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THESIS

**STRUCTURAL AND PERFORMANCE ANALYSIS OF
NAVY SHIP OPERATION AND MAINTENANCE
BUDGETS 1999–2017**

by

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June 2018

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OPERATION AND MAINTENANCE BUDGETS 1999–2017**

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ABSTRACT

The Navy has been concerned recently with the readiness of the surface fleet. Because one driver of fleet readiness is the sufficiency of resources, this study examines the last 18 years of budgets that have the most direct impact on the readiness of the fleet. Both a quantitative and qualitative analysis was done of the budgets for Mission and Other Ship Operations (1B1B) and Ship Maintenance (1B4B). Quantitatively, the study compared projected and actual spending and the reported performance measures in both accounts. Qualitatively, the study examined the budget justifications and structure, compared to best practices in the literature. The results indicate that the Navy's budget in both accounts has risen in real terms, and the Navy has consistently spent more than projected in both accounts. The higher spending mirrored a higher operating tempo, but lower numbers of maintenance availabilities. Those availabilities may have been more costly than originally budgeted because of the higher operating tempo or changes to fleet scheduling. The operations budgets do not report consistent performance measures, hindering trend analysis. Qualitatively, the justifications for the level of funding appeared to be consistent with the naval strategy and global operations. The study makes recommendations for strengthening the quality of budgets, citing the literature on best practices.

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LIST OF ACRONYMS AND ABBREVIATIONS

1B	1B Ship Operations funding
1B1B	1B1B Mission and Other Ship Operations funding
1B4B	1B4B Ship Depot Maintenance funding
BCA	Budget Control Act of 2011
CBO	Congressional Budget Office
CNO	Chief of Naval Operations
CPI	Continuous Process Improvement
CR	Continuing Resolution
DoD	Department of Defense
DON	Department of the Navy
ESORTS	Enhanced status of readiness and training system
EPA	Environmental Protection Agency
FY	Fiscal Year
FYDP	Future Year Defense Plan
GWOT	Global War on Terror
LSS	Lean Six Sigma
JIC	Joint Inflation Calculator
NMS	National Military Strategy
NSS	National Security Strategy
OCO	Overseas Contingency Operations
O&M	Operations and Maintenance
OMB	Office of Management and Budget
OPTEMPO	Operational tempo
PESTO	Personnel, equipment, supply, training, ordnance
PIA	Planned Incremental Availability
PMA	Phased Maintenance Availability
PPBE	Planning, Programming, Budget and Execution
QDR	Quadrennial Defense Review
SECNAV	Secretary of the Navy
SORTS	Status of readiness and training system

SRA	Selected Restricted Availability
SRR	Strategic Readiness Review
SWE	Surface Warfare Enterprise

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I. INTRODUCTION

The Surface Navy has faced many issues related to ship material readiness. These issues have increased awareness of Surface Navy spending trends and evaluations on effectiveness with many pre-conceptions created without a basis in budgetary analysis. This study sought to create a foundation for understanding the Surface Navy spending trends and the budgetary literature focuses and framing to evaluate spending effectiveness and efficiencies.

In determining the effectiveness of fleet readiness, the plan was to conduct a quantitative and qualitative analysis of the specific Surface Navy budgets which most directly affect fleet material readiness, the Operations and Maintenance (O&M), 1B Ship Operations focusing on the ship mission operations (1B1B) and shipyard maintenance (1B4B). Using the publicly available archived O&M budgets data of the past 18 years from 1999 to 2017, this study analyzed the trends in funding levels and compared the amount budgeted, appropriated and actual spent totals. It compared funding levels with projected and completed workloads with performance factors such as the ship-years supported and operating tempo (OPTEMPO). Qualitatively, the study looked at the narrative justifications in the budget for explanations for data changes across the designated years. This study analyzed the changes in the budget format and budget literature over the study period, and possible implications of formatting changes.

This study took two primary approaches to analyze the O&M budget for effectiveness and efficiency: quantitative analysis, and qualitative comparison. This quantitative analysis addressed the primary question regarding accuracy of the surface navy operations and maintenance predictions of actual funding levels and did spending enable the desired surface performance. During evaluation of this uncertainty, the O&M, Navy 1B Ship Operations budget was used with further budget definition from the sub-budgets of O&M, Navy 1B1B Mission and Other Ship Operations budget and the O&M, Navy 1B4B Shipyard Support/Depot maintenance budget. From these budgets, there was a determination of funding trends for ship operations and maintenance as well as an

evaluation of the effectiveness in the reported performance metrics. This analysis answered whether the Navy was spending appropriations in accordance with its planned budget and how the fleet performed with the prescribed budget. Using the funding trends and performance analysis, relationships between budgets and performance metrics were determined. These trends and performance metrics allowed for a determination of the overall effectiveness of the Navy's spending trends in relation to its performance and identified areas for improvement.

In determining a qualitative analysis of the budgets, this study sought to address the effectiveness of the budget justifications within the published budget but also through the published budget justification documentation, Navy Budget Highlights Book. The Highlights book, drafted by Naval leadership, describes and justifies the funding requests annually and is presented to Congress with the Navy budget. The Highlights Books addressed the programs Naval Leadership were seeking attention for with higher strategy guidance and long-term Navy composition and capability goals as justification. These books provided an insight into what Naval leadership were most concerned about and the determined direction for improvement of the fleet. Based on the contents of the books, this study sought to determine any suggestions for budgeting improvement and practices based on the programs and activities described. This study analyzed the emphasized points and capabilities trends within the Highlights Books for congruency within the requested budget.

II. LITERATURE REVIEW

There are well-documented concerns with federal budgeting processes. For example, in each year from Fiscal Year (FY) 2010 through FY2018, the defense appropriation was late and the Department of Defense (DoD) operated under a continuing resolution (CR) authority for a minimum of 78 days to a maximum of 217 days (“Budget Tracker,” 2018). The Budget Control Act (BCA) of 2011 (P.L. 112–25) was designed to curb federal deficits, but the budget caps it set were raised in 2013, 2015, and 2018, showing a lack of budgeting discipline. As described later, CRs and the caps have had a deleterious effect on executive agencies. There is no shortage of recommendations to improve the federal budget process. In 2014, James Capretta analyzed the current budgeting process and recommended changes, and Alice Rivlin (2014) pointed out that budget changes will need to be institutional philosophy changes working to correct partisan polarization within the process and should incorporate all leadership in Congress. In service to the research question, this literature review describes the characteristics of good budgeting in general; briefly reviews the efforts of the BCA and CRs for the military; and describes the challenges of assessing military readiness to be used in the budget process.

The effectiveness of the congressional budgetary process has always been scrutinized with suggestions for improvement. Meyers (1996) discussed the challenges Congress has faced creating an effective budgeting process and suggested that a budget process should account for and effectively utilize all available resources and should reduce insolvency. The budget should be honest, that is, without biased projections. It should be perceptive, by which he meant it should consider both long- and short-term needs. Budgets must be fiscally constrained and seek the most cost-effective allocation. The process should be cooperative, timely, transparent, legitimate, and responsive to public needs for the preservation of democratic ideals (Meyers, 1996). Meyers (1996) stressed the need for cooperation among stakeholders on all levels for an efficient and effective budgetary process, the major impediment being uncompromising politicians.

The effectiveness of a budget is related to its structure and ability to address the concerns as well as ensuring the use of applicable and effective performance measures.

Pettijohn and Grizzle (1997) used regression analysis to determine that structural changes to the budgets influenced the engagement of congressional leadership and content and depth of congressional budgetary debate. The foundation for budgeting process and improvement was gained through making an association between its presentation and documentation. Pettijohn and Grizzle (1997) summed it up, “whoever controls the budget format controls the nature and focuses of the budget debate” (p. 15). They determined that the formatting preferences demonstrated by the President within his budget submission to Congress sets the tone for the final budget (Pettijohn & Grizzle, 1997). The power and responsibility held by the president over the budget structure may be a leading cause of the changes seen from year to year.

When utilizing performance measures, Robinson (2007) found that there was a significant link between activities and outputs and outcomes and outputs, and that defining the links between them allows for understanding of performance budget motivators and drivers. He determined that there is a relationship between the levels of effort and outputs that are used to define the achieved success (Robinson, 2007). Understanding the cause and effect relationship between activities and output is key to applying the principles to performance measures. Robinson (2007) defined output measurements (product result of activity), as compared to outcome measurements (application of outputs with external factors). The difference between output and outcome measurements informed the evaluation of performance measurements for effectiveness in addressing the desired end-state of a program or activity. Wanna, Jensen, and DeVries made several similar budgetary observations to those of Pettijohn, Grizzle, and Robinson. Wanna et al. (2003) pinpointed the relationship between the president’s budget, compiled by the Office of Management and Budget (OMB) under the president’s guidance for submission to Congress. The topics emphasized by the president will be the areas focused on by Congress, possibly causing inattentiveness to other areas (Wanna et al., 2003). The importance of applicable performance measurements and budget structure is key to ensuring appropriate spending to create the desired outcomes targeted by each budget.

Due to the complexity of the DoD budgeting process, government analysts discuss recommendations for improving the process and increase organizational efficiency. Ball

and LeRoux (2006) pointed out that good budgeting within the military (DoD) sector must have similar traits: the relevance of good practice, the principles of sound public expenditure management, and the key principles of democratic governance. They cite 10 principles; the most relevant to this study are the importance of *good information*, so that policy changes are measured over a medium-term horizon, and are based on accurate information on cost, outputs and outcomes; *transparency*, so that decision makers are aware of relevant issues, have the right information for decisions, and they are transmitted to the public; *predictability*, which is important for general budget stability; and *accountability* for those decisions (Ball & LeRoux, 2006, p. 16).

Determining changes within the Planning, Programming, Budgeting, and Execution (PPBE) systems requires an understanding of the changing influences and subsequent impacts upon the system. In September 2011, The Congressional Budget Office (CBO) conducted a study to analyze the possible effects of the BCA upon the PPBE process and specified appropriations. The study used the August 2011 Navy baseline budget to estimate the budgetary changes upon several budget line-items: new discretionary appropriations for defense, new discretionary appropriations for non-defense programs, mandatory budgetary-resource programs for non-exempt defense programs, and Medicare (CBO, 2011b). CBO pointed out that the impact of the BCA regulations was within the control of the deficit reduction committee, which could either allow the BCA outlined reductions to take effect or pass additional legislation each year to supersede and modify the reduction percentages for any program (CBO, 2011b). The reductions outlined in BCA would reduce new discretionary appropriations for defense program spending, new discretionary appropriations for non-defense program spending, and mandatory budgetary resources for non-exempt defense program spending; Medicare spending would decrease; and mandatory budgetary resources for non-exempt non-defense programs and activities spending would be reduced (CBO, 2011b). The total automatic budgetary cuts would yield \$1.1 trillion from 2013 to 2021 (CBO, 2011b). In addition to the monetary impact to the programs, the CBO anticipates additional non-budgetary social, political, and economic impacts that cannot be quantified (CBO, 2011b).

