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MASTER OF MILITARY STUDIES

SERVICE IMPACTS TO JOINT ACQUISITION PROGRAMS:
70 YEARS OF FAILURE

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

MAJOR BRYON MCCLAIN, UNITED STATES AIR FORCE

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Executive Summary

Title: Service Impacts to Joint Acquisition Programs: 70 Years of Failure

Author: Major Bryon McClain, United States Air Force

Thesis: Service parochialism continues to be the common cause behind joint acquisition programs experiencing twice as many acquisition failures than service-specific programs.

Discussion: Failure, in an acquisition program, can be defined as a serious increase above the program baseline. The Department of Defense (DoD) acquisition community refers to this as a Nunn-McCurdy breach. Performing a statistical analysis on fiscal year 2014 major acquisition programs highlights that joint acquisition programs, programs combining more than one service, are nearly twice as likely to experience a Nunn-McCurdy breach than service-specific programs. With this discrepancy as a starting point, this paper addresses the history of this problem. In 1983, the Government Accountability Office (GAO) reviewed joint acquisition programs and concluded service parochialism was likely the root-cause behind the many failures. For example, the likely reason the DoD cancelled the F-111B variant was because the Navy did not feel invested in the joint program, not because of requirement failures. Following the reforms of the 1980s, including the Goldwater-Nichols act to improve joint capabilities within the DoD, service parochialism still contributes to acquisition program failures. The Marines desire to be the "first to fight" drove them to push the V-22 Osprey joint program to adopt competing, technically challenging and state of the art requirements. The resulting capability, while useful in specific missions, is not cost effective for the Marines' primary mission of opposed amphibious assault. The Air Force's desire to rapidly replace the F-16 pressured the F-35 Joint Strike Fighter program to alter the system design approach. This decision is one of three root causes behind the subsequent acquisition failure and ultimate delay to the entire program. The Joint Primary Aircraft Trainer System program encountered the rumbling of service parochialism when developing the seat configuration requirement. However, pressure from Congress and the DoD left the service no choice but to find a solution, controlling the service parochialism. Lastly, the Joint Tactical Radio System program attempted to solve one of the side effects of service parochialism, lack of integration, with a technical approach that was nearly impossible. Over the course of almost 10 years, the program's demise was in the inability of the services to unite and fully back the joint program.

Conclusion: Running an acquisition program is difficult; running a joint acquisition program is more difficult, due to service parochialism. Before the Goldwater-Nichols act, the GAO found a history of service parochialism harming joint acquisition programs. Following the Goldwater-Nichols act, the negative impacts of service parochialism continue to reduce the chances of success from joint acquisition programs. Until the DoD, possibly through the Joint Staff, instead of the services, fund and manage joint programs, along with their requirements, joint programs will continue to fail twice as often as service programs.

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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Preface

The origin of this paper is a discussion I had with an experienced, and highly respected, program manager who was resistant to my suggestion that he take the lead of a hypothetical joint program office. The result of my research is that his trepidation was well founded. However, the intent of this paper is not to criticize the Department of Defense, the Services, or the professionals in the acquisition community. Nor is it to declare that joint acquisition programs are impossible. Rather, the intent is to identify the bias impacting joint acquisition programs with the hope the services, or the DoD, can actively mitigate or address this bias and thereby realize the potential fiscal benefits.

A project of this scope is not without many thanks. First, thank you to the expert acquisition input provided by Mr. Robert Younger a civilian with the U.S. Navy; COL James Dell'Olio, U.S. Army; and Lt Col Michael McMellon, U.S. Air Force. Additional thanks for the guidance and support from Dr. Paul Gelpi, my advisor, along with the editorial input from Lt Col Brent Grometer, U.S. Air Force. Naturally, I save the most important thanks for my wife, Rachel, and my son, Collin for allowing me the time to accomplish this, the eyes to review it, and their continuous and unwavering support.

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Introduction

In 2014, the enacted budget of the United States (U.S.) Department of Defense (DoD) was over $581 billion. Of that, nearly 30%, or $162 billion, went directly to acquisition programs. Another 45% of the budget operates and maintains existing weapon systems and infrastructure.[1] Given the quantity of the budget influenced by acquisition programs, the DoD needs affordable, yet capable, weapon systems. One approach to affordable weapon systems, used since 1947, is the development of a common weapon system to meet the requirements of two or more services, also known as a joint acquisition program. A common example of a joint acquisition program is the F-111 Aardvark aircraft program, which the Air Force and Navy began developing in 1958. Unfortunately, that program delivered only 33% of the initially anticipated aircraft, as the Navy declared the final product did not meet requirements.[2] A more recent joint program is the F-35 Joint Strike Fighter (JSF) that, in 2014, reached the unenviable milestone of being the most expensive DoD acquisition program ever.[3] There are non-aircraft joint programs as well, such as the Joint Tactical Radio System (JTRS). This program, started in 1997, brought together all services to design a common radio, but the DoD closed the joint program office in 2012, without ever fielding a joint radio.[4] These three examples suggest joint programs are prone to failure. However, all DoD programs are under high scrutiny, due to years of problems. The Government Accountability Office (GAO) highlighted the scope and concern in 2013 when they stated, "DOD weapon system acquisition, an area that has been on GAO's high-risk list for more than 20 years, still represents one of the largest areas of the government's discretionary spending."[5] This raises an interesting topic for research, determining if there are actual problems unique to joint acquisition programs that make them more susceptible to failure than service-specific acquisition programs.

Before looking at specific cases, a definition of failure for acquisition programs is required. The Defense Acquisition University defines an acquisition program as a, "funded effort that provides a...capability in response to an approved need."[6] One definition of failure is a program that does not deliver the required capability. One problem with using requirements as a metric for failure is that specific requirements are typically not part of the public record, nor are test reports documenting the program's success or failure in meeting the requirements. This makes analysis, using public information, difficult.

