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POSEIDON ON PATROL: A COMPREHENSIVE ANALYSIS OF THE U.S. NAVY P-8A PROGRAM

September 2023

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The P-8A Poseidon program represents the Navy's cutting-edge Maritime Patrol and Reconnaissance Aircraft (MPRA). A comprehensive analysis of the program is notably missing from the repertoire of acquisitions research. This work provides that missing comprehensive piece. This project includes an exploration of the P-8A program holistically from the earliest days of conceptualization through the present, as well as with an eye toward the future of the program. This research involves utilizing a strengths, weaknesses, opportunities, and threats (SWOT) analysis with associated root cause analyses to identify and analyze these different attributes of the P-8A program. The primary study finding is that, due to a variety of factors, the P-8A program is an overall acquisition success with various future opportunities for program growth and evolution. The results indicate that the P-8A program is one that other programs can model to achieve similar success.

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A COMPREHENSIVE ANALYSIS OF THE U.S. NAVY P-8A PROGRAM

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

ABA	application based architecture
AI	artificial intelligence
AoA	analysis of alternatives
APB	acquisition program baseline
APUC	average procurement unit cost
ASuW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
BAE	British Aerospace Systems
CLS	contractor logistics support
COTS	commercial off-the-shelf
CUI	Controlled Unclassified Information
DMO	Distributed Maritime Operations
DOD	Department of Defense
DODIG	Department of Defense Inspector General
DOT&E	Director, Operational Test and Evaluation
FRS	Fleet Replacement Squadron
GAO	Government Accountability Office
GOTS	government off-the-shelf
GWOT	Global War on Terror
HSI	human systems integration
ISR	intelligence, surveillance, and reconnaissance
MDAP	Major Defense Acquisition Program
MMA	Multi-Mission Maritime Aircraft
MPRA	Maritime Patrol and Reconnaissance Aircraft
NAVAIR	Naval Air Systems Command
OEM	original equipment manufacturer
PANDA	Predictive Analytics and Decision Assistant

PATRECON	patrol and reconnaissance
PAUC	program average unit cost
PMA	Program Management Activity
SaaS	software as a service
SAR	special acquisitions report
SE	systems engineering
SLEP	Service Life Extension Program
SWOT	strengths, weaknesses, opportunities, and threats
TOC	Tactical Operations Center
TOMS	Tactical Open Mission System
TWD	test work description
UAV	unmanned aerial vehicle

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I. INTRODUCTION

Acquisition research often tends to focus on where a program has failed in one way or another. This may be due, in part, to the fact that most of the press surrounding Department of Defense (DOD) acquisitions tends to focus on the programs that are facing cost overruns, schedule challenges, and failure to achieve the performance capabilities the warfighter requires. It is certainly important to learn from those mistakes to continue to improve DOD acquisitions. However, this research focuses on a program that is widely regarded as successful and has produced an unparalleled Maritime Patrol and Reconnaissance Aircraft (MPRA). As Admiral Harry Harris, Jr., former commander of the U.S. Pacific Fleet, said, “This is a super aircraft. Within just three months of arriving for its first-ever deployment, it’s already a huge leap forward in capability for the Pacific Fleet” (Florida Times Union Staff 2014, para. 3). The program this research focuses on is the P-8A Poseidon program, also known as the Multi-Mission Maritime Aircraft (MMA) program. This program is important from an acquisition research perspective, as it provides a crucial study in how to procure a highly technical weapons system in a cost-, schedule-, and performance-effective way. In addition to the aforementioned reasons, the program also provides insight into employing various commercial off-the-shelf (COTS), government off-the-shelf (GOTS), and new and evolving systems. Further, from the very beginning, the MMA program was designed to evolve and keep pace with an ever-changing environment of threats. The program is not without its faults, and those are addressed within this research as well. This research presents an analysis of the successes and failures encountered thus far in the P-8A acquisition life cycle and presents various lessons learned that can be employed in future acquisition programs.

