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Preliminary Findings: Is the Ratio of Investment Between R&D to Production Experiencing Fundamental Change?

Rhys McCormick—is an Associate Fellow with the Defense-Industrial Initiatives Group (DIIG) at CSIS. His work focuses on unmanned systems, global defense industrial base issues, and U.S. federal and defense contracting trends. Prior to working at DIIG, he interned at the Abshire-Inamori Leadership Academy at CSIS and the Peacekeeping and Stability Operations Institute at the U.S. Army War College. He holds a bachelor's degree in security and risk analysis from Pennsylvania State University and a master's degree in security studies from Georgetown University.

Andrew Hunter—is a Senior Fellow in the International Security Program and Director of the Defense-Industrial Initiatives Group at CSIS. From 2011 to 2014, he served as a Senior Executive in the Department of Defense, serving first as Chief of Staff to Under Secretaries of Defense (AT&L) Ashton B. Carter and Frank Kendall, before directing the Joint Rapid Acquisition Cell. From 2005 to 2011, Hunter served as a Professional Staff Member of the House Armed Services Committee. Hunter holds a master's degree in applied economics from Johns Hopkins University and a bachelor's degree in social studies from Harvard University.

Greg Sanders—is a Fellow in the International Security Program and Deputy Director of the Defense-Industrial Initiatives Group at CSIS, where he manages a research team that analyzes data on U.S. government contract spending and other budget and acquisition issues. In support of these goals, he employs SQL Server, as well as the statistical programming language R. Sanders holds a master's degree in international studies from the University of Denver, and he holds a bachelor's degree in government and politics and a bachelor's degree in computer science from the University of Maryland.

Abstract

With the advent of the information age, both commercial industry and the Department of Defense are moving towards complex R&D-intensive systems over the simpler, mass-produced systems of the industrial age. This paper uses budgetary and program data to better understand the historical trends in the relationship of production costs to development costs in complex acquisition programs.

Introduction

This paper presents preliminary analysis of the historical trends in the relationship of production costs to development costs in complex acquisition programs. To understand this phenomenon, the study team examines it at two different levels. The first is the macro investment level where portfolio management trade-offs are made between aggregate development and procurement and between programs. The second level are individual programs where the ambitions of the program and the underlying technology shape the resources required for a program to complete development.

Starting with the macro level, for all militaries, finding the proper investment balance between the needs of the current force structure and the potential future force structures is a recurring challenge. Militaries must find a balance between the procurement of existing systems with the development of new platforms and technologies. In the United States, this dynamic has followed a cyclical historical pattern in the ratio of procurement to research, development, test, and evaluation (RDT&E) in the Department of Defense (DoD) budgets. When the overall DoD budget increases, procurement rises disproportionately and thus the ratio of procurement to RDT&E also increases. Inversely, when the defense budget falls, procurement spending falls faster than the overall budget and the ratio of procurement to RD&TE also falls. Overall, since fiscal year (FY) 1955, the DoD has spent an average of 2.2 dollars on procurement for every dollar it spent on RDT&E. However, as shown in Figure 1,

the center of the range of this cycle abruptly shifted downwards following the peak of the Regan buildup when the DoD was spending 3.25 dollars on procurement to one dollar on RDT&E.

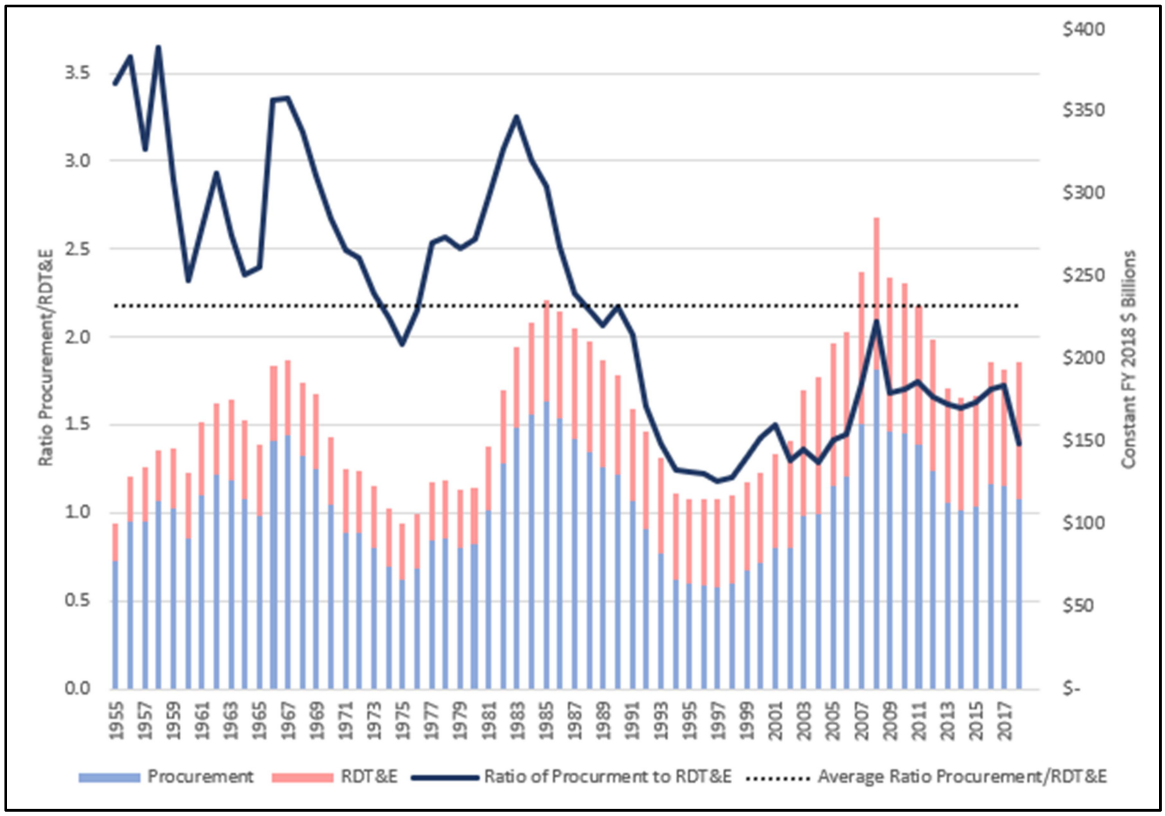


Figure 1. DoD Ratio of Procurement to RDT&E, 1955–2018
(OUSD[C], 2017; CSIS analysis)

Following the peak of the Reagan buildup, the ratio of procurement to RDT&E fell as the overall defense budget declined, but this time it fell more sharply than previous drawdowns and failed to rebound to expected levels during subsequent budget increases. The ratio of procurement to RDT&E fell to a historic low of 1.22 in FY 1998 compared to the previous historic low: 1.95 in FY 1975, as a result of the 1990s "procurement holiday" that led to sharp cuts in procurement spending and only relatively modest declines to RDT&E. Furthermore, when defense contracting rebounded in the 2000s, the 2.17 ratio of procurement to RDT&E in FY 2008, remained well below the historical average and significantly below the 3.24 to 3.64 ratios of previous peak buildup periods. The historically low ratio of procurement to RDT&E seen during the 1990s can be explained by the decisions made following the end of the Cold War, the success of the Gulf War in prioritizing the development of next-generation weapon systems, and the "procurement holiday" in the 1990s that slashed procurement budgets. But why did the ratio of procurement to RDT&E remain below historical averages during the mid-to-late 2000s, despite historic modernization budgets? Is there something different about this generation of major defense acquisition programs (MDAP) or are there other factors at play?