The military acquisition process introduces another issue with the requirements based analytical approach. A weapon system is not a commercial product, meaning the military need for the capability can outweigh massive cost and schedule growth. In the commercial world, the need for return on investment typically outweighs the need for a capability, thus terminating programs experiencing massive cost and schedule growth. Within the DoD, military necessity trumps cost. For example, the Evolved Expendable Launch Vehicle program for the U.S. Air Force, "is currently the sole provider of launch vehicles for U.S. military and intelligence satellites."[7] Yet, the program has experienced growth of almost 250% or $46 billion dollars. The program continues to exist because the requirement to place military satellites is a military necessity, not because the acquisition program is successful. A requirements based metric for measuring successful military acquisition programs is misleading, as it does not factor in cost overruns, which cause many fielded programs to seem like failures in the eyes of American taxpayers.

To document acquisition program problems, and ensure proper DoD oversight, Congress, in 1982, introduced language into Section 2433 of Title 10, U.S. Code for unit cost reporting. This section requires program managers to estimate and monitor per-unit costs and notify Congress in

the event of significant deviations. A serious deviation, referred to as a, "Nunn-McCurdy breach,"[8] typically results in a new program manager, program restructuring, and auditing from senior DoD acquisition officials. In severe cases, the Secretary of Defense must certify to Congress the program's military necessity to national security in order to keep the program funded. The Nunn-McCurdy breach, documented in the public record, provides a suitable definition of acquisition program failure.

This research hinges on the assumption that joint acquisition programs are more likely to experience failures than service-specific acquisition programs. Using Nunn-McCurdy breaches as a definition of program failure, a comparison of service to joint programs using 2014 data suggests joint programs are more likely to experience a Nunn-McCurdy breach than service-specific programs. Appendix A contains the dataset of programs used in this analysis. The 2014 GAO analysis of Selected Weapon Systems provided the list of programs.[9] The report documented which programs were joint programs or service specific programs. Additional research identified the number of Nunn-McCurdy breaches each program experienced.

Table 1. Summary statistics of major weapon programs

Program Type		**Sample Size**	**Average Nunn-McCurdy Breaches**	**Sample Standard Deviation**
	Symbol	*n*	$\overline{X}$	*S*
Service-specific	*1*	33	0.546	0.711
Joint	*2*	10	1.000	0.816

Statistical tools can support a conclusion that two groups are not the same, which the data in Table 1 suggests. The hypothesis, for statistical testing, is that the Average Nunn-McCurdy Breaches from Service-specific programs ($\overline{X}_1$) equals the Average Nunn-McCurdy Breaches

from Joint programs ($\overline{X}_2$).[i] A standard statistical tool to determine if two samples come from the same population, meaning they are equal, is the T-Test statistic.[10] Analyzing the full data in Appendix A, the resulting T-Test static is 1.7119, which, according to the T-Distribution, corresponds to a low probability, 0.095, that the hypothesis is true. Therefore, the alternate hypothesis, that the two samples are not from the same population, is likely, with a confidence of just over 90%. The F-Test statistic[ii] supports the required assumption of the T-Test that both samples have a similar population variance.[11] Thus, a statistical analysis on publicly available data, utilizing the definition of failure as a Nunn-McCurdy breach, suggests joint programs are, on average, nearly two times as likely to experience a failure than service-specific programs.

With documentation that joint programs experience almost twice as many Nunn-McCurdy breaches as service programs, the analysis can focus on the common cause, or causes, for this difference. This paper analyzes joint programs before and after the Goldwater-Nichols act of 1986, an act designed to improve joint activities within the DoD. The existing research on acquisition programs before Goldwater-Nichols suggests service parochialism was a common cause of joint acquisition failures. With this as a starting point, a case-study analysis of selected major programs post Goldwater-Nichols, the V-22 Osprey, F-35 JSF, Joint Precision Aircraft Trainer System (JPATS), and JTRS, highlights that service parochialism continues to plague joint acquisition programs. The conclusion is that despite the need to reduce acquisition costs, service parochialism persists as the common cause behind joint acquisition programs experiencing more failures than service-specific programs.

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[i] Mathematically the equation for the null hypothesis is $\overline{X}_1 = \overline{X}_2$.

[ii] The F-Test statistic is 0.76, which is not statistically significant. Therefore, the hypothesis for the F-test, that the two samples come from populations with equal variances, is not disproved.

Joint Acquisition Programs Prior to Goldwater-Nichols

Ever since Congress combined the services into a singe department, the DoD has attempted to execute joint programs. In 1947, Congress combined service-specific acquisition processes through the Armed Services Procurement Act (ASPA) of 1947. This act formed the foundation of the modern acquisition system within the DoD. By 1956, Congress formalized ASPA as Chapter 137 in Title X of U.S. code.[12] Besides laying the groundwork for the modern acquisition system, ASPA took the first step towards acquisition programs involving multiple services, by establishing a Joint Research and Development Board, as well as a Joint Munitions Board. By 1953, President Eisenhower restructured both boards, due to the, "inability of the service representatives on each board to take a DoD-wide perspective when an issue conflicted with the interests of their particular service."[13] To solve this issue, President Eisenhower directed the assistant secretaries of defense, for research and development as well as applications engineering, to coordinate between the services. While the assistant secretaries were now advising the Secretary of Defense, they lacked any direct control over the services.[14] Thus, the civilian leadership was unable to halt service parochialism.

