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ACQUISITION RESEARCH PROGRAM:
CREATING SYNERGY FOR INFORMED CHANGE

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ACQUISITION RESEARCH PROGRAM:
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Assessing the Reliability of the Future Years Defense Program and Building a Forecast

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Abstract

Discerning, negotiating, and communicating priorities are necessary tasks for the U.S. defense acquisition system to effectively implement its portion of the National Defense Strategy. One of the Department of Defense's central tools for doing so is the Future Years Defense Plan (FYDP), a projection of the cost and composition of the force over the next five years. However, the publicly released FYDP suffers from important limitations: there is tension between expressing administration preferences and accurate projection, no confidence intervals or other measures of reliability are provided, predictable budget elements have been transferred beyond the scope of the FYDP, and the detailed investment projections are challenging to gather and employ. This project works to make the FYDP more accessible and more easily evaluated. It posits two hypotheses using Fiscal Year (FY) 2018 budget request data: first, that FYDP projections could estimate actual 2019 spending more reliably than the President's Budget alone, and second, that the reliability of projections would vary between services. The simple regression model employed found that the two-year-out FYDP projections significantly improved the reliability of estimates for procurement line items and RDT&E program elements.

Disclaimer

The Center for Strategic and International Studies (CSIS) does not take specific policy positions; accordingly, all views expressed in this presentation should be understood to be solely those of the author(s).

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and Shivani Pandya, that included collection of some of the justification book files used in this report and contributed valuable experience. That team along with Kayla Keller and Yuanjing Han also worked to develop a tool to make the data more accessible that inspired the forecasting approach that will be included in this project's final technical report. Kyle Libby and Simone Williams also offered valuable quality checking towards that effort that informed our understanding of the sources included in this paper. Finally, the study team would like to thank their DIIG colleagues for their review and support.

Introduction

Discerning, negotiating, and communicating priorities are necessary tasks for the U.S. defense acquisition system to effectively implement its portion of the National Defense Strategy. One of the Department of Defense's (DoD) central tools for doing so is the Future Years Defense Plan (FYDP), a projection of the cost and composition of the force over the next five years. Annually updated and submitted as part of the president's budget submission projection, the FYDP provides important insights into the DoD's priorities and projections of the future, both internally and externally. Internally within the DoD, wherein the FYDP is constructed, the process forces the stakeholders involved to debate trade-offs and outline their visions of the future. Externally, it lays out for Congress a vision of how U.S. national security strategies could be implemented in practice, which the legislature must then choose whether to fund or alter. It helps the U.S. defense industry understand where the DoD plans to invest and thereby allows companies within the industry to align themselves with current priorities. It helps scholars identify trends and do research on major capital-intensive projects, which can be used to inform future projects, both defense and nondefense. It helps U.S. citizens identify how the government plans to spend their taxpayer dollars. However, the FYDP has a few major drawbacks for these stakeholders that undercut its ability to communicate priorities.

The first drawback is the inherent tension between the FYDP's role expressing the funding amount that the executive branch deems necessary to support the strategy and its role forecasting the funding amount that will actually materialize. Most years, this has meant that the administration requests and projects more funding than is ultimately provided which can undermine its role in priority-setting.

A second, related shortfall is the absence of any measure of reliability or confidence intervals for the projections. Some parts of the DoD budget are easier to predict than others, but the point estimate provided by the FYDP does not differentiate between known quantities, like the purchase of uniforms, and cutting-edge technology, like the development of a next generation alloy. That said, by design, Overseas Contingency Operations (OCO) budgets operate as a pressure valve for uncertainty by taking some of the most volatile spending out of the base budgets and FYDP and managing them through OCO methods instead. However, the intended functionality of the OCO accounts is muddled when predictable spending is moved to OCO accounts to avoid budget caps.

Third, the unclassified FYDP is released in a form that makes it straightforward to study topline spending or individual line items or programs but challenging to analyze anything in between. This is because the FYDP is released in hundreds of PDFs through separate justification books, and not as a centralized database or even in summary documents. Collectively, these limitations present a higher barrier to entry to stakeholders and make it laborious for specialists and unappealing for anyone else to put investment plans in a meaningful context. Without analysis, it is difficult to tell the difference between a figure reliably reported for years and an uninformative placeholder.

To give context to these results, the background section details how the FYDP is constructed and key related concepts: OCO budgets and the two accounts that make up



investment spending, Procurement and Research, Development, Test, and Engineering (RDT&E). Building off this background, the conceptual framework outlines hypotheses regarding FYDP reliability and drivers thereof.

This report tests the value of the unclassified FYDP for investment spending, RDT&E and Procurement, as a bottom-up indicator of DoD priorities by testing whether the FYDP information released with the fiscal year (FY) 2018 President's Budget (FY 2018 PB) was capable of meaningfully forecasting actual spending in 2019. The FYDP was largely prepared by the prior administration and not formally released that year. Moreover, the budget request was submitted at the end of May, the "latest a budget has been submitted to Congress since the president was first required to submit budget requests in FY 1923" (Harrison & Daniels, 2017, p. IV). To test these hypotheses and to make the FYDP more accessible and more easily evaluated, the study team, in cooperation with other researchers, has systematically imported budget data with the most complete data captured from the 2018 through 2021 President's Budgets. The Data and Methods sections lay out where this data comes from and how it was imported and validated, and then introduces the variables and a model that examines how well the FYDP from the 2018 President's Budget predicts actual spending in 2019.