Weapon systems, and other complex acquisition programs, have always grown in complexity from generation to generation, but has the information age brought about a fundamental change in the relationship between R&D and production? Compared to the

simpler mass-produced systems of earlier generations, today's systems are exponentially more complex and heavily leveraged on software. In 1960, software performed only 8% of an F-4's functions. By 1982, software performed 45% of the functions in the F-16, and by 2000, software performed 80% of the functions in the F-22 (DSB, 2000). The DoD's software development and maintenance requirements have been estimated to be growing somewhere between 15% to 20% annually (Tate, 2017). These trends are not unique to defense. Boeing's 787 Dreamliner required 14 million source lines of code (SLOC). Some of today's premium-class cars utilize up to 100 million SLOC. When compared to the 400,000 SLOC in the original Space Shuttle, the importance of software is evident.

The growth in software requirements is staggering, but is a fundamental change in the relationship between production and development underway? Has the information age changed the importance of R&D, or has it just shifted the focus of R&D efforts to software? For companies, this question could have business-altering dynamics. For firms like Boeing and others in the defense marketplace, the business model has been to conduct development and early production at a financial loss before turning a profit as production ramps up. However, if a fundamental change in the relationship between development and production is underway, these business models may no longer be sustainable.

Declining Procurement–RDT&E Ratios: The Result of a Broken Acquisition System?

The problems with the current MDAP portfolio are well-known and have led many to state that the defense acquisition system is broken. However, are there truly significant differences between this generation of MDAPs and previous generations? In 2008, the Government Accountability Office (GAO) made headlines when it reported that 70% of the DoD's MDAPs were over budget and behind schedule. Cumulative MDAP cost-growth totaled $295 billion and the average MDAP was 21 months behind schedule (GAO, 2008). Are the delays and cost growth associated with today's MDAPs higher than historic rates?

Policymakers and analysis have been concerned about the development and procurement of major weapon system platforms since the advent of the modern defense industrial base at the end of World War II. Despite the ever-increasing complexity of weapon systems generation to generation, studies of the changes of the procurement system show that the management problems have been remarkably consistent. Multiple studies have shown that weapon system cost growth during development and procurement and schedule growth has remained largely consistent over time (Bolten et al., 2008; Drezner et al., 1993; IDA, 2010; Jarvaise, Drezner, & Norton, 1996; Marshall & Meckling, 1959; Younossi et al., 2007). Additionally, recent analysis both in and out of government shows that cost growth today is similar to historical rates (OUSD[AT&L], 2016; Watts & Harrison, 2011). These studies suggest that most cost-growth in MDAPs occurs during the development phase. Average overall cost growth ratio during development totals approximately 1.6, but there are differences between types of platforms (Younossi et al., 2007).

Concerning cycle times, Tate found that "highly-visible programs," those with the greatest total acquisition costs, are driving a false perception that cycle times have been increasing over the past 25-plus years (Tate, 2016). Instead, Tate (2016) found that for all commodity types, including "highly-visible programs," cycle growth over the past 25 years has been statistically insignificant. Scholars have found a difference in the cost growths of programs resulting from the differing conditions of the funding climate for when programs achieve Milestone B status. McNicol and Wu (2014) found that if a program attained Milestone B status when the budget climate was relatively constrained, the program could be burdened by overly optimistic costing assumptions. When these optimistic assumptions

fail to pan out, the result is significant cost growth. Thus, McNicol and Wu (2014) conclude that programs that attain Milestone B status in "bust" periods are more likely to experience cost growth than programs that attain Milestone B status in "boom" periods.

The literature suggests that the cost and schedule growth in MDAPs since the 1990s is not beyond historical norms and does not explain the top-line trends in the declining ratio of procurement to RDT&E. Although these previous studies extensively studied cost and schedule growth in MDAPs, there has been little analysis of the ratio of procurement to RDT&E. Previous analysis has largely focused on the topline budget trends previously highlighted (Harrison, 2013; Harrison, 2016) or topline MDAP data. The *Performance of the Defense Acquisition System: 2015 Annual Report* stated that for the 76 active MDAPs, "at the median, the procurement share is more than six times larger than the RDT&E share" (Office of the Under Secretary of Defense for Acquisition Technology and Logistics [OUSD(AT&L)], 2015). However, these reports contained no further breakdowns of the data service or platform.

Research Approach

Given the literature suggesting that these trends are not necessarily the result of a broken acquisition system, but other factors, this paper seeks to further investigate the potential sources of the declining ratio of procurement to RDT&E across the DoD. Additionally, given the software growth trends occurring in defense and non-defense complex acquisition programs, this paper looks to see if there are similar trends occurring in the broader economy. Specifically, this paper seeks to answer the following questions:

- Has the relative importance of R&D changed across the broader economy over the past four decades?
- What are the historical trends in the ratio of procurement to R&D funding in the military services? Are there significant differences between the military services?
- What are the top-line historical trends in the ratio of procurement to RDT&E funding for the MDAP portfolio?

Data Methodology

To compare the DoD's budget trends to broader economic trends, this paper looks at the historical R&D intensity trends in select industries. The study team selected industries that are similar in nature to the defense industry. R&D intensity is measured by total expenditure of all firms on R&D over total net sales in an industry. Although R&D intensity is not perfectly analogous to the DoD's budgetary trends, it provides a rough approximation given limited visibility into more specific budgetary trends within private companies. Additionally, while R&D intensity is not without issues (Hughes, 1988), it is a commonly used method of measuring "the relative importance of R&D across industries and among firms in the same industry" (National Science Board, 2008).

To measure the top-line historical ratio trends for the MDAP portfolio, this paper uses the data from Selected Acquisition Reports (SAR). The issues associated with SARs have

been well-noted[1], but they still provide the most reliable source of data (Hough, 1992). This paper uses the annual SAR data accessed through Defense Acquisition Management Information Retrieval (DAMIR) for MDAPs from FY 1997 to FY 2017. For analytical purposes, the CSIS team excluded any program in each year that reported incomplete procurement or RDT&E data. Additionally, the study team focused only on the current estimated ratio in a given SAR. Future analysis will expand this analysis to compare the current estimates against projected ratios at different acquisition milestones.

To enable preliminary historical comparisons, the DAMIR SAR data is supplemented with historical data from RAND's Defense System Cost Performance Database (DSCPD) made available in *The Defense System Cost Performance Database: Cost Growth Analysis Using Selected Acquisition Reports* (Jarvaise et al., 1996). The DSCPD provides a summary of SAR data from the 1960s to FY 1994. The DSCPD provides funding breakdowns, both the stated planned estimates at different acquisition milestones and "current" for historical MDAPs.

From the historical dataset, this paper looks at the historical trends in the ratio of procurement to RDT&E funding for MDAPs. This paper begins by looking at the historical ratio trends estimated at Milestone B/II, the "official start of a program." Next, this paper looks at the actual spending for programs that are completed, or have largely been completed and are no longer submitting annual SARs.