The result of these failed attempts at joint research and development was the founding of what became the Defense Advanced Research Project Agency (DARPA).[15] To break the hold of service parochialism, President Eisenhower established the Advanced Research Projects Agency, in 1958. What made this unique was it was, "the first time [the Office of the Secretary of Defense (OSD)] became involved directly in implementing acquisition programs."[16] Additionally, the Defense Reorganization Act of 1958 gave OSD the power to, "approve, disapprove, or modify service acquisition programs."[17] It appeared the antidote to service

parochialism would be control from OSD; but, this approach underestimated the strength of the services.

The first Secretary of Defense to utilize the new acquisition powers was Robert McNamara. Shortly after assuming the position, in January of 1961, McNamara directed the Navy and the Air Force to join their pending fighter programs into the Tactical Fighter Experiment (TFX) program, later designated the F-111 Aardvark.[18] This required two services to coordinate on requirements and develop the first, major, joint acquisition program. The Navy was looking for a fighter capable of fleet defense, by intercepting enemy aircraft. The Air Force needed strike aircraft that could deliver nuclear weapons after penetrating the enemy defense by flying supersonic speeds at low altitude.[19] The technical solution to these differing requirements was a movable wing, or swing-wing, design. Being the first production aircraft with this technology, the decision included technical risk the program office exacerbated through a concurrent development schedule. Delays in technological development of the high-risk technology caused impacts to the program schedule.[20] While the TFX program encountered challenges from the combined requirements, two models were still delivered for testing, the F-111A for the Air Force and the F-111B for the Navy. It was in testing that service parochialism halted the joint acquisition program.

The DoD terminated the Navy variant of the TFX program, before production, based on claims by the Navy that the joint program was not meeting the Navy's requirements. The Air Force had the lead on the Joint Program, lending credibility to the Navy's claim the other service did not prioritize their requirements equally. By 1967, the DoD canceled the Navy variant, F-111B, allowing the Navy to begin work on a new fleet interceptor, the F-14.[21] At the time, the argument that the F-111B did not meet minimum Navy requirements was true, as the F-111B

was clearly deficient. However, when comparing the F-111B to the F-14, the Navy's requirement argument appears to be more of an excuse to abandon a joint program. Robert Coulam compared the F-111B performance, at the time of DoD cancelation, to the F-14's actual performance, and found that in most aspects, the F-111B may have made a better fleet defense interceptor than the F-14. One of the Navy's biggest complaints regarding the F-111B was its weight, being nearly 26% heavier than the requirement. However, the fielded F-14 weighed 18% above the F-111B's requirement.[22] Additionally, the F-111B had a longer loiter time, cost significantly less, and was powered by the same engine as the F-14.[23] In one aspect, wind-over-deck performance measures, the F-14 was superior. Nevertheless, this requirement assumed 4,200 pounds less weight than the F-111B requirement. The Navy fixed requirements for the joint F-111B program, but adjusted requirements for the service-specific F-14 program. As Poole remarked in his analysis, the F-111 program highlighted, "the pervasive influence of service parochialism."[24]

Following the TFX, the 1970s and early 1980s yielded multiple attempts at joint programs. This included the Global Positioning System (GPS) and the Joint Tactical Information Distribution System (JTIDS). The GAO reviewed these two systems along with 11 other systems and compiled a report on joint acquisition programs. This report concluded, "no major joint program successfully completed...and a number of developing programs [were] in trouble."[25] The key problem was, "interservice disagreement on requirements."[26] In most cases, the report identified that OSD, or congress, were required to intervene to keep a joint program from becoming service-specific. For example, in the GPS program, OSD repeatedly reversed service decisions that reduced the joint nature of the program. In the end, the services fielded both GPS and JTIDS but only through continuous oversight keep service parochialism at bay.

The GAO study from 1983 did identify a successful joint strategy: the joint procurement of service-specific development programs. The F-4 Phantom was an attack fighter developed as a service-specific program for the U.S. Navy in the 1950s.[27] However, in the 1960s, the U.S. Air Force purchased the F-4 with minimal customization. As the GAO recognized, the resulting aircraft, "proved to be quiet compatible with Air Force missions and doctrine and was well liked by Air force pilots."[28] While highlighted in the report, the GAO did not consider this a joint program as a single service performed the development phase of the acquisition program. The DoD report comments argued the definition of a joint program, "should include programs in which the Services collaborated on any portion of the total acquisition cycle."[29] This definition softens the report's conclusion that there were "zero" successful joint programs, but does not alter the more important conclusion that service parochialism negatively impacts the requirements definition of programs.

Between the establishment of the DoD in 1947 and 1986, the lack of integration between the services was a problem larger than joint acquisition programs. Service parochialism was so strong that Congress intervened and passed the Department of Defense Reorganization Act of 1986, commonly called the Goldwater-Nichols Act. One of the reasons behind the act was to, "strengthen the representation of the joint military perspective and improve the performance of joint military duties."[30] The underlying problem the act identified was that, "under current arrangements, the three Military Departments and four Services exercise power and influence which are out of proportion to their statutory duties."[31]

The acquisition community also underwent major changes in the 1980s. In 1982, President Regan combined various government acquisition regulations into the single Federal Acquisition Regulation.[32] The Packard Commission, report from 1986, recommended a joint requirements

board and created the acquisition chain of command from service acquisition executives to program managers.[33] With the focus on joint service integration, and a restructuring of the acquisition processes, the intent was the DoD could finally realize the cost savings from joint acquisition programs.

Joint Acquisition Programs Post Goldwater-Nichols

With the restructuring of the acquisition processes in place, and Goldwater-Nichols forcing the services to behave in a joint manner, the stage was presumably set for successful joint acquisition programs. Unfortunately, based on the following research, service parochialism still negatively influences joint programs. This analysis highlights the impact from service parochialism via case studies of the V-22 Osprey, F-35 JSF, JPATS, and JTRS acquisition programs. All four of these programs were affected by, or started after, the Goldwater-Nichols Act.

