ACQUISITION INNOVATION RESEARCH CENTER

DoD Obligation and Expenditure Rates

More-Realistic Benchmarks and the Effects of Continuing Resolutions and Other Events on Obligation Rates

EXECUTIVE SUMMARY AND REPORT

FEBRUARY 2024

PRINCIPAL INVESTIGATOR

Philip S. Antón, *Stevens Institute of Technology*

CO-PRINCIPAL INVESTIGATOR

Douglas J. Buettner, *Stevens Institute of Technology*

STEVENS INSTITUTE OF TECHNOLOGY 1870

SPONSOR

Commission on Planning, Programming, Budgeting, and Execution (PPBE) Reform
(a legislative advisory committee established under Section 1004 of the National Defense Authorization Act (NDAA) for Fiscal Year 2022, Public Law 117-81, 12/27/2021)

DISCLAIMER

The Acquisition Innovation Research Center (AIRC) is a multi-university partnership led and managed by the Stevens Institute of Technology and sponsored by the U.S. Department of Defense (DoD) through the Systems Engineering Research Center (SERC)—a DoD University-Affiliated Research Center (UARC).

This material is based upon work supported, in whole or in part, by the U.S. Department of Defense through the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S)) and the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) under Contract HQ0034-19-D-0003, TO#0190.

The views, findings, conclusions, and recommendations expressed in this material are solely those of the authors and do not necessarily reflect the views or positions of the United States Government (including the Department of Defense (DoD) and any government personnel) or the Stevens Institute of Technology.

No Warranty.

This Material is furnished on an "as-is" basis. The Stevens Institute of Technology makes no warranties of any kind—either expressed or implied—as to any matter, including (but not limited to) warranty of fitness for purpose or merchantability, exclusivity, or results obtained from use of the material.

The Stevens Institute of Technology does not make any warranty of any kind with respect to freedom from patent, trademark, or copyright infringement.

SYSTEMS ENGINEERING RESEARCH CENTER

AIRC ACQUISITION INNOVATION RESEARCH CENTER

STEVENS INSTITUTE OF TECHNOLOGY 1870

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RESEARCH TEAM

Name	Organization	Labor Category
Philip S. Antón	Stevens Institute of Technology	Principal Investigator; AIRC Chief Scientist
Douglas J. Buettner	Stevens Institute of Technology	Co-Principal Investigator; AIRC Deputy Chief Scientist

ACKNOWLEDGEMENTS

We would like to thank the Commission on Planning, Programming, Budgeting, and Execution (PPBE) Reform for their sponsorship and support throughout this research. In particular, the questions, discussions, and feedback from the Commission chairs and staff were extremely helpful: the HON. Robert Hale, the HON. Ellen Lord, as well as the commission staff, especially Lara Sayer (our sponsor of record), Annie Crum, Elizabeth Bieri, Caroline Bledsoe, Kelle McCluskey, Brooks Minnick, and Soleil Sykes. We would also like to thank David Cadman and Mark Krzysko of OUSD(A&S), for assistance in obtaining Level-1 earned-value data, and John Stedge in the Chief Digital and Artificial Intelligence Office (CDAO), for guiding us on how to pull the Obligations and Expenditures data from Advana. Thanks to Scott Lucero and Nathan Self from Virginia Tech for support with extracting USASpending.com data from their data repository. Finally, we would like to acknowledge and thank our Stevens staff: Technical Editor, Nancy Méndez-Booth for her editorial review comments and suggestions, and Tara Kelly for her project management skills, edits, and overall support.

ACRONYMS AND ABBREVIATIONS

ACWP	Actual Cost of Work Performed
AIRC	Acquisition Innovation Research Center
CR	Continuing Resolution
CRS	Congressional Research Service
DAU	Defense Acquisition University
DC	District of Columbia
DoD	Department of Defense
Exp.	Expenditures
EVM	Earned-Value Management
FPDS	Federal Procurement Data System
FY	Fiscal Year
GAO	Government Accountability Office
HON.	Honorable
MAB	Month After Budget
MABP	Months After Budget Passed
MILCON	Military Construction
MILPERS	Military Personnel
NDIA	National Defense Industrial Association
O&M	Operation and Maintenance
Obl.	Obligations
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OUSD(A&S)	Office of the Under Secretary of Defense for Acquisition and Sustainment
OUSD(R&E)	Office of the Under Secretary of Defense for Research and Engineering
PALT	Procurement Administrative Lead Time (sometimes also defined as Procurement Action Lead Time)
PPBE	Planning, Programming, Budgeting, and Execution
PROC	Procurement
R&D	Research and Development
RDT&E	Research, Development, Test, and Evaluation
SERC	Systems Engineering Research Center

UARC	University-Affiliated Research Center
U.S.	United States
USD	Under Secretary of Defense

ABSTRACT

This paper reviews relevant theory and data to assess ways to improve Department of Defense (DoD) execution benchmarks for the obligation and expenditure of funds. Linear models of obligation data find that budgetary Continuing Resolutions (CRs) from Congress result in higher Obligation rates in the 2nd to 4th months after the full budget is passed (i.e., once managers know their authorized spending). Obligation rates also are lower statistically the first October in the spending cycle, higher the first March in the spending cycle (before the midyear spending reviews), and usually higher in September. Expenditures for Research, Development, Test, and Evaluation (RDT&E), Procurement, and Operation and Maintenance (O&M) follow S-shaped curves rather than the linear profiles in DoD benchmarks. Recommendations are made, including adjustments for variable effects on obligations, considering S-curve profiles for improved benchmarking, and leveraging improved DoD data environments to switch to plan-based benchmarking. The analyses also highlighted areas for suggested future research that are summarized in Chapter 4 of this paper.

EXECUTIVE SUMMARY

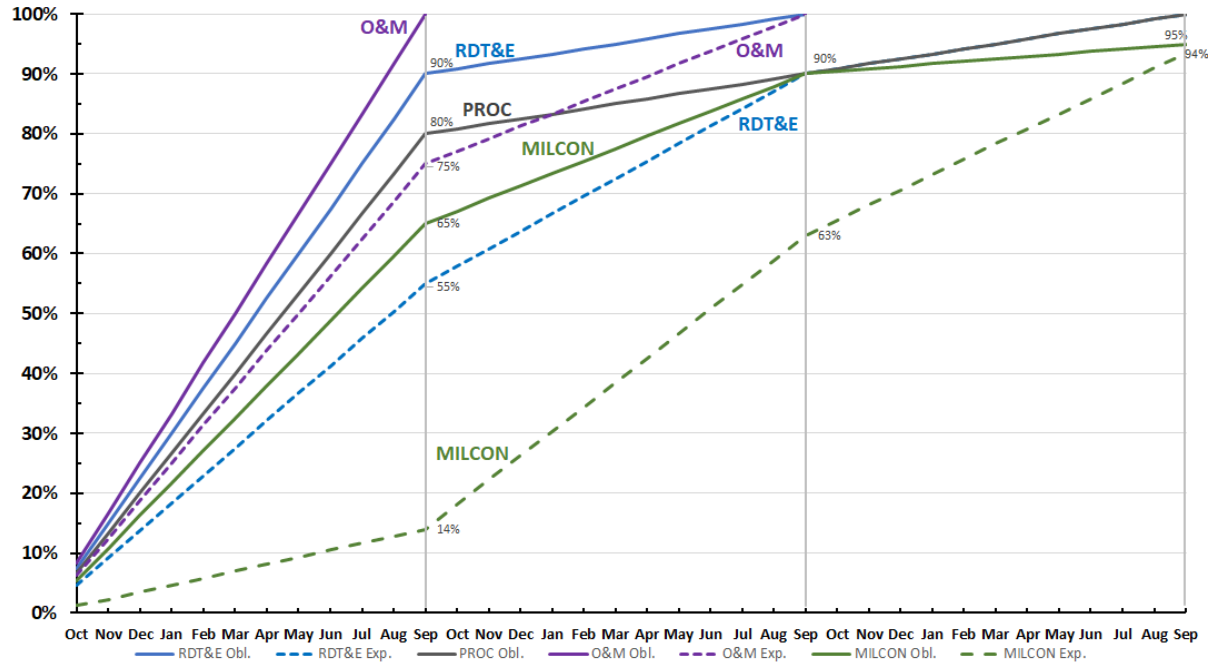
What gets measured gets managed – even when it's pointless to measure and manage it, and even if it harms the purpose of the organization to do so.

Peter Drucker

A common management tool for overseeing program execution is to use benchmarks to compare against the actual obligation rates of funds and their final expenditures (outlays or disbursements). The Department of Defense (DoD) uses linear benchmarks for each category of funding (see Figure S-1). Such benchmarks can help identify programs and activities that may have issues in spending funds within the year(s) of availability and thus may be candidates for further review to have portions of their budgets reprogrammed for critical priorities that emerged in the year of execution.

This paper assesses these benchmarks through quantitative analysis of DoD obligation and expenditures over time, earned-value management (EVM) data on contractor execution rates, and a review of existing theory and qualitative data from experts. It also assesses the statistical effects of delayed full fiscal year (FY) appropriations associated with continuing resolutions (CRs), calendar-month effects (e.g., at the start and end of the FY), and time trends on DoD obligation rates. These analyses provide new insights into the realism of DoD obligation and expenditure benchmarks, leading to recommendations for improving these benchmarks.

Figure S-1. Current Comptroller Obligations and Expenditures Rule-of-Thumb Benchmarks



SOURCE: Under Secretary of Defense (Comptroller), as reported in Tomasini (2017).

NOTES: The dashed lines are the obligation (Obl.) benchmarks over time, and the solid lines are the associated expenditure (Exp.) benchmarks over time. The O&M benchmark curves rise the fastest, followed by RDT&E and PROC. Tomasini (2017) reports that Procurement expenditures are "N/A." Exp. = expenditures; MILCON = Military Construction; O&M = Operation and Maintenance; Obl. = obligations; PROC = Procurement; RDT&E = Research, Development, Test, and Evaluation.

OBLIGATION RATES: EFFECTS OF CONTINUING RESOLUTIONS AND OTHER EVENTS

One concern often raised related to the Planning, Programming, Budgeting, and Execution (PPBE) process is the potential effect of continuing resolutions (CRs) on spending in the DoD. Statistical analysis of DoD obligation rates for Research, Development, Test, and Evaluation (RDT&E), Procurement (PROC), Operation and Maintenance (O&M), Military Personnel (MILPERS), Military Construction (MILCON) found the following (see Table S-1 and Table S-2):

- Obligation rates are higher in the two to six months after the full budget is passed (MAB)—i.e., once managers know their authorized spending. Thus, CRs delay a portion of funding into later in the FY.
- S&T and Management Support within RDT&E have a significantly lower obligation rate during CR months that other types of funding did not exhibit.
- Obligation rates are often lower the first October in the spending cycle, possibly reflecting assertions in the literature that it takes time to delegate spending authorization to program managers.
- Obligation rates are often higher the first March in the spending cycle (i.e., the month before the midyear spending reviews).
- Obligation rates for some types of funding are higher in September.
- While each category of funding has a general underlying linear trend, MILPERS obligations are linear with slight upward trend.
- RDT&E and Procurement dollars obligate the first year on a fairly linear basis but then inflect to a reduced, curved basis. Thus, obligations are modeled well by linear models with these variate effects.
- Military Construction (MILCON) shows a significant upward curve in the first year rather than the straight line in the benchmark but becomes fairly linear afterwards. Also, a significant fraction of MILCON obligations occurs after year 3, which is not in alignment with the benchmark targets.

These statistical models align somewhat with linear obligation rate targets set by the DoD Comptroller and are compatible with anecdotal assertions that when told to obligate, programs do. This does not account for any changes in DoD priorities given new threats or technological opportunities since the budgets were first drafted early in the PPBE process, but when told to spend or risk losing their funds, individuals across the DoD appear to do so to a large extent.

Table S-1. Contributions of CRs and Other Variables Affecting RDT&E Obligation Rates: S&T, Development, and Management Support (FY 2011–2023 Appropriations)

		1st Year of Availability				2nd Year of Availability			
		Combined	S&T	DEV	Mgt	Combined	S&T	DEV	Mgt
Avg. Base		5.9%	6.4%	6.0%	6.3%	1.7%	2.3%	1.6%	2.5%
Add CR Effects	CR		-1.0%		-1.4%				
	1 MAB		-1.6%						
	2 MAB	4.3%		3.0%	2.1%				
	3 MAB	6.3%	4.8%	7.1%	2.1%				
	4 MAB	3.7%	4.3%	4.8%					
	5 MAB		1.5%						
	6 MAB		1.8%						
Add Calendar Month Effects	Oct.	-2.3%	-3.5%	-1.9%				0.40%	-0.63%
	Nov.		-1.1%			0.91%		0.52%	
	Mar.	2.3%	1.6%	1.7%					0.68%
	Sept.		2.4%		2.9%	1.0%	1.3%	0.84%	1.3%
Time Trend	Time (mo.)					-0.10%	-0.15%	-0.10%	-0.10%
Adj. R2		63%	84%	60%	42%	32%	48%	50%	33%

MAB = month after budget is passed; CR = month under a continuing resolution (the months before 1 MAB); BA = Budget Activity; S&T = Science and Technology (BA-1, BA-2, and BA-3 combined); DEV = development (BA-4, BA-5, and BA-7 combined); Mgt = Management [Support] (BA-6); mo. = month; Oct. = October; Nov. = November; Jan. = January; Mar. = March; Aug. = August; Sept. = September.

Table S-2. Contributions of CRs and Other Variables Affecting Obligation Rates (FY 2011–2023 Appropriations)

			RDT&E (combined)		PROC		O&M	MILPERS
			1st Year	2nd Year	1st Year	2nd–3rd Years		
Average Base	Monthly Rate	*Base rate:*	5.9%	1.7%	5.0%	2.0%	7.5%	7.9%
CR Effects	1st MAB	*If true, add:*					1.2%	
	2nd MAB	*If true, add:*	4.3%		1.8%		2.4%	
	3rd MAB	*If true, add:*	6.3%		4.6%		2.4%	
	4th MAB	*If true, add:*	3.7%		2.2%		1.6%	
Calendar Month Effects	October	*If true, add:*	−2.3%		−3.6%		−1.1%	
	November	*If true, add:*		0.9%		0.6%	−0.8%	
	December	*If true, add:*				0.9%		
	March	*If true, add:*	2.3%		2.6%	0.4%		
	July	*If true, add:*					2.4%	
	August	*If true, add:*					−1.8%	
	September	*If true, add:*		1.0%	4.6%	1.4%	4.1%	0.4%
Time Trend	Time (month)	*If true, add:*		−0.1%		−0.1%		0.1%

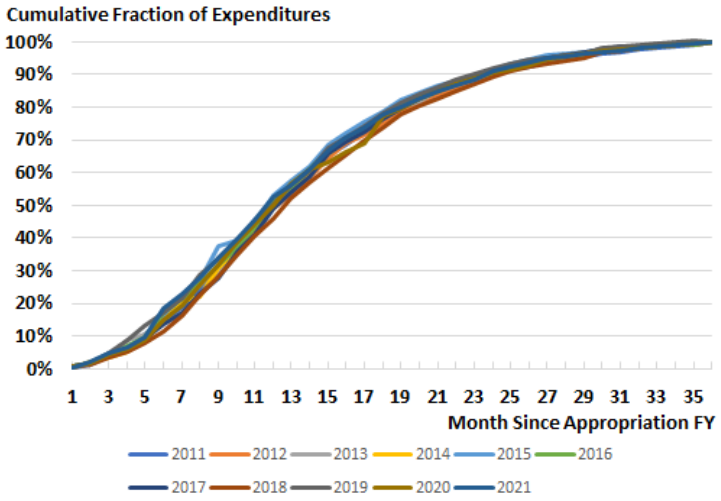
MAB = month after budget is passed.

EXPENDITURE RATES

Analysis of DoD data show that RDT&E, Procurement, and O&M expenditures follow an S-curve shape rather than the linear profiles in the DoD's benchmarks. This aligns with over 50 years of data and theory in the literature.[1]

While the S-curve for RDT&E meets the 12- and 24-month targets of 55% and 90%, respectively, the average 6-month value of 15.5% is well below the benchmark of 27.5% (see Figure S-2). Thus, the DoD's linear RDT&E benchmark poorly informs the midyear execution review for RDT&E. RDT&E, O&M, and MILCON expenditure differences between actuals over the last decade and the current linear benchmarks can be as large as $10 billion, $23 billion, and $3 billion, respectively.

Figure S-2. Cumulative RDT&E Expenditures by Month After Appropriation (FY 2011–2021 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

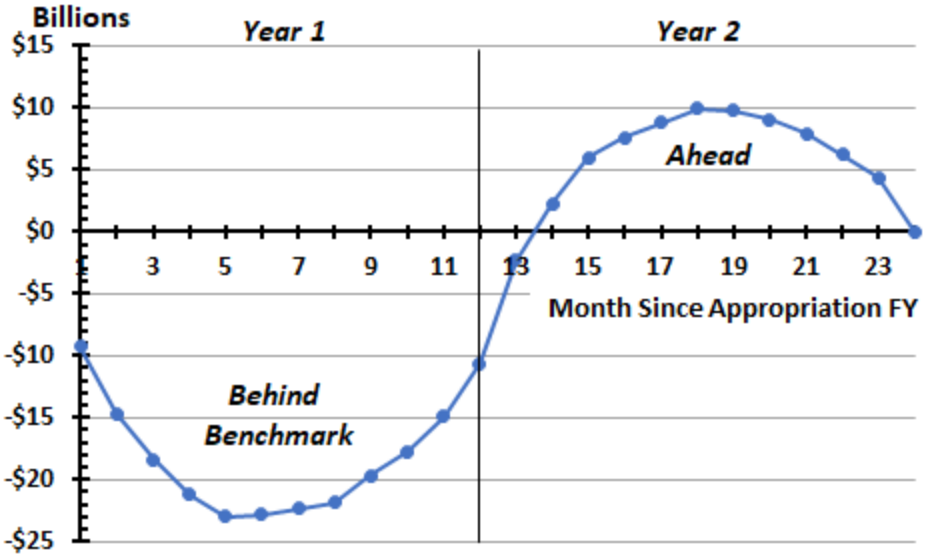
ALIGNING OBLIGATION AND EXPENDITURE BENCHMARKS WITH THEORY AND DATA

This paper reached the following conclusions based on the review of theory and analysis of available data.

At the least, benchmarks should be adjusted to reflect realities evident in recent years. DoD obligation and expenditure data consistently show statistically significant differences between average actuals and simple linear benchmarks. If benchmarks are not adjusted, then benchmarks are less effective at identifying potential issues. When average (normal) actuals are behind the benchmark, then too many programs may be undergoing subsequent deep-dive performance reviews. Likewise, when average actuals are above the benchmarks, then too few programs may be undergoing subsequent deep-dive performance reviews. Thus, these are indicators that updating benchmarks may improve the effectiveness and efficiency of performance reviews by helping to focus better on programs that may be behind. For example, Figure S-3 shows that O&M expenditures are, on average, as much as $23 billion below benchmarks in months 5–6 (right before mid-year reviews) and as much as $10 billion over benchmarks by month 18. This indicates potentially significant inefficiencies given limited oversight resources.

[1] See, for example, Norden, 1970; Watkins, 1082; Lee, Hogue, and Gallagher, 1993; Lee, Hogue, and Hoffman, 1993; Gallagher and Lee, 1996; Davis, 2008; Behn, 2008; Davis et al., 2009; Burgess et al., 2014; Brown et al., 2015; Schiavoni, 2019.

Figure S-3. Dollar Difference Between Average Cumulative O&M Expenditures and Current Benchmark (FY 2011–2022 Appropriations)



The best shape of obligation benchmark curves ultimately comes down to intent and theory. While the data in Chapter 2 show that managers in the DoD tend to obligate at rates that generally align with current linear obligation benchmarks, there are good reasons to reconsider these profiles. First, even with pressures to obligate on a straight line, actual data show startup delays as well as reductions due to CR effects. Also, RDT&E inherently involves engineering uncertainty and surprises, so it may be more effective for the DoD and the country to target more obligations in the second year than in the first. In addition, shifting more obligation targets for RDT&E and Procurement into the second year would give DoD managers more time to make investments when needed (earlier or later), negotiate better deals (e.g., prices, intellectual property rights, and deliverables), and fully assess contractors' execution, subcontracting, and supply-chain plans and risks.

Benchmarks should be adjusted for CR and financial-management realities. Regardless of the basic shape of the benchmarks, the statistical analysis in Chapter 2 shows real-world effects that should be considered for RDT&E, Procurement, and O&M. CRs result in obligation bumps after full budgets are passed as well as reductions during CRs for S&T and Management Support. Obligation rates in the first month (October of the first year) are lower than the current benchmarks (probably from the time it takes for the financial management system to allocate spending authority to program managers). These CR effects introduce some level of S-curve patterns into actual obligation rates.

S-curves for obligation benchmarks may be beneficial for RDT&E, PROC, and O&M. While actual obligations have underlying linear bases, shifting to an S-curve profile for obligations would allow more time for improved performance and deals, addressing the points above.

Benchmarks can be useful but require additional due diligence. When combined with further due diligence, benchmarks can help the DoD and Congress identify funds that could be reprogrammed to address higher-priority threats and needs that emerge during the spending periods. The combined effects of these benefits can improve DoD mission outcomes by identifying badly needed resources. However, the emphasis here is on proper use and due diligence to ensure a balance between the benefits and issues. The use of benchmarks alone does not provide insight into the practical realities and issues in execution. Anecdotes indicate that DoD and Congressional leadership do not rely solely on benchmarks to identify from whom to take money for new urgent priorities that arise during the year of execution. However, other anecdotal evidence indicates that program managers believe otherwise, adding to the concern that these managers may prioritize spending to benchmarks over more prudent uses of financial resources, leading to undesirable or unforeseen negative side effects.

Avoid unforeseen negative consequences from managing to benchmarks. Finally, metrics drive behavior. This concern is well documented in the literature[2] and also can be seen in the increased obligation rates in March immediately before the midyear reviews that identify programs spending below the benchmark rates for potential budget reprogramming to other programs and needs. While management metrics can be useful tools for insight, management pressures will drive behavior to the exclusion of other factors. Forcing people to spend to a curve will get spending to that curve whether or not that spending results in the best use of taxpayer dollars and the best results for national security. This axiom also applies to other potential uses of these benchmarks, such as adjusting Office of Management and Budget (OMB) apportionments based on changes in benchmarks.

SUGGESTIONS FOR FUTURE RESEARCH

These analyses highlighted the following areas for suggested future research that are summarized in Chapter 4 of this paper, which may lead to additional recommendations:

- Piloting modified benchmarks.
- Identifying expenditure benchmark profiles for Procurement.
- Assess obligation and expenditure rates at the account level within each category.
- Assess sources of obligation and expenditure data errors.

RECOMMENDATIONS

Based on these observations, we recommend that the DoD Comptroller consider modifying their benchmarks. Four optional variants are discussed in the report. The preferred option includes adding additional S-curve ramp-up elements on top of historical obligation behaviors and recommends replacing linear expenditure profiles with historical S-curve profiles. Table S-3 summarizes our recommendations. Table S-5 and Table S-6 show the recommended Option 1 benchmarks for the first three years of availability. These benchmarks include S-curves added to the beginning of historical averages for obligations; expenditure benchmarks reflect recent historical patterns.

In addition to aligning expenditure benchmarks to actual data and theoretical objectives, such changes could help eliminate the negative side effects cited in theory and the literature that program managers may seek expenditures prematurely just to meet comptroller benchmarks at the expense of other program and department objectives of prudent use of the resources (see, for example, Marsalis, 2022; Commission on PPBE Reform, 2023, p. 33). Slight delays in switching to S-curves with their lower initial expenditure benchmarks should give program managers more time to get good deals for the program, the DoD, and taxpayers rather than having to rush negotiations and contracting to meet somewhat arbitrary benchmarks or risk losing their funding.

[2] See, for example, National Research Council, 2005; Behn, 2008.

There would be some cultural and process adjustments for both Congress and the DoD (and industry) to adjusting the obligation and expenditure benchmark profiles over time, but the benefits could be improved performance given the financial resources provided by Congress and the taxpayers to the DoD. In the end, keep in mind the following insightful quote.

Tell me how you measure me, and I will tell you how I will behave.
If you measure me in an illogical way…do not complain about illogical behavior.

Eliyahu Moshe Goldratt

Table S-3. Recommendations for Improving Obligation and Expenditure Benchmarks

Obligations	Expenditures
• Reduce obligation benchmarks for the first 1–2 months for RDT&E, PROC, and O&M to reflect process delays in allocating spending authorities. • Consider changing benchmarks to S-curves instead of straight lines. • Consider allowing more time in benchmarks for later spending to give time to get better negotiated deals and address surprises.	• Change benchmarks to S-curves for RDT&E, PROC, and O&M. • At a minimum, if the benchmarks are not changed to S-curves, consider: » Reducing expenditure benchmarks for the first 3 months. » Changing benchmark shapes to straight lines across all years for multi-year funds rather than front-loading in the first year. • Add predictive metrics to identify more likely spending shortfalls.
• Explore switching to plan-based benchmarks instead of fixed benchmark curves, using Advana to collect plans from program offices. • Ensure proper due diligence along with spending relative to benchmarks before taking program funds. • Use needs, plans, and priorities for budgeting—not just spending. • Avoid overly enforcing benchmarks and other metrics. Keep these as information tools. • To avoid slowing down DoD acquisition, do not use obligation and expenditure benchmarks as a guide to OMB apportionments—instead inform apportionments based on the distribution data of recent actual obligations and expenditures. • Pilot these changes before pursuing more aggressive shifts to lower benchmarks in earlier years to understand better the effects (if any) on changes in unobligated and unexpended funds at the end of normal availability.	

Table S-4. Recommended Benchmarks: Benchmarks Options: Elements and Ranking

	Obligations		Expenditures	RDT&E	Rank
	Base Shape	***Variables***			
Option 1	S-curves on historic	CR, MAB, Calendar, and Time Effects	Historic (S-curved)	Separate S&T, DEV, Mgt	1 (Preferred)
Option 2	S-curves on historic			Combined	2
Option 3	Historic (linear base)			Separate S&T, DEV, Mgt	2
Option 4	Historic (linear base)			Combined	3
Option 5	As-is (arbitrary lines)	None	As-is (arbitrary lines)	Combined	4

Table S-5. Option 1 Separate RDT&E Benchmarks: S-Curved Obligation and Historical Expenditure Curves

		S&T (BAs 1, 2, 3)				Development (BAs 4, 5, 7)			Management (BA-6)			
Year	Month	Obs.			Exp.	Obs.		Exp.	Obs.			Exp.
			Add if in CR	Add after CRs			Add after CRs			Add if in CR	Add after CRs	
1st	Oct	1.1%	-1.04%		0.52%	1.1%		0.36%	1.1%	-1.42%		0.69%
	Nov	3.9%	-2.08%		1.6%	3.9%		1.2%	3.9%	-2.84%		2.8%
	Dec	8.3%	-3.12%	1st MAB: -1.6%	3.2%	8.3%	1st MAB: 0%	3.5%	8.3%	-4.27%	1st MAB: 0%	5.7%
	Jan	15.1%	-4.16%	2nd MAB: -1.6%	5.1%	15.1%	2nd MAB: 3.0%	6.0%	15.1%	-5.69%	2nd MAB: 2.1%	8.9%
	Feb	22.7%	-5.20%	3rd MAB: 3.3%	7.3%	22.7%	3rd MAB: 10.1%	9.4%	22.7%	-7.11%	3rd on: 4.2%	12.4%
	Mar	31.5%	-6.24%	4th MAB: 7.5%	10.5%	31.5%	4th on: 14.9%	14.9%	31.5%	-8.53%		16.5%
	Apr	40.5%	-7.28%	5th MAB: 9.0%	14.3%	40.5%		19.6%	40.5%	-9.96%		21.9%
	May	48.5%	-8.32%	6th on: 10.8%	18.4%	47.9%		25.6%	50.0%	-11.38%		26.7%
	Jun	54.9%	*		22.9%	53.9%		31.3%	56.4%	*		32.0%
	Jul	61.3%	*		27.7%	59.9%		38.3%	62.7%	*		36.9%
	Aug	67.8%	*		33.3%	65.9%		43.8%	69.0%	*		42.3%
	Sep	76.6%	*		39.6%	71.9%		50.7%	76.9%	*		47.9%
2nd	Oct	85.1%			44.8%	88.8%		56.4%	78.4%			52.6%
	Nov	87.0%			49.4%	90.7%		60.7%	80.7%			55.8%
	Dec	88.9%			54.3%	92.0%		67.1%	82.9%			59.0%
	Jan	90.5%			58.9%	93.2%		70.7%	85.0%			62.2%
	Feb	92.1%			63.4%	94.3%		74.1%	86.9%			65.1%
	Mar	93.4%			68.9%	95.3%		78.9%	89.5%			68.9%
	Apr	94.7%			72.8%	96.2%		81.7%	91.3%			71.7%
	May	95.8%			76.4%	97.0%		84.2%	93.0%			74.0%
	Jun	96.7%			79.5%	97.7%		86.3%	94.5%			76.5%
	Jul	97.5%			82.4%	98.3%		88.2%	96.0%			79.0%
	Aug	98.2%			84.8%	98.8%		89.9%	97.4%			81.2%
	Sep	100.0%			87.7%	100.0%		91.8%	100.0%			84.2%
3rd	Oct				89.5%			93.1%				86.2%
	Nov				91.0%			94.2%				87.9%
	Dec				92.4%			95.4%				89.6%
	Jan				93.6%			96.1%				91.3%
	Feb				94.6%			96.7%				92.6%
	Mar				95.9%			97.7%				94.4%
	Apr				96.8%			98.3%				95.6%
	May				97.5%			98.6%				96.6%
	Jun				98.2%			99.1%				97.6%
	Jul				98.8%			99.4%				98.5%
	Aug				99.4%			99.8%				99.3%
	Sep				100.0%			100.0%				100.0%

* The data included no CRs extending past may, but it may make sense to continue adding -1.04% (for S&T) or -1.42% (for Mgt.) for each month under a CR from June–Sept, or adjust based on the size of any full-year CR budget for the BA(s).

SOURCE: Authors' analysis of FYs 2013, 2014, 2017–2023 DoD obligations and expenditures data.

NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. Our sample only included CRs through May, so we only included the CR effects through May in the table. There were no significant reductions during CR months for RDT&E development (BAs 4, 5, 7). MAB = month after full budget is passed. If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 1st MAB would be January and the S&T obligation benchmarks for December would be 8.3% - 3.12% = 5.18% and the January benchmark would be 15.1% - 1.6% = 13.5%.

Table S-6. Option 1–2 PROC, O&M, and MILCON Benchmarks: Obligation S-Curves and Historical Expenditure Patterns: 1st–3rd Years of Availability

		Procurement			O&M			MILCON	
Year	Month	Obs.		Exp.	Obs.		Exp.	Obs.	Exp.
			Add after CRs			*Add after CRs*			
First	Oct	0.55%		0.43%	3.0%		1.9%	0.60%	0.00%
	Nov	1.6%		1.0%	6.0%		5.6%	1.0%	0.11%
	Dec	3.6%	1st MAB: 0.0%	1.9%	11.0%	1st MAB: 1.2%	10.0%	1.6%	0.34%
	Jan	5.8%	2nd MAB: 1.8%	3.7%	19.0%	2nd MAB: 3.6%	15.0%	3.3%	0.31%
	Feb	9.3%	3rd MAB: 6.5%	5.0%	30.0%	3rd MAB: 6.0%	20.4%	5.9%	0.50%
	Mar	13.8%	4th on: 8.7%	7.2%	41.0%	4th on: 7.7%	26.7%	8.9%	0.76%
	Apr	18.3%		8.7%	52.0%		33.1%	11.3%	0.99%
	May	23.3%		10.6%	60.5%		39.5%	15.8%	1.1%
	Jun	28.8%		13.0%	69.3%		46.7%	22.9%	1.6%
	Jul	34.2%		15.5%	76.9%		53.8%	27.6%	2.1%
	Aug	39.6%		18.4%	84.7%		61.3%	33.9%	2.7%
	Sep	45.7%		21.8%	92.3%		69.2%	47.4%	3.9%
Second	Oct	59.1%		23.9%			75.4%	49.1%	4.6%
	Nov	63.2%		26.6%			79.5%	50.8%	5.5%
	Dec	68.3%		30.2%			83.2%	53.1%	6.7%
	Jan	72.1%		32.9%			86.0%	55.1%	7.9%
	Feb	75.3%		35.4%			88.7%	56.3%	9.3%
	Mar	78.9%		38.8%			91.3%	57.9%	10.6%
	Apr	81.6%		41.4%			93.3%	59.7%	12.4%
	May	84.0%		43.5%			94.9%	61.1%	14.4%
	Jun	86.2%		46.6%			96.5%	62.8%	16.8%
	Jul	88.0%		48.8%			97.7%	64.3%	19.3%
	Aug	89.8%		51.2%			98.9%	67.1%	21.7%
	Sep	91.7%		54.1%			100.0%	70.8%	24.6%
Third	Oct	93.1%		56.3%				71.4%	27.2%
	Nov	94.2%		59.0%				72.7%	29.2%
	Dec	95.2%		61.6%				73.7%	31.5%
	Jan	96.0%		63.3%				74.7%	33.7%
	Feb	96.6%		65.0%				75.7%	35.8%
	Mar	97.4%		68.2%				76.5%	37.5%
	Apr	98.0%		70.3%				77.2%	40.1%
	May	98.4%		72.1%				77.9%	42.2%
	Jun	99.0%		74.1%				78.8%	44.4%
	Jul	99.3%		75.8%				79.8%	46.6%
	Aug	99.6%		77.6%				80.5%	48.9%
	Sep	100.0%		79.6%				82.9%	51.3%

SOURCE: Authors' analysis of FY 2011–2023 DoD obligations and expenditures data.

NOTE: Years 4–6 of availability for Procurement and MILCON are the same as in Table 4 4 in the report. Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. MAB = month after full budget is passed. If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 1st MAB would be January and the Procurement obligation benchmarks for January–June that year would be 5.8%, 11.1%, 20.3%, 27.0%, 32.0%, and 37.5%, respectively.

INTRODUCTION

What gets measured gets managed – even when it's pointless to measure and manage it, and even if it harms the purpose of the organization to do so.
Peter Drucker

A common management tool for overseeing program execution is to monitor spending over time to ensure progress and identify any programs that may be falling behind. In the Federal government, program and contract spending involve two basic steps:

- *Obligations*, which commit funds from the U.S. Treasury for payment of goods and services (e.g., on a contract).[3]
- *Expenditures* (also called *outlays* or *disbursements*), which are the actual financial payments (money) from the U.S. Treasury to liquidate an obligation (e.g., upon receipt of goods or services under a contract).[4]

THE BENEFITS AND DANGERS OF BENCHMARKS AND METRICS

Program managers should attend to items that are important enough to measure. The problem is that we get exactly what we measure when we enforce and incentivize the metric. People will spend—one way or another, and often regardless of unintended side effects—if we measure execution against a metric and especially if we apply enforcement consequences and incentives.[5]

Below is a short overview of the principles, theory, and realities of setting, using, and enforcing benchmarks and metrics. This is just a short overview, but it is important to begin by reminding ourselves what these metrics result in—good and bad.

BENEFITS

Benchmarks can help identify performance issues. Some programs do not obligate or expend all their authorized and appropriated funding. Thus, monitoring the level of funding can be a quick way to identify programs that eventually may not fully execute their spending. With the recognition that such benchmarks are but one source of needed information, they can help focus attention on more likely candidates.

Monitored benchmarks can ensure that attention is paid to managing financial resources. When not emphasized to the extreme, monitored benchmarks like these can motivate program managers to properly plan and track spending along with associated risks.

[3] The Government Accountability Office (GAO) defines an *obligation* as "A definite commitment that creates a legal liability of the government for the payment of goods and services ordered or received, or a legal duty on the part of the United States that could mature into a legal liability by virtue of actions on the part of the other party beyond the control of the United States. Payment may be made immediately or in the future. An agency incurs an obligation, for example, when it places an order, signs a contract, awards a grant, purchases a service, or takes other actions that require the government to make payments to the public or from one government account to another" (GAO, 2005, p. 70).

[4] The GAO defines an *outlay* (i.e., expenditure or disbursement) as "The issuance of checks, disbursement of cash, or electronic transfer of funds made to liquidate a federal obligation. Outlays also occur when interest on the Treasury debt held by the public accrues and when the government issues bonds, notes, debentures, monetary credits, or other cash-equivalent instruments in order to liquidate obligations" (GAO, 2005, pp. 73–74).

[5] See, for example, anecdotal and survey evidence in Marsalis (2002) and Commission on Planning, Programming, Budgeting, and Execution (PPBE) Reform (2023).

CONCERNS

Untailored benchmarks may not align with program realities and plans. Programs have spending needs based on plans as well as events and decisions that need to be made during the spending period. Some programs may plan to obligate funds as soon as they are authorized and appropriated while others may have good reasons to obligate late in the spending period. Untailored (a priori) fixed benchmarks may be out of synch with such plans. Also, programs may not know in advance when they need to obligate. For example, programs, especially in Research, Development, Test, and Evaluation (RDT&E) (which often involves systems that have never been developed before), may need to address issues that arise during the spending period, address unforeseen costs or schedule challenges, or to change priorities based on new threats or technology issues and opportunities. Again, fixed benchmarks would only reflect such spending profiles from random chance.

Benchmarks can drive undesirable behaviors or effects. It is well known in business and psychology that enforced or even monitored benchmarks will drive behaviors to achieve the benchmarks despite negative consequences (Norden, 1970; Behn, 2008; Marsalis, 2022). This is a real concern in the Department of Defense (DoD) to avoid wasting resources in programs—either by not spending what could be used elsewhere, or by wasting it through less-than-prudent (but entirely understandable from an incentives perspective) spending.

Input (consumption) benchmarks lack prioritization and thus require additional information before acting on below-target programs. Finally, spending benchmarks like these are simply input metrics (as opposed to output or outcome metrics[6]) that lack measures of the *value* of the spending. A program (and thus the DoD and taxpayers) may get better value from early spending, or it may get higher value by giving a program more time to obligate (or a contractor more time to execute). Instead, programs appear mostly driven to avoid unspent funds (which does happen in non-trivial amounts) and to identify potential resources for new urgent priorities that arise during the spending period. Thus, they can only identify potential candidates for further (deeper) assessment to understand a program's status. Without this added consideration, these metrics can devolve into blind bureaucratic taking of resources with undesirable outcomes.

OBLIGATION AND EXPENDITURE BENCHMARKS IN THE DOD

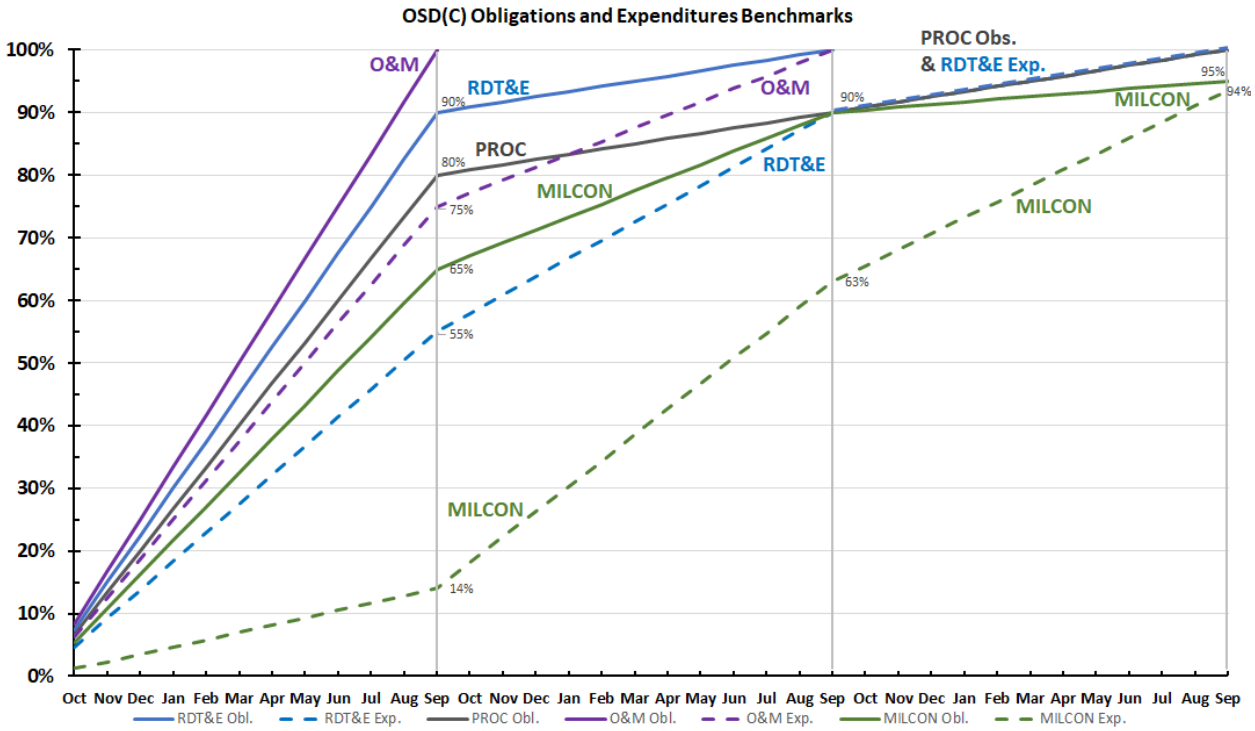
In the DoD, the Comptroller uses rate curves as benchmarks to compare against actuals to monitor obligations and expenditures of appropriated funds over time (see Figure 1-1). Currently, the Comptroller and Congress use such benchmarks to identify programs and activities that appear to have issues in spending funds and thus are candidates for "marks" and reallocation of their funds to other priorities.

This approach has four potential problems. First, these linear benchmarks appear to be overly simplistic heuristics that, while in common use by management, do not align with theory and available data on normal spending profiles. Second, they may not account for the effects of delays in final fiscal year (FY) authorizations and appropriations as well as other variables that could increase or decrease obligations in a fiscal month. Third, these benchmarks tend to be applied on programs regardless of their spending plans and whether they need more time to obtain better value. Last but not least, the front-loaded nature of the current benchmarks can emphasize spending quickly rather than wisely (e.g., potentially leading to worse negotiated deals with contractors, who know the DoD is under pressure to obligate, or not spending on higher priorities that can only be known later in the obligation period).[7]

[6] See, for example, National Research Council (2005) for a very useful review of the theory and application of different types of metrics to achieve desired performance and outcomes.

[7] See, for example, Tremaine and Seligman (2013); Marsalis (2022).

Figure 1-1. Comptroller Obligations and Expenditures Rule-of-Thumb Benchmarks



SOURCE: Under Secretary of Defense (Comptroller), as reported in Tomasini (2017).
Exp. = expenditures; MILCON = Military Construction; O&M = Operation and Maintenance; Obl. = obligations; PROC = Procurement; RDT&E = Research, Development, Test, and Evaluation.
NOTES: The dashed lines are the obligation (Obl.) benchmarks over time, and the solid lines are the associated expenditure (Exp.) benchmarks over time. The O&M benchmark curves rise the fastest, followed by RDT&E and PROC. Tomasini (2017) reports that Procurement expenditures are "N/A."

This paper assesses these concerns through quantitative analysis of DoD obligation and expenditures over time, analogous earned-value management (EVM) data on contractor execution rates, and a review of existing theory and qualitative data from experts.

ORGANIZATION OF THE REPORT

Chapter 2 analyzes the statistical effects of delayed FY appropriations (nominally with associated Continuing Resolutions (CRs)), calendar-month effects (e.g., at the start and end of the FY), and time trends on DoD obligation rates, assessing the realism of obligation and expenditure benchmarks based on statistical analyses detailed in Appendix B.

Chapter 3 analyzes expenditure rates based on theory, contractor EVM execution data, and DoD expenditure data, and assesses the realism of expenditure benchmarks based on these findings.

Chapter 4 summarizes the observations from prior chapters and makes recommendations for improving obligation and expenditure benchmarks.

Appendix A summarizes earlier analysis using the combined total monthly obligations and expenditures when combined from multiple appropriation years. Comparing these results with those from Chapter 2 shows that it is important to track appropriations by both category (color of money) and appropriation year to obtain better insight into the effects of CRs and other variables on obligation rates.

Appendix B provides the detailed data from statistical analyses in Chapter 2.

Appendix C provides the aggregated data from Advana as monthly percentages relative to a final baseline month.

Appendix D provides distribution statistics on the cumulative monthly obligation and expenditure rates in the DoD data.

OBLIGATION RATES AND THE EFFECTS OF CONTINUING RESOLUTIONS AND OTHER EVENTS

One concern in the Planning, Programming, Budgeting, and Execution (PPBE) process is the potential effect on DoD spending from delays in final authorizations and appropriations from Congress for a FY. In such cases, Congress usually passes CRs to provide interim funding. CRs often provide only partial funding—say, spending up to 80 or 90 percent of last year's appropriations—and usually prevents new program starts unless explicitly authorized in the CR. Also, if the final appropriations are lower than the requested budgets, then the program will likely need to replan and spend differently to reoptimize; this uncertainty makes it hard to know what to obligate during a CR. Even with CRs, final funding delays could potentially affect obligation rates on acquisition programs, procurement, sustainment, or operations. As a result, one might expect DoD obligations to be slower during a CR and then increase at a higher rate after a full budget is passed (i.e., showing an inflection point after the CR is passed).

In response to a request from the Commission on PPBE Reform, we conducted statistical analyses on available data to see if periods of CRs correlate with changes in the rate at which the DoD obligates funds.

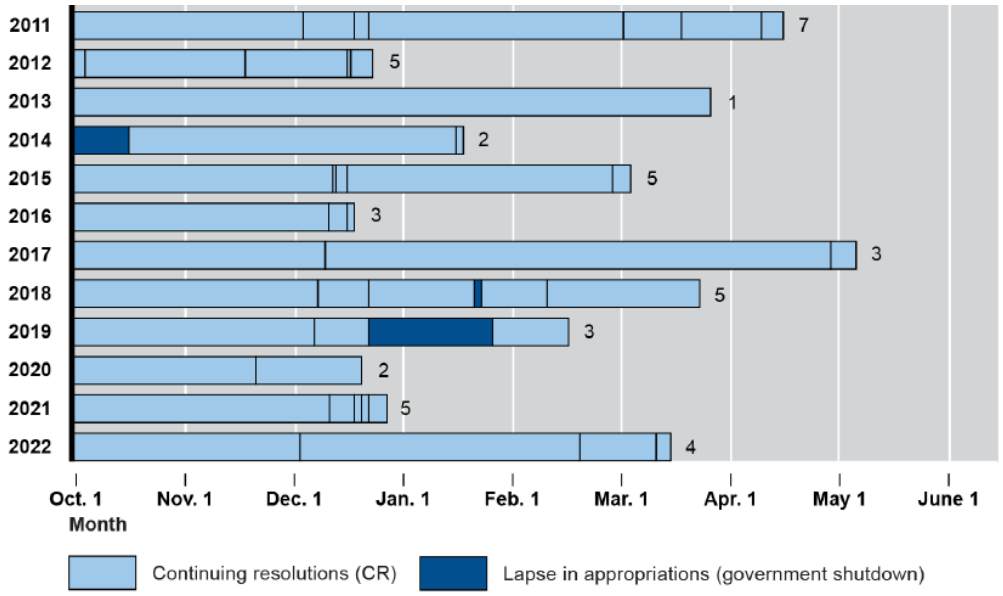
Below, we first present summary data on CRs, followed by analysis of correlates that affect monthly obligation rates following the authorization and appropriation of funds for a FY's budget. This includes analysis of the following major categories of funding: Research, Development, Test, and Evaluation (RDT&E), Procurement (PROC), Operation and Maintenance (O&M), Military Personnel (MILPERS), and Military Construction (MILCON). Finally, we compare these results to analysis of the combined obligation rates for contracts across all funding types.

CONTINUING RESOLUTIONS IN FISCAL YEARS 2010–2022

When the U.S. Congress is unable to authorize and appropriate spending by the beginning of a FY, which starts on October 1, then Congress often passes one or more CRs. These resolutions provide interim funding to avoid a partial government shutdown until a full year-long budget (authorized and appropriations) can be enacted (for example, GAO, 2022b). As shown in Figure 2-1, there were CRs in every FY from 2011–2022, as well as three lapses in appropriations that resulted in government shutdowns.

Table 2-1 lists the dates when final authorization and appropriation acts were passed by Congress and became law (usually when signed by the President of the United States). For our analysis, we coded a variable for each month after the full-year budget was passed to test for consistent changes in obligation rates after CRs were over. These months after budget (MABs) are also shown in Table 2-1.

Figure 2-1. Number and Duration of Federal-Wide CRs and Lapses in Appropriations (FY 2011–2022)



SOURCE: GAO, 2022b.
NOTE: These are federal-wide CRs. In FY 2019, the DoD actually received its authorization and appropriation acts before the start of the FY.

Table 2-1. Dates of Final DoD Authorization and Appropriation Acts and MABs (FY 2011–2023)

FY	Authorizations	Appropriations	1 MAB	2 MAB	3 MAB	4 MAB
2011	1/7/2011	4/15/2011	April	May	June	July
2012	12/31/2011	12/23/2011	January	February	March	April
2013	1/2/2013	3/26/2013	April	May	June	July
2014	12/26/2013	1/17/2014	January	February	March	April
2015	12/19/2014	12/16/2014	January	February	March	April
2016	11/25/2015	12/18/2015	January	February	March	April
2017	12/23/2016	5/5/2017	May	June	July	August
2018	12/12/2017	3/3/2018	March	April	May	June
2019	8/13/2018	9/28/2018	October	November	December	January
2020	12/20/2019	12/20/2019	January	February	March	April
2021	1/1/2021	12/27/2020	January	February	March	April
2022	3/15/2022	3/15/2022	March	April	May	June
2023	12/23/2022	12/29/2022	January	February	March	April

SOURCE: Commission on PPBE Reform, 2023, p. 33.
NOTE: If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st month after budget (MAB) is the month of passage, else the following calendar month is the 1st MAB (1 MAB). For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB.

MONTHLY OBLIGATION RATES BY CATEGORIES OF FUNDING

We obtained data from the DoD's Advana data environment on monthly obligated dollars for separate accounts (e.g., within military services or defense wide) and categories of funding (RDT&E, Procurement, O&M, MILPERS, and MILCON) going back to FY 2011. The data also included a range of other categories such as MILCON and smaller accounts that are not analyzed in this paper.

We aggregated these data to obtain monthly obligation dollars by category across all accounts, then calculated the percentage obligated in each month compared to the total dollars obligated by the final month. For example, if the RDT&E obligated in month 2 was $5,112,653, and the total obligated by month 24 was $71,339,247, then the month 2 percentage is about 7.17% (= $5,112,653 / $71,339,247). Table 2-2 lists the number of nominal months available to obligate by category of funding.