The report section describes the results of the simple regression models included in this report: the two-year-out FYDP projections significantly improved the reliability of estimates for procurement line items and RDT&E program elements compared to the President's Budget alone. The Discussion and Conclusion section analyzes these results with the conclusion and next steps, drawing out larger implications and previewing the next stages of this research.

Background

Planning, Programming, Budgeting, and Execution Process

Planning, Programming, Budgeting, and Execution (PPBE) is a DoD process to allocate resources based on strategic objectives. This process was formerly called the Planning, Programming, and Budgeting System (PPBS) and was established by Secretary of Defense (SECDEF) Robert S. McNamara in 1961 with the goal of connecting budget allocations with specific objectives and plans. In a typical fiscal year cycle, the PPBE process starts more than two years before the expected year of budget execution (McGarry, 2020).

The first phase, planning, is led by the under secretary of defense for policy. In addition, the chairman of the Joint Chiefs of Staff (CJCS) also plays an important part in this process. "The phase involves reviewing the President's National Security Strategy (NSS), the SECDEF's National Defense Strategy (NDS), and the CJCS's National Military Strategy (NMS) to ensure the resulting Defense Planning Guidance (DPG) aligns with the Administration's policy goals and takes into account potential threats, force structure, readiness posture, and other factors" (McGarry, 2020, p. 1). The planning phase focuses on reviewing threats and assessing capabilities but is not constrained by expected resource levels.

The programming phase is executed by the services in coordination with the Office of Cost Assessment and Program Evaluation (CAPE). The main focus of this phase is compliance with DPG. Being more constrained by resource and fiscal considerations, the programming phase is tasked with turning DPG into achievable and affordable programs. To do so, the heads of the military departments are charged with creating a Program Objective Memorandum (POM). These POMs cover five years of resource requirements and are reviewed and updated by CAPE, with any changes made via Resource Management Decisions.

The third phase of the PPBE process, budgeting, is led by the under secretary of defense (comptroller). The budgeting stage focuses on preparing an "executable and defensible



budget" with input from the military services (Hebert, 2011, p. 27). The comptroller, under OMB guidance, reviews estimates for the FYDP's first year. Those results are then reviewed by the SECDEF with help from comptroller analysts, and, after any changes are resolved with the military services, submitted to the OMB (McGarry, 2020).

The OMB works on the budget during the winter months, and the President's Budget is typically transmitted to Congress in February (McGarry, 2020). Congress in turn possesses the power of the purse and may choose to change the amounts in the budget bills. The potential for disagreement between the two branches is an important limitation on projection reliability. This phase ends when the president signs the authorization and appropriation bills into law. If the appropriation bill is not signed into law by October 1, Congress may pass a continuing resolution (CR) which usually locks in pre-existing spending levels and prevents new starts. If neither the appropriation bill nor CR is enacted, the government would go into a temporary shutdown, although even in a shutdown "[normally] ... DoD continues minimum essential operations based on national defense requirements" (Department of the Army, 2016, p. 24). The occurrence of CRs and shutdowns does not bode well for effective projection, budgeting, or implementation.

The final phase, execution, is primarily focused on the implementation of the strategy using the funds made available by the budget. The program results are reviewed during this phase, "develop[ing] performance metrics, measur[ing] performance against plan, assess[ing] actual output against planned performance, and adjust[ing] resources to achieve desired performance goals" (Hebert, 2011, p. 28). These execution reviews are conducted in parallel with program and budget reviews to allow this information to feed back into prioritization and spending decisions (McGarry, 2020).

Future Years Defense Plan

The FYDP projects resource needs over a five-year period, which include the President's Budget and the next four years, also called the out years. The FYDP is conducted annually with a rolling five-year window. Within the PPBE process, it is typically created in the programming phase and updated to reflect decisions made during the budgeting phase. The FYDP database illustrates programs and plans by components (military service or defense agency), Major Force Programs, and appropriation titles (military personnel, procurement, RDT&E, operations and maintenance, etc.; McGarry & Peters, 2020). The FYDP database itself is not publicly released, but since 1989, significant portions are unclassified and published as part of the budget release (Mehta, 2020). The form of the unclassified FYDP numbers varies from between the appropriation titles, but consistently includes actual and enacted spending totals for the two years leading up to the budget in addition to the five years of projections, thus covering a total of seven years in each release. As a result, the information released from the FYDP is a vital tool to evaluate the growth or decline of various programs within the DoD.

Historically, most administrations project more funding than materializes, showing "systematic fiscal optimism" (Jordan, 2015, p. 274). This can be seen in Figure 1, which shows in black the actual base budget authority going back to the projections and actuals for Fiscal Year 1980 (FY80). The FYDP projections are shown by dashed lines, with their color varying by the administration responsible for putting together the FYDP.¹ When the dashed line is above the black line, the FYDP is estimating more resources than will actually be available. This optimism is a problem for the acquisition system because it means that when something goes

¹ The process of preparing the FYDP takes long enough that when a new administration takes office in January after an election year, much of the work has been done by the prior administration, albeit with possible input from the new administration's transition team after the prior year's November election.



wrong, there is not a reserve of resources to address the problem. Effective projection should force difficult choices in the present, before expensive commitments have been made, rather than in the future, where cost overruns or budget shortfalls may terminate programs experiencing difficulty or raid funds from programs that are presently successful. This can also become a problem for the defense industry. Firms investing based on soaring spending projections may quickly go into debt, and vendors that lose faith based on projections that rarely materialize may be unprepared to meet demand when higher budgets do come.