V-22 Osprey

The Bell Helicopter Company derived the V-22 Osprey from a NASA and U.S. Army prototype tilt-rotor aircraft, known as the XV-15. In 1981, the Undersecretary of Defense for Research and Development pressured the services to develop one new aircraft, instead of the six proposals he had seen. This created the Joint Services Advanced Vertical Lift Aircraft (JVX) program.[34] The Army was the lead agency planning on procuring 288 aircraft for special electronic missions. The Air Force agreed to purchase 200 aircraft for its combat search and rescue and long-range special operations missions. The Marines planned on procuring 552 aircraft to support its lift mission and replace the CH-46 Sea Knight assault lift helicopters.

Lastly, the Navy had agreed to procure 50 aircraft for its combat search and rescue missions.[35] The program lasted nearly 30 years, fielding the Marine version in October 2007, and the Air Force version in 2009.[36] The cause of this time span was numerous technical and bureaucratic issues, stemming from key decisions influenced by service parochialism.

The V-22 experienced numerous, well publicized, technical challenges, many of which originate from the initial requirements. The four services involved in the program agreed on a requirement document calling for a sea-based aircraft, capable of at least 250 nautical miles per hour (kts) airspeed, with a ceiling altitude of at least 30,000 feet, and a crew capacity of at least 24.[37] The speed and ceiling requirements were unattainable for helicopters, but the experimental XV-15 tilt-rotor aircraft could meet these requirements. While the initial plan was to scale up the X-15 in size, the sea-basing requirement limited the maximum size of the rotor blades to ensure maneuverability of the aircraft on the flight deck of an amphibious assault ship.[38] To meet the requirements, the aircraft needed shorter rotor blades and stronger engines, which increased the overall weight of the aircraft. In fact, the thrust to weight ratio for vertical takeoff and landing was over twice that of a normal helicopter.[39] These requirements induced technical challenges that, "would spark hot debates years later."[40]

What makes this requirements issue so interesting is that there was no concept of operations as to why the Marines required a fast, high-flying, and sea-based aircraft. The Marines tout the V-22 as a critical system, enabling the operational concept of ship-to-objective maneuver. However, ship-to-objective maneuver derived from a concept known as operational maneuver from the sea, developed in 1996, 15 years after the initiation of the V-22 program.[41] Furthermore, a study by the Institute for Defense Analysis (IDA), performed during the early 1990s, found the V-22 would not be mission effective in an opposed amphibious assault without

support helicopters, thus negating the advantages of the tilt-rotor.[42] As a proof of this study, in 2013, a noncombatant evacuation operation in south Sudan was aborted after three V-22 Ospreys were attacked, injuring four U.S. service members.[43] In this instance, the aircraft flew farther and faster than armed escort helicopters could, and the hostile personnel in the area thwarted the mission. The failed mission to rapidly insert U.S. troops into a distant hostile environment was the reason the Marines needed the V-22 to have tilt-rotor capability.[44]

A contrary perspective is that the V-22 does provide an amazing capability. In fact, the failed noncombatant evacuation operation did demonstrate the survivability of the aircraft, as the aircraft aborted safely, even after sustaining multiple hits.[45] Additionally, in March of 2011, two sea-based V-22s rescued a downed U.S. pilot in Libya within 90 minutes, something helicopters could not accomplish.[46] While these are examples of the great capabilities, the requirement for combat search and rescue was not a Marine requirement, but rather a Navy and Air Force requirement. The disconnect between the actual capability, the Marines requirement, and the missing concept of employment is important when considering the technical challenges and cost of the program.

The V-22 requirements were not for a specific documented Marine mission, but rather came from the interest of senior Marine leaders, and concern regarding their overall legitimacy within the four services. A key supporter of the V-22 program, Secretary of the Navy, John Lehman appeared following a demonstration of the XV-15 at the 1981 Paris Air-show.[47] At this time, the services were in need of multiple replacement rotor-wing aircraft to replace aging aircraft. Secretary Lehman, following the air-show, had pressured the Vice Commandant of the Marine Corps to procure a tilt-rotor aircraft as their replacement. The Secretary of the Navy's support to the tilt-rotor design resonated strongly within the Marine Corps. Before Secretary saw the X-15,

a fixed wing aviator, who had called the helicopter, “an interim vehicle,” began drafting the initial requirements for the Marines follow-on aircraft.[48] Thus, the Secretary’s push already linked with draft requirements. Later, following the Desert One disaster, the Bell Helicopter Company highlighted how tilt-rotor capabilities negated the need for a similar landing site, while directly marketing to Marine pilots.[49] Given these influences, the Marines involved in the JVX program drove high-speed and long-range requirements into the joint requirements document.[50]

The Marine Corps’ service perspective further influenced the requirement for a high-speed and long-range aircraft. When General Krulak examined factors influencing the future of the Marine Corps, the first factor he identified was, “the oppressive influence of threat.”[51] This referenced the 15 previous times the President, services, or other influential individuals threatened the existence of the Marines as an independent organization.[52] By the end of the Vietnam War, in the late 1970s, there were rumors some defense officials, and members of think-tanks, were hypothesizing it was time for the Marine Corps to change, or reduce in size. Marines needed a unique capability that would allow them to be the, “first to fight” and project power.[53] This service perspective simmered under the surface when the Secretary of the Navy suggested the Marines procure a tilt-rotor aircraft. The Marines were hungry for a unique aircraft that could provide speed and range to project power, and the Secretary of the Navy was pushing for the same technology. As Whittle identified, the Marines, with help from the Secretary of the Navy, had decided on a tilt-rotor solution, before documenting requirements.[54]