Table 2-2. Month Used for Final Obligation Values

Category	Years to Obligate	Final Month
RDT&E	2	24
Procurement	3	36
O&M	1	12
MILPERS	1	12
MILCON	5	60

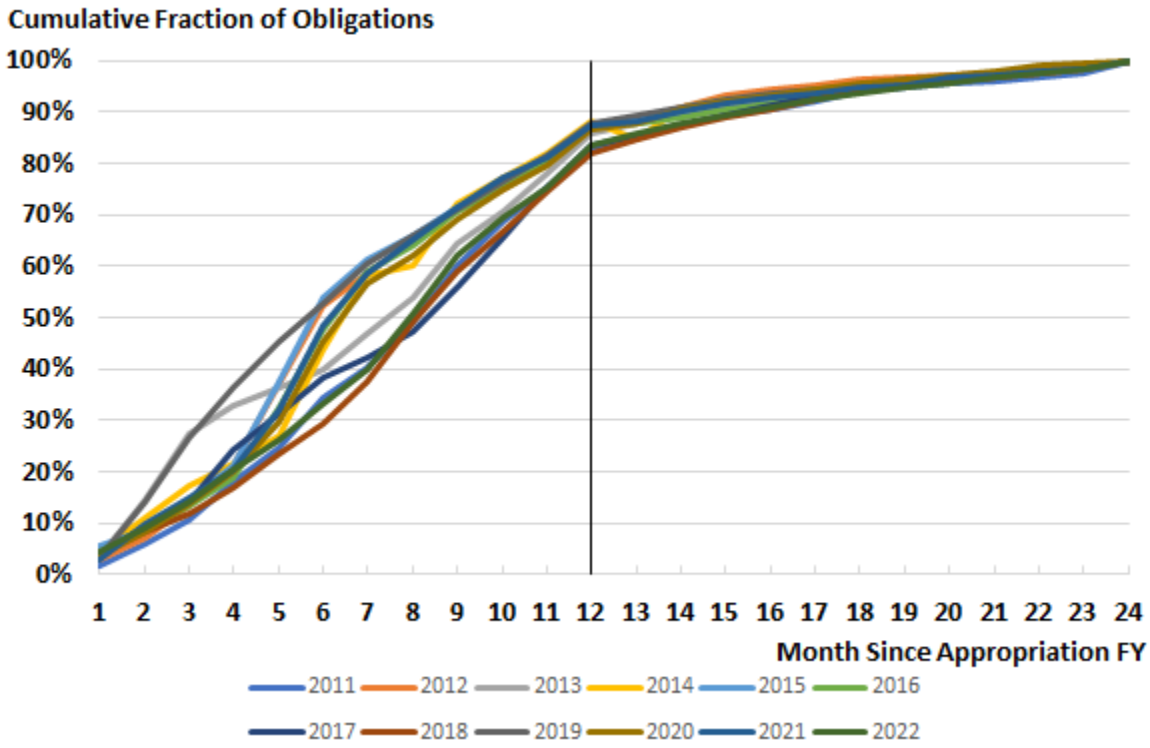
SOURCES: DoD 7000.14-R Vol. 2A, Section 1.7.2.25 (years for new obligations unexpired). MILCON final month was based on when the reported obligations in the DoD data began to flatten on average.

This yielded a series of monthly obligation rates (percentages) for each FY's authorization and appropriation out to the end of those obligations. Thus, we have a 24-month series for FY 2011 RDT&E obligations. Likewise, we have 36-month, 12-month, and 12-month series of obligation rates for FY 2011 Proc, O&M, and MILPERS, respectively. This allows us to analyze the obligation rates for each FY's authorized and appropriated dollars separately even when they extend into subsequent years (e.g., analyze the FY 2011 RDT&E dollars obligated in FY 2012 separately from the FY 2012 RDT&E dollars obligated in FY 2012).

RDT&E MONTHLY OBLIGATION RATES

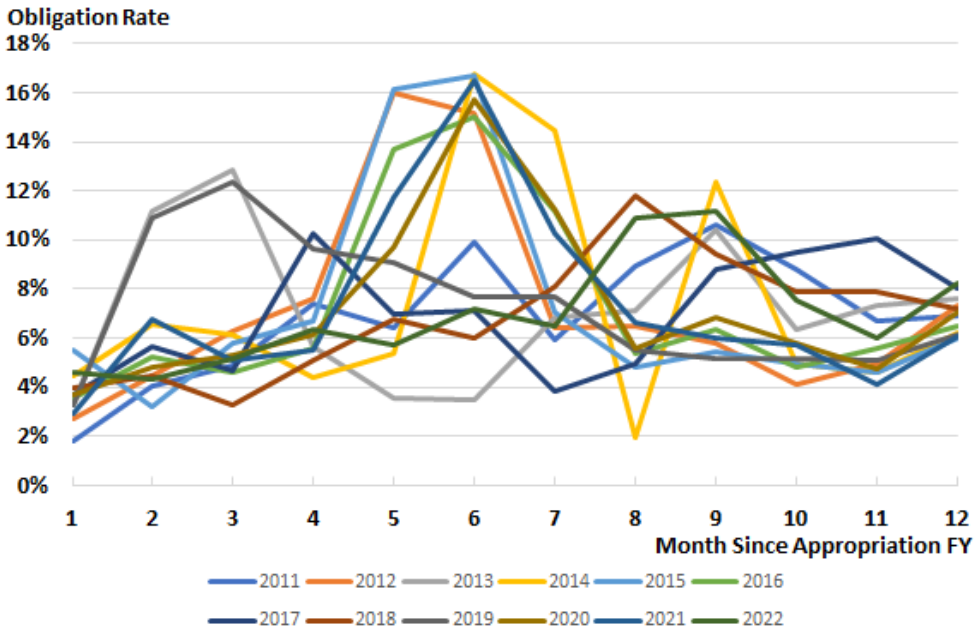
Figure 2-2 shows the cumulative RDT&E obligations as a percentage of the total by month 24 of the allotted time to obligate RDT&E. Note that 85.8% of the RDT&E is obligated by the end of the first year. Figure 2-3 shows these data as monthly obligation rates for the first year, and Figure 2-4 shows the monthly rates for the second year.

Figure 2-2. Fraction of Cumulative RDT&E Obligations by Month (FY 2011–2022 Appropriations)



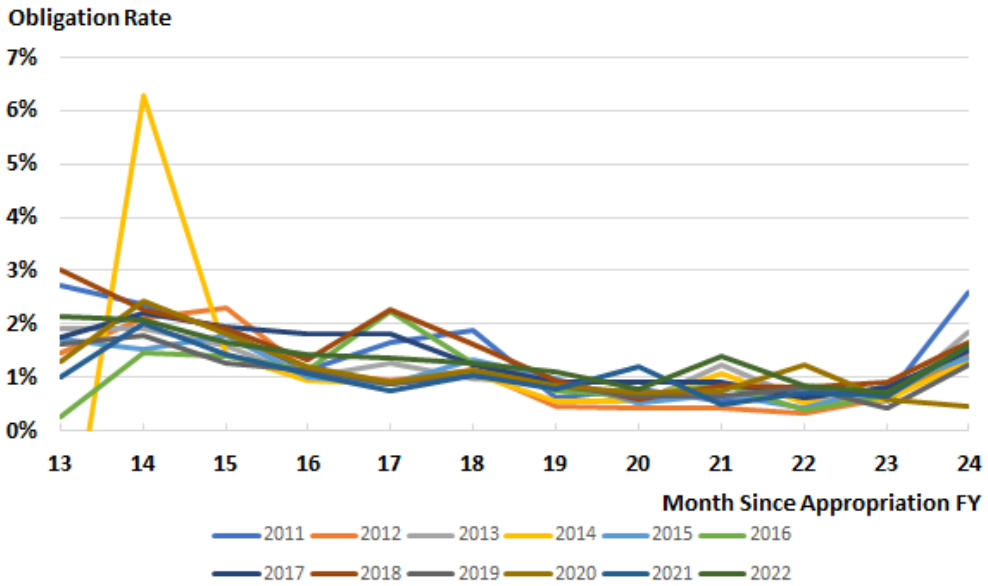
NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 2-3. RDT&E Monthly Obligation Fractional Rates: Year 1 (FY 2011–2022 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 2-4. RDT&E Monthly Obligation Fractional Rates: Year 2 (FY 2011–2022 Appropriations)

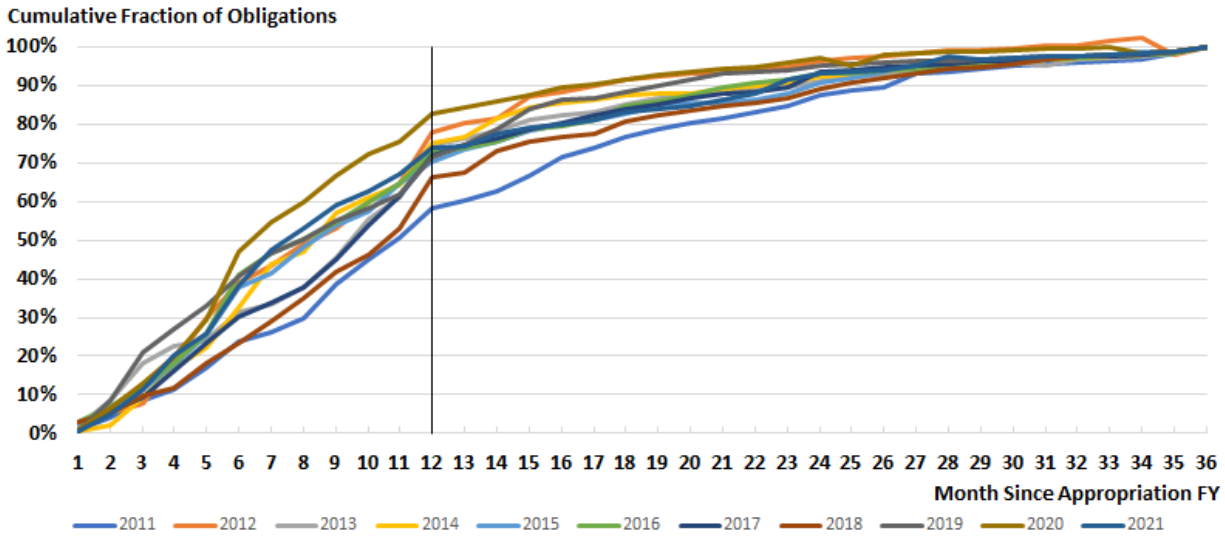


NOTE: Month 13 is October in year after the FY in which the appropriations were made.

PROCUREMENT MONTHLY OBLIGATION RATES

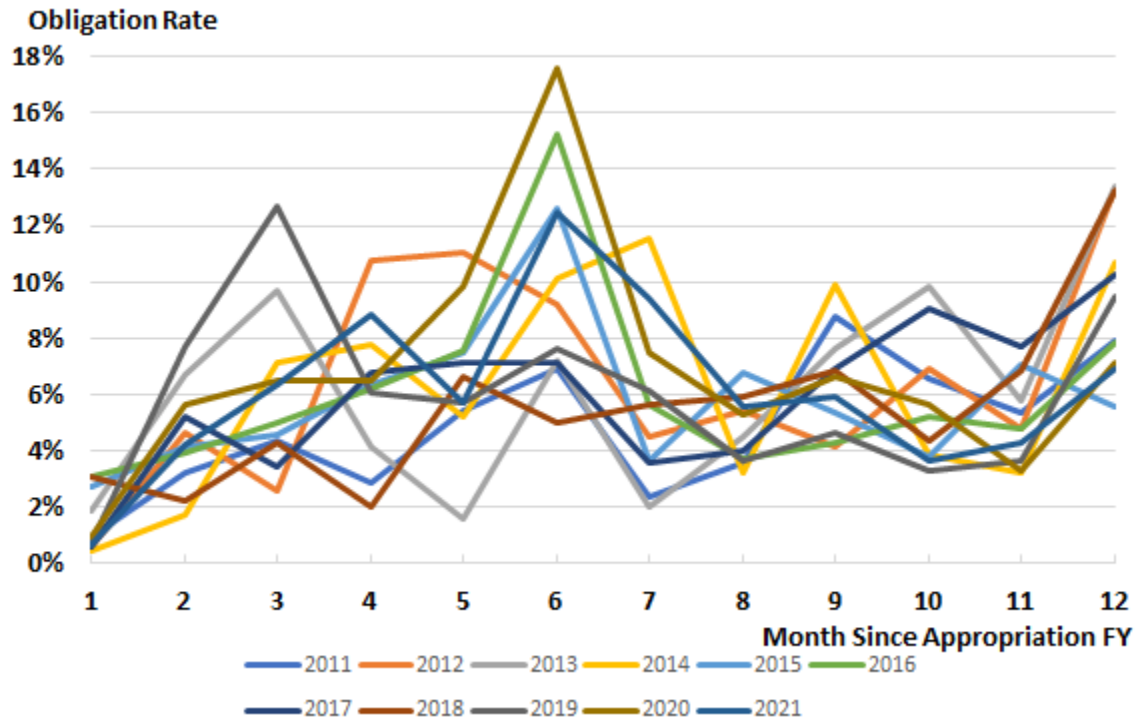
Figure 2-5 shows the cumulative Procurement obligations as a percentage of the total by month 36. Note that on average 72.3% of Procurement dollars are obligated by the end of the first year. Figure 2-6 shows these data as monthly obligation rates for the first year, and Figure 2-7 shows the monthly rates for the second and third years after appropriation.

Figure 2-5. Fraction of Cumulative Procurement Obligations by Month (FY 2011–2021 Appropriations)



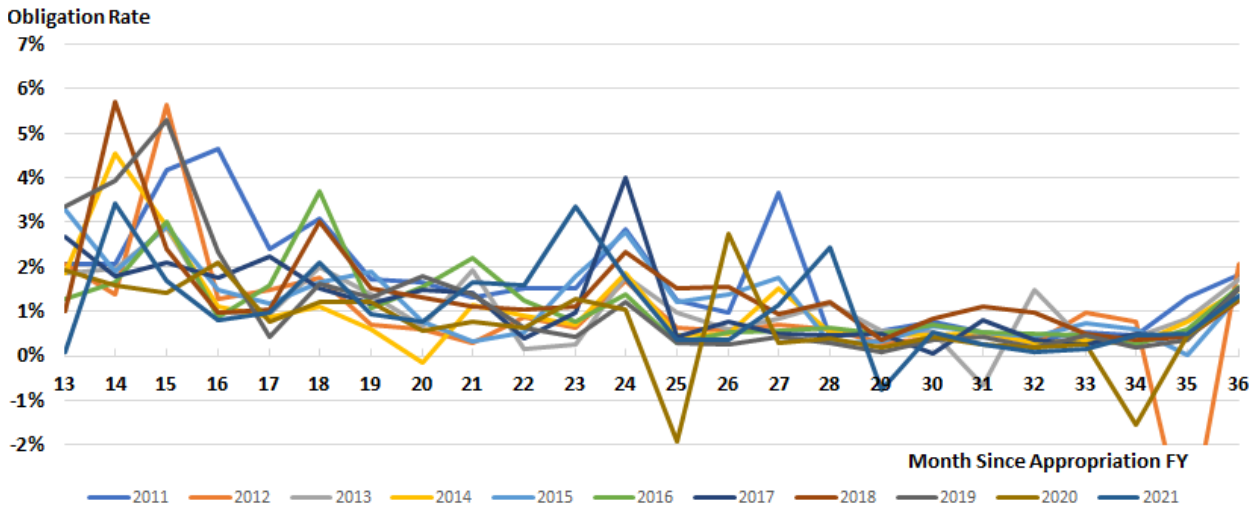
NOTE: Month 1 is October of the FY in which the appropriations were made

Figure 2-6. Procurement Monthly Obligation Fractional Rates: Year 1 (FY 2011–2021 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made

Figure 2-7. Procurement Monthly Obligation Fractional Rates: Years 2–3 (FY 2011–2021 Appropriations)

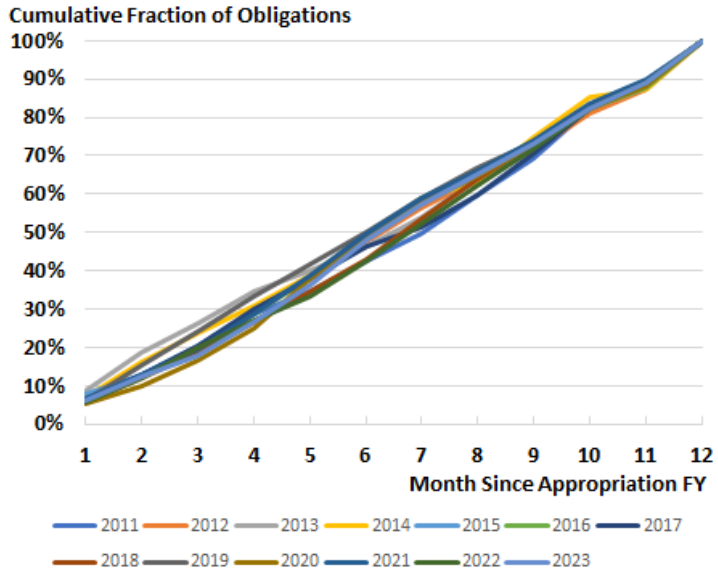


NOTE: Month 13 is October in year after the FY in which the appropriations were made.

O&M MONTHLY OBLIGATION RATES

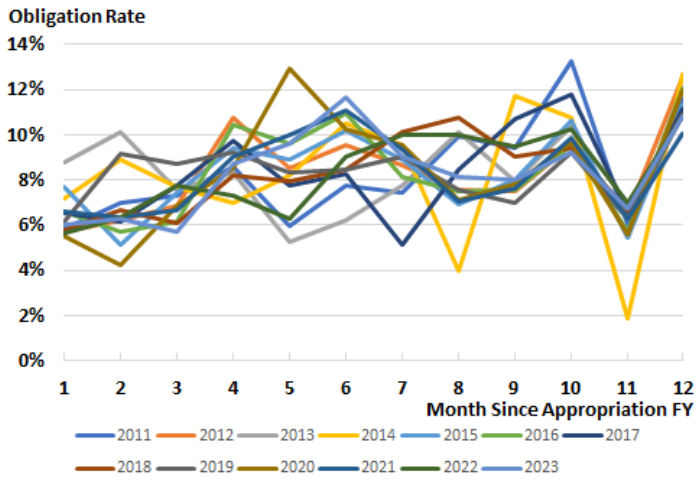
Figure 2-8 shows the cumulative O&M obligations as a percentage of the total by the end of the FY. Figure 2-9 shows the monthly obligation rates for the year.

Figure 2-8. Fraction of Cumulative O&M Obligations by Month (FY 2011–2023 Appropriations



NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 2-9. O&M Monthly Obligation Fractional Rates (FY 2011–2023 Appropriations)

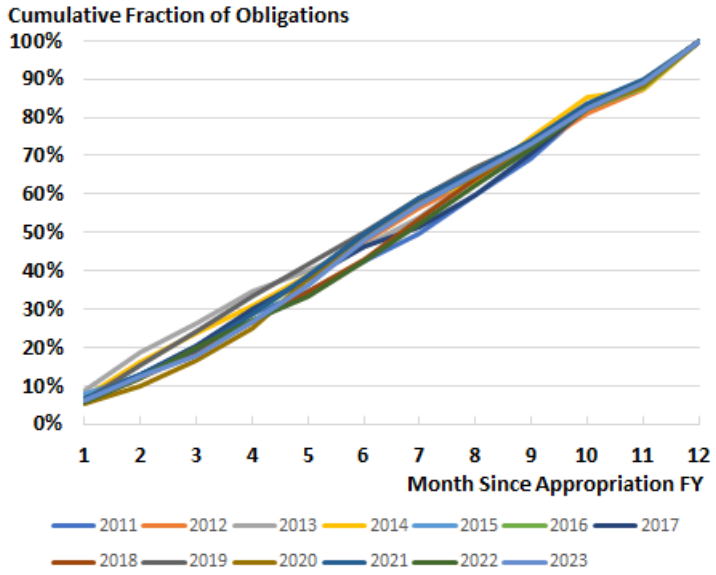


NOTE: Month 1 is October of the FY in which the appropriations were made.

MILITARY PERSONNEL MONTHLY OBLIGATION RATES

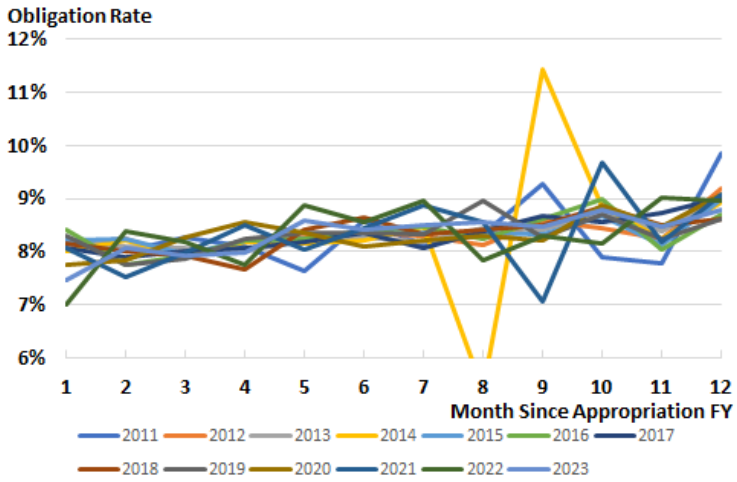
Figure 2-10 shows the cumulative MILPERS obligations as a percentage of the total by month 12. Figure 2-11 shows these data as monthly obligation rates for the year available for obligation.

Figure 2-10. Fraction of Cumulative MILPERS Obligations by Month (FY 2011–2023 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 2-11. MILPERS Monthly Obligation Fractional Rates (FY 2011–2023 Appropriations)



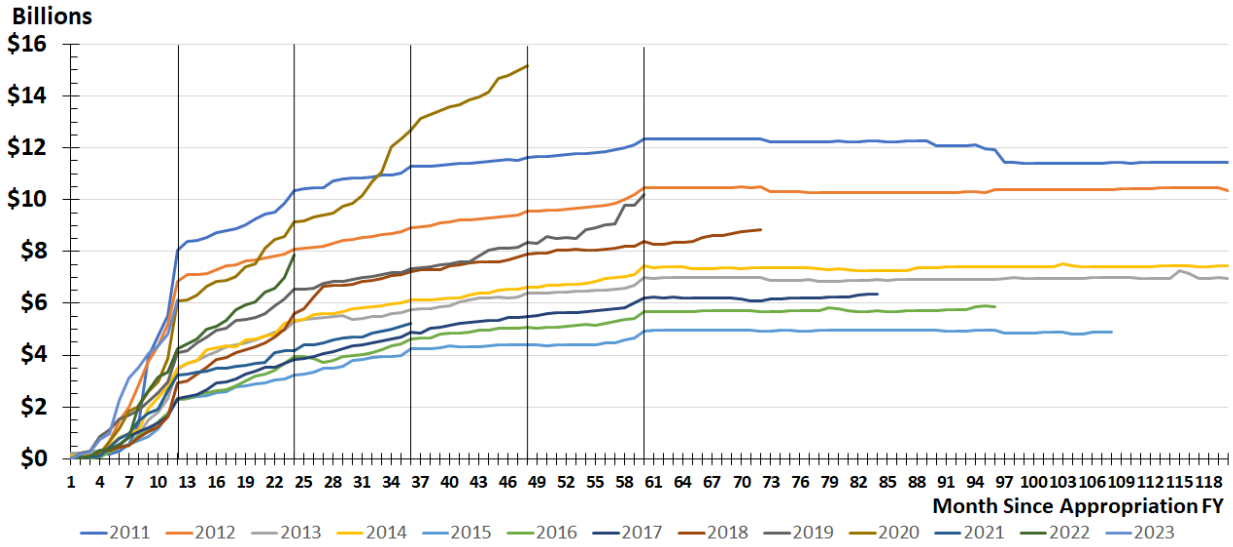
NOTE: Month 1 is October of the FY in which the appropriations were made.

MILCON MONTHLY OBLIGATION RATES

Figure 2-12 shows the cumulative dollars obligated by month for MILCON in appropriation years FY 2011–2023. The larger obvious data issues were cleaned, especially through month 60, but what appear to be drops in data reporting can still be seen. Also, there continue to be significant obligations after month 36 (despite what the benchmarks seek).

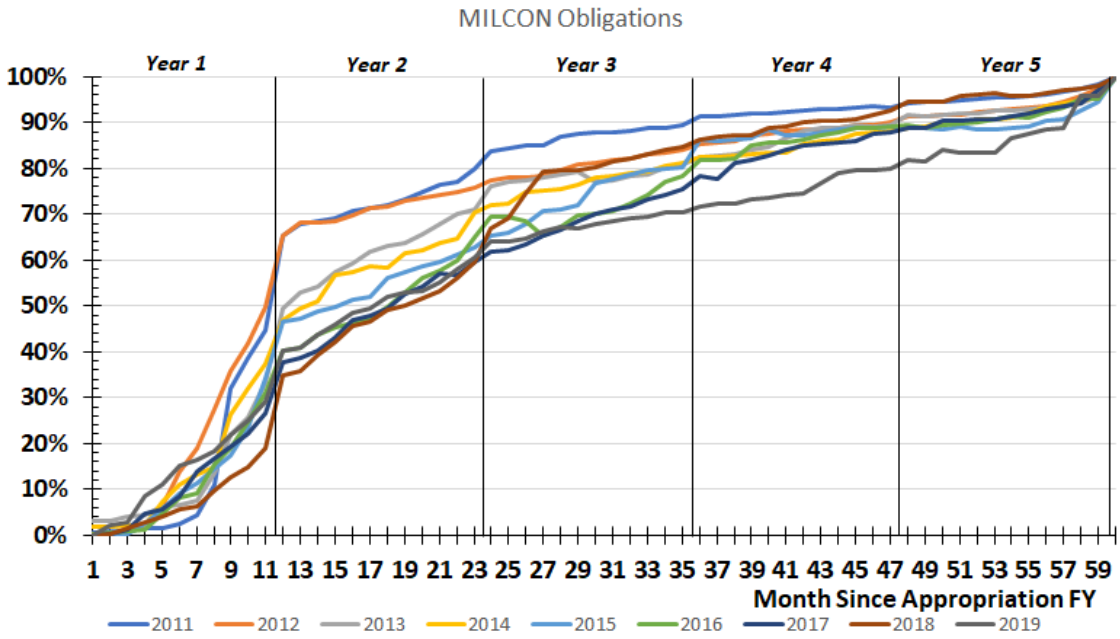
Figure 2-13 shows the cumulative MILCON obligations as a percentage of the total by month 60. Figure 2-14 shows the average of these obligation percentages along with the benchmark percentages by month. Figure 2-15 shows the percent difference between these averages and the benchmark for each month, and Figure 2-16 shows what those average differences are in dollars averaged across FY 2011–2021, which can be as high as $1.7 billion at the peak average. Because it is unclear what the final obligation values are (see Figure 2-12), we used the value at month 60 as the final total for the actuals when calculating percentages of total. This skews the tail end of this chart and may not align with how the Comptroller applies the benchmarks against the total obligation authority values that they have. Thus, the values towards the end of these figures are less accurate.

Figure 2-12. Cumulative MILCON Obligation Dollars by Month (FY 2011–2023 Appropriations)



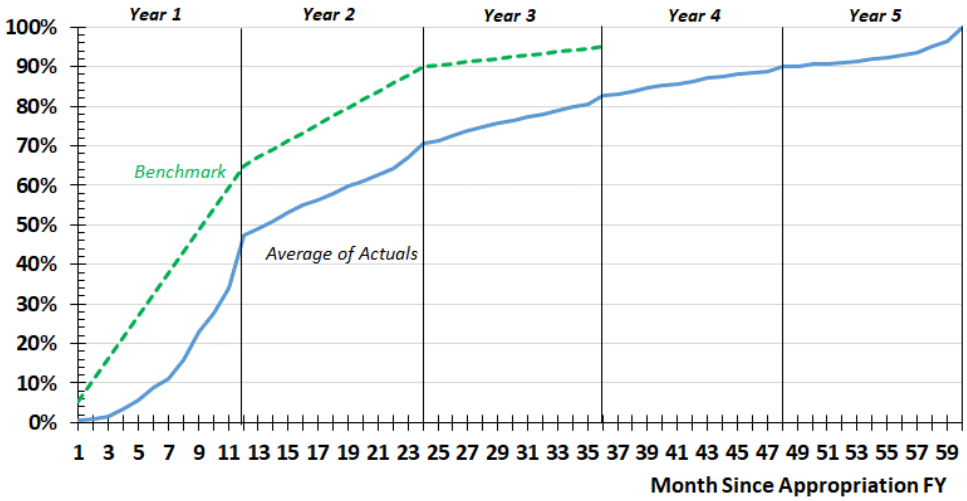
NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 2-13. Fraction of Cumulative MILCON Obligations by Month (FY 2011–2019 Appropriations)



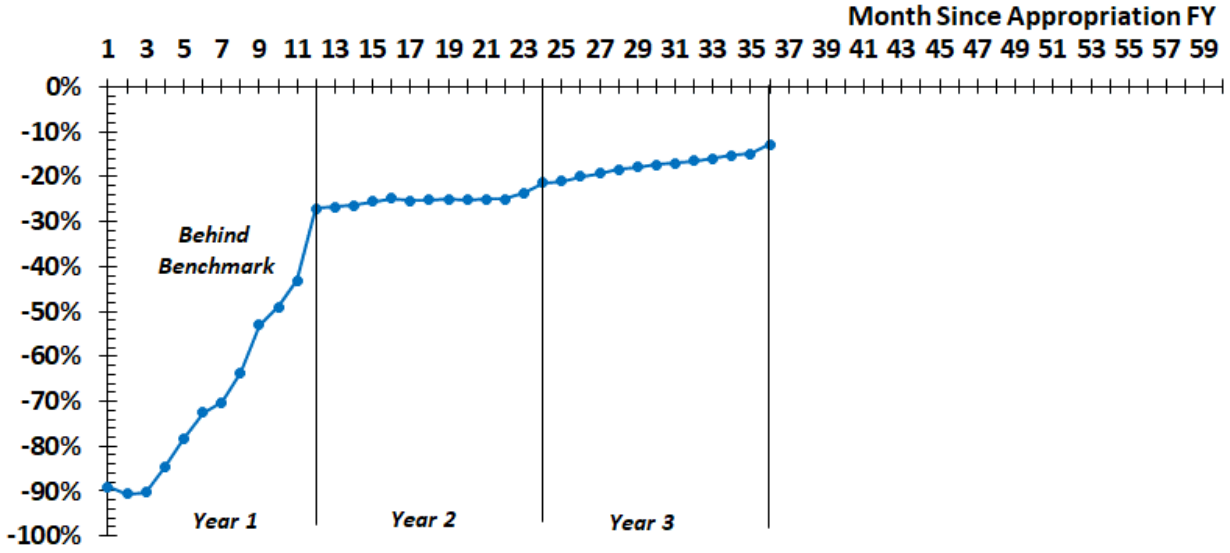
NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 2-14. Average Cumulative MILCON Obligation Fraction versus Benchmark as Percentage of Month 60 Obligations (FY 2011–2019 Appropriations)



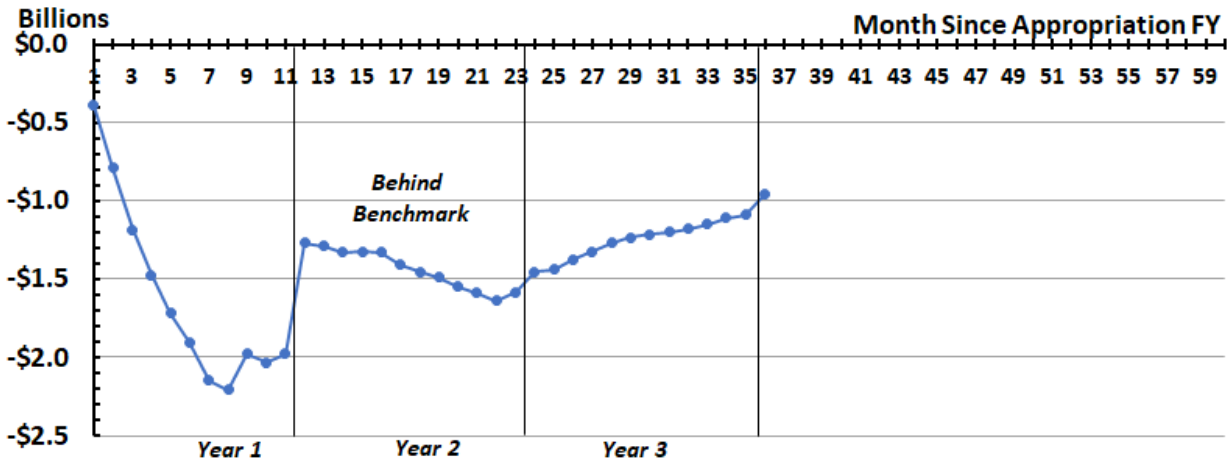
NOTE: The final obligation values are not precise given the continued obligations shown in Figure 2-12, so we used the final value at month 60 as the total baseline for the actuals. This skews the tail end of this chart and may not align with how the Comptroller applies the benchmarks against the total obligation authority values that they have.

Figure 2-15. Percent Difference between Average Cumulative MILCON Obligations and Benchmark (FY 2011–2019 Appropriations)



NOTE: The final obligation values are unclear given the continued obligations shown in Figure 2-12, so we used the final value at month 60 as the total baseline for the actuals. This skews the tail end of this chart and may not align with how the Comptroller applies the benchmarks against the total obligation authority values that they have.

Figure 2-16. Dollar Difference between Average Cumulative MILCON Obligations and Benchmark (FY 2011–2019 Appropriations)



NOTE: The final obligation values are unclear given the continued obligations shown in Figure 2-12, so we used the final value at month 60 as the total baseline for the actuals. This skews the tail end of this chart and may not align with how the Comptroller applies the benchmarks against the total obligation authority values that they have.

CR AND OTHER EFFECTS ON DOD OBLIGATION MONTHLY RATES

Using the data from Advana, we conducted multivariate linear regressions on individual obligation categories (colors of money) to identify any variables that correlate with changes in the normal monthly obligation rates. Table 2-3 lists the variables tested for correlation (i.e., with a p-value no higher than 0.05). Visual examination of the monthly obligation rates indicated that the first year of obligation behaved differently than any subsequent years, so for multi-year appropriations (RDT&E and PROC) we conducted separate regressions for the first and subsequent years.

Table 2-4 summarizes the statistical results with the following observations.[8] The data are well modeled by a linear obligation rate (the constant base) with adjustments for the variables shown. For example, on average, the RDT&E rate in October of the first year of obligating a FY's appropriation was 5.9% − 2.3% = 3.6%. If March of the first spending year was also the third month after the budget was passed (3 MAB), then on average the obligation rate would be about 5.9% + 6.3% + 2.3% = 14.5% (which is close to the actual value of 15.1% for FY 2012, for example).

Table 2-3. Variables Tested for Effects on Monthly Obligation Rates

Type	Variables
FY calendar month	October, November, December, January, February, March, April, May, June, July, August, September
Month after full budget passed	1 MAB, 2 MAB, 3 MAB, 4 MAB, 5 MAB, 6 MAB
Time (month #)	Time

[8] Statistically, we note the following:

- While all have descent Adjusted R2 values, the values for RDT&E (1st year), PROC, and O&M are the highest. Thus, the latter explain the variation in the data well.
- The models (the constant monthly linear contribution plus the contributions from the variables in the model) are fairly linear, with the RDT&E 1st-year for RDT&E and PROC (respectively) and O&M being very linear.

Table 2-4. Contributions of CR and Other Variables Affecting Obligation Rates (FY 2011–2023 Appropriations)

			RDT&E		PROC		O&M	MILPERS
			1st Year	2nd Year	1st Year	2nd–3rd Years		
Average Base	**Monthly Rate**	*Base rate:*	5.9%	1.7%	5.0%	2.0%	7.5%	7.9%
CR Effects	**1st MAB**	*If true, add:*					1.2%	
	2nd MAB	*If true, add:*	4.3%		1.8%		2.4%	
	3rd MAB	*If true, add:*	6.3%		4.6%		2.4%	
	4th MAB	*If true, add:*	3.7%		2.2%		1.6%	
Calendar Month Effects	**October**	*If true, add:*	−2.3 %		−3.6%		−1.1%	
	November	*If true, add:*		0.9%		0.6%	−0.8%	
	December	*If true, add:*				0.9%		
	March	*If true, add:*	2.3%		2.6%	0.4%		
	July	*If true, add:*					2.4%	
	August	*If true, add:*					−1.8%	
	September	*If true, add:*		1.0%	4.6%	1.4%	4.1%	0.4%
Time Trend	**Time (month)**	*If true, add:*		−0.1 %		−0.1%		0.1%
Linearity	***Multiple R***		*0.80*	*0.58*	*0.77*	*0.66*	*0.84*	*0.48*
% of variation explained	***Adjusted R^2***		*63%*	*32%*	*57%*	*43%*	*68%*	*22%*

CRs affect obligation rates as a 2–3-month increase after the budget is passed. CRs affect obligations for RDT&E, PROC, and O&M but not MILPERS. These effects are seen predominantly as increased obligations in the second through fourth months after the budgets are passed but do not extend into subsequent months. The effect is strongest for RDT&E, wherein about a seventh (14.4%) of all RDT&E appears to be withheld until after the budget is passed, contributing to a bump of 14.4% spread over the second through fourth months after passage, about doubling the obligation rates in months 2–3 MAB and six-tenths higher in 4 MAB. This is true also for PROC and O&M, but the bump is smaller at 8.7% and 7.7%, respectively. With PROC rates about double in 3 MAB and O&M rates about a third higher in 2–3 MAB. Interestingly, this effect is a short-lived bump rather than an inflection in the rates. MILPERS shows no significant post-CR effects.

Obligation rates are lower at the start of the FY. As expected, obligations are lower in October (the first month of the FY) by about 40% for RDT&E, 72% for PROC, and 25% for O&M. There is no statistical effect for MILPERS. This effect likely reflects qualitative evidence that it takes 30–45 days or more for program offices and agencies to receive their obligation authorities in the DoD financial management system (Marsalis, 2022). Interestingly, this effect is spread over two months for O&M.

Obligation rates are higher the month before the midyear appropriation review. For RDT&E and PROC, there is an increase in March by about 40–50%. This may be due to proactive increases in anticipation of the midyear budget reviews in the April and May timeframe. These reviews compare planned to actual obligation and expenditure rates and are "the beginning of major reprogramming activity within the Defense Department, to ensure all appropriated funds are used" (Department of the Air Force, 2022, p. 54).

Obligation rates are higher in September—but not for RDT&E's first year of obligating. As expected, there is a significant increase in obligating at the end of the FY. This effect almost doubles the PROC rate in the first year and causes an approximate two-thirds rate increase for RDT&E and PROC's subsequent years.[9] The effect of one-twentieth is almost negligible for MILPERS. Interestingly, there is no increase for RDT&E at the end of its first year—perhaps because people know that they have a second year to spend remaining funds and most of the funds (usually about 80%) are already obligated by then.

O&M shows higher obligations in July and lower in August. The basis for this effect is unclear but may be due to the holiday and summer vacations in those months, although if so, then one would expect lower obligations in July rather than higher.

Subsequent-year RDT&E and PROC obligation rates are higher near the year-end holidays. Statistically, 2nd-year rates for RDT&E and 2nd–3rd-year rates are higher by about half for RDT&E and PROC. It is not quite clear why, especially given these effects are not consistent across colors of money and do not show up in the first year of obligations.

O&M and MILPERS obligations are fairly linear, although MILPERS shows an increasing curved trend upwards. These obligation rates are fairly linear, with the addition of the consistent variations discussed above. The statistically significant time variable for MILPERS gives its rate a slight upward curvature.

RDT&E and O&M dollars obligate the first year on a linear basis, then inflect to a reduced, curved basis. The first year of obligation rates are fairly linear, with the addition of the consistent variations discussed above. Obligation rates for RDT&E and PROC multiyear dollars then become a curved downward shape after the first year, slowing by a tenth of a percent from the prior month after the first year of obligating a FY's appropriations on top of a base rate that is about a third as fast as in the first year.

MILCON obligations are not linear in the first year but become so afterwards. There are significant ramp-ups in obligation rates (as opposed to linear obligations) in the first year. This can be clearly seen in Figure 2-14. Thus, in contrast to the other categories of funds, MILCON obligations are not able to meet the benchmarks despite oversight and review pressures. Also, Figure 2-12 shows that a significant fraction of MILCON obligations occurs after year 3, which is not in alignment with the benchmark targets. Further data cleaning and analysis are needed to better understand how much.

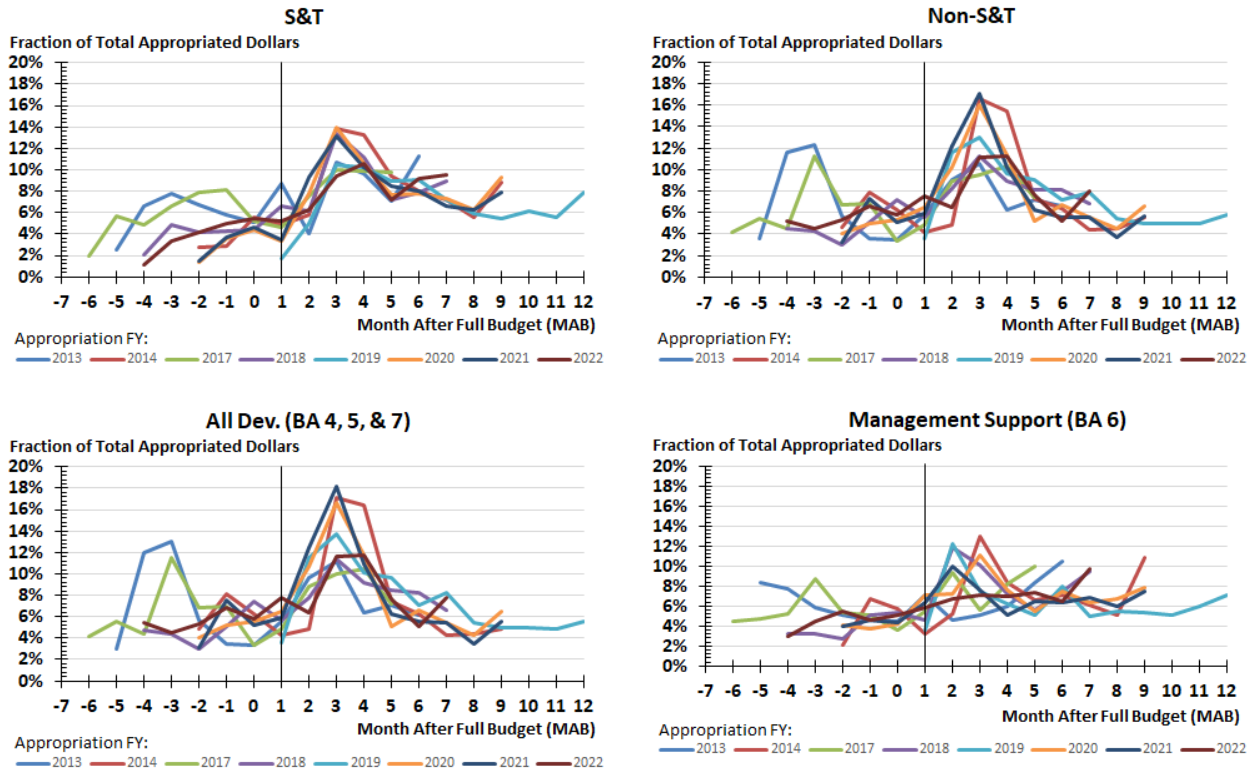
[9] This, of course leads to a significant burden on the contracting officers, but this staff burden could be relieved by obligating earlier in the year.

CR AND OTHER EFFECTS ON DOD OBLIGATION MONTHLY RATES: RDT&E BY BUDGET ACTIVITY

The analysis above examined RDT&E obligations together. Subsequently, we obtained DoD monthly RDT&E obligations data broken down by Budget Activity (BA) for appropriation FYs 2013, 2014, and 2017–2022. Table 2-5 shows the results of the linear regressions on the RDT&E monthly obligation rates as percentages of appropriation-year dollars associated variables across all of RDT&E (original Advana data) and broken down by S&T, development, and management accounts. Table 2-6 further shows the breakout of S&T by Budget Activity (BA) 1–3. RDT&E obligations for each FY extend for two years. The monthly obligation rates show a major inflection after the first year, so separate regressions were made for each obligation FY. These tables show the average percentage rates (the "average base") plus the additional percentage-points associated with the variables shown.

When breaking S&T and BAs out of the earlier aggregated RDT&E model uncovered a direct continuing resolution (CR) effect. BAs 2–3 (in S&T) and BA-6 (Management Support [Mgt]) had statistically significant reductions in monthly obligation rates in the first year of about 1.0 to 1.4 percent. That is in addition to the prior short-term increases in the few months after the full FY budget was passed (MAB). Both the increase in obligation rates in the first few MABs as well as the CR effects for RDT&E and BA-6 can be seen in Figure 2-17, which plots monthly obligation rates for different appropriation FYs with the budget passage (MABs) aligned instead of by calendar month. This figure also shows that the MAB result is larger for non-S&T but not BA-6 (which has the lowest and more inconsistent MAB effect. In addition, the CR effect also can be seen clearly in the S&T plot in Figure 2-18.

Figure 2-17. Monthly S&T Obligation Rates for Appropriation FYs aligned to when the Full Budget is Passed (FY 2013-14, 2017-22 Appropriations)



As an example of how to read the model results in Table 2-5 and Table 2-6, if January was the first month after the budget was passed (the "1 MAB") for an appropriation FY, then the model would predict the monthly appropriation rates shown in Table 2-7. In our data sample, appropriations from FYs 2014, 2020, and 2021 had their first MAB in January. Figure 2-18 shows that their incremental monthly obligation rates align to each other and to the model shown in Table 2-7 for FYs with January 1MABs. Here, months 1-3 (October through December) operated under a CR and thus were below the base constant of 6.4%. The model showed that October was an additional 3.5 percentage points low and November an additional 1.1 percentage points lower than the baseline minus the CR effect. This can be seen in the lower-left of the figure. The first MAB is 1.6 percentage points lower in the model, but rises significantly in MABs 3–8, then returning closer to the base constant with a final increase in September. The example shows that the expected cumulative obligations should be about 84% by September; the actuals for FYs 2014, 2020, and 2021 are 88.0%, 83.3%, and 83.1%, respectively (85% on average—close to the 84% from the model).

Not only are there differences between S&T and non-S&T BAs, but the BAs within S&T show differences on which variables correlate with the monthly incremental obligation rates. For example, rates for BA-2 and BA-3 now show a significant drop in all months when there is a CR (-1.1 and -1.2 percentage-points below the average base rate). There is neither such CR correlation in RDT&E overall nor any of the other account categories (Procurement, O&M, and MILPERS).

Table 2-5. Contributions of CR and Other Variables Affecting RDT&E Obligation Rates (FY 2013-2014, 2017–2022 Appropriations)

		1st Year of Availability				2nd Year of Availability			
		All	S&T	DEV	Mgt	All	S&T	DEV	Mgt
Avg. Base		5.9%	6.4%	6.0%	6.3%	1.7%	2.3%	1.6%	2.5%
Add CR Effects	CR		-1.0%		-1.4%				
	1 MAB		-1.6%						
	2 MAB	4.3%		3.0%	2.1%				
	3 MAB	6.3%	4.8%	7.1%	2.1%				
	4 MAB	3.7%	4.3%	4.8%					
	5 MAB		1.5%						
	6 MAB		1.8%						
Add Calendar Month Effects	Oct.	-2.3%	-3.5%	-1.9%				0.40%	-0.63%
	Nov.		-1.1%			0.91%		0.52%	
	Mar.	2.3%	1.6%	1.7%					0.68%
	Sept.		2.4%		2.9%	1.0%	1.3%	0.84%	1.3%
Time Trend	Time (mo.)					-0.10%	-0.15%	-0.10%	-0.10%
Adj. R2		63%	84%	60%	42%	32%	48%	50%	33%

MAB = month after budget is passed; CR = month under a continuing resolution (the months before 1 MAB); BA = Budget Activity; S&T = Science and Technology (BA-1, BA-2, and BA-3 combined); DEV = development (BA-4, BA-5, and BA-7 combined); Mgt = Management [Support] (BA-6); mo. = month; Oct. = October; Nov. = November; Jan. = January; Mar. = March; Aug. = August; Sept. = September.

Table 2-6. Contributions of CR and Other Variables Affecting RDT&E Obligation Rates (FY 2013-2014, 2017–2022 Appropriations)

		1st Year of Availability								2nd Year of Availability							
		All	BA-1	BA-2	BA-3	S&T	ACDP	BA-5,7	Mgt	All	BA-1	BA-2	BA-3	S&T	ACDP	BA-5,7	Mgt
Avg. Base		5.9	7.5	6.3	6.2	6.4	5.7	5.9	6.3	1.7	1.8	2.4	2.4	2.3	1.6	1.7	2.5
Add CR Effects	CR			-1.1	-1.2	-1.0			-1.4								
	1 MAB			-1.2	-1.6	-1.6											
	2 MAB	4.3					4.2	2.6	2.1								
	3 MAB	6.3	5.1	4.8	4.8	4.8	7.5	7.7	2.1								
	4 MAB	3.7	3.4	4.0	4.9	4.3	3.3	5.8									
	5 MAB			1.4	1.7	1.5		2.0									
	6 MAB			2.0	1.9	1.8											
Add Calendar Month Effects	Oct.	-2.3	-5.4		-3.6	-3.5		-2.5				-0.42				0.53	-0.63
	Nov.		-3.1		-0.95	-1.1	1.7			0.91						0.59	
	Jan.		-3.5														
	Mar.	2.3		1.5	2.0	1.6	2.5										0.68
	May														-0.48		
	July														0.51		
	Sept.			2.9	2.4	2.4			2.9	1.0	1.2	1.3	1.5	1.3	0.82	0.91	1.3
Time Trend	Time (mo.)									-0.10	-0.11	-0.17	-0.15	-0.15	-0.10	-0.11	-0.10
Adj. R2		63%	54%	77%	87%	84%	56%	57%	42%	32%	21%	49%	39%	48%	22%	51%	33%

MAB = month after budget is passed; CR = month under a continuing resolution (the months before 1 MAB); BA = Budget Activity; S&T = Science and Technology (BA-1, BA-2, and BA-3 combined); ACDP = Advanced Component Development and Prototypes (BA-4); Mgt = Management [Support] (BA-6); mo. = month; Oct. = October; Nov. = November; Jan. = January; Mar. = March; Aug. = August; Sept. = September.

NOTE: The regression models for BA-1 and ACDP (highlighted in yellow) in the second year of availability are rather low, only explaining 21% and 22% of the variation in the data, respectively. Also, the data for appropriations from FY 2015 and 2016 were not available.