The global geopolitical environment is changing rapidly, and DOD acquisitions must continue to innovate to stay ahead of these changes and field the equipment that will allow American warfighters to win the conflicts and wars of the 21st century and to achieve peace through strength. At present, war rages between Russia and Ukraine, and the Chinese are becoming increasingly bold in their interactions with the United States and its allies (and especially the free people of Taiwan). Iran continues to attack shipping vessels in the Persian Gulf, international terrorist organizations are still carrying out heinous crimes in various places around the globe, and the international relations landscape is continuing to change, calling into question alliances and partnerships that were once thought to be unassailable. Of particular concern to the United States is the rise of China. Over the past two decades, the Chinese have become a global power dominating economically, diplomatically, and, perhaps most concerning, in growing military might. While the United States was focused on other challenges, namely the Global War on Terror (GWOT), the Chinese were focused on becoming a global power and regional hegemon. In addition to these geopolitical challenges, DOD acquisition programs have come under fire countless times due to ballooning budgets, the slow timeframes for acquiring new systems, and programs falling short of promised performance goals. With these challenges in mind, it is paramount that the DOD acquisitions process continues to improve and adapt to ever-changing global threats to quickly supply U.S. warfighters with effective equipment at the best price possible.

A. RESEARCH QUESTION AND OBJECTIVES

This research focuses on the U.S. Navy's P-8A Poseidon program as a contribution to the broad spectrum of acquisition research. The P-8A program is widely regarded as an acquisition success delivering a high-performance product in a timely manner for a reasonable cost (Department of the Navy [DON], 2021; Government Accountability Office [GAO], 2016; Leone, 2019; McIntosh, 2019; Rogoway, 2021; Thompson, 2023). Despite the program being widely perceived as a success, there is a notable lack of comprehensive research on the program, with the majority of the research surrounding the P-8A focusing on specific systems or functions of the aircraft. The P-8A platform is ultra-modern and at the cutting edge of a variety of mission areas, including Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASuW), and intelligence, surveillance, and reconnaissance (ISR), as well as having essential search and rescue capabilities. This leads to the questions, "What are the lessons learned from the P-8A acquisition program, and how can those lessons be applied more broadly to other programs?" Answering these questions is the root of this acquisition research. Another important function of this research is to serve as a repository of sorts for information and research regarding the P-8A program from its inception to the current state of the program. Recognizing the lack of such a comprehensive source, one of the secondary goals of this research is to provide a resource for future studies in order to further acquisition research surrounding the P-8A program.

B. RELEVANCY OF RESEARCH

Many organizations from across government and industry have displayed a keen interest in the P-8A program for various reasons. The GAO uses the program as a relevant case study in many of its reports. A long list of selected acquisition reports (SAR) regarding the P-8A exists, and researchers and journalists have published numerous articles regarding various aspects of the program. These reports and articles have been useful both in the program background as well as the analysis portion of this research project. The P-8A program has created numerous jobs around the country, and that is an important consideration, as it should be expected that a variety of entities would have a vested interest in the program.

One might rightly ask, “Why research the P-8A program as opposed to another program?” The P-8A program is relevant for a variety of reasons. First, the P-8A is a Major Defense Acquisition Program (MDAP), which is the highest level of defense acquisition program. Second, the P-8A program has been hailed as an acquisition success by the Navy, the press, and partner nations that have purchased the platform (Jouppi, 2022; Florida Times Union Staff 2014; Boeing, 2023). Third, the program employed an iterative process in development of the P-8A as well as an evolutionary design for the platform. As mentioned, the United States is heading into a much more competitive environment abroad, and the ability to procure effective weapons systems quickly and cost-effectively is more important now than ever. Research often looks to what went wrong in an acquisition program, but this research differs by looking primarily at what went right in the P-8A program.