The level of resources, and by extension, the processes that determine the level, have gained greater attention from the general public due to tragic events within the military, particularly in 2017 with the two ship collisions in U.S. 7th Fleet. In the wake of these incidents, the Secretary of the Navy directed a Strategic Readiness Review (SRR) focused on the U.S. Navy, as an organization, to determine areas for improvement. The SRR reviewed numerous areas including the budgetary and appropriations spending trends, which may have contributed to the incidents. The report cited the changing industrial base, the unintended consequences of sequestration, numerous continuing resolutions passed by Congress, misunderstanding of performance measurements, and challenges with ship depot maintenance (Roughead & Bayer, 2017). The SSR identified a relationship between resourcing levels and the spending priority across operating, manpower, and recapitalization accounts (Roughead & Bayer, 2017). The SRR discussed the impacts of CRs upon U.S. Navy operations and modernization to meet operational requirements (Roughead & Bayer, 2017). The unintended consequences discussed in the report included sequestration and the BCA, which have affected the Navy's ability to balance fleet size, manning levels, readiness, and training causing the stigma of "do more with less" (Roughead & Bayer 2017, p. 58).

CRs have limited the Navy's ability to procure the needed equipment and upgrades for increased or new capabilities without the ability to take advantage of cost savings and "best value" opportunities (Roughead & Bayer, 2017, pp. 58–59). The SRR discussed the impact of miscalculated and misunderstood performance measurements as inhibiting the ability of decision-makers to make decisions in the best interest of overall fleet readiness due to an inadequate understanding of fleet readiness (Roughead & Bayer, 2017). Ship depot maintenance was discussed as an increasing area of concern due to the OPTEMPO changes accelerating the consumption of ship service life requiring greater maintenance needs. The SRR highlighted maintenance funding calculations which were completed two years prior based on relevant needs without anticipating the needs after two additional years of service. The funding for any ship's maintenance was lower than the actual needed, and the emergent issues exceeded the amount designated for expected work growth (Roughead & Bayer, 2017).

The SRR made four recommendations for improving fiscal responsibility to Navy leadership. First, there was a need to find a better fiscal balance between OPTEMPO, personnel needs, material maintenance needs, and resource management to enable the highest fleet functions. Second, the Navy needs to extend the expiration date for O&M appropriation to be either one year from the start of account expenditure, or to change the baseline life of O&M appropriations to two years. This would allow the Navy greater appropriations flexibility when operating under CRs. Third, a training and readiness tracker should be utilized to standardize performance metrics fleet-wide, which could aid in determining requirements and areas for improvement of capabilities across all assets. Finally, there was a need for using standard maintenance periods, not a continual maintenance cycle philosophy, to better ensure that the maintenance needs of the fleet are addressed (Roughead & Bayer, 2017).

To improve the readiness of the fleet, accurate performance measures and readiness metrics are critical to understanding the fleet's condition. Webb and Candreva analyzed the ability of the performance management system within the Naval Surface Fleet to operate, train, and maintain ships globally. The case analyzed the Surface Warfare Enterprise (SWE), which are designed to aid the process of making ships operationally ready and provide decision-making leadership with information to aid in the budgeting process (Webb & Candreva, 2010). The study analyzed the personnel, equipment, supplies, training, and ordnance (PESTO) performance indicators of military unit readiness focused on reporting accuracy, use, and understanding of the PESTO information, and costs and budgeting using that information (Webb & Candreva, 2010). They found that while the PESTO model was effective in communicating an individual ship's capability, the interrelationship among the metrics was neither well defined, nor did the operational capabilities assessments adequately support the budget process (Candreva & Webb, 2010). Building upon the performance measures evaluated by Robinson and the PESTO model, the SWE framework added greater information for assessing a ship's ability to perform an assigned mission through amplified explanations (Webb & Candreva, 2010). The cost analysis showed a lack of accurate cost data or performance metrics to enable the estimating of maintenance prices, and that gaining greater control over price variation

would aid in budgeting (Webb & Candreva, 2010). The disconnect between the expanded details of the individual performance measures with the overall ship capabilities was similar to Robinson's (2007) observations between activities, outcomes, and outputs. When applying performance measures to an operational activity, greater care needs to be taken to ensure that appropriate definition and application result in the desired end state.

A noted flaw of the Navy performance metrics has been the handling of ship (platform) funding within the budget, as there has been ship funding in addition to separate individual mission capability funding (Webb & Candreva, 2010). The budgeting and acquisition process is based on funding capabilities irrespective of the platform it is installed on, causing funding discrepancies between the contactor budgeting and the baseline funding throughout the scheduling of upgrades and maintenance process (Webb & Candreva, 2010). The results of the study showed that the performance metrics and budgeting systems do not produce the outcomes desired and should be reconstructed to better address operational and leadership needs (Webb & Candreva, 2010). Webb and Candreva (2010) used Robinson's (2007) performance measures evaluation on the SWE framework effectively and highlighted areas for possible improvement within the Navy performance metrics and budgeting process.

The Congressional Budget Office studied military readiness measures and compared them to the performance metrics within the DoD's O&M budget. The analysis focused on two spending categories, mission-related funding and infrastructure related spending (CBO, 2011a). The CBO evaluated the DoD's readiness systems—Status of Resources and Training System (SORTS) and Enhanced Status of Resources and Training System (ESORTS)—and determined that they have limited value due to biased ratings, incentivized higher ratings by commanding officers for deployment readiness, and rated tasks that are not reflective of wartime roles of units (CBO, 2011a). The study determined that the complexities of military combat were greater than the metrics could capture and accurately report. There needed to be a secondary system to provide relevant data to decision-making budgeting leadership, separate yet similar, to the deployment readiness assessment used by operational leadership (CBO, 2011a).

In 2013, researchers conducted a study focused on the Environmental Protection Agency's (EPA's) budget from 1970 to 2010 as a life cycle analysis (Balint, 2013). Balint discussed the current budget theories and how the quantitative analysis of life cycle theories proved inconclusive. The inconclusiveness of these theories suggested that certain influencing factors were not being accounted for within the quantitative variables. The quantitative analysis was a regression model with four independent variables to test. Several variations of the model showed that the independent variables failed to support the incremental theories which had been used by the EPA. Balint proved that the model and performance measures used by the EPA were not producing the desired outcomes, yet there was no effort to make the changes for improving. Several anomalies found were within certain years due to leadership changes, budgetary changes, and the reformatting for "business-like transactions" between government agencies (Balint, 2013, p. 18). The use of regression to identify the trends and influencing factors of the EPA budget was inconclusive because the variables used did not fuel the budgetary changes. The study did find that the EPA budget fluctuations were in proportion with and had similar timing to the overall federal non-defense budget. Balint (2013) suggested using the regression model produced to study other federal agency budgets.

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III. BUDGETARY JUSTIFICATION REVIEW

Every Department of the Navy (DON) budget submission is accompanied by justification for the funding needed to execute operations and maintain the fleet. To understand the budget trends of the DON, a review of the justification documentation accompanying the DON budget submission to OMB can be useful. The annual justification documentation is called the *Highlights of The Department of the Navy Budget*. The *Highlights* book contains a written overview of the year's budget specifically for Congress, focused on the programs and mission areas that naval leadership believed were important. In analyzing the framing and determined focuses which naval leadership believed were important, the budgetary decisions of congressional leadership may be understood. This section will identify prevailing themes and observations throughout the Highlights Books for the 18-year period of this case study.

A. TIMELINE OF LAYOUT CHANGES IN THE NAVY HIGHLIGHTS BOOKS

Across the analyzed period of 1999 to 2017, the contents and chapter organization of the annual *Highlights* books shifted several times. All the *Highlights* books discussed the personnel, readiness, procurement, and infrastructure in a different order, under different titles, and sometimes with subsections. There were five distinct thematic shifts in organization, as shown in Table 1, with overarching focus points displayed in Table 2.

Table 1. Historical Shift of Highlights Books Table of Contents.
Source: DON (1999–2017).

1999–2004	2005–2007	2008–2009
Intro	Intro	Intro
Readiness	Winning Today/Right force	Prosecuting GWOT
Recapitalization	Shaping 21st Century Manpower	Building a Fleet for the Future
Infrastructure	Improving Business Practices	Sustaining Combat Readiness
Financial Summary	Sustaining Combat Readiness	Developing 21st Century Leaders
	Changing the Way We Fight	Preparing Our Facilities for the Future
	Financial Summary	Financial Summary
2010–2014		2015–2017
Balance for Efficiency with Fiscal Awareness		Intro
Sustained Support for the Warfighter		Personnel
Shaping a Full-Spectrum Naval Force		Readiness
Protecting Readiness to Meet Challenges in Era of Reduced budget		Procurement
Investing in Fleet/Force for Future Needs		Development
Revitalizing the Force Ashore		Infrastructure
Improving Performance/ Driving Innovation		Revolving Funds
Financial Summary		OCO
		Financial Operations

Table 2. Highlights Books' Overarching Themes. Source: DON (1999–2017).

Highlight Books Themes Focus			
Year	Primary	Secondary	Tertiary
1999	Fleet Shaping (Downsizing)	Streamline Force/ 21st Century Surface Combatant (DD21)	Defense Strategy
2000	Fleet Modernization with Cost Effectiveness	Manpower Readiness	Strategy Implementation
2001	Streamlining Fleet IAW QRD and NMS	Manpower /Increase Retention	FYDP&DD21 Fleet Upgrade and Modernizing
2002	DD21 Work/Life Balance	Challenges in Industrial Base-Contracts vs Build Rates for Modernizing Fleet	DON Business Practices Implementation
2003	QRD/DD21/SECNAV 4 Focuses	GWOT/Warfighter capabilities	Risk Management and Mitigation
2004	QRD/ Naval Power 21 /Sea Power 21 fleet Shaping	Operational Focus/GWOT Support/OPTEMPO Goals	Modernization/ Capabilities
2005	QRD/Naval Power 21/Sea Power 21	GWOT Update and Continued Efforts	Modernization for GWOT Support
2006	GWOT/FYDP/FRP Strategies	Business Practices for Risk Management and Fiscal Efficiency	Sea Power 21 Modernization
2007	Force Composition for GWOT/Regional Focuses	Increasing Capabilities NP21/SP21	Adherence to Guidance/Strategies
2008	Joint Capabilities / FRP	GWOT Support requires Modernization	Manpower/Training Fit/Fill Balance
2009	New Strategies and Desired Capabilities	Supporting GWOT needs Funding/OPTEMPO/ Increased Capabilities	Manpower/Training Fit/Fill Balance
2010	New Strategies and Desired Capabilities	Recruiting Challenges Fit/Fill	OPTEMPO vs Fleet Modernization
2011	QDR/FYDP modernization	SEVNAV Great Green Fleet-Energy Conscience	Integration of OCO Supporting Ongoing Missions
2012	OPTEMPO/FYDP Fleet Readiness Needs	OCO vs Great Green Fleet Funding	Adherence to Guidance/Strategies
2013	OCO/FYDP with Asia/Pac Focus	GGF/Strategy Application	FRP/21st Century Defense Investment
2014	Fiscal Constraint (2011 BCA) on FYDP Plans	OPTEMPO/FYDP	Asia-Pac/ME Demands
2015	Adherence to Strategic Guidance	QDR/21st Century	Fiscal Stewardship: Manpower vs Materiel
2016	Fiscal Constraint while Adhering to Guidance Strategies	Capabilities/Platform Investment	Manpower/Training
2017	Capabilities for Changing Battlespace	Investment in FYDP/Personnel QOL	Adherence to Strategic Guidance

The heading shifts and content breakdown complexity were amplified with the increased U.S. participation in overseas operations. From 1999–2004, the contents and breakdown were based on peacetime operations with force and industrial base reductions in terms of categories. With the increased focus on the Global War on Terror (GWOT) and its progression into modern asymmetric urban warfare, the 2005–2007 documentation were broken down into themes which emphasized capability employment to justify the increased funding requests. Naval leadership prioritized GWOT above other aspects of the fleet with the placement of the operational status as the second chapter of the document. Through the 2008 and 2009 budgets, naval leadership reprioritized the themes from previous years compared to the importance of GWOT. There was an increased need for greater fleet strength and capability through supporting the industrial base within the *Highlights* books. By 2010, the budget themes were focused on the support of the fleet to affect the capabilities and operations executed. The simple chapter headings which reappear in 2015 emphasized fleet streamlining and aspects in the “challenging fiscal environment” and to “provide a balanced force aligned” with the priorities stipulated in numerous governing documents (DON, 2014, p. 8). The changes that naval leadership have made to the headings and the ordering of the topics, within each budget document, set the tone for the entire budget for policy and the budgetary decision-makers.