Table 2-7. Example of How to Read the Obligation Models

Monthly S&T Obligation Rates from the Model for a FY with Full Budget Passed in January

Mo.	#	Variables Active in that month	Avg. Base	+ Variable Effects (CR effects + Oct.–Sept. + MAB effects)	= Expected Obligation Rate
Oct.	1	CR & Oct.	**6.4%**	**−1.0% − 3.5%** *(the CR and Oct. constants)*	**= 1.9%**
Nov.	2	CR & Nov.	**6.4%**	**−1.0% −1.1%** *(the CR and Nov. constants)*	**= 4.3%**
Dec.	3	CR	**6.4%**	**−1.0%** *(the CR constant; no Dec. constant)*	**= 5.4%**
Jan.	4	1 MAB	**6.4%**	**−1.6%** *(the 1 MAB constant)*	**= 4.8%**
Feb.	5	2 MAB	**6.4%**	*(no 2 MAB constant in the model)*	**= 6.4%**
March	6	3 MAB & March	**6.4%**	**+ 4.8% + 1.6%** *(the 3 MAB and March constants)*	**= 12.8%**
April	7	4 MAB	**6.4%**	**+ 4.3%** *(the 4 MAB constant)*	**= 10.7%**
May	8	5 MAB	**6.4%**	**+ 1.5%** *(the 5 MAB constant)*	**= 7.9%**
June	9	6 MAB	**6.4%**	**+ 1.8%** *(the 6 MAB constant)*	**= 8.2%**
July	10	*none*	**6.4%**	*(no July constant in the model)*	**= 6.4%**
Aug.	11	*none*	**6.4%**	*(no Aug. constant in the model)*	**= 6.4%**
Sept.	12	Sept.	**6.4%**	**+ 2.4%** *(the Sept. constant)*	**= 8.8%**
				Subtotal for 1st Year	***84%***

NOTE: The constants from the S&T obligation model are taken from the second column in Table 2-5, which is the same as the fifth column in Table 2-6.

Figure 2-18. Monthly S&T Obligation Rates for Appropriation FYs with Full Budget Passed in January (FY 2014, 2020, and 2021 Appropriations)

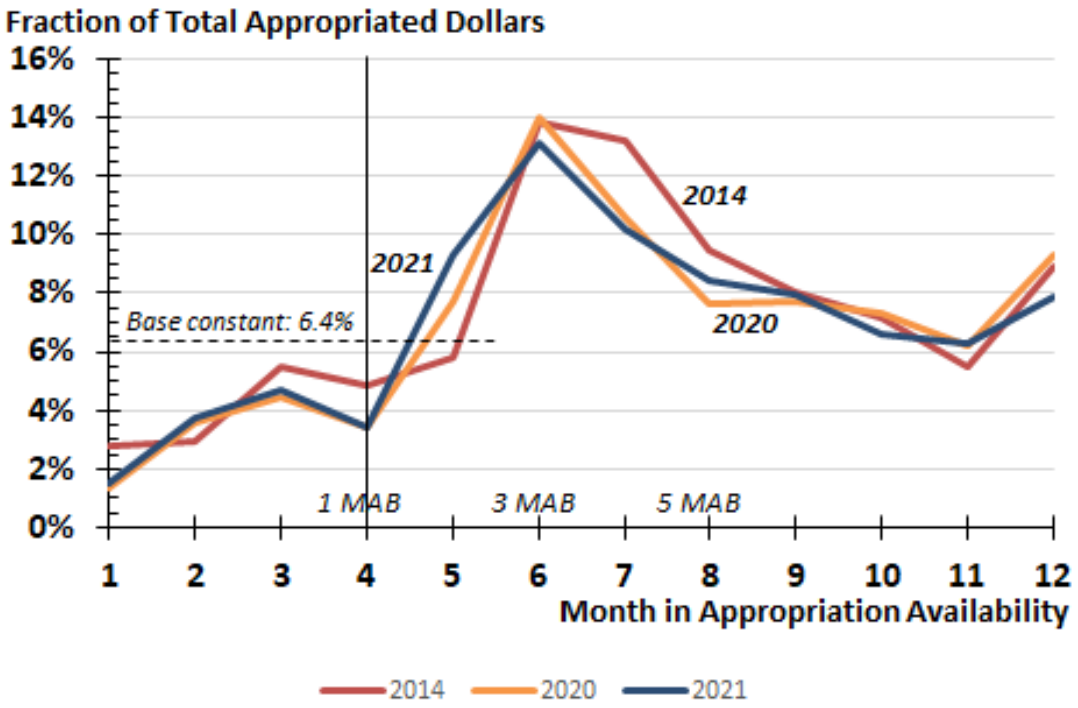


Figure 2-19 shows the average cumulative fraction of RDT&E obligations for three combined sets of BAs within RDTYE: S&T (BA 1–3), Dev457 (development: BA 4, 5, and 7), and Management Support (Mgt). These averages all exhibit the rather linear rise in the first year (months 1–12 in the appropriation availability), 77–87% by September (approaching but below the current Comptroller target of 90% for month 12). The curve for the second year of availability shows a curved line, as seen in the regression results with the time factor (see Table 2-5).

Figure 2-20 shows the average cumulative fraction of RDT&E obligations when combining Management Support (BA 6) with the three development BAs (4, 5, and 7) as a single non-S&T collection. Because management support always has lower values than Dev457 (and almost always lower than S&T), the combined effect is to lower the non-S&T curve slightly towards the S&T curve. The effect is small because management support dollars are less than those in Dev457.

Figure 2-21 shows the average cumulative fraction of RDT&E obligations of each RDT&E BA (1–7) individually. BA 4, 5, and 7 are close together, providing support for combining them in obligation benchmarks. Figure 2-22 shows the curves when just combining BA 5 and 7. BAs 1–3 are in the middle, with BA 1 having the highest rate of the three and BA 3 having the lowest. Finally, management support (BA 6) has the lowest rate.

Figure 2-19. Average Cumulative Fraction of RDT&E Obligations by Month: S&T vs. Development (BA 4, 5, 7) vs. Management Support (BA 6) (FY 2013–14, 2017–22 Appropriations)

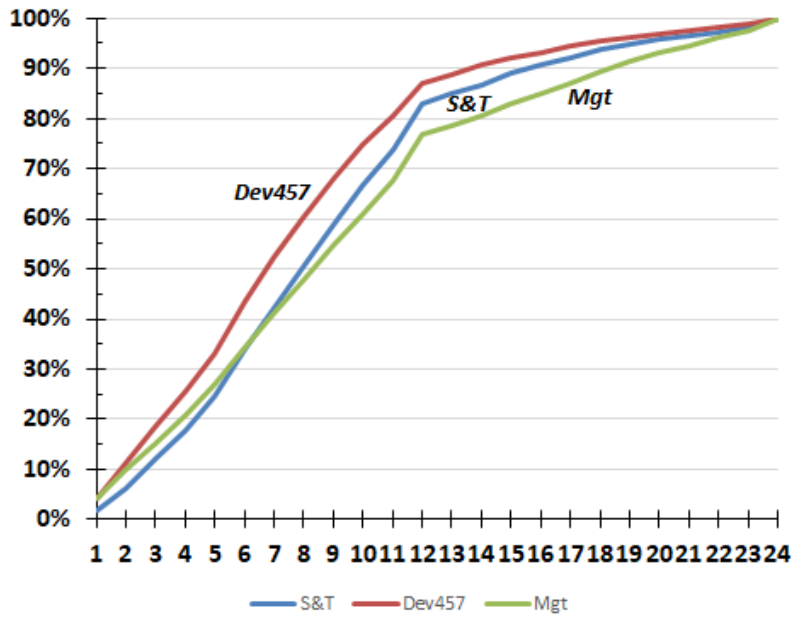


Figure 2-20. Average Cumulative Fraction of RDT&E Obligations by Month: S&T vs. Non-S&T (FY 2013–14, 2017–22 Appropriations)

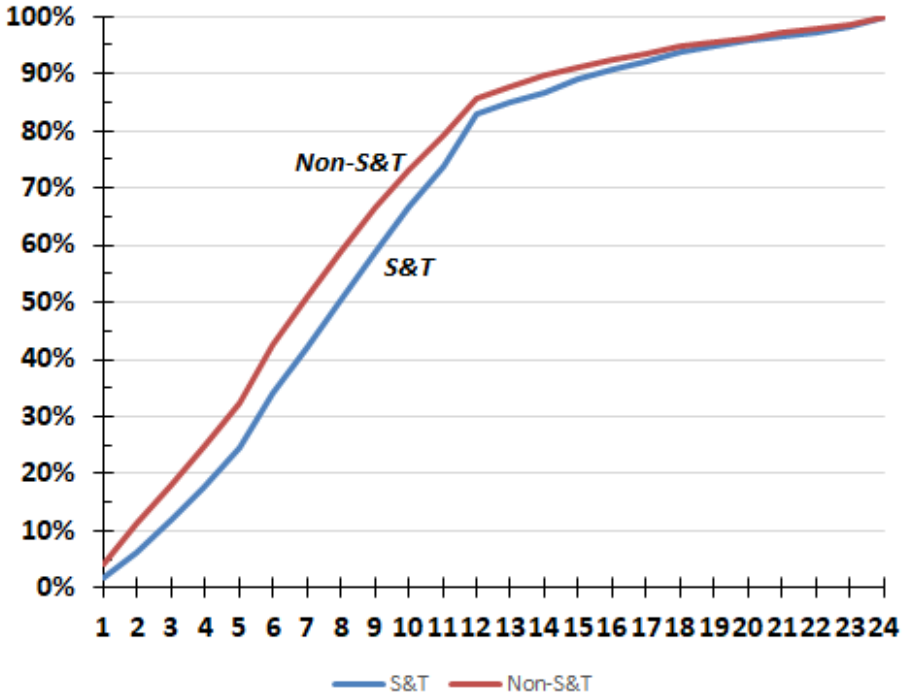


Figure 2-21. Average Cumulative Fraction of RDT&E Obligations by Month and BA (FY 2013–14, 2017–22 Appropriations)

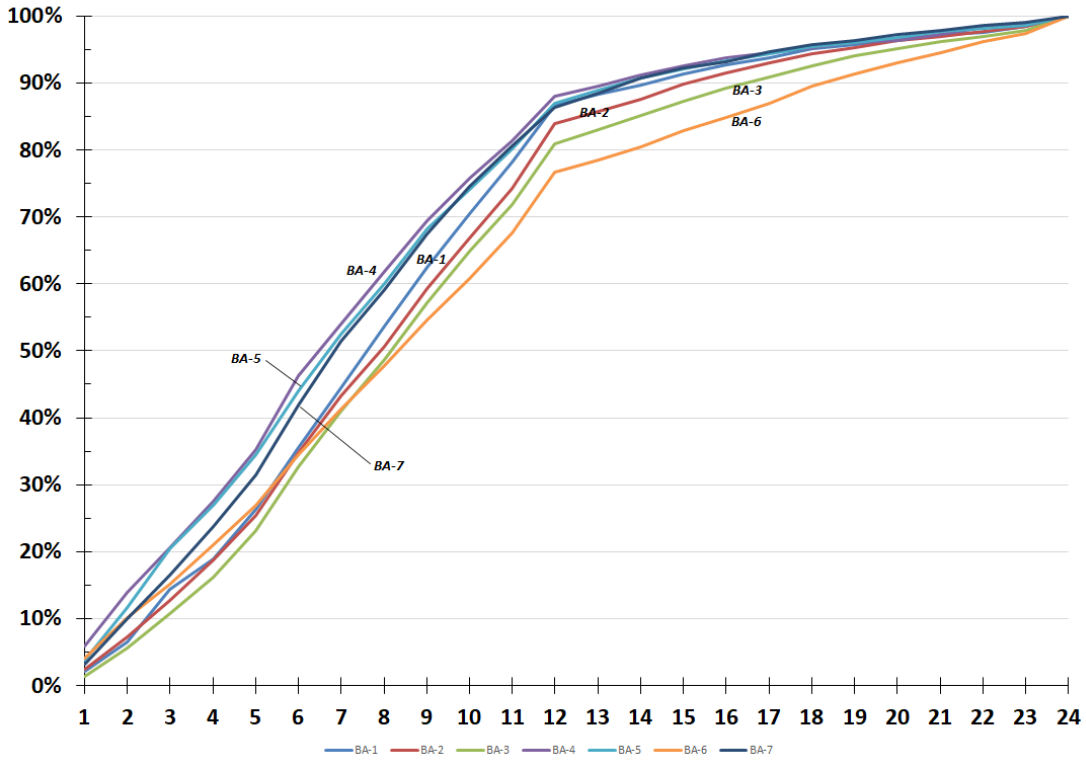
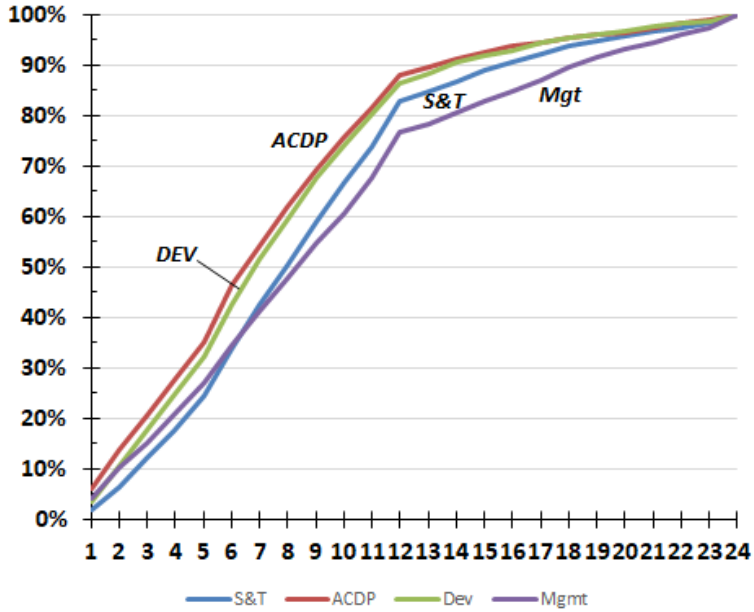


Figure 2-22. Average Cumulative Fraction of RDT&E Obligations by Month: S&T vs. Other (FY 2013–14, 2017–22 Appropriations)



CONCLUSIONS ON OBLIGATION BENCHMARKS

Theory, data, and analysis identified several complications that affect the realism of the current Comptroller benchmark profiles.

It takes time for organizations to receive funds, delaying obligations. While the benchmarks expect obligations to begin on October 1, it takes 30–45 days or more for program offices and agencies to receive their obligation authorities in the DoD financial management system (Marsalis, 2022). This is true of all types of funds, including O&M. Thus, obligation benchmarks that begin in October are limited to those offices and organizations that receive faster obligations and thus may be unrealistic generally.

Time needed to issue contract awards further delays obligations. If the obligation is on a contract (versus, say, DoD personnel), it takes time to issue a contract award. The Office of Federal Procurement Policy (2021) defines the Procurement Administrative Lead Time (PALT) as "the time between the date on which an initial solicitation for a contract or order is issued by a federal department or agency and the date of the award of the contract or order [i.e., the date of the obligation]."[10] PALT does not include the time it takes to prepare and obtain approvals for the purchase request. Table 2-8 outlines sample DoD PALT times used for planning purposes. Figure 2-23 shows the distribution of actual PALTs for FY 2020, wherein the median PALT for the DoD is about two-fifths of a year (about 5 months).

While solicitations can be prepared in advance (in anticipation of obtaining obligation authority), the actual award will still take time. Also, if a program or activity needs a new start approval or is uncertain whether they will receive authorizations and appropriations, they may not be in a position to begin solicitations and thus may be subject to a full PALT time and preparatory activities before PALT.

Operating under CRs can also delay obligations. As mentioned earlier, while there is no general slowing of actual obligations during a CR (except for S&T and BA-6 within RDT&E), statistical analysis found statistically significant increases in several months after final appropriations are passed (see the MAB variable results in the regressions above). Tremaine and Seligman (2013) also published a survey of 229 DoD personnel. The survey indicated that CRs can delay obligations. Thus, there is quantitative and qualitative evidence supporting an adjustment in obligation benchmarks due to CRs. The three-month surge after budget passage may be due to new starts or to other program authorization and appropriation effects on obligations.

There is also a concern that the general restrictions on new starts during a CR drives the DoD to spend on older priorities rather than providing an ability to respond to new immediate threats and their associated reprioritizations on spending needs in the DoD.

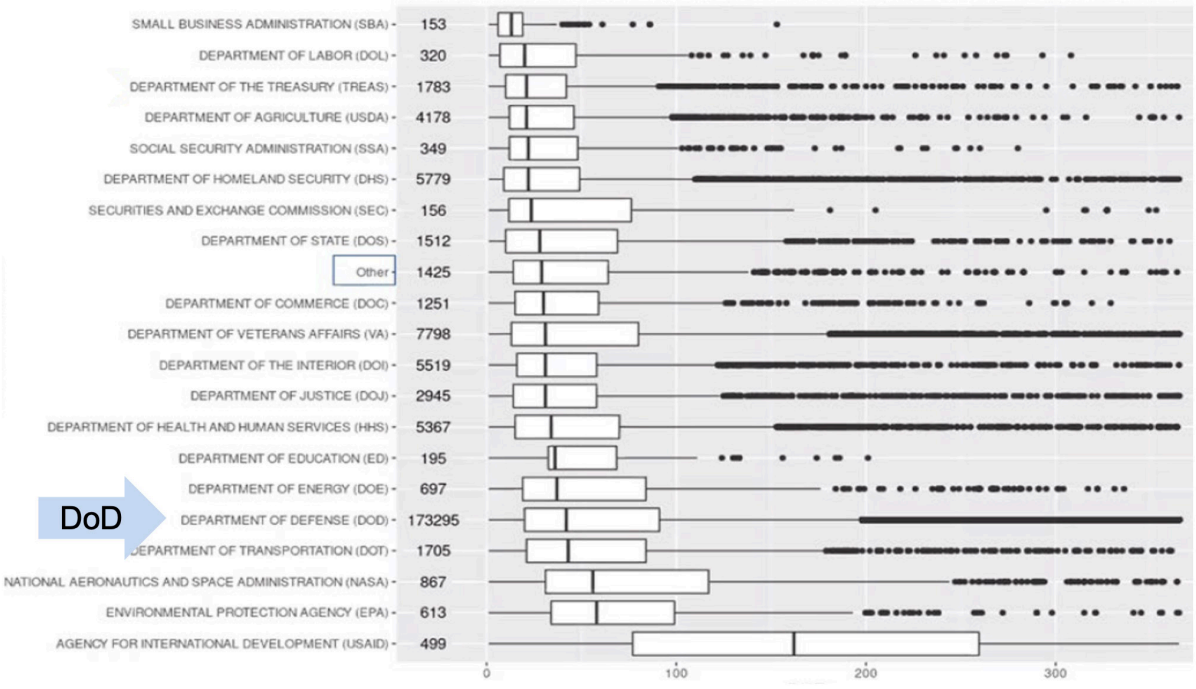
[10] PALT "…includes the time required to process/assemble the purchase request (including the independent government estimate), statement of work/performance work statement, technical exhibits/attachments, service contract approvals (ref. DFARS 237.170-2), quality assurance surveillance plan for services, and any applicable sole source justification & approval. It also includes the time required to solicit the Government requirement, evaluate the offers received, and obtain necessary approvals before making the final contract award. PALT does not include Production Lead Time (see the section on Production Lead Time below)." Defense Acquisition University (DAU), undated.

Table 2-8. PALT Planning Guidelines (from Purchase Request to Award)

Total Acquisition Value	Supplies	Services*
$10K – $250K	30 days	60 days
$250K – $7M	120 days	150 days
$7M – $10M	190 days**	240 days**
$10M – $50M	270 days**	290 days**
$50M+	365 days**	365 days**

* Extra time is required for services due to: additional required regulatory documentation; the time required for contractors to prepare their quotes/proposals; and performing technical and past performance evaluations, cost/price analysis, and offeror responsibility determinations.
** Requirements in excess of $10M require additional review periods and approvals from higher headquarters prior to solicitation release and prior to award.
SOURCE: Marine Corps Installations East (2021).

Figure 2-23. Actual PALT Time Distributions by Federal Agency (FY 2020)



SOURCE: USASpending.gov, as reported by Gill (2021).
NOTE: The numbers to the left of the graphics are the number of contracts in the data set.

EXPENDITURE RATES: THEORY AND DATA

Like obligation rates, the DoD and Congress track actual work execution by monitoring expenditures. This chapter assesses expenditure rates based on theory, contractor EVM execution data from the literature and the DoD's EVM Central Repository, and DoD expenditure data from Advana.

EXPENDITURE BENCHMARKS: ALIGNING WITH EXECUTION THEORY AND EARNED-VALUE DATA

We use historical expenditure data in the literature as well as the actual cost of work performed (ACWP)[11] on major acquisition programs as early indicators of expenditures (outlays).[12] In comparison, analysis of DoD expenditure data is provided in the following section.

ACWP reflects the costs by a contractor during execution and is in advance of actual expenditures (outlays) by the DoD for payment (Marsalis, 2022, p. 7). Thus, ACWP gives us a temporal pattern; DoD expenditures will be delayed slightly as invoicing and payment actions are made. The amount of shifting may depend on whether there are acceptance criteria or withholdings for test events, acceptance, or final auditing of invoices.

There is significant reporting in the literature that both expenditures and ACWP over time are not usually linearly increasing (monotonic) functions. Rather, ACWP typically displays a slower initial start-up period and slower spending during the tail end of an effort. This aligns with program experience—that an effort often involves start-up activities and staffing, and that the end of efforts involves trailing work, reporting, and close-out activities (Norden, 1970). Thus, rather than straight lines, spending curves have a sideways "S" shape over the life of the effort in terms of cumulative costs (expenditures). These shapes are well fit by Weibull, Rayleigh, and Beta distributions.[13, 14]

Figure 3-1 shows this nonlinear shape in data reported from 20 historical DoD acquisition programs. Likewise, Figure 3-2 shows this pattern for ACWP as the proxy for expenditures on the F-15 airframe development program.

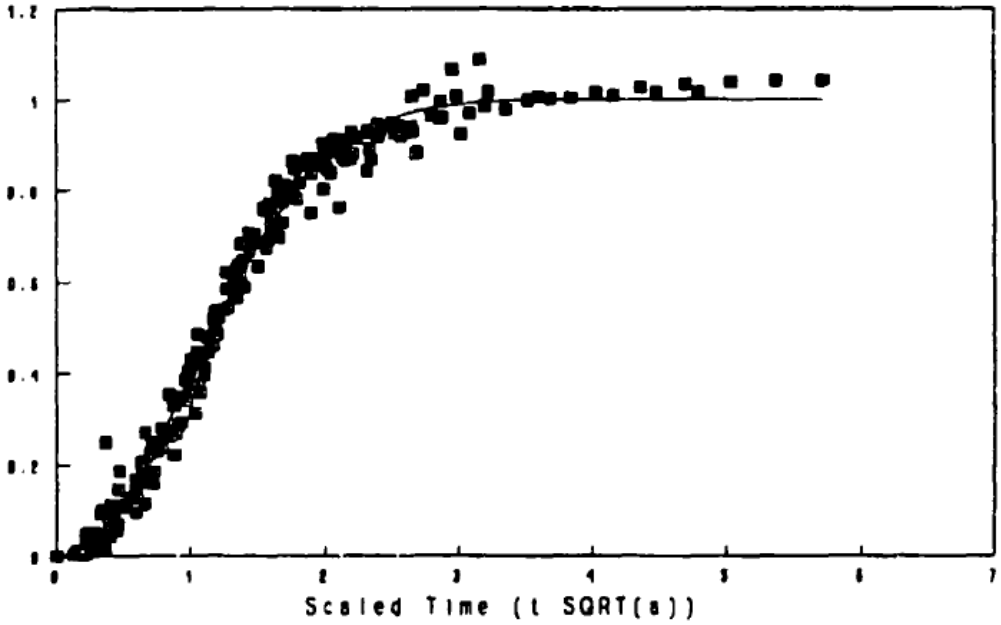
[11] As reported to the DoD in Earned-Value Management (EVM) Central Repository.

[12] For similar use of ACWP as a proxy for expenditures (outlays), see, for example, Gallagher and Lee (1995).

[13] See, for example, Watkins (1982); Lee, Hogue, and Gallagher (1993); Gallagher and Lee (1995); Davis (2008); Davis, Christle, and Abba (2009); Burgess et al. (2014); Brown et al. (2015); Schiavoni (2019).

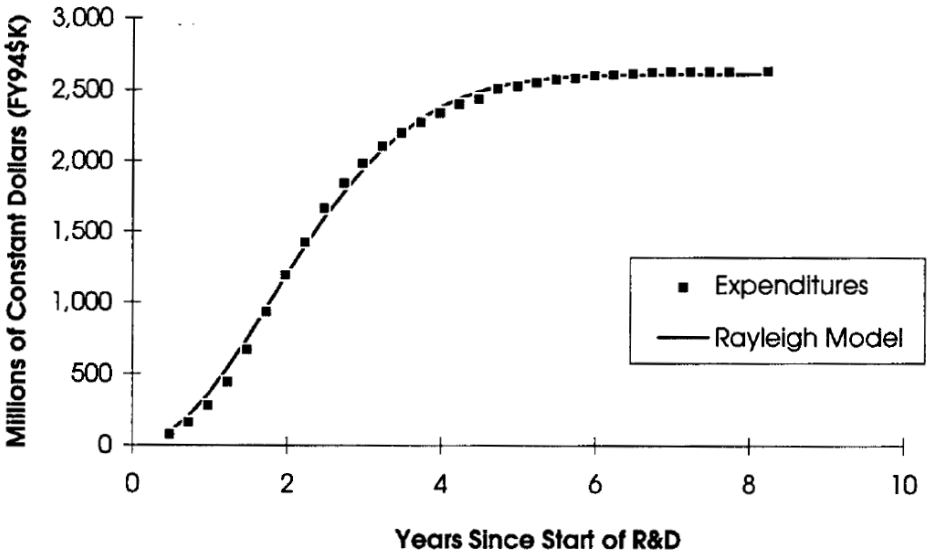
[14] Note that Rayleigh functions are special cases of Weibull distributions.

Figure 3-1. Actual Expenditures (Outlays) from 20 Defense Acqusition Programs



SOURCE: Lee, Hogue, and Hoffman (1993), as reproduced in Lee, Hogue, and Gallagher (1994).
NOTE: Square dots are actual outlay data scaled to align on the y-axis. The line is a Rayleigh function. The x-axis is scaled to align the different lengths of the 20 contracts.

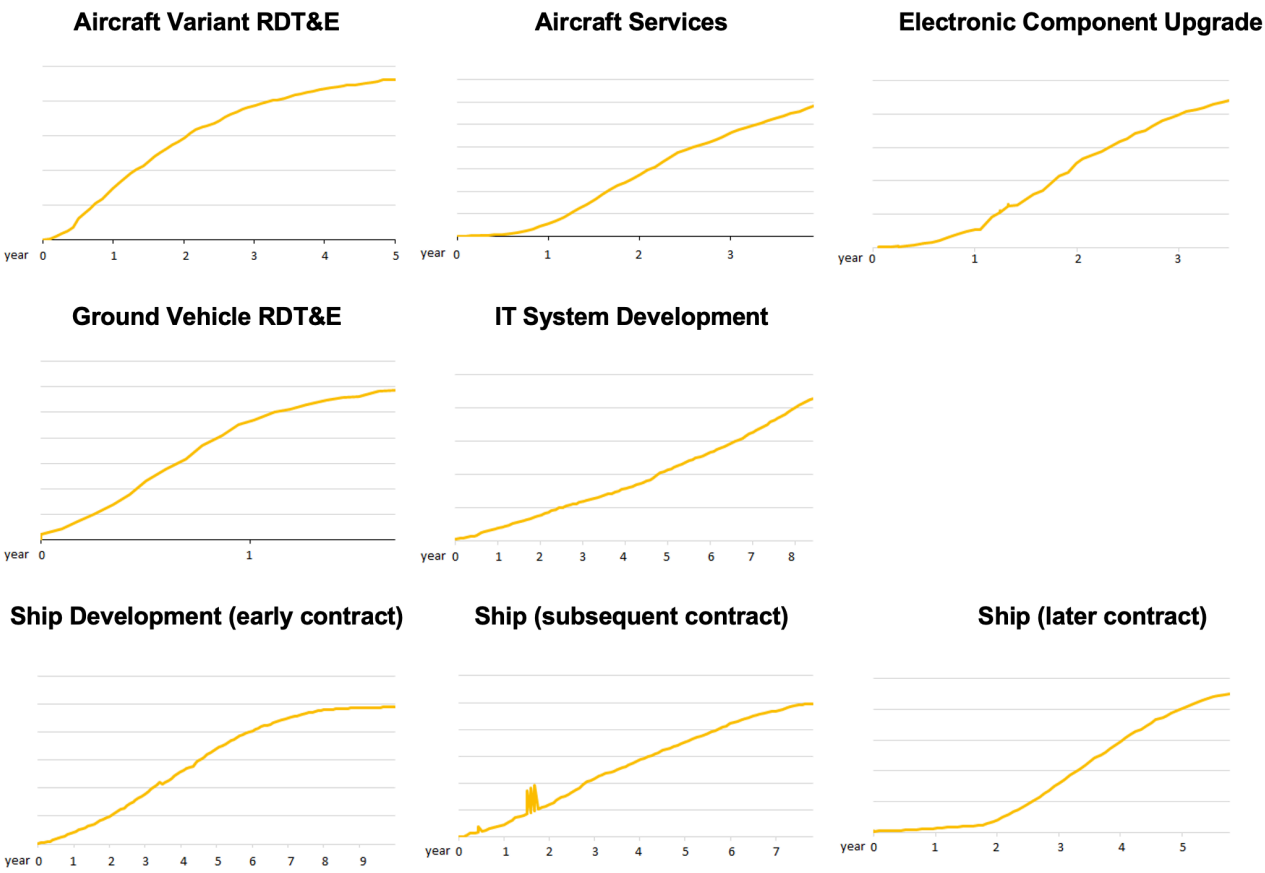
Figure 3-2. F-15 Airframe Contract Expenditures



SOURCE: Gallagher and Lee (1995)

To confirm that these shapes continue to be exhibited in more recent contracts in defense acquisition, we plotted ACWP for programs with data from the DoD's EVM Central Repository.[15] Figure 3-3 shows these results and confirms that the general S-curve shapes remain dominant. Most of these examples have an "S"-curve shape, although there are variations in start-up and close-out patterns on the ends of the curves (as discussed in the literature).[13] Note that these are generally cost-type contracts in RDT&E, but we included an aircraft services contract as well as some contracts to upgrade components on an existing system.

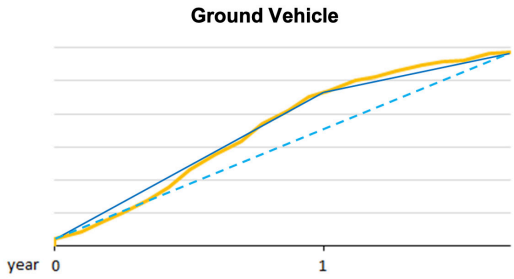
Figure 3-3. Examples of ACWP on Acquisition Contracts



SOURCE: DoD EVM Central Repository.
NOTE: Despite some noise in the data (the data were not cleaned before plotting), the general S-curve shape is clearly visible in most of these examples.

[15] https://www.acq.osd.mil/asda/ae/ada/ipm/about-evm-cr.html

Figure 3-4. Annual Linear Approximations of Expenditures—Short Contract



NOTE: The solid orange line shows an actual expenditure profile for a ground vehicle. The solid blue line shows the Comptroller benchmark lines, and the dash blue line shows a single straight line from start to finish.

Figure 3-5. Annual Linear Approximations of Expenditures—Longer Contracts

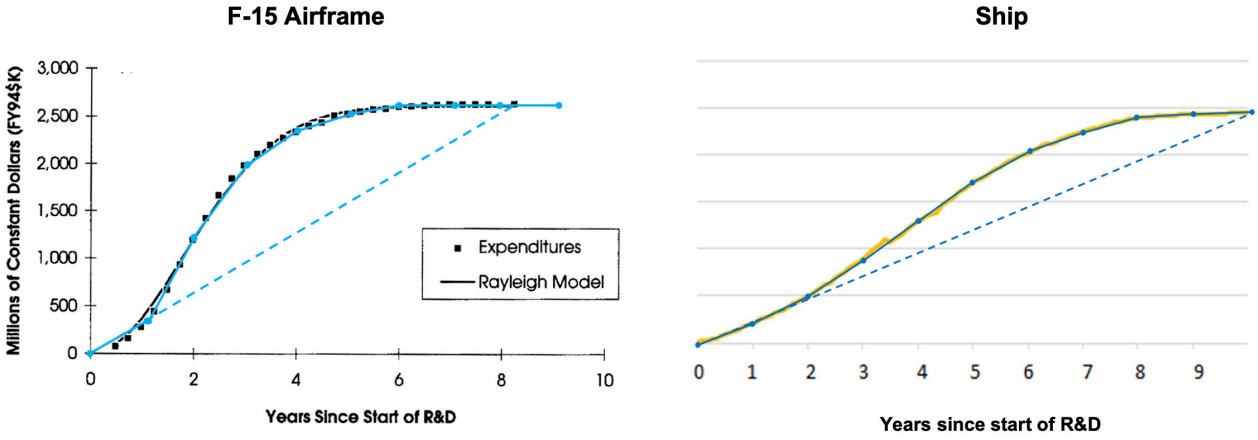
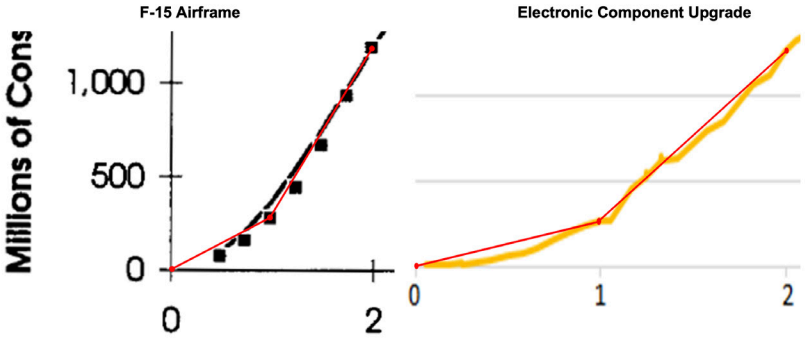


Figure 3-6. Annual Linear Approximations of Expenditures—First Year of Longer Contracts



Shorter contracts are not well represented by straight lines (instead of S-curves). Straight lines are poor expenditure approximators (and thus poor expenditure benchmarks) for contracts that last only a year or two (at least on these types of contracts). At the beginning of the contract, a linear benchmark is too high because it does not reflect slow expenditures during startup. Towards the end of the contract, a linear benchmark underestimates actuals. This can be seen in Figure 3-4, which is a relatively short contract for a ground vehicle. Linear segments for each year are better than a single straight line from beginning to end. This can also be seen in other examples in Figure 3-5 (if those were just a year or so in length).

Longer contracts with single-year expenditures could be approximated by lines for each year—except for first year. Interestingly, if contracts last for many years, then individual lines for each year are not bad approximators (benchmarks) for the expenditures in most of the years (see Figure 3-5). However, linear lines are not good approximators (benchmarks) for the first year—when the effort is ramping up—because actual expenditures fall well below such lines (see Figure 3-6).

Longer contracts with multi-year expenditure benchmarks do not align well. The problem, however, with using annual straight lines for multi-year contracts is that current DoD Comptroller multi-year expenditure benchmarks are not straight lines across the multiple years. As shown in Figure 1-1 above, multi-year expenditure benchmarks expect faster expenditures in the first year, with slower expenditures in the remaining years. Benchmarks for RDT&E expenditures, for example, are 55 percent over the first year, then another 35 percent over the second year, then the final 10 percent over the third year. This results in a concave shape that would match the later years of a long expenditure curve (when spending starts to slow) but not in the early years, when the expenditure curve is concave.

MONTHLY DOD EXPENDITURE RATES BY CATEGORIES OF FUNDING: ACTUAL DOD DATA

As with obligations (discussed in Chapter 2), we obtained expenditure data from the DoD's Advana data environment in the form of monthly expended dollars (also called disbursements or outlays) for military services and defense-wide funding accounts for categories of funding (e.g., Army RDT&E, Navy Aircraft Procurement, Defense-Wide O&M, and Air Force Military Personnel) from FY 2011–2023. We aggregated these data to obtain monthly expenditure dollars by category across all accounts, then calculated the percentage expended in each month compared to the total dollars expended by the final month. Table 3-1 lists the time periods used to observe monthly expenditure rates and trends as a percentage of the final month. Although some trends will extend further in time, this provides a good window into the bulk of the trends for analysis.

Table 3-1. Month Used for Final Expenditure Values

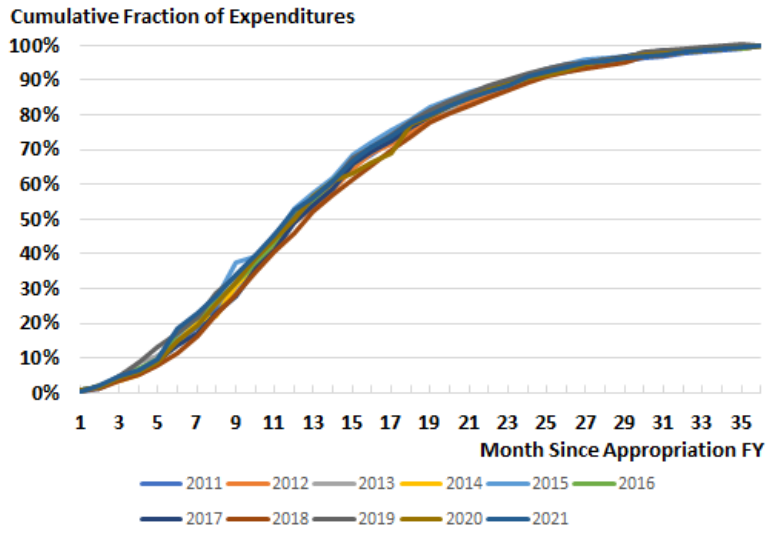
Category	Years to Expend	Final Month
RDT&E	3	36
Procurement	3*	36*
O&M	2	24
MILPERS	1	12
MILCON	6**	72**

* We used 36 months as the reference time to expend PROC dollars, although some procurements have longer to obligate and disburse funds.
** In the DoD data, MILCON reached about 90% on average by the end of year 6.
NOTE: These periods provide us with a simple way to measure and observe expenditure trends and rates.

RDT&E

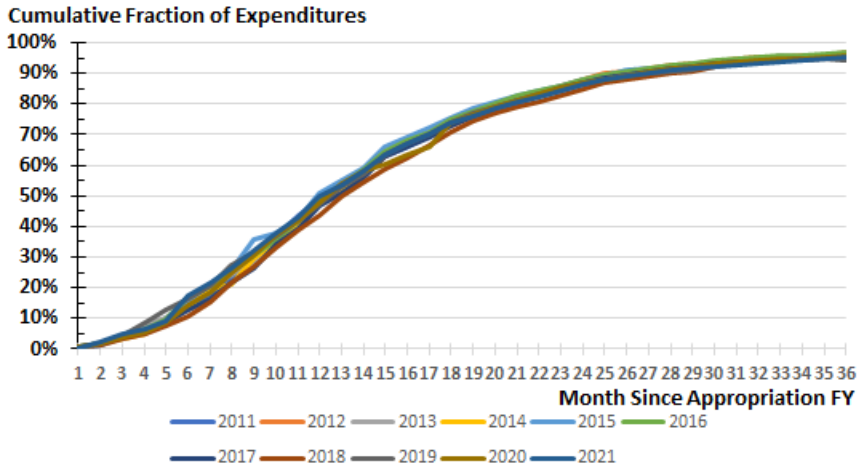
Figure 3-7 shows the cumulative RDT&E expenditures as a percentage of the total expenditures by month 36 of the allotted time to expend RDT&E. In comparison, Figure 3-8 shows the fraction as a percentage of the reported expenditures in month 36.

Figure 3-7. Cumulative RDT&E Expenditures by Month After Appropriation as Percentage of Month 36 Expenditures (FY 2011–2021 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

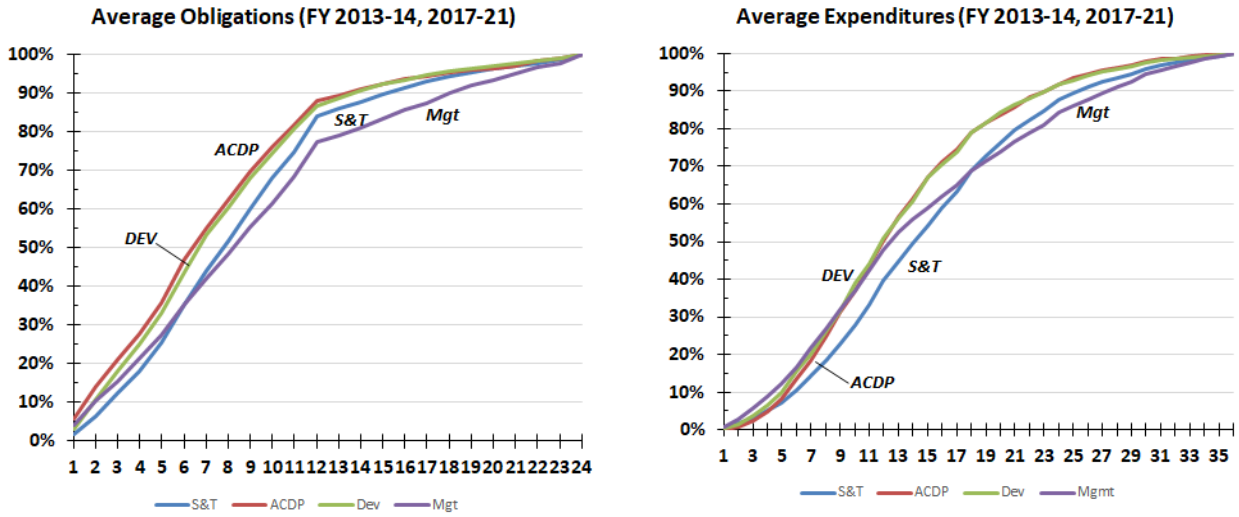
Figure 3-8. Cumulative RDT&E Expenditures by Month After Appropriation as Percentage of Month 36 Expenditures (FY 2011–2021 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 3-9 compares the cumulative rates at which obligations and expenditures are made for S&T (BA 1–3), ACDP (BA-4), development (BA-5 and BA-7), and Management Support (Mgt, BA-6). Here we see that expenditures for all continue to exhibit S-curve profiles, and those BAs that obligate faster also have faster S-curves. Also, the Management (BA-6) obligations start off higher in the first two months but then are much lower than the development and S&T curves; this appears to contribute to the Mgt expenditure curve dropping below the other two curves in the plot on the left.

Figure 3-9. Average Cumulative RDT&E Obligations and Expendituresby Month: S&T vs. Other (FY 2013–14, 2017–21)

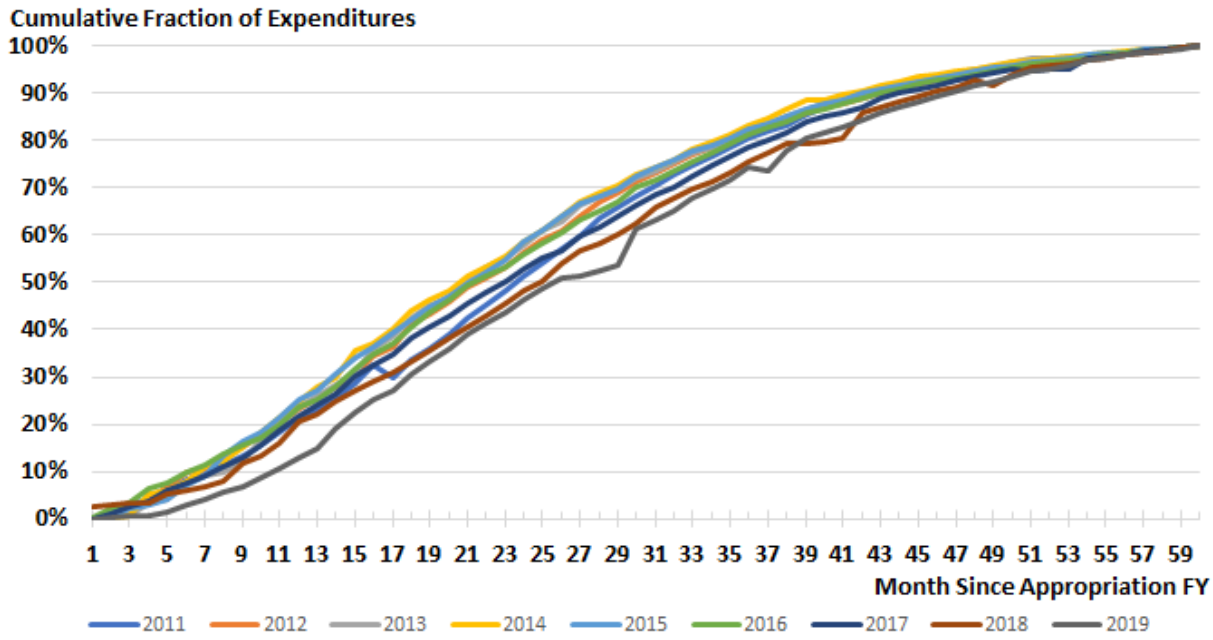


NOTE: The average cumulative expenditures in the plot on the right does not include FY 2022 because we do not have the final expenditure values yet for the end of FY 2024 (which has not happened yet as of the date of this report and the data). As a result, we removed FY 2022 data from the plot of average cumulative obligations from the values shown earlier in Figure 2-22. The obligation differences with and without FY 2022 are barely noticeable.

PROCUREMENT

Figure 3-10 shows the cumulative Procurement expenditures as a percentage of the total by month 60 (used as a reference point to compare expenditure rates). The general shape and patterns are the same except where the end point lands (100% for the first figure and about 96% for the second).

Figure 3-10. Cumulative Procurement Expenditures by Month After Appropriation (FY 2011–2019 Appropriations)

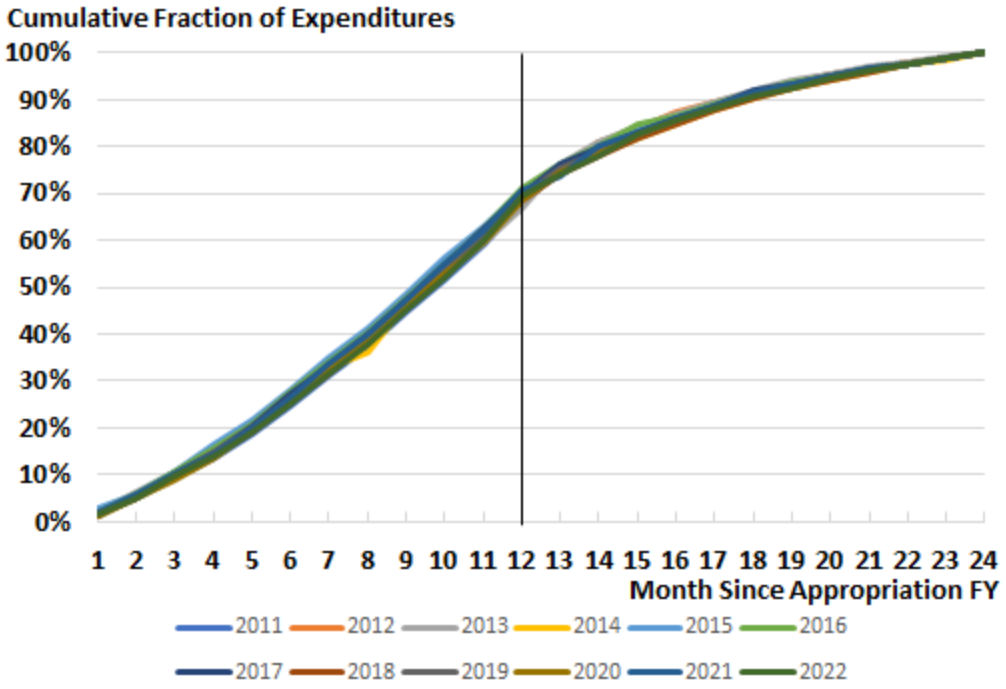


NOTE: Month 1 is October of the FY in which the appropriations were made.

O&M

Figure 3-11 shows the cumulative O&M expenditures as a percentage of the total by month 24 of the allotted time. Here we see a modified s-curve. We postulate that this curve is a hybrid of a fairly straight line (from the expenditures paying for continually budgeted civilian and contractor-support personnel) and an s-curve pattern (from contracts providing maintenance, system upgrades, and other operational activities paid by O&M).

Figure 3-11. Cumulative O&M Expenditures by Month After Appropriation (FY 2011–2022 Appropriations)

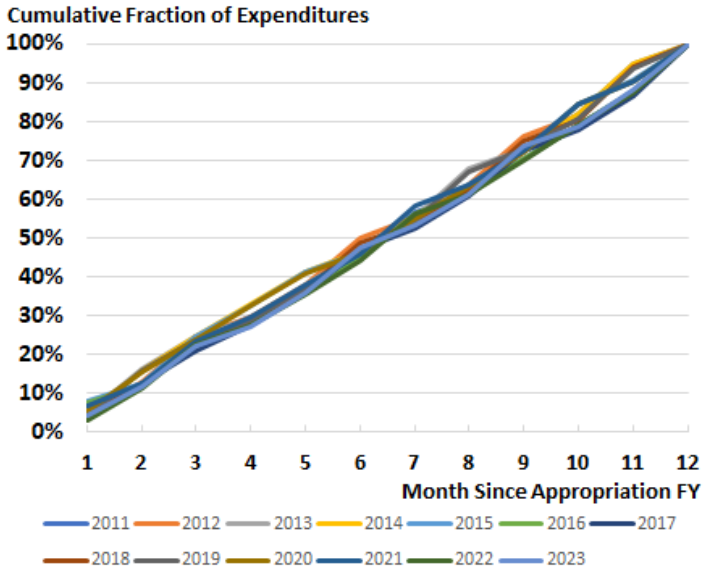


NOTE: Month 1 is October of the FY in which the appropriations were made.

MILPERS

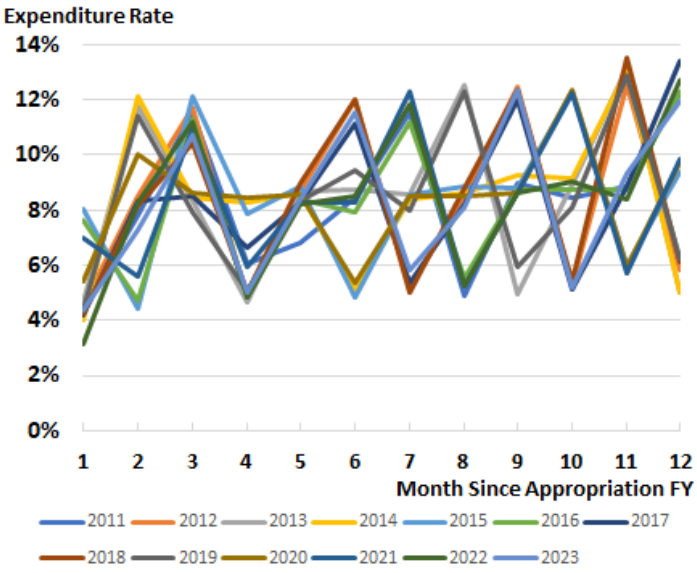
Figure 3-12 shows the cumulative MILPERS expenditures as a percentage of the total by month 12. Figure 3-13 plots these data as monthly expenditure rates.

