provided delivery performance goals are met.
3. If the shipyards fail to meet cost and delivery goals on more than a certain number of availabilities in a given time period, there would be a provision for canceling even the long-term contract for capacity.

Implementing such a strategy would both require and force greater transparency, especially from the shipyards, in master plans as well as status of each availability. For example, the shipyards will have to create project control mechanisms to objectively justify why they need to use the cost buffer. They will also have to share their capacity development plans and status with NAVSEA.

The proposed strategy, while eminently feasible, could also create new challenges and risks, to be anticipated and addressed proactively. Specifically, the issue of data integrity, efficiency, transportability, and readability are challenges needing to be addressed in these proposed contracting strategies.

Conclusion

Research in defense acquisition reform has a common goal of renewing the contractual relationship experience in both private and government participants. Awareness of assumptions necessary for meeting needs may lead to enlightened worldviews of how to balance risk accountability more appropriately. We look forward to future research supporting evolution in the current contracting system to resolve existing conflict and facilitate a symbiotic relationship between the government and industry, for each to achieve its respective mission objectives within a mutually beneficial acquisition environment. This will involve new strategies for handling workload and capacity assumptions, and a necessity for acquisition proficiency in offering flexibility through available mechanisms.

Biographies

Mason Beninger, BA, CTFL, ITIL is a Technical Program Manager at nGAP Incorporated. With a background as a software test engineer, He studies and researches information systems and business processes in Naval ship construction, maintenance, modernization, and repair. His current research focus is in information systems, contract change management, and improving Naval readiness. [Mason@ngap.com]

Joseph M. Bradley, PhD, PE has had an extensive career in ship operations, maintenance, repair and organizational design. Repeatedly called upon to start new activities for the United States Navy, he successfully met a succession of unique challenges. He is currently an adjunct research associate at Old Dominion University and president of Leading Change, LLC. [josephbradley@leading-change.org]

Kaitlynn M. Castelle, PhD, PMP, CSM is an adjunct professor at Old Dominion University in the Engineering Management and Systems Engineering Department, teaching project management, agile development, systems engineering management. She also and leading workshops designed to improve organizational agility and is a consultant in Agile transformation for local and federal government programs. [kcastell@odu.edu]

Sanjeev Gupta is CEO of Realization Technologies, Inc., a provider of project delivery software and services that has delivered more than $7B of value by helping public and private sector organizations shorten project cycle times and improve due-date performance. He is been honored with a Lifetime Achievement Award by the Theory of Constraints International Organization for his contributions to project and supply chain management. [sgupta@realization.com]

References

Ackroyd, B. (2018) Collaborating/Relational Contracting in Practice, Presented to IPT, University of Canberra, Canberra, ACT, Australia.

Alberts, David S. 2011. The Agility Advantage: A Survival Guide for Complex Enterprises and Endeavors. Washington, DC: CCRP.

Assistant Secretary of Defense Logistics & Materiel Readiness (ASD (L&MR)). 2011a. DOD Product Support Business Case Analysis Guidebook. Washington, DC: Assistant Secretary of Defense (L&MR), April. https://www.dau.mil/guidebooks/Shared%20Documents/PBL%20Guidebook.pdf

Barrett, J. M. (2011). Doubling the Fleet: An Analysis of the Causal Factors Behind the U.S. Navy's Warship Building Program from 1933-1941. Fort Leavenworth: Nimble Books, LLC.

Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., Thomas, D. ... & Kern, J. (2001). Manifesto for agile software development. Agile Alliance. Archived from the original on 14 June 2010. Retrieved 6 June 2010.

Buckley, S. R. (2015). *A High-Value Best-Value Approach to Public Shipyard Human Capital Management to Improve Ship Availability*. Naval Postgraduate School Monterey United States.

Braxton, P. J., Hetrick, K. S., Webb, K. R., Whitehead-Scanlon, I., & Ross D. J. Contract Incentives Under Uncertainty: Data-Driven Contract Geometry Best Practices. International Cost Estimating and Analysis Association (ICEAA), 2017.