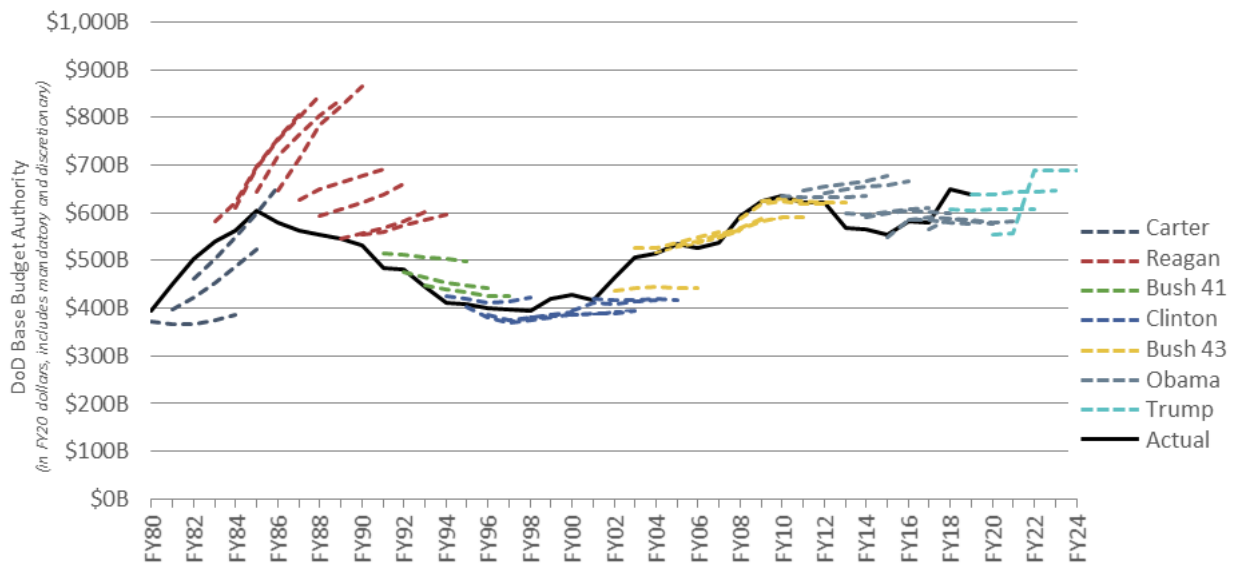


Figure 1. Topline DoD FYDP Projections Reported by DoD Greenbook

(Harrison and Daniels 2020, p. 11)

In light of the tension between the FYDP’s role in communicating the administrations’ intentions and the most likely future, as well as the scrambled signals about projection reliability, why is the FYDP worth studying? First, an effective defense strategy requires “maintain[ing] a reasonable balance among three factors: preparing to be ready today (readiness), preparing to be ready tomorrow (investment), and sizing the force (structure)” (Hicks, 2017). Amid a crisis, boosts in structure and readiness are not available off the shelf, and policymakers must instead make do in the near term with what capabilities are already in place. For investment spending, the focus of this report, time horizons are long. Time frames for even moderate-risk new programs are measured in years and with the upper range in excess of a decade before reaching initial operating capability (Tate, 2016; Wagner & Decker, 2011). Long-term estimates for individual weapon systems are necessary for making trade-offs in time and cost, but still must be put in a larger context to allow for trade-offs both between investment programs and across readiness, investment, and structure.

However, if some form of understanding of this trade space is critical for defense planning, does the FYDP provide enough value to make up for its widely observed weaknesses? Stakeholders in Congress and outside analysts weighed in after a March 2020 Pentagon legislative proposal that would “remove the statutory requirement to submit an Unclassified Future-Years Defense Program (FYDP) to the Congress, the Congressional Budget Office, the Comptroller General of the United States, and the Congressional Research Service” (Aftergood, 2020, p. 1). The proposal was grounded not in the aforementioned critiques



of the FYDP, but in concerns of how adversaries could use the information.² The response was an immediate backlash, with House Armed Services Committee Ranking member Mac Thornberry saying that he understood the concern but that the proposal was “a bad idea” (Mehta, 2020). Rep. Thornberry elaborated:

The House believes “that the greater good is the transparency with the American people. So that’s our default position, I think in both parties,” Thornberry said. “They hadn’t made their case to me yet, but I think it’s going to be hard for them to overcome that default position.” (Mehta, 2020)

Thomas Mahnken, president of the Center for Strategic and Budgetary Assessment and former deputy assistant secretary for policy planning, noted that the Pentagon has long protected certain aspects of the budget from scrutiny but made the case that this has been successfully balanced with disclosure and that “there is also a compelling case for disclosing how the Defense Department plans to spend its resources and whether its budget is aligned with its strategy. ... Transparency ultimately helps the Defense Department make the case for the resources it needs in Congress as well as the public at large” (Mehta, 2020).

Steven Aftergood (2020), who broke the news of the proposal, made the case that the FYDP was irreplaceable for oversight:

Without an unclassified FYDP, Congress and the public would be deprived of unclassified analyses like *Long-Term Implications of the 2020 Future Years Defense Program* produced last year by the Congressional Budget Office (2019). Other public reporting by GAO (1993), CRS (McGarry & Peters, 2019), the news media and independent analysts (Karako & Rumbaugh, 2020) concerning the FYDP and future defense spending would also be undermined.

The DoD has subsequently stated that the proposal should be interpreted as merely a repeal of the reporting requirement passed in 2018 and that the change “would not affect or change how DoD currently provides budget information” (Mehta, 2020). There is a multitude of defenders of public access to the FYDP because, for all of its limitations, “it is an indication, with considerable detail, of the Defense Department’s priorities and trade-offs among modernization, force structure, and readiness” (Harrison & Daniels, 2020, p. 11).