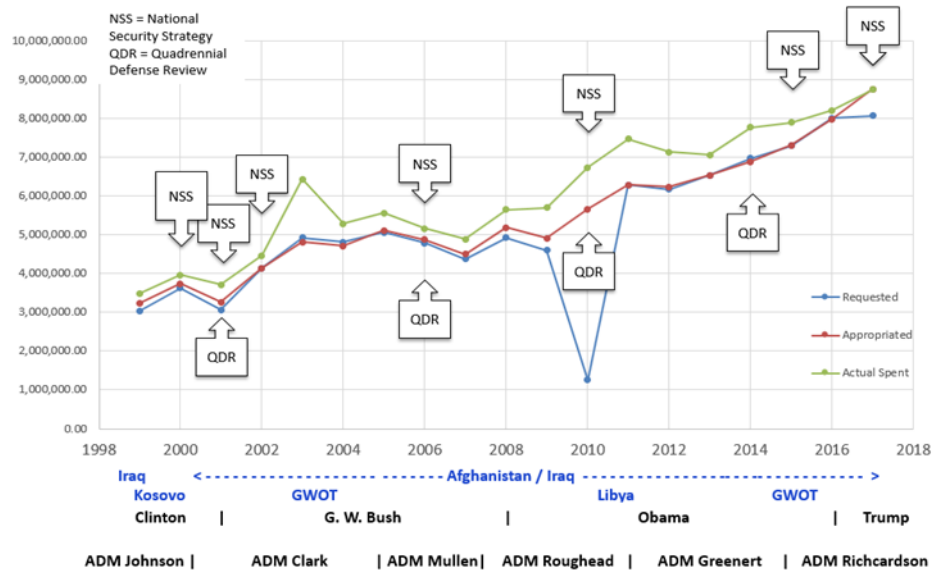
B. INFLUENTIAL BUDGETARY PLANNING DOCUMENTS.

The Navy budget requested each year has been guided by the goals, strategies and plans laid out in numerous guiding documents from higher headquarters and leadership. There have been guidance documents and programs published by higher leadership which have had greater impact or which leadership prioritize over others. The Quadrennial Defense Review (QDR), National Military Strategy (NMS), and the Future Year Defense Program (FYDP), each have had continual budgetary impact throughout the entire period of analysis. There were consistent references throughout the *Highlights* books to the applicable QDR for implementation of recommendations and updates during the years between published reviews. There was consistent application of the NMS through support of ongoing operations, emphasizing the need for fleet growth and increased capabilities. A prevalent reference throughout the entire analysis period was the application and

progression of the FYDP. Naval leadership frequently cited the FYDP as evidence of appropriate spending levels to build and develop the fleet and Marine Corps assets. In later years of the 18-year period, there was an associated discussion of fiscal responsibility while working to expand the number of assets through efficiency and effectiveness of appropriated funding.

Within the DON, several programs have consistently endured as primary guidance for development of the fleet. Sea Power 21 (Clark, 2002) was a transformation plan to develop fleet capabilities to meet the future challenges of a changing battlespace and was used as justification for various expenditures and program decisions. *A Cooperative Strategy for 21st Century Sea Power* (Conway, Roughead, & Allen, 2008) was a joint strategy that unified maritime strategy across the U.S. Coast Guard, U.S. Marine Corps, and U.S. Navy. This written joint strategy was a commitment for capabilities and operational support to the other services as well as national defense and vital interests. This document was cited frequently to ensure that capabilities were maintained while also justifying upgrades, modifications, and capability acquisitions. Figure 1 delineates the timeline of publication for certain documents in relation to the 1B4B Ship Depot Maintenance budget and the major military operations.

Navy Ship Maintenance (1B4B) Budget, Key events



Adapted from Secretary of the Navy (SECNAV) (1999–2017); DON (1999–2017).

Figure 1. Navy Ship Depot Maintenance (1B4B) Budget with Key Document Publications, Military Campaigns, U.S. Presidents, Chief of Naval Operations.

C. FISCAL RESPONSIBILITY MEASURES AND APPLICATION

Across the entire period analyzed, the *Highlights* books described measures and actions for Navy fiscal responsibility through efficiency and effectiveness of appropriation expenditures but the discussion of the application of fiscal responsibility has changed. In the beginning years of this study, Navy fiscal responsibility meant downsizing the fleet and decreasing appropriations in peace time. Fiscal responsibility was a primary topic for “pursuing business practice reforms” which increase accountability and efficiency (DON 1999, p. 53). With the events of 9/11, the conversation shifted to required spending for increased force capabilities through acquisition and training to meet the changing battlespace. By 2005, with the GWOT turning into a long-term campaign, the application of business transformation practices became a focus through the use of the “Balanced Scorecard” of four categories, one being “Improved Business Practices” (DON, 2004, p. 10). The 2005–2007 budgetary documentation had an entire section titled “Improved Business Practices” which detailed the business practices which were determined to “improve management effectiveness and efficiency,” and with readiness levels linked to performance metrics (DON, 2004, p. 84). The efforts made toward the implementation of business practices within the DON became focused on enabling the warfighter through efficiency and effectiveness in appropriations. The DON emphasized the value placed on organizational change and the challenges in maintaining a highly functional force.

From 2010 to 2014, business transformations became increasingly intertwined with the operational capability of the fleet after the 2011 BCA passed. The 2010–2014 budgets had dual justification because fiscal responsibility was weighed against the necessary capabilities of the changing battlespace. Since the FY2015 budget, there has not been a discussion of business practices but rather, there was a discussion of sustaining capabilities within the “challenging fiscal environment” (DON, 2015, p. 7). While the focus on business practices waned, there was a new discussion on auditability and “Audit Readiness” with necessary milestones for the achievement a full DON audit by FY 2017 (DON, 2015, p. 89). The financial strain under increasing operational demands changed the budgetary tone from working to streamline appropriations into working to prioritize

required capabilities due to the decreasing appropriations. This was the DON's attempt to find a compromised solution between capabilities and fiscal responsibility.

Establishing fiscal measurements required detailed performance metrics, which evolved over years of refinement and the consolidation of metrics from various programs. Over this 18-year case study, each new president and QDR approached performance metrics and evaluation differently. In building off the Scorecard concept, naval leadership incorporated performance metrics into the discussion of each capability and platform evaluation separately within each section and placed the full Scorecard matrix in the appendix without elaboration (DON, 2008). In the FY2009, leadership sought to utilize the latest business practices for performance metrics introducing Lean Six Sigma (LSS) and Continuous Process Improvement (CPI) to the entire DON organization (DON, 2008). With the introduction of the new processes, program and capability performance became interspersed with the discussion of each program within the *Highlights* books and the Scorecard system was removed completely. Within the 2015–2017 *Highlights* books, there was not a section for the performance metrics or inclusion of details about applied performance measurement criteria. The continual shifting of the performance measure process without justification shows a lack of application of Robinson's (2007) performance measurements which related activities to output and outcomes. The Navy appeared to not be evaluating activities which would achieve the desired outcomes.

Throughout the period of study, several performance metrics were consistently present. The measurement for OPTEMPO for surface ships was consistently the number of underway days per quarter for deployed ships and the number of days underway for non-deployed ships. Within the Navy appropriations for maintenance, the only fiscal measurement used was the determination of the budget for a percentage of active ship maintenance each year. This percentage was present in each *Highlights* book but the actual data was not included in the budget, and the percentage changed from annually due to other obligations, operations, and the capacity of the industrial base to support required repairs. The financial figures displayed within the budgetary document showed a high percentage of projected maintenance funded annually.

Over the period analyzed for this study, the *Highlights* books were responsible for portraying the condition of the fleet to aid Congress as it made funding decisions for the upcoming year. As the key messaging tool for Navy leadership, the *Highlights* books have been useful for gaining an understanding of the programs and capabilities determined to enhance and extend fleet capabilities. There were significant changes in framing and focuses from year to year which may be sending mixed messages. Having a standard format and required details for each section may add continuity within the sections from year to year allowing for the important points to be readily apparent. Without the confusion created by the inconsistencies within the *Highlights* Books, congressional leadership may gain a better understanding of the fleet's condition and be able to make more informed decisions. The themes and focuses displayed within the *Highlights* Books were used to evaluate the effectiveness of communicating fleet needs and potential reactions Congress may have had when appropriating funds.

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IV. BUDGET DATA METHODOLOGY

To assess the funding levels and the effectiveness of Navy spending, it is important to understand the lines of funding and their impact on ship readiness and maintenance. Line items and performance metrics were specified within the budgets over the study period to determine trends, commonalities, and differences from year to year. For this case study, the 1B Ship Operating (1B) budget, 1B1B Mission and other Ship Operations (1B1B) budget and the 1B4B Ship Depot Maintenance (1B4B) budget and the accompanying performance metrics were analyzed. The data was retrieved from the Assistant Secretary of the Navy Financial Management and Comptroller Budget Materials available in the archive found on their website. The use of the 1B budget was for comparison purposes between the different subordinate budgets. To identify trends in the budgets from year to year, and to evaluate overall budget effectiveness, comparisons were made between the budgets and the themes and focuses of the *Highlights* books.

A. 1B1B MISSION AND OTHER SHIP OPERATIONS

To evaluate the effectiveness of Navy budgeting, the 1B1B budget was used to determine spending trends related to the mission and operational needs of the ships in both a deployed and in a non-deployed status. When comparing the spending trends across the 18-year case study, there was a determination whether the desired outcomes stated in the *Highlights* books were being realized and identify areas for improvement.