The requirements for the V-22 were the result of service parochialism. Those requirements caused technical and bureaucratic challenges, resulting in increasing costs, a reduction of participating services, and an attempt by the Secretary of Defense to cancel the program. From an acquisition perspective, the program was a failure. The cost grew by 43%, while delivering

50% fewer aircraft, resulting in a per unit cost growth of 185%.[55] Additionally the program experienced one Nunn-McCurdy cost breach. Even in 2010, there were still calls to terminate the V-22 due to, "the program's 'troubled history' and maintenance issues."[56] The V-22 really is, "greatly increasing the reach of U.S. ground forces with an aircraft that is both more versatile and more survivable than any conventional helicopter."[57] Unfortunately, service parochialism influences, to fashion this into a Marine compatible aircraft, created technical constraints that buried a good capability under 30 years of negative history.

F-35 Joint Strike Fighter (JSF)

A more recent joint aircraft program is the F-35 JSF. The goal of the program is to minimize costs over the life of the aircraft, by developing a common aircraft, with minor modifications to meet the mission specific requirements.[58] The Air force requirement was for a low-cost, lightweight, fighter to fill the roles of the F-16 and A-10. The Navy requirement was to replace the A-6 with a two seat, carrier based, fighter that could perform long-range missions, in all weather. Lastly, the Marines required a long-range, supersonic, fighter replacement for the AV-8B Harrier, that had a short take off vertical landing (STOVL) capability.[59] All three services were expecting the aircraft to incorporate stealth technology. The DoD recognized that no one aircraft could meet these competing requirements. The method to reduce life-cycle cost was to have commonality between the different variants. The goal was for 80% of the aircraft to be similar, reducing the logistics burden and maintenance costs.[60] With this strategy in mind, the Joint Staff, a military organization working for the Chairman of the Joint Chiefs of Staff, managed the compilation of requirements into a single document. By leveraging the Joint Staff, the DoD helped to minimize the potential for one service to over prioritize their requirements, as the Navy had claimed in the F-111 program.[61] The next ideas the DoD implemented were to

ensure the Navy and Air Force equally shared the fiscal burden, and that both services staffed the program office with personnel. Additionally, the services agreed to rotate the program director and senior acquisition responsibilities between them to ensure equality.[62] The joint program office for the F-35 was set to attempt a technically ambitious program as no previous aircraft had combined all the requirements in the Joint Staff approved document.

The initial plan to ensure commonality, when developing the F-35, was to design the complex STOVL variant first. The developing contractor would then modify the STOVL model for the Air Force mission by replacing the vertical lift mechanism with an extra fuel tank. The development plan would address the difficult design aspects first, ensuring maximum commonality. However, this resulted in a long development timeline negatively affecting the Air Force. As a result, the Air Force pressed hard to shorten the time for an F-16 replacement.

To meet the Air Force's need, the program office designed the conventional version first, and two years later, developed the STOVL variant. When designing the conventional aircraft, weight, a high priority for the latter STOVL variant, was prioritized below other requirements. Years later, when working the challenges for the STOVL variant, weight became a major issue. The weight reduction program for the STOVL variant is the largest contributor to the lack of commonality between variants.[63] In fact, the STOVL variant is only 27% common with the other F-35 variants, increasing the overall life-cycle cost.[64] Developed after the conventional aircraft, the STOVL variant is essentially a new aircraft.[65] Service parochialism affected the cost of the F-35 to such an extent in the design phase that it was one of three root causes to a Nunn-McCurdy breach.[66] The second order impact from lack of commonality is, "the most recent [DoD developed] cost estimate for operating and supporting the F-35 fleet is more than $1 trillion, which DOD officials have deemed unaffordable."[67]

Currently, the F-35 program is one of the largest, most scrutinized, acquisition programs. In 12 years, the total program cost increased 47%, quantities dropped by 14%, and the per-unit-cost increased 72%. The acquisition time grew 100%, from 10 years to 20 years.[68] Additionally, the F-35 program has already experienced two Nunn-McCurdy cost breaches. Once again, one of the causes behind the acquisition program failure is the negative influence form service parochialism.

Joint Primary Aircraft Trainer System (JPATS)

Around 1988, the Air Force and the Navy were looking for a commercial aircraft to replace the existing student pilot trainer. Congress directed a DoD report, documenting the future pilot-training plans, in an effort to link the two independent programs into a joint acquisition program.[69] While both services required a new trainer, Congress, the DoD, and the Air Force, each had different approaches to solve the requirement. The Navy had not yet selected an approach, adding needed flexibility. Congress pushed to shorten the lifespan of both Air Force trainers, the T-37 for initial pilot training and the T-38 for follow-on training. The DoD proposed to delay the follow-on initial trainer by having the Air Force fill the training gap with the Navy's T-45 trainer, which would incur higher operations costs. The Air Force plan was to avoid the costs of multiple service-life-extension programs for the T-37 by quickly replacing the aircraft with a more modern one, but continue the T-38 program.[70] The Air Force recognized the best opportunity to reach its goals was to work with the Navy and quickly create a joint program, satisfying both needs and preventing Congress or the DoD from forcing a decision the Air Force did not want. The Air Force had a simple need, a pilot-training aircraft, which could be met with minimal modification to commercially available products, in a very tenuous political situation.

Due to the pressure of this situation, and only because the Air Force actively worked to suppress it, service parochialism did not contribute to an acquisition failure.