When considering the data included in the unclassified release of the FYDP, a few areas are worth special consideration. First, while OCO spending is excluded from the four years of FYDP projections past the President’s Budget, it is important to understand the category of spending to make sense of the larger budget context. Second, projections are especially important for those appropriation titles with longer time frames, RDT&E, and Procurement. These investment budgets are the focus of this paper, and their relationship is key to understanding the life cycle of programs working through the FYDP.

Overseas Contingency Operations

OCO is funding set aside in the federal budget to cover marginal expenses for overseas operations, including conflict and other emergencies. This source of funding helps cover the

² Specifically, the proposal noted risks that adversaries could apply modern information technology to combine the unclassified FYDP with other open source information and “derive sensitive information by compilation about the Department’s weapons development, force structure, and strategic plans” (Aftergood, 2020, p. 1).



costs of equipment and maintenance over and above the course of normal operations.³ Given this emphasis, OCO spending is inherently volatile and dependent on the state of the larger world. As a result, the elements of the budget covered by OCO would be inherently difficult to estimate regardless of the budgetary process used. OCO funding is exempt from most of the PPBE Multi-Year Budgeting process and is excluded from the FYDP projections in the four years beyond the President's Budget. This division has the advantage of easing the process of creating a reliable FYDP by excluding some of the least predictable elements of the defense budget.

However, this distinction has been undercut by budgetary maneuvering since the passage of the Budget Control Act (BCA) of 2011. In an attempt to reduce federal budget deficits, the BCA established spending limits on discretionary budget authority, applying to both defense and non-defense programs. These limits do not apply to the OCO budget. Subsequently, the executive and legislative branches have evaded the caps by transferring some predictable enduring spending out of the base budget and into OCO spending. This approach has been criticized by some defense experts and government officials from both parties. Katherine Blakeley and Lawrence Korb (2014) from the Center for American Progress voice their concerns that "financially, the free flow of war funding has decimated any pretense of fiscal discipline at the Pentagon. ... Unclear budget guidance and poor financial management have allowed DoD to pay for substantial enduring costs with war funding rather than the base budget, further muddying the waters" (Blakeley & Korb, 2014, p. 28). Acting White House Chief of Staff Mick Mulvaney has also criticized in strong terms the "use of OCO funding for base budget requirements" (McGarry & Epstein, 2019, p. 9).

The Congressional Budget Office (CBO) estimates that from 2006 to 2018, more than \$50 billion in OCO funding per year (in 2019 dollars), on average, has gone toward the costs of enduring activities rather than the temporary costs of overseas operations. This is particularly transparent in the FY 2020 President's Budget, the last dashed cyan line on Figure 1, which is below current levels for two years and then leaps above current levels for the remaining three years. As Harrison and Daniels (2020) report, "the request shifted entire categories of funding, such as Army Ammunition Procurement, from the base budget into OCO" (p. 4). With the coming expiration of the BCA caps in FY 2021, the FYDP released with the FY 2020 budget request then shifts all the money back to base spending after the expiration. The zigzag line of the FY 2020 FYDP does not inspire trust in the quality of the projections for the years where OCO spending is implied but not reported.

The insertion of enduring items within the OCO budget does not necessarily undermine the value of OCO in those cases where it is still used as intended. Andrew Hunter (2019) defends OCO by noting that in the last decade, a major portion of OCO funds was used to support the operations of Afghan security forces. As the actual size, operational employment, and equipage of these forces has changed rapidly, OCO funds were extremely useful to sustain the mission. Due to the fact that the levels are not planned out a full five years in advance, OCO allows the performance of missions that might be practically impossible otherwise. Moreover, the origin of OCO was an attempt to bring more oversight and transparency to wartime emergency supplemental bills. Senator McCain, objecting to the inclusion of non-emergency procurement in a supplemental bill, "demanded that DoD submit its request for war funding along with the regular budget so that it might receive a similar level of congressional scrutiny as the base budget and so that it would be less easy to embellish with non-war-related funding"

³ Andrew Hunter (2019) outlines an example: "the base budget pays the salaries of an Army unit and its normal organizational and training expenses, but OCO pays the additional marginal cost of transporting the unit overseas for operations, the costs of fueling and resupplying the unit while deployed, and special pays associated with deploying the unit such as hostile fire/imminent danger pay."



(Hunter, 2019). The shift of predictable spending from the FYDP to OCO accounts is contrary to the spirit of those reforms and a failure to communicate executive branch priorities to Congress, industry, and other observers.

Procurement and RDT&E

Projections are especially important to investment spending, which in the U.S. system is covered under the RDT&E and Procurement appropriation titles. Taken together, RDT&E and Procurement accounted for an average of over 30% (12% and 19%, respectively) of DoD budgets between 2001 and 2017 (Mann, 2017).