The 1B1B budget was selected for its encompassing of the operational spending for the fleet. Each published final budget states an estimated request for the current year, the appropriated totals by Congress for the previous year, and the final spending totals for two years prior. Using these reported totals, the requested budget, the appropriated totals and the actual spent totals, budgeting trends can be analyzed and graphed. These three totals were used to calculate the percent changes between the years as well as the contribution percentages of the overall 1B budget. All of the totals were reported in “then-year” dollars and not comparable due to inflation until normalized to 2017 constant dollars. To achieve this, the Joint Inflation Calculator published by the National Center of Cost Analysis on

January 19, 2018, was used for adjusting all totals. The fluctuations between the three totals each year showed the accuracy level for the budgeting process. For each year, various calculations were performed to determine percentages of each budget total of the 1B, the percent change between the different totals, calculations using the performance metrics to determine the cost of each ship annually, and the annual cost of operations based on ship years supported with requested totals and actual spent totals. These calculations will be analyzed in later sections.

Starting in FY2009, the Overseas Contingency Operations (OCO) funding was included as part of budgeting and reported next to the Navy baseline funding as it was included in the overall budget totals for 1B1B funding. The reporting format and inclusion of OCO spending within the final budget was not solidified until FY2010 which led to a reporting discrepancy of the FY2009 and FY2010 totals resulting in the lack of comparable OCO data for those two years. The use of CRs within the annual budgeting process created multiple budgets, therefore this case study used the latest dated cumulative budget passed.

The 1B1B budget was accompanied by performance metrics, which were used to show ship performance at the end of the fiscal year. While there were several performance metrics reported for the surface fleet, there were only a few performance metrics which pertained to this study focus of ships classified as warships. Within the 1B1B Performance Criteria and Evaluation Summary (Secretary of the Navy (SECNAV), 2000–2017), there was a difference in reported performance metrics across the entire 18-year study period, shown in Table 3. Performance metrics were not formally reported within the 1999 budget. The reported performance metrics used from 2000 to 2003 were subdivided into the categories of conventional surface ship and nuclear powered ship (C/N). From 2004 to 2017, the performance metrics were subdivided into the categories of deployed and non-deployed (D/ND), shown in Table 3. Additional metrics were reported within each budget but were not relevant to surface warship performance and determined not pertinent to this study. The budgets, as well as comparisons to the performance metrics reported, were graphed for greater understanding and displayed in later sections of this study.

Table 3. Shifting Performance Criteria over the Study Period. Source: SECNAV (1999–2017).

1B1B Mission and Other Ship Operations Performance Criteria Reported											
Year	Ship Inventory C/N	OPTEMPO Goal Days C/N	Ship Years Supported C/N	Ship Operating Months Supported C/N	UW Steaming Hrs C/N	OPTEMPO Goal Days D/ND	Ship Years Supported Total	OPTEMPO Days per Qtr D/ND	Ship operating Months Supported D/ND	Ship Steaming Days per Qtr D/ND	UW Steaming Hrs D/ND
1999											
2000	X	X	X	X	X						
2001	X	X	X	X	X						
2002	X	X	X	X	X						
2003	X		X	X	X	X					
2004	X		X	X	X	X					
2005						X	X	X	X	X	X
2006						X	X	X	X	X	X
2007						X	X	X	X	X	X
2008						X	X	X	X	X	X
2009						X	X	X	X	X	
2010						X	X	X	X	X	
2011						X	X	X		X	
2012						X	X	X		X	
2013						X	X	X		X	
2014						X	X	X		X	
2015						X	X	X		X	
2016						X	X	X		X	
2017						X	X	X		X	

B. 1B4B SHIP DEPOT MAINTENANCE

With the maintenance concerns of the Navy described in the *Highlights* books, the 1B4B was selected to assess the maintenance spending for ships while executing maintenance under depot level contracts and not maintenance conducted by the crew. This allowed for analysis of repair activities and the scheduling of ship maintenance periods, or availabilities. A baseline schedule has been maintained for each type of ship indicating when system upgrades and overhauls are required. Understanding the funding for these availabilities may aid the understanding of the expressed concerns and need for upgrades described within the *Highlights* books.

The 1B4B budget, taken from the Navy O&M budget, used a similar configuration as the 1B1B budget. For each year within the study period, the requested totals were from the current year budget, the appropriated totals were from the following year budget when published, and the actual spent totals were published two years following the designated year once accounts were finalized. These three categories, which are reported in then-year dollars, were normalized to 2017 constant dollars by applying annual inflation with the Joint Inflation Calculator by the National Center of Cost Analysis published on January 19, 2018. Using the 2017 constant dollar values, the three total categories were used for other calculations and graphing, which aided budget analysis to evaluate for effectiveness and efficiency. Starting in FY2009, the OCO funding was included as part of budgeting and reported next to the Navy baseline funding to comprise the overall budget totals for 1B1B funding. The reporting format and inclusion of OCO spending into the final budget was not solidified until the FY2010 budget which led to a reporting discrepancy of OCO funding for FY2009 and FY2010 resulting in the lack data for those two years. The use of CRs in various years resulted in multiple budget documents being passed by Congress; therefore, the final budget passed was the data used for this study. Calculations for this study included finding the percent change between the three different totals and finding their percentages of the 1B Ship Operations budget. Trends and observations are analyzed in the next section.

The 1B4B Ship Maintenance Performance Criteria and Evaluation Summary (SECNAV, 1999–2017) data reported for the 18-year study period remained relatively uniform with only small deviations. The reported metrics which were deemed applicable and used in this study are displayed in Table 4. Several calculations were applied to these metrics for a greater understanding of the repair trends. The totaling of all the availabilities per year which resulted in a final year total of both projected and actual availabilities allowed for comparison between the years. Using the annual availability totals divided by the number of ship years supported produced the average number of availabilities as a percentage of ship years supported for both projected and actual totals. The availabilities as a percentage of total ship years supported shows the amount of depot level repairs being conducted in relation to the ship’s operational time.

Table 4. 1B4B Performance Criteria as Reported in the O&M Budget across 1999–2017. Source: SECNAV (1999–2017).

1B4B Performance Criteria Reported													
Year	Overhauls	SRA	PMA	Emergent Repairs	MISC RA/TA	PIAs	Continuous Maintenance	Unallocated Overhauls	Intermediate Maintenance	Reimbursable Overhead	Service Craft Overhauls	NWCF Buyout Funding	Carrier Incremental Availability
1999													
2000	X	X	X	X	X								
2001	X	X	X	X	X								
2002	X	X	X	X	X	X							
2003	X	X	X	X	X	X	X						
2004	X	X	X	X	X	X	X	X	X				
2005	X	X	X	X	X	X	X		X	X			
2006	X	X	X	X	X	X	X		X	X			
2007	X	X	X	X	X	X	X		X	X	X	X	
2008	X	X	X	X	X	X	X		X	X	X	X	
2009	X	X	X	X	X	X	X		X	X	X	X	
2010	X	X	X	X	X	X	X		X	X	X		X
2011	X	X	X	X	X	X	X		X	X	X		X
2012	X	X	X	X	X	X	X		X	X	X		X
2013	X	X	X	X	X	X	X		X	X	X		X
2014	X	X	X	X	X	X	X		X	X	X		X
2015	X	X	X	X	X	X	X		X	X	X		X
2016	X	X	X	X	X	X	X		X	X	X		X
2017	X	X	X	X	X	X	X		X	X	X		X

C. COMBINATION COMPARISON

Analyzing the spending trends of the 1B1B in relation to the 1B4B showed the relationship between the operational demand changes and the need for maintenance. Understanding this relationship aided in determining if the effectiveness of performance-based budgeting as indicated is consistent with the good business practices according to the reviewed literature and detailed in the *Highlights* books. The 1B1B and 1B4B budgets for projected and actual spent totals were divided by the 1B1B performance metric, ship inventory, to determine the annual operational cost per ship. Graphing performance data over time allowed for analysis through the comparison of the projected and the actual spent totals. With the absence of data for 2003 in certain measures, several graphs have a gap for that year. Using the projected and actual spent totals of selected restricted availability (SRA) and phased maintenance availability (PMA), the graph data showed the cost of budgeted availabilities compared to the actual spent totals on the availabilities executed in the given year. A comparison can be made between the OPTEMPO budgeted projections with to the actual days ships spent operating underway to determine the effectiveness of the projections model as well as the efficiency of the appropriations. Comparing the graphs of the availabilities to the budget trends may reveal relationships between the total costs and types of availabilities and the changes in OPTEMPO of the fleet. The graphing and detailed analysis is found within the next chapter.

Based on indications from previous studies and observations, the reported OCO data was aggregated in terms of the funding for reported operations. The reporting of OCO starting in 2009 shifted formats several times within the full Navy O&M budget before being submitted as a separate document. While the Navy O&M budget reported the separate OCO and baseline funding levels, the separate OCO budget reported the subdivision of funding between the active Operations. Due to the continual changes within the separately reported OCO budget, the delineation between the various operations funding was determined to not be significant for this study.

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V. TRENDS ANALYSIS

To gain insight into the effectiveness of fleet budgeting and performance, the data was consolidated, manipulation within various calculations, and graphed to illuminate trends across the 1B1B and 1B4B budgets and their performance metrics. The steady increases in spending across both budgets does not appear to translate into increased ship performance and operational longevity. The performance metrics being reported to higher level leadership may not be portraying an accurate depiction of the fleet's condition. This section will discuss these observations and trends.

A. 1B1B MISSION AND OTHER SHIP OPERATIONS ANALYSIS

1. 1B1B EMPIRICAL ANALYSIS

There are several key observations for the 1B1B budget data. The requested and appropriated totals remain close over the 18-year study period, while the actual amount spent was greater during the entire study period except for 2009–2010 and 2015–2017 per Table 5 and Figure 2. Prior to 2009, the 1B1B budget requested, appropriated, and actual spent totals were mostly within a margin of \$3 million with a 5% change, but in 2000 there was a \$4 million difference, as shown in Table 5 and Figure 2. Throughout the entire study period, the requested and appropriated totals remain within 7% of each other, except in 2009 and 2010. The 2009–2010 introduction and formalized reporting of OCO as a separate account for operational funding resulted in possible budgetary uncertainty within the 1B Ship Operations budget and caused an increase in the percent difference of over 20%, as displayed in Table 5. The possible change in operational funding may have contributed to the proportional decreases in the 1B1B appropriations and actual spent totals. In 2015, the amounts requested, appropriated, and actual spent totals were closer than in the previous 15 years. In 2016, the amount requested was significantly higher than the appropriated, and the amount appropriated was also higher than the actual spent total, a complete trend reversal than previously seen. In 2017, Congress appropriated more to the 1B1B budget than what was requested, yet the actual spent total was lower than the appropriated total as seen in Figure 2. Over the case study period, there was a trend that

the Navy received equal to or greater appropriations from Congress than what was requested. The Navy also had a trend of spending more than the appropriated amount by the end of the fiscal year shown in Table 5 and Figure 2.

Table 5. 1B1B annual spending in 2017 Thousands of Dollars
Consolidated from the O&M Budgets with Percentage Calculations.
Source: SECNAV (1999–2018).