Due to the gap in data from FY 1995 to FY 1996, this paper only presents the study team's preliminary findings which are subject to change. The study team has identified additional data sources to be used to supplement and validate existing data, as well as addressing the gaps in the data. CSIS will incorporated the additional data sources, where available, into its final technical report to be released in late 2018.

Analysis

The following sections present analysis of the data related to the three research questions. This section begins with analysis of the historical R&D intensity across the broader economy, followed by analysis of ratio trends within the services and concludes by analyzing the MDAP portfolio topline trends.

Historical R&D Intensity Trends by Industry

How do these trends compare to the broader marketplace? Although software and high-tech intensive devices get much of the media attention, are we seeing shifts in the importance of R&D to industry generally? These questions are challenging to address. The data on civilian firms is not as thorough as the defense budget which makes perfectly analogous comparisons difficult for outside researchers. Instead, the study team looks to R&D intensity which is an economic metric that aids in understanding the general importance of R&D to firms in a certain sector.

[1] Some of the problems with utilizing SARs include, but are not limited to, inconsistent baseline cost estimates, exclusion of some significant cost elements, exclusion of special access programs, constantly changing preparation guidelines of SARs, inconsistent interpretations of preparation guidelines across programs, cost sharing in joint programs, and the reporting of the effects of costs changes rather than their root causes.

Analysis of historical analysis of R&D intensity trends within industries is complicated by the creation of the North American Industry Classification System (NAICS) in 1997 and subsequent move away from, and eventually elimination of the Standard Industrial Classification (SIC) system. This report uses the R&D intensity data from the National Science Foundation who used SIC codes up until 1998, before switching to NAICS codes in 1999. Given the shift from SIC codes to NAICS codes, this paper focuses on the general trends from 1970 to 1998 and then from 1998 to 2014.

R&D Intensity: 1970–1998

The data show that R&D intensity in the manufacturing sector did not following a singular long-term trend, but a series of intermediate trends as shown in Figure 2 below. Throughout the 1970s, manufacturing R&D intensity gradually fell from approximately 3.7 in 1970 to 2.6 in 1979. Then from 1980 to 1986, manufacturing R&D intensity grew at 7.68% Compound Annual Growth Rate (CAGR). Finally, from 1986 to 1996 manufacturing R&D declined at -2.84% CAGR.

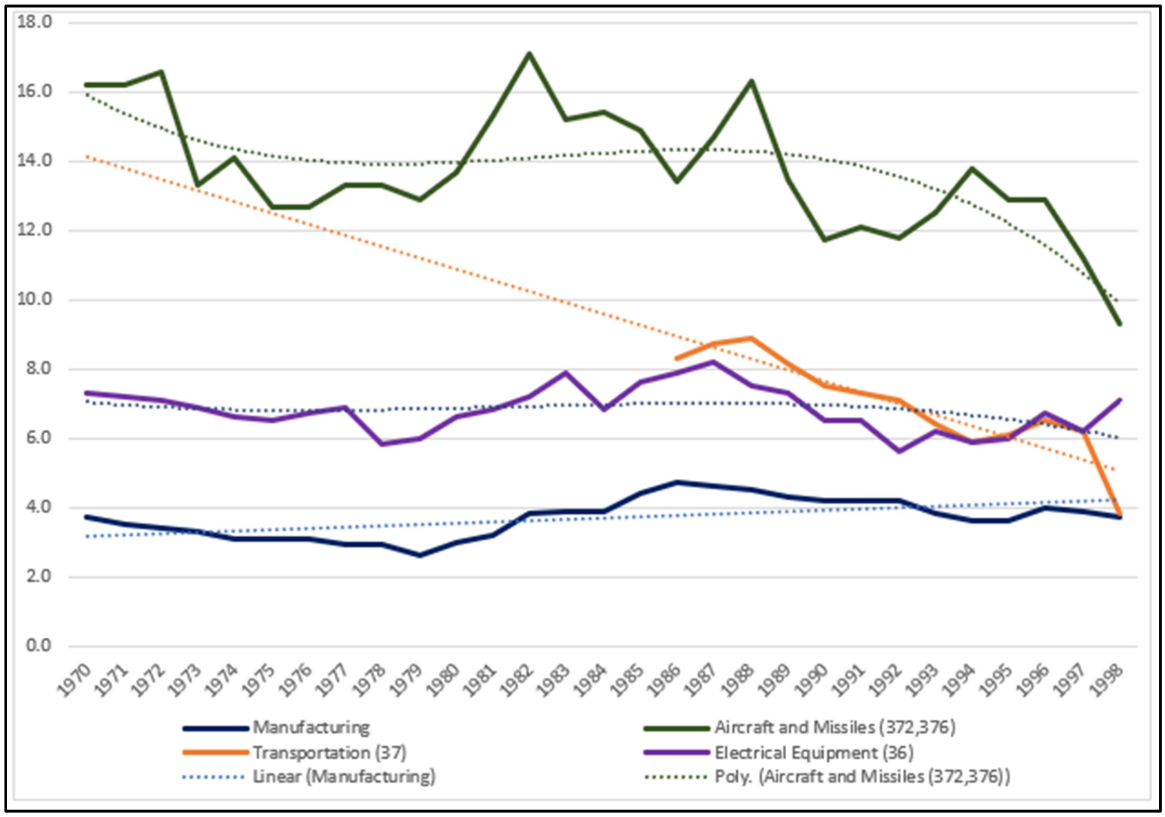


Figure 2. R&D Intensity in Manufacturing and Select Industries, 1970–1998
(National Science Foundation Industrial Research and Development Information System; CSIS analysis)

Beyond the top-line manufacturing R&D intensity trends, the data show that the trends could vary between industries. Across the broader Transportation industry, the data show that R&D intensity was on a downward trend since the late 1980s. R&D intensity in the Transportation industry declined at -6.3% CAGR from 1987 to 1998. Comparatively, the Electrical Equipment industry followed a more cyclical pattern, but remained relatively steady.

One subset of the Transportation industry is of particular interest to this paper, Aircraft and Missiles. Of note, the data show that R&D intensity trends in the Aircraft and Missile industry followed a cyclical pattern, relatively similar to the DoD's trend in the ratio of procurement to RDT&E. In the Aircraft and Missile industry, R&D had cyclical periods of growth followed by periods of decline and vice versa, but has been broadly trending downward since the mid-1980s.

R&D Intensity: 1999–2014

The data show that there is not an overall trend in the importance of R&D, as measured by R&D intensity, but that there is more uncertainty at lower levels.

As shown in Figure 3, R&D intensity in the manufacturing industry was on an upward trajectory until the onset of the fiscal crisis, but fell sharply in the following years. Manufacturing R&D intensity has started trending back upwards in the last two years of available data, but sustained growth is necessary before any definitive conclusions can be drawn. Comparatively, R&D intensity in the non-manufacturing sector had been gradually declining even prior to the fiscal crisis and the one-year sharp decline. However, R&D intensity in the non-manufacturing industry rebounded quicker than the manufacturing sector and has been on a steady growth pass since, but still remains below historical averages since 1999.