C. METHODOLOGY

Because this research focuses on the P-8A program as a whole, it follows a case study design. The study explores various aspects of the P-8A program throughout all milestones and stages up to the present day. As part of the case study, this research utilizes a strengths, weaknesses, opportunities, and threats (SWOT) analysis to provide a framework with which to effectively analyze the case. Within this SWOT framework, root cause analysis is also used to further the depth of the SWOT analysis performed. This analysis includes an investigation of the major milestone decisions and turning points in the program throughout the concept development, platform decision, system demonstration, and production and deployment phases of the platform. The case utilizes various sources of documentation, such as government reports, official program documentation, press relating to the program, and other sources as appropriate. An exhaustive complement of sources functions to both aid in the analysis of the P-8A program and also contribute to the repository of sources available to future researchers. It should be noted that the most significant challenge in researching the P-8A program has been the absence of official program documentation available to researchers regarding the program. Normal avenues and databases for acquisition research have yielded sparse results and have been an obstacle to the research process.

D. ORGANIZATION

The next section of this capstone applied project includes a synthesis of the literature available regarding the P-8A program. Following that is an overview and history of the P-8A program. Next, the research moves to an analysis of the P-8A program to explore answers to the proposed research question. This analysis includes the SWOT analysis and root cause analyses. Conclusions and a summary of the findings appear next. Finally, a discussion, implications for other programs, research limitations, proposals for further research, and final remarks conclude this research.

II. PROGRAM HISTORY AND OVERVIEW

The P-8A is primarily a "persistent Anti-Submarine Warfare and Anti-Surface Warfare" platform but has other capabilities such as ISR, advanced communications, and Search and rescue (DON, 2021, p. 2). The platform was developed using an evolutionary systems replacement approach to be "dynamic and flexible" to "attain the strategic vision for tomorrow's Naval forces" (DON, 2021, p. 2). Additionally, the P-8A is one of multiple systems in the MPRA "Family of Systems" that includes "the MQ-4C Triton Unmanned Aircraft System, the EP-3, and the Tactical Operations Center" (DON, 2021, p. 2). The P-8A is a capable, interoperable, and foresightful aircraft capable of taking on the challenges of today with an eye towards those of tomorrow.

A. THE NEED FOR A NEW OR UPDATED MARITIME PATROL AND RECONNAISSANCE AIRCRAFT

What is now the P-8A Poseidon aircraft has a long history, dating back to calls for a new naval patrol and reconnaissance (PATRECON) aircraft as far back as the mid-1980s (Defense Industry Daily Staff, 2023). However, with the Cold War coming to a close, this push for a new PATRECON aircraft lost steam, as the Russian threat was virtually nonexistent, and the United States was experiencing a time of unparalleled supremacy on the world stage. Due to these circumstances, the Navy canceled two planned replacements, both the Lockheed P-7A "a stretched and re-engined P-3, and the Boeing-led Update IV programme [sic]" and opted rather to employ a Service Life Extension Program (SLEP; Navy International, 2005, para. 7). As the 1990s came to an end, new threats emerged, the Russians were becoming increasingly concerning, there was trouble in the Middle East, and the Chinese threat was growing at a rapid pace. The current P-3C airframe was rapidly approaching the end of its fatigue life at this time and was plagued by obsolescence issues that were contributing to vastly reduced availability (DON, 2002, p. 3).

With these challenges came the renewed push for a maritime aircraft capable of meeting the challenges of the 21st century. All these things considered, the Navy had three options: extend the service life of the current P-3C Orion, upgrade the P-3C Orion aircraft as a new variant, or procure an entirely new platform. As stated in the Component Advanced Development Phase II documentation, the purpose of the new MMA program was "to provide a weapon system to recapitalize P-3 aircraft capabilities" (DON, 2002, p. 3). "An element of that weapon system has been determined to be a land-based manned aircraft. Additionally, the Government believes that Unmanned Aerial Vehicles (UAVs) will play a role in MMA as an adjunct weapons systems element" (DON, 2002, p. 3). These ideas would be the start of the MMA program that would eventually become the P-8A Poseidon program. Concept studies for the replacement aircraft began in 1997 and ran through 1999 prior to milestone zero and an analysis of alternatives going into the new millennium (AoA; Multimission Maritime Aircraft Program Office, 2003).