Prior to moving to the procurement phase, programs are often considered in development and funded through the Research phase; RDT&E plays a crucial role in maintaining U.S. defense technological superiority. Spending is divided across seven Budget Activities, from Basic Research (6.1) to operational Systems Development (6.7).⁴ These budget activities largely track the life cycle of technology maturation:

Funding in codes 6.1 to 6.3 is referred to by DoD as the science and technology (S&T) budget. This portion of DoD RDT&E is often singled out for attention by analysts, as it is seen as the pool of knowledge necessary for the development of future military systems. In contrast, 6.4, 6.5, and 6.7 funds are focused on the application of existing scientific and technical knowledge to meet current or near-term operational needs. The funds in 6.6 are for RDT&E management and support work in any of the other RDT&E. (Sargent, 2019, pp. 1–2)

RDT&E programs that mature past the Engineering and Manufacturing Development Phase or other items with less need for development may then be purchased under the Procurement appropriation title. The DoD procurement appropriations title “provides funds for non-construction related investment costs—the costs to acquire capital assets, such as an F-35 Joint Strike Fighter aircraft or a Virginia class submarine” (McGarry & Peters, 2020, p. 1). Under the policy of full funding, “the total funding necessary to acquire a useable end item is approved by Congress in a single fiscal year, even though related work may span many years” (McGarry & Peters, 2020, p. 1). Incremental funding is another annual option, one that divides the system’s cost over multiple annual increments. However, this approach is largely limited to ships and submarines. A third approach, oriented towards savings per unit, is Multiyear Procurement (MYP). The prerequisites for Congress authorizing MYP include “significant savings, stable funding and design, and other standards” (McGarry & Peters, 2020, p. 2). Thus, MYP is at the opposite end of the predictability scale from OCO spending, as the costs and funding sources should both be well understood. The government gives up flexibility under MYP, making advance commitments and payments, in exchange for lower total costs. This discussion of full funding, incremental funding, and MYP is focused at the system level, but another way to break up procurement over multiple years is to procure components of a larger system rather than the entire platform. Advanced procurement applies to MYP, but also is relevant to a larger swath of component purchases for major programs that may not meet the MYP criteria (McGarry & Peters, 2020, p. 2). While the specifics vary, FYDP projects are especially relevant to, and should be informed by, any alternative to single year full funding.

⁴ Justin Doubleday (2020) reported earlier this year that the DoD was considering an eighth budget activity to cover software. Like 6.6 funding, this classification would be more focused on the type of work being done rather than the stage of research.



Scope and Hypotheses

The objective of this research is to assess the reliability of the FYDP as a planning tool and to develop publicly assessible analytical tools for defense spending that take the underlying reliability into account. This paper seeks to answer the following questions:

- How reliable are projections within the FYDP as an indicator for actual spending?
- Which services and budget categories have the most and least reliable projections?

The hypotheses discussed next are intended to add rigor and structure to the exploration of FYDP reliability and to address the first and second research questions, respectively.

Future Years Defense Projection and Changes in Actual Spending—Direct Relationship

Creating and implementing a strategy is a process of matching means to ends. The planning stage of the PPBE incorporates the opinions of combatant commanders and service leadership outlining what resources they will need to meet the strategy laid out by executive branch civilian leadership. This planning is shaped by intentions but requires setting priorities and choosing what balance of investments will be best able to meet the strategy's future needs. The programming process, which produces the FYDP, seeks to further tether these priorities to real world constraints and to identify where further trade-offs are necessary to reconcile plans across the department. This priority setting exercise means that even when systemic biases are present, the process of FYDP creation should identify which procurement line items and RDT&E programs are more or less important to the DoD. This means that the bottom-up detailed information in the FYDP can be valuable even if the topline spending estimate is off the mark. Moreover, the longer cycle-times of investment spending mean that even a critical new technology will be ramping up spending over multiple years or a somewhat outmoded platform may be allowed time to complete its current block of production. Thus, at the margins, each year of the FYDP should reveal information about prioritization above and beyond that in the President's Budget and therefore add value at the margins to forecasting efforts.

H_{1A}: A future years defense projection of an increase (decrease) for a procurement line item directly predicts an increase (decrease) in actual spending for that line item.

H_{1B}: A future years defense projection of an increase (decrease) for an RDT&E program element directly predicts an increase (decrease) in actual spending for that program element.

Projecting Component and Reliability of Future Years Defense Projection Estimates

The planning process that feeds into the FYDP is filtered through the separate processes of the military departments which have their own distinct leadership, history, bureaucratic incentives, and approaches. These differences were further shaped by the different time horizons of the platforms they focus on. In particular, the 30-year shipbuilding plans reflect the Navy's orientation emphasis on a smaller number of complex and high value platforms where new technology may be more readily inserted from ship to ship and limited shipyard space strictly contains the number of units that can be under production simultaneously. Likewise, the military departments often put different weights on the importance of readiness, force structure, and investments, and thus may prioritize other funding accounts over investment spending as well as the associated analytical processes and personnel used for projection. As a result, the reliability of projects should vary between DoD components. For this hypothesis, the categorical variable of DoD component acts as a mediating variable for the reliability of FYDP projections.



H_{2A}: The reliability with which a procurement line item's future years defense projection directly predicts actual spending for that line items varies based on the DoD component responsible for the projection.

H_{2B}: The reliability with which an RDT&E program element's future years defense projection directly predicts actual spending for that program element varies based on the DoD component responsible for the projection.