1B1B Mission and Other Ship Operations					
Year	Requested	Appropriated	Appropriated as % of Request	Actual Spent	Actual Spent as % of Appropriated
1999	3,105,351.00	3,069,118.60	98.83	3,254,365.90	106.04
2000	2,851,028.90	2,908,215.80	102.01	2,983,969.10	102.60
2001	3,248,547.40	3,266,838.60	100.56	3,394,738.70	103.92
2002	3,285,977.60	3,300,497.20	100.44	3,549,115.80	107.53
2003	3,406,776.30	3,415,924.60	100.27	4,538,210.30	132.85
2004	3,353,060.30	3,278,980.40	97.79	3,716,632.40	113.35
2005	3,375,289.30	3,364,244.60	99.67	4,103,999.30	121.99
2006	3,620,761.20	3,656,982.20	101.00	4,357,828.50	119.16
2007	3,724,333.40	3,942,558.50	105.86	4,508,954.40	114.37
2008	3,868,300.50	4,146,022.20	107.18	4,896,075.10	118.09
2009	3,929,516.10	3,383,041.00	86.09	4,223,144.50	124.83
2010	3,573,111.30	4,760,638.30	133.24	4,897,606.30	102.88
2011	5,055,286.30	5,055,286.30	100.00	5,271,708.20	104.28
2012	5,128,985.90	5,073,473.60	98.92	5,398,963.30	106.42
2013	5,263,357.50	5,263,357.50	100.00	5,380,982.00	102.23
2014	4,908,316.70	4,905,893.20	99.95	5,123,115.50	104.43
2015	5,024,746.30	5,078,037.60	101.06	4,985,161.00	98.17
2016	5,563,592.80	5,230,805.20	94.02	5,073,441.70	96.99
2017	4,586,163	4,969,213	108.35	4,792,709	96.45

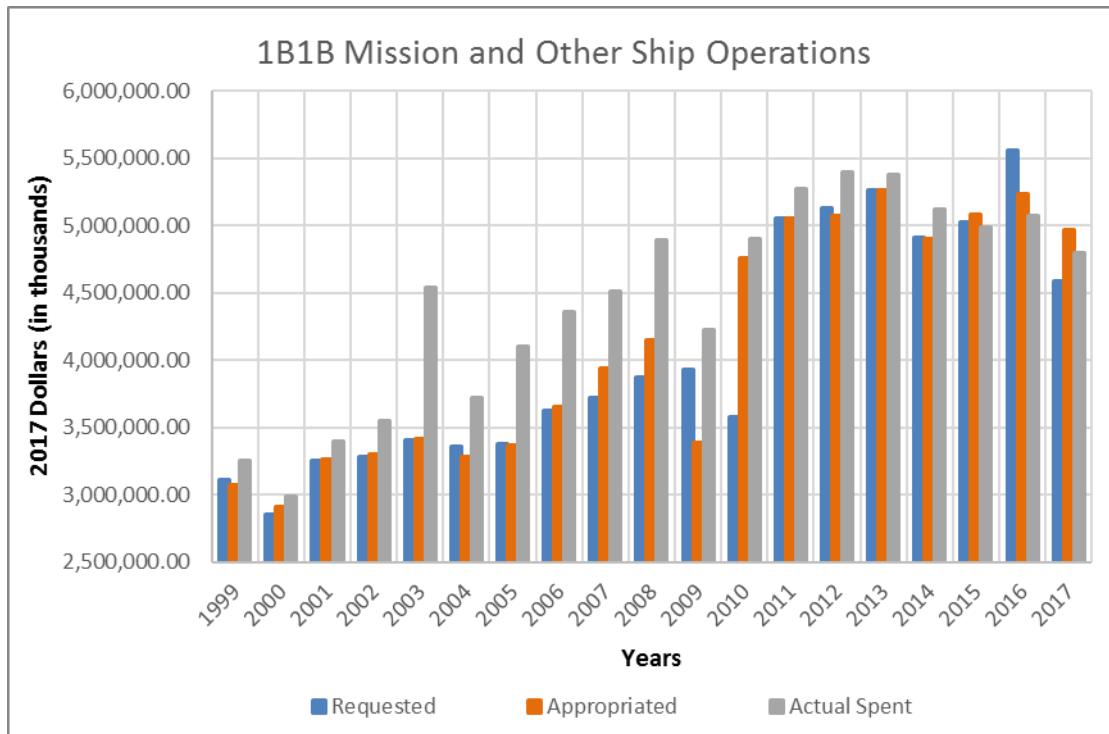


Figure 2. 1B1B Mission and Other Ship Operations totals.

The chosen 1B1B performance metrics have not accurately reported the operational abilities of the surface fleet. Over the course of the 18-year period, there are only two measures which are constantly reported: OPTEMPO, measured as the number of days underway, and the total number of Ship Years Supported. Graphing the total OPTEMPO days budgeted against the actual days ships were operational depicts a steady increase in actual the operational underway days which is consistently greater than the number budgeted, shown in Figure 3. There was a small spike in the 2013 budgeted and actual underway days which may have resulted from Congress’s approval of the Navy’s request to increase the funded number of OPTEMPO days for deployed forces by five days per quarter. This increase was a single event and was not incorporated into the new baseline OPTEMPO. The OPTEMPO actual underway days has an increasing trend despite the consistently lower number of budgeted days.

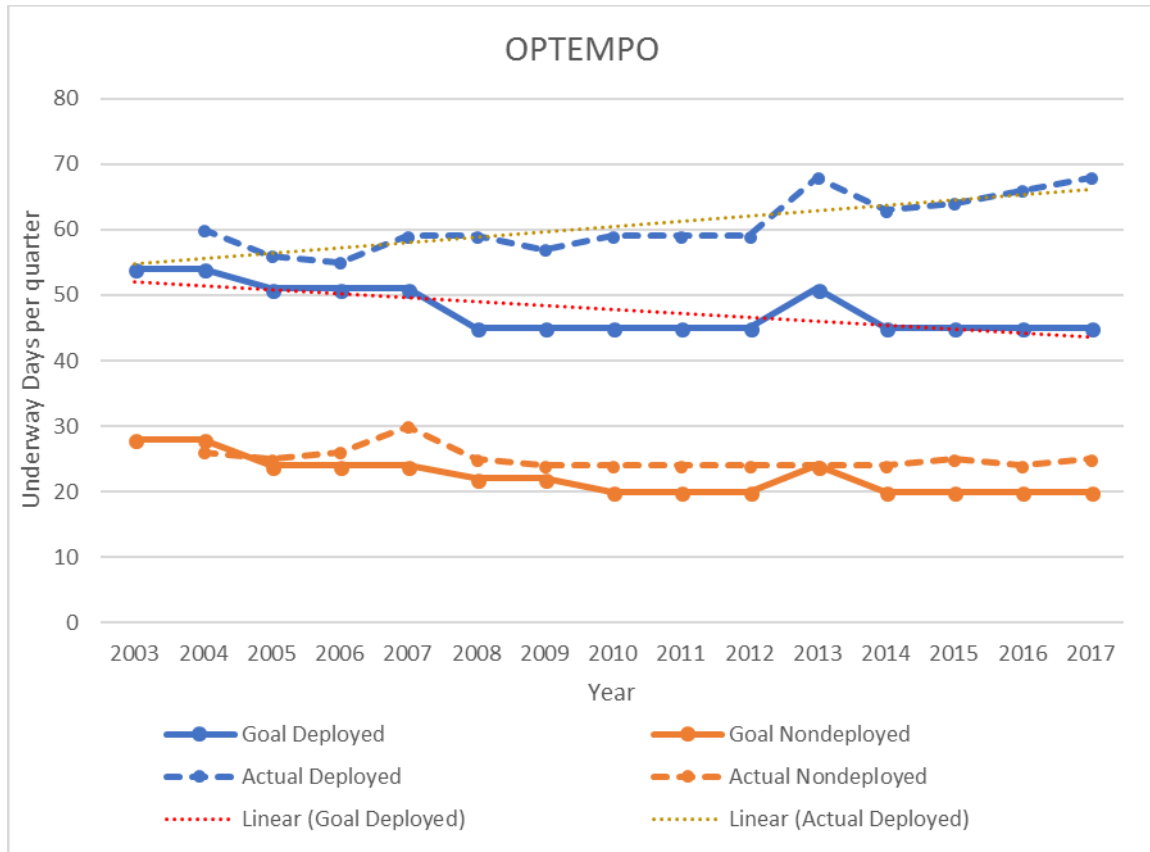


Figure 3. OPTEMPO for Actual Deployed Days Increasing Compared to the Decreasing Trend in Goal Deployed Days.

Within the ship years supported metric, there are two subcategories which change in 2003 and 2004 from conventional and nuclear assets (C/N) to deployed and non-deployed assets (D/ND). There is no explanation for the change within the budget section narrative, but it resulted in a lack of data in 2003 due to the conversion between the metrics. In 2008, two of the five reported metrics were removed with no explanation. The lack of consistently reported performance metrics, shown in Table 6, may have created uncertainty regarding the effectiveness and efficiency of the budget.

Table 6. 1B1B Performance Metrics as Reported in O&M, N Budgets 1999–2017. Source: SECNAV (1999–2017).

1B1B Mission and Other Ship Operations Performance Criteria Reported											
Year	Ship Inventory C/N	OPTEMPO Goal Days C/N	Ship Years Supported C/N	Ship Operating Months Supported C/N	UW Steaming Hrs C/N	OPTEMPO Goal Days D/ND	Ship Years Supported Total	OPTEMPO Days per Qtr D/ND	Ship operating Months Supported D/ND	Ship Steaming Days per quarter D/ND	UW Steaming Hrs D/ND
1999	X	X	X	X							
2000	X	X	X	X	X						
2001	X	X	X	X	X						
2002	X	X	X	X	X						
2003	X		X	X	X	X					
2004	X		X	X	X	X					
2005						X	X	X	X	X	X
2006						X	X	X	X	X	X
2007						X	X	X	X	X	X
2008						X	X	X	X	X	X
2009						X	X	X	X	X	
2010						X	X	X	X	X	
2011						X	X	X		X	
2012						X	X	X		X	
2013						X	X	X		X	
2014						X	X	X		X	
2015						X	X	X		X	
2016						X	X	X		X	
2017						X	X	X		X	

2. 1B1B DOCUMENTATION EFFECTIVENESS

The *Highlights* books consistently address the budgetary concerns and funding requirements of the programs in accordance with the overarching strategy and planning documentation. The Navy budget has been stretched to meet the increasing operational requirements with a decreasing fleet inventory which has increasing maintenance needs. The *Highlights* books place significant emphasis on the formulation of the budget based on guiding documentation, mission execution, and capabilities requirements. In 2014, the *Highlights* book detailed the 2013 congressional approval of an increase in OPTEMPO days for deployed forces by five days per quarter. However, the one-year increase demonstrated the need for the fleet to increase operations, leading to an increasing trend of actual OPTEMPO days for deployed forces from 2014 to 2017 as seen in Figure 4.