Not surprisingly, the Air Force and Navy were able to come to agreement on joint requirements. On 6 December 1988, the Navy and Air Force started a joint program by signing a memorandum of understanding.[71] Over the next year, the Air Force and Navy reviewed their differences in training methodology and requirements. Towards the end of 1989, a working group, consisting of senior officers in the grade of O-6, met to reconcile the differences. By 12 December 1989, the Air Force and Navy had agreed, in writing, on the basic joint requirements. This included the Air Force sidelining service parochialism and conceding the requirement for tandem seating. To an outside observer this seems like a small difference, but as the Air Force Air Education and Training Command historian outlined, this actually, "was a big step for the Air Force, which had operated with side-by-side seating in the T-37 for over 30 years."[72] From the perspective of Air Force instructor pilots, there are advantages and disadvantages to each configuration. The ability to see the actions a student performs while flying is beneficial, especially for the initial flights; however, when a student can see your actions, specifically to prevent their mistakes, it can have a negative impact on training. As one former instructor pilot stated, "it just takes some time to adjust to a new configuration."[73] Given the follow-on T-38 training aircraft, with tandem seating, the need for a specific requirement, either way, seems to counter common sense, especially when the program desired a commercially available product.[74] The discussion of the seating configuration highlights what McNicol identified as a, "Service's doctrinal preconceptions."[75] In the case of the JPATS program, the pressure from DoD and Congress was sufficient in ensuring the difference in seating configurations only resulted in a paragraph in the program's history, and not a cause of the program's failure.

While the Air Force and Navy arrived at agreement, the requirements included another issue. The requirements from 1989 were continually refined through the early 1990s in preparation for the release of the request for proposal. However, the services based the requirements on previous student demographics, similar in both services, meaning they ensured the majority of male pilots could fit into the cockpit. The demographics of the new students had shifted as they now included female students. This meant that, based on the requirements as written, approximately 50% of all potential female pilots could not fly the aircraft because they were too small to fit into the cockpit, and access the controls. After direct involvement of the Undersecretary of Defense in 1993, the requirement changed to include at least 80% of the female population.[76] While the services worked around their smaller competing interests, they were still blinded to how the demographics of their personnel had changed.

The JPATS acquisition program, with technically available needs, and cooperating services, still encountered many issues. The ongoing reform of the acquisition system ensured senior DoD acquisition leadership interest into the acquisition strategy, resulting in delays in contract release.[77] Additionally, the reform was encouraging flexibility for contractors so some system requirements, traditionally included in a standard military specification, were absent. This caused confusion amongst the various bidders and delayed the contract award.[78] Further, issues in production maturity and changes to the commercial design resulted in more cost impacts.[79] In the end, the program was 50% over total estimated cost, but, due to a 10% increase in quantities, only experienced a 35% increase in per-unit cost.[80]

The program did have a Nunn-McCurdy breach, which the DoD attributed to unspecified requirements issues.[81] The JPATS program is an important case study because it demonstrates that it is possible to curb service parochialism. In this instance, the fear of the alternatives forced

the Air Force to implement a senior-officer working-group to find a solution, and ultimately accept another service's requirements. Unfortunately, the JPATS program also demonstrates the difficult nature of acquisition programs. In this case, service parochialism did not cause a Nunn-McCurdy breach; other factors were responsible.

Joint Tactical Radio System (JTRS)

The need for the JTRS resulted from intra-service communications issues, due to independent service acquisition programs. DoD officials, with urging from Congress, pushed the services to form the JTRS joint program office in 1997 to create a common radio for all services.[82] The origin of the DoD challenge was radios were hand-held and installed in various fielded weapon systems. Upgrading hardware in a fielded system remains a costly endeavor, so the JTRS solution required compatibility with multiple different hardware forms, capability for easy upgrade, and a man-portable option.[83] This was the same time when the personal computer was flooding the commercial market. The software-based operating system, Microsoft Windows, ensured that different hardware could run the same applications. Thus evolved the JTRS architectural concept of a software-defined radio (SDR).[84] By using software to develop the output radio signal, referred to as a waveform, each service could design hardware in accordance with a common software interface. Radio upgrades would be accomplished via a simple software update. Hence, no costly hardware upgrades and rapid fielding of new waveforms. Service parochialism guaranteed JTRS program failure given this technologically challenging concept.

The JTRS program was very complex, technically. The requirements covered the spectrum of current and future radio capabilities. The DoD envisioned JTRS performing High Frequency, Very High Frequency, and Ultra High Frequency communications; typically, each of these is

accomplished by a specialized radio. Additionally, JTRS needed to operate without existing infrastructure and carry data traffic from multiple independent levels of security.[85] In current terms, JTRS software needed to operate on an Apple, Blackberry, or Android smart-phone, while the hardware included the capabilities of a smart-phone and cellular tower, in one portable device. Additionally, the smart-phone purchased five years ago now needs to run the most current connection, either 3G or 4G LTE, without a hardware upgrade.[86] The commercial world long ago abandoned the software-only architecture for communications because, as a RAND study identified, "most PCs do not provide wireless communications capabilities and do not require specialized antennas, power amplifiers, and [analog to digital] A/D converters."[87] In fact, these specialized pieces of hardware make it extremely difficult to maintain software independent from hardware.[88] An IDA study of the JTRS technology concluded, "it appears safe to conclude at this point that achieving this [SDR] vision for military radios will be very difficult, if not impossible, especially given the cutting-edge performance requirements of military systems."[89] Furthermore, that study stated, "a vision that sees hardware staying in service for years or decades, upgraded only via software, is nothing like the path that personal computers and cellular telephones have taken."[90] Given today's knowledge, it is probable that technical challenges alone would have sunk the JTRS program, but service parochialism ensured failure.