Data and Methods

Data Sources and Structure

DoD budget data is reported in multiple forms and through multiple sources. At the aggregate level, the OMB Public Budget Database covers budget authority for the FYDP across the federal government. The DoD comptroller site also provides the DoD Greenbook, which provides decades of history on a variety of different measures of spending, again aggregated at a high level. The DoD Greenbook provides topline Procurement and RDT&E for the overall DoD as well as the military departments. The OMB data offers greater granularity, particularly for Procurement, including main account codes such as "Procurement of Weapons and Tracked Combat Vehicles, Army" or "NATO cooperative defense programs."⁵

The most pertinent limitation of the OMB and the DoD Greenbook is that they do not provide detail on priorities within those broad accounts. These sources can inform a truck manufacturer of the Army Procurement topline, but not the anticipated need for various categories of cargo transports. Likewise, an analyst that finds certain areas of technology to be promising or overhyped cannot easily observe changes in patterns of investment. For major weapon systems, there are multiple government sources that overcome this limitation: the DoD provides a document on Program Acquisition Costs by Weapon System and Selected Acquisition Reports,⁶ and the GAO produces its Weapon System Annual Assessment that casts an often skeptical eye on DoD cost and schedule estimates.⁷ However, while this reporting on Major Defense Acquisition Platforms does cover a significant portion of DoD investment spending, it does not include many smaller items or early stage research, which is not associated with specific programs. This project seeks to go beyond these major programs for both financial and policy reasons. Todd Harrison (2016) reports that as of the FY 2016 President's Budget, "these smaller programs account for an average of 57 percent of the total acquisition budget over the FYDP" (p. 24). Moreover, during the study period, the DoD is increasingly experimenting with alternate channels, including mid-tier acquisition and other transaction authority, responding to pressure from the executive branch and Congress to pursue speed and innovation.

To better understand this era of reduced reliance on the major weapons system pipeline, this report chooses to focus its attention on procurement line items and RDT&E program elements. This is not the most detailed level of analysis available; however, it has the advantage of being a unit of analysis of interest to a broad community of practitioners and observers while

⁵ The study team recommends Todd Harrison and Seamus Daniels' (2020) *Analysis of the FY 2020 Defense Budget and Its Implications for FY 2021 and Beyond* as an accessible walkthrough of the data in these and other topline reports.

⁶ SAR topline link. Thanks to Freedom of Information Act requests, many of the underlying documents, rich with qualitative and quantitative data, are available through the DoD FOIA reading room.

⁷ See Oakley, S. S. (2019). *Weapon system annual Assessments: Limited use of knowledge-based practices continues to undercut DoD's investments* (GAO-19-336SP). GAO.



also being available from multiple sources. The first pair of these sources are the P-1s for Procurement and R-1s for RDT&E. These budget documents are provided as spreadsheets that cover the entire DoD enterprise, going back to the 1998 President's Budget.⁸ However, these detailed and convenient documents do not include projections past the President's Budget and are missing the bulk of the FYDP.

Instead, for detailed future year projections at the procurement line item (P-40) and RDT&E program element (R-2) level, it is necessary to turn to the Justification Books. In these documents, the military departments and agencies lay out their spending requests and describe what is being bought as well as provide program management details. A major challenge for open source researchers is that these documents are provided as large PDFs, not in the machine-readable format of the sources discussed earlier. Moreover, for investment spending alone, each President's Budget is accompanied by dozens of these files, splitting the information based on organization and funding account.

Importing and Validation

This project seeks to overcome the limitations of the justification books and does so with the benefit of two external sources. First, a predecessor FYDP analysis led by Gabriel Coll bulk laid the foundation for this project by downloading many of the justification books, converting them, exporting them to rough spreadsheets, and then cleaning them up and combining that spreadsheet information.⁹ A parallel effort by CSIS's Defense Budget Analysis (DBA) group greatly accelerated this effort with the discovery of the justification books, which, starting with the FY 2013 FYDP, have included XML encoded spreadsheets that do not require the intensive data cleaning effort necessary when scraping PDFs. The DBA effort provided the FY 2020 and FY 2021 FYDP, which has been extended back to FY 2018 by this study at the time of this report.

To allow for cross-comparisons, the team has imported R-1s and P-1s files from the comptroller website for the budget requests from FY 2011 to FY 2021; the study team often had multiple choices as to which file, and in some cases, which columns to include. As a rule, if appended reports were available, the most recent one was preferred for this report. Similarly, the reporting of enacted budgets in multiple years, typically those with continuing resolutions or multiple supplementals, include variant columns. In those cases, whether the columns covered base, supplemental, or total spending, the column that included continuing resolutions or more recent enactments was chosen.

Where possible, greater granularity was also preserved. For all of the years in this report, there was OCO spending, and for enacted and president's budget years, the dataset was constructed to allow differentiation between base and OCO spending. The level of granularity available varies based on the source. The reported actual values in both sources are always aggregated, and the FYDP reporting also aggregates the enacted amounts. The enacted amounts for the R-1s and P-1s show the greatest variation between years, reflecting the range of divergences from usual order as budgets were enacted late, requiring continuing resolutions, and sometimes split spending across multiple supplemental bills.

The largest validation challenge has been inconsistency in the unique identifiers across years and sources. This has been the biggest issue with Procurement line items, where the P-1 may use one identifier and the P-40s use another in the same source year, with the same line item description, and the same actual, enacted, and president's budget numbers. In future

⁸ The budget materials may be found at the DoD Comptroller's website:
<https://comptroller.defense.gov/Budget-Materials/>

⁹ The acknowledgments at the start of this paper recognize the team behind this predecessor effort.



steps, the study team intends to match line items and program elements across years and sources to the extent practicable.

Measuring Dependent and Independent Variables

Table 1 shows the two reporting years for the FYDP that were included in this model: the FY 2018 FYDP and the FY 2021 FYDP. For this report, the modeling was limited to P-40 and R-2 data only and to those line items and program elements that matched across both; the years projection is constructed entirely with elements available in the FY 2018 FYDP, which can be seen bolded in Table 1: actual spending (FY 2016) as a comparison baseline, the PB Base and OCO requests (FY 2018 for both), and the second year of the FYDP (FY 2019). The light blue arrows show the connection between the first two years of the FYDP and the subsequent reporting year for the corresponding actual data. The reported actual spending always lags the start of the FYDP by two years, and so it is necessary to wait three years to find out if the second year of the FYDP was accurate and a full six years to find out if the fifth year of the FYDP projections were on target.