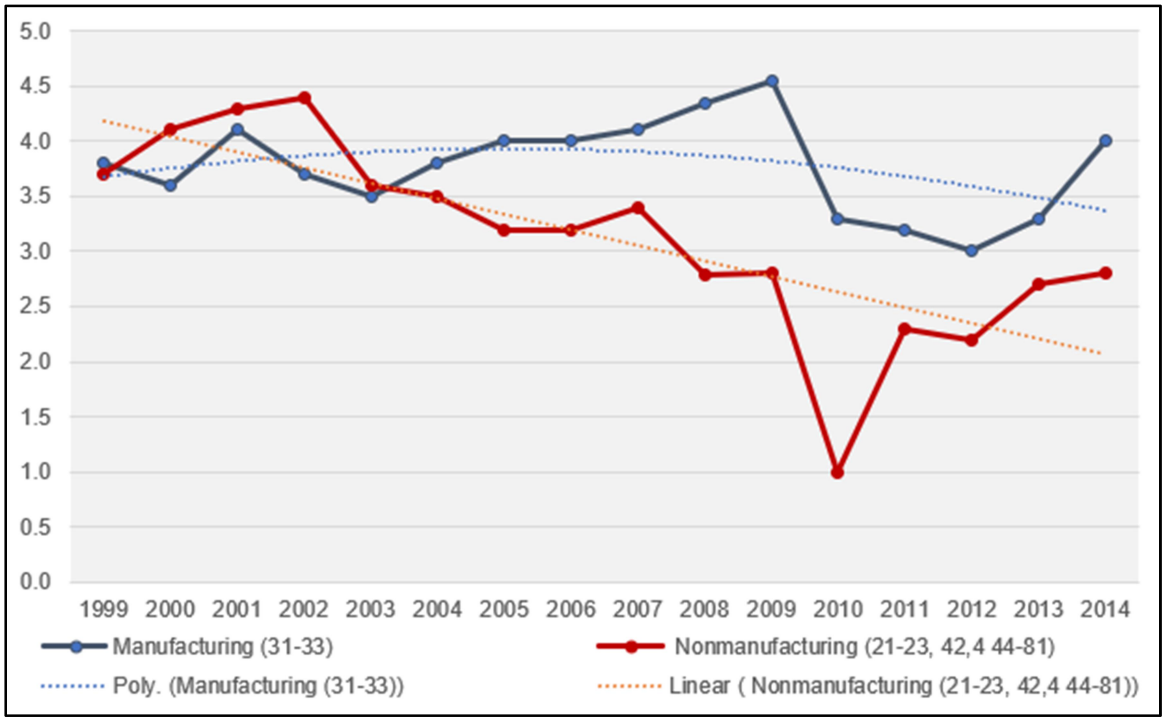
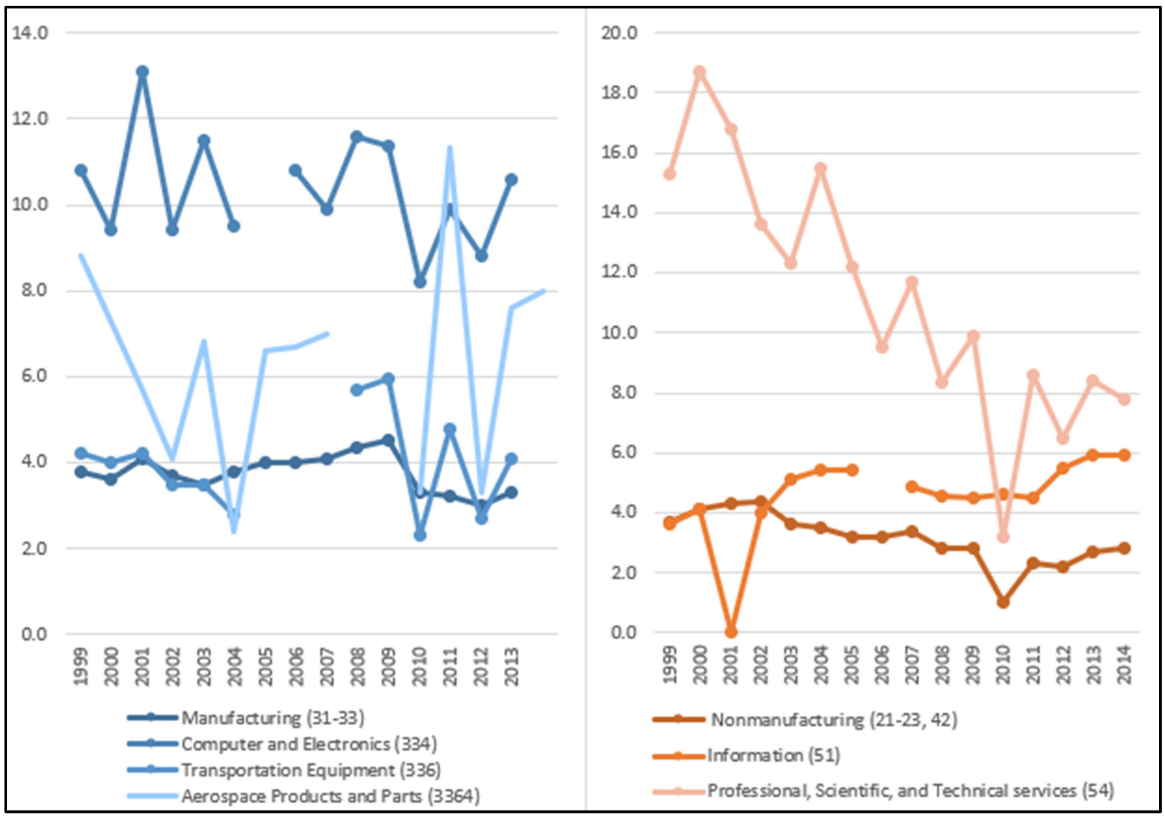


Figure 3. Manufacturing and Non-Manufacturing R&D Intensity, 1999–2014
(National Science Foundation Business Research and Development Innovation Survey; CSIS analysis)

The data show that below the Manufacturing, there are no obvious trends in the data. Amongst the selected manufacturing industries and sub-industries (Computer and Electronics, Transportation Equipment, Aerospace Products and Parts), the data is often noisy, with significant variance from year to year.

The data for selected industries in the non-manufacturing sector is less noisy overall and does suggest more definitive certain trends. Figure 4 shows the selected industries within the Manufacturing and Non-Manufacturing sectors from 1999 to 2014. The data show that, in general, R&D intensity in the Professional, Scientific, Technical Services industry (NAICS code 54), is on a downward trend since 2000. From a peak of 18.7 intensity in 2001, R&D intensity for that sector fell as low as 3.2 in 2010, and is currently 7.8 in the last available data. In the other selected non-manufacturing industry, information, after holding steady throughout the years reporting data, R&D intensity has been slightly trending upward in the past few years. However, just as the trend for the broader manufacturing sector, it is too early to draw definitive conclusions.



Note. Gaps in the data in certain years are due to the NSF masking that year's data.

Figure 4. R&D Intensity in Select Industries, 1999–2014
(National Science Foundation Business Research and Development Innovation Survey; CSIS analysis)

In general, the data do not show an overall shift in the importance of R&D across the broader market over the past 40 years as measured using R&D intensity. There are certain trends in the broader Manufacturing sector and the Information industry that suggests a shift could be occurring, it remains too early to draw definitive conclusions.