B. PROPOSALS FOR THE NEW OR UPDATED AIRCRAFT

Initially, extending the service life of the P-3C was seriously considered due to the ease of the procurement as well as the reduced cost of such a proposal (Tran, 2013, p. 7). With the P-3C already a proven platform, simply extending the service life of the current airframe was a viable consideration, as these service-life extensions are common among a variety of platforms not only in the Navy but in the other services as well. As an example, the U.S. Air Force B-52 program has seen multiple service-life extensions over the years and is poised to be the first aircraft in history to serve continuously for over 100 years. However, in the case of the P-3C, most of the aircraft in service were approaching the maximum fatigue life on the airframe itself, and there was no viable option to extend that maximum life (DON, 2002, p. 3). This would result in the need to simply procure more P-3Cs, which were already suffering from other obsolescence issues and an inability to evolve and integrate cutting edge technologies necessary to reach far into the 21st century, and which may have been much less economical due to the lack of P-3C production for decades prior. Moving forward, the Navy was looking at a maritime aircraft capable of a variety of missions, with the ability to be upgraded and evolve as a platform as necessary (DON, 2002, p. 4).

Upgrading the P-3C to an Orion 21 variant was also considered during phase 1 of the AoA, as the P-3C was a proven platform with more than 30 years of maritime service for not only the U.S. Navy but also many partner nations (Naval Air Systems Command, 2006). Improving and upgrading the platform through reengineering was certainly a logical consideration, as it was likely to be both cost effective and timely because many of the improvements were likely to be focused on sensors and technology, with minimal changes to the airframe itself. However, this proposal would still be leveraging existing airframes, and due to the already identified fatigue and obsolescence issues, would likely have resulted in a costly platform riddled with maintenance and obsolescence issues.

Finally, replacing the P-3C with an entirely new aircraft was considered, and, from the outset, there were a variety of proposals. During the AoA exploration for the MMA, the Navy had a variety of options to consider. In phase 1 of the analysis, these included a medium-sized commercial derivative based on either the Boeing 737 or the Airbus A320, a large-sized commercial system based on either the Boeing 757 or the Airbus A321, and, finally, a military derivative based on the British Aerospace Systems (BAE)–produced Nimrod MRA4 (shown in Figures 1 and 2; Evans, 2003, p. 293). One of the core elements validated early on was the need for both a land-based and a manned system (DON, 2002, p. 3). This did not eliminate any of the aforementioned airframes. During phase 2 of the AoA, a U.S. Air Force Common Wide Body concept based on the Boeing 767 or Airbus A310, a carrier-based manned/unmanned option, and a land-based unmanned option were considered as well (Evans, 2003, p. 293). With these systems in mind, one of the key aspects of the MMA program was an "evolutionary systems replacement approach" that would allow for a dynamic and flexible aircraft able to evolve over time and be a transformational system for the warfighter (Evans, 2003, p. 293). In keeping with central tenets of the program, each of these alternatives would be studied and tested, and the upgradeability of the platform would be of utmost importance.