Figure 3-12. Cumulative MILPERS Expenditures by Month After Appropriation (FY 2011–2023 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

Figure 3-13. MILPERS Monthly Expenditure Rates (FY 2011–2023 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made.

MILCON

Figure 3-14 shows the cumulative MILCON expenditures in then-year (unadjusted) dollars. Figure 3-15 plots these data as cumulative fraction of the final dollar values at the end of year 6.

Figure 3-14. MILCON Expenditures Dollars (FY 2011–2023 Appropriations)

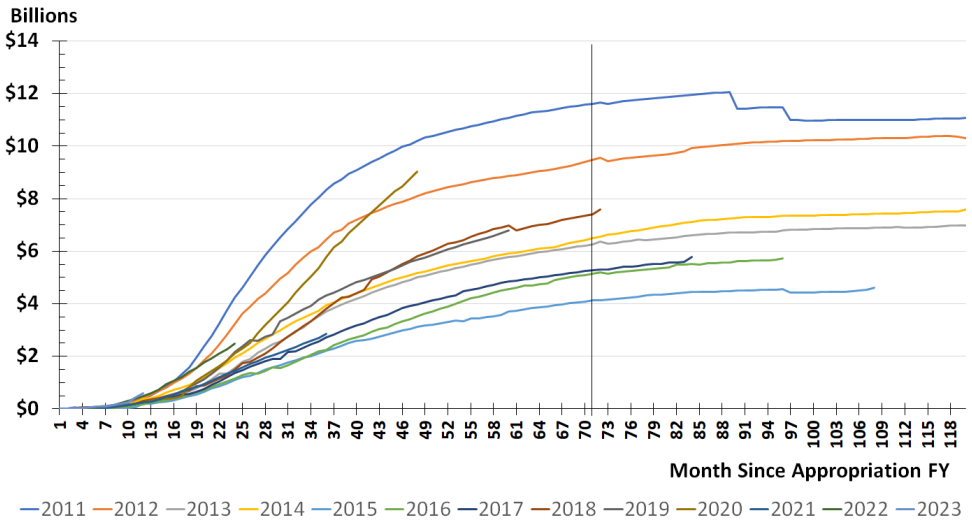
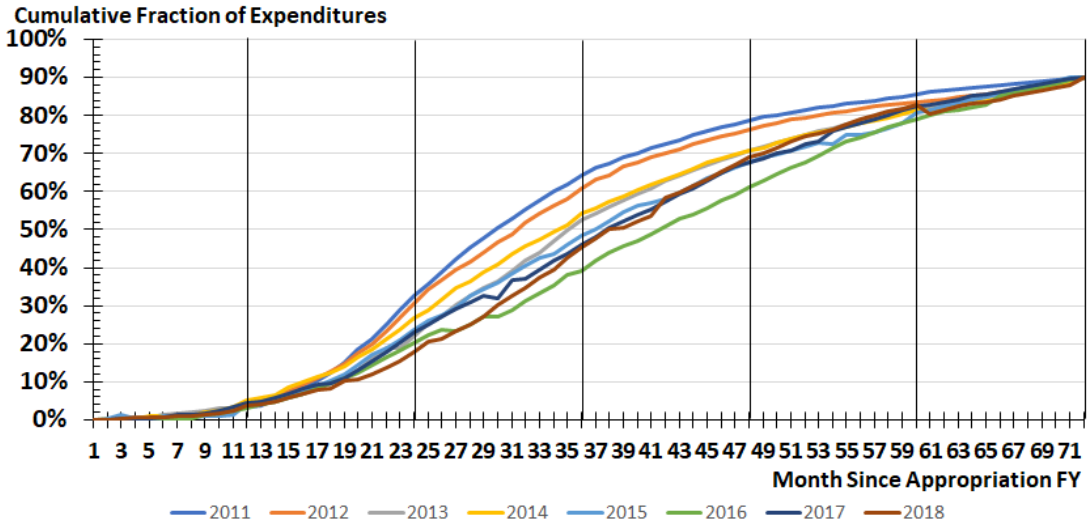


Figure 3-15. Cumulative MILCON Expenditures by Month After Appropriation (FY 2011–2018 Appropriations)



NOTE: Month 1 is October of the FY in which the appropriations were made. Rates were scaled with the assumption of 90% expenditure (on average) by month 71.

OBSERVATIONS

Figure 3-7 and Figure 3-10 show that, as anticipated from EVM theory and data, cumulative RDT&E and Procurement have S-curve shapes. This is not surprising given the ACWP reflects the work that contractors will in turn invoice to the DoD for payment, but it is useful (and reassuring) to see the S-curves in DoD expenditure data.

The S-curve shape for RDT&E meets the 12- and 24-month targets of 55% and 90%, respectively, but the average 6-month value of 15.5% is well below the benchmark of 27.5%. Thus, the DoD's linear RDT&E benchmark poorly informs the midyear execution review[16] for RDT&E.

Cumulative O&M expenditures in Figure 3-11 have a modified S-curve, reflecting that part of O&M expenditures pay for ongoing DoD civilian salaries in addition to companies executing contract work. The civilian salaries are probably consistent and thus linear (like MILPERS).

Finally, cumulative MILPERS expenditures are fairly straight with some oscillations in the data. Figure 3-13 plots these data as monthly expenditure rates. Here we see an odd oscillation pattern. Statistically, October and January are down significantly (−3.8 and −3.0 percentage-points lower, respectively) with December 1.3 percentage-points higher than the normal average of 8.9%. The third month after the budget is passed (3 MAB) is lower by −1.6 percentage points. There also appears to be an oscillation pattern of about 4 months in length. This model only explains about 27% of the variation in the data. Further analysis or more data would be needed to understand what may be happening here, so our insight so far is that the spending is linear but with some oscillations around the average.

COMPARING ACTUAL VERSUS BENCHMARK EXPENDITURE RATES

Using the data plotted above, we can now compare actual expenditure rates to the Comptroller's benchmarks shown in Figure 1-1 (page 28). When average (normal) actuals are behind the benchmark, then too many programs may be undergoing subsequent deep-dive performance reviews. Likewise, when average actuals are above the benchmarks, then too few programs may be undergoing subsequent deep-dive performance reviews. Thus, these are indicators that updating benchmarks may improve the effectiveness and efficiency of performance reviews by helping to focus better on programs that may be behind.

RDT&E

Figure 3-16 shows the actual average cumulative RDT&E expenditures as a percentage of reported expenditures for month 36 along with the current linear benchmarks. Figure 3-17 shows the monthly percent difference between the actuals and benchmark. For example, in the first month, the actuals are about 88% below the benchmark. Figure 3-18 shows these differences in dollars. The actuals are almost $10 billion behind the benchmark by month 5 and about $9 billion by the mid-year review of month 6. In years 2–3, the actuals run ahead of the benchmarks, reaching over $3 billion ahead by the middle of year 2.

[16] Department of the Air Force, 2022, p. 54.

Figure 3-16. Average Cumulative RDT&E Expenditures Versus Benchmark as Percentage of Month 36 Expenditures (FY 2011–2021 Appropriations)

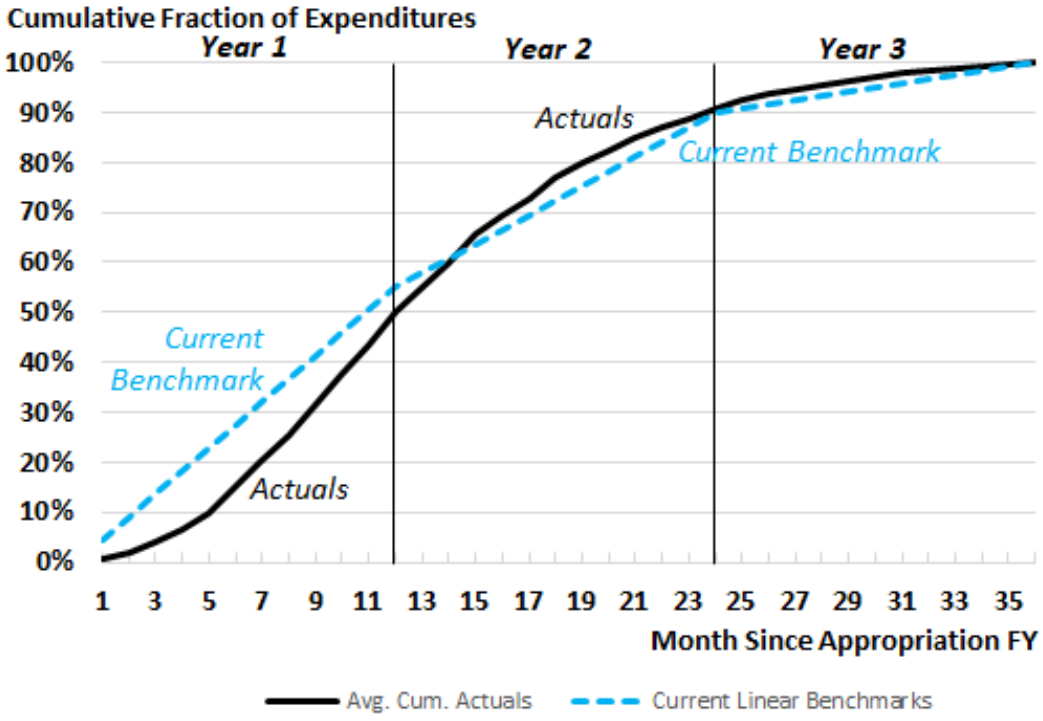


Figure 3-17. Percent Difference Between Average Cumulative RDT&E Expenditures and Benchmark (FY 2011–2021 Appropriations)

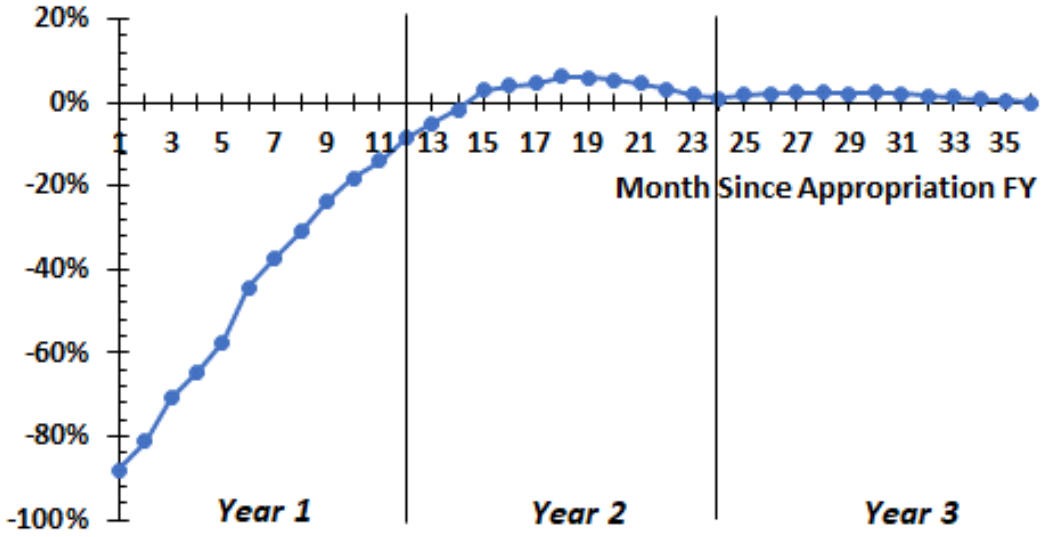
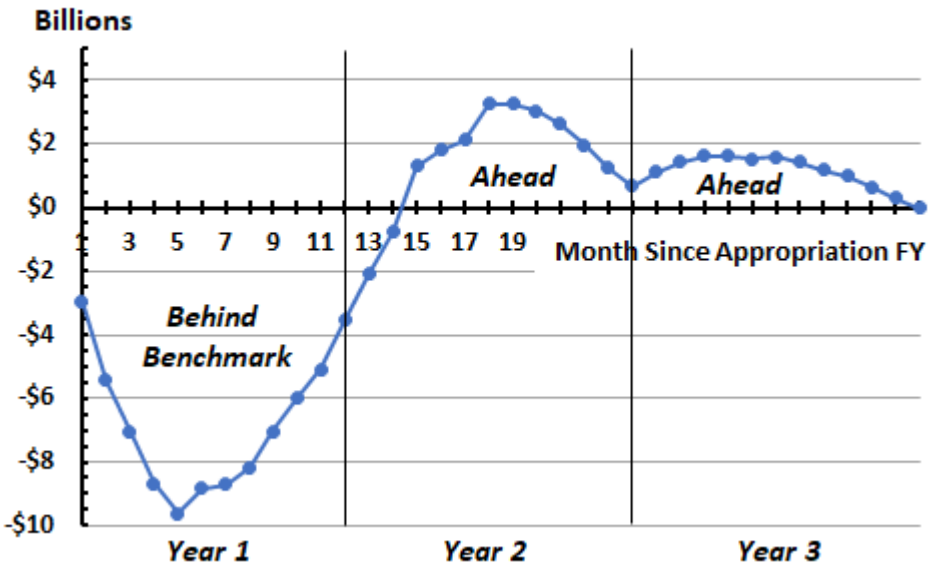


Figure 3-18. Dollar Difference Between Average Cumulative RDT&E Expenditures and Benchmark (FY 2011–2021 Appropriations)



PROCUREMENT AND MILPERS

There are no current benchmarks for Procurement and MILPERS in the published Comptroller benchmarks to compare current actuals against.

O&M

Figure 3-19 shows the actual average cumulative O&M expenditures as a percentage of reported expenditures for month 24 along with the current linear benchmarks. Figure 3-20 shows the monthly percent difference between the actuals and benchmark. Figure 3-21 shows these differences in dollars. The average actuals fall more than $23 billion below the benchmark by month 5 and nearly $10 billion above the benchmark at month 18. The Figure 3-21 dollar differences in year 2 are so large relative to the percentage differences shown in Figure 3-20 because the average amount of dollars that are supposed to be expended grows over time. Also, these dollar differences are much larger than for RDT&E (shown in the preceding figures) because the O&M accounts are larger (have more dollars).

Figure 3-19. Average Cumulative O&M Expenditures Versus Benchmark as Percentage of Month 24 Expenditures (FY 2011–2022 Appropriations)

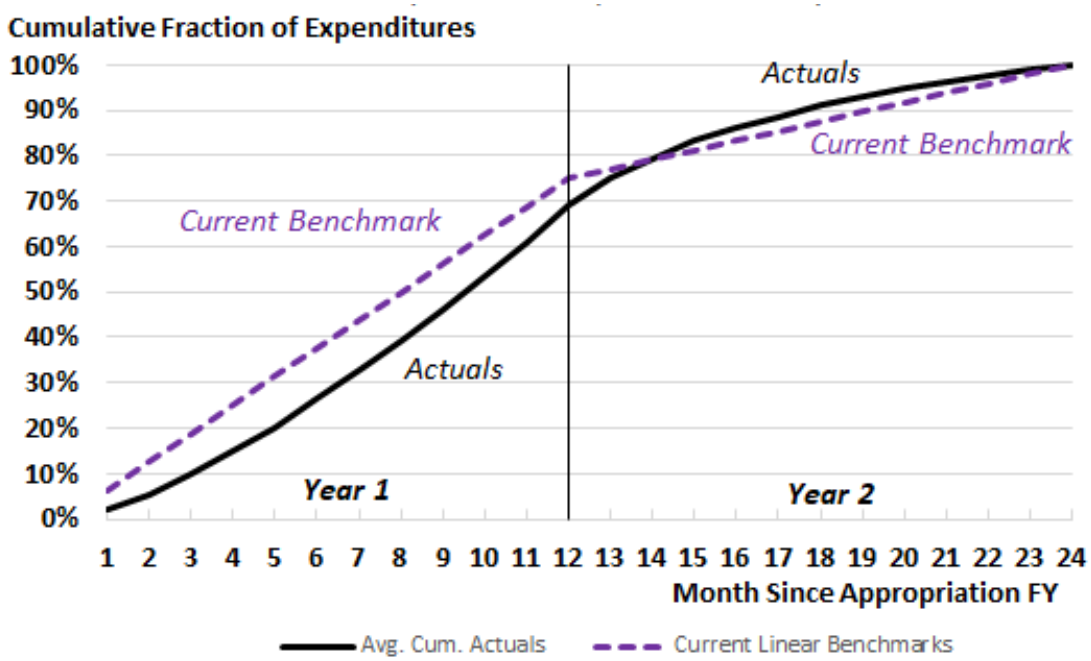


Figure 3-20. Percent Difference Between Average Cumulative O&M Expenditures and Benchmark (FY 2011–2022 Appropriations)

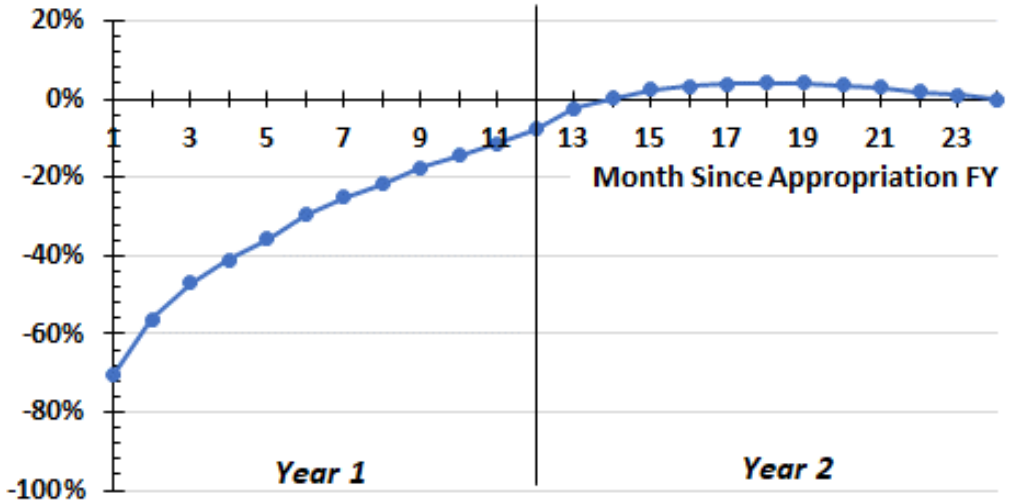
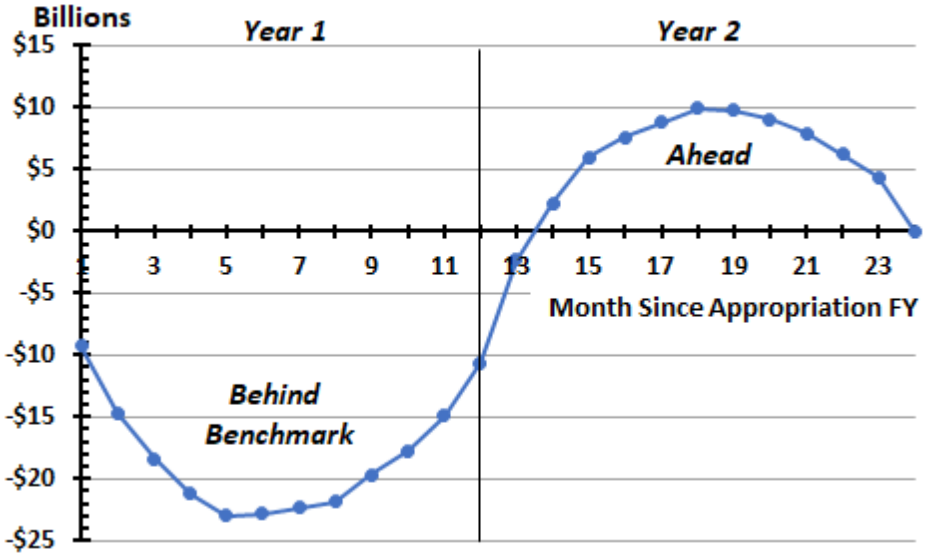


Figure 3-21. Dollar Difference Between Average Cumulative O&M Expenditures and Current Benchmark (FY 2011–2022 Appropriations)



NOTE: The dollar differences in year 2 are so large relative to the percentage differences shown in Figure 3-20 because the average amount of dollars that are supposed to be expended grows over time.

MILCON

Expenditures for MILCON are more complicated than for RD&TE and O&M. Benchmarks end at month 36 below 100%, and the actual values in the Advana data go for as long as 120 months (10 years). As a result, we cleaned most of the expenditures data through month 72 and used the expenditures for month 72 as the base denominator for calculating percentages. Figure 3-14 above shows these data with the remaining discontinuities after month 72. It also shows the sloped ramp-up of MILCON expenditures (almost negligible in the first year).

Figure 3-22 shows the actual average cumulative MILCON expenditures as a percentage of reported expenditures for month 72 along with the current linear benchmarks. Figure 3-23 shows the monthly percent difference between the actuals and benchmark. Figure 3-24 shows these differences in dollars.

Figure 3-22. Average Cumulative MILCON Expenditures Versus Benchmark as Percentage of Month 72 Expenditures (FY 2011–2018 Appropriations)

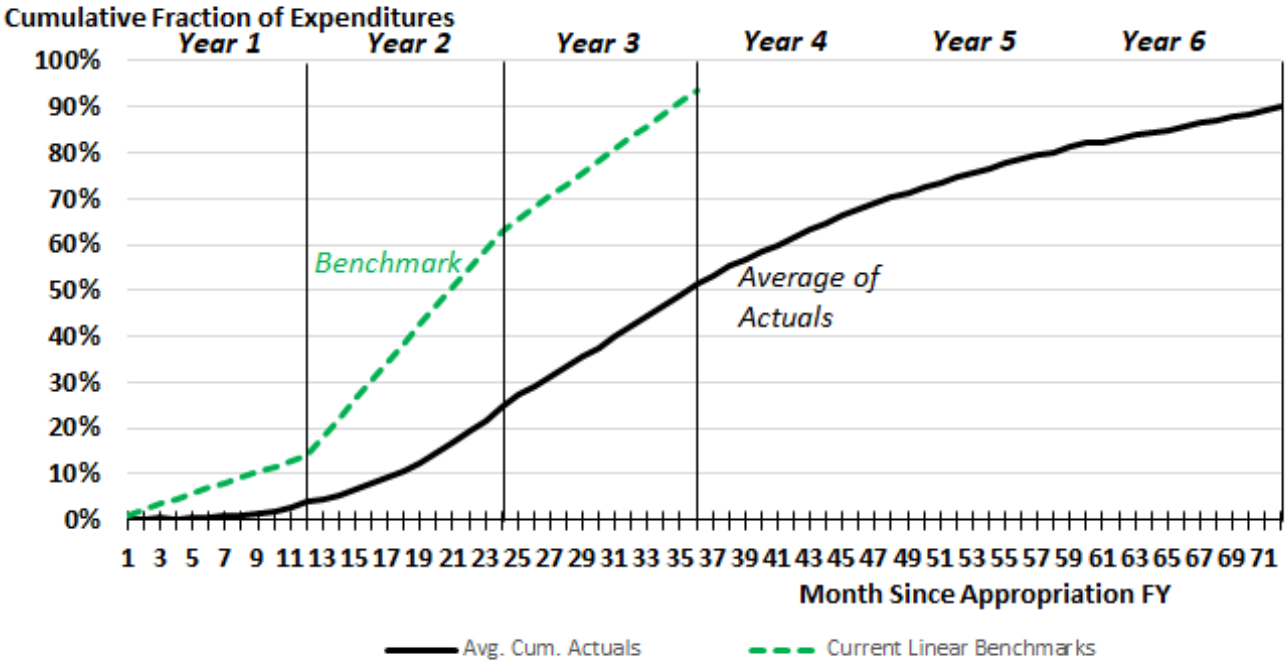


Figure 3-23. Percent Difference Between Average Cumulative MILCON Expenditures and Benchmark (FY 2011–2018 Appropriations)

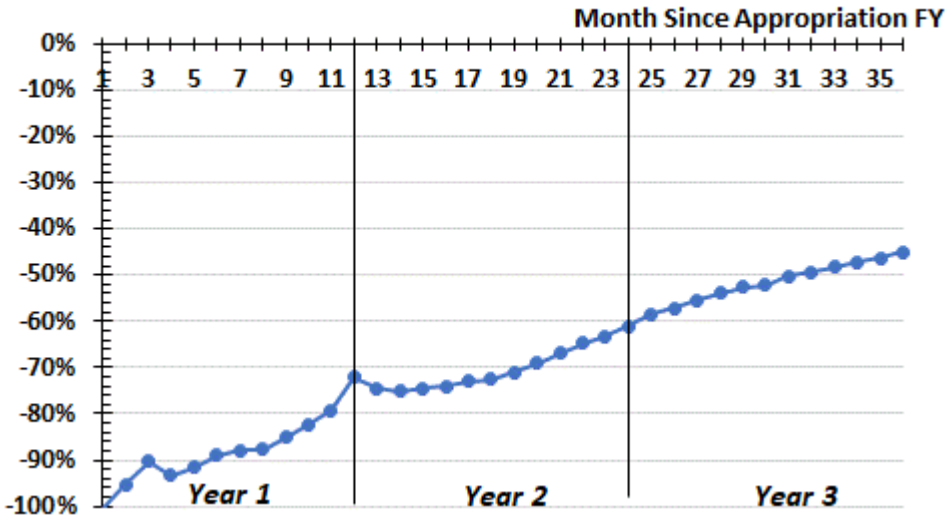
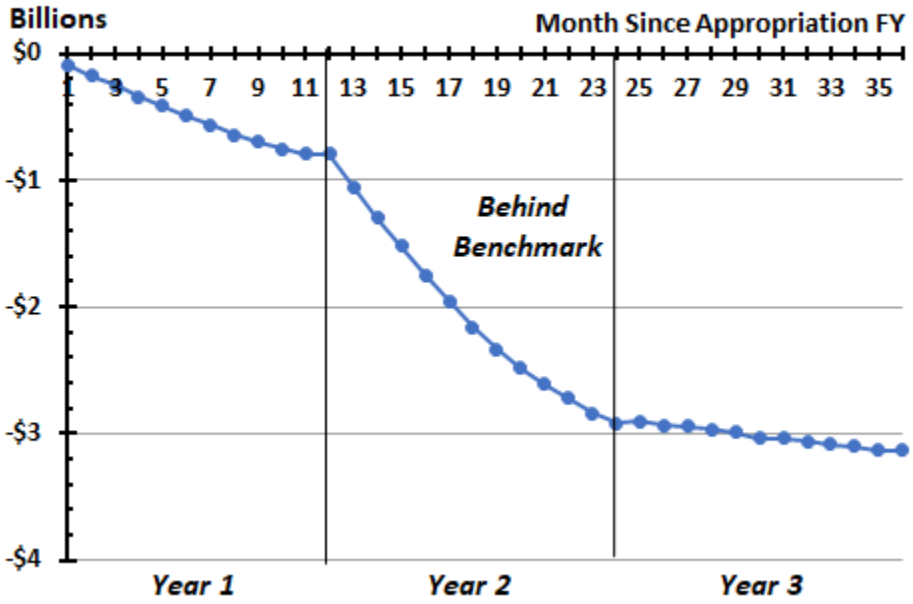


Figure 3-24. Dollar Difference Between Average Cumulative MILCON Expenditures and Benchmark (FY 2011–2018 Appropriations)



CONCLUSIONS ON EXPENDITURE BENCHMARKS

Several observations can be made from these data.

Expenditures dominated by contracts are better represented by S-curves instead of straight lines. Straight lines are poor expenditure approximators (and thus poor expenditure benchmarks) for RDT&E, Procurement, and O&M in aggregate. For example, an S-curve would correctly align the midyear review benchmark to the actual average of 15.5% rather than the misleading target of 27.5%. The figures above show the implication of these seemingly small differences in both percentages and dollars. RDT&E, O&M, and MILCON expenditure differences can be as large as $10 billion, $23 billion, and $3 billion, respectively. These differences will make it harder to identify programs that are truly behind while also increasing the labor involved in seeking poorly performing programs.

Interestingly, the MILCON benchmark profile already exhibits a linearized S-curve with a slow start in the first year, a steep rise in the second and third year. Based on these data, the MILCON profile is more realistic, but the actuals extend far further into year 6 and beyond.

Expenditure benchmarks should reflect slow rises at the start of the FY. As discussed above, obligations for a FY often do not trickle down to program offices by October 1.[17] Thus, obligation benchmarks should show a delay in the first quarter of a FY. In turn, this delay also results in a delay in expenditures in the first quarter of a FY. However, the Comptroller benchmarks, shown in Figure 1-1, start linearly at the beginning of the FY (i.e., in October). The expenditure curves for RDT&E and PROC both show these slow starts. The first month of RDT&E expenditures is just 0.6 percent of total dollars in October before rising to 1.2 and 2.3 percent in November and December of the first FY. Likewise, PROC expenditure rates average 0.4, 0.6, and 0.9 percent for October through December, respectively, before jumping to 1.8, 1.2, and 2.2 percent of the total dollars for January through March of the first FY. A properly fitted S-curve for RDT&E, PROC, and O&M expenditures would reflect both the overall shape and this slow rising phenomenon. Interestingly, MILPERS expenditures are slightly lower on average in October by about a sixth of the normal average rate. It is not clear why given that personnel rates are generally linear. Thus, it may make sense to leave the MILPERS benchmark as simple lines.

MILCON expenditures extend significantly longer than current benchmarks. Based on appropriation FY 2011–2014 longitudinal data, it took 6 years, on average, to reach 90% of expended dollars. Thus, MILCON benchmarks need to be adjusted accordingly—or replaced with plan-based benchmarks that reflect the actual expected lengths of individual construction programs.

[17] See interview data in Marsalis, 2022, pp. 4–5.

CONCLUSIONS AND RECOMMENDATIONS

Perhaps what you measure is what you get. More likely, what you measure is all you'll get. What you don't (or can't) measure is lost.

H. Thomas Johnson

As discussed, the Comptroller uses straight lines over each year as monthly benchmark targets for the obligations of resources (see Figure 1-1). For multi-year obligations, those lines have inflection points at the change of the Federal FY, starting on October 1. Targets expect front-loading for multi-year RDT&E, Procurement, and MILCON (i.e., the Comptroller wants more appropriations spent in the first year than in the second year or subsequent years).

In comparing actual historic obligation and expenditure rates against these benchmarks, we found consistently significant differences. This aligns with the findings from Daniels and Harrison (2020) that found differences between actual and benchmarked obligations at the end of each FY. Our analysis of obligation rates further found many variables that correlate with changes in the monthly obligation rates for different types of funding.

CONCLUSIONS

The best shape of obligation benchmark curves ultimately comes down to intent and theory. While the data in Chapter 2 show that managers in the DoD tend to obligate at rates that generally align with current linear obligation benchmarks, there are good reasons to reconsider these profiles and provide more flexibility. For example, RDT&E inherently involves uncertainty and surprises, so it may be more effective for the DoD and the country to allow more obligations in the second year than in the first. Also, shifting more obligation targets for RDT&E and Procurement into the second year would give DoD managers more time to negotiate better deals with contractors (e.g., better prices, intellectual property rights, and deliverables) and allow time to fully assess contractors' execution, subcontracting and supply-chain plans and risks.

Benchmarks should be adjusted for CR and financial-management realities. Regardless of the shape of the benchmarks, the statistical analysis in Chapter 2 shows real-world effects that should be taken into account for RDT&E, Procurement, and O&M. CRs result in obligation bumps after full budgets are passed. Obligations in the first month (October of the first year) are delayed (probably from the time it takes for the financial management system to allocate spending authority down to program managers).

S-curves for obligation benchmarks may be beneficial for RDT&E, PROC, and O&M. While actual obligations can meet current benchmark profiles, shifting to an S-curve profile for obligations would allow for more time for improved performance, deals, and negotiations, addressing the points above.

Benchmarks can be useful but require additional due diligence. When combined with further due diligence, benchmarks can help the DoD and Congress identify funds that could be reprogrammed to address higher-priority threats and needs that emerge during the spending periods. The combined effects of these benefits can improve DoD mission outcomes by identifying badly needed resources. However, the emphasis here is on proper use and due diligence to ensure a balance between the benefits and issues. The use of benchmarks alone does not provide insight into the practical realities and issues in execution. Anecdotes indicate that DoD and Congressional leadership do not simply rely on benchmarks to identify from whom to take money for new urgent priorities that arise during the year of execution. However, other anecdotes indicate that program managers believe otherwise, adding to the following "negative consequences from managing to benchmarks" effect.

Avoid unforeseen negative consequences from managing to benchmarks. Finally, as the quotes indicate, metrics drive behavior. This can be seen also in the increased obligation rates in March immediately before the midyear reviews that identify programs spending below the benchmark rates for potential budget reprogramming away to other programs and needs. While management metrics can be useful tools for insight, management pressures will drive behavior to the exclusion of other factors. Forcing people to spend to a curve will get spending to that curve whether or not that spending results in the best use of taxpayer dollars and the best results for national security. This axiom also applies to other potential uses of these benchmarks, such as adjusting Office of Management and Budget (OMB) apportionments[18] based on changes in benchmarks.

Based on the data and analysis above, we make the following recommendations for improving the obligation and expenditure benchmarks.

RECOMMENDATIONS: OBLIGATION BENCHMARKS

Reduce obligation benchmarks for the first 1–2 months for RDT&E, PROC, and O&M. Given that it takes at least 1–2 months for budget authorities to work their way down to program offices and agencies, obligation for October–November (and probably December) should be lower (if not zero).[19] An S-curve would accomplish this objective, as would a delay in the linear benchmarks.

Consider changing benchmarks to S-curve profiles. In addition to delays from the time needed to allocate funding authority to programs and agencies, the significant times involved in PALT (as well as preparatory and approval activities before submitting solicitation requests before that), the benchmarks should reflect a start-up growth period similar to that seen in the EVM execution data. PALT has less of an effect on existing contracts, but they still involve work (and thus time). We do not have actual data on the combined effect of these delays, but the same management theory accompanying EVM data indicates that S-curves (e.g., Weibull [including Rayleigh] and Beta Distributions) would be reasonable (better) benchmarks.[20] While the actual obligation profiles in Chapter 2 show that the DoD can meet linear benchmarks, an S-curve would allow for less time pressures when ramping up a program while driving for high obligation rates in the middle period. Note especially, since MILCON actuals are not able to keep up with the benchmark shapes in the first obligation year and though somewhat linear in subsequent years, they are still below the benchmark percentages. Average obligations fall as much as $1.7 billion behind the benchmarks as a result of the lack of a ramp-up in the first year.

Consider switching to back-loaded benchmarks for multi-year funds. For funds such as RDT&E, Procurement, and MILCON, it may make better sense to target more obligations in later years rather than in earlier years. This would give programs more time to negotiate better deals in negotiations with contractors and address unforeseen issues in research and development (R&D).

[18] See Sec. 120 of OMB (2023) for a discussion of apportionments.

[19] See, for example, the recommended RDT&E benchmark curves in Marsalis (2002, p. 20).

[20] Again, see Marsalis (2002, p. 20) for example S-curves for RDT&E benchmarks.

Explore switching to plan-based benchmarks. The current pattern-based benchmarks could be replaced with dynamic benchmarks based on a program's actual expenditure plan that reflect the timing and realities of program, negotiations, supply-chain realities, and other factors known best by the program manager and the prime contractor (Tremaine and Seligman, 2013; Anton, 2022). With the advent of Advana, the DoD may now have the infrastructure to collect individual obligation plans and then compare obligation rates against these actual plans rather than against the current *a priori* abstract benchmark curve. The program's Milestone Decision Authority or other oversight leader could review and approve the plans to ensure rigor and quality. This would require reporting plans from program offices. DoD systems, such as Advana, may be well poised to receive such submissions (with some work on data interfaces).

RECOMMENDATIONS: EXPENDITURE BENCHMARKS

Change benchmarks to S-curves. Comptroller expenditure benchmark curves should reflect the decades of extensive data and analysis of business theory and actual expenditure profiles since the 1970s and even earlier, and change to S-curves (e.g., Weibull [including Rayleigh] and Beta Distributions). MILCON already has such a profile, but RDT&E, Procurement, and O&M benchmark profiles should be adjusted accordingly. This aligns with the recommendations in Marsalis (2002) for RDT&E benchmarks. An S-curve would correctly align the midyear review[21] benchmark to the actual average of 15.5% rather than the misleading target of 27.5%. Note that the O&M's S-curve should reflect the mixed realities of linear staff expenditures and S-curve contractor execution.

Reduce expenditure benchmarks for the first three months. Given that it takes about 1–3 months for budget authorities to work their way down to program offices, and then added time for the contractor to ramp up activities on new efforts, expenditures for October–November (and probably December) should be reduced, with the benchmark curve rising first in January.[22] As with obligations, an S-curve for expenditures would accomplish this objective, as would a delay in the linear benchmarks.

At least change benchmark shapes to straight lines across all years. At a minimum, if the benchmarks are not changed to S-curves, consider straight line benchmarks across all the years—not higher in the first year with reductions in subsequent years. This would only make sense, however, for incrementally funded multi-year contracts. Ideally, however, benchmarks would seek lower expenditures in the first year—not higher.

Explore switching to plan-based benchmarks. Finally (as with obligation benchmarks), these pattern-based benchmarks could be replaced with dynamic benchmarks based on a program's actual expenditure plan that reflects the timing and realities of program, negotiations, supply-chain realities, and other factors known best by the program manager and the prime contractor (Tremaine and Seligman, 2013; Anton, 2022). Again, Advana needs to be in a position to serve this need.

Use predictive metrics to identify anticipated shortfalls. In addition to using actual program temporal plans for benchmarks, the DoD should use available EVM data on RDT&E contracts to inform predictive measures of actual expenditures. For example, the National Defense Industrial Association (NDIA) published a very useful Guide to Managing Programs Using Predictive Measures (NDIA, 2017). Some of those predictive measures help forecast when a contractor is falling behind in execution and thus may not fully execute and invoice the obligated funds in the allowable period. In such cases and with further due diligence to validate whether the contractor will not complete performance in time, the DoD could repurpose those resources (either on other program needs or reprogrammed to other high-priority needs).

[21] Department of the Air Force, 2022, p. 54.

[22] See, for example, the recommended RDT&E benchmark curves in Marsalis (2002, p. 20).

RECOMMENDATIONS ACROSS BENCHMARKS

Ensure proper due diligence along with benchmarks when taking funding. While these notional benchmark curves may be useful filters to identify programs that may be falling behind, continued use of additional due diligence is necessary to understand each situation and avoid causing damage to programs that are actually well managed. Yes, identifying new funds in the year of execution for critical, new needs is important, but notional benchmarks alone are blind to the actual execution realities in programs. Anecdotes indicate that DoD and Congressional leadership do not simply rely on benchmarks to identify from whom to take money for new urgent priorities that arise during the year of execution. However, other anecdotes indicate that program managers believe otherwise, adding to the concern of unforeseen negative side effects from overly managing to benchmarks.

Use needs, plans, and priorities for budgeting—not just spending. As a corollary to the concerns raised with the incentives associated with obligation and expenditure benchmarks is that of spending one's budget to ensure that next year's budget is not cut. As with these benchmarks used for management oversight and potential reprogramming, not spending one's budget (or having one's budget reduced in the spending period) is a useful but not sufficient data point for setting subsequent budget levels. Budgeting should always be needs-based, and spending alone is not sufficient to establish need.

Avoid over managing to benchmarks and other metrics. Finally, management training and execution should continually caution against managing closely to benchmarks and other metrics. They should remain informative but not strongly enforced. This is in line with the DoD's 2012 memorandum on managing unobligated funds and the basic tenets of obligation rates (Office of the Secretary of Defense, 2012).

RECOMMENDED OPTIONS FOR IMPROVED BENCHMARKS

Based on the analysis above, we assembled improved benchmark tables patterned after the current Comptroller tables to facilitate consideration and potential use. Table 4-1 lists the range of options, their elements, and a ranking based on our analyses and reviews of the relevant theory and available literature. The new benchmark options start with the average actual obligation and expenditures from recent years, including CR, MAB, monthly calendar, and time effects that were statistically significant. In the case of the recommended S-curve versions, the profiles are modified to provide more start-up time. Tables for Options 1–4 are provided in the subsections below; option 5 (the current benchmarks) are shown in Figure 1-1 and the comparison tables and plots below.

In the rankings, separating RDT&E into the S&T (BAs 1–3), Development (BAs 4, 5, and 7), and Management Support (BA 6) is preferred because they have different actual profiles, as shown earlier in Figure 2-19. Introducing a consistent S-curve start-up for obligations are preferred for the reasons discussed previously in this paper.

Table 4-1. Benchmarks Options: Elements and Ranking

	Obligations		Expenditures	RDT&E	Rank
	Base Shape	***Variables***			
Option 1	S-curves on historic	CR, MAB, Calendar, and Time Effects	Historic (S-curved)	Separate S&T, DEV, Mgt	1 (Preferred)
Option 2	S-curves on historic			Combined	2
Option 3	Historic (linear base)			Separate S&T, DEV, Mgt	2
Option 4	Historic (linear base)			Combined	3
Option 5	As-is (arbitrary lines)	None	As-is (arbitrary lines)	Combined	4

OPTION 1 (PREFERRED): S-CURVED OBLIGATION AND HISTORICAL EXPENDITURE BENCHMARKS—SEPARATE S&T, RDT&E DEVELOPMENT, AND RDT&E MANAGEMENT SUPPORT

Table 4-2, Table 4-3, and Table 4-4 show the most-realistic obligation and expenditure benchmarks based on theory and analysis of recent data. This option carves out start-up S-curves in the initial few months for S&T, RDT&E Development, RDT&E Management Support, Procurement, O&M, and MILCON. These S-curves are patterned after insights gained from analysis of the historical trends plus theoretical insights to give program managers more time to negotiate contracts (e.g., better understand proposed supply-chains and associated risks; negotiate intellectual property rights; and understand contractor costs to negotiate fair prices). Expenditures reflect recent historical average (which already exhibit S-curve shapes).

Table 4-2 and Table 4-3 show the benchmark values for the first, second, and third years when funds are available for obligation and expenditure. Compared to the current benchmarks, these shift some of RDT&E obligations to the second year. Larger shifts may be preferable and could be reflected in future modifications to these tables.

Table 4-4 shows benchmark values for years 4–6 of availability. The increased length of the recommended MILCON benchmarks reflects that the actual DoD obligations from FY 2011–2018 extend about 6 years (much longer than the current benchmarks). Similarly, actual DoD MILCON expenditures from FY 2011–2014 extend 10 years (much longer than the current benchmarks) and the data indicate that subsequent years are on track to do the same. Note that current DoD benchmarks do not provide benchmarks beyond the third year of availability and do not have expenditure benchmarks for procurement. The values in these tables are informed by the time patterns and lengths of actual obligation and expenditure in DoD data. Further analysis is needed to reflect the different lengths of different procurement accounts.

Table 4-2. Option 1 Separate RDT&E Benchmarks: S-Curved Obligation and Historical Expenditure Curves

		S&T (BAs 1, 2, 3)				Development (BAs 4, 5, 7)			Management (BA-6)			
Year	Month	Obs.			Exp.	Obs.		Exp.	Obs.			Exp.
			Add if in CR	*Add after CRs*			*Add after CRs*			*Add if in CR*	*Add after CRs*	
1st	Oct	1.1%	*-1.04%*		0.52%	1.1%		0.36%	1.1%	*-1.42%*		0.69%
	Nov	3.9%	*-2.08%*		1.6%	3.9%		1.2%	3.9%	*-2.84%*		2.8%
	Dec	8.3%	*-3.12%*	*1st MAB: -1.6%*	3.2%	8.3%	*1st MAB: 0%*	3.5%	8.3%	*-4.27%*	*1st MAB: 0%*	5.7%
	Jan	15.1%	*-4.16%*	*2nd MAB: -1.6%*	5.1%	15.1%	*2nd MAB: 3.0%*	6.0%	15.1%	*-5.69%*	*2nd MAB: 2.1%*	8.9%
	Feb	22.7%	*-5.20%*	*3rd MAB: 3.3%*	7.3%	22.7%	*3rd MAB: 10.1%*	9.4%	22.7%	*-7.11%*	*3rd on: 4.2%*	12.4%
	Mar	31.5%	*-6.24%*	*4th MAB: 7.5%*	10.5%	31.5%	*4th on: 14.9%*	14.9%	31.5%	*-8.53%*		16.5%
	Apr	40.5%	*-7.28%*	*5th MAB: 9.0%*	14.3%	40.5%		19.6%	40.5%	*-9.96%*		21.9%
	May	48.5%	*-8.32%*	*6th on: 10.8%*	18.4%	47.9%		25.6%	50.0%	*-11.38%*		26.7%
	Jun	54.9%	*		22.9%	53.9%		31.3%	56.4%	*		32.0%
	Jul	61.3%	*		27.7%	59.9%		38.3%	62.7%	*		36.9%
	Aug	67.8%	*		33.3%	65.9%		43.8%	69.0%	*		42.3%
	Sep	76.6%	*		39.6%	71.9%		50.7%	76.9%	*		47.9%
2nd	Oct	85.1%			44.8%	88.8%		56.4%	78.4%			52.6%
	Nov	87.0%			49.4%	90.7%		60.7%	80.7%			55.8%
	Dec	88.9%			54.3%	92.0%		67.1%	82.9%			59.0%
	Jan	90.5%			58.9%	93.2%		70.7%	85.0%			62.2%
	Feb	92.1%			63.4%	94.3%		74.1%	86.9%			65.1%
	Mar	93.4%			68.9%	95.3%		78.9%	89.5%			68.9%
	Apr	94.7%			72.8%	96.2%		81.7%	91.3%			71.7%
	May	95.8%			76.4%	97.0%		84.2%	93.0%			74.0%
	Jun	96.7%			79.5%	97.7%		86.3%	94.5%			76.5%
	Jul	97.5%			82.4%	98.3%		88.2%	96.0%			79.0%
	Aug	98.2%			84.8%	98.8%		89.9%	97.4%			81.2%
	Sep	100.0%			87.7%	100.0%		91.8%	100.0%			84.2%
3rd	Oct				89.5%			93.1%				86.2%
	Nov				91.0%			94.2%				87.9%
	Dec				92.4%			95.4%				89.6%
	Jan				93.6%			96.1%				91.3%
	Feb				94.6%			96.7%				92.6%
	Mar				95.9%			97.7%				94.4%
	Apr				96.8%			98.3%				95.6%
	May				97.5%			98.6%				96.6%
	Jun				98.2%			99.1%				97.6%
	Jul				98.8%			99.4%				98.5%
	Aug				99.4%			99.8%				99.3%
	Sep				100.0%			100.0%				100.0%

* The data included no CRs extending past may, but it may make sense to continue adding -1.04% (for S&T) or -1.42% (for Mgt.) for each month under a CR from June–Sept, or adjust based on the size of any full-year CR budget for the BA(s).

SOURCE: Authors' analysis of FYs 2013, 2014, 2017–2023 DoD obligations and expenditures data.

NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. Our sample only included CRs through May, so we only included the CR effects through May in the table. There were no significant reductions during CR months for RDT&E development (BAs 4, 5, 7). If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 1st MAB would be January and the S&T obligation benchmarks for December would be 8.3% - 3.12% = 5.18% and the January benchmark would be 15.1% - 1.6% = 13.5%.

Table 4-3. Option 1–2 PROC, O&M, and MILCON Benchmarks: Obligation S-Curves and Historical Expenditure Patterns: 1st–3rd Years of Availability

		Procurement			O&M			MILCON	
Year	Month	Obs.		Exp.	Obs.		Exp.	Obs.	Exp.
			Add after CRs			*Add after CRs*			
First	Oct	0.55%		0.43%	3.0%		1.9%	0.60%	0.00%
	Nov	1.6%		1.0%	6.0%		5.6%	1.0%	0.11%
	Dec	3.6%	1st MAB: 0.0%	1.9%	11.0%	1st MAB: 1.2%	10.0%	1.6%	0.34%
	Jan	5.8%	2nd MAB: 1.8%	3.7%	19.0%	2nd MAB: 3.6%	15.0%	3.3%	0.31%
	Feb	9.3%	3rd MAB: 6.5%	5.0%	30.0%	3rd MAB: 6.0%	20.4%	5.9%	0.50%
	Mar	13.8%	4th on: 8.7%	7.2%	41.0%	4th on: 7.7%	26.7%	8.9%	0.76%
	Apr	18.3%		8.7%	52.0%		33.1%	11.3%	0.99%
	May	23.3%		10.6%	60.5%		39.5%	15.8%	1.1%
	Jun	28.8%		13.0%	69.3%		46.7%	22.9%	1.6%
	Jul	34.2%		15.5%	76.9%		53.8%	27.6%	2.1%
	Aug	39.6%		18.4%	84.7%		61.3%	33.9%	2.7%
	Sep	45.7%		21.8%	92.3%		69.2%	47.4%	3.9%
Second	Oct	59.1%		23.9%			75.4%	49.1%	4.6%
	Nov	63.2%		26.6%			79.5%	50.8%	5.5%
	Dec	68.3%		30.2%			83.2%	53.1%	6.7%
	Jan	72.1%		32.9%			86.0%	55.1%	7.9%
	Feb	75.3%		35.4%			88.7%	56.3%	9.3%
	Mar	78.9%		38.8%			91.3%	57.9%	10.6%
	Apr	81.6%		41.4%			93.3%	59.7%	12.4%
	May	84.0%		43.5%			94.9%	61.1%	14.4%
	Jun	86.2%		46.6%			96.5%	62.8%	16.8%
	Jul	88.0%		48.8%			97.7%	64.3%	19.3%
	Aug	89.8%		51.2%			98.9%	67.1%	21.7%
	Sep	91.7%		54.1%			100.0%	70.8%	24.6%
Third	Oct	93.1%		56.3%				71.4%	27.2%
	Nov	94.2%		59.0%				72.7%	29.2%
	Dec	95.2%		61.6%				73.7%	31.5%
	Jan	96.0%		63.3%				74.7%	33.7%
	Feb	96.6%		65.0%				75.7%	35.8%
	Mar	97.4%		68.2%				76.5%	37.5%
	Apr	98.0%		70.3%				77.2%	40.1%
	May	98.4%		72.1%				77.9%	42.2%
	Jun	99.0%		74.1%				78.8%	44.4%
	Jul	99.3%		75.8%				79.8%	46.6%
	Aug	99.6%		77.6%				80.5%	48.9%
	Sep	100.0%		79.6%				82.9%	51.3%

SOURCE: Authors' analysis of FY 2011–2023 DoD obligations and expenditures data.

NOTE: Years 4–6 of availability for Procurement and MILCON are the same as in Table 4-4 below. Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 1st MAB would be January and the Procurement obligation benchmarks for January–June that year would be 5.8%, 11.1%, 20.3%, 27.0%, 32.0%, and 37.5%, respectively.