Ratio of Procurement/RDT&E by Service

The topline data shows that the ratio of procurement to RDT&E is down across the board in the DoD, but are similar trends occurring in the parts of the DoD making the actual investment decisions—the military services?

Navy

Amongst the military services, the Navy has the highest historical average ratio of procurement to RDT&E: 3.38. Figure 5 shows the ratio of procurement to RDT&E in the Navy's budget from FY 1955 to FY 2018.

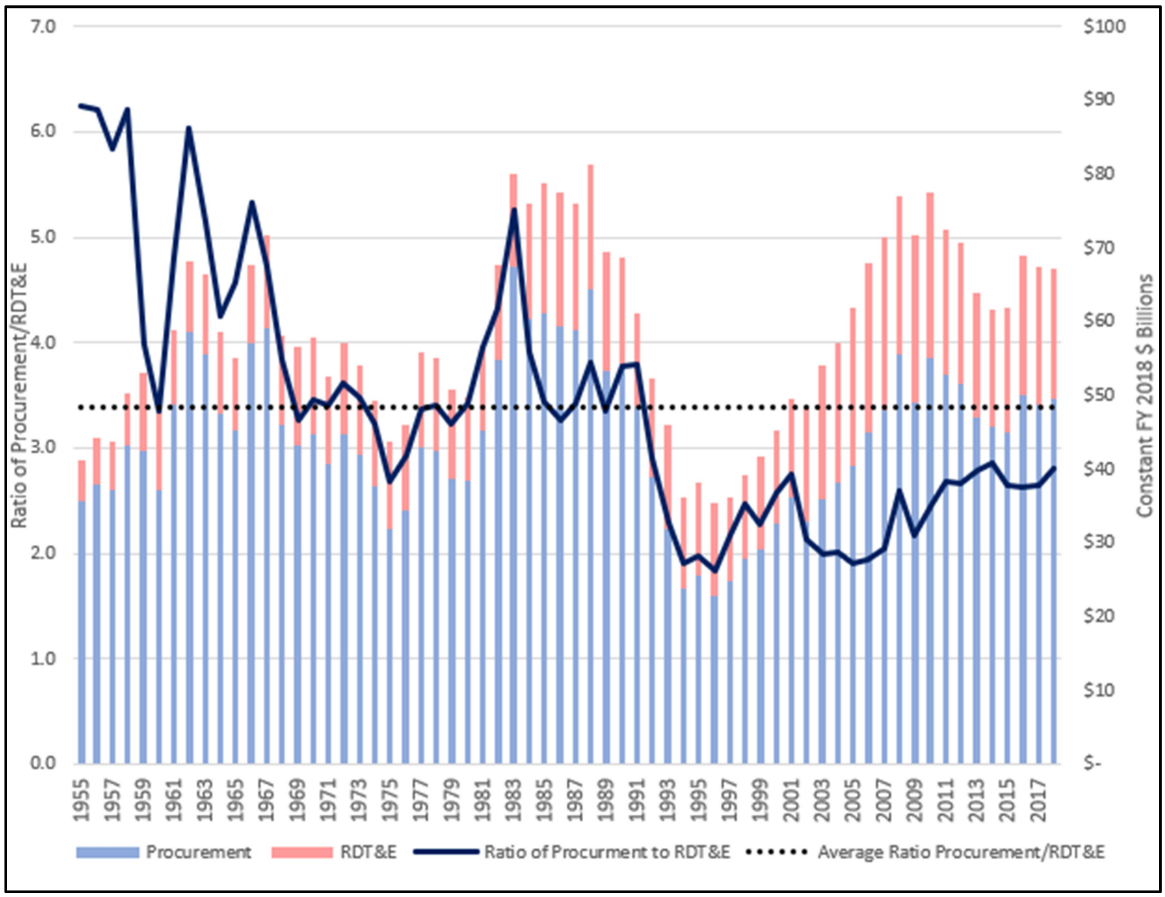


Figure 5. Navy Ratio of Procurement to RDT&E, 1955–2018
(OUSD[C], 2017; CSIS analysis)

The Navy ratio trends generally followed overall DoD trends, with a few notable differences. After the ratio of procurement to RDT&E in the Navy peaked in 1983, that ratio fell precipitously in the following years despite near-historic procurement budgets. Whereas overall DoD budget trends in those years were largely driven by procurement funding declining quicker than RDT&E funding, that was not the case in the Navy. Instead, the declining ratio in the Navy was driven by a $5 billion increase in RDT&E over a five-year period while the procurement budgets stayed relatively flat. In recent years, the ratio of procurement to RDT&E in the Navy fell from FY 2000 to FY 2005, during which time Navy RRDT&E funding grew at nearly three times the rate of procurement funding. Since FY 2005, the Navy's ratio of procurement to RDT&E has been on a stable, but gradual growth path.

Air Force

Of the three military services, the Air Force has the lowest historical ratio of procurement to RDT&E, spending 1 dollar on development for every 2.05 dollars spent on production. This is not surprising given the Air Force's cultural preference for new, high-tech solutions even before it became its own military service in 1947. Figure 6 shows the ratio of procurement to RDT&E in the Air Force's budget from FY 1955 to FY 2018.