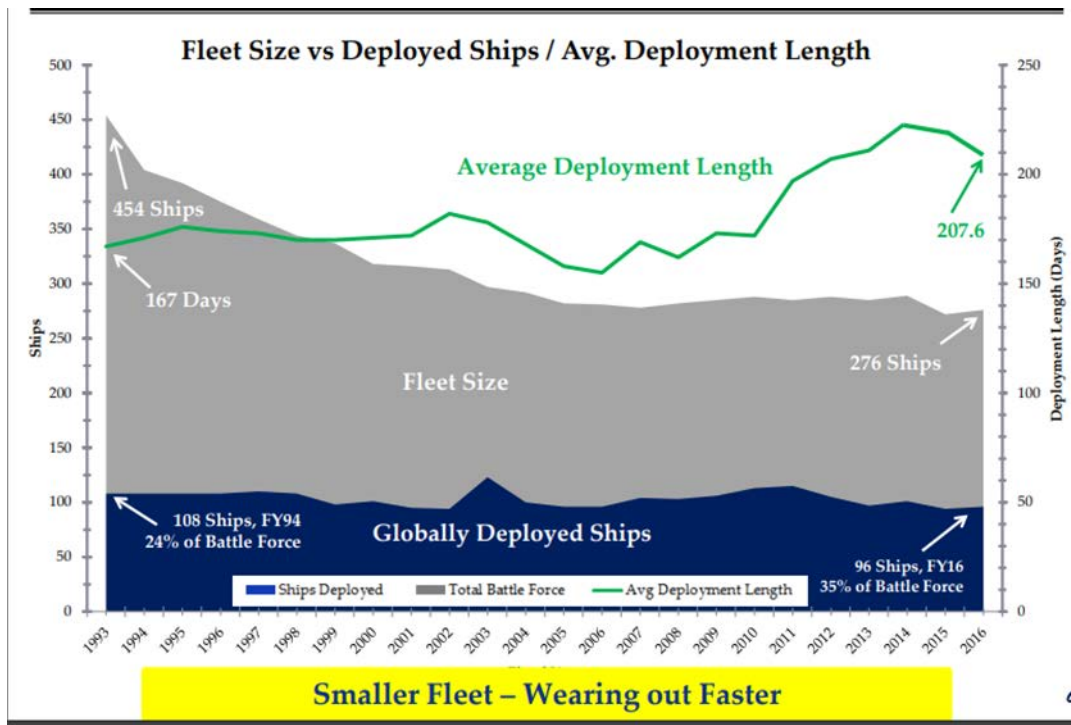


Figure 4. Fleet Size vs. Deployed Ships/ Average Deployment Length (Days). Source: DON, 2018, p. 6.

Over the 18-year study period, the *Highlights* books do an adequate job of explaining most of the budgetary changes. The graphical depictions of performance metrics show an increasing demand on ships due to the increasing OPTEMPO with an increasing budget yet a decreasing fleet size. The 1B1B funding does not appear to utilize adequate performance metrics to inform budgetary decisions but maintains strict adherence to governing documents and leadership guidance. The reporting challenge may be in the determination of which metrics are most informational to aid budgetary decision-makers. Despite the increase of fleet operations depicted, the consistent growth of the number of OPTEMPO actual underway days has not motivated congressional leadership to change the baseline OPTEMPO budgeted.

B. 1B4B SHIP DEPOT MAINTENANCE ANALYSIS

1. 1B4B EMPIRICAL ANALYSIS

For the 1B4B budget, the projected and appropriated totals remain close to each other over the 18-year study period, except for 2010 and 2017. While all three totals mirror one another in movement, the requested and appropriated totals remain within 6 % of each other, but the actual spent totals remain higher than the other two categories, per Figure 5 and Table 7. A dip in the 2010 projected totals may be due to the uncertainty surrounding the inclusion of OCO funding. The percent difference between the requested and appropriated totals in 2010 was over 200%, while the percent difference between the appropriated and actual spent totals were only within 20%. The actual spent totals were greater than the requested and appropriated totals yet vary in magnitude. There are two points in the actual spent totals where there was a dramatic spike, in 2003 and 2011. A note in the 2011 budget explanation stipulates that the requested budgeting does not include supplemental OCO funding (DON, 2011). Over the 18-year study period, the increase in the actual spent totals annually met or exceeded the requested totals for the scheduled maintenance despite the encountered uncertainties, shown in Figure 5 and Table 7.

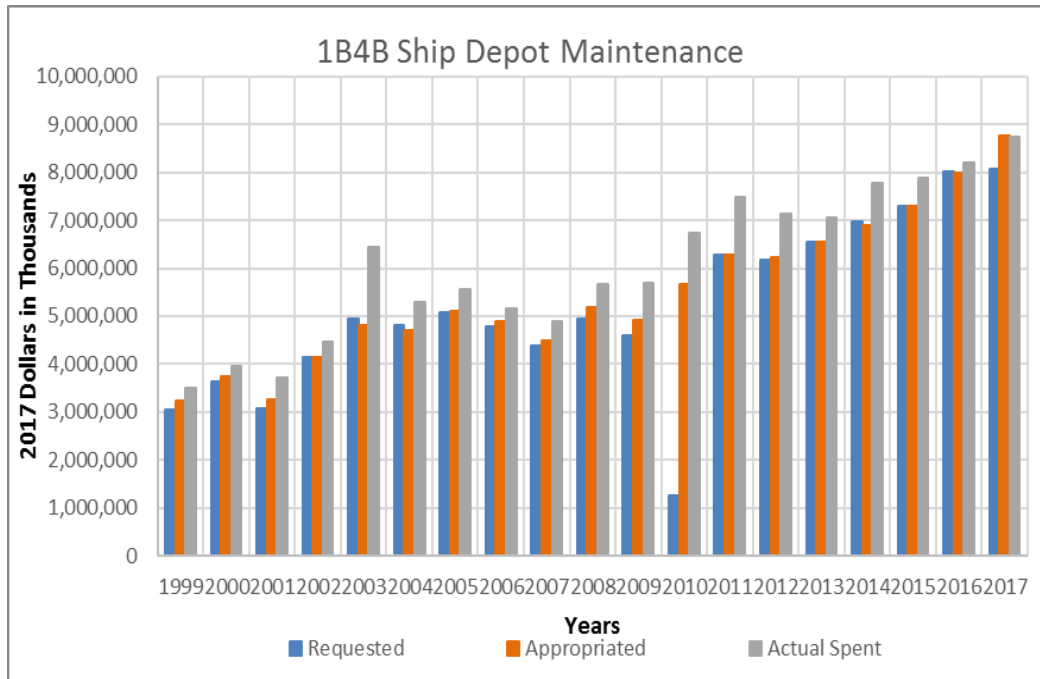


Figure 5. 1B4B Ship Depot Maintenance Totals by Year in 2017 Thousands of Dollars. Source: DON, 1999–2019.

The performance metrics for the 1B4B budget were constant across the 18-year study period. The SRA is a major ship repair period, scheduled by the Chief of Naval Operations, usually done within a shipyard drydock and includes hull and propulsion maintenance. The PMA is a ship repair period conducted with the ship pier side consisting of small systems and software upgrades. When graphed, the SRA projected and actual execution totals remain close for the first 10 years of the study period but deviate after 2010. The PMA actual executed totals are greater than the projected totals throughout the entire study period. Summing up the projected and actual availabilities for each year, the final availability totals can be used with other metrics to evaluate for availability budgeting effectiveness and efficiency annually. In the first 10 years of the study period, the availabilities budgeted and actual executed totals were very close. However, from 2010 to 2017, the number of availabilities budgeted was less than the number actually executed causing an increasing differential between the total number of budgeted and actual executed availabilities.

Table 7. 1B4B Ship Depot Maintenance Budget in 2017 Thousands of Dollars with Calculations for % of Previous Spent Totals.
Source: DON, 1999–2018.

1B4B Ship Depot Maintenance					
Year	Requested	Appropriated	Appropriated as % of Request	Actual Spent	Actual Spent as % of Appropriated
1999	3,042,163.70	3,240,595.50	106.52	3,489,520.60	107.68
2000	3,626,725.20	3,739,475.00	103.11	3,967,858.90	106.11
2001	3,068,448.60	3,270,338.20	106.58	3,719,125.20	113.72
2002	4,141,342.70	4,137,676.60	99.91	4,460,486.00	107.80
2003	4,931,780.50	4,819,677.70	97.73	6,440,231.30	133.62
2004	4,812,588.30	4,714,577.30	97.96	5,290,434.90	112.21
2005	5,066,813.90	5,113,887.20	100.93	5,568,801.00	108.90
2006	4,788,368.00	4,878,052.20	101.87	5,160,915.90	105.80
2007	4,377,921.00	4,499,315.80	102.77	4,885,621.00	108.59
2008	4,932,343.60	5,192,832.90	105.28	5,653,034.30	108.86
2009	4,599,641.10	4,916,655.50	106.89	5,700,308.50	115.94
2010	1,259,959.50	5,666,528.30	449.74	6,742,490.20	118.99
2011	6,285,485.20	6,285,485.20	100.00	7,479,800.40	119.00
2012	6,182,762.50	6,240,052.80	100.93	7,139,047.60	114.41
2013	6,540,515.60	6,540,515.60	100.00	7,057,822.00	107.91
2014	6,976,265.40	6,889,405.90	98.75	7,780,683.60	112.94
2015	7,297,468.90	7,307,758.20	100.14	7,894,784.30	108.03
2016	8,014,957.10	7,987,550.60	99.66	8,210,702.80	102.79
2017	8071704	8759163	108.52	8748872	99.88

When evaluating the types of availabilities, the number of budgeted and actual SRAs and PMAs overlap with each other from 1999 to 2009. From 2010 to 2017, there was a growing difference between the projected and actual SRA and PMA totals. The difference between the budgeted and actual executed totals of both SRAs and PMAs follows the same trends as the total availabilities, shown in Figure 6. However, the differential is most notable in the SRA budgeted and actual executed totals, as the number of availabilities executed was, on average, greater than the projected totals. Based on the 1B4B budget, shown in Figure 5, the Navy may not have been budgeting for SRAs as seen in years past, evident in the upward trending execution funding of the 1B4B totals in Figure

5. The overall 1B4B funding, in Figure 5, has an upward trend while the reported SRAs and PMAs totals, in Figure 6, are both downward trending. The SRAs and PMAs downward trends are in contrast to the OPTEMPO, which continued to increase ship wear and tear, leading to an increased need for depot level ship repairs, shown in Figures 3 and 4.