Table 4-4. Options 1–4 PROC and MILCON Benchmarks (continued): 4th–6th Years of Availability

Year	Month	Procurement Exp.	MILCON Obs.	MILCON Exp.
Fourth	Oct	80.8%	83.0%	53.4%
	Nov	82.7%	83.6%	55.3%
	Dec	84.4%	84.5%	56.9%
	Jan	85.3%	85.2%	58.4%
	Feb	86.3%	85.7%	59.7%
	Mar	88.1%	86.4%	61.7%
	Apr	89.3%	87.1%	63.2%
	May	90.2%	87.6%	64.6%
	Jun	91.3%	88.2%	66.2%
Fifth	Jul	92.1%	88.5%	67.6%
	Aug	92.9%	88.9%	68.9%
	Sep	93.8%	89.9%	70.2%
	Oct	94.2%	89.9%	71.4%
	Nov	95.2%	90.6%	72.4%
	Dec	96.0%	90.8%	73.6%
	Jan	96.3%	91.0%	74.6%
	Feb	96.7%	91.2%	75.5%
	Mar	97.6%	91.8%	76.5%
	Apr	98.0%	92.2%	77.7%
	May	98.5%	93.0%	78.4%
	Jun	99.0%	93.6%	79.3%
	Jul	99.3%	95.2%	80.2%
	Aug	99.6%	96.4%	81.1%
	Sep	100.0%	100.0%	82.1%
Sixth	Oct			82.3%
	Nov			83.1%
	Dec			83.7%
	Jan			84.3%
	Feb			84.8%
	Mar			85.7%
	Apr			86.4%
	May			87.1%
	Jun			87.8%
	Jul			88.4%
	Aug			89.2%
	Sep			90.0%

SOURCE: Authors' analysis of FY 2011–2023 DoD obligations and expenditures data.

NOTE: This table provides the benchmarks for the years after those shown in Table 4-3, Table 4-5, and Table 4-8. Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown.

OPTION 2 BENCHMARKS: S-CURVED OBLIGATION AND HISTORICAL EXPENDITURE PATTERNS—COMBINED RDT&E

Table 4-5 shows the benchmarks if RDT&E is combined rather than broken down by S&T, Development, and Management Support. For obligations, S-curves are added to the benchmarks, as in Option 1. Table 4-4 above shows benchmark values for years 4–6 of availability.

Table 4-5. Option 2 Benchmarks: Obligation S-Curves and Historical Expenditure Patterns: 1st–3rd Years of Availability (Combined RDT&E)

		RDT&E (combined)			Procurement			O&M			MILCON	
Year	Month	Obs.		Exp.	Obs.		Exp.	Obs.		Exp.	Obs.	Exp.
			Add after CRs			*Add after CRs*			*Add after CRs*			
First	Oct	1.0%		0.6%	0.55%		0.43%	3.0%		1.9%	0.60%	0.00%
	Nov	3.3%		1.7%	1.6%		1.0%	6.0%		5.6%	1.0%	0.11%
	Dec	7.1%		4.0%	3.6%		1.9%	11.0%		10.0%	1.6%	0.34%
	Jan	12.9%	1st MAB: 0.0%	6.5%	5.8%	1st MAB: 0.0%	3.7%	19.0%	1st MAB: 1.2%	15.0%	3.3%	0.31%
	Feb	19.5%	2nd MAB: 4.3%	9.8%	9.3%	2nd MAB: 1.8%	5.0%	30.0%	2nd MAB: 3.6%	20.4%	5.9%	0.50%
	Mar	27.0%	3rd MAB: 10.7%	15.3%	13.8%	3rd MAB: 6.5%	7.2%	41.0%	3rd MAB: 6.0%	26.7%	8.9%	0.76%
	Apr	34.7%	4th on: 14.4%	20.2%	18.3%	4th on: 8.7%	8.7%	52.0%	4th on: 7.7%	33.1%	11.3%	0.99%
	May	42.8%		25.3%	23.3%		10.6%	60.5%		39.5%	15.8%	1.1%
	Jun	49.2%		31.5%	28.8%		13.0%	69.3%		46.7%	22.9%	1.6%
	Jul	55.9%		37.5%	34.2%		15.5%	76.9%		53.8%	27.6%	2.1%
	Aug	61.0%		43.4%	39.6%		18.4%	84.7%		61.3%	33.9%	2.7%
	Sep	65.8%		50.2%	45.7%		21.8%	92.3%		69.2%	47.4%	3.9%
Second	Oct	83.9%		55.0%	59.1%		23.9%			75.4%	49.1%	4.6%
	Nov	87.1%		59.7%	63.2%		26.6%			79.5%	50.8%	5.5%
	Dec	89.6%		65.7%	68.3%		30.2%			83.2%	53.1%	6.7%
	Jan	92.2%		69.3%	72.1%		32.9%			86.0%	55.1%	7.9%
	Feb	94.0%		72.7%	75.3%		35.4%			88.7%	56.3%	9.3%
	Mar	95.5%		77.0%	78.9%		38.8%			91.3%	57.9%	10.6%
	Apr	96.6%		79.9%	81.6%		41.4%			93.3%	59.7%	12.4%
	May	97.6%		82.5%	84.0%		43.5%			94.9%	61.1%	14.4%
	Jun	98.4%		84.9%	86.2%		46.6%			96.5%	62.8%	16.8%
	Jul	99.1%		86.9%	88.0%		48.8%			97.7%	64.3%	19.3%
	Aug	99.5%		88.8%	89.8%		51.2%			98.9%	67.1%	21.7%
	Sep	100.0%		90.9%	91.7%		54.1%			100.0%	70.8%	24.6%
Third	Oct			92.4%	93.1%		56.3%				71.4%	27.2%
	Nov			93.6%	94.2%		59.0%				72.7%	29.2%
	Dec			94.7%	95.2%		61.6%				73.7%	31.5%
	Jan			95.6%	96.0%		63.3%				74.7%	33.7%
	Feb			96.3%	96.6%		65.0%				75.7%	35.8%
	Mar			97.2%	97.4%		68.2%				76.5%	37.5%
	Apr			97.8%	98.0%		70.3%				77.2%	40.1%
	May			98.3%	98.4%		72.1%				77.9%	42.2%
	Jun			98.9%	99.0%		74.1%				78.8%	44.4%
	Jul			99.2%	99.3%		75.8%				79.8%	46.6%
	Aug			99.6%	99.6%		77.6%				80.5%	48.9%
	Sep			100.0%	100.0%		79.6%				82.9%	51.3%

SOURCE: Authors' analysis of FY 2011–2023 DoD obligations and expenditures data.

NOTE: Years 4–6 of availability for Procurement and MILCON are the same as in Table 4-4 above. Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 2nd MAB would be February and the RDT&E obligation benchmarks for February–June that year would be 23.8%, 37.7%, 49.1%, 57.2%, 63.6%, respectively.

OPTION 3 BENCHMARKS: HISTORIC OBLIGATION AND EXPENDITURE PATTERNS—SEPARATE S&T, RDT&E DEVELOPMENT, AND RDT&E MANAGEMENT SUPPORT

Table 4-6 shows the benchmarks for recent obligation averages (no added S-curves) with separate benchmarks for S&T, RDT&E Development, and RDT&E Management Support. Table 4-7 shows the benchmarks for Procurement, O&M, and MILCON. Table 4-4 above shows benchmark values for years 4–6 of availability.

OPTION 4 BENCHMARKS: HISTORICAL HISTORIC OBLIGATION AND EXPENDITURE PATTERNS—COMBINED RDT&E

Table 4-8 shows the benchmarks for recent obligation averages (no added S-curves) and if RDT&E is combined rather than broken down by S&T, Development, and Management Support. Table 4-4 above shows benchmark values for years 4–6 of availability.

Table 4-6. Option 3 Separate RDT&E Benchmarks: Historical Obligation and Expenditure Curves

		S&T (BAs 1, 2, 3)				Development (BAs 4, 5, 7)			Management (BA-6)			
Year	Month	Obs.			Exp.	Obs.		Exp.	Obs.			Exp.
			Add if in CR	Add after CRs			Add after CRs			Add if in CR	Add after CRs	
1st	Oct	3.0%	-1.04%		0.52%	4.1%		0.36%	6.3%	-1.42%		0.69%
	Nov	8.3%	-2.08%		1.6%	10.1%		1.2%	12.5%	-2.84%		2.8%
	Dec	14.8%	-3.12%	1st MAB: -1.6%	3.2%	16.1%	1st MAB: 0%	3.5%	18.8%	-4.27%	1st MAB: 0%	5.7%
	Jan	21.2%	-4.16%	2nd MAB: -1.6%	5.1%	22.2%	2nd MAB: 3.0%	6.0%	25.1%	-5.69%	2nd MAB: 2.1%	8.9%
	Feb	27.6%	-5.20%	3rd MAB: 3.3%	7.3%	28.2%	3rd MAB: 10.1%	9.4%	31.4%	-7.11%	3rd on: 4.2%	12.4%
	Mar	35.6%	-6.24%	4th MAB: 7.5%	10.5%	35.9%	4th on: 14.9%	14.9%	37.6%	-8.53%		16.5%
	Apr	42.1%	-7.28%	5th MAB: 9.0%	14.3%	41.9%		19.6%	43.9%	-9.96%		21.9%
	May	48.5%	-8.32%	6th on: 10.8%	18.4%	47.9%		25.6%	50.2%	-11.38%		26.7%
	Jun	54.9%	*		22.9%	53.9%		31.3%	56.4%	*		32.0%
	Jul	61.3%	*		27.7%	59.9%		38.3%	62.7%	*		36.9%
	Aug	67.8%	*		33.3%	65.9%		43.8%	69.0%	*		42.3%
	Sep	76.6%	*		39.6%	71.9%		50.7%	78.1%	*		47.9%
2nd	Oct	85.1%			44.8%	88.8%		56.4%	78.4%			52.6%
	Nov	87.0%			49.4%	90.7%		60.7%	80.7%			55.8%
	Dec	88.9%			54.3%	92.0%		67.1%	82.9%			59.0%
	Jan	90.5%			58.9%	93.2%		70.7%	85.0%			62.2%
	Feb	92.1%			63.4%	94.3%		74.1%	86.9%			65.1%
	Mar	93.4%			68.9%	95.3%		78.9%	89.5%			68.9%
	Apr	94.7%			72.8%	96.2%		81.7%	91.3%			71.7%
	May	95.8%			76.4%	97.0%		84.2%	93.0%			74.0%
	Jun	96.7%			79.5%	97.7%		86.3%	94.5%			76.5%
	Jul	97.5%			82.4%	98.3%		88.2%	96.0%			79.0%
	Aug	98.2%			84.8%	98.8%		89.9%	97.4%			81.2%
	Sep	100.0%			87.7%	100.0%		91.8%	100.0%			84.2%
3rd	Oct				89.5%			93.1%				86.2%
	Nov				91.0%			94.2%				87.9%
	Dec				92.4%			95.4%				89.6%
	Jan				93.6%			96.1%				91.3%
	Feb				94.6%			96.7%				92.6%
	Mar				95.9%			97.7%				94.4%
	Apr				96.8%			98.3%				95.6%
	May				97.5%			98.6%				96.6%
	Jun				98.2%			99.1%				97.6%
	Jul				98.8%			99.4%				98.5%
	Aug				99.4%			99.8%				99.3%
	Sep				100.0%			100.0%				100.0%

* The data included no CRs extending past May, but it may make sense to continue adding -1.04% (for S&T) or -1.42% (for Mgt.) for each month under a CR from June–Sept, or adjust based on the size of any full-year CR budget for the BA(s).
SOURCE: Authors' analysis of FYs 2013, 2014, 2017–2023 DoD obligations and expenditures data.
NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. Our sample only included CRs through May, so we only included the CR effects through May in the table. There were no significant reductions during CR months for RDT&E development (BAs 4, 5, 7). If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB (1 MAB). For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 1st MAB would be January and the S&T obligation benchmarks for December would be 8.3% - 3.12% = 5.18% and the January benchmark would be 15.1% - 1.6% = 13.5%.

Table 4-7. Option 3 PROC, O&M, and MILCON Benchmarks: Historical Obligation and Expenditure Patterns: 1st–3rd Years of Availability

		Procurement			O&M			MILCON	
Year	Month	Obs.		Exp.	Obs.		Exp.	Obs.	Exp.
			Add after CRs			*Add after CRs*			
First	Oct	1.4%		0.43%	6.4%		1.9%	0.60%	0.00%
	Nov	6.4%		1.0%	13.0%		5.6%	1.0%	0.11%
	Dec	11.4%	1st MAB: 0.0%	1.9%	20.5%	1st MAB: 1.2%	10.0%	1.6%	0.34%
	Jan	16.4%	2nd MAB: 1.8%	3.7%	28.0%	2nd MAB: 3.6%	15.0%	3.3%	0.31%
	Feb	21.4%	3rd MAB: 6.5%	5.0%	35.4%	3rd MAB: 6.0%	20.4%	5.9%	0.50%
	Mar	29.0%	4th on: 8.7%	7.2%	42.9%	4th on: 7.7%	26.7%	8.9%	0.76%
	Apr	34.0%		8.7%	50.3%		33.1%	11.3%	0.99%
	May	39.0%		10.6%	57.8%		39.5%	15.8%	1.1%
	Jun	44.0%		13.0%	65.3%		46.7%	22.9%	1.6%
	Jul	49.0%		15.5%	75.2%		53.8%	27.6%	2.1%
	Aug	54.0%		18.4%	80.8%		61.3%	33.9%	2.7%
	Sep	63.6%		21.8%	92.3%		69.2%	47.4%	3.9%
Second	Oct	74.1%		23.9%			75.4%	49.1%	4.6%
	Nov	76.5%		26.6%			79.5%	50.8%	5.5%
	Dec	79.1%		30.2%			83.2%	53.1%	6.7%
	Jan	80.7%		32.9%			86.0%	55.1%	7.9%
	Feb	82.3%		35.4%			88.7%	56.3%	9.3%
	Mar	84.1%		38.8%			91.3%	57.9%	10.6%
	Apr	85.4%		41.4%			93.3%	59.7%	12.4%
	May	86.7%		43.5%			94.9%	61.1%	14.4%
	Jun	87.9%		46.6%			96.5%	62.8%	16.8%
	Jul	89.0%		48.8%			97.7%	64.3%	19.3%
	Aug	90.0%		51.2%			98.9%	67.1%	21.7%
	Sep	92.3%		54.1%			100.0%	70.8%	24.6%
Third	Oct	93.2%		56.3%				71.4%	27.2%
	Nov	94.5%		59.0%				72.7%	29.2%
	Dec	96.1%		61.6%				73.7%	31.5%
	Jan	96.7%		63.3%				74.7%	33.7%
	Feb	97.2%		65.0%				75.7%	35.8%
	Mar	97.9%		68.2%				76.5%	37.5%
	Apr	98.3%		70.3%				77.2%	40.1%
	May	98.5%		72.1%				77.9%	42.2%
	Jun	98.7%		74.1%				78.8%	44.4%
	Jul	98.7%		75.8%				79.8%	46.6%
	Aug	98.7%		77.6%				80.5%	48.9%
	Sep	100.0%		79.6%				82.9%	51.3%

SOURCE: Authors' analysis of FY 2011–2023 DoD obligations and expenditures data.

NOTE: Years 4–6 of availability for Procurement and MILCON are the same as in Table 4-4 above. Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 1st MAB would be January and the Procurement obligation benchmarks for January–June that year would be 5.8%, 11.1%, 20.3%, 27.0%, 32.0%, and 37.5%, respectively.

Table 4-8. Option 4 Benchmarks: Historical Obligations and Expenditures: 1st–3rd Years of Availability (Combined RDT&E)

		RDT&E (combined)			Procurement			O&M			MILCON	
Year	Month	Obs.		Exp.	Obs.		Exp.	Obs.		Exp.	Obs.	Exp.
			Add after CRs			*Add after CRs*			*Add after CRs*			
First	Oct	3.6%		0.6%	1.4%		0.43%	6.4%		1.9%	0.60%	0.00%
	Nov	9.6%		1.7%	6.4%		1.0%	13.0%		5.6%	1.0%	0.11%
	Dec	15.5%		4.0%	11.4%		1.9%	20.5%		10.0%	1.6%	0.34%
	Jan	21.4%	1st MAB: 0.0%	6.5%	16.4%	1st MAB: 0.0%	3.7%	28.0%	1st MAB: 1.2%	15.0%	3.3%	0.31%
	Feb	27.4%	2nd MAB: 4.3%	9.8%	21.4%	2nd MAB: 1.8%	5.0%	35.4%	2nd MAB: 3.6%	20.4%	5.9%	0.50%
	Mar	35.6%	3rd MAB: 10.7%	15.3%	29.0%	3rd MAB: 6.5%	7.2%	42.9%	3rd MAB: 6.0%	26.7%	8.9%	0.76%
	Apr	41.6%	4th on: 14.4%	20.2%	34.0%	4th on: 8.7%	8.7%	50.3%	4th on: 7.7%	33.1%	11.3%	0.99%
	May	47.5%		25.3%	39.0%		10.6%	57.8%		39.5%	15.8%	1.1%
	Jun	53.4%		31.5%	44.0%		13.0%	65.3%		46.7%	22.9%	1.6%
	Jul	59.4%		37.5%	49.0%		15.5%	75.2%		53.8%	27.6%	2.1%
	Aug	65.3%		43.4%	54.0%		18.4%	80.8%		61.3%	33.9%	2.7%
	Sep	71.3%		50.2%	63.6%		21.8%	92.3%		69.2%	47.4%	3.9%
Second	Oct	87.2%		55.0%	74.1%		23.9%			75.4%	49.1%	4.6%
	Nov	89.6%		59.7%	76.5%		26.6%			79.5%	50.8%	5.5%
	Dec	91.0%		65.7%	79.1%		30.2%			83.2%	53.1%	6.7%
	Jan	92.2%		69.3%	80.7%		32.9%			86.0%	55.1%	7.9%
	Feb	93.4%		72.7%	82.3%		35.4%			88.7%	56.3%	9.3%
	Mar	94.5%		77.0%	84.1%		38.8%			91.3%	57.9%	10.6%
	Apr	95.5%		79.9%	85.4%		41.4%			93.3%	59.7%	12.4%
	May	96.4%		82.5%	86.7%		43.5%			94.9%	61.1%	14.4%
	Jun	97.2%		84.9%	87.9%		46.6%			96.5%	62.8%	16.8%
	Jul	97.9%		86.9%	89.0%		48.8%			97.7%	64.3%	19.3%
	Aug	98.5%		88.8%	90.0%		51.2%			98.9%	67.1%	21.7%
	Sep	100.0%		90.9%	92.3%		54.1%			100.0%	70.8%	24.6%
Third	Oct			92.4%	93.2%		56.3%				71.4%	27.2%
	Nov			93.6%	94.5%		59.0%				72.7%	29.2%
	Dec			94.7%	96.1%		61.6%				73.7%	31.5%
	Jan			95.6%	96.7%		63.3%				74.7%	33.7%
	Feb			96.3%	97.2%		65.0%				75.7%	35.8%
	Mar			97.2%	97.9%		68.2%				76.5%	37.5%
	Apr			97.8%	98.3%		70.3%				77.2%	40.1%
	May			98.3%	98.5%		72.1%				77.9%	42.2%
	Jun			98.9%	98.7%		74.1%				78.8%	44.4%
	Jul			99.2%	98.7%		75.8%				79.8%	46.6%
	Aug			99.6%	98.7%		77.6%				80.5%	48.9%
	Sep			100.0%	100.0%		79.6%				82.9%	51.3%

SOURCE: Authors' analysis of FY 2011–2023 DoD obligations and expenditures data.

NOTE: Years 4–6 of availability for Procurement and MILCON are the same as in Table 4-4 above. Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown. MAB = month after full budget is passed. If there were at least 10 working days in the month that the final budget (appropriation) was passed, then the 1st MAB is the month of passage, else the following calendar month is the 1st MAB. For example, for FY 2014, passage was on 1/17/2014 with at least 10 working days in January, so 1 MAB was January. However, in FY 2015, passage was on 12/16/2014, so with the end-of-year holidays we used January instead of December as the 1 MAB. Thus, if the final budget was passed in mid-December, then the 2nd MAB would be February and the RDT&E obligation benchmarks for February–June that year would be 23.8%, 37.7%, 49.1%, 57.2%, 63.6%, respectively.

COMPARISON OF RECOMMENDED AND CURRENT DOD OBLIGATION AND EXPENDITURE BENCHMARKS

The following figures graphically show the differences between some of the recommended benchmarks (with S-curves for RDT&E, Procurement, and O&M along with historically patterned benchmarks) and alternate benchmarks (all with benchmarks patterned after historical data from FY 2011–2023) in the preceding tables and the current DoD benchmarks.

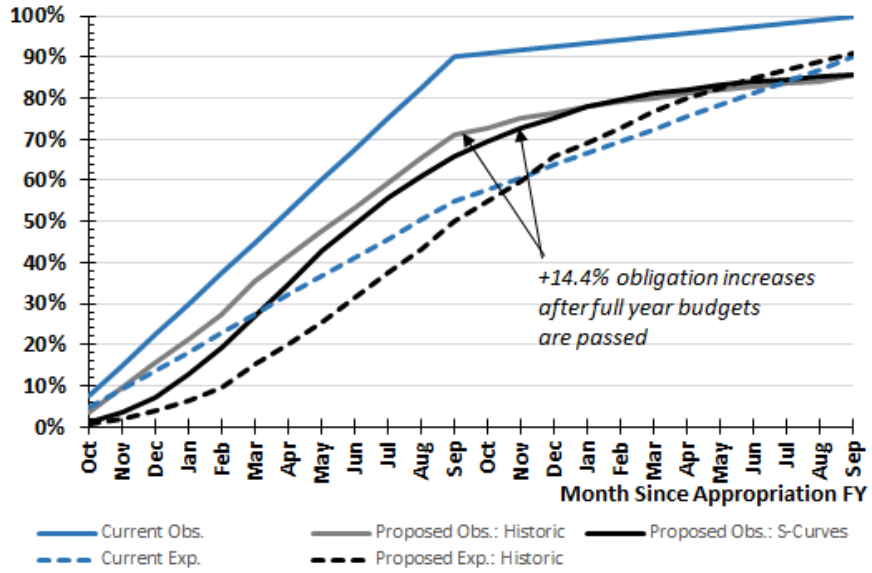
Figure 4-1 compares the current and recommended RDT&E benchmarks. The recommended obligation curves show the cumulative amounts, not counting the bumps that would be added in after the full FY budgets are passed. Figure 4-2 and Figure 4-3 illustrate how the MAB obligation effect would add based on what month the full budget is passed. The first figure shows the effect when lowering the initial portion to further strengthen the s-curve effect while the second figure shows the effect based solely on the historical values from FY 2011–2022 actual obligations. These plots illustrate the strong effect on obligations of delayed final appropriations for the FY.

Figure 4-4 compares the current and recommended Procurement benchmarks. Again, the recommended obligation curves show the cumulative amounts not counting the bumps that would be added in after the full FY budgets are passed. Recall again that there is no current expenditure benchmark for Procurement. The recommended benchmarks reflect insights from analyzing actual procurement benchmarks across all DoD Procurement accounts. Further analysis is needed to reflect the different lengths of different procurement accounts.

Figure 4-7 compares the current and recommended O&M benchmarks. Again, the recommended obligation curves show the cumulative amounts not counting the bumps that would be added in after the full FY budgets are passed.

Finally, Figure 4-10 compares the current and recommended MILCON benchmarks. Recall again that increased length of these recommended benchmarks reflects that the actual DoD obligations from FY 2011–2018 extend about 6 years (much longer than the current benchmarks). Similarly, actual DoD MILCON expenditures from FY 2011–2014 extend 10 years (much longer than the current benchmarks) and the data indicate that subsequent years are on track to do the same.

Figure 4-1. Cumulative Fraction of RDT&E Obligations and Expenditure by Month for Current and Proposed Benchmarks (FY 2011–2022 Appropriations)



NOTE: See Figure 4-2 and Figure 4-3 for how the 14.4% obligation increases are added depending on when the final FY appropriations are passed.

Figure 4-2. Current and Proposed S-Curve Benchmarks: Cumulative Fraction of RDT&E Obligations by Month for (FY 2011–2022 Appropriations)

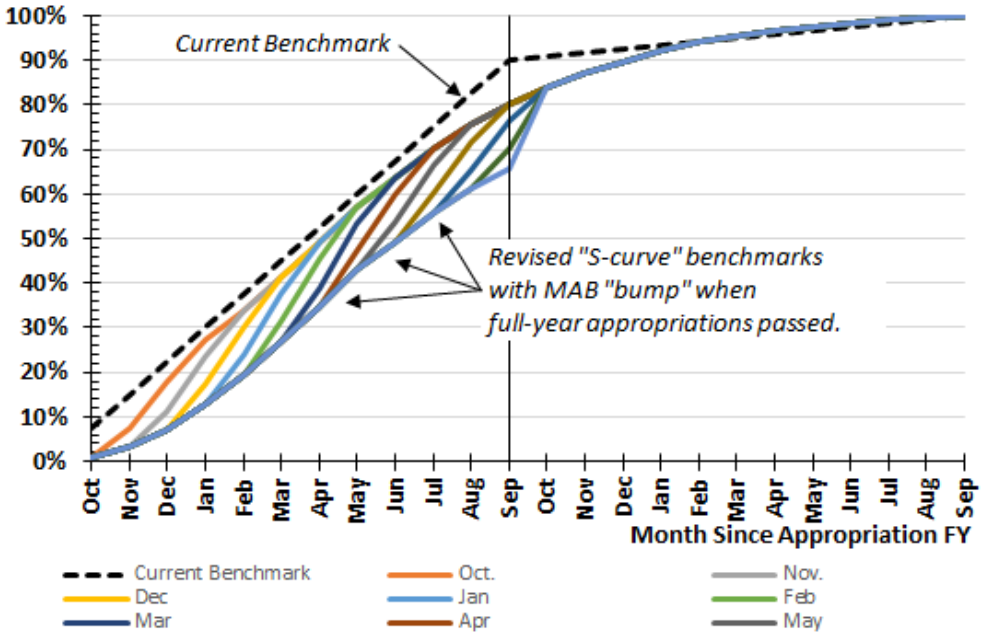


Figure 4-3. Current and Proposed History-Based Benchmarks: Cumulative Fraction of RDT&E Obligations by Month for (FY 2011–2022 Appropriations)

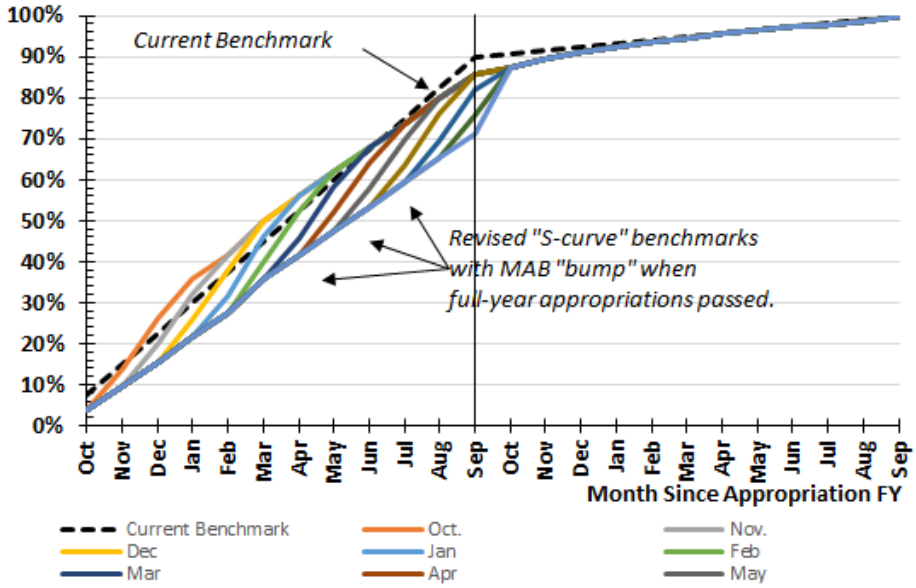
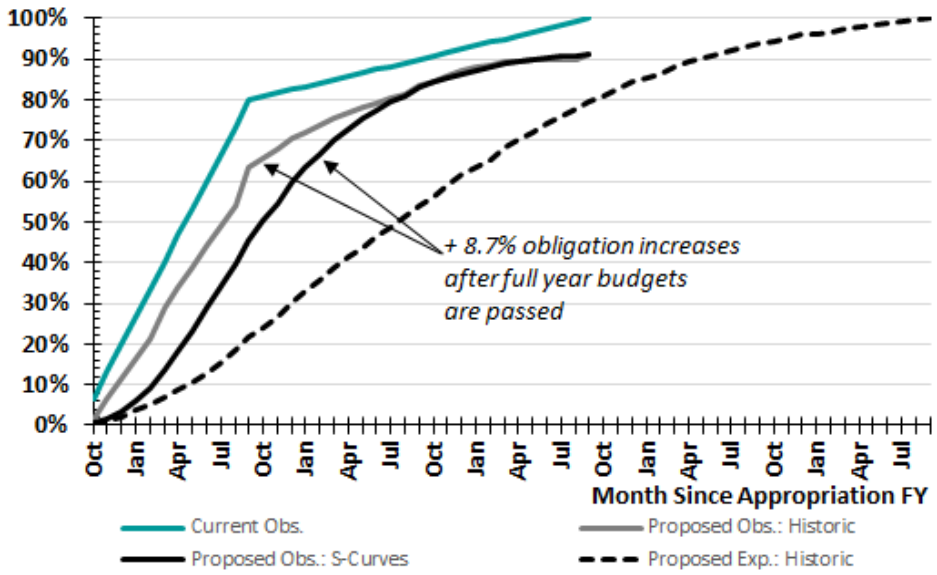


Figure 4-4. Cumulative Fraction of Procurement Obligations and Expenditure by Month for Current and Proposed Benchmarks (FY 2011–2021 Appropriations)



NOTE: See Figure 4-5 and Figure 4-6 for how the 8.7% obligation increases are added depending on when the final FY appropriations are passed.

Figure 4-5. Current and Proposed S-Curve Benchmarks: Cumulative Fraction of PROC Obligations by Month for (FY 2011–2021 Appropriations)

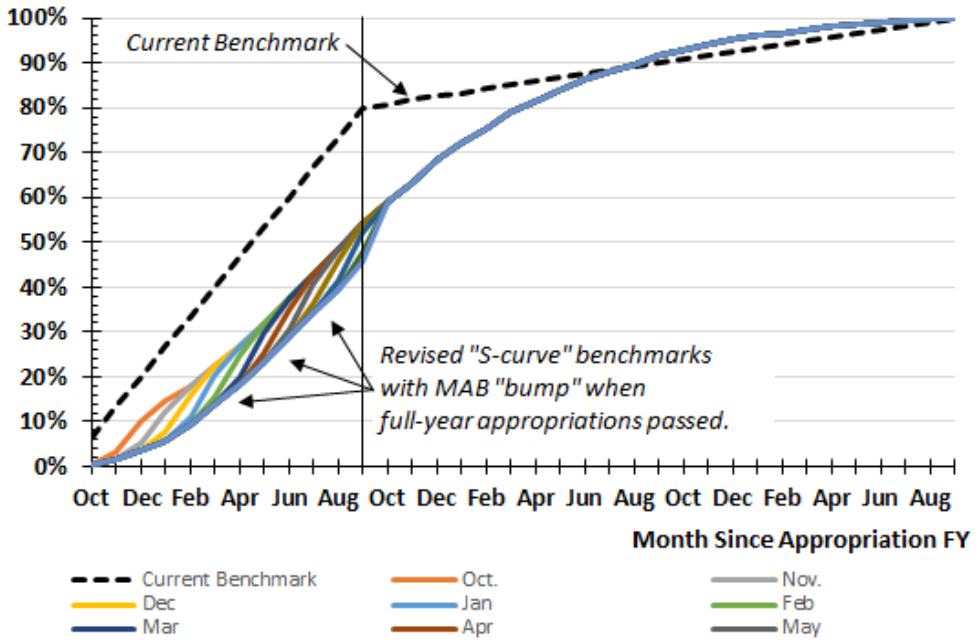


Figure 4-6. Current and Proposed History-Based Benchmarks: Cumulative Fraction of PROC Obligations by Month for (FY 2011–2021 Appropriations)

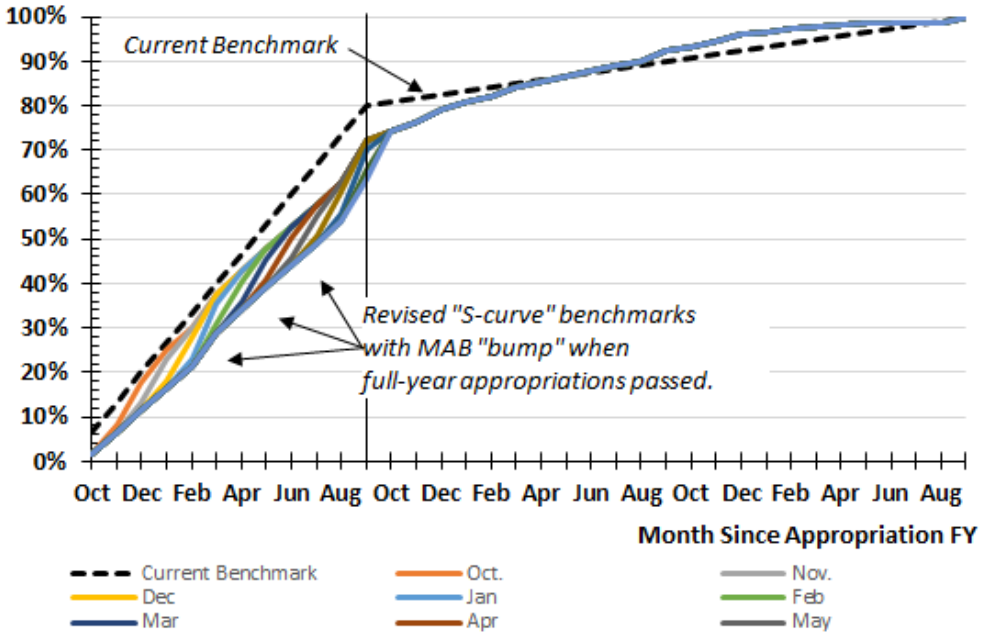
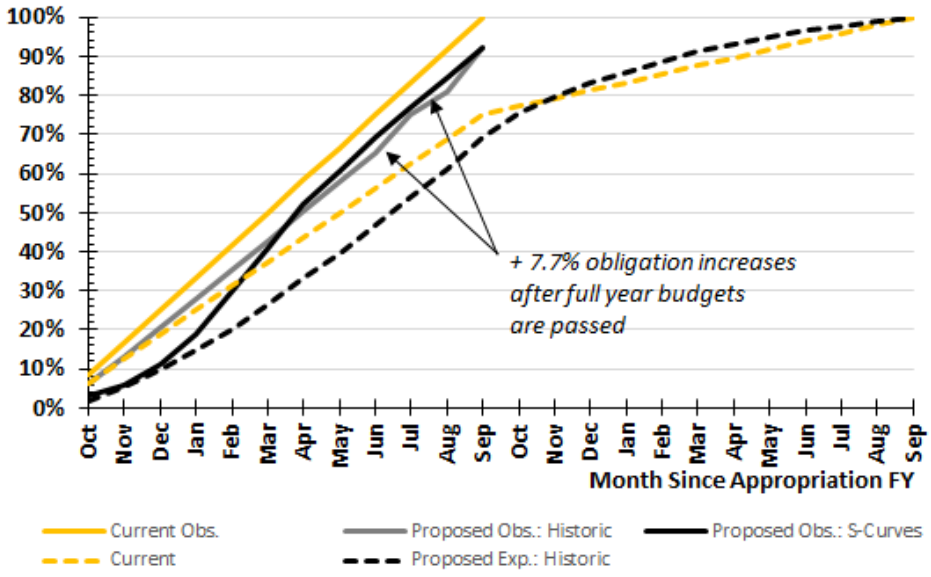


Figure 4-7. Cumulative Fraction of O&M Obligations and Expenditure by Month for Current and Proposed Benchmarks (FY 2011–2023 Appropriations)



NOTE: See Figure 4-8 and Figure 4-9 for how the 7.7% obligation increases are added depending on when the final FY appropriations are passed.

Figure 4-8. Current and Proposed S-Curve Benchmarks: Cumulative Fraction of O&M Obligations by Month for (FY 2011–2023 Appropriations)

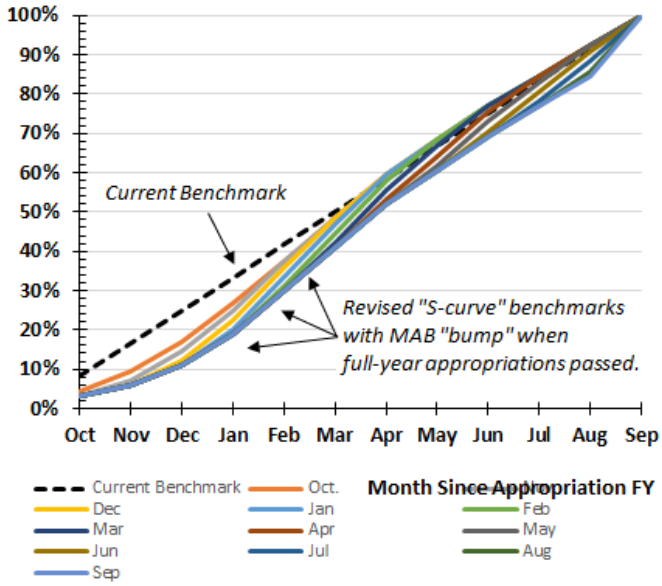


Figure 4-9. Current and Proposed History-Based Benchmarks: Cumulative Fraction of O&M Obligations by Month for (FY 2011–2023 Appropriations)

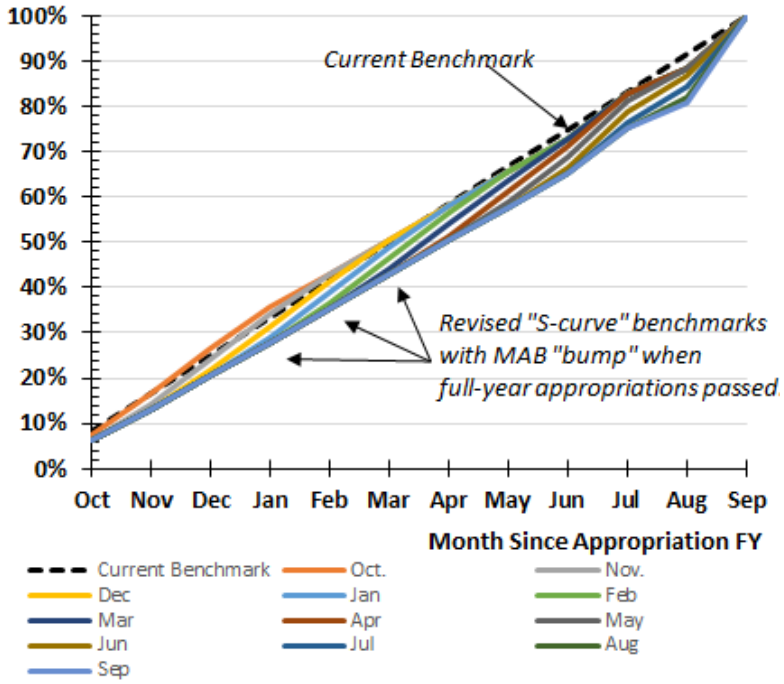


Figure 4-10. Cumulative Fraction of MILCON Obligations and Expenditure by Month for Current and Proposed Benchmarks (FY 2011–2021 Appropriations)

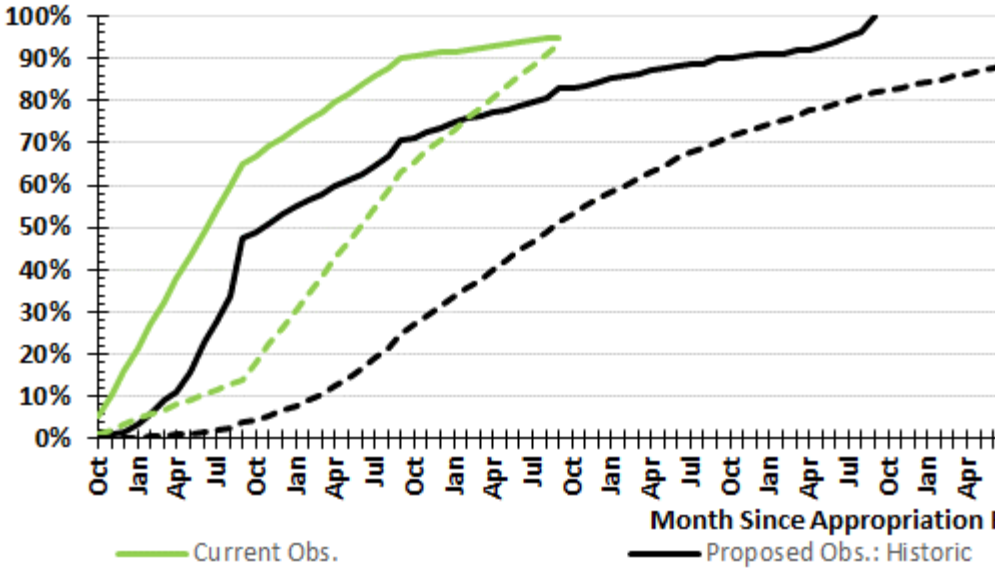


Table 4-9 provides the numerical values comparing the current and optional benchmarks for RDT&E split into S&T, Development, and Management. Table 4-10 provides the numerical values comparing the current and optional benchmarks for RDT&E (combined) and O&M. Likewise, Table 4-11 and Table 4-12 provide the numerical values comparing the current and optional benchmarks for Procurement and MILCON, with the second table of the two showing the values for the fourth through sixth years of availability.

Table 4-9. Comparing Current and Options 1 and 3 Obligation Benchmarks: S&T, Development, and Management Support

			S&T (BAs 1, 2, 3)				Development (BAs 4, 5, 7)			Management (BA-6)			
			Obs.				Obs.			Obs.			
Year	Month	Current	Option 1	Option 3	*Add if in CR*	*Add after CRs*	Option 1	Option 3	*Add after CRs*	Option 1	Option 3	*Add if in CR*	*Add after CRs*
1st	Oct	8%	1.1%	3.0%	*-1.04%*		1.1%	4.1%		1.1%	6.3%	*-1.42%*	
	Nov	15%	3.9%	8.3%	*-2.08%*		3.9%	10.1%		3.9%	12.5%	*-2.84%*	
	Dec	23%	8.3%	14.8%	*-3.12%*	*1st MAB: -1.6%*	8.3%	16.1%	*1st MAB: 0%*	8.3%	18.8%	*-4.27%*	*1st MAB: 0%*
	Jan	30%	15.1%	21.2%	*-4.16%*	*2nd MAB: -1.6%*	15.1%	22.2%	*2nd MAB: 3.0%*	15.1%	25.1%	*-5.69%*	*2nd MAB: 2.1%*
	Feb	38%	22.7%	27.6%	*-5.20%*	*3rd MAB: 3.3%*	22.7%	28.2%	*3rd MAB: 10.1%*	22.7%	31.4%	*-7.11%*	*3rd on: 4.2%*
	Mar	45%	31.5%	35.6%	*-6.24%*	*4th MAB: 7.5%*	31.5%	35.9%	*4th on: 14.9%*	31.5%	37.6%	*-8.53%*	
	Apr	53%	40.5%	42.1%	*-7.28%*	*5th MAB: 9.0%*	40.5%	41.9%		40.5%	43.9%	*-9.96%*	
	May	60%	48.5%	48.5%	*-8.32%*	*6th on: 10.8%*	47.9%	47.9%		50.0%	50.2%	*-11.38%*	
	Jun	68%	54.9%	54.9%	*		53.9%	53.9%		56.4%	56.4%	*	
	Jul	75%	61.3%	61.3%	*		59.9%	59.9%		62.7%	62.7%	*	
	Aug	83%	67.8%	67.8%	*		65.9%	65.9%		69.0%	69.0%	*	
	Sep	90%	76.6%	76.6%	*		71.9%	71.9%		76.9%	78.1%	*	
2nd	Oct	91%	85.1%	85.1%			88.8%	88.8%		78.4%	78.4%		
	Nov	92%	87.0%	87.0%			90.7%	90.7%		80.7%	80.7%		
	Dec	93%	88.9%	88.9%			92.0%	92.0%		82.9%	82.9%		
	Jan	93%	90.5%	90.5%			93.2%	93.2%		85.0%	85.0%		
	Feb	94%	92.1%	92.1%			94.3%	94.3%		86.9%	86.9%		
	Mar	95%	93.4%	93.4%			95.3%	95.3%		89.5%	89.5%		
	Apr	96%	94.7%	94.7%			96.2%	96.2%		91.3%	91.3%		
	May	97%	95.8%	95.8%			97.0%	97.0%		93.0%	93.0%		
	Jun	98%	96.7%	96.7%			97.7%	97.7%		94.5%	94.5%		
	Jul	98%	97.5%	97.5%			98.3%	98.3%		96.0%	96.0%		
	Aug	99%	98.2%	98.2%			98.8%	98.8%		97.4%	97.4%		
	Sep	100%	100.0%	100.0%			100.0%	100.0%		100.0%	100.0%		

* The data included no CRs extending past may, but it may make sense to continue adding -1.04% (for S&T) or -1.42% (for Mgt.) for each month under a CR from June–Sept, or adjust based on the size of any full-year CR budget for the BA(s).

NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown.

Table 4-10. Comparing Current and Proposed Benchmarks: RDT&E (combined) and O&M

		RDT&E (combined)						O&M					
		Obligations				Expenditures		Obligations				Expenditures	
Year	Mo.	Current	Option 2	Option 4		Current	Option 1–4	Current	Option 3–4	Option 3–4		Current	Option 1–4
					Add after CRs						*Add after CRs*		
1st	Oct	8%	1.0%	3.6%		5%	0.6%	8.3%	3.0%	6.4%		6%	1.9%
	Nov	15%	3.3%	9.6%		9%	1.7%	16.7%	6.0%	13.0%		13%	5.6%
	Dec	23%	7.1%	15.5%	MAB:	14%	4.0%	25.0%	11.0%	20.5%	MAB:	19%	10.0%
	Jan	30%	12.9%	21.4%	1st 0.0%	18%	6.5%	33.3%	19.0%	28.0%	1st 1.2%	25%	15.0%
	Feb	38%	19.5%	27.4%	2nd 4.3%	23%	9.8%	41.7%	30.0%	35.4%	2nd 3.6%	31%	20.4%
	Mar	45%	27.0%	35.6%	3rd 10.7%	28%	15.3%	50.0%	41.0%	42.9%	3rd 6.0%	38%	26.7%
	Apr	53%	34.7%	41.6%	4th+ 14.4%	32%	20.2%	58.3%	52.0%	50.3%	4th+ 7.7%	44%	33.1%
	May	60%	42.8%	47.5%		37%	25.3%	66.7%	60.5%	57.8%		50%	39.5%
	Jun	68%	49.2%	53.4%		41%	31.5%	75.0%	69.3%	65.3%		56%	46.7%
	Jul	75%	55.9%	59.4%		46%	37.5%	83.3%	76.9%	75.2%		63%	53.8%
	Aug	83%	61.0%	65.3%		50%	43.4%	91.7%	84.7%	80.8%		69%	61.3%
	Sep	90%	65.8%	71.3%		55%	50.2%	100.0%	92.3%	92.3%		75%	69.2%
2nd	Oct	91%	83.9%	87.2%		58%	55.0%					77%	75.4%
	Nov	92%	87.1%	89.6%		61%	59.7%					79%	79.5%
	Dec	93%	89.6%	91.0%		64%	65.7%					81%	83.2%
	Jan	93%	92.2%	92.2%		67%	69.3%					83%	86.0%
	Feb	94%	94.0%	93.4%		70%	72.7%					85%	88.7%
	Mar	95%	95.5%	94.5%		73%	77.0%					88%	91.3%
	Apr	96%	96.6%	95.5%		75%	79.9%					90%	93.3%
	May	97%	97.6%	96.4%		78%	82.5%					92%	94.9%
	Jun	98%	98.4%	97.2%		81%	84.9%					94%	96.5%
	Jul	98%	99.1%	97.9%		84%	86.9%					96%	97.7%
	Aug	99%	99.5%	98.5%		87%	88.8%					98%	98.9%
	Sep	100%	100.0%	100.0%		90%	90.9%					100%	100.0%
3rd	Oct					91%	92.4%						
	Nov					92%	93.6%						
	Dec					93%	94.7%						
	Jan					93%	95.6%						
	Feb					94%	96.3%						
	Mar					95%	97.2%						
	Apr					96%	97.8%						
	May					97%	98.3%						
	Jun					98%	98.9%						
	Jul					98%	99.2%						
	Aug					99%	99.6%						
	Sep					100%	100.0%						

NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown.

Table 4-11. Comparing Current and Proposed Benchmarks: Procurement and MILCON: 1st–3rd Years of Availability

		Procurement						MILCON			
		Obligations				Exp.		Obs.		Exp.	
Year	Month	Current	Option 1–2	Option 3–4		Current	Option 1–4	Current	Option 1–4	Current	Option 1–4
					Add after CRs						
First	Oct	7%	0.55%	1.4%		N/A	0.43%	5%	0.60%	1%	0.00%
	Nov	13%	1.6%	6.4%		N/A	1.0%	11%	1.0%	2%	0.11%
	Dec	20%	3.6%	11.4%		N/A	1.9%	16%	1.6%	4%	0.34%
	Jan	27%	5.8%	16.4%	1st MAB: 0.0%	N/A	3.7%	22%	3.3%	5%	0.31%
	Feb	33%	9.3%	21.4%	2nd MAB: 1.8%	N/A	5.0%	27%	5.9%	6%	0.50%
	Mar	40%	13.8%	29.0%	3rd MAB: 6.5%	N/A	7.2%	33%	8.9%	7%	0.76%
	Apr	47%	18.3%	34.0%	4th on: 8.7%	N/A	8.7%	38%	11.3%	8%	0.99%
	May	53%	23.3%	39.0%		N/A	10.6%	43%	15.8%	9%	1.1%
	Jun	60%	28.8%	44.0%		N/A	13.0%	49%	22.9%	11%	1.6%
	Jul	67%	34.2%	49.0%		N/A	15.5%	54%	27.6%	12%	2.1%
	Aug	73%	39.6%	54.0%		N/A	18.4%	60%	33.9%	13%	2.7%
	Sep	80%	45.7%	63.6%		N/A	21.8%	65%	47.4%	14%	3.9%
Second	Oct	81%	59.1%	74.1%		N/A	23.9%	67%	49.1%	18%	4.6%
	Nov	82%	63.2%	76.5%		N/A	26.6%	69%	50.8%	22%	5.5%
	Dec	83%	68.3%	79.1%		N/A	30.2%	71%	53.1%	26%	6.7%
	Jan	83%	72.1%	80.7%		N/A	32.9%	73%	55.1%	30%	7.9%
	Feb	84%	75.3%	82.3%		N/A	35.4%	75%	56.3%	34%	9.3%
	Mar	85%	78.9%	84.1%		N/A	38.8%	78%	57.9%	39%	10.6%
	Apr	86%	81.6%	85.4%		N/A	41.4%	80%	59.7%	43%	12.4%
	May	87%	84.0%	86.7%		N/A	43.5%	82%	61.1%	47%	14.4%
	Jun	88%	86.2%	87.9%		N/A	46.6%	84%	62.8%	51%	16.8%
	Jul	88%	88.0%	89.0%		N/A	48.8%	86%	64.3%	55%	19.3%
	Aug	89%	89.8%	90.0%		N/A	51.2%	88%	67.1%	59%	21.7%
	Sep	90%	91.7%	92.3%		N/A	54.1%	90%	70.8%	63%	24.6%
Third	Oct	91%	93.1%	93.2%		N/A	56.3%	90%	71.4%	66%	27.2%
	Nov	92%	94.2%	94.5%		N/A	59.0%	91%	72.7%	68%	29.2%
	Dec	93%	95.2%	96.1%		N/A	61.6%	91%	73.7%	71%	31.5%
	Jan	93%	96.0%	96.7%		N/A	63.3%	92%	74.7%	73%	33.7%
	Feb	94%	96.6%	97.2%		N/A	65.0%	92%	75.7%	76%	35.8%
	Mar	95%	97.4%	97.9%		N/A	68.2%	93%	76.5%	78%	37.5%
	Apr	96%	98.0%	98.3%		N/A	70.3%	93%	77.2%	81%	40.1%
	May	97%	98.4%	98.5%		N/A	72.1%	93%	77.9%	83%	42.2%
	Jun	98%	99.0%	98.7%		N/A	74.1%	94%	78.8%	86%	44.4%
	Jul	98%	99.3%	98.7%		N/A	75.8%	94%	79.8%	88%	46.6%
	Aug	99%	99.6%	98.7%		N/A	77.6%	95%	80.5%	91%	48.9%
	Sep	100%	100.0%	100.0%		N/A	79.6%	95%	82.9%	94%	51.3%

NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown.