Caprio, J. L., & Leszczynski, D. (2012). A preliminary investigation into CNO availability schedule overruns. NAVAL POSTGRADUATE SCHOOL MONTEREY CA.

Commander Naval Regional Maintenance Center (2013). CNRMC Shipbuilding Specialist (SBS) Desk Guide. Published February 22nd 2013.

Duncan, M. E., & Hartl, R. (2015). Multiple Award, Multiple Order Contracts-The Future of Navy

Surface Maintenance Procurement. Naval Postgraduate School Monterey United States.

Eckstein, M. (January 31, 2019). Navy Awards 2-Carrier Contract to Newport News Shipbuilding. United States Naval Institute.

Ewer, M. S. (2015). An analysis of Department of Defense policy and guidance for implementation of Performance-Based Logistics. Naval Postgraduate School Monterey United States.

Graham, T., Sydor, S., Beninger, M., Glaze, P. (2018). Optimizing Contract Modifications Under One Universal Mod. NGAP Incorporated.

Keane, R. G., Jaquith, P. E., Tibbitts, B. F., Mierzwicki, T., Hough, J. J., & Arcano, J. T. T. (2018). Rapid Warship Acquisition: A Case for Fundamental Change in Design and Acquisition Policy. *Naval Engineers Journal*, *130*(4), 57-72.

Kendall, F. (2016). Better Buying Power principles: What are they. Under Secretary of Defense for Acquisition, Technology, and Logistics Washington United States.

Martin, B., McMahon, M. E., Riposo, J., Kallimani, J. G., Bohman, A., Ramos, A., & Schendt, A. (2017). A Strategic Assessment of the Future of US Navy Ship Maintenance. *Challenges and Opportunities. RAND Corporation*.

Martin, B., Yardley, R. J., Pardue, P., Tannehill, B., Westerman, E., & Duke, J. (2018). *An Approach to Life-Cycle Management of Shipboard Equipment*. RAND Corporation.

Northrup, D. S. (2015). A Business Process Analysis of the Surface Navy. Naval Postgraduate School. Monterey, CA, United States.

OPNAV N431 (Fleet Readiness and Logistics). (2010). *Maintenance Policy for United States Navy Ships*, OPNAVINST 4700.7L.

O'Rourke, R. & Schwartz, M. (2017). Multiyear Procurement and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress. Congressional Research Service.

Porter Jr, B. W. (2016). Using system architecture, review entry criteria, and standard work package data to enable rapid development of integrated master schedules. Naval Postgraduate School. Monterey, CA, United States.

Porter, P. H. (2016). *Organic Versus Contractor Logistics Support For Depot-Level Repair: Factors That Drive Sub-Optimal Decisions*. Air War College Maxwell AFB United States.

Riposo, J., McMahon, M. E., Kallimani, J. G., & Tremblay, D. (2017). *Current and Future Challenges to Resourcing US Navy Public Shipyards* (No. RR-1552-NAVY). RAND Corporation Santa Monica United States.

Smith, D. (1999). *The measurement nightmare: How the theory of constraints can resolve conflicting strategies, policies, and measures.*

SUBMEPP Commander. (n.d.) *Joint Fleet Maintenance Manual (JFMM)*, COMUSFLTFORCOMIST 4790.3. Volume II: Contracted Ship Maintenance, Portsmouth, NH.: Department of the Navy.

Verma, A. K., & Ghadmode, A. (2004). An integrated lean implementation model for fleet repair and maintenance. Naval Engineers Journal, 116(4), 79-90.

United States Government Accountability Office (GAO). (2010, July). *Defense Acquisitions: Guidance Needed on Navy's Use of Investment Incentives at Private Shipyards* (GAO-10-686). Washington, DC: Government Printing Office.

United States Government Accountability Office (GAO). (2016, May). *Federal agencies need to address aging legacy systems.* Testimony before the Committee on Oversight and Government Reform (GAO-16-468). Washington, DC: Government Printing Office.

United States Government Accountability Office (GAO). (2017, September). *Navy Ship Maintenance: Action Needed to Maximize New Contracting Strategy's Potential Benefits.* (GAO-17-809T). Washington, DC: Government Printing Office.