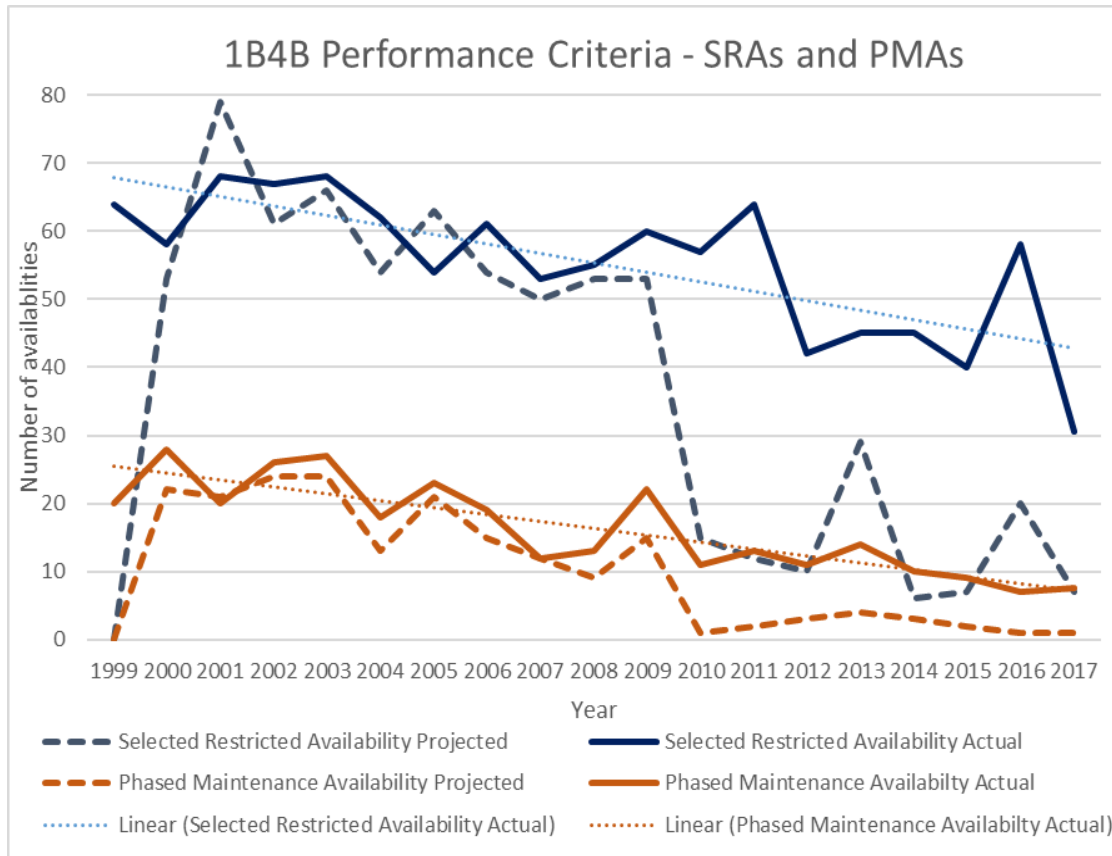


Figure 6. 1B4B SRAs and PMA Totals Projected and Actual Totals Executed 1999–2017.

2. 1B4B DOCUMENTATION EFFECTIVENESS

The *Highlights* books offered some explanation concerning the differential in 1B4B budget trends, but do not directly address the gap between the decreasing budgeted totals and the increasing actual spent totals. The decrease in the 2010 1B4B baseline budget may be partially due to the additional OCO funding for repairs and maintenance and the

realignment of “SSBN ERO funding to align the ERO work and budget responsibilities with those of other ship depot maintenance” (DON, 2010, p. 52). The actual spent totals remained above the other two budget totals by varying degrees and appeared to be reactionary to the desired strategies and fleet needs. The overall increasing trend in the 1B4B budget was discussed in the 2011 *Highlights* book as being due to the changes in the private shipyard costs for the industrial base and the expenses associated with availability growth work. The increasing 1B4B budget requested and actual spent totals were discussed regularly throughout the *Highlights* Books. The 1B4B budget increases were attributed to the increasing project expenses borne by civilian company contractors and their increasing operating costs associated with the changing demands of the growth work (DON, 2011–2015).

C. INTERACTIONS OF 1B1B AND 1B4B BUDGETS AND PERFORMANCE MEASURES

The budget trends and performance metrics offered additional understanding of the overall spending trends when used in combination with other trends and performance metrics. The total number of SRAs and PMAs executed was used with the ship years supported totals to calculate the number of availabilities as a percentage of ship years supported. These percentages described the total availabilities each year as a percentage of the ship years supported annually. The resulting graph showed that over time there was a growing differential between the actual and projected percentages. The lack of 2003 data caused the gap, shown in Figure 7, but there was a visible downward trend over the period of available data. The decreasing trendline is steeper for the projected percentages when compared to the actual percentages indicating that the budget was accounting for a greater decrease in the number of repairs budgeted than those actually executed.

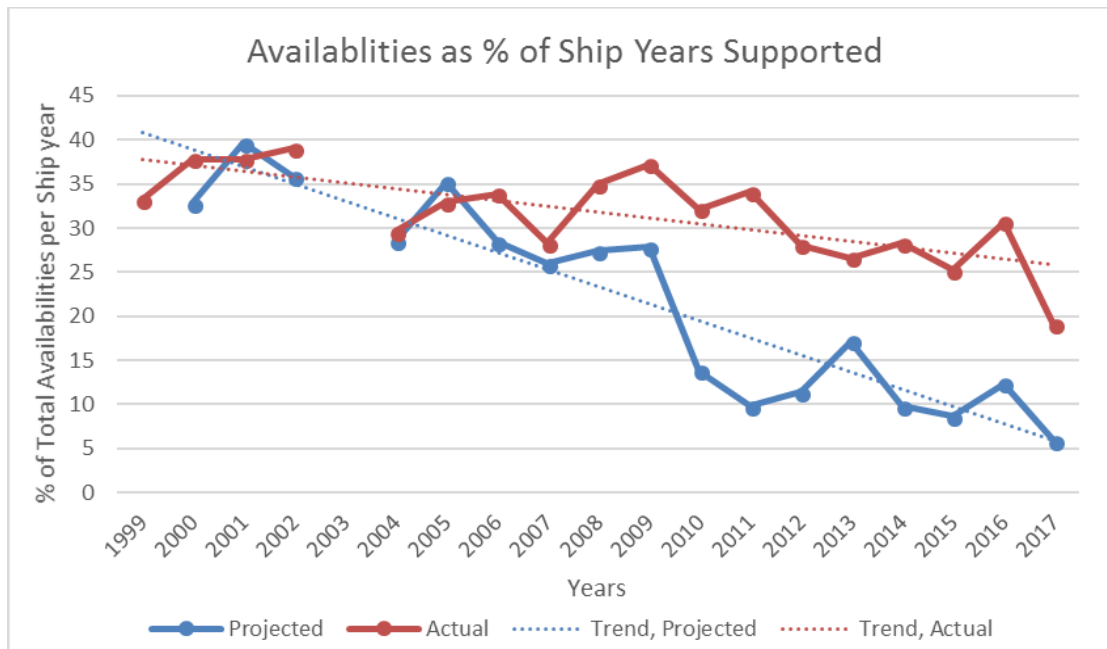


Figure 7. 1B4B Total Availabilities as Percentage of 1B1B Ship Years Supported.

The percentage of ship years supported, with assets in availabilities which were not operational, demonstrated the effectiveness of the maintenance to keep ships operational. The decreasing trendline for both projected and actual executed availabilities showed, that over the course of the year, a ship was spending a decreasing amount of time conducting depot repairs in an availability. This decreasing trend may be a contributing factor to any issues surrounding ship material readiness. A comparison of the availabilities as a percentage of ship years supported, shown in Figure 7, to the overall 1B4B funding, shown in Figure 5, showed the increased funding over the 18-year period with a decreasing number of executed availabilities. This may be due to the increasing cost attributed to each ship availability.

Using the 1B1B budget with the ship years supported total, the annual operating cost per ship year was calculated and graphed in Figure 8. Over the 18-year study period, the annual operating cost of each ship increased, with a spike in 2008 which may be due to the change in OPTEMPO budgeted days per quarter.

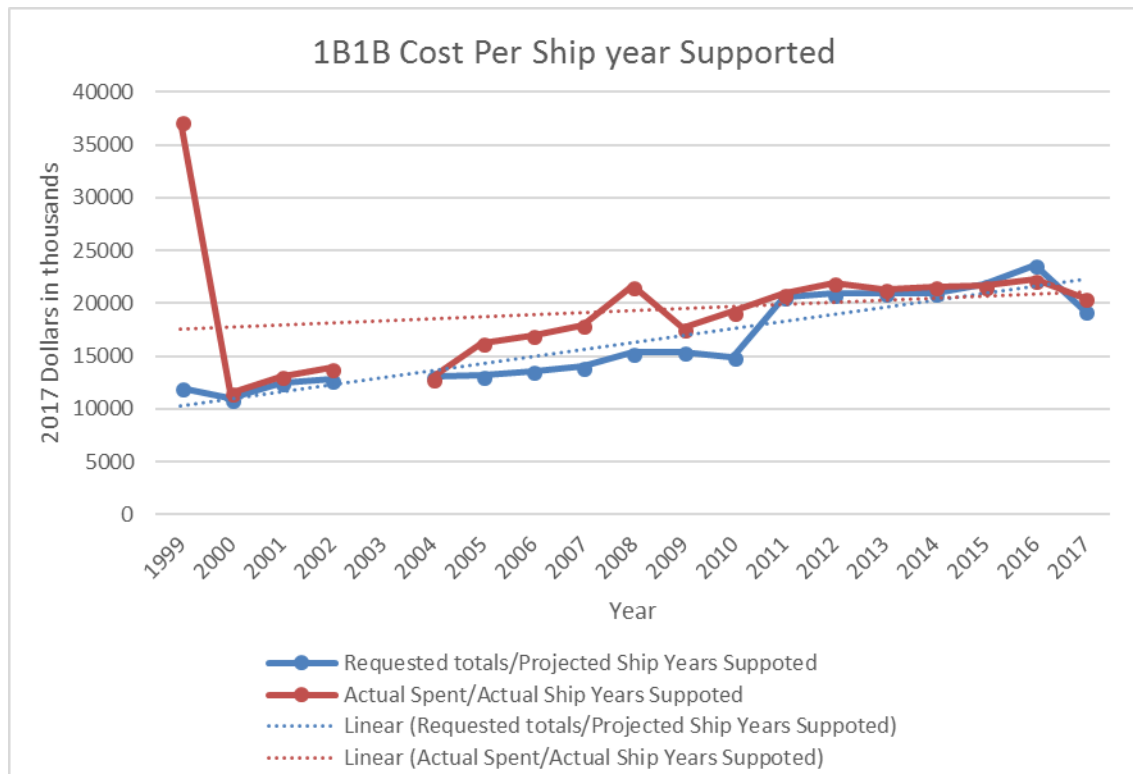


Figure 8. Calculated Cost of Operation per ship, 1B1B Funding Divided by Ship Year Supported.

Unfortunately, the 2008 OPTEMPO change was not used to inform later years as 2009 showed a decrease in OPTEMPO actual underway days. The overall increasing trendline slopes of both the requested and the actual spent totals indicate the increasing cost of operations supporting the increased demand for ship operations. The slope differences, in Figure 8, between the two trendlines show that the requested funding and projected ship years supported are getting closer to the actual spent totals in support of the actual ship years supported. Leadership may be working effectively to close the differential between the overall budget projections and the reality of annual fleet operations.