Table 4-12. Comparing Current and Proposed Benchmarks: Procurement and MILCON: 4th–6th Years of Availability

Year	Month	Procurement			MILCON			
		Obligations	Expenditures		Obs.		Exp.	
			Current	Option 1–4	Current	Option 1–4	Current	Option 1–4
Fourth	Oct		N/A	80.8%	N/A	83.0%	N/A	53.4%
	Nov		N/A	82.7%	N/A	83.6%	N/A	55.3%
	Dec		N/A	84.4%	N/A	84.5%	N/A	56.9%
	Jan		N/A	85.3%	N/A	85.2%	N/A	58.4%
	Feb		N/A	86.3%	N/A	85.7%	N/A	59.7%
	Mar		N/A	88.1%	N/A	86.4%	N/A	61.7%
	Apr		N/A	89.3%	N/A	87.1%	N/A	63.2%
	May		N/A	90.2%	N/A	87.6%	N/A	64.6%
	Jun		N/A	91.3%	N/A	88.2%	N/A	66.2%
	Jul		N/A	92.1%	N/A	88.5%	N/A	67.6%
	Aug		N/A	92.9%	N/A	88.9%	N/A	68.9%
	Sep		N/A	93.8%	N/A	89.9%	N/A	70.2%
Fifth	Oct		N/A	94.2%	N/A	89.9%	N/A	71.4%
	Nov		N/A	95.2%	N/A	90.6%	N/A	72.4%
	Dec		N/A	96.0%	N/A	90.8%	N/A	73.6%
	Jan		N/A	96.3%	N/A	91.0%	N/A	74.6%
	Feb		N/A	96.7%	N/A	91.2%	N/A	75.5%
	Mar		N/A	97.6%	N/A	91.8%	N/A	76.5%
	Apr		N/A	98.0%	N/A	92.2%	N/A	77.7%
	May		N/A	98.5%	N/A	93.0%	N/A	78.4%
	Jun		N/A	99.0%	N/A	93.6%	N/A	79.3%
	Jul		N/A	99.3%	N/A	95.2%	N/A	80.2%
	Aug		N/A	99.6%	N/A	96.4%	N/A	81.1%
	Sep		N/A	100.0%	N/A	100.0%	N/A	82.1%
Sixth	Oct						N/A	82.3%
	Nov						N/A	83.1%
	Dec						N/A	83.7%
	Jan						N/A	84.3%
	Feb						N/A	84.8%
	Mar						N/A	85.7%
	Apr						N/A	86.4%
	May						N/A	87.1%
	Jun						N/A	87.8%
	Jul						N/A	88.4%
	Aug						N/A	89.2%
	Sep						N/A	90.0%

NOTES: Any cumulative CR and MAB effects for the 2nd and subsequent years are already added to the cumulative monthly benchmark values shown.

RISKS AND MITIGATIONS

Below are some potential side effects and mitigation ideas associated with these recommendations.

Possible reductions in OMB apportionments with lower benchmarks. As one of the Commission directors mentioned, OMB may decide to lower apportionments to the DoD if the benchmarks are lowered. This could reduce the ability of the DoD to obligate or expend faster (above the benchmarks) as needs arise.

Potential Mitigation. These recommended benchmarks are largely based on obligation and expenditure rates since FY 2011, but the data also provide the distributions of the rates since then. Appendix D provides these distributions, which could inform the actual apportionments. For example, if these last 10 years or so are an indication of usual consumption rates, then the apportionments could be set at the maximum of these distributions or slightly lower (say, the 95th percentile). Lower apportionments increase the risk that the DoD will be overly constrained and need to request reapportionments from OMB.

Possible increases in unobligated or unexpended funds at the end of the authorized period. Lower benchmarks early on could increase the dollar amount for appropriations that expire. This is probably more of a concern for obligations given that actual expenditures already take much longer than the benchmarks and execution rates tend to rely on contractor execution, which is harder to control. For example, the recommended benchmarks with S-curves delays a small percentage of RDT&E obligations into the second year of authority. This might lead to more RDT&E not being obligated by the end of the second year.

Potential Mitigations. One approach is to take small steps in extending the obligations that extend into subsequent years. For example, the recommended RDT&E curve is fairly conservative in not moving more of the benchmark into the second year. Another mitigation could be to focus more reviews in the subsequent years (e.g., in December and March of the second year for RDT&E) to ensure that the programs are on track. Finally, if the DoD were to move towards plan-based benchmarks as recommended, then the system would be less reliant on fine tuning these theoretical and historical benchmarks and more reliant on actual plans against which programs can be more substantively examined.

SUGGESTED FUTURE RESEARCH

These analyses have highlighted areas for future research that could lead to a deeper understanding of the effects from the recommendations made in this report.

Piloting modified benchmarks. The conclusions and recommendations above are a first step. Additional applied research would be needed to further develop and test these ideas within the DoD, including determining which S-curve functions and associated constants best fit the S-curves for RDT&E and PROC as well as the modified S-curve for O&M.

Identifying expenditure benchmark profiles for Procurement. The published Comptroller benchmarks (Tomasini, 2017) do not include expenditure benchmarks for Procurement—just RDT&E, PROC, O&M, and MILCON. Future applied research could assess what the Comptroller may be doing to monitor Procurement expenditures and analyze actual data against those benchmarks. If no benchmarks are available, then they could be developed based on the actual data and theory discussed in this paper.

Assess obligation and expenditure rates at the account level within each category. For expedience, this research aggregated all the accounts within each funding category (RDT&E, PROC, O&M, MILPERS, and MILCON). There may be additional insights from statistical analysis at the account level. For example, there may be significant differences among the military departments or insights into the variation by account type (e.g., aircraft versus missiles).

Assess sources of obligation and expenditure data errors. As noted, there are some obvious errors in the reported data. Further research could identify these sources and help the Comptroller improve data reported to Advana. For example, some errors may just be that programs that have completed obligations or expenditures stopped reporting for a FY's appropriations, resulting in drops in the totals reported at the account level. Correcting such data issues will become increasingly important as these data are made more available for this type of longitudinal trend analysis. Also, further data cleaning of the MILCON data after the third year is warranted; this may enlighten exactly how long into the future MILCON obligation and expenditures extend—and by what fractions of the total.

FINAL THOUGHTS

In addition to aligning expenditure benchmarks to actual data and theoretical objectives, such changes could help eliminate the negative side effects cited in theory and the literature that program managers may seek expenditures prematurely just to meet comptroller benchmarks at the expense of other program and department objectives of prudent use of the resources (Marsalis, 2022; Commission on PPBE Reform, 2023, p. 33). Slight delays in switching to S-curves with their lower initial expenditure benchmarks should give program managers more time to get good deals for the program, the DoD, and taxpayers[23] rather than having to rush negotiations and contracting to meet somewhat arbitrary benchmarks or risk losing their funding.

There would be some cultural and process adjustments for both Congress and the DoD to adjusting the obligation and expenditure benchmark profiles over time, but the benefits could be improved performance given the financial resources provided by Congress and the taxpayers to the DoD.

[23] e.g., negotiating better prices, intellectual property rights, and deliverables plus allow time to fully assess contractors' execution, subcontracting and supply-chain plans and risks.

Tell me how you measure me, and I will tell you how I will behave.
If you measure me in an illogical way...do not complain about illogical behavior.
Eliyahu Moshe Goldratt

APPENDIX A. ANALYSIS OF OVERLAPPING MONTHLY OBLIGATION RATES

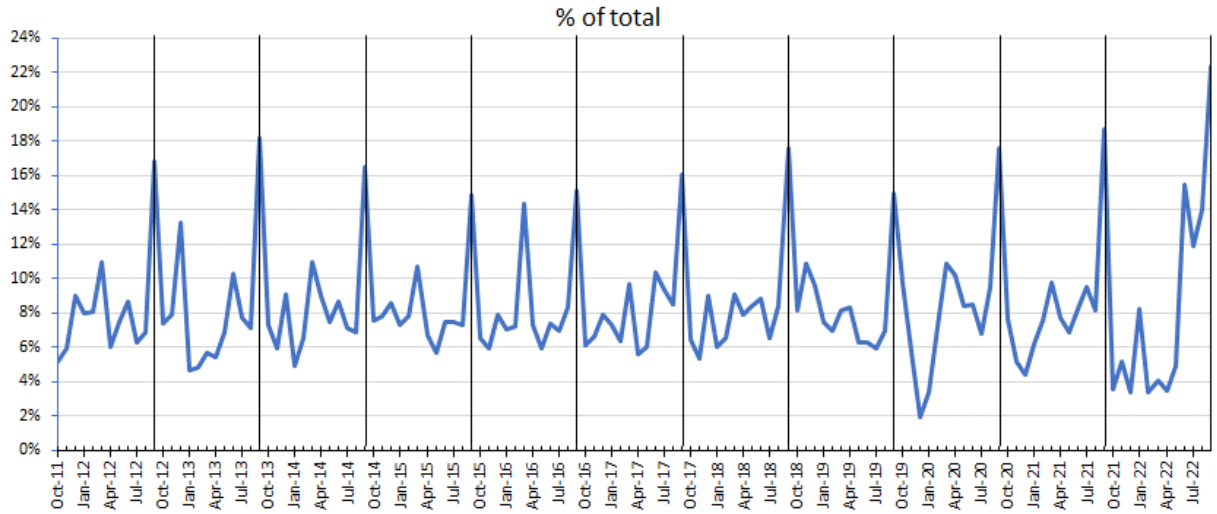
In comparison with the more detailed analyses in the main body of this report, we also collected readily available data on monthly total DoD contract obligation rates across all categories of funding to test for such CR effects and to identify any other statistically significant correlations at this combined level. The first dataset was digitized from Congressional Research Service (CRS) extracts of the Federal Procurement Data System (FPDS) data for FYs 2012–2016. The second dataset was a download from USAspending.gov, grouped by month and converted to percentage of total FY spending by month. The obligated dollars are plotted in Figure A-1 by month of obligation in the resulting dataset.

Note that these data include all DoD contracts—not just those related to acquisition. Thus, there could be significant effects in budget categories that are dominated by acquisition (such as research, development, test, and evaluation (RDT&E) or procurement) that are masked by this combination. Also, these data only reflect the month of the obligated dollars regardless of when those dollars were appropriated (e.g., they include prior-year appropriations of multi-year dollars). Also, these data probably include some contracting by the DoD on behalf of other government agencies. These are tested in subsequent sections.

If the DoD was uniformly obligating across each month of the year, then we would see a straight line in Figure A-1 at 8.3 percent (= 100 percent / 12). While the monthly rates hover around 8 percent, there is apparent variation, so there is at least some noise and possibly correlative events. The most significant apparent change is the jump in obligations in September (the last month of the FY). These observations are tested statistically below.

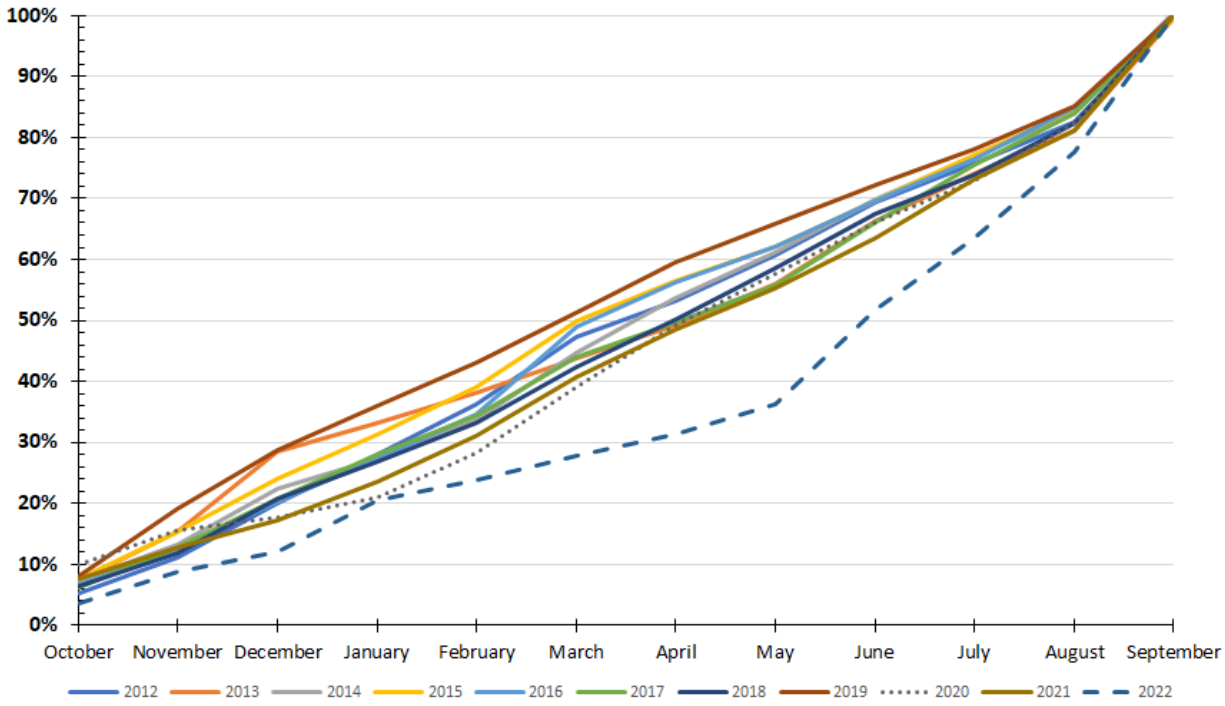
To help identify potential correlative drivers, we replotted these data as cumulative percentages (see Figure A-2). Here we can see that the rates are fairly linear but with some variations, especially in FY 2022.

Figure A-1. Monthly DoD Obligation Rates as a Percentage of FY Total: Overlapping Appropriations (FY 2012–2022)



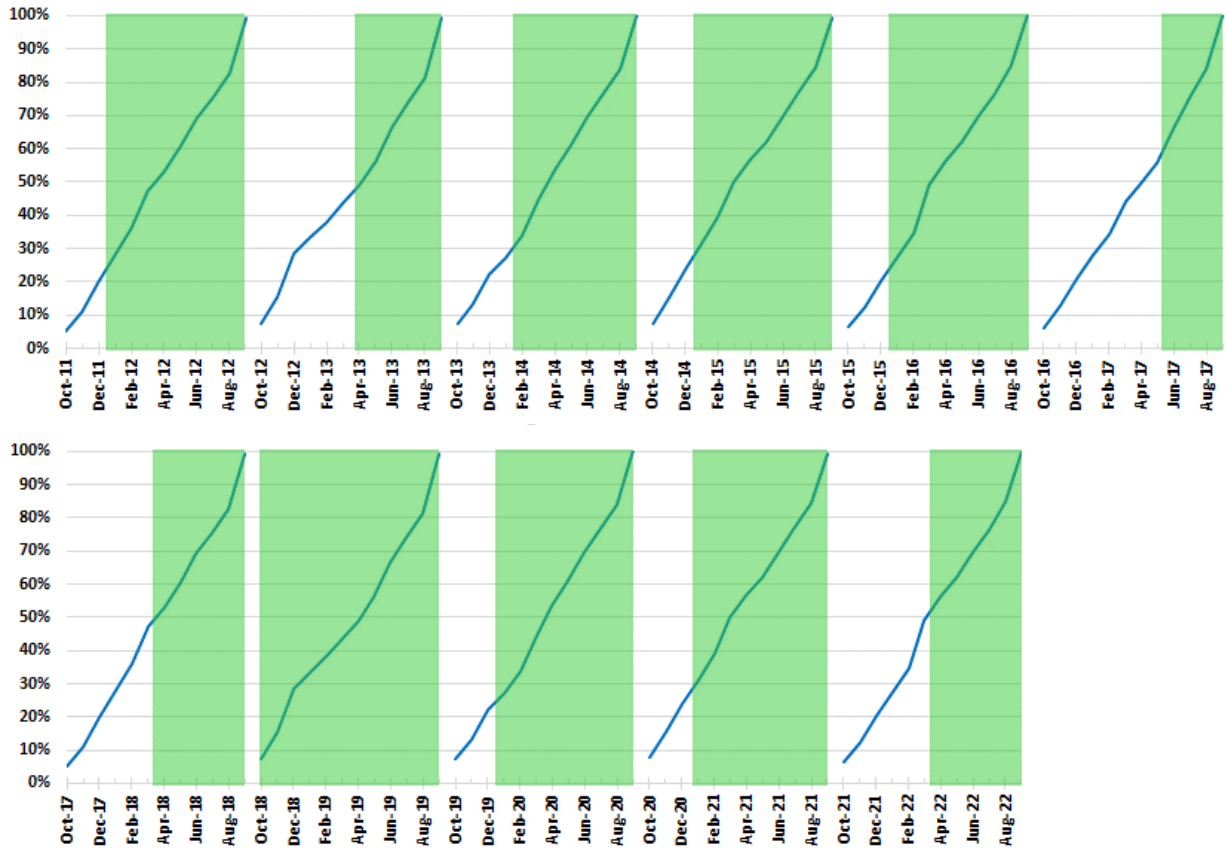
SOURCE: CRS (2017) extracts from FPDS.gov; USASpending.gov.

Figure A-2. Cumulative Monthly DoD Obligations as a Percentage of FY Total: Overlapping Appropriations (FY 2012–2022)



SOURCE: CRS (2017) extracts from FPDS.gov; USASpending.gov.

Figure A-3. Cumulative Monthly DoD Obligations with Shaded Final Appropriations Periods: Overlapping Appropriations (FY 2012–2022)



STATISTICAL ANALYSIS

To test whether the monthly obligation rates shown in Figure A-2 are truly linear and whether there are statistically significant events (such as CRs) that affect these rates, we first visually examined the individual FY cumulative rates with an overlay of the periods when the final DoD appropriations were enacted. Figure A-3 plots these data, with the periods of final appropriations shown in green shaded boxes.

Based on these observations, we postulated and tested multiple candidate independent variables: one, two, and three months after the final budget is passed as well as October, December, and September obligations. Of those, only two were statistically significant: September obligations and those made three months after the final budget was passed. Table A-1 shows the statistics and coefficients for this linear regression. This model explains 82 percent of the variation in monthly obligations across these 11 FYs. Each month, the DoD nominally obligates about 7.2 percent of its annual obligations; except three months after the budget was passed (MAB), the DoD obligates an additional 3.6 percentage points (on average). Also, in the last month of the FY, the DoD obligations indeed surged by an additional 10 percentage points.

Table A-1. Linear Regression Statistics: Monthly Combined DoD Obligation Rates: Overlapping Appropriations (FY 2012–2022)

Multiple R	82%
R Square	68%
Adjusted R Square	67%
Standard Error	0.01977076
# Observations	132

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	7.2%	0.001885068	38.16608	3.83E-72
3rd MAB	3.6%	0.006252063	5.706409	7.52E-08
Sept	10.0%	0.006252063	15.94714	2.67E-32

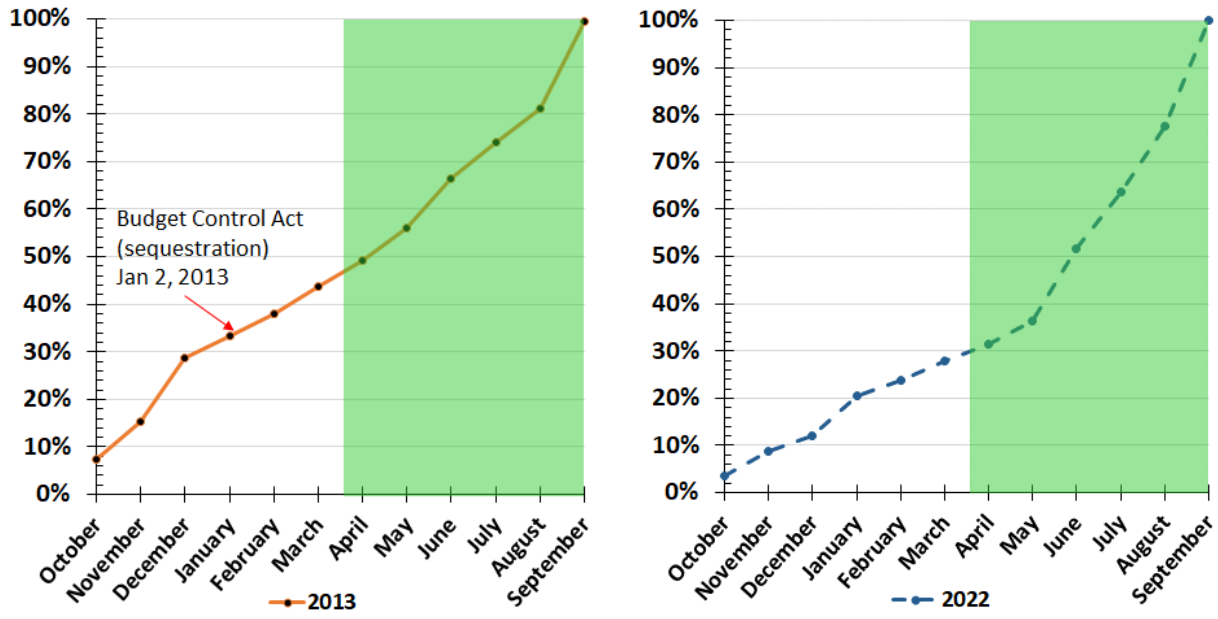
NOTE: 3rd MABP = Third month after budget passed.

Other than a 50% increase in obligations the third month after a full budget is passed, there was no statistically significant inflection point around CRs across the 11-year sample period. However, we did notice two FYs in Figure A-2 that appeared to display an inflection: FY 2013 and FY 2022 (see Figure A-4).

In the case of FY 2013, the inflection started when the Budget Control Act (sequestration) forced a reduction in Federal spending on January 2, 2013, not after the full budget was passed.

As for FY 2022, further analysis would be required to determine what may have caused that inflection, which started three months after the budget was passed. It could be, for example, that the final budget levels for the DoD were increased beyond expectations or beyond what the CRs allowed.

Figure A-4. Cumulative Monthly DoD Obligations and Final Appropriations Periods: Overlapping Appropriations (FY 2013 and FY 2022)



APPENDIX B. STATISTICAL ANALYSIS DETAILS: OBLIGATIONS BY APPROPRIATION YEAR

Below are the statistical details from the multivariate linear regressions reported in Chapters 2 and 3.

Table B-1. Linear Regression Statistics: S&T Monthly Obligation Rates: 1st Year (FY 2013, 2014, 2017–2022 Appropriations)

Multiple R	0.93
R Square	86%
Adjusted R Square	84%
Standard Error	1%
# Observations	96

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	6.43%	0.002609892	24.63795123	1.81445E-40
Oct	-3.46%	0.004836201	-7.145232457	2.87319E-10
Nov	-1.06%	0.004790122	-2.207887154	0.029945207
Mar	1.56%	0.004798295	3.251135081	0.001648581
CR	-1.04%	0.003667822	-2.837080217	0.005690994
1st MAB	-1.58%	0.005078172	-3.10847538	0.002558076
3rd MAB	4.84%	0.005200545	9.308784715	1.27993E-14
4th MAB	4.25%	0.004897702	8.687297027	2.31993E-13
5th MAB	1.48%	0.004796557	3.085794102	0.002739889
6th MAB	1.77%	0.005079651	3.484673975	0.0007816
Sept.	2.35%	0.004678379	5.023853976	2.76479E-06

NOTE: 2nd MAB was not significant.

Table B-2. Linear Regression Statistics: S&T Monthly Obligation Rates: 2nd Year (FY 2013, 2014, 2017–2022 Appropriations)

Multiple R	0.70
R Square	49%
Adjusted R Square	48%
Standard Error	0.47%
# Observations	96

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	2.3%	0.001082972	20.87501329	7.24874E-37
Sept	1.3%	0.001994347	6.578624873	2.75354E-09
Time	-0.15%	0.000159676	-9.140652615	1.34577E-14

NOTE: "Time" is the amount to add for each month in the second year (starting with October).

Table B-3. Linear Regression Statistics: Development (BAs 4, 5, and 7) Monthly Obligation Rates: 1st Year (FY 2013, 2014, 2017–2022 Appropriations)

Multiple R	0.79
R Square	62%
Adjusted R Square	60%
Standard Error	2.11%
# Observations	96

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	6.01%	0.00271097	22.17859049	3.0361E-38
Oct	-1.89%	0.007924874	-2.385105685	0.019171841
Mar	1.69%	0.008271388	2.041868696	0.044091673
2nd MAB	3.01%	0.007924874	3.794987511	0.000267343
3rd MAB	7.10%	0.008271388	8.581319316	2.55511E-13
4th MAB	4.84%	0.007924874	6.11075274	2.49213E-08

Table B-4. Linear Regression Statistics: Development (BAs 4, 5, and 7) Monthly Obligation Rates: 2nd Year (FY 2013, 2014, 2017–2022 Appropriations)

Multiple R	0.72
R Square	52%
Adjusted R Square	50%
Standard Error	0.43%
# Observations	96

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	1.59%	0.001463045	10.84802958	4.38636E-18
Time	-0.10%	0.000196092	-5.042090488	2.33309E-06
Oct	0.40%	0.001986895	2.026210387	0.045670957
Nov	0.52%	0.001877439	2.787127106	0.006472924
Sept	0.84%	0.001877439	4.491568688	2.07025E-05

Table B-5. Linear Regression Statistics: Management Support (RDT&E BA 6) Monthly Obligation Rates: 1st Year (FY 2013, 2014, 2017–2022 Appropriations)

Multiple R	0.67
R Square	45%
Adjusted R Square	42%
Standard Error	1.65%
# Observations	96

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	6.27%	0.002609703	24.03134212	3.51866E-41
CR	-1.42%	0.003914554	-3.633716265	0.000462079
2nd MAB	2.13%	0.00639244	3.333986696	0.001239607
3rd MAB	2.11%	0.00639244	3.295464778	0.001401579
Sept	2.87%	0.00639244	4.481907614	2.14847E-05

Table B-6. Linear Regression Statistics Management Support (RDTYE BA 6) Monthly Obligation Rates: 2nd Year (FY 2013, 2014, 2017–2022 Appropriations)

Multiple R	0.59
R Square	35%
Adjusted R Square	33%
Standard Error	0.54%
# Observations	96

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	2.48%	0.001510491	16.41405606	6.08644E-29
Time	-0.10%	0.000209244	-4.775168331	6.83657E-06
Oct	-0.63%	0.00231328	-2.707672857	0.008093195
Nov	0.68%	0.002003359	3.406757257	0.000980463
Sept	1.31%	0.002301684	5.712252386	1.39018E-07

Table B-7. Linear Regression Statistics: RDT&E (Total) Monthly Obligation Rates: 1st Year (FY 2011–2022 Appropriations)

Multiple R	0.80
R Square	64%
Adjusted R Square	63%
Standard Error	2.0%
# Observations	144

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	5.9%	0.002077062	28.59019804	7.64646E-60
Oct	-2.3%	0.006114704	-3.799590601	0.000216596
Mar	2.3%	0.006783655	3.420778599	0.000821671
2nd MAB	4.3%	0.006114704	7.044074917	8.07876E-11
3rd MAB	6.3%	0.006783655	9.351460295	2.10527E-16
4th MAB	3.7%	0.006114704	6.110823535	9.54454E-09

Table B-8. Linear Regression Statistics: RDT&E (Total) Monthly Obligation Rates: 2nd Year (FY 2011–2022 Appropriations)

Multiple R	0.58
R Square	33%
Adjusted R Square	32%
Standard Error	0.7%
# Observations	144

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	1.7%	0.001401242	11.81253124	9.00101E-23
Time	-0.1%	0.00019777	-4.804901756	3.93829E-06
Nov	0.9%	0.002175474	4.184635096	5.01796E-05
Sept	1.0%	0.002280799	4.358192911	2.52129E-05

Table B-9. Linear Regression Statistics: PROC Monthly Obligation Rates: 1st Year (FY 2011–2021 Appropriations)

Multiple R	0.77
R Square	59%
Adjusted R Square	57%
Standard Error	2.1%
# Observations	132

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	5.0%	0.002406646	20.74763506	2.6476E-42
Oct	-3.6%	0.006680721	-5.333196363	4.36379E-07
Mar	2.6%	0.007597039	3.420037942	0.000846218
Sept	4.6%	0.006680721	6.935011905	1.93384E-10
2nd MAB	1.8%	0.006680721	2.755181906	0.00674299
3rd MAB	4.6%	0.007597039	6.083033103	1.3305E-08
4th MAB	2.2%	0.006680721	3.307781808	0.001228347

Table B-10. Linear Regression Statistics: PROC Monthly Obligation Rates: 2nd and 3rd Years (FY 2011–2021 Appropriations)

Multiple R	0.66
R Square	44%
Adjusted R Square	43%
Standard Error	0.8%
# Observations	264

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	2.0%	0.001178987	16.60788468	1.26578E-42
Time	-0.1%	7.78036E-05	-11.03268599	1.93829E-23
Nov	0.6%	0.001903407	2.914838236	0.003871247
Dec	0.9%	0.001889442	4.982990775	1.14868E-06
Mar	0.4%	0.001866475	1.974856462	0.049350546
Sept	1.4%	0.001907378	7.26041672	4.54529E-12

Table B-11. Linear Regression Statistics: O&M Monthly Obligation Rates (FY 2011–2023 Appropriations)

Multiple R	0.84
R Square	70%
Adjusted R Square	68%
Standard Error	1.2%
# Observations	144

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	7.5%	0.0017	43.91364	2.02E-81
Oct	-1.1%	0.003699	-2.86335	0.004867
Nov	-0.8%	0.003699	-2.26008	0.02543
July	2.4%	0.003654	6.65643	6.58E-10
Aug	-1.8%	0.003707	-4.88376	2.92E-06
Sept	4.1%	0.003746	10.81398	5.55E-20
1st MAB	1.2%	0.003699187	3.146596588	0.002035779
2nd MAB	2.4%	0.003699187	6.60938623	8.3661E-10
3rd MAB	2.4%	0.003707498	6.551154023	1.12471E-09
4th MAB	1.6%	0.003654138	4.451077204	1.78169E-05

Table B-12. Linear Regression Statistics: MILPERS Monthly Obligation Rates (FY 2011–2023 Appropriations)

Multiple R	0.48
R Square	23%
Adjusted R Square	22%
Standard Error	0.5%
# Observations	144

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	7.9%	0.000898204	88.35086867	2.435E-125
Time	0.1%	0.000132433	4.245116944	3.94108E-05
Sept	0.4%	0.001654087	2.336040331	0.020898486

Table B-13. Linear Regression Statistics: MILPERS Monthly Expenditure Rates (FY 2011–2023 Appropriations)

Multiple R	0.53
R Square	28%
Adjusted R Square	27%
Standard Error	2.3%
# Observations	156

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	8.9%	0.002195273	40.66604974	3.04878E-83
Oct	-3.8%	0.006637882	-5.797106377	3.80913E-08
Dec	1.3%	0.006605391	2.019785184	0.04517432
Jan	-3.0%	0.006637882	-4.47339996	1.50559E-05
3rd MAB	-1.6%	0.006605391	-2.48950249	0.013876396

APPENDIX C. DATA ON OBLIGATION AND EXPENDITURE RATES

Below are the monthly DoD obligation and expenditure (disbursement) rates calculated from the dollars obtained from Advana. Rates are shown as a percentage of a final reference total, as discussed in Chapter 1. The range of FYs available is limited by whether FY 2023 is the end of the data range for each category of funding. The Advana data also included a range of other categories such as MILCON and smaller accounts that were not analyzed in this paper.

OBLIGATED DOLLARS AND DATA CLEANING NOTES: RDT&E, PROC, O&M, MILPERS, AND MILCON

Table C-1 and Table C-2 list the cumulative obligated dollars by the last month used for calculating monthly obligation percentages. A very small portion of the data underwent minimal cleaning to remove obligation and expenditure reports that appear incomplete or erroneous. Notes are included below the table on the issues identified and associated cleaning actions taken. In a few other cases, the data looked odd but were left in to be conservative. For example, the FY 2014 RDT&E obligation data shows a large −3.3% monthly rate followed by a high 6.3% increase the following month. This could be either a reporting error and correction, or a large de-obligation and subsequent re-obligation. This instance is highlighted in yellow in Table C-6.

Table C-1. S&T, DEV, and Mgt. Obligated Dollars by Appropriation FY at Month 24 (FY 2013, 2014, 2017–2022 Appropriations)

Appropriation FY	S&T Month 24	DEV Month 24	Mgt. Month 24
2011	n/a	n/a	n/a
2012	n/a	n/a	n/a
2013	$10,896,747,000*	$32,413,650,000*	$5,077,215,000*
2014	$11,669,353,000	$30,795,669,000	$5,184,151,000
2015	n/a	n/a	n/a
2016	n/a	n/a	n/a
2017	$13,441,935,000	$35,299,605,000	$5,771,508,000
2018	$14,391,420,000	$43,468,711,000	$8,269,346,000
2019	$15,200,106,000	$45,064,652,000	$8,972,198,000
2020	$15,660,527,000	$53,098,076,000	$9,610,724,000
2021	$16,291,051,000	$53,207,621,000	$9,382,664,000
2022	$18,367,903,000	$57,523,312,000	$10,888,004,000

*Assumed that significant drops in values in months 23 and 24 were from some programs that stopped reporting, so the values were adjusted to make the curves monotonic.

Table C-2. Obligated Dollars by Appropriation FY at End of Period (FY 2011–2023 Appropriations)

Appropriation FY	RDT&E Total Month 24	PROC Month 36	O&M Month 12	MILPERS Month 12	MILCON Month 60
2011	$ 57,817,449 *	$ 77,769,370 †	$ 256,291,783	$ 142,495,631	$ 12,334,354 ‡
2012	$ 71,339,247	$ 101,846,675	$ 241,829,478	$ 141,774,043	$ 10,450,894 ‡
2013	$ 46,585,082 **	$ 96,538,475	$ 223,041,163	$ 137,940,704	$ 6,979,791 ‡
2014	$ 62,923,378	$ 94,571,020	$ 215,880,465	$ 136,169,352	$ 7,433,277 ‡
2015	$ 62,683,232	$ 98,468,247	$ 206,203,903	$ 132,005,015	$ 4,945,046 ‡
2016	$ 69,583,135	$ 110,999,804	$ 208,675,653	$ 131,675,377	$ 5,672,070 ‡
2017	$ 73,802,617	$ 117,406,140	$ 216,893,111	$ 132,067,004	$ 6,211,688 ‡
2018	$ 90,446,670	$ 136,450,133	$ 231,718,277	$ 136,004,434	$ 8,389,595
2019	$ 94,330,241	$ 110,575,886††	$ 240,540,637	$ 141,428,910	$ 10,209,320
2020	$ 103,815,830	$ 130,793,501	$ 254,440,896	$ 146,333,394	
2021	$ 106,187,019	$ 135,182,971	$ 244,324,683	$ 154,779,144	
2022	$ 118,590,045		$ 261,726,289	$ 157,441,648	
2023			$ 291,052,848	$ 164,773,759	

* Removed *Navy RDT&E* obligations from the FY 2011 data. They dropped at month 17 and never came back near appropriated levels shown in the DoD Comptroller's FY 2013 R1 document.
** Removed *Defense-wide RDT&E* from the FY 2013 data. The cumulative obligations looked well behaved up to month 22, then dropped significantly and never came back near the appropriated amount of $17,390,232 reported in the Comptroller's R1 budget documents.
† Removed all Navy PROC accounts from the FY 2011 data. Starting after month 17, the obligation numbers for all the Navy PROC accounts drop dramatically and increase back to earlier levels, departing significantly from the FY 2011 actual appropriations of $47,010,540 total across the Navy reported in the FY 2013 P1 budget document.
†† Removed *Air Force Other Procurement* from the FY 2019 data. The reported values suddenly dropped at month 23 and stayed low.
‡ Added drops in *Defense-Wide MILCON* back to the running cumulative totals. It appears that subaccount(s) stopped reporting and were therefore no longer appearing in the totals. We calculated the drops right after months 46, 35, 77, 23, 65, 53, 41, 30, and 18 for FYs 2011, 2012, 2012, 2013, 2013, 2014, 2015, 2016, and 2017, respectively, and added that back into the subsequent cumulative totals.

MONTHLY OBLIGATION RATES: RDT&E, PROC, O&M, AND MILPERS

Table C-3. Monthly S&T (RDT&E BAs 1–3) Obligation Rates (FY 2013, 2014, 2017–2022 Appropriations)

Month	2013	2014	2017	2018	2019	2020	2021	2022	*Avg*
1	2.512%	2.742%	1.940%	2.107%	1.677%	1.337%	1.480%	1.140%	1.867%
2	6.652%	2.931%	5.636%	4.815%	5.038%	3.593%	3.733%	3.299%	4.462%
3	7.820%	5.517%	4.854%	4.116%	10.424%	4.416%	4.659%	4.192%	5.750%
4	6.731%	4.831%	6.612%	4.230%	10.269%	3.394%	3.419%	4.924%	5.551%
5	5.832%	5.839%	7.931%	4.454%	8.900%	7.737%	9.307%	5.415%	6.927%
6	5.058%	13.883%	8.075%	6.616%	9.066%	13.978%	13.122%	5.178%	9.372%
7	8.713%	13.220%	5.243%	6.127%	7.141%	10.605%	10.212%	6.306%	8.446%
8	4.094%	9.434%	4.649%	13.343%	5.881%	7.674%	8.464%	9.366%	7.863%
9	10.740%	8.068%	7.546%	11.118%	5.481%	7.752%	7.962%	10.524%	8.649%
10	9.600%	7.185%	9.995%	7.148%	6.158%	7.294%	6.607%	7.218%	7.651%
11	7.060%	5.513%	9.932%	7.922%	5.570%	6.243%	6.286%	9.231%	7.220%
12	11.312%	8.877%	9.736%	8.917%	7.893%	9.299%	7.889%	9.573%	9.187%
13	2.744%	2.419%	1.360%	2.030%	2.342%	1.598%	1.262%	1.704%	1.932%
14	1.057%	0.682%	2.302%	2.333%	2.147%	2.316%	2.082%	2.735%	1.957%
15	1.887%	1.675%	2.662%	1.902%	1.432%	2.241%	2.251%	2.606%	2.082%
16	1.699%	1.343%	1.999%	1.769%	1.743%	1.729%	1.442%	2.082%	1.726%
17	1.253%	1.254%	1.413%	1.568%	1.317%	1.369%	1.669%	2.436%	1.535%
18	1.606%	0.879%	1.695%	2.393%	1.136%	1.132%	1.331%	1.934%	1.513%
19	0.805%	0.757%	1.133%	1.144%	1.635%	1.255%	0.724%	1.322%	1.097%
20	0.606%	0.607%	1.258%	1.391%	0.907%	0.855%	1.046%	1.266%	0.992%
21	0.339%	0.832%	0.883%	0.932%	0.940%	0.885%	0.826%	1.307%	0.868%
22	0.707%	-0.005%	0.551%	0.743%	0.795%	0.466%	0.996%	1.206%	0.683%
23	0.000%	0.401%	1.256%	1.061%	0.542%	1.030%	1.178%	1.333%	0.850%
24	1.173%	1.116%	1.340%	1.821%	1.564%	1.802%	2.053%	3.700%	1.821%

NOTE: Monthly rates are a percentage of the total dollar value by month 24.

Table C-4. Monthly RDT&E Development Obligation Rates (FY 2013, 2014, 2017–2022 Appropriations)

Month	2013	2014	2017	2018	2019	2020	2021	2022	*Avg*
1	3.021%	4.916%	4.125%	4.752%	3.579%	4.051%	3.104%	5.431%	4.122%
2	12.016%	8.071%	5.568%	4.378%	11.534%	5.178%	7.587%	4.515%	7.356%
3	13.050%	6.300%	4.447%	3.026%	13.730%	5.530%	5.251%	5.287%	7.078%
4	5.699%	4.253%	11.540%	5.143%	10.076%	6.439%	5.879%	6.824%	6.982%
5	3.422%	4.805%	6.869%	7.474%	9.585%	10.638%	12.436%	5.839%	7.633%
6	3.372%	17.101%	6.983%	5.693%	7.105%	16.691%	18.170%	7.790%	10.363%
7	5.602%	16.370%	3.337%	7.829%	8.221%	11.788%	10.878%	6.418%	8.805%
8	9.626%	7.390%	4.816%	11.407%	5.403%	5.130%	6.243%	11.678%	7.712%
9	11.199%	6.253%	8.875%	9.117%	4.959%	6.615%	5.509%	11.762%	8.036%
10	6.336%	4.247%	9.974%	8.432%	4.975%	5.412%	5.423%	7.716%	6.564%
11	7.042%	4.394%	10.515%	8.226%	4.874%	4.241%	3.416%	5.110%	5.977%
12	6.177%	4.903%	7.159%	6.553%	5.570%	6.502%	5.509%	7.777%	6.269%
13	1.983%	1.679%	2.010%	3.485%	1.437%	1.297%	0.896%	2.339%	1.891%
14	1.591%	1.146%	2.195%	2.353%	1.594%	2.513%	2.043%	1.866%	1.913%
15	1.471%	1.237%	1.808%	1.938%	1.088%	1.685%	1.128%	1.393%	1.469%
16	0.754%	0.779%	1.768%	1.204%	0.791%	0.981%	0.934%	1.317%	1.066%
17	1.270%	0.961%	1.877%	2.571%	0.719%	0.715%	0.465%	0.912%	1.186%
18	0.815%	0.990%	0.932%	1.355%	0.941%	0.877%	0.718%	0.921%	0.944%
19	0.983%	0.414%	0.717%	0.870%	0.564%	0.648%	0.651%	0.864%	0.714%
20	0.707%	0.507%	0.795%	0.302%	0.541%	0.619%	1.023%	0.599%	0.636%
21	1.108%	1.101%	0.839%	0.754%	0.482%	0.671%	0.329%	1.091%	0.797%
22	0.849%	0.533%	0.605%	0.743%	0.784%	1.375%	0.473%	0.633%	0.749%
23	0.000%	0.526%	0.787%	0.808%	0.326%	0.419%	0.447%	0.643%	0.495%
24	1.908%	1.124%	1.460%	1.587%	1.123%	-0.015%	1.489%	1.275%	1.244%

NOTE: Monthly rates are a percentage of the total dollar value by month 24.

Table C-5. Monthly RDT&E Management Support (BA 6) Obligation Rates (FY 2013, 2014, 2017–2022 Appropriations)

Month	2013	2014	2017	2018	2019	2020	2021	2022	*Avg*
1	8.341%	2.154%	4.523%	3.205%	3.577%	4.145%	4.027%	3.017%	4.124%
2	7.666%	6.742%	4.731%	3.249%	12.278%	3.721%	4.660%	4.488%	5.942%
3	5.831%	5.675%	5.258%	2.753%	7.509%	4.238%	4.295%	5.442%	5.125%
4	5.062%	3.280%	8.700%	5.096%	6.206%	7.065%	6.290%	4.624%	5.790%
5	4.556%	5.274%	5.362%	5.355%	5.075%	7.211%	9.962%	5.088%	5.985%
6	4.486%	12.976%	5.095%	4.652%	7.964%	11.056%	7.600%	5.878%	7.463%
7	7.063%	8.376%	3.585%	11.861%	5.017%	7.540%	5.080%	6.669%	6.899%
8	4.621%	6.543%	5.483%	10.159%	5.510%	5.502%	6.462%	7.111%	6.424%
9	5.075%	7.108%	9.345%	7.207%	5.314%	7.467%	6.396%	6.944%	6.857%
10	6.004%	6.153%	5.538%	5.581%	5.110%	6.322%	6.858%	7.345%	6.114%
11	8.339%	5.137%	8.257%	7.422%	5.989%	6.787%	6.027%	6.529%	6.811%
12	10.493%	10.894%	9.917%	9.506%	7.160%	7.883%	7.525%	9.714%	9.136%
13	2.806%	2.157%	1.123%	2.010%	2.388%	0.871%	1.488%	1.181%	1.753%
14	1.724%	0.938%	2.497%	1.985%	2.988%	2.070%	1.781%	2.530%	2.064%
15	2.469%	2.167%	2.306%	2.248%	2.452%	2.252%	2.668%	2.294%	2.357%
16	2.239%	1.685%	2.350%	2.088%	2.088%	2.026%	1.850%	1.759%	2.011%
17	1.995%	1.310%	2.709%	1.868%	2.162%	1.633%	1.818%	3.048%	2.068%
18	2.167%	1.516%	2.858%	2.962%	1.936%	3.175%	3.393%	2.493%	2.562%
19	1.917%	1.348%	2.097%	1.657%	1.745%	1.898%	1.949%	2.729%	1.917%
20	1.403%	1.348%	1.539%	1.607%	1.290%	1.273%	3.030%	1.485%	1.622%
21	1.708%	0.591%	1.760%	1.639%	1.813%	1.275%	1.206%	2.535%	1.566%
22	1.120%	2.039%	1.480%	1.564%	1.267%	1.166%	2.529%	1.705%	1.609%
23	0.000%	1.514%	0.385%	1.780%	1.143%	1.127%	1.344%	2.352%	1.206%
24	2.914%	3.077%	3.101%	2.545%	2.020%	2.299%	1.762%	3.042%	2.595%

NOTE: Monthly rates are a percentage of the total dollar value by month 24.

Table C-6. Monthly Combined RDT&E Obligation Rates (FY 2011–2022 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	*Avg*
1	1.831%	2.711%	3.292%	4.425%	5.493%	3.541%	3.687%	3.979%	3.258%	3.658%	2.938%	4.567%	*3.62%*
2	4.032%	4.456%	11.196%	6.540%	3.207%	5.198%	5.613%	4.447%	10.889%	4.814%	6.733%	4.336%	*5.96%*
3	4.845%	6.278%	12.834%	6.124%	5.782%	4.614%	4.682%	3.249%	12.345%	5.296%	5.061%	5.169%	*6.36%*
4	7.406%	7.626%	5.665%	4.385%	6.695%	5.545%	10.282%	5.074%	9.663%	6.136%	5.539%	6.348%	*6.70%*
5	6.440%	15.996%	3.526%	5.353%	16.156%	13.677%	6.976%	6.740%	9.077%	9.726%	11.695%	5.716%	*9.26%*
6	9.939%	15.150%	3.512%	16.742%	16.686%	15.036%	7.089%	5.978%	7.645%	15.731%	16.457%	7.205%	*11.43%*
7	5.903%	6.396%	6.853%	14.439%	7.075%	11.163%	3.840%	8.107%	7.643%	11.231%	10.290%	6.470%	*8.28%*
8	8.959%	6.503%	7.121%	1.915%	4.787%	5.358%	4.960%	11.805%	5.493%	5.555%	6.628%	10.892%	*6.66%*
9	10.604%	5.761%	10.398%	12.350%	5.435%	6.337%	8.800%	9.433%	5.168%	6.865%	5.991%	11.185%	*8.19%*
10	8.803%	4.131%	6.343%	4.928%	4.928%	4.785%	9.463%	7.865%	5.160%	5.786%	5.739%	7.516%	*6.29%*
11	6.661%	4.928%	7.321%	4.584%	4.609%	5.604%	10.079%	7.895%	5.093%	4.769%	4.088%	5.973%	*5.97%*
12	6.905%	7.323%	7.598%	6.200%	6.020%	6.498%	8.033%	7.174%	6.162%	7.055%	6.047%	8.229%	*6.94%*
13	2.713%	1.469%	1.911%	-3.253%	1.732%	0.267%	1.767%	3.012%	1.631%	1.303%	1.005%	2.140%	*1.31%*
14	2.369%	2.100%	1.931%	6.293%	1.535%	1.459%	2.208%	2.280%	1.797%	2.445%	2.026%	2.062%	*2.38%*
15	1.853%	2.302%	1.580%	1.427%	1.773%	1.398%	1.964%	1.926%	1.269%	1.821%	1.445%	1.663%	*1.70%*
16	1.155%	1.122%	1.005%	0.934%	1.012%	1.137%	1.820%	1.339%	1.141%	1.191%	1.083%	1.428%	*1.20%*
17	1.652%	0.949%	1.255%	0.886%	0.894%	2.237%	1.807%	2.278%	0.888%	0.899%	0.767%	1.362%	*1.32%*
18	1.881%	1.125%	0.980%	1.069%	1.326%	1.280%	1.234%	1.635%	1.033%	1.128%	1.048%	1.260%	*1.25%*
19	0.628%	0.473%	0.920%	0.569%	0.988%	0.753%	0.900%	0.960%	0.851%	0.852%	0.773%	1.107%	*0.81%*
20	0.786%	0.430%	0.516%	0.574%	0.533%	0.668%	0.921%	0.591%	0.651%	0.709%	1.199%	0.779%	*0.70%*
21	0.552%	0.417%	1.236%	1.091%	0.701%	0.878%	0.909%	0.845%	0.651%	0.757%	0.482%	1.395%	*0.83%*
22	0.827%	0.341%	0.601%	0.541%	0.424%	0.395%	0.635%	0.812%	0.812%	1.222%	0.734%	0.861%	*0.68%*
23	0.671%	0.616%	0.557%	0.578%	0.841%	0.649%	0.827%	0.919%	0.430%	0.577%	0.640%	0.735%	*0.67%*
24	2.584%	1.398%	1.848%	1.307%	1.368%	1.522%	1.505%	1.656%	1.251%	0.473%	1.591%	1.604%	*1.51%*

NOTE: Monthly rates are a percentage of the total dollar value by month 24. The highlighted values in months 13 and 14 for FY 2014 could be from errors or from a large de-obligation and subsequent re-obligation. We could not tell and left the data as-is.