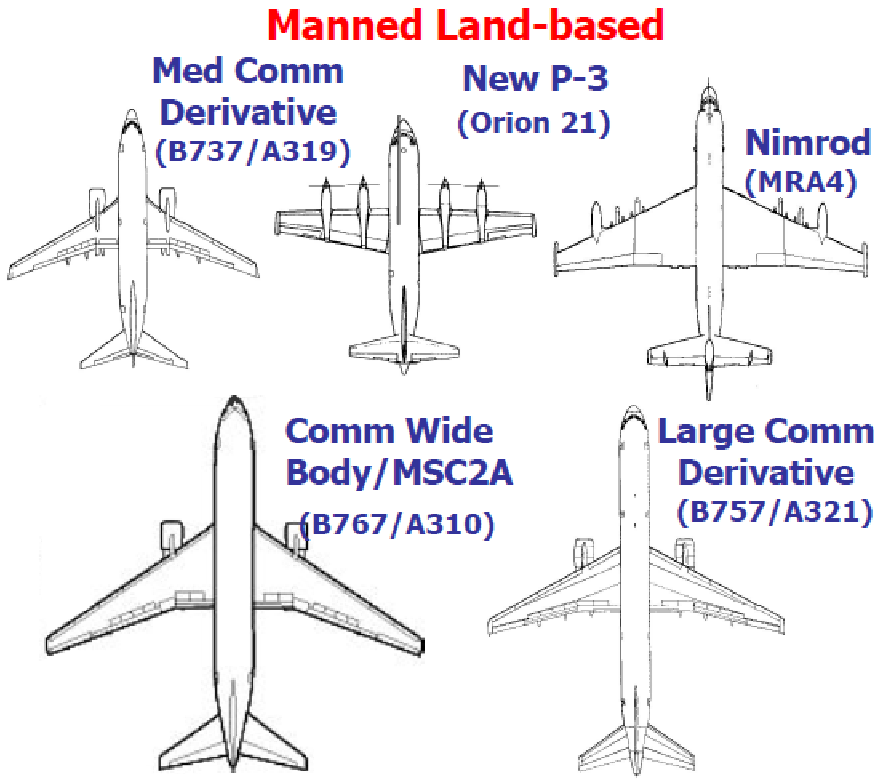


Figure 1. Multimission Maritime Aircraft Initial Proposals. Source: Multimission Maritime Aircraft Program Office (2003).

Figure 2. Boeing P-8A Poseidon (Top) and BAE Nimrod MRA4 (Bottom). Source: BAE Systems (n.d.).

C. CHOOSING THE BOEING PROPOSAL

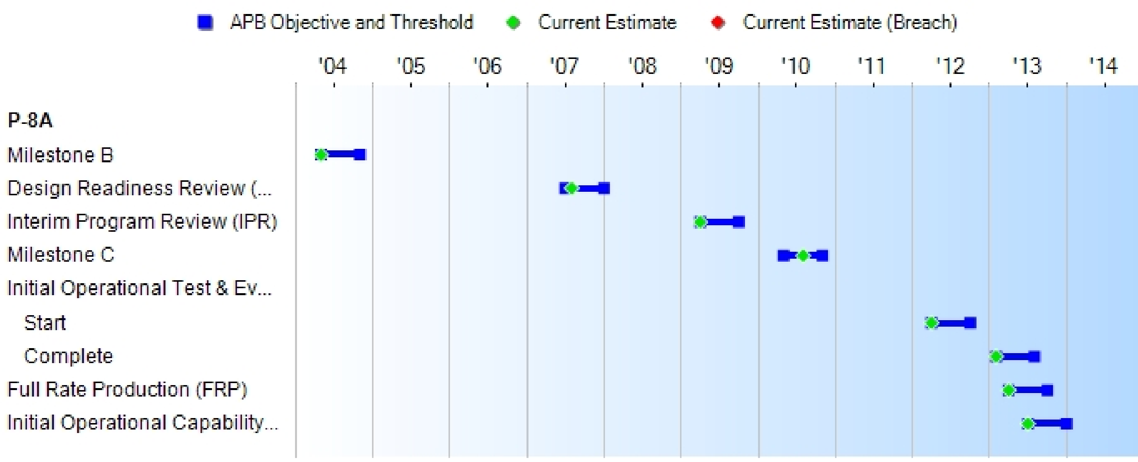
Ultimately, after a thorough AoA, the Boeing 737–800ERX proposal was chosen as the MMA and would receive the designation of P-8A Poseidon (Boeing, 2004). To be more specific, "the production aircraft is based on the Boeing 737–800 aircraft, [sic] but uses the 737–900 extended-range wing" (Office of the Director, Operational Test and Evaluation, 2010, p. 163). This design was designated P-8A on March 30, 2005 (Naval Air Systems Command, 2005). Boeing competed very effectively, even against the longstanding leader in the maritime patrol community, Lockheed, to ultimately be chosen to produce the new MMA platform. This choice was based on a few key factors. The first factor was relying on an "open architecture" platform that could be upgraded quickly and affordably (Scott, 2008, para. 11). The second factor was the "production and through-life cost savings" of the platform due to the massive 737 production capabilities already in existence supplying commercial airlines (Scott, 2008, para. 11). Third, the "Next Generation 737 and its CFM56-7 engines have already been proven to have incredible reliability having logged more than 30 million flight hours while maintaining an unequalled 0.002% in-flight shutdown rate per 1,000 flying hours" (Scott, 2008, para 11). In addition to these factors, Boeing was also able to demonstrate not only parity with P-3C capabilities early on but also increased capability in many cases. For instance, in 2002, Boeing demonstrated maritime tactics in a modified 737–800 meant to mimic their MMA proposal (Scott, 2008). In this demonstration, Boeing showed that the 737 got similar fuel economy (to the P-3C) at low altitude, could perform high intensity banks at low power, could operate safely and effectively on a single engine, and could even outclimb the P-3C on only one engine (Scott, 2008).