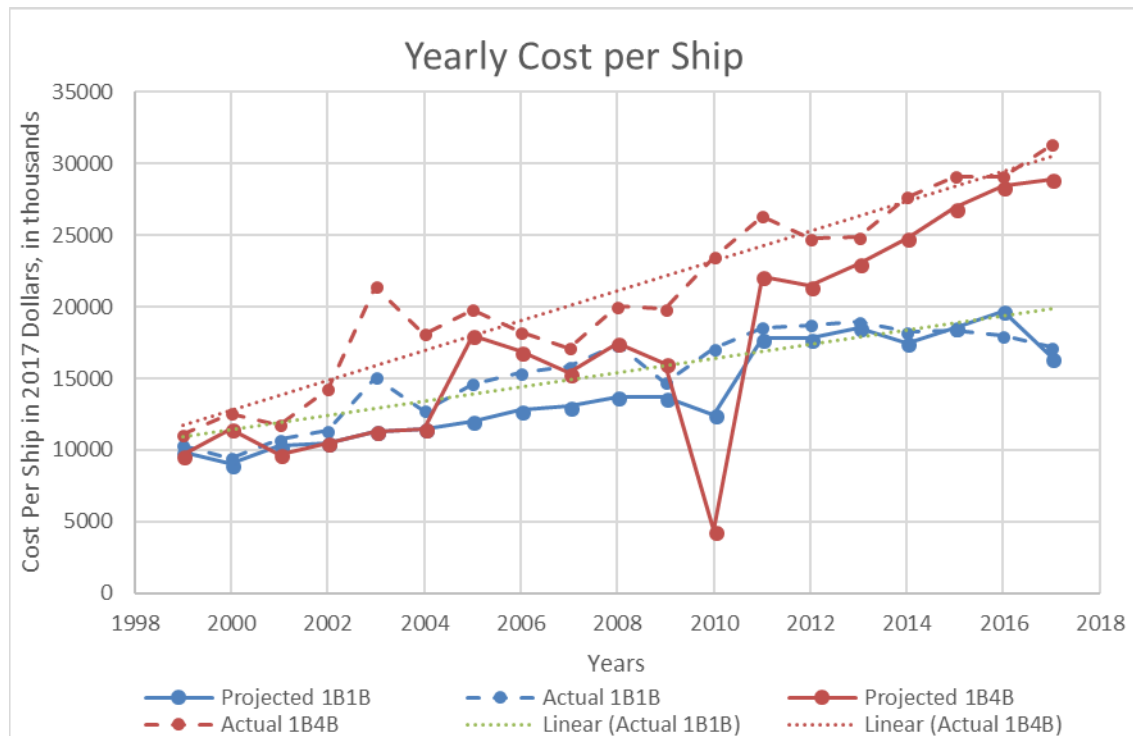


Figure 9. Yearly Cost per Ship under 1B1B and 1B4B Spending.

Using the requested and actual 1B1B and 1B4B totals with the aggregate ship inventory budgeted and actual, the operating cost budgeted per ship was calculated and graphed in Figure 9. There is a steep increasing trendline for the actual spent totals and gradually increasing trendline for the projected totals. Empirically, this demonstrates the increasing actual operating costs for the Navy, which was different from the budgeted costs of both 1B1B and 1B4B budgets.

Overall, the Highlights books do an adequate job justifying the requested budget, but, at certain points, there have been differences in what Congress appropriated and what the Navy requested. Much of what the Navy was requesting got appropriated, and more frequently, there were actual spent totals greater than even what Congress appropriated. The OPTEMPO underway days per quarter increased without a rise in aggregate ship inventory. The number of availabilities decrease with a reduction in annual time spent in a depot maintenance phase. The operating cost per ship and the cost of an availability were

increasing across the 18-year study period. There were increasing operational demands without an increase in assets or the proportional increase maintenance availabilities.

The trends and observations of this study show the overall changes in Navy budget formulation and Congress's general trust in the Navy leadership to determine the funding requirements to execute operations and adhere to guiding strategy. While the Navy O&M funding enables the success of deployed operations, there are areas for improvement in support of ships not in a deployed status.

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VI. CONCLUSION AND RECOMMENDATIONS

This study focused on the trends of the Navy 1B Ship Operations budget, specifically the 1B1B Mission and Other Ship Operations budget and the 1B4B Ship Depot Maintenance budget over an 18-year study period. In analyzing these budgets, several assessments were determined regarding Navy spending trends: trends in relation to the requested budget, the reflections of Navy ship performance compared to the planned budget, and the determination of a relationship between the funding levels and the reported performance metrics. The final aspect of this study discussed the accompanying budget literature to determine if the budget justification reflects the quantitative request in the budget.

A. CONCLUSIONS

The Navy spending of the 1B1B and 1B4B budgets showed different trends. The 1B1B budget requested and appropriated totals were within 5% of each other for most of the study period with the noted exceptions of a 2009 and 2010 due to OCO impacts on the budget. The 1B1B actual spent totals were more than 10% greater than the appropriated totals throughout most of the study period. However, from 2015 to 2017, the actual spent totals was less than the appropriated totals. These differences in spending may indicate a disparity in the budgetary model used to determine adequate funding levels for a given year. Within the last three years of the study period, there was a change in spending habits within the Navy toward not spending the full appropriated totals. There may have been a fiscal course correction within the Navy to only spend the appropriated budget.

The 1B4B budget shows different spending trends over the 18-year study period. There was an overall increase in the budget for the requested, appropriated and actuals spent totals. The percentage difference between the requested and appropriated totals were on average within 5%, with one exception in 2010, and the difference between the appropriated and actual spent totals were within 10%. The actual spent totals were greater than the appropriated totals except for 2017, which showed a 0.12% decrease. The closeness of all three totals indicated that funding was spent as intended.

An analysis of the performance metrics reported within the 1B1B and the 1B4B determined very different trends for each budget. The 1B1B performance metrics reported were inconsistent across the 18-year study period, making an analysis of ship performance difficult. There were only two performance metrics which were reported across all years, the aggregate ship inventory and the total ship years supported. These two metrics portray a limited picture of ship performance in relation to the budget. There were two distinct periods of performance metrics used, 2000 to 2002 and 2004 to 2017. The performance metrics used from 2000 to 2002 were not comparable to the metrics used from 2003 to 2017. In 2003, the shift in reporting metrics meant that the reported data was different than all other metrics resulting in a gap of comparable performance metrics. Using the consistently reported performance metrics from 2004 to 2017, the budgeted OPTEMPO remained relatively unchanged despite an increase actual OPTEMPO totals. According to the 1B1B performance metrics, the Navy may be underbudgeting or regularly exceeding budgeted performance.

The 1B4B performance metrics show continuity across the 18-year study period and demonstrate consistent performance trends. There are six metrics that are consistently reported and were used to determine performance trends for the budget. Using the SRA and PMA projected and actual executed totals, there were steep downward trends in budgeting availabilities with less steep downward trends in the actual execution of both types of availabilities. When compared to the 1B4B budget, the downward trend of metrics and the upward trend in the overall budget, may indicate there are other factors involved in the maintenance spending or possibly the increased expense of maintenance execution.

Evaluating the relationship between funding levels and performance metrics within this study consisted of determining whether the reporting of performance metrics was influential in the funding decisions by budgetary decision-makers. Budgetary decision-makers do not appear to have the information they need to evaluate the funding effectiveness when using the 1B1B performance metrics due to the lack of reporting consistency across the 18-year study period. There were no explanation of the metrics within the budgets to inform the reader and provide data and performance metrics context. Without a budgetary explanation of the performance metrics and their application to

funding, the performance metrics are only data points. The 1B4B performance metrics have greater consistency from year to year which enabled annual comparison. The reported performance metrics are applicable to the activities of the 1B4B funding which allow for budgetary decision-makers to have pertinent information when making funding decisions. The relevance of the 1B4B performance metrics was indicated through the small percent-change between the requested, appropriated and actual spent totals.

Within the budgetary literature, there are many themes which changed annually based on many influential factors. The literature showed chapter fluctuations between themes and categories while focusing on overarching topics for emphasis to Congress. The format fluctuations make overall performance comparison difficult. The literature mainly emphasized the governing strategy documents published by higher headquarters and the near-term funding goals for specific and high-visibility concerns of Navy leadership. Leadership changes, global issues, and force composition were all common threads throughout the literature over the 18-year study period. Improving budget practices would be facilitated through the solidifying a standard format for the budgetary literature, as well as solidifying standard performance metrics particularly for the 1B1B budget. The inconsistencies within the literature format were reflected in the performance metrics reported which may be due to the changes of leadership authoring both documents.

The consistency of budget formatting was a significant conclusion of Grizzle and Pettijohn (1997), who stressed that regularity within the budget format and the reported data had an impact on the decisions made. The differences in the effectiveness of the 1B1B budget and the 1B4B budget supports this conclusion. The information the performance metrics conveyed within the 1B4B budget have been applicable and informative, whereas the 1B1B performance metrics may not have been as descriptive of the fleet condition for budgetary decision-makers. The lack of streamlined formatting was identified by Grizzle and Pettijohn (1997) and Balint (2013), respectively, as having been within the control of the Executive Branch leadership, yet there was not the rigorous oversight needed. The differences between the 1B1B budget and the 1B4B budget emphasis Robinson's (2007) findings, differentiating the outcome verses output measures in budget formulation. The comparative success of the 1B4B budget to the 1B1B budget showed that the application

and relevance of reported performance metrics may lead to greater budgeting precision by congressional leadership. This study found similar findings to the SRR (Roughead & Bayer, 2017) which specified the need of greater use of applicable performance metrics. The SRR (Roughead & Bayer, 2017) identified OPTEMPO and the maintenance schedule as significant performance metrics for fleet condition assessment.

Certain budget practice recommendations by Ball and LeRoux (2006) were validated by this study. They determined that inefficiencies within the budgeting process caused the deviation from good business principles (Ball & LeRoux, 2006). The overall inconsistency and lack of transparency between annual budgets and literature formatting prevent the formulation of an effective and efficient budget (Ball & LeRoux, 2006). This study demonstrated the need of increased business practice applications.

For this case study, there were several points which limited the scope and depth of the study. When analyzing the 1B1B and 1B4B budgets, the inclusion of OCO to determine overall effect on the baseline was hindered due to the reporting format of the separate OCO funding document. The OCO budget was subdivided by the active operations for that fiscal year, which changed from year to year. This annual change makes comparison of budget trends difficult, thus not analyzed in this study. Additionally, there are not associated performance metrics which could be used for determining effectiveness and efficiency of the OCO spending. This study only analyzed the budgets selected due to lack of available budgetary data for more specific funding accounts. As research was conducted into line items on the 1B1B and 1B4B budgets, there was a loss of fidelity of subsequent budgets. This issue is addressed in several years of budget literature which emphasizes a need for increased fiscal accountability at all levels of command.

B. RESEARCH RECOMMENDATIONS

Expanding or building off this study could take various forms. An analysis of the OCO 1B1B budget could reveal interesting spending trends or if there is a relationship between the OCO spending and the 1B1B baseline spending. Since the introduction of OCO spending in 2009, an analysis of OCO supplemental funding could evaluate the

effects experienced on the 1B1B budget. Additional analysis could determine implications of re-aligning the 1B1B budget baseline spending for deployed ships to decrease a possible dependence on OCO spending and identify the areas for improvement and the challenges such a realignment would pose.

An analysis of the 1B1B budget focused on tracing the funding down to the ships' individual accounts may determine the percentages spent on resources for the ship compared to the funding of administrative costs. This would reveal the amount the ships receive from the appropriated budget for parts and services, and how much of the budget is spent on administrative support of the ship throughout the chain of command. An analysis of the 1B4B budget focused on tracing the funding to the specific contracts and companies may aid in determining the amount actually spent on ship repair, the percentage of growth work incurred, and the cost of administrative support for each contract.

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