Table C-7. Monthly PROC Obligation Rates (FY 2011–2020 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	*Avg*
1	0.966%	0.610%	1.889%	0.455%	2.715%	3.088%	0.596%	3.057%	0.762%	0.935%	*1.21%*
2	3.246%	4.665%	6.734%	1.764%	4.149%	3.969%	5.236%	2.263%	7.678%	5.640%	*3.81%*
3	4.377%	2.599%	9.705%	7.154%	4.604%	4.985%	3.480%	4.330%	12.650%	6.517%	*5.13%*
4	2.848%	10.736%	4.158%	7.745%	6.362%	6.193%	6.757%	2.037%	6.083%	6.534%	*5.25%*
5	5.440%	11.061%	1.627%	5.244%	7.486%	7.543%	7.132%	6.673%	5.714%	9.806%	*5.65%*
6	6.922%	9.224%	7.201%	10.115%	12.608%	15.230%	7.161%	5.027%	7.671%	17.621%	*8.56%*
7	2.379%	4.514%	2.011%	11.522%	3.639%	5.658%	3.570%	5.649%	6.167%	7.500%	*4.77%*
8	3.577%	5.454%	4.479%	3.206%	6.811%	3.707%	3.987%	5.961%	3.636%	5.277%	*3.98%*
9	8.768%	4.127%	7.665%	9.914%	5.373%	4.302%	6.941%	6.855%	4.631%	6.657%	*5.47%*
10	6.553%	6.900%	9.847%	3.852%	3.800%	5.254%	9.052%	4.388%	3.287%	5.614%	*4.79%*
11	5.373%	4.789%	5.792%	3.213%	7.074%	4.827%	7.680%	6.883%	3.693%	3.281%	*4.38%*
12	7.905%	13.299%	13.410%	10.688%	5.607%	7.886%	10.285%	13.283%	9.460%	7.147%	*8.15%*
13	2.049%	2.079%	1.846%	1.856%	3.284%	1.295%	2.677%	1.018%	3.371%	1.917%	*1.65%*
14	2.052%	1.390%	1.958%	4.546%	1.901%	1.660%	1.786%	5.716%	3.945%	1.597%	*2.31%*
15	4.161%	5.639%	2.889%	2.929%	2.920%	3.019%	2.113%	2.407%	5.294%	1.408%	*2.65%*
16	4.665%	1.280%	0.959%	1.122%	1.486%	0.865%	1.749%	0.962%	2.339%	2.087%	*1.41%*
17	2.402%	1.476%	0.928%	0.862%	1.184%	1.571%	2.237%	1.051%	0.442%	0.771%	*1.07%*
18	3.101%	1.769%	1.989%	1.121%	1.652%	3.689%	1.514%	3.001%	1.611%	1.213%	*1.75%*
19	1.722%	0.695%	1.377%	0.598%	1.876%	1.066%	1.176%	1.503%	1.308%	1.199%	*1.04%*
20	1.671%	0.599%	0.660%	-0.166%	0.774%	1.556%	1.488%	1.297%	1.775%	0.573%	*0.84%*
21	1.309%	0.289%	1.910%	1.147%	0.312%	2.191%	1.432%	1.104%	1.369%	0.783%	*1.04%*
22	1.522%	0.868%	0.161%	0.914%	0.541%	1.248%	0.401%	1.036%	0.626%	0.632%	*0.73%*
23	1.513%	0.624%	0.266%	0.692%	1.796%	0.755%	0.974%	1.121%	0.444%	1.264%	*0.99%*
24	2.833%	1.680%	1.782%	1.870%	2.769%	1.368%	4.003%	2.347%	1.196%	1.030%	*1.74%*
25	1.244%	0.620%	0.963%	0.463%	1.199%	0.281%	0.414%	1.519%	0.295%	-1.921%	*0.42%*
26	0.960%	0.558%	0.583%	0.512%	1.389%	0.523%	0.762%	1.540%	0.259%	2.739%	*0.78%*
27	3.671%	0.709%	0.839%	1.516%	1.767%	0.551%	0.506%	0.930%	0.425%	0.276%	*0.95%*
28	0.415%	0.609%	1.177%	0.520%	0.293%	0.636%	0.470%	1.203%	0.301%	0.379%	*0.65%*
29	0.560%	0.307%	0.580%	0.496%	0.328%	0.479%	0.507%	0.366%	0.074%	0.203%	*0.24%*
30	0.775%	0.398%	0.544%	0.457%	0.649%	0.698%	0.065%	0.851%	0.374%	0.417%	*0.44%*
31	0.522%	0.523%	-0.676%	0.525%	0.518%	0.544%	0.790%	1.102%	0.412%	0.259%	*0.37%*
32	0.362%	0.295%	1.497%	0.287%	0.427%	0.507%	0.371%	0.974%	0.176%	0.195%	*0.40%*
33	0.542%	0.975%	0.282%	0.360%	0.723%	0.458%	0.245%	0.510%	0.472%	0.257%	*0.38%*
34	0.452%	0.752%	0.423%	0.265%	0.605%	0.252%	0.498%	0.350%	0.197%	-1.548%	*0.21%*
35	1.304%	-4.175%	0.828%	0.759%	0.021%	0.588%	0.440%	0.443%	0.346%	0.447%	*0.11%*
36	1.839%	2.062%	1.714%	1.478%	1.359%	1.559%	1.508%	1.243%	1.518%	1.294%	*1.30%*

NOTE: Monthly rates are a percentage of the total value by month 36.

Table C-8. Monthly O&M Obligation Rates (FY 2011–2023 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	*Avg*
1	5.811%	5.697%	8.756%	7.153%	7.703%	6.627%	6.554%	5.756%	6.154%	5.525%	6.626%	5.650%	6.038%	*6.47%*
2	6.969%	6.230%	10.134%	8.898%	5.127%	5.733%	6.156%	6.652%	9.191%	4.203%	6.314%	6.364%	6.304%	*6.79%*
3	7.273%	6.883%	7.543%	7.674%	7.403%	6.124%	7.727%	6.109%	8.710%	6.886%	6.689%	7.760%	5.672%	*7.11%*
4	8.605%	10.746%	8.322%	7.014%	9.419%	10.414%	9.729%	8.210%	9.208%	8.497%	9.044%	7.312%	8.716%	*8.86%*
5	5.983%	8.494%	5.259%	8.176%	8.889%	9.602%	7.740%	7.944%	8.315%	12.937%	9.962%	6.272%	9.619%	*8.40%*
6	7.762%	9.525%	6.217%	10.482%	10.193%	10.970%	8.262%	8.472%	8.442%	10.237%	11.070%	9.058%	11.666%	*9.41%*
7	7.402%	8.668%	7.767%	9.577%	8.930%	8.165%	5.114%	10.100%	9.035%	9.514%	9.360%	9.967%	9.064%	*8.67%*
8	9.922%	7.557%	10.106%	3.962%	6.911%	7.469%	8.479%	10.759%	7.571%	7.107%	7.070%	10.022%	8.129%	*8.08%*
9	9.423%	7.483%	7.952%	11.739%	7.983%	7.573%	10.715%	9.012%	6.995%	7.844%	7.642%	9.503%	8.008%	*8.61%*
10	13.237%	9.572%	10.374%	10.777%	10.666%	9.548%	11.794%	9.416%	9.236%	9.664%	9.863%	10.280%	9.232%	*10.28%*
11	6.007%	6.557%	5.431%	1.877%	5.447%	5.703%	6.583%	6.693%	6.271%	5.604%	6.302%	6.982%	6.742%	*5.86%*
12	11.606%	12.588%	12.139%	12.671%	11.331%	12.071%	11.147%	10.875%	10.871%	11.983%	10.059%	10.830%	10.809%	*11.46%*

NOTE: Monthly rates are a percentage of the total value by month 12.

Table C-9. Monthly MILPERS Obligation Rates (FY 2011–2023 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	*Avg*
1	8.157%	8.164%	8.228%	8.011%	8.219%	8.415%	8.056%	8.165%	8.291%	7.752%	8.072%	7.002%	7.453%	*8.00%*
2	7.995%	8.253%	8.106%	8.204%	8.235%	7.761%	7.897%	8.008%	7.757%	7.846%	7.515%	8.393%	8.063%	*8.00%*
3	8.270%	7.889%	8.071%	7.916%	7.941%	7.920%	8.012%	7.913%	7.875%	8.270%	7.971%	8.188%	7.919%	*8.01%*
4	8.101%	8.198%	7.997%	8.178%	8.214%	8.200%	8.071%	7.667%	8.242%	8.561%	8.512%	7.745%	7.978%	*8.13%*
5	7.641%	8.258%	8.209%	8.148%	8.229%	8.242%	8.182%	8.409%	8.356%	8.364%	8.044%	8.873%	8.585%	*8.27%*
6	8.586%	8.363%	8.267%	8.210%	8.349%	8.392%	8.353%	8.641%	8.366%	8.094%	8.450%	8.567%	8.423%	*8.39%*
7	8.116%	8.288%	8.170%	8.484%	8.345%	8.469%	8.074%	8.325%	8.313%	8.223%	8.880%	8.973%	8.502%	*8.40%*
8	8.328%	8.133%	8.428%	5.389%	8.349%	8.244%	8.383%	8.422%	8.949%	8.292%	8.554%	7.826%	8.560%	*8.14%*
9	9.277%	8.589%	8.423%	11.435%	8.324%	8.614%	8.675%	8.501%	8.279%	8.202%	7.072%	8.296%	8.462%	*8.63%*
10	7.896%	8.449%	8.738%	8.853%	8.678%	8.995%	8.568%	8.850%	8.698%	8.876%	9.677%	8.149%	8.791%	*8.71%*
11	7.772%	8.234%	8.389%	8.245%	8.130%	8.037%	8.722%	8.498%	8.247%	8.457%	8.191%	9.026%	8.474%	*8.34%*
12	9.860%	9.183%	8.975%	8.927%	8.986%	8.712%	9.007%	8.600%	8.626%	9.063%	9.061%	8.962%	8.790%	*8.98%*

NOTE: Monthly rates are a percentage of the total value by month 12.

Table C-10. Monthly MILCON Obligation Rates (FY 2011–2019 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	*Avg*
1	0.423%	0.112%	2.681%	1.502%	0.000%	0.094%	0.002%	0.017%	0.001%	*0.54%*
2	0.747%	0.270%	2.749%	1.618%	0.079%	0.404%	0.118%	0.165%	2.049%	*0.91%*
3	0.864%	0.456%	3.719%	1.895%	0.186%	0.722%	1.044%	1.321%	2.507%	*1.41%*
4	1.245%	1.898%	4.033%	2.069%	2.348%	0.990%	4.114%	2.601%	7.657%	*3.00%*
5	1.457%	5.741%	5.768%	6.527%	4.981%	4.326%	4.983%	3.594%	10.008%	*5.27%*
6	2.284%	12.568%	5.921%	10.015%	8.260%	7.223%	7.527%	4.974%	13.580%	*8.04%*
7	4.055%	17.140%	6.672%	11.869%	10.160%	8.221%	12.610%	5.551%	14.928%	*10.13%*
8	9.819%	24.683%	12.277%	13.451%	12.959%	14.036%	15.104%	8.866%	16.503%	*14.19%*
9	28.829%	32.290%	19.544%	23.776%	15.592%	17.136%	17.260%	11.337%	19.699%	*20.61%*
10	34.695%	37.706%	23.088%	28.742%	21.119%	22.316%	19.910%	13.404%	22.462%	*24.83%*
11	40.350%	44.728%	30.071%	33.555%	30.870%	27.856%	23.862%	17.129%	26.125%	*30.51%*
12	58.726%	58.837%	44.380%	42.326%	41.838%	36.266%	33.979%	31.253%	36.288%	*42.65%*
13	61.144%	61.225%	47.633%	44.502%	42.540%	36.883%	34.849%	32.192%	36.895%	*44.21%*
14	61.609%	61.243%	48.843%	45.960%	43.911%	39.453%	36.151%	35.279%	39.373%	*45.76%*
15	62.252%	61.692%	51.543%	50.989%	44.728%	40.817%	38.766%	37.935%	41.328%	*47.78%*
16	63.563%	62.738%	53.414%	51.788%	46.329%	41.617%	42.209%	41.066%	43.763%	*49.61%*
17	64.313%	64.148%	55.646%	52.666%	46.916%	42.443%	43.215%	41.960%	44.382%	*50.63%*
18	64.787%	64.554%	56.693%	52.415%	50.427%	44.925%	44.509%	44.091%	46.926%	*52.15%*
19	65.868%	65.665%	57.456%	55.395%	51.512%	47.745%	47.355%	45.148%	47.553%	*53.74%*
20	67.481%	66.111%	59.051%	55.885%	52.776%	50.494%	48.885%	46.552%	47.955%	*55.02%*
21	68.878%	66.665%	61.177%	57.423%	53.601%	52.004%	51.350%	47.989%	49.542%	*56.51%*
22	69.414%	67.339%	63.132%	58.257%	55.151%	54.003%	50.993%	50.386%	52.203%	*57.88%*
23	72.016%	68.123%	63.913%	63.327%	56.409%	58.380%	53.523%	53.550%	54.410%	*60.41%*
24	75.380%	69.725%	68.601%	64.862%	58.649%	62.405%	55.586%	60.272%	57.787%	*63.70%*
25	75.929%	70.141%	69.236%	64.997%	59.263%	62.616%	55.965%	62.222%	57.774%	*64.24%*
26	76.382%	70.249%	69.746%	67.424%	61.095%	61.676%	57.032%	67.020%	58.125%	*65.42%*
27	76.420%	70.493%	70.251%	67.651%	63.511%	58.820%	58.880%	71.315%	59.646%	*66.33%*
28	78.243%	71.591%	70.887%	68.065%	63.954%	60.390%	59.955%	71.746%	60.376%	*67.25%*
29	78.730%	72.716%	71.370%	68.831%	64.925%	62.752%	61.735%	71.705%	60.350%	*68.12%*
30	79.104%	72.952%	69.234%	70.242%	69.097%	62.942%	62.956%	72.109%	60.987%	*68.85%*
31	79.036%	73.518%	69.703%	70.587%	69.902%	63.570%	63.814%	73.324%	61.563%	*69.45%*
32	79.265%	73.904%	70.575%	71.152%	70.833%	64.970%	64.575%	73.969%	62.122%	*70.15%*
33	79.819%	74.648%	70.797%	71.287%	71.558%	66.862%	66.035%	74.837%	62.582%	*70.94%*
34	79.889%	74.984%	72.164%	72.407%	71.838%	69.369%	66.884%	75.704%	63.455%	*71.85%*
35	80.495%	75.592%	72.763%	73.021%	72.328%	70.536%	67.941%	76.085%	63.427%	*72.47%*
36	82.339%	76.799%	74.123%	74.117%	77.529%	73.599%	70.565%	77.534%	64.604%	*74.58%*
37	82.362%	77.141%	74.449%	74.131%	77.388%	73.758%	70.058%	78.135%	65.022%	*74.72%*
38	82.485%	77.464%	74.757%	74.454%	77.505%	73.844%	73.189%	78.466%	65.202%	*75.26%*
39	82.667%	78.437%	75.697%	74.871%	77.899%	76.596%	73.702%	78.482%	66.025%	*76.04%*
40	82.896%	78.672%	76.231%	74.937%	79.699%	77.181%	74.495%	80.010%	66.355%	*76.72%*
41	83.115%	79.313%	78.033%	75.070%	78.523%	77.082%	75.579%	80.253%	66.853%	*77.09%*
42	83.315%	79.538%	79.231%	76.694%	78.635%	77.646%	76.404%	81.032%	67.139%	*77.74%*
43	83.546%	79.671%	79.943%	77.493%	79.006%	78.563%	76.829%	81.406%	69.080%	*78.39%*
44	83.647%	80.057%	79.921%	77.598%	79.594%	78.958%	77.160%	81.414%	70.961%	*78.81%*
45	83.889%	80.382%	80.462%	78.839%	79.933%	79.870%	77.420%	81.713%	71.755%	*79.36%*
46	84.187%	80.546%	80.169%	79.037%	80.065%	79.961%	78.931%	82.381%	71.669%	*79.66%*
47	84.057%	81.137%	80.414%	79.252%	80.343%	80.215%	79.072%	83.404%	71.908%	*79.98%*
48	84.928%	82.188%	82.449%	79.967%	80.072%	80.611%	79.808%	84.943%	73.564%	*80.95%*
49	85.018%	82.288%	82.276%	80.111%	80.055%	79.925%	80.038%	85.152%	73.407%	*80.92%*
50	85.184%	82.488%	82.433%	80.937%	79.721%	80.629%	81.374%	85.202%	75.683%	*81.52%*
51	85.480%	82.574%	82.706%	81.198%	80.182%	80.739%	81.494%	86.337%	75.003%	*81.75%*
52	85.729%	82.993%	82.929%	81.521%	79.737%	80.980%	81.708%	86.511%	75.201%	*81.92%*
53	85.812%	83.259%	83.240%	81.669%	79.761%	81.749%	81.730%	86.677%	74.983%	*82.10%*
54	85.912%	83.659%	83.487%	81.929%	80.043%	82.333%	82.254%	86.260%	77.875%	*82.64%*
55	86.250%	84.050%	83.764%	82.671%	80.340%	81.921%	82.684%	86.224%	78.653%	*82.95%*
56	86.527%	84.127%	83.917%	84.199%	81.318%	83.192%	83.517%	86.834%	79.766%	*83.71%*
57	87.163%	85.008%	84.540%	84.775%	81.649%	84.008%	84.111%	87.224%	80.031%	*84.28%*
58	87.542%	86.101%	84.739%	85.332%	83.253%	85.572%	84.680%	87.782%	86.105%	*85.68%*
59	88.509%	87.754%	86.177%	86.042%	85.061%	85.766%	87.256%	88.123%	86.231%	*86.77%*
60	90.000%	90.000%	90.000%	90.000%	90.000%	90.000%	90.000%	90.000%	90.000%	*90.00%*

NOTE: Monthly rates are a percentage of the 90% value at month 60.

EXPENDED DOLLARS AND CLEANING NOTES: RDT&E, PROC, O&M, MILPERS, AND MILCON

Table C-11 and Table C-12 list the cumulative expended dollars by the last month used for calculating monthly expenditure percentages. For MILCON, the dollar value shown was assumed to represent 90% of the available obligation dollars by the end of the sixth year of availability (the average value for FY 2012–2014 for which we had 10 years of good longitudinal data). For RDT&E, PROC, O&M, and MILPERS, they generally reached about 100% obligation in the data by the months shown and thus were used to scale to 100% by the month shown.

A very small portion of the data underwent minimal cleaning to remove expenditure reports that are obviously incomplete or erroneous. Notes are included below the table on the issues identified and associated cleaning actions taken.

Table C-11. S&T, DEV, and Mgt. Expended (Disbursed) Dollars by Appropriation FY at Month 36 (FY 2013, 2014, 2017–2021 Appropriations)

Appropriation FY	S&T Month 36	DEV Month 36	Mgt. Month 36
2011	n/a	n/a	n/a
2012	n/a	n/a	n/a
2013	$10,004,986,000	$41,717,526,000	$4,761,768,000
2014	$11,139,857,000	$39,271,840,000	$4,918,821,000
2015	n/a	n/a	n/a
2016	n/a	n/a	n/a
2017	$12,669,503,000	$48,359,810,000	$5,404,367,000
2018	$13,553,665,000	$60,957,039,000	$7,638,346,000
2019	$14,256,429,000	$62,390,101,000	$8,328,020,000
2020	$14,508,443,000	$75,764,142,000	$8,960,965,000
2021	$15,014,088,000	$77,056,721,000	$8,702,847,000

*Assumed that significant drops in values in months 23 and 24 were from some programs that stopped reporting, so the values were adjusted to make the curves monotonic.

Table C-12. Expended (Disbursed) Dollars by Appropriation FY at End of Period (FY 2011–2023 Appropriations)

Appropriation FY	RDT&E Month 36	PROC Month 60	O&M Month 24	MILPERS Month 12	MILCON Month 72
2011	$ 55,545,641*	$ 105,625,411†	$ 184,959,005•	$ 137,823,334	$ 11,083,878 ‡
2012	$ 69,197,708**	$ 95,951,607††	$ 235,678,757	$ 132,846,260	$ 8,860,058 ‡
2013	$ 44,689,742***	$ 91,657,641	$ 212,637,718••	$ 128,398,191	$ 5,777,961
2014	$ 60,173,491****	$ 90,747,640	$ 197,849,417	$ 127,080,763	$ 5,927,638 ‡
2015	$ 60,096,855	$ 93,656,769	$ 191,033,884	$ 123,766,219	$ 3,711,493 ‡
2016	$ 67,433,841*****	$ 105,216,398	$ 193,619,976	$ 127,616,147	$ 4,558,038
2017	$ 70,225,408	$ 110,692,550	$ 200,384,634	$ 128,024,863	$ 4,849,159
2018	$ 86,296,905	$ 128,049,922	$ 212,805,038	$ 127,814,094	$ 6,977,553
2019	$ 89,023,562	$ 101,259,272†††	$ 221,063,101	$ 133,690,039	$ 6,789,944
2020	$ 99,453,483		$ 231,799,309	$ 137,690,535	
2021	$ 101,002,263		$ 225,224,759	$ 145,930,273	
2022			$ 243,793,445	$ 153,026,772	
2023				$ 159,629,427	

* Removed *Navy RDT&E* expenditures from the FY 2011 data. Expenditures dropped at month 17 and never came back near appropriated levels of $17,865,538 (Comptroller FY 2013 R1 document).
** Adjusted *Defense-Wide RDT&E* for months 35–36 of FY 2012 data. They appeared to have missed a trailing zero (off by a factor of 10), so we added a zero to the end of the values, which now align better with prior obligation and expenditure levels and trends.
*** Removed *Defense-Wide RDT&E* from the FY 2013 data. The cumulative expenditures looked well behaved up to month 22, then dropped significantly and never came back near the appropriated levels of $17,390,232 (Comptroller's R1 document).
**** Adjusted *Army RDT&E* at month 21 in the FY 2014 data. That month jumped significantly, then dropped back to the trend in the following month, so replaced month 21 with a linear interpolation between months 20 and 22.
***** Adjusted *Army RDT&E* in FY 2016 data. A few months dropped significantly, then came back to the prior trending, so replaced those months with linear interpolations between numbers that were tracking at the obligation levels.
† Removed *Defense-Wide PROC* from the FY 2011 data. Values dropped significantly at month 46 and stayed low.
†† Removed *Defense-Wide PROC* from the FY 2012 data. Values dropped significantly at month 34 and stayed low.
††† Removed *Air Force Other PROC* from the FY 2019 data. Values dropped significantly at month 23 and stayed low.
• Removed *Navy O&M* expenditures from the FY 2011 data. At month 17, the values dropped significantly and never recovered back to the appropriated levels.
•• Adjusted *Defense-Wide O&M* in the FY 2013 data. At month 23, the values suddenly dropped significantly below appropriated levels and stayed down. Replaced months 23-24 with the value from month 22.
‡ Added drops in *Defense-Wide MILCON* back to the running cumulative totals. It appears that subaccount(s) stopped reporting and were therefore no longer appearing in the totals. We calculated the drops right after months 46, 35, 77, 23, 65, 53, 41, 30, and 18 for FYs 2011, 2012, 2012, 2013, 2013, 2014, and 2015, respectively, and added that back into the subsequent cumulative totals.

MONTHLY CUMULATIVE EXPENDITURES: RDT&E, PROC, O&M, MILPERS, AND MILCON

Table C-13. Monthly S&T (RDT&E BAs 1–3) Expenditure Rates (FY 2013, 2014, 2017–2021 Appropriations)

Month	2013	2014	2017	2018	2019	2020	2021	*Avg*
1	0.719%	0.438%	0.468%	0.413%	0.554%	0.437%	0.594%	*0.517%*
2	1.333%	0.825%	1.319%	1.140%	0.838%	0.967%	1.220%	*1.092%*
3	1.794%	1.179%	1.692%	1.547%	1.543%	2.404%	1.266%	*1.632%*
4	1.965%	1.709%	1.691%	1.685%	3.259%	0.576%	1.910%	*1.828%*
5	2.526%	2.117%	2.107%	1.960%	2.554%	2.215%	2.486%	*2.281%*
6	3.070%	3.570%	3.186%	2.697%	3.168%	3.314%	3.102%	*3.158%*
7	5.021%	3.783%	3.261%	3.452%	3.403%	4.308%	3.565%	*3.828%*
8	2.404%	4.497%	3.736%	3.797%	4.575%	4.496%	4.631%	*4.019%*
9	4.504%	4.152%	4.509%	5.101%	4.385%	4.179%	4.705%	*4.505%*
10	4.527%	5.132%	4.843%	4.729%	5.128%	5.177%	4.649%	*4.884%*
11	5.509%	5.643%	5.882%	6.110%	5.156%	5.264%	5.499%	*5.581%*
12	6.173%	6.769%	6.533%	5.554%	6.463%	5.834%	6.297%	*6.232%*
13	7.876%	7.238%	3.295%	4.886%	4.631%	4.767%	4.062%	*5.251%*
14	3.073%	2.298%	6.957%	4.665%	5.391%	4.815%	4.885%	*4.583%*
15	5.488%	5.527%	5.976%	5.797%	4.305%	2.098%	4.977%	*4.881%*
16	5.263%	4.740%	4.587%	4.456%	4.873%	3.691%	4.776%	*4.627%*
17	5.184%	4.738%	4.917%	5.019%	4.018%	3.518%	4.315%	*4.530%*
18	5.274%	4.733%	4.282%	5.335%	4.589%	8.968%	4.908%	*5.441%*
19	4.267%	3.584%	4.493%	3.432%	4.279%	3.898%	3.665%	*3.945%*
20	4.093%	3.670%	3.393%	3.847%	3.369%	3.478%	3.279%	*3.590%*
21	2.809%	3.252%	3.266%	3.347%	2.949%	3.121%	2.961%	*3.101%*
22	2.724%	3.347%	2.458%	2.736%	2.919%	2.889%	2.910%	*2.855%*
23	0.000%	2.812%	3.133%	2.621%	2.706%	3.021%	2.535%	*2.404%*
24	3.645%	2.966%	2.628%	3.079%	2.566%	3.063%	2.768%	*2.959%*
25	1.652%	1.503%	1.723%	1.977%	1.952%	1.744%	1.674%	*1.747%*
26	0.691%	1.738%	1.522%	1.769%	1.537%	1.843%	1.808%	*1.558%*
27	1.520%	1.361%	1.395%	1.322%	0.841%	1.546%	1.651%	*1.377%*
28	1.171%	1.001%	1.148%	1.324%	0.944%	1.366%	1.411%	*1.195%*
29	1.054%	1.058%	1.020%	1.042%	0.930%	1.093%	0.976%	*1.025%*
30	1.112%	1.022%	1.042%	0.966%	2.143%	1.345%	1.428%	*1.294%*
31	0.692%	0.773%	0.758%	0.999%	0.810%	0.849%	0.958%	*0.834%*
32	0.657%	0.627%	0.711%	0.855%	0.675%	0.851%	0.998%	*0.768%*
33	0.798%	0.518%	0.597%	0.588%	0.699%	0.758%	0.833%	*0.684%*
34	0.538%	0.551%	0.551%	0.590%	0.581%	0.620%	0.695%	*0.589%*
35	0.421%	0.704%	0.502%	0.565%	0.657%	0.768%	0.902%	*0.646%*
36	0.452%	0.424%	0.417%	0.600%	0.610%	0.719%	0.701%	*0.560%*

NOTE: Monthly rates are a percentage of the total dollar value by month 36.

Table C-14. Monthly Development (RDT&E BAs 4, 5, and 7) Expenditure Rates (FY 2013, 2014, 2017–2021 Appropriations)

Month	2013	2014	2017	2018	2019	2020	2021	*Avg*
1	0.515%	0.140%	0.492%	0.490%	0.224%	0.584%	0.059%	*0.358%*
2	0.316%	1.563%	0.655%	0.571%	0.746%	0.615%	1.753%	*0.888%*
3	1.643%	1.191%	2.177%	2.534%	3.119%	2.364%	2.565%	*2.228%*
4	4.632%	1.440%	2.374%	1.358%	4.188%	1.616%	1.748%	*2.479%*
5	2.276%	4.739%	3.135%	2.958%	5.017%	2.849%	3.180%	*3.450%*
6	4.637%	5.369%	4.403%	3.337%	4.400%	7.051%	9.524%	*5.532%*
7	5.793%	6.276%	3.206%	4.512%	3.899%	4.415%	4.220%	*4.617%*
8	4.331%	4.535%	6.730%	6.477%	8.345%	5.814%	5.840%	*6.010%*
9	3.631%	7.421%	4.913%	5.996%	4.802%	7.411%	5.876%	*5.722%*
10	9.330%	4.650%	8.776%	7.069%	5.370%	7.685%	6.421%	*7.043%*
11	4.468%	6.796%	5.564%	5.567%	5.678%	4.722%	5.541%	*5.477%*
12	8.588%	6.310%	8.223%	5.384%	5.548%	6.224%	7.978%	*6.894%*
13	5.854%	5.768%	4.007%	6.733%	6.439%	7.151%	3.776%	*5.675%*
14	3.423%	3.519%	5.075%	4.223%	4.706%	4.796%	4.824%	*4.367%*
15	8.158%	7.857%	8.469%	5.067%	7.462%	2.125%	5.696%	*6.405%*
16	3.801%	3.412%	3.383%	3.455%	3.195%	3.574%	4.284%	*3.586%*
17	3.493%	3.181%	3.012%	4.650%	3.558%	2.465%	3.185%	*3.363%*
18	3.935%	5.204%	3.801%	4.779%	4.314%	8.194%	3.366%	*4.799%*
19	2.918%	2.473%	2.954%	3.730%	3.047%	2.340%	2.018%	*2.783%*
20	2.361%	2.168%	2.959%	2.424%	2.051%	2.794%	2.756%	*2.502%*
21	2.250%	1.881%	2.356%	2.152%	1.982%	2.238%	1.962%	*2.117%*
22	1.930%	2.186%	1.803%	1.811%	2.192%	1.912%	1.743%	*1.940%*
23	0.826%	1.421%	2.304%	2.023%	1.561%	1.601%	1.965%	*1.671%*
24	2.327%	2.385%	1.673%	1.891%	1.956%	1.294%	1.977%	*1.929%*
25	1.464%	1.246%	1.261%	1.787%	1.105%	1.089%	0.992%	*1.278%*
26	0.873%	0.952%	1.113%	1.391%	1.163%	1.078%	1.146%	*1.102%*
27	1.246%	1.302%	1.191%	0.965%	0.267%	1.689%	1.370%	*1.147%*
28	0.810%	0.671%	0.684%	0.829%	0.531%	0.752%	0.707%	*0.712%*
29	0.693%	0.648%	0.726%	0.817%	0.399%	0.581%	0.519%	*0.626%*
30	0.689%	0.700%	0.766%	1.727%	1.601%	0.669%	0.602%	*0.965%*
31	0.702%	0.662%	0.627%	0.933%	0.407%	0.388%	0.454%	*0.596%*
32	0.511%	0.414%	-0.242%	0.431%	0.450%	0.219%	0.428%	*0.316%*
33	0.414%	0.373%	0.544%	0.551%	0.399%	0.700%	0.533%	*0.502%*
34	0.257%	0.310%	0.315%	0.623%	0.384%	0.347%	0.355%	*0.370%*
35	0.381%	0.406%	0.374%	0.346%	0.256%	0.293%	0.315%	*0.339%*
36	0.521%	0.436%	0.193%	0.408%	-0.759%	0.360%	0.322%	*0.212%*

NOTE: Monthly rates are a percentage of the total dollar value by month 36.

Table C-15. Monthly Management Support (RDT&E BA 6) Expenditure Rates (FY 2013, 2014, 2017–2021 Appropriations)

Month	2013	2014	2017	2018	2019	2020	2021	*Avg*
1	1.293%	0.913%	0.592%	0.449%	0.716%	0.459%	0.405%	*0.689%*
2	2.634%	1.368%	1.751%	1.222%	3.649%	1.525%	2.707%	*2.122%*
3	1.919%	2.045%	2.553%	2.000%	3.164%	3.662%	4.741%	*2.869%*
4	2.886%	3.468%	2.767%	2.110%	3.342%	4.828%	3.382%	*3.255%*
5	4.673%	2.948%	3.518%	2.251%	3.629%	3.411%	3.718%	*3.450%*
6	4.076%	4.502%	4.509%	2.812%	4.562%	4.368%	4.202%	*4.147%*
7	5.217%	4.018%	3.344%	10.799%	4.139%	4.697%	5.413%	*5.375%*
8	3.822%	4.647%	4.456%	5.225%	6.357%	6.033%	3.061%	*4.800%*
9	4.806%	5.096%	5.319%	6.311%	4.725%	4.709%	6.092%	*5.294%*
10	4.498%	5.016%	3.844%	4.774%	4.610%	5.309%	6.489%	*4.934%*
11	4.933%	6.094%	6.124%	5.250%	5.909%	5.242%	4.199%	*5.393%*
12	5.187%	6.697%	5.275%	5.688%	5.386%	5.284%	5.403%	*5.560%*
13	5.429%	5.330%	3.189%	5.403%	4.376%	4.787%	4.771%	*4.755%*
14	2.828%	2.581%	4.154%	2.836%	3.240%	3.136%	3.206%	*3.140%*
15	4.197%	4.102%	3.982%	3.131%	3.086%	1.102%	3.179%	*3.254%*
16	3.867%	3.432%	3.414%	2.885%	3.444%	2.403%	2.674%	*3.160%*
17	3.433%	3.026%	2.975%	3.461%	3.074%	2.202%	2.137%	*2.901%*
18	3.513%	3.425%	3.734%	3.126%	3.117%	6.594%	2.901%	*3.773%*
19	3.441%	2.498%	3.024%	2.607%	3.115%	2.537%	2.318%	*2.791%*
20	1.544%	2.131%	2.888%	2.503%	2.560%	2.618%	2.350%	*2.371%*
21	3.067%	2.319%	2.781%	2.385%	2.306%	2.559%	1.789%	*2.458%*
22	2.661%	2.785%	2.475%	2.402%	2.316%	2.606%	2.555%	*2.543%*
23	0.000%	2.567%	2.730%	2.607%	2.344%	1.807%	2.869%	*2.132%*
24	4.156%	3.247%	3.309%	2.619%	2.532%	2.996%	2.637%	*3.071%*
25	2.696%	1.708%	2.063%	1.885%	1.803%	1.607%	1.771%	*1.933%*
26	1.120%	1.952%	1.894%	1.766%	1.805%	1.753%	2.029%	*1.760%*
27	1.932%	1.881%	1.924%	1.434%	1.039%	1.640%	2.017%	*1.695%*
28	1.621%	1.542%	1.795%	1.693%	1.270%	1.728%	1.792%	*1.634%*
29	1.301%	1.673%	1.674%	1.252%	0.964%	1.338%	1.378%	*1.369%*
30	1.811%	1.439%	1.691%	1.386%	2.694%	1.631%	1.678%	*1.761%*
31	1.040%	1.248%	1.356%	1.317%	1.164%	0.875%	1.123%	*1.160%*
32	0.934%	1.118%	1.123%	1.157%	0.944%	1.070%	1.160%	*1.072%*
33	0.813%	0.807%	1.113%	0.796%	0.851%	1.089%	1.168%	*0.948%*
34	0.880%	0.855%	1.097%	0.875%	0.754%	0.801%	0.900%	*0.880%*
35	1.132%	1.005%	0.736%	0.762%	0.715%	0.731%	0.818%	*0.843%*
36	0.638%	0.517%	0.828%	0.822%	0.301%	0.864%	0.968%	*0.705%*

NOTE: Monthly rates are a percentage of the total dollar value by month 36.

Table C-16. Monthly Cumulative RDT&E Expenditures (FY 2011–2021 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	0.476%	0.380%	0.792%	0.392%	0.657%	0.846%	0.635%	0.626%	0.389%	0.601%	0.315%
2	1.472%	1.728%	1.719%	1.953%	1.561%	1.720%	1.659%	1.375%	1.802%	1.749%	2.206%
3	3.780%	3.881%	3.781%	3.407%	3.899%	4.129%	3.914%	3.602%	4.778%	4.186%	4.942%
4	5.529%	5.861%	8.576%	5.253%	6.322%	6.936%	6.266%	5.137%	8.911%	5.910%	6.577%
5	10.60%	8.541%	10.58%	9.509%	9.744%	9.783%	9.264%	7.852%	13.257%	8.714%	9.681%
6	14.54%	15.04%	15.26%	14.68%	16.55%	17.24%	13.65%	11.25%	17.19%	14.99%	18.38%
7	18.95%	20.12%	21.27%	20.56%	22.26%	21.43%	17.09%	16.35%	21.62%	19.48%	22.79%
8	23.84%	26.56%	25.44%	21.98%	26.93%	25.92%	22.85%	22.48%	28.80%	25.65%	27.80%
9	30.01%	31.22%	30.16%	30.77%	37.39%	31.62%	27.93%	28.32%	33.47%	31.94%	33.97%
10	38.36%	36.04%	37.75%	36.10%	39.47%	37.14%	35.76%	34.93%	38.70%	38.87%	39.80%
11	45.35%	43.50%	42.35%	42.27%	44.52%	43.38%	41.19%	40.68%	44.48%	44.03%	45.33%
12	50.91%	49.01%	50.58%	50.41%	53.06%	51.10%	49.10%	45.88%	50.23%	49.88%	52.42%
13	54.19%	53.66%	55.20%	54.78%	57.62%	55.14%	53.71%	52.24%	55.95%	56.37%	56.21%
14	58.93%	58.22%	58.94%	59.96%	61.90%	60.82%	58.90%	56.90%	60.52%	60.84%	61.08%
15	65.47%	64.64%	66.53%	66.07%	68.62%	66.75%	65.87%	61.60%	67.44%	63.08%	66.64%
16	68.55%	68.78%	69.98%	70.00%	72.11%	70.07%	69.28%	65.34%	70.83%	66.43%	70.75%
17	72.42%	71.72%	73.50%	73.54%	75.60%	73.23%	72.47%	69.71%	74.18%	69.03%	74.04%
18	76.38%	75.28%	77.20%	78.02%	78.68%	77.27%	76.47%	74.02%	78.37%	77.20%	77.85%
19	78.84%	78.50%	80.18%	80.54%	82.02%	79.98%	79.62%	78.01%	81.48%	79.80%	79.93%
20	81.35%	81.86%	81.73%	82.89%	84.25%	82.87%	82.65%	80.52%	83.91%	82.61%	82.65%
21	83.67%	84.03%	85.13%	85.12%	86.45%	85.32%	85.18%	82.82%	86.17%	84.99%	84.72%
22	86.16%	85.80%	87.54%	87.46%	88.11%	87.11%	87.06%	84.80%	88.29%	87.08%	86.64%
23	87.90%	88.29%	89.09%	89.04%	89.60%	88.80%	89.49%	86.98%	90.09%	88.91%	88.65%
24	90.11%	90.85%	91.29%	91.44%	91.64%	90.82%	91.34%	89.15%	92.18%	90.57%	90.93%
25	91.33%	92.61%	93.14%	92.76%	93.11%	92.19%	92.86%	90.91%	93.49%	91.74%	92.23%
26	92.51%	93.35%	94.20%	93.87%	94.78%	93.63%	94.14%	92.33%	94.71%	93.07%	93.54%
27	93.58%	94.62%	94.97%	95.08%	95.80%	94.75%	95.21%	93.36%	95.23%	94.61%	94.96%
28	94.77%	95.40%	95.87%	95.91%	96.34%	95.74%	96.16%	94.34%	95.80%	95.59%	95.56%
29	95.52%	96.14%	96.59%	96.65%	96.93%	96.35%	96.88%	95.11%	96.41%	96.29%	96.28%
30	96.22%	96.86%	97.18%	97.37%	97.65%	97.07%	97.71%	96.62%	98.10%	97.13%	96.91%
31	96.99%	97.49%	97.83%	98.02%	98.25%	97.62%	98.42%	97.45%	98.64%	97.71%	97.49%
32	97.59%	98.04%	98.30%	98.50%	98.70%	98.09%	98.48%	98.03%	99.16%	98.16%	98.09%
33	98.16%	98.50%	99.63%	98.91%	99.24%	98.63%	99.00%	98.64%	99.62%	98.72%	98.69%
34	98.54%	98.89%	99.10%	99.29%	99.59%	98.89%	99.39%	99.17%	100.02%	99.15%	99.14%
35	99.07%	98.90%	99.52%	99.61%	99.91%	99.24%	99.72%	99.55%	100.39%	99.68%	99.57%
36	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

NOTE: Monthly rates are a percentage of the total value by month 36.

Table C-17. Monthly Cumulative Procurement Expenditures (FY 2011–2019 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	0.04%	0.24%	0.08%	0.00%	0.17%	0.11%	0.06%	2.56%	0.05%
2	1.49%	0.57%	0.36%	0.18%	0.26%	2.12%	1.23%	2.96%	0.15%
3	3.07%	0.68%	0.76%	0.62%	2.26%	3.52%	2.39%	3.30%	0.54%
4	4.01%	4.21%	3.49%	5.34%	2.96%	6.59%	3.71%	3.33%	0.82%
5	6.20%	6.87%	4.03%	6.07%	4.29%	7.58%	6.15%	5.37%	1.31%
6	8.50%	9.81%	8.13%	7.99%	7.23%	10.05%	7.69%	6.10%	2.91%
7	9.44%	10.66%	9.03%	11.16%	8.92%	11.55%	9.05%	6.81%	4.13%
8	11.44%	13.03%	10.05%	12.03%	13.40%	13.70%	11.06%	8.14%	5.49%
9	13.36%	15.29%	12.02%	15.22%	16.21%	15.48%	12.99%	11.86%	6.98%
10	15.77%	17.95%	16.93%	18.45%	18.31%	17.34%	15.53%	13.15%	8.66%
11	18.27%	20.42%	20.80%	21.57%	21.24%	20.04%	18.59%	16.18%	10.57%
12	21.26%	23.33%	23.86%	24.70%	25.26%	23.56%	21.70%	20.51%	12.98%
13	23.06%	25.52%	25.91%	27.87%	27.14%	25.19%	24.00%	22.17%	15.02%
14	25.67%	28.00%	28.30%	29.70%	30.56%	27.91%	26.29%	24.69%	18.95%
15	28.49%	30.45%	31.08%	35.41%	33.89%	31.64%	30.04%	27.01%	22.56%
16	32.40%	34.44%	35.87%	37.21%	36.35%	34.68%	32.36%	29.00%	25.09%
17	29.99%	36.19%	38.56%	40.07%	39.29%	36.93%	34.94%	31.02%	27.30%
18	33.69%	41.24%	42.50%	44.21%	42.13%	40.71%	38.16%	33.43%	30.59%
19	36.11%	43.31%	45.35%	46.39%	44.73%	43.72%	40.61%	35.71%	33.40%
20	39.14%	46.07%	46.69%	48.09%	47.05%	46.19%	42.81%	38.08%	35.83%
21	42.43%	49.03%	50.58%	51.14%	49.85%	49.28%	45.71%	40.66%	38.92%
22	45.37%	51.02%	53.12%	53.20%	52.22%	51.40%	47.89%	42.85%	41.17%
23	48.08%	53.36%	55.27%	55.48%	54.91%	53.35%	50.24%	45.48%	43.49%
24	51.37%	56.32%	58.00%	58.58%	58.66%	56.01%	52.76%	48.26%	46.42%
25	54.12%	58.94%	60.74%	60.74%	60.80%	58.11%	55.00%	50.31%	48.67%
26	57.02%	61.05%	62.65%	64.07%	63.98%	60.52%	56.80%	53.91%	51.09%
27	59.84%	64.01%	66.34%	67.04%	66.66%	63.30%	59.69%	56.78%	51.36%
28	63.52%	67.05%	68.22%	68.84%	68.32%	65.04%	61.68%	58.38%	52.46%
29	65.85%	69.12%	69.91%	70.65%	69.78%	66.92%	63.84%	60.26%	53.64%
30	68.32%	71.32%	72.05%	72.79%	72.61%	69.95%	66.40%	62.62%	61.15%
31	70.38%	73.31%	73.76%	74.43%	74.33%	71.79%	68.43%	65.81%	63.23%
32	72.75%	74.97%	75.37%	76.05%	75.87%	73.64%	70.29%	67.81%	65.33%
33	74.90%	77.06%	77.35%	78.06%	77.77%	75.67%	72.30%	69.73%	67.74%
34	76.78%	78.40%	78.75%	79.54%	79.13%	77.26%	74.91%	71.38%	69.61%
35	78.54%	79.89%	80.15%	81.19%	80.65%	79.37%	76.67%	73.28%	71.58%
36	80.60%	81.90%	82.05%	83.23%	82.30%	81.17%	78.41%	75.64%	74.19%
37	81.90%	83.03%	83.57%	84.60%	83.62%	82.66%	79.95%	77.35%	73.56%
38	83.27%	84.36%	85.00%	86.59%	85.02%	83.95%	81.46%	79.47%	77.72%
39	85.63%	85.91%	86.52%	88.38%	86.59%	85.70%	83.88%	79.22%	80.42%
40	86.91%	86.91%	87.73%	88.65%	87.80%	86.73%	84.93%	79.71%	81.61%
41	88.10%	87.80%	88.63%	89.63%	88.65%	87.87%	85.85%	80.38%	82.93%
42	89.27%	89.10%	89.65%	90.48%	89.90%	88.98%	87.07%	85.83%	84.50%
43	90.50%	90.06%	90.83%	91.50%	90.78%	90.16%	88.84%	86.84%	85.85%
44	91.15%	91.05%	91.61%	92.32%	91.59%	90.93%	89.95%	88.04%	86.99%
45	92.30%	91.88%	92.56%	93.43%	92.53%	91.91%	90.93%	89.46%	88.27%
46	92.97%	92.71%	93.44%	93.96%	93.13%	92.66%	91.68%	90.34%	89.28%
47	93.67%	93.41%	94.12%	94.64%	93.95%	93.33%	92.60%	91.40%	90.33%
48	94.43%	94.24%	94.91%	95.19%	94.65%	94.06%	93.56%	92.63%	91.72%
49	95.14%	94.78%	95.45%	95.80%	95.34%	94.67%	94.33%	91.67%	92.48%
50	95.67%	95.42%	96.48%	96.42%	95.91%	95.32%	94.98%	94.05%	93.49%
51	96.54%	96.03%	97.19%	97.11%	96.59%	96.19%	94.75%	95.33%	94.77%
52	96.81%	96.53%	97.23%	97.44%	97.01%	96.55%	94.91%	95.82%	95.19%
53	97.23%	97.02%	97.58%	97.80%	97.48%	96.92%	95.07%	96.34%	95.94%
54	97.66%	97.55%	97.95%	98.22%	98.02%	97.48%	97.41%	97.10%	96.99%
55	98.19%	98.03%	98.22%	98.56%	98.36%	98.15%	97.88%	97.51%	97.47%
56	98.50%	98.46%	98.67%	98.95%	98.72%	98.69%	98.31%	98.06%	98.17%
57	99.00%	98.86%	99.10%	99.16%	99.15%	99.09%	98.92%	98.67%	98.67%
58	99.37%	99.29%	99.44%	99.42%	99.45%	99.45%	99.32%	99.09%	99.01%
59	99.63%	99.62%	99.72%	99.67%	99.67%	99.73%	99.62%	99.54%	99.44%
60	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

NOTE: Monthly rates are a percentage of the total value by month 60.

Table C-18. Monthly O&M Cumulative Expenditures (FY 2011–2022 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	1.555%	1.887%	2.074%	2.565%	2.686%	1.947%	1.616%	1.455%	1.283%	1.345%	2.013%	1.787%
2	4.947%	5.307%	6.165%	5.744%	5.884%	5.861%	5.389%	4.984%	5.605%	4.884%	5.699%	5.104%
3	9.362%	9.943%	10.530%	10.133%	10.642%	10.685%	10.232%	9.625%	9.761%	8.684%	9.959%	9.587%
4	13.70%	14.71%	15.88%	15.12%	16.37%	15.48%	15.02%	14.23%	14.77%	13.43%	14.48%	13.92%
5	18.64%	20.03%	21.15%	20.57%	21.73%	20.60%	20.48%	19.28%	20.14%	19.65%	20.07%	18.90%
6	24.68%	26.58%	26.98%	26.41%	27.96%	27.62%	27.28%	25.38%	26.21%	25.98%	26.53%	24.87%
7	31.21%	32.44%	32.98%	32.88%	34.69%	34.18%	33.22%	31.52%	32.66%	32.31%	33.74%	31.39%
8	37.58%	39.35%	39.97%	36.30%	41.24%	40.52%	39.93%	38.17%	39.98%	38.86%	40.19%	37.83%
9	44.71%	45.71%	46.15%	46.28%	48.38%	47.62%	47.46%	45.82%	46.38%	45.83%	47.18%	45.16%
10	51.68%	52.36%	52.78%	53.22%	56.05%	54.95%	54.49%	52.76%	53.73%	52.83%	54.91%	52.11%
11	59.38%	59.91%	59.69%	61.15%	62.94%	62.45%	62.54%	60.50%	61.40%	59.79%	62.31%	59.95%
12	68.24%	67.60%	67.04%	69.13%	70.82%	71.02%	69.98%	68.53%	69.44%	68.41%	70.61%	69.35%
13	74.66%	75.30%	76.14%	75.39%	76.33%	76.40%	76.12%	74.22%	75.54%	74.44%	73.60%	74.24%
14	79.15%	81.10%	81.13%	78.25%	79.90%	80.02%	79.59%	78.05%	78.90%	78.36%	79.96%	78.17%
15	83.05%	84.14%	84.37%	81.87%	83.52%	84.97%	83.10%	81.70%	82.76%	82.58%	83.32%	82.73%
16	85.85%	87.34%	86.91%	84.83%	85.99%	86.66%	86.22%	84.99%	85.75%	85.57%	86.03%	85.54%
17	88.53%	89.60%	89.55%	87.68%	88.92%	88.92%	88.80%	87.63%	88.54%	88.17%	88.84%	88.20%
18	90.98%	91.64%	91.95%	90.22%	91.23%	91.69%	91.97%	90.19%	91.15%	91.02%	91.57%	90.81%
19	92.86%	93.60%	94.02%	92.33%	93.34%	93.63%	93.46%	92.53%	93.21%	93.05%	93.41%	92.71%
20	94.80%	95.45%	95.33%	94.19%	94.95%	95.18%	95.15%	94.41%	94.96%	94.66%	95.07%	94.68%
21	96.31%	96.82%	97.02%	95.88%	96.35%	96.78%	96.70%	96.08%	96.49%	96.23%	96.56%	96.20%
22	97.67%	97.93%	98.25%	97.45%	97.50%	97.79%	97.82%	97.52%	97.75%	97.62%	97.71%	97.48%
23	98.93%	99.03%	99.24%	98.66%	98.96%	98.94%	99.04%	98.75%	98.79%	98.80%	98.88%	98.78%
24	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

NOTE: Monthly rates are a percentage of the total dollar value by month 24.