While JTRS was a technically challenging program, the lack of support from the services during the development cycle removed any chance of success. In 1999, two years after the program began, the GAO raised concerns regarding the joint program. From a development perspective, the GAO found that, "DOD and service research programs [were] not adequately

coordinated with JTRS development plans, reducing opportunities for the program to directly address technology needs not satisfied by the commercial marketplace."[91] Given the technical challenges, this turned out to be a large issue. The GAO further predicted, "problems in achieving interoperability goals may also be expected because each of the services places higher priority on meeting its own rather than joint requirements."[92] In 2003, the GAO follow-up report confirmed this prediction, finding the services had not committed all of the previously budgeted JTRS funding.[93] Further, the JTRS program management was powerless to attain agreement across the services, crucial as information system technology and requirements change at a rapid rate.[94] By 2007, the GAO found that the actual spending on the JTRS program between fiscal years (FY) 2003 through 2007 was $2.5 billion, 17% below the planned $3 billion. At the same time, the spending on the existing radios, known as legacy radios, increased over 2,400%, from a planned $235 million to $5.7 billion.[95] The cause of this increase was the ongoing wars in Iraq and Afghanistan, combined with a change in battlefield tactics that required more radios per unit.[96] With the war on terror, the U.S. military needed quality modern radios immediately and could not wait to upgrade old radios, disrupting the original JTRS fielding plan. The immediate needs of troops in combat are the highest priority for acquisition personnel. The JTRS joint program office was the place in the DoD that best understood the risks and future challenges to the joint radio and the current legacy capabilities. Unfortunately, there were not given the task of meeting immediate needs and adjusting long-term plans. The services instead ceased coordination with the JTRS program and acquired many more legacy radios.[97] The lack of commitment to the joint program by the services before 2003 ensured that the services abandoned the joint approach and independently procured legacy radios.

The JTRS program failed from an acquisition program perspective and in terms of meeting the requirements. The DoD canceled the Army's variant while the Air Force and Navy variant allowed the contract to end without fielding any hardware.[98] The Army variant ended up costing $1.8 billion and encountered a Nunn-McCurdy breach, while the Air Force and Navy variant reached $8.1 billion.[99] The technical challenges of SRD architecture set the JTRS program heading towards failure, but service parochialism, manifesting in a lack of support, removed the flexibility of the program office to change course, find solutions, and avoid failure.

Conclusion

The research, development, production, fielding, and maintenance of multi-billion dollar programs are challenging, even in the commercial world. For example, the Boeing 787 Dreamliner cost an estimated $32 billion to develop.[100] However, once in service, the Federal Aviation Administration decided to conduct a review of the aircraft, "after the 787 aircraft experienced a series of problems including an electrical fire at Boston's Logan International Airport."[101] For DoD acquisition professionals, the challenges are even greater. The service-specific EELV program grew nearly 250%, but remains today due to military necessity. The DoD cancelation the Army's future combat system resulted in $20 billion spent with no end product.[102] Both of these examples are service-specific programs. When competing perspectives and interests from multiple services are integrated into a joint program, the probability of acquisition failure, a Nunn-McCurdy breach, almost doubles. Based on analysis from the 1980s, and current case studies, it appears the issue common in joint program failures, and thus the reason behind this doubling, is service parochialism.

Service parochialism negatively influences joint acquisition programs. Based on Coulam's research, the likely reason the DoD cancelled the F-111B variant was because the Navy did not feel invested in the joint program. It was probably not due to the failure of the aircraft to meet all the requirements, as the Navy claimed. Whittle's extensive research into the V-22 identified the Marines desire to be the, “first to fight” drove them to push a joint program to adopt competing, technically challenging, and state of the art requirements. The resulting capability, while useful in specific missions, is not cost effective for the Marines primary mission of opposed amphibious assault. As the RAND Corporation identified, the Air Force desire to replace the F-16 rapidly, pressured the F-35 joint program to alter the system design approach from a low risk development with a long time span. This decision is one of three root causes behind the subsequent acquisition failure and ultimate delay to the entire program. Even the JPATS program encountered the rumbling of service parochialism in the development of the seat configuration requirement. However, pressure from Congress and DoD left the service no choice but to find a solution, controlling the service parochialism. Lastly, the JTRS program attempted to solve one of the outcomes of service parochialism, lack of integration, with a technical approach both IDA and RAND identified as extremely difficult. As the GAO found, over the course of almost 10 years, the program’s demise was the inability for the services to unite and fully back the joint program. In the four case studies, post Goldwater-Nichols, two programs, the V-22 and the F-35, experienced Nunn-McCurdy breaches due to service parochialism. The third program, JPATS, kept service parochialism at bay, but the difficulties of the acquisition program resulted in a Nunn-McCurdy breach anyway. The fourth program, JTRS, floundered once it encountered a huge technical challenge because of a consistent lack of

service support and the DoD ultimately canceled the program, but not before it encountered a Nunn-McCurdy breach as well.