Simply put, the Boeing proposal could outperform the current P-3C as well as the Orion 21 proposal with room for evolutionary upgrades throughout the life of the program as well as significant commonality with an incredibly successful commercial airframe. This had excellent implications for cost concerns, as savings could be realized in production as well as sustainment. Additionally, due to the mass production of the 737 line of aircraft, schedule risks could also be more effectively managed to quickly replace the rapidly aging P-3C.

D. ACQUISITION PROGRAM BASELINE

The acquisition program baseline (APB) outlines the cost, schedule, and performance goals of government programs and provides a reference by which to analyze these metrics throughout the program's development. For the P-8A program, the original APB estimates were established in 2004 after the selection of the Boeing 737–based proposal. The original APB estimates for program cost included a total program cost of $30.2 billion with a program acquisition unit cost (PAUC) of $263 million. Additionally, the predicted Average Procurement Unit Cost (APUC) was $211 million. The APB thresholds for milestones are illustrated in Table 1. The performance thresholds include a mission radius of 1,200 nautical miles with 4 hours' time on station, a mixed stores loadout of 10,000 lbs, an initial on-station altitude of 25,000 ft, an operational availability (for ASW missions) of 80%, 100% force protection, and the ability to fully support execution of joint critical operational activities (DON, 2010). These baselines serve as an important tool in the analysis and discussion portions of the research, as cost, schedule, and performance risk management are the primary concerns in program development, and success or failure in these areas can make or break a program.

Table 1. APB P-8A Program Milestones. Source: DON (2010, p. 6).



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III. LITERATURE REVIEW

The P-8A Poseidon program is still a newer program (as government programs can span many decades) despite having roughly a 26-year history. The first production P-8A aircraft was delivered to Patrol Squadron (VP) 30 in 2012, some 13 years after the initial exploratory phases of the program began (Pierce, 2012). Due to this fact, research focusing on the acquisition of the P-8A platform is limited and mainly focuses on very specific aspects of the P-8A program. However, the P-8A will be in service for many years to come and will continue to be an important acquisition to be studied. Research into the program so far has focused on several areas: program development, sustainment, logistics, training, expeditionary missions, and potential future mission sets. The research in each of these areas has important implications for various aspects of the P-8A program, and there is a great deal of overlap between these different categories. However, the literature also highlights the gap that exists in comprehensive program research regarding the P-8A Poseidon.

A. PROGRAM DEVELOPMENT

Research focusing on program development has taken a couple of forms. McDermott (2009) focused on the P-8A test work descriptions (TWD) written during the intermediate phases of the program. McDermott's intent was to focus on "baselining the current P-8A TWD process, modeling the process, and running simulations while varying key parameters to identify opportunities to improve the processes throughput" (p. 3). McDermott employed lessons learned from other naval aircraft testing programs such as the V-22 Osprey, F/A-18E/F Super Hornet, and E-2D Hawkeye (pp. 20, 22, 26). Through this research, McDermott analyzed three alternative TWD models and identified one that was able to keep the testing schedule on track with program timelines (p. 62). This research is useful, as it aids in analyzing various aspects of the P-8A testing program and identifying lessons learned from that process.

In addition to that research on the TWD process, Naegle and