Table C-19. Monthly MILPERS Cumulative Expenditures (FY 2011–2022 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	4.419%	4.538%	4.640%	4.003%	8.058%	7.628%	4.179%	4.239%	4.387%	5.434%	7.003%	3.140%
2	12.19%	13.06%	16.42%	16.11%	12.48%	12.32%	12.49%	12.41%	15.80%	15.42%	12.60%	11.44%
3	23.71%	24.76%	24.77%	24.55%	24.61%	23.62%	21.00%	22.86%	23.70%	24.02%	23.58%	22.62%
4	29.77%	29.51%	29.45%	32.84%	32.46%	28.54%	27.64%	27.87%	28.75%	32.45%	29.52%	27.47%
5	36.60%	38.17%	38.11%	41.46%	41.30%	36.91%	35.89%	36.82%	37.09%	41.03%	37.78%	35.66%
6	45.04%	50.19%	46.83%	46.50%	46.15%	44.82%	47.02%	48.80%	46.54%	46.37%	46.05%	44.19%
7	56.59%	55.37%	55.40%	54.87%	54.68%	56.03%	52.39%	53.81%	54.53%	54.89%	58.36%	56.03%
8	61.48%	63.85%	67.93%	63.50%	63.53%	61.55%	60.62%	62.63%	66.85%	63.38%	63.61%	61.27%
9	70.44%	76.34%	72.89%	72.76%	72.35%	70.30%	72.60%	74.98%	72.77%	71.99%	72.22%	69.89%
10	78.89%	81.65%	81.82%	81.91%	84.63%	79.01%	77.75%	80.39%	80.89%	84.33%	84.44%	78.89%
11	87.75%	94.16%	95.00%	94.97%	90.64%	87.73%	86.62%	93.91%	93.79%	90.26%	90.17%	87.29%
12	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

NOTE: Monthly rates are a percentage of the total dollar value by month 12.

Table C-20. Monthly Cumulative MILCON Expenditures (FY 2011–2018 Appropriations)

Month	2011	2012	2013	2014	2015	2016	2017	2018
1	0.04%	0.03%	-0.02%	0.02%	-0.07%	-0.04%	0.01%	0.00%
2	0.09%	0.11%	0.02%	0.17%	0.42%	-0.07%	0.08%	0.08%
3	0.13%	0.29%	0.14%	0.28%	1.35%	-0.07%	0.15%	0.45%
4	0.32%	0.30%	0.53%	0.43%	0.15%	-0.14%	0.26%	0.62%
5	0.51%	0.49%	0.76%	0.86%	0.38%	-0.07%	0.42%	0.62%
6	0.57%	0.56%	1.31%	1.00%	0.89%	0.29%	0.70%	0.79%
7	0.74%	0.74%	1.81%	1.05%	1.02%	0.45%	1.18%	0.94%
8	1.00%	1.14%	2.18%	1.09%	0.70%	0.40%	1.49%	1.16%
9	1.48%	1.51%	2.23%	1.86%	0.82%	1.40%	1.83%	1.45%
10	1.85%	2.07%	3.19%	2.43%	1.04%	1.77%	2.36%	1.79%
11	2.34%	2.85%	3.21%	3.50%	1.32%	2.30%	3.31%	2.40%
12	3.26%	3.84%	3.72%	5.25%	4.05%	3.12%	4.32%	3.59%
13	3.91%	5.02%	4.47%	5.71%	4.54%	4.13%	4.86%	4.21%
14	5.30%	6.30%	4.80%	6.64%	5.34%	4.82%	5.97%	4.91%
15	6.78%	7.58%	5.89%	8.46%	6.26%	5.82%	7.00%	5.89%
16	8.11%	9.37%	6.80%	9.92%	7.07%	6.97%	8.08%	6.68%
17	10.11%	10.90%	8.05%	11.25%	8.93%	8.12%	9.22%	7.72%
18	12.25%	12.59%	9.66%	12.46%	10.41%	9.62%	9.64%	8.18%
19	15.02%	14.58%	11.08%	14.16%	11.90%	10.90%	10.96%	10.20%
20	18.41%	17.37%	13.16%	16.39%	14.31%	12.34%	13.06%	10.46%
21	21.36%	19.92%	16.00%	18.42%	16.98%	14.27%	15.34%	11.97%
22	25.13%	23.21%	18.80%	21.21%	18.78%	16.29%	17.66%	13.57%
23	29.00%	26.69%	18.97%	23.71%	21.05%	18.24%	20.31%	15.39%
24	32.65%	30.48%	22.05%	26.68%	23.81%	20.09%	23.11%	17.69%
25	35.62%	34.30%	25.41%	28.78%	26.08%	22.14%	25.01%	20.64%
26	38.83%	36.60%	27.06%	31.57%	27.58%	23.58%	27.28%	21.19%
27	42.24%	39.54%	30.11%	34.58%	29.48%	23.47%	29.02%	23.19%
28	45.28%	41.58%	32.45%	36.54%	32.55%	24.95%	30.88%	25.06%
29	47.80%	44.00%	34.79%	38.76%	34.21%	27.28%	32.46%	27.13%
30	50.33%	46.75%	36.44%	40.92%	36.18%	27.03%	32.07%	30.06%
31	52.81%	48.75%	39.10%	43.60%	38.39%	28.99%	36.87%	32.59%
32	55.18%	51.71%	41.98%	45.65%	40.43%	31.24%	37.10%	34.67%
33	57.55%	54.22%	43.88%	47.39%	42.50%	33.25%	39.38%	37.42%
34	59.97%	56.42%	47.08%	49.37%	43.60%	35.48%	41.74%	39.51%
35	61.97%	58.09%	49.69%	51.29%	45.96%	37.99%	43.75%	42.50%
36	64.28%	60.86%	52.61%	54.22%	48.32%	39.10%	46.14%	45.24%
37	66.21%	63.15%	54.26%	55.69%	50.18%	41.94%	48.01%	47.74%
38	67.34%	64.30%	56.08%	57.33%	52.30%	43.92%	50.47%	50.27%
39	68.98%	66.48%	57.78%	58.83%	54.73%	45.63%	52.23%	50.62%
40	70.16%	67.69%	59.31%	60.42%	56.36%	47.03%	53.82%	52.17%
41	71.38%	68.93%	60.82%	61.75%	57.19%	48.79%	55.42%	53.58%
42	72.53%	70.22%	62.71%	63.25%	58.12%	50.84%	57.37%	58.39%
43	73.65%	71.26%	64.16%	64.72%	59.67%	52.89%	59.42%	59.77%
44	74.80%	72.43%	65.59%	66.04%	61.56%	53.86%	60.89%	61.57%
45	75.88%	73.51%	66.90%	67.53%	63.40%	55.79%	63.01%	63.38%
46	76.97%	74.40%	68.21%	68.73%	64.78%	57.69%	65.02%	65.37%
47	77.70%	75.37%	69.48%	69.80%	66.20%	59.21%	66.66%	67.13%
48	78.70%	76.43%	70.79%	70.76%	67.68%	61.02%	67.64%	68.92%
49	79.77%	77.37%	71.67%	71.61%	68.99%	62.89%	68.67%	70.09%
50	80.12%	78.09%	72.67%	72.70%	69.86%	64.47%	70.15%	71.29%
51	80.82%	78.92%	73.87%	73.91%	70.79%	66.26%	70.88%	73.02%
52	81.41%	79.45%	74.74%	74.92%	71.93%	67.68%	72.39%	74.40%
53	81.97%	80.00%	75.87%	75.71%	72.84%	69.34%	73.21%	75.23%
54	82.48%	80.63%	76.66%	76.19%	72.65%	71.30%	76.07%	76.20%
55	82.99%	81.24%	77.56%	77.09%	75.06%	73.12%	77.03%	77.69%
56	83.43%	81.85%	78.44%	77.92%	74.84%	74.05%	77.99%	79.06%
57	83.97%	82.31%	79.40%	78.66%	75.73%	75.46%	79.08%	80.05%
58	84.48%	82.79%	80.23%	79.52%	76.55%	76.81%	80.04%	81.01%
59	85.00%	83.09%	81.13%	80.43%	77.85%	78.07%	81.54%	81.91%

Month	2011	2012	2013	2014	2015	2016	2017	2018
60	85.55%	83.52%	81.79%	81.26%	80.71%	79.05%	82.34%	82.73%
61	86.08%	83.80%	82.28%	81.46%	81.39%	80.07%	82.79%	80.46%
62	86.55%	84.30%	83.00%	82.15%	82.31%	81.19%	83.59%	81.51%
63	87.02%	84.72%	83.79%	82.98%	83.43%	81.41%	84.03%	82.36%
64	87.23%	85.23%	84.49%	83.49%	84.13%	82.14%	85.06%	83.01%
65	87.60%	85.60%	84.89%	83.90%	84.93%	82.77%	85.56%	83.48%
66	88.01%	86.16%	85.50%	84.42%	85.90%	85.21%	86.22%	84.24%
67	88.37%	86.64%	86.04%	85.59%	86.69%	86.03%	86.93%	85.15%
68	88.74%	87.14%	86.68%	86.41%	87.48%	86.69%	87.69%	85.82%
69	89.05%	87.75%	87.32%	87.18%	88.40%	87.61%	88.33%	86.42%
70	89.32%	88.64%	87.96%	88.01%	88.96%	88.36%	89.01%	87.29%
71	89.62%	89.24%	88.73%	89.13%	90.01%	89.21%	89.55%	87.93%
72	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%

NOTE: Monthly rates are a percentage of the 90% value at month 72 (end of the 6th year of availability).

APPENDIX D. DISTRIBUTIONS OF OBLIGATION AND EXPENDITURE RATES

Below are the distributions of the actual monthly DoD obligation and expenditure (disbursement) rates from FY 2011–2023 calculated from the dollars obtained from Advana. Shown are the following percentiles: 0th (minimum), 20th, 50th (average), 80th, 90th, 95th, and 100th (maximum).

CUMULATIVE OBLIGATION DISTRIBUTIONS: RDT&E, PROC, O&M, MILPERS, AND MILCON

Table D-1. Distribution of Cumulative Obligations: RDT&E (FY 2011–2022 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	1.83%	3.00%	3.60%	3.62%	4.34%	4.55%	4.98%	5.49%
2	5.86%	8.44%	8.82%	9.57%	10.71%	13.83%	14.30%	14.49%
3	10.71%	13.37%	14.03%	15.93%	16.62%	25.55%	26.87%	27.32%
4	16.75%	19.10%	20.74%	22.62%	23.71%	32.12%	34.41%	36.16%
5	23.49%	26.27%	31.60%	31.88%	36.96%	37.31%	40.89%	45.23%
6	29.47%	35.26%	44.46%	43.31%	51.46%	52.81%	53.39%	54.02%
7	37.58%	40.75%	57.30%	51.60%	58.76%	60.35%	60.78%	61.09%
8	47.13%	49.64%	61.03%	58.26%	65.30%	65.83%	65.94%	66.01%
9	55.93%	60.34%	69.74%	66.45%	71.29%	71.33%	71.76%	72.27%
10	65.39%	68.89%	74.90%	72.74%	76.32%	77.00%	77.13%	77.20%
11	74.57%	75.43%	79.75%	78.71%	81.10%	81.41%	81.59%	81.78%
12	81.75%	83.52%	86.75%	85.65%	87.34%	87.57%	87.77%	87.98%
13	84.73%	85.09%	87.60%	86.95%	88.53%	88.71%	88.95%	89.23%
14	87.04%	87.54%	89.82%	89.33%	90.74%	91.00%	91.02%	91.02%
15	88.96%	89.45%	91.38%	91.03%	92.27%	92.44%	92.76%	93.13%
16	90.30%	90.97%	92.43%	92.23%	93.39%	93.43%	93.80%	94.25%
17	92.07%	92.68%	93.68%	93.55%	94.28%	94.32%	94.72%	95.20%
18	93.52%	94.23%	94.86%	94.80%	95.35%	95.40%	95.82%	96.32%
19	94.58%	95.18%	95.62%	95.61%	96.19%	96.26%	96.50%	96.80%
20	95.37%	95.76%	96.52%	96.31%	96.82%	96.96%	97.09%	97.23%
21	95.92%	96.84%	97.20%	97.14%	97.56%	97.64%	97.68%	97.73%
22	96.75%	97.61%	97.78%	97.82%	98.09%	98.30%	98.60%	98.95%
23	97.42%	98.35%	98.49%	98.49%	98.68%	98.74%	99.10%	99.53%
24	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D-2. Distribution of Cumulative Obligations: PROC (FY 2011–2021 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	0.455%	0.610%	0.935%	1.43%	2.71%	3.06%	3.07%	3.09%
2	2.22%	4.87%	5.83%	5.94%	7.06%	8.44%	8.53%	8.62%
3	7.87%	9.31%	11.22%	12.00%	13.09%	18.33%	19.71%	21.09%
4	11.44%	16.07%	18.23%	18.21%	20.03%	22.49%	24.83%	27.17%
5	16.88%	22.36%	25.32%	24.89%	29.43%	29.67%	31.28%	32.89%
6	23.39%	30.36%	37.92%	35.00%	40.56%	41.01%	44.03%	47.05%
7	26.18%	33.32%	43.41%	40.63%	46.73%	47.58%	51.07%	54.55%
8	29.75%	37.80%	48.37%	45.33%	50.37%	53.19%	56.51%	59.83%
9	38.52%	44.86%	53.75%	51.80%	57.12%	59.11%	62.80%	66.49%
10	45.08%	53.91%	58.28%	57.46%	60.97%	62.78%	67.44%	72.10%
11	50.45%	61.11%	64.18%	62.63%	64.76%	67.09%	71.24%	75.38%
12	58.35%	70.23%	72.64%	72.26%	74.87%	77.98%	80.25%	82.53%
13	60.40%	73.51%	74.55%	74.21%	76.73%	80.06%	82.25%	84.45%
14	62.45%	75.41%	77.54%	76.94%	81.27%	81.45%	83.75%	86.04%
15	66.61%	78.33%	79.22%	80.07%	84.20%	87.09%	87.27%	87.45%
16	71.28%	79.48%	80.20%	81.74%	86.38%	88.37%	88.95%	89.54%
17	73.68%	80.99%	82.44%	83.00%	86.82%	89.84%	90.08%	90.31%
18	76.78%	82.65%	84.74%	85.07%	88.43%	91.52%	91.57%	91.61%
19	78.51%	84.03%	85.81%	86.29%	89.74%	92.31%	92.51%	92.72%
20	80.18%	84.78%	87.13%	87.29%	91.52%	92.91%	93.10%	93.29%
21	81.49%	85.62%	88.89%	88.52%	92.88%	93.19%	93.64%	94.08%
22	83.01%	86.16%	89.20%	89.38%	93.51%	94.06%	94.39%	94.71%
23	84.52%	87.95%	90.49%	90.55%	93.96%	94.69%	95.33%	95.97%
24	87.35%	90.72%	92.92%	92.60%	95.15%	96.37%	96.69%	97.00%
25	88.60%	91.92%	93.20%	93.10%	95.08%	95.45%	96.22%	96.99%
26	89.56%	92.79%	93.73%	94.02%	95.71%	97.55%	97.68%	97.82%
27	92.96%	93.63%	94.99%	95.15%	96.13%	98.10%	98.18%	98.25%
28	93.64%	94.81%	95.37%	95.91%	97.44%	98.48%	98.67%	98.86%
29	94.20%	95.39%	95.87%	96.20%	96.66%	98.68%	98.92%	99.17%
30	94.98%	95.93%	96.33%	96.72%	97.20%	99.10%	99.33%	99.57%
31	95.26%	96.48%	96.87%	97.16%	97.46%	99.36%	99.72%	100.09%
32	95.86%	97.14%	97.31%	97.63%	97.55%	99.55%	99.97%	100.39%
33	96.40%	97.50%	97.70%	98.08%	98.02%	99.81%	100.58%	101.36%
34	96.86%	97.76%	98.14%	98.33%	98.31%	98.62%	100.37%	102.11%
35	97.94%	98.29%	98.49%	98.46%	98.66%	98.71%	98.73%	98.76%
36	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D-3. Distribution of Cumulative Obligations: O&M (FY 2011–2023 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	5.52%	5.72%	6.15%	6.47%	6.94%	7.59%	8.12%	8.76%
2	9.73%	12.15%	12.71%	13.26%	14.38%	15.91%	17.19%	18.89%
3	16.61%	18.50%	19.77%	20.37%	22.41%	23.99%	25.01%	26.43%
4	25.11%	26.87%	28.90%	29.23%	30.51%	32.76%	33.86%	34.75%
5	33.36%	35.34%	38.05%	37.63%	38.80%	39.79%	40.64%	41.58%
6	42.40%	44.35%	48.02%	47.04%	49.44%	49.66%	49.83%	50.02%
7	49.81%	52.73%	57.08%	55.71%	58.50%	59.04%	59.06%	59.07%
8	59.73%	62.62%	64.10%	63.79%	65.17%	65.95%	66.33%	66.63%
9	69.15%	71.53%	72.68%	72.40%	73.46%	73.75%	74.14%	74.67%
10	80.85%	82.24%	82.43%	82.68%	83.08%	83.56%	84.36%	85.45%
11	87.33%	87.89%	88.67%	88.54%	89.15%	89.19%	89.49%	89.94%
12	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D-4. Distribution of Cumulative Obligations: MILCON (FY 2011–2019 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	0.000%	0.002%	0.094%	0.537%	0.854%	1.74%	2.21%	2.68%
2	0.079%	0.147%	0.404%	0.911%	1.79%	2.19%	2.47%	2.75%
3	0.186%	0.616%	1.04%	1.41%	2.14%	2.75%	3.23%	3.72%
4	0.990%	1.64%	2.35%	3.00%	4.07%	4.82%	6.24%	7.66%
5	1.46%	4.03%	4.98%	5.27%	6.07%	7.22%	8.62%	10.01%
6	2.28%	5.54%	7.53%	8.04%	11.04%	12.77%	13.17%	13.58%
7	4.05%	6.22%	10.16%	10.13%	13.54%	15.37%	16.25%	17.14%
8	8.87%	11.29%	13.45%	14.19%	15.66%	18.14%	21.41%	24.68%
9	11.34%	16.52%	19.54%	20.61%	25.80%	29.52%	30.91%	32.29%
10	13.40%	20.64%	22.46%	24.83%	31.12%	35.30%	36.50%	37.71%
11	17.13%	25.22%	30.07%	30.51%	36.27%	41.23%	42.98%	44.73%
12	31.25%	35.35%	41.84%	42.65%	50.12%	58.75%	58.79%	58.84%
13	32.19%	36.07%	42.54%	44.21%	53.04%	61.16%	61.19%	61.22%
14	35.28%	38.08%	43.91%	45.76%	53.80%	61.32%	61.46%	61.61%
15	37.94%	40.00%	44.73%	47.78%	55.60%	61.80%	62.03%	62.25%
16	41.07%	41.97%	46.33%	49.61%	57.14%	62.90%	63.23%	63.56%
17	41.96%	42.91%	46.92%	50.63%	59.05%	64.18%	64.25%	64.31%
18	44.09%	44.76%	50.43%	52.15%	59.84%	64.60%	64.69%	64.79%
19	45.15%	47.47%	51.51%	53.74%	60.74%	65.71%	65.79%	65.87%
20	46.55%	48.51%	52.78%	55.02%	61.88%	66.38%	66.93%	67.48%
21	47.99%	50.63%	53.60%	56.51%	63.37%	67.11%	67.99%	68.88%
22	50.39%	51.72%	55.15%	57.88%	64.81%	67.75%	68.58%	69.41%
23	53.52%	54.07%	58.38%	60.41%	65.60%	68.90%	70.46%	72.02%
24	55.59%	58.30%	62.40%	63.70%	69.05%	70.86%	73.12%	75.38%
25	55.96%	58.67%	62.62%	64.24%	69.60%	71.30%	73.61%	75.93%
26	57.03%	59.91%	67.02%	65.42%	69.95%	71.48%	73.93%	76.38%
27	58.82%	59.34%	67.65%	66.33%	70.82%	72.34%	74.38%	76.42%
28	59.96%	60.38%	68.07%	67.25%	71.65%	73.05%	75.64%	78.24%
29	60.35%	62.35%	68.83%	68.12%	72.11%	73.92%	76.32%	78.73%
30	60.99%	62.95%	69.23%	68.85%	72.45%	74.18%	76.64%	79.10%
31	61.56%	63.72%	69.90%	69.45%	73.40%	74.62%	76.83%	79.04%
32	62.12%	64.81%	70.83%	70.15%	73.93%	75.03%	77.15%	79.27%
33	62.58%	66.53%	71.29%	70.94%	74.72%	75.83%	77.83%	79.82%
34	63.45%	68.38%	72.16%	71.85%	75.27%	76.54%	78.22%	79.89%
35	63.43%	69.50%	72.76%	72.47%	75.79%	76.97%	78.73%	80.50%
36	64.60%	72.39%	74.12%	74.58%	77.53%	78.50%	80.42%	82.34%
37	65.02%	72.28%	74.45%	74.72%	77.69%	78.98%	80.67%	82.36%
38	65.20%	73.58%	74.76%	75.26%	77.89%	79.27%	80.88%	82.49%
39	66.03%	74.40%	76.60%	76.04%	78.46%	79.32%	80.99%	82.67%
40	66.35%	74.76%	77.18%	76.72%	79.82%	80.59%	81.74%	82.90%
41	66.85%	75.38%	78.03%	77.09%	79.69%	80.83%	81.97%	83.11%
42	67.14%	76.58%	78.63%	77.74%	80.14%	81.49%	82.40%	83.32%
43	69.08%	77.23%	79.01%	78.39%	80.53%	81.83%	82.69%	83.55%
44	70.96%	77.42%	79.59%	78.81%	80.60%	81.86%	82.75%	83.65%
45	71.76%	78.27%	79.93%	79.36%	80.96%	82.15%	83.02%	83.89%
46	71.67%	78.99%	80.07%	79.66%	81.28%	82.74%	83.47%	84.19%
47	71.91%	79.18%	80.34%	79.98%	82.04%	83.53%	83.80%	84.06%
48	73.56%	79.90%	80.61%	80.95%	83.44%	84.93%	84.94%	84.94%
49	73.41%	79.99%	80.11%	80.92%	83.38%	85.04%	85.10%	85.15%
50	75.68%	80.27%	81.37%	81.52%	83.57%	85.19%	85.19%	85.20%
51	75.00%	80.52%	81.49%	81.75%	83.82%	85.65%	85.99%	86.34%
52	75.20%	80.48%	81.71%	81.92%	84.09%	85.89%	86.20%	86.51%
53	74.98%	80.91%	81.75%	82.10%	84.28%	85.98%	86.33%	86.68%
54	77.87%	81.17%	82.33%	82.64%	84.56%	85.98%	86.12%	86.26%
55	78.65%	81.29%	82.68%	82.95%	84.92%	86.23%	86.24%	86.25%
56	79.77%	82.44%	83.92%	83.71%	85.13%	86.59%	86.71%	86.83%
57	80.03%	83.06%	84.54%	84.28%	85.87%	87.18%	87.20%	87.22%
58	83.25%	84.72%	85.57%	85.68%	86.68%	87.59%	87.69%	87.78%
59	85.06%	85.93%	86.23%	86.77%	87.90%	88.20%	88.35%	88.51%
60	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%

Table D-5. Distribution of Cumulative Expenditures: RDT&E (FY 2011–2021 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	0.315%	0.389%	0.601%	0.555%	0.657%	0.792%	0.819%	0.846%
2	1.38%	1.56%	1.72%	1.7%	1.80%	1.95%	2.08%	2.21%
3	3.41%	3.78%	3.90%	4.0%	4.19%	4.78%	4.86%	4.94%
4	5.14%	5.53%	6.27%	6.5%	6.94%	8.58%	8.74%	8.91%
5	7.85%	8.71%	9.68%	10%	10.58%	10.60%	11.93%	13.26%
6	11.25%	14.54%	15.04%	15%	17.19%	17.24%	17.81%	18.38%
7	16.35%	18.95%	20.56%	20%	21.62%	22.26%	22.53%	22.79%
8	21.98%	22.85%	25.65%	25%	26.93%	27.80%	28.30%	28.80%
9	27.93%	30.01%	31.22%	32%	33.47%	33.97%	35.68%	37.39%
10	34.93%	36.04%	37.75%	38%	38.87%	39.47%	39.64%	39.80%
11	40.68%	42.27%	43.50%	43%	44.52%	45.33%	45.34%	45.35%
12	45.88%	49.10%	50.41%	50%	51.10%	52.42%	52.74%	53.06%
13	52.24%	53.71%	55.14%	55%	56.21%	56.37%	57.00%	57.62%
14	56.90%	58.90%	59.96%	60%	60.84%	61.08%	61.49%	61.90%
15	61.60%	64.64%	66.07%	66%	66.75%	67.44%	68.03%	68.62%
16	65.34%	68.55%	69.98%	69%	70.75%	70.83%	71.47%	72.11%
17	69.03%	71.72%	73.23%	73%	74.04%	74.18%	74.89%	75.60%
18	74.02%	76.38%	77.20%	77%	78.02%	78.37%	78.53%	78.68%
19	78.01%	78.84%	79.93%	80%	80.54%	81.48%	81.75%	82.02%
20	80.52%	81.73%	82.65%	82%	82.89%	83.91%	84.08%	84.25%
21	82.82%	84.03%	85.12%	85%	85.32%	86.17%	86.31%	86.45%
22	84.80%	86.16%	87.08%	87%	87.54%	88.11%	88.20%	88.29%
23	86.98%	88.29%	88.91%	89%	89.49%	89.60%	89.84%	90.09%
24	89.15%	90.57%	90.93%	91%	91.44%	91.64%	91.91%	92.18%
25	90.91%	91.74%	92.61%	92%	93.11%	93.14%	93.32%	93.49%
26	92.33%	93.07%	93.63%	94%	94.20%	94.71%	94.75%	94.78%
27	93.36%	94.61%	94.96%	95%	95.21%	95.23%	95.51%	95.80%
28	94.34%	95.40%	95.74%	96%	95.91%	96.16%	96.25%	96.34%
29	95.11%	96.14%	96.35%	96%	96.65%	96.88%	96.91%	96.93%
30	96.22%	96.86%	97.13%	97%	97.65%	97.71%	97.91%	98.10%
31	96.99%	97.49%	97.71%	98%	98.25%	98.42%	98.53%	98.64%
32	97.59%	98.04%	98.16%	98%	98.50%	98.70%	98.93%	99.16%
33	98.16%	98.63%	98.72%	99%	99.24%	99.62%	99.63%	99.63%
34	98.54%	98.89%	99.15%	99%	99.39%	99.59%	99.80%	100.00%
35	98.90%	99.24%	99.57%	100%	99.72%	99.91%	100.00%	100.00%
36	100.00%	100.00%	100.00%	100%	100.00%	100.00%	100.00%	100.00%

Table D-6. Distribution of Cumulative Expenditures: PROC (FY 2011–2019 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	0.003%	0.045%	0.085%	0.367%	0.195%	0.700%	1.63%	2.56%
2	0.148%	0.227%	0.568%	1.03%	1.74%	2.29%	2.62%	2.96%
3	0.535%	0.655%	2.26%	1.90%	3.16%	3.34%	3.43%	3.52%
4	0.819%	3.18%	3.71%	3.83%	4.66%	5.59%	6.09%	6.59%
5	1.31%	4.18%	6.07%	5.32%	6.47%	7.01%	7.30%	7.58%
6	2.91%	6.78%	7.99%	7.60%	9.02%	9.86%	9.95%	10.05%
7	4.13%	8.07%	9.05%	8.97%	10.86%	11.23%	11.39%	11.55%
8	5.49%	9.28%	11.44%	10.93%	13.18%	13.46%	13.58%	13.70%
9	6.98%	11.96%	13.36%	13.27%	15.37%	15.63%	15.92%	16.21%
10	8.66%	14.58%	16.93%	15.79%	18.10%	18.34%	18.39%	18.45%
11	10.57%	17.43%	20.04%	18.63%	20.97%	21.31%	21.44%	21.57%
12	12.98%	20.96%	23.33%	21.91%	24.20%	24.81%	25.04%	25.26%
13	15.02%	22.71%	25.19%	23.99%	26.40%	27.28%	27.58%	27.87%
14	18.95%	25.28%	27.91%	26.67%	28.86%	29.87%	30.22%	30.56%
15	22.56%	27.90%	30.45%	30.06%	32.54%	34.19%	34.80%	35.41%
16	25.09%	31.01%	34.44%	33.04%	36.06%	36.52%	36.87%	37.21%
17	27.30%	30.61%	36.19%	34.92%	38.85%	39.45%	39.76%	40.07%
18	30.59%	33.58%	40.71%	38.52%	42.28%	42.84%	43.53%	44.21%
19	33.40%	35.95%	43.31%	41.04%	44.98%	45.56%	45.97%	46.39%
20	35.83%	38.72%	46.07%	43.33%	46.83%	47.26%	47.67%	48.09%
21	38.92%	41.72%	49.03%	46.40%	50.14%	50.69%	50.92%	51.14%
22	41.17%	44.36%	51.02%	48.69%	52.58%	53.14%	53.17%	53.20%
23	43.49%	47.04%	53.35%	51.07%	55.06%	55.32%	55.40%	55.48%
24	46.42%	50.13%	56.01%	54.04%	58.23%	58.60%	58.63%	58.66%
25	48.67%	52.60%	58.11%	56.38%	60.74%	60.76%	60.78%	60.80%
26	51.09%	55.64%	60.52%	59.01%	63.18%	64.00%	64.03%	64.07%
27	51.36%	58.52%	63.30%	61.67%	66.47%	66.74%	66.89%	67.04%
28	52.46%	60.36%	65.04%	63.72%	68.26%	68.42%	68.63%	68.84%
29	53.64%	62.41%	66.92%	65.55%	69.83%	70.06%	70.35%	70.65%
30	61.15%	64.89%	69.95%	68.58%	72.28%	72.65%	72.72%	72.79%
31	63.23%	67.39%	71.79%	70.61%	73.99%	74.35%	74.39%	74.43%
32	65.33%	69.30%	73.64%	72.45%	75.57%	75.91%	75.98%	76.05%
33	67.74%	71.27%	75.67%	74.51%	77.52%	77.83%	77.94%	78.06%
34	69.61%	73.49%	77.26%	76.19%	78.90%	79.21%	79.37%	79.54%
35	71.58%	75.32%	79.37%	77.93%	80.35%	80.76%	80.98%	81.19%
36	74.19%	77.30%	81.17%	79.94%	82.15%	82.48%	82.86%	83.23%
37	73.56%	78.91%	82.66%	81.14%	83.59%	83.81%	84.21%	84.60%
38	77.72%	80.67%	83.95%	82.98%	85.00%	85.33%	85.96%	86.59%
39	79.22%	82.49%	85.70%	84.69%	86.55%	86.95%	87.66%	88.38%
40	79.71%	83.60%	86.91%	85.66%	87.75%	87.97%	88.31%	88.65%
41	80.38%	84.68%	87.87%	86.65%	88.64%	88.84%	89.24%	89.63%
42	84.50%	86.57%	89.10%	88.31%	89.75%	90.01%	90.24%	90.48%
43	85.85%	88.04%	90.16%	89.48%	90.80%	90.96%	91.23%	91.50%
44	86.99%	89.19%	91.05%	90.40%	91.60%	91.75%	92.04%	92.32%
45	88.27%	90.34%	91.91%	91.47%	92.54%	92.73%	93.08%	93.43%
46	89.28%	91.14%	92.71%	92.24%	93.25%	93.54%	93.75%	93.96%
47	90.33%	92.12%	93.41%	93.05%	94.01%	94.22%	94.43%	94.64%
48	91.72%	93.19%	94.24%	93.93%	94.76%	94.97%	95.08%	95.19%
49	91.67%	93.59%	94.78%	94.41%	95.39%	95.52%	95.66%	95.80%
50	93.49%	94.61%	95.42%	95.31%	96.11%	96.43%	96.46%	96.48%
51	94.75%	95.10%	96.19%	96.06%	96.80%	97.12%	97.15%	97.19%
52	94.91%	95.57%	96.55%	96.39%	97.10%	97.27%	97.36%	97.44%
53	95.07%	96.18%	97.02%	96.82%	97.52%	97.62%	97.71%	97.80%
54	96.99%	97.29%	97.55%	97.60%	97.98%	98.06%	98.14%	98.22%
55	97.47%	97.73%	98.15%	98.04%	98.28%	98.40%	98.48%	98.56%
56	98.06%	98.25%	98.50%	98.50%	98.70%	98.76%	98.85%	98.95%
57	98.67%	98.79%	99.00%	98.96%	99.12%	99.15%	99.16%	99.16%
58	99.01%	99.21%	99.37%	99.32%	99.44%	99.45%	99.45%	99.45%
59	99.44%	99.59%	99.63%	99.63%	99.69%	99.72%	99.72%	99.73%
60	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D-7. Distribution of Cumulative Expenditures: O&M (FY 2011–2022 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	1.28%	1.48%	1.84%	1.85%	2.06%	2.52%	2.62%	2.69%
2	4.88%	5.01%	5.50%	5.46%	5.84%	5.88%	6.01%	6.16%
3	8.68%	9.59%	9.95%	9.93%	10.47%	10.63%	10.66%	10.69%
4	13.43%	13.98%	14.74%	14.76%	15.41%	15.84%	16.10%	16.37%
5	18.64%	19.35%	20.11%	20.10%	20.59%	21.10%	21.41%	21.73%
6	24.68%	25.50%	26.47%	26.37%	27.22%	27.59%	27.77%	27.96%
7	31.21%	31.68%	32.77%	32.77%	33.64%	34.14%	34.41%	34.69%
8	36.30%	37.90%	39.64%	39.16%	40.15%	40.49%	40.84%	41.24%
9	44.71%	45.73%	46.22%	46.39%	47.40%	47.61%	47.96%	48.38%
10	51.68%	52.44%	53.02%	53.49%	54.82%	54.95%	55.45%	56.05%
11	59.38%	59.82%	60.83%	61.00%	62.42%	62.53%	62.72%	62.94%
12	67.04%	68.28%	69.24%	69.18%	70.48%	70.80%	70.91%	71.02%
13	73.60%	74.28%	75.34%	75.20%	76.14%	76.32%	76.36%	76.40%
14	78.05%	78.27%	79.37%	79.38%	80.01%	81.00%	81.12%	81.13%
15	81.70%	82.61%	83.07%	83.17%	84.01%	84.35%	84.64%	84.97%
16	84.83%	85.55%	85.92%	85.97%	86.57%	86.89%	87.11%	87.34%
17	87.63%	88.18%	88.67%	88.61%	88.92%	89.49%	89.57%	89.60%
18	90.19%	90.84%	91.19%	91.20%	91.68%	91.92%	91.96%	91.97%
19	92.33%	92.74%	93.27%	93.18%	93.57%	93.63%	93.81%	94.02%
20	94.19%	94.66%	94.95%	94.90%	95.17%	95.32%	95.39%	95.45%
21	95.88%	96.21%	96.42%	96.45%	96.77%	96.82%	96.91%	97.02%
22	97.45%	97.50%	97.69%	97.71%	97.82%	97.92%	98.07%	98.25%
23	98.66%	98.78%	98.90%	98.90%	99.01%	99.03%	99.13%	99.24%
24	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table D-8. Distribution of Cumulative Expenditures: MILCON (FY 2011–2019 Appropriations)

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
1	0.000%	0.000%	0.004%	0.000%	0.026%	0.036%	0.040%	0.044%
2	0.000%	0.045%	0.089%	0.112%	0.144%	0.244%	0.330%	0.416%
3	0.000%	0.135%	0.218%	0.341%	0.385%	0.718%	1.03%	1.35%
4	0.000%	0.194%	0.309%	0.308%	0.493%	0.559%	0.589%	0.620%
5	0.000%	0.393%	0.499%	0.495%	0.702%	0.789%	0.825%	0.861%
6	0.293%	0.561%	0.743%	0.762%	0.954%	1.09%	1.20%	1.31%
7	0.451%	0.741%	0.979%	0.993%	1.13%	1.37%	1.59%	1.81%
8	0.404%	0.820%	1.12%	1.15%	1.36%	1.70%	1.94%	2.18%
9	0.817%	1.42%	1.49%	1.57%	1.85%	1.97%	2.10%	2.23%
10	1.04%	1.78%	1.96%	2.06%	2.40%	2.66%	2.92%	3.19%
11	1.32%	2.32%	2.62%	2.65%	3.27%	3.37%	3.44%	3.50%
12	3.12%	3.39%	3.78%	3.89%	4.21%	4.60%	4.93%	5.25%
13	3.91%	4.16%	4.50%	4.61%	4.96%	5.23%	5.47%	5.71%
14	4.80%	4.86%	5.32%	5.51%	6.17%	6.40%	6.52%	6.64%
15	5.82%	5.89%	6.52%	6.71%	7.34%	7.84%	8.15%	8.46%
16	6.68%	6.87%	7.57%	7.87%	8.87%	9.53%	9.73%	9.92%
17	7.72%	8.08%	9.07%	9.29%	10.58%	11.00%	11.13%	11.25%
18	8.18%	9.63%	10.04%	10.60%	12.37%	12.50%	12.55%	12.59%
19	10.20%	10.93%	11.49%	12.35%	14.41%	14.71%	14.87%	15.02%
20	10.46%	12.63%	13.73%	14.44%	16.98%	17.68%	18.05%	18.41%
21	11.97%	14.70%	16.49%	16.78%	19.32%	20.35%	20.85%	21.36%
22	13.57%	16.84%	18.79%	19.33%	22.41%	23.79%	24.46%	25.13%
23	15.39%	18.53%	20.68%	21.67%	25.49%	27.38%	28.19%	29.00%
24	17.69%	20.88%	23.46%	24.57%	28.96%	31.13%	31.89%	32.65%
25	20.64%	23.29%	25.74%	27.25%	32.09%	34.70%	35.16%	35.62%
26	21.19%	24.97%	27.43%	29.21%	34.59%	37.27%	38.05%	38.83%
27	23.19%	25.69%	29.80%	31.45%	37.56%	40.35%	41.29%	42.24%
28	24.95%	27.39%	32.50%	33.66%	39.57%	42.69%	43.98%	45.28%
29	27.13%	29.35%	34.50%	35.80%	41.90%	45.14%	46.47%	47.80%
30	27.03%	30.86%	36.31%	37.47%	44.42%	47.83%	49.08%	50.33%
31	28.99%	34.30%	38.74%	40.14%	46.69%	49.97%	51.39%	52.81%
32	31.24%	35.65%	41.21%	42.25%	49.29%	52.75%	53.97%	55.18%
33	33.25%	38.20%	43.19%	44.45%	51.49%	55.22%	56.39%	57.55%
34	35.48%	40.40%	45.34%	46.65%	53.60%	57.48%	58.73%	59.97%
35	37.99%	43.00%	47.83%	48.91%	55.37%	59.26%	60.62%	61.97%
36	39.10%	45.60%	50.47%	51.35%	58.20%	61.88%	63.08%	64.28%
37	41.94%	47.85%	52.22%	53.40%	60.17%	64.07%	65.14%	66.21%
38	43.92%	50.35%	54.19%	55.25%	61.51%	65.21%	66.28%	67.34%
39	45.63%	51.26%	56.26%	56.91%	63.42%	67.23%	68.10%	68.98%
40	47.03%	52.83%	57.83%	58.37%	64.78%	68.43%	69.29%	70.16%
41	48.79%	54.32%	59.01%	59.73%	66.06%	69.66%	70.52%	71.38%
42	50.84%	57.67%	60.55%	61.68%	67.43%	70.91%	71.72%	72.53%
43	52.89%	59.52%	61.96%	63.19%	68.64%	71.98%	72.82%	73.65%
44	53.86%	61.16%	63.58%	64.59%	69.87%	73.14%	73.97%	74.80%
45	55.79%	63.16%	65.15%	66.18%	71.12%	74.22%	75.05%	75.88%
46	57.69%	64.87%	66.79%	67.65%	72.13%	75.17%	76.07%	76.97%
47	59.21%	66.39%	68.31%	68.94%	73.14%	76.07%	76.88%	77.70%
48	61.02%	67.66%	69.84%	70.24%	74.17%	77.11%	77.91%	78.70%
49	62.89%	68.80%	70.85%	71.38%	75.09%	78.09%	78.93%	79.77%
50	64.47%	69.98%	71.98%	72.42%	75.94%	78.70%	79.41%	80.12%
51	66.26%	70.83%	73.45%	73.56%	76.92%	79.49%	80.16%	80.82%
52	67.68%	72.11%	74.57%	74.61%	77.64%	80.04%	80.72%	81.41%
53	69.34%	72.99%	75.47%	75.52%	78.35%	80.59%	81.28%	81.97%
54	71.30%	74.02%	76.20%	76.52%	79.04%	81.19%	81.84%	82.48%
55	73.12%	75.85%	77.33%	77.72%	79.82%	81.77%	82.38%	82.99%
56	74.05%	76.07%	78.22%	78.45%	80.73%	82.32%	82.88%	83.43%
57	75.46%	76.90%	79.24%	79.33%	81.40%	82.81%	83.39%	83.97%
58	76.55%	77.89%	80.14%	80.18%	82.08%	83.29%	83.89%	84.48%

Month	Min	20th Percentile	50th Percentile	Average	80th Percentile	90th Percentile	95th Percentile	Max.
59	77.85%	79.01%	81.33%	81.13%	82.62%	83.66%	84.33%	85.00%
60	79.05%	80.93%	82.07%	82.12%	83.21%	84.13%	84.84%	85.55%
61	80.07%	80.83%	81.87%	82.29%	83.40%	84.49%	85.28%	86.08%
62	81.19%	81.77%	82.66%	83.08%	84.02%	84.97%	85.76%	86.55%
63	81.41%	82.61%	83.61%	83.72%	84.44%	85.41%	86.21%	87.02%
64	82.14%	83.20%	84.31%	84.35%	85.16%	85.83%	86.53%	87.23%
65	82.77%	83.65%	84.91%	84.84%	85.58%	86.20%	86.90%	87.60%
66	84.24%	84.74%	85.70%	85.71%	86.19%	86.75%	87.38%	88.01%
67	85.15%	85.77%	86.34%	86.43%	86.83%	87.36%	87.87%	88.37%
68	85.82%	86.52%	86.91%	87.08%	87.61%	88.01%	88.37%	88.74%
69	86.42%	87.24%	87.68%	87.76%	88.37%	88.60%	88.82%	89.05%
70	87.29%	87.98%	88.50%	88.44%	88.99%	89.11%	89.21%	89.32%
71	87.93%	88.89%	89.23%	89.18%	89.59%	89.73%	89.87%	90.01%
72	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%

REFERENCES

Anton, Philip S. *Thoughts on Agility Through Appropriations: If BA-8 Is Successful, What Next?* Acquisition Innovation Research Center, Stevens Institute of Technology, Hoboken, NJ, October 2022. https://acqirc.org/publications/research/thoughts-on-agility-through-appropriations/. Accessed October 2023.

Behn, Robert D. "On why, to improve performance, measurement is rarely enough." *Bob Behn's Public Management Report*, 5(9), May 2008.

Brown, Gregory E., Edward D. White, Jonathan D. Ritschel, & Michael J. Seibel. "Time Phasing Aircraft R&D Using the Weibull and Beta Distributions." *Journal of Cost Analysis and Parametrics*, 8:3, 2015, pp. 150–164. https://doi.org/10.1080/1941658X.2015.1096219. Accessed October 2023.

Burgess, Erik, James Smirnoff, & Brianne Wong. "Weibull Analysis Method," briefing. *ICEAA Annual Symposium*. Denver, CO. June 2014.

Commission on Planning, Programming, Budgeting, and Execution (PPBE) Reform. *Interim Report*. August 2023. https://ppbereform.senate.gov/wp-content/uploads/2023/08/PPBE-Commission-Interim-Report-Final.pdf. Accessed October 2023.

Congressional Research Service (CRS). "End-Year DOD Contract Spending." IF10365, Version 6, Washington, D.C., November 17, 2017. https://crsreports.congress.gov/product/pdf/IF/IF10365/6. Accessed October 2023.

Daniels, Seamus P., & Todd Harrison. *Actual Obligation Rates versus Comptroller Projected Obligation Rates*. Center for Strategic & International Studies. Washington DC. March 2020. 200302_ObligationRates_v6.pdf (csis-website-prod.s3.amazonaws.com). Accessed January 2024.

Davis, Dan. "Early Warning Model for Acquisition Program Cost and Schedule Growth." *2008 SCEA-ISPA Joint Annual Conference and Training Workshop*. April 15, 2008. https://www.iceaaonline.com/wp-content/uploads/2017/09/EVM04.pdf. Accessed October 2023.

Davis, Dan, Gary Christle, & Wayne Abba. *Using the Rayleigh Model to Assess Future Acquisition Contract Performance and Overall Contract Risk: The future isn't what it used to be. (Yogi Berra) (Volume I)*. CRM D0019289.A2/Final, Center for Naval Analysis, January 2009. https://www.cna.org/archive/CNA_Files/pdf/d0019289.a2.pdf. Accessed October 2023.

Defense Acquisition University (DAU). "Procurement Lead Time," Acquipedia article, undated. https://www.dau.edu/acquipedia-article/procurement-lead-time. Accessed October 2023.

Department of the Air Force. *Planning, Programming, Budgeting, and Execution System Training Program: Reference Manual*. February 2022. https://afacpo.com/AQDocs/PPBE.pdf. Accessed December 2023.

Gallagher, Mark A., & David A. Lee. "Final-Cost Estimates for Research & Development Programs Conditioned on Realized Costs." *Military Operations Research*. 2(2), June 1996, pp. 51–65 (prepublication dated June 1995). https://www.researchgate.net/profile/Mark-Gallagher-5/publication/233620264_Final-Cost_Estimates_for_Research_Development_Programs_Conditioned_on_Realized_Costs/links/55956b8808ae5d8f3930f1ff/Final-Cost-Estimates-for-Research-Development-Programs-Conditioned-on-Realized-Costs.pdf. Accessed October 2023.

Gill, David. "Understanding PALT Timeframes with Big Data Analytics," briefing. *Naval Postgraduate School Acquisition Research Symposium*, May 22, 2021. https://dair.nps.edu/bitstream/123456789/4426/3/SYM-AM-21-119.pdf. Accessed October 2023.

Government Accountability Office (GAO). *A Glossary of Terms Used in the Federal Budget Process*." GAO-05-734SP, Washington, D.C., September 2005. https://www.gao.gov/assets/gao-05-734sp.pdf. Accessed October 2023.

Lee, David A., Michael R. Hogue, & Mark. A. Gallagher. *Determining a Budget Profile from a Development Cost Estimate*. September 1, 1993. https://apps.dtic.mil/sti/pdfs/ADA275864.pdf. Accessed October 2023.

Lee, D., Hogue, M., & Hoffman, D. "Time Histories of Expenditures for Defense Acquisition Programs in the Development Phase." *Annual Meeting of the International Society for Parametric Analysis*, 1993.

Marsalis, Jesse R. "The Negative Impacts of the Benchmarks." Senior Acquisition Course, National Defense University, 2022. fc216616-7b4c-45e6-d4fa-c4bc48a6b71f (nps.edu). Accessed October 2023.

Marine Corps Installations East. "Procurement Lead Action Time (PALT)," webpage. U.S. Marine Corps, 2021. https://www.mcieast.marines.mil/Staff-Offices/Contracting/Procurement-Administrative-Lead-Time/. Accessed October 2023.

National Defense Industrial Association (NDIA). *A Guide to Managing Programs Using Predictive Measures, Revision 2*. Arlington, VA. September 12, 2017.

National Research Council 2005. Thinking Strategically: The Appropriate Use of Metrics for the Climate Change Science Program. Washington, D.C.: The National Academies Press. https://doi.org/10.17226/11292.

Norden, Peter V. "Useful Tools for Project Management." *Management of Production*. William Voris & M. K. Starr (eds.). Baltimore MD: Penguin, 1970, pp.71–101.

Office of Federal Procurement Policy. "Reducing procurement administrative lead time using modern business practices," memorandum, January 14, 2021. https://www.whitehouse.gov/wp-content/uploads/2021/01/OFPPPALTMemorandum-01-14-2021.pdf. Accessed October 2023.

Office of Management and Budget (OMB). *Circular No. A-11: Preparation, Submission, and Execution of the Budget*. Executive Office of the President. August 2023. https://www.whitehouse.gov/wp-content/uploads/2018/06/a11.pdf. Accessed January 2024.

Office of the Secretary of Defense (OSD). "Department of Defense Management of Unobligated Funds; Obligation Rate Tenets," memorandum by the USD(Comptroller) and USD(Acquisition, Technology, and Logistics). Washington, D.C.: Department of Defense, September 10, 2012. https://www.acq.osd.mil/dpap/policy/policyvault/DoD_Mgt_of_Unobligated_Funds_Obligation_Rate_Tenets.pdf. Accessed January 2024.

Schiavoni, Michael L. "Adaptive Curve Fitting: An Algorithm in a Sea of Models," briefing. ICEAA Professional Development & Training Workshop, Tampa FL, May 14-17, 2019. https://www.iceaaonline.com/wp-content/uploads/2019/06/AM05-Adaptive-Curve-Fitting-Schiavoni.pdf. Accessed October 2023.

Tomasini, Roberta. "OUSDC Rule-of-Thumb Acquisition Obligation and Expenditure Rates." Defense Acquisition University, 2017. https://www.dau.edu/sites/default/files/Migrated/ToolAttachments/OSD%20%28C%29%20Color%20Rule-of-Thumb%20Acq%20Obligation%20and%20Expenditure%20Rates.pdf and https://www.dau.edu/tools/ousdc-rule-thumb-acquisition-obligation-and-expenditure-rates. Accessed October 2023.

Tremaine, Robert L., & Donna J. Seligman. "OSD's Obligation and Expenditure Rate Goals." *Defense AT&L*. July-Aug. 2013, pp. 14–21. https://apps.dtic.mil/sti/pdfs/ADA608878.pdf. Accessed October 2023.

U.S. Army Contracting Command (ACC). "FY18 Procurement Action Lead Time (PALT) Metric," memorandum, Redstone Arsenal, AL: Department of the Army, March 12, 2018. https://acc.army.mil/contractingcenters/acc-orl/palt_files/paltsession/ACCFY18PALTMemo12Mar18.pdf. Accessed October 2023.

U.S. Department of Defense. *Financial Management Regulation*. DoD 7000.14R, Vol. 2A, October 2008. As of 12/29/23: https://comptroller.defense.gov/Portals/45/documents/fmr/current/02a/02a_01.pdf

Watkins, Harry. *An Application of Rayleigh Curve Theory to Contract Cost Estimation and Control*, Master's Thesis, Naval Postgraduate School, Monterey, California, March 1982. https://apps.dtic.mil/sti/pdfs/ADA118213.pdf. Accessed October 2023.