Service parochialism appears to complicate requirements and limit service commitment to program success. A RAND corporation study on DoD acquisition cost growth found, "in [their] sample of 35 mature programs, development cost growth [was] driven equally by cost-estimating errors and requirements growth, which [combined] account for almost two-thirds of the total."[103] The same study also identified that, "procurement cost growth [was] driven by quantity changes (usually increases in quantity), which account[ed] for more than half the total growth."[104] The influences of service parochialism complicate the two factors that have the largest impact on cost growth and thus acquisition program failure. As McNicol identified, "within the basic DoD organizational architecture, joint development programs are somewhere between difficult and impossible to conduct successfully if the requirements established for the joint program seriously conflict with one of the participating Service's doctrinal preconceptions."[105]

The DoD has been pushing for joint programs since 1947. In those 67 years, the examples of success are limited, but point to a way forward. In 1983, the GAO identified one successful strategy for joint acquisition programs; one service performs the research and development of a weapon system, and another service procures that same system, typically with minor modifications. The JPATS case study highlighted the other strategy; the DoD tackles service parochialism head-on by ensuring the joint program is, from the service perspective, the lesser of multiple evils. This is a starting point for further research, how the DoD can control service parochialism. This research reaffirms the 1983 GAO conclusion that, "the various entities in

DoD have lacked the sustained 'clout' to gain acceptance and implementation of decisions; for example, requirements disputes that the services cannot settle on their own."[106]

Congress provided the Chairman of the Joint Chiefs of Staff the authority to prioritize requirements. In 2013, Congress strengthened the Chairman's role with the statutory task of, "[r]ecommending to the Secretary appropriate trade-offs among life-cycle cost, schedule, and performance objectives, and procurement quantity objectives, to ensure that such trade-offs are made in the acquisition of materiel and equipment to support the strategic and contingency plans required by this subsection in the most effective and efficient manner."[107] This function is currently performed via the Joint Requirements Oversight Counsel (JROC), as part of the Joint Capabilities Integration and Development System (JCIDS) process. The JROC is led by the Vice Chairman of the Joint Chiefs of Staff and is, "comprised of officers in the grade of General or Admiral from the Services and [Combatant Commands]."[108] If this Joint Staff construct were expanded to include program management functions, the potential exists to create a truly joint acquisition program. Instead of utilizing service acquisition oversight, the Joint Staff acquisition function would fall directly under the Undersecretary of Defense for Acquisition Technology and Logistics, to minimize potential service parochialism. The Joint Staff would then include an acquisition arm, similar to the United States Special Operations Command, which also undertakes joint acquisition activities.[109]

This recommendation provides a springboard for further research into the existing structures and laws to develop functional joint acquisition agency. This plan also needs to address the possible drawbacks. For example, if funding is not controlled by the proposed joint acquisition agency, then services continue to parochially influence the process. Additionally, to prevent a repeat of the F-111B program, the joint acquisition agency must have the ability to make

necessary requirements trade-offs, yet force a service to accept a product. While this may be a concerning prospect, the existing Joint Staff processes already recognize this difficulty. Specifically, "[t]he most critical aspect of the JCIDS process is to allow the JROC and its subordinate boards, as informed by other stakeholders in the requirements process, to manage and prioritize capability requirements within and across capability requirement portfolios of the Joint Force,"[110] The ultimate arbitrator, in this case, is the Vice Chairman of the Joint Chiefs of Staff. It is time to leverage the lessons and success of the existing JCIDS process to expand the Joint Staff role in management and leading joint acquisition programs. Until the DoD, instead of the services, fund and manage joint programs, along with service requirements, joint programs will continue to fail twice as often as service-specific programs.

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Appendix A Data Set

Program	Joint?	# Nunn-McCurdy
Advanced Extremely High Frequency Satellite (AEHF)	No	2
AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)	No	1
CH-53K Heavy Lift Replacement Helicopter (CH-53K)	No	0
DDG 1000 Zumwalt Class Destroyer (DDG 1000)	No	1
EA-18G Growler	No	0
Evolved Expendable Launch Vehicle (EELV)	No	1
Excalibur Precision 155mm Projectiles (Excalibur)	No	1
Family of Beyond Line-of-Sight - Terminals (FAB-T)	No	0
Future Combat System	No	0
Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78)	No	0
Global Positioning System III (GPS III)	No	0
Ground/Air Task Oriented Radar (G/ATOR)	No	0
Integrated Air and Missile Defense (IAMD)	No	0
Joint Air-to-Surface Standoff Missile + Extended Range (JASSM/JASSM-ER)	No	1
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	No	2
Joint Precision Approach and Landing System Increment 1A (JPALS Inc 1A)	No	1
KC-46 Tanker Modernization Program (KC-46)	No	0
LHA 6 America Class Amphibious Assault Ship (LHA 6)	No	0
Littoral Combat Ship (LCS)	No	1
MQ-1C Gray Eagle Unmanned Aircraft System (MQ-1C Gray Eagle)	No	0
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	No	0
MQ-8 (Fire Scout)	No	1
MQ-9 Reaper Unmanned Aircraft System (MQ-9 Reaper)	No	0
Next Generation Operational Control System (GPS OCX)	No	0
P-8A Poseidon Multi-Mission Maritime Aircraft (P-8A)	No	0
Paladin Integrated Management (PIM)	No	0
RQ-4A/B Global Hawk Unmanned Aircraft System (RQ-4A/B Global Hawk)	No	2
Ship to Shore Connector Amphibious Craft (SSC)	No	0
Small Diameter Bomb Increment II (SDB II)	No	0

Program	Joint?	# Nunn-McCurdy
Space Based Infrared Satellite System (SBIRS High)	No	2
Virginia Class Submarine (SSN 774)	No	1
Warfighter Information Network-Tactical Increment 2 (WIN-T Inc 2)	No	1
Warfighter Information Network-Tactical Increment 3 (WIN-T Inc 3)	No	0
Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	Yes	0
F-35 Lightning II Program (F-35)	Yes	2
Joint High Speed Vessel (JHSV)	Yes	0
Joint Light Tactical Vehicle (JLTV)	Yes	0
Joint Primary Aircraft Training system (JPATS)	Yes	2
Joint Tactical Radio System Ground Mobile Radios (JTRS GMR)	Yes	1
Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios (JTRS HMS)	Yes	1
National Polar-orbiting Operational Environmental Satellite System (NPOES)	Yes	2
V-22 Osprey	Yes	1
Wideband Global Satcom (WGS)	Yes	1

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