Table 1. Guide to FY Reporting Available from the FY 2018 FYDP to the FY 2021 FYDP

FYDP Reporting Year	Budget Request (Available in P-1s, P-40s, R-1s, and R-2s)			Out Years (FYDP Exclusive [i.e., P-40s and R-2s])			
	Actual Spending	Enacted Budget	President's Budget	2 nd Year of FYDP	3 rd Year of FYDP	4 th Year of FYDP	5 th Year of FYDP
FY 2018 FYDP	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
FY 2019 FYDP	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	
FY 2020 FYDP	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022		
FY 2021 FYDP	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025

All dollar amounts are current dollars, with one exception noted in Δ Actual ('19 vs. '16), and all values are derived from the unclassified FYDP released alongside the FY 2018 budget request.

Dependent Variable

Rather than estimating the absolute level of spending in 2019, this model attempts to capture the change in spending levels. This approach assumes that with all else equal, base budgets would remain constant from year to year and that the value of projections is to discern whether they will instead be increasing or decreasing and, if so, by what magnitude.

Δ Actual('19 vs. '16) measures the difference between the FY 2016 and FY 2019 actual spending for a line item or program element. Those amounts are reported in current dollars in the FY 2018 PB and the FY 2021 PB respectively. A positive number means spending increased; a negative one means it was reduced.

Study Variables

The study variable is the projection for the second year of the FYDP, expressed in two different ways depending on the model. The study team's preference would be to be consistent between both models, but for the procurement model, including both Δ FYDP2('19 vs. '18 PB Base) and Δ PB Base('18 vs. '16 Actual) violated the diagnostic thresholds for multicollinearity.

Δ FYDP2('19 vs. '18 PB Base) measures the difference between the second year FYDP projection for FY 2019 versus the PB base request for 2018 for a line item or program element. This variable is intended to be used in conjunction with **Δ PB Base ('18 vs. '16 Actual)** to capture the marginal contribution that the inclusion of the second year of the FYDP provides to the model. It is used in the R-2 model.



ΔFYDP2('19 vs. '16 Actual) measures the difference between the second year FYDP projection for FY 2019 versus actual spending in 2016 for a line item or program element. This variable includes the entire difference between the projection for '19 and the actual spending for '16, disregarding the base figure in the President's Budget. Use of this variable thus provides less granularity but still tests the predictive power of the second year out FYDP projection. It is used in the P-40 model study model.

Other Independent Variables

ΔPB Base('18 vs. '16 Actual) measures the difference between the President's Budget base request for FY 2018 versus the actual spent amount for 2016 for a line item or program element. This variable is intended to capture the portion of change from 2016 to 2019 that could have been estimated by the budget request alone. It is used in the R-2 model and the P-40 control model.

PB OCO ('18) is the President's Budget OCO request for 2018. Unlike the other variables it is included in absolute rather than difference terms. FYDP projections do not include OCO spending so they can be compared to the PB base request in a straightforward manner, but OCO falls in a different, more volatile category. It is used in all three models.

Estimating Equation

The change in line item or program element spending is estimated using ordinary least squares regression.

Equation 1 RDT&E Program Element Estimating Equation

$$\text{Estimated } y_i = \beta_1 \text{Intercept} + \beta_2 \Delta \text{FYDP2 ('19 vs. '18 PB Base)}_i + \beta_3 \Delta \text{PB Base ('18 vs. '16 Actual)}_i + \beta_4 \text{PB OCO ('18)}_i + \epsilon_i,$$

Equation 2 Procurement Line Item Control Estimating Equation

$$\text{Estimated } y_i = \beta_1 \text{Intercept} + \beta_2 \Delta \text{PB Base ('18 vs. '16 Actual)}_i + \beta_3 \text{PB OCO ('18)}_i + \epsilon_i,$$

Equation 3 Procurement Line Item Study Estimating Equation

$$\text{Estimated } y_i = \beta_1 \text{Intercept} + \beta_2 \Delta \text{FYDP2 ('19 vs. '16 Actual)}_i + \beta_3 \text{PB OCO ('18)}_i + \epsilon_i,$$

Results

How complete is the FYDP?

Modeling FY 2018 PB Estimate of 2019 Actual Spending

The results of both the RDT&E and Procurement models are shown in Table 2. Because the R-2 model did not encounter multicollinearity challenges, it is able to include both the second year out base prediction and the PB base prediction in the same model. That was not possible for the P-40 sample, and thus two models are presented, a control model in the middle that only includes information available in the PB and a study model on the right that includes the second year out projections.

In the R-2 model in the second column, the study variable, ΔFYDP2('19 vs. '18 PB Base), shows a direct relationship between the FYDP2 estimate and actual spending and is significant at the 0.1% level, affirming H_{1A}. All of the budget variables are denominated in thousands of dollars. The coefficient of 0.61 means that for a \$100,000 increase (decrease) in between the PB base and the FYDP2 projection, the actual amount spent is estimated to



increase (decrease) by \$61,000. The difference between the PB base and the actual spend is also significant at the 0.1% level and has a greater magnitude coefficient. A \$100,000 increase (decrease) in PB base request over the actual spend is estimated to increase (decrease) the actual spending by \$84,000. While the coefficient for the PB OCO request is slightly larger than that for the study variable, the standard error for PB OCO is larger still, suggesting considerable volatility.