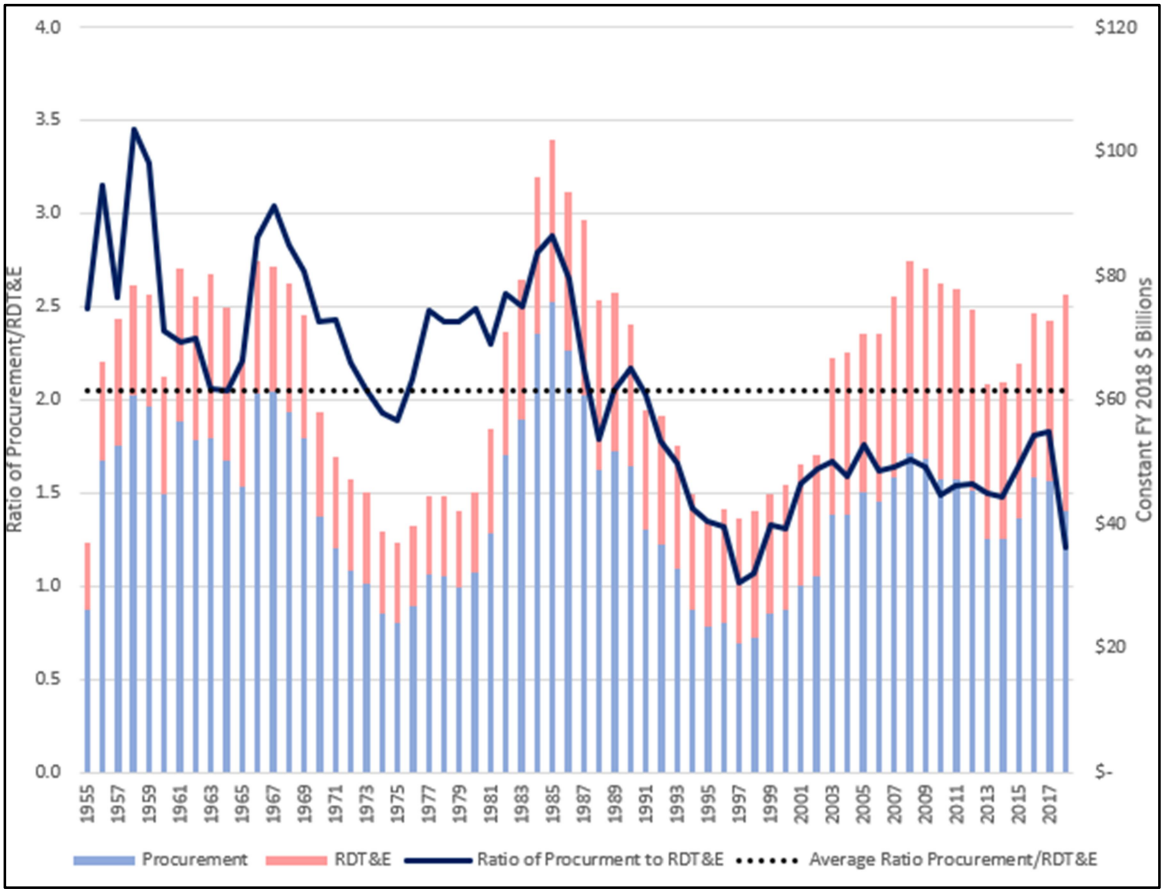


Figure 6. Figure 6: Air Force Ratio of Procurement to RDT&E, 1955–2018
(OUSD[C], 2017; CSIS analysis)

The Air Force differs from the other services in a few notable ways. First, whereas the other services saw a rapid spike followed by a quick decline during the Reagan buildup, the Air Force experienced a smaller spike earlier, followed by a more gradual rise to its crescendo. Second, the Air Force ratio fell lower than any of the services during the 1990s, falling to as low as 1.07 in 1997. That year, the Air Force spent nearly one dollar on RDT&E for each dollar it spent on procurement.

After hitting a historic low in FY 1997, the Air Force's ratio of procurement to RDT&E gradually grew from FY 1998 to FY 2008. The ratio then began to fall again from FY 2008 to FY 2014, before increasing from FY 2014 to FY 2017.

Army

The data show that the Army, unlike the Navy and Air Force, has continued to follow cyclical historical patterns. Since FY 1955, the Army has spent on average, 2.36 dollars on procurement for every dollar spent on RDT&E. Figure 7 shows the ratio of procurement to RDT&E in the Army's budget from FY 1955 to FY 2018.

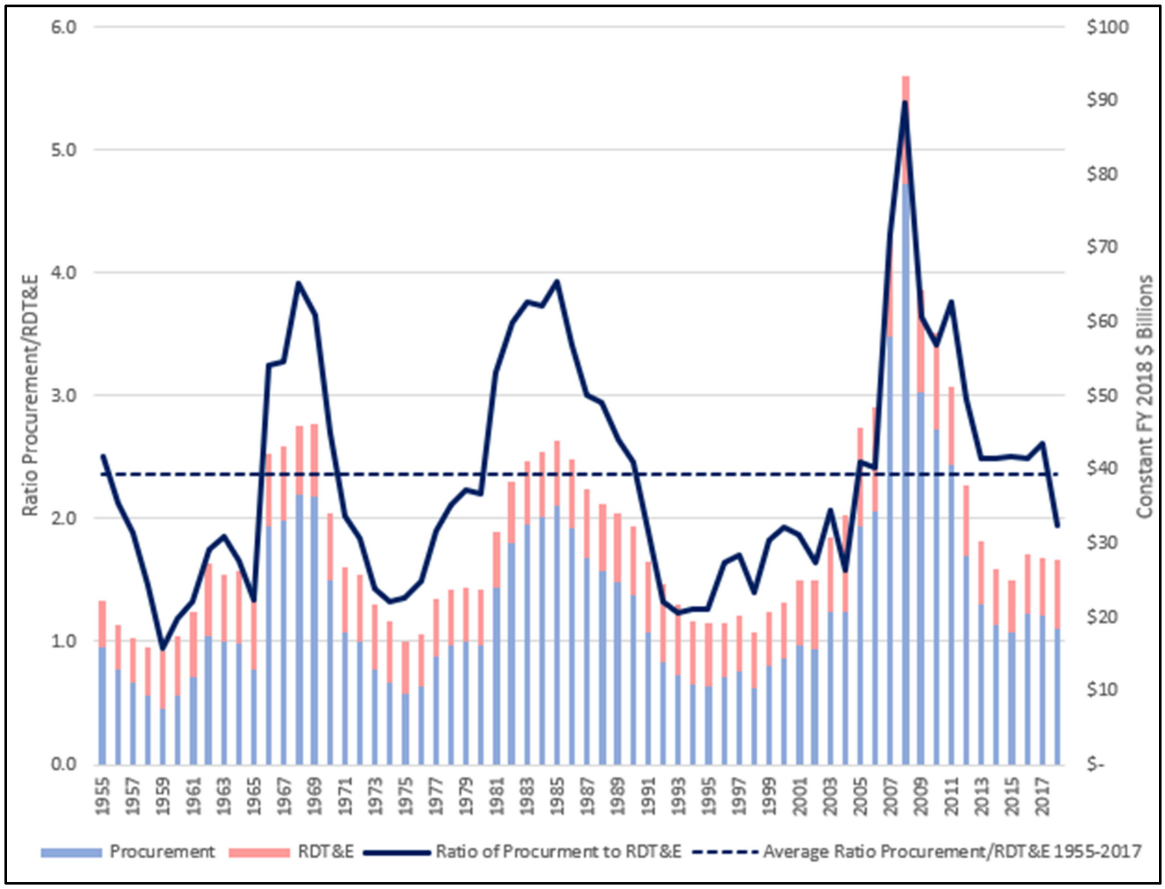


Figure 7. Army Ratio of Procurement to RDT&E, 1955–2018
(OUSD[C], 2017; CSIS analysis)

The Army was the only service that returned to the historical cyclical pattern during the mid-2000s. This trend was driven, in a large part due to the operations in Iraq and Afghanistan, but these trends are interesting given the failures of nearly all the Army's marquee acquisition programs over that period. Additionally, as the wars in Iraq and Afghanistan began to wind down and end, the ratio of procurement to RDT&E remained above historical averages contrary to previous cycles. During this most-recent drawdown, Army RDT&E fell much more sharply than in previous cycles.

Annual Current Estimates MDAP Portfolio Ratio of Procurement/RDT&E

Figure 8 displays the statistical distribution of the current reported ratio of procurement to RDT&E for MDAPs in each year's December SAR from FY 1997 to FY 2017.[2]

[2] The 2008 data is excluded because of a temporary policy guidance change that led the DoD to only submit SAR for programs with a Nunn-McCurdy breach, which was only the H-1 Upgrade that year.

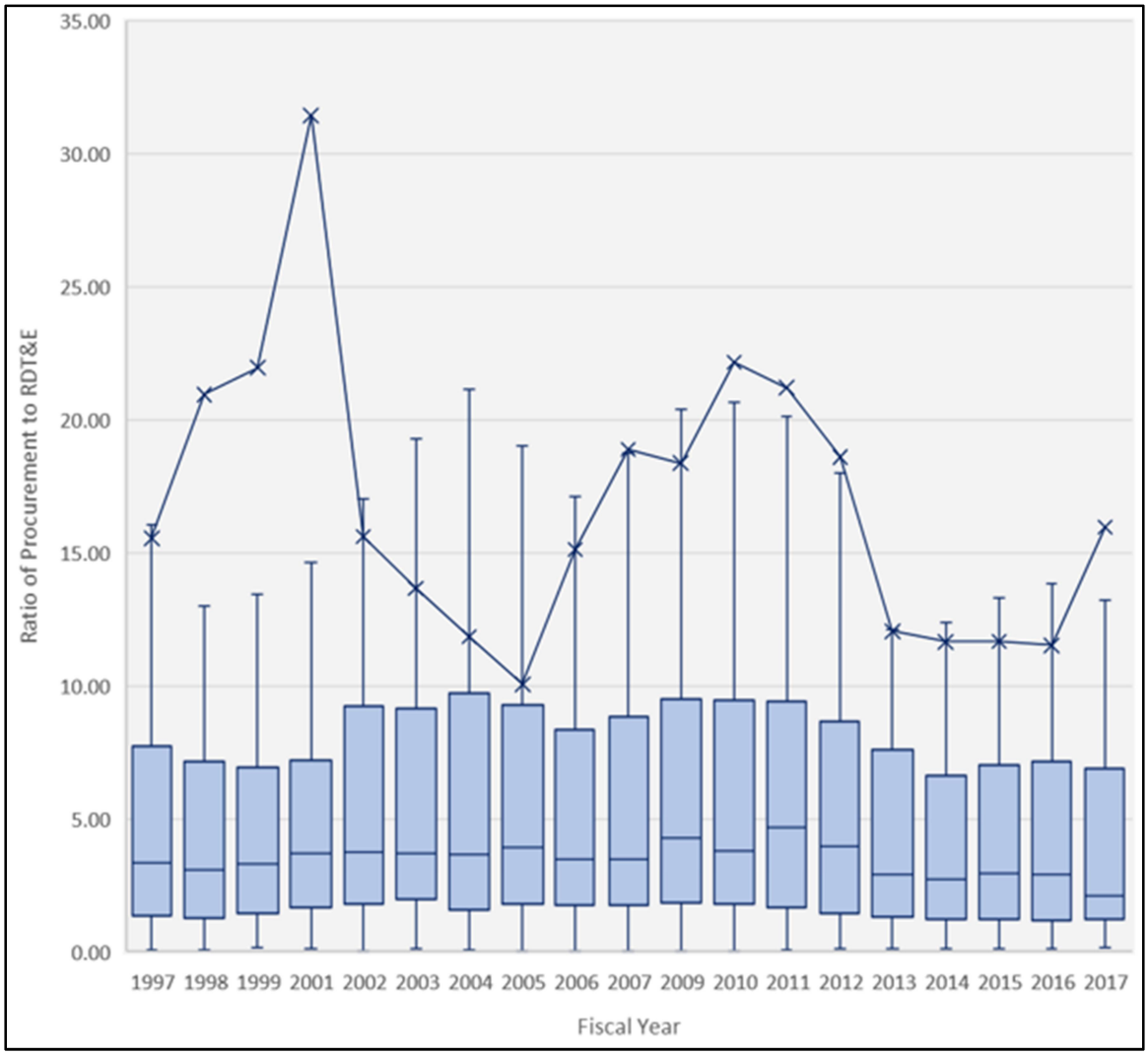


Figure 8. Ratio of Procurement to RDT&E Across the MDAP Portfolio, 1997–2017
(December Selected Acquisition Reports accessed through DAMIR; CSIS analysis)

The topline data is inconclusive and varies based on the measure used. The data show that from FY 1997 to FY 2012, excluding FY 2009, the topline median remained relatively steady.[3] It has only really been since FY 2013 that the median has started to fall. The mean of the ratio is far more volatile, as it is influenced by extremes at both ends of the scale, including outliers not shown in the box-and-whiskers plot. More pertinent are the upper and lower quartiles, shown as the top and bottom of each blue box. The lower quartile has a slow rise, starting in 1998, is stable from 2002 to 2010, before beginning a slow decline that flattens out in 2014. The pattern for the upper quartile is similar but more volatile. Starting in FY 2002, the upper quartile of the distribution of MDAP ratio of

[3] FY 2009 was an outlier due to the rapid procurement of large quantities of Mine-Resistant Ambush Protected vehicles.

procurement to RDT&E rose sharply, and with two exceptions, remained at that higher level for the next 10 years before gradually declining and leveling off over the last five or so years. There is possibly a cycle at work here, but not one that aligns with the account-level defense trends seen in Figure 1. The elevated period between 2002 and 2011 does align with rising wartime procurement spending, but shows no sign of the rapid rise from 2004 to 2008.

It is possible the decline in recent years across multiple measures might indicate a longer-term shift in the ratio, but if so, the magnitude is minimal and the timing does not clearly align with a greater role for software. Moreover, DAMIR coverage begins with programs still active in 1997, which is after the larger shift in the ratio as that coincided with the end of the Reagan build up and post-Cold War draw down had already taken place. To give a greater historical perspective on the change in individual programs, the study team turned to a dataset produced by RAND in cooperation with the office of Program Analysis and Evaluation, the predecessor to today's office of Cost Assessment and Program Evaluation.