Table 2. Estimating Actual 2019 Spending

	R-2 Study Model	P-40 Control Model	P-40 Study Model
(Intercept)	10727.85*** (2215.47)	10928.14 (11777.66)	18884.76** (5765.87)
Study Variables			
ΔFYDP2('19 vs. '18 PB Base)	0.61*** (0.05)		
ΔFYDP2('19 vs. '16 Actual)			0.85*** (0.02)
Budget Request			
ΔPB Base('18 vs. '16 Actual)	0.84*** (0.03)	0.16*** (0.02)	
PB OCO ('18)	0.62 (1.11)	0.33 (0.38)	0.80*** (0.19)
AIC	21913.63	14314.40	13578.59
BIC	21937.51	14331.38	13595.57
Log Likelihood	-10951.82	-7153.20	-6785.30
Deviance	3608321622957.78	34976739933940.22	8380737385908.66
Num. obs.	877	515	515

***p < 0.001, **p < 0.01, *p < 0.05, p < 0.1.

The P-40 model was unable to include ΔFYDP2('19 vs. '18 PB Base) and ΔPB Base('18 vs. '16 Actual) in the same model due to multicollinearity issues. To test the hypothesis, the study team tested two different models, one with only the PB requests and one with ΔFYDP2('19 vs. '16 Actual) replacing both ΔFYDP2('19 vs. '18 PB Base) and ΔPB Base('18 vs. '16 Actual). Both the Akaike information criterion (AIC) and Bayesian information criteria (BIC) metrics prefer the model with the lower score, which in this case is favorable for the P-40 study model over the P-40 control model. In addition, the 0.85 coefficient for ΔFYDP2('19 vs. '16 Actual) is notably larger than for the control parameter, although both are significant at the 0.1% level. This support for a direct relationship between FYDP2 projections and actual spending affirms H_{1B}. In the study model, a \$100,000 increase in the difference between the FYDP2 estimate and the three years earlier actual spend estimates \$85,000 more in spending. For this model, the PB OCO parameter is also significant with a \$100,000 PB OCO request in 2018 estimating \$80 more in actual spending in 2019.

Discussion and Conclusions

Both the RDT&E and procurement variants of Hypothesis 1 were upheld, as the FYDP2 projections for 2019 were able to significantly estimate actual spending, even after controlling



for the base and OCO estimates in the FY 2018 PB. This positive result was achieved even though the acting DoD comptroller noted that the OMB reported that the FYDP topline was not created in a manner that inspired confidence: “what OMB has provided to date for the Defense Department is a flat top line beyond F.Y. '18, which is simply the F.Y. '18 number that is extrapolated and inflated across the out years” (Roth & Ierardi, 2017). Similarly, the support for Hypothesis 1 cannot be attributed to the role of top-level leadership, as the same press conference warned that “the secretary has not spent any time at all looking at anything beyond F.Y. '18 to date” due to an ongoing process up updating the larger strategy” (Roth & Ierardi, 2017).¹⁰

This result underlines the value of making the detailed FYDP RDT&E and procurement projections accessible, as they contain information that cannot be derived simply from looking at topline numbers or listening to leadership briefings. This result does not, in and of itself, contradict critiques of the FYDP as on average only three- to four-fifths of the estimated changes materialized. Moreover, an alternate interpretation of the absence of high level attention is not that it risks undercutting the FYDP process but that the Office of the Secretary of Defense letting the services run the PPBE process may have actually been more effective at capturing their preferences in a way that may not be replicated in other administrations. Nonetheless, the significance of the model suggests that the priority signal in the FYDP is worth listening to and that further efforts to increase its transparency and adjust for its weaknesses would improve communications to policymakers, analysts, and industry.

Next Steps

The next stage of this project will incorporate additional years of FYDP data, cross-reference this data across sources and years, and increase the sophistication of modeling techniques to address two additional research questions:

- What measurable factors are correlated with projection accuracy or inaccuracy?
- Where is a more accurate forecast for future DoD spending possible, and what would it look like?

By incorporating unclassified FYDP data from FY 2013 to FY 2017, the project will be able to examine further-out FYDP projections and compare other starting years with the unusual conditions in FY 2018. In addition, the study team will develop a code book to ease matching up procurement line items, in particular, across years and between the P-40s and P-1s. Combining these sources, in addition to pulling in other funding-account level contract information, will allow for addition of new variables to the model and aid in understanding the drivers of FYDP reliability.

In addition to expanding, improving, and publishing a dataset to make FYDP data easier to understand and more transparent, the next stage will include an assessment of the reliability of select DoD budget plans. This will include an assessment of how accurate projections are compared to actual spending overall and by key budget categories. Therefore, companies, media, and academia will have a clearer sense of how likely defense investment is to materialize.

¹⁰ That said, John Roth went on to specify that “the goal was that new defense strategy would be in -- would inform anything beyond FY '19 in terms of the FY '19 to 23 program, for example” (Roth & Ierardi, 2017). Thus, further analysis on the significance of a changing strategy with regards the predictive value of the FYDP projections released in FY will have to await the availability of actual FY 2020 spending numbers.



Third, building off the modeling in this paper, the final report will use predictive analytics to develop a most likely budget forecast for the selected categories. By accounting for these factors, the final product will give stakeholders in government, industry, and the public a more accurate assessment of budget projections.

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