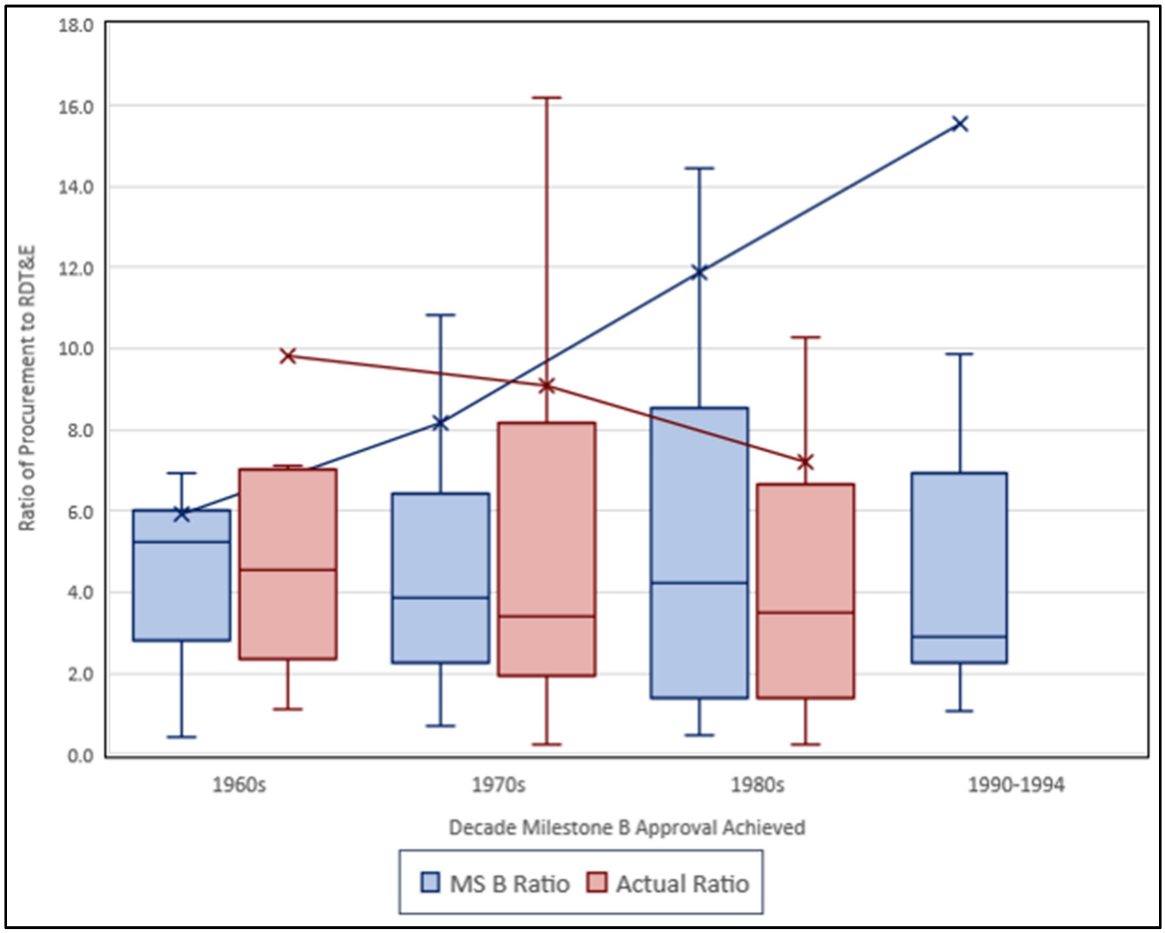


Figure 9. Comparison of Estimated Ratio of Procurement to RDT&E at Milestone B v. Production
(Jarvaise et al., 1996; CSIS analysis)

Figure 9 shows the statistical distribution of the ratio of procurement to RDT&E for MDAPs estimated at Milestone B versus the actual rates. MDAPs were categorized in both groupings based on the decade the program achieved Milestone B approval.

The historical SARs data show two critical trends. First, the data show significant variance between the ratio of procurement to RD&TE estimated at Milestone B and the final report ratio of procurement to RDT&E. Changes in the ratio of procurement to RDT&E are not necessarily the result of negative factors (cost growth, schedule slippage, etc.), but could also be the result of other factors such as significant increases in procurement quantities. For example, the F-16 Milestone B approval only planned on procuring 650 planes, but the Air Force ended up purchasing more than 2,000 by the end of the program. Second, the data show that while the average planned estimated ratio of procurement to RDT&E at Milestone B has been trending upwards, the actual average ratio of procurement to RDT&E has been on a gradual downwards trend. This finding is consistent with the existing literature showing that acquisition program estimates are often based on optimistic assumptions that aren't reflected in the final programs.

Building on the declining ratios for actual expenditures, the decade to decade trends also align with the account level trends seen in Figure 1. The sixties and eighties had higher median ratios while the seventies and nineties had lower ones. For the final technical report, the study team seeks to combine this dataset with the DAMIR dataset to gain a better understanding of trends across the entire period.

Conclusion

Has the relative importance of R&D, as measured by R&D intensity, changed across the broader economy over the past four decades?

The R&D intensity trends shows no overall trend in the change of importance of R&D, across the broader economy over the past four decades. The data show that from 1970 to 1998, R&D intensity in the manufacturing sector followed a series of cyclical up and down intermediate trends, but remained relatively steady in the aggregate. During that period, R&D intensity in the Aircraft and Missiles industry followed a cyclical pattern not dissimilar from the DoD's ratio of procurement spending to RDT&E, and had been on a downward trend since the mid-1980s.

Since 1999, there has been no change in the overall R&D intensity trends, but there is more uncertainty at lower levels. Prior to the fiscal crisis, R&D intensity within the manufacturing sector was increasing, before plummeting during the fiscal crisis. The R&D intensity in this sector has since recovered in recent years and begun to rise again, but additional data is still necessary to confirm that these current trends are not an anomaly. The information industry in the non-manufacturing sector has also shown a similar positive trend in recent years, but additional data is also still required.

There has been a more definitive downward trend in the Professional, Scientific, and Technical Services industry. At the start of the century, R&D intensity in the Professional, Scientific, and Technical Services industry was comparable to the Computer and Electronics industry, but has since fallen sharply. From 2000 to 2014, R&D intensity in the Professional, Scientific, and Technical Services industry declined at -5.7% CAGR.

What are the historical trends in the ratio of procurement to R&D funding in the military services? Are there significant differences between the military services?

The data show that there are significant differences between the different military services. Across the DoD historically, the Navy has the highest ratio of procurement to RDT&E amongst the military. The Navy's 3.38 ratio of procurement to RDT&E is 43% higher than the Army's (2.36) and 65% higher than the Air Force's (2.05).

The Navy and the Air Force generally followed the same cyclical historical trends as the overall trends, but with a few points of interest worth noting. In the Navy, the ratio of procurement to RDT&E began to decline despite continued, near-historic procurement budgets as a result of increases to the RDT&E budget. In the other services, the declining ratio was largely the result of procurement funding falling more sharply than RDT&E funding, but that wasn't the case with the Navy. Of note in the Air Force, the ratio of procurement to RDT&E fell as low as 1.07 in 1997.

Meanwhile, the Army did not see a shift away from the historical cyclical pattern, unlike the Navy or the Air Force, and returned to levels above historical averages during the mid-2000s. These trends are heavily influenced by operations in Iraq and Afghanistan, but are still interesting given the failure of the Army modernization's programs since the end of the Cold War. The Army, more so than any other service, has been maligned for the failures and problems of its acquisition system.

What are the historical trends in the ratio of procurement to RDT&E funding for the MDAP portfolio?

The SARs data from the 1970s to FY 1994, show that, historically, there is notable variance between the ratio of procurement to RDT&E estimated at Milestone B and the program's final ratio during production. This is neither a good nor bad trend as there are many influencing factors, but instead highlights that the initial estimates are often inaccurate. Second, these data show that the ratio for actual expenditures gradually declined from the 1960s to the 1980s in alignment with the account level trends.

Looking at the DAMIR data since 1997, the topline trends are inconclusive. Only in recent years, the ratio of procurement to R&D has declined across multiple measures and even the magnitude of those declines was relatively minimal and not below past low water marks.

The study team is not yet prepared to make definitive conclusions until it has had more time to explore the details closely to isolate potential findings hidden in the topline data noise.

Next Steps

Moving forward, the CSIS study team will focus its efforts on expanding its analysis of the MDAPs data to further explore the trends in the historical relationship between R&D and production. The study team will begin by incorporating the previously mentioned additional data sources to bridge the three-year gap in SARs data between RAND's DSCPD and DAMIR. These datasets will then be combined into a singular, standardized dataset.

From this dataset, the study team will expand its analysis of the MDAPs to include additional program characteristics that enable the team to provide more granular analysis of the data. These additional characteristics include, but are not limited to, the military service responsible for the program, the platform type, whether the program had a prototyping phase, and the program's length. With the addition of these program characteristics, the study team can better isolate potential changing dynamics that don't appear in the topline data. For example, the study plans to closely examine the historical trends in the Aircraft sector after the addition of these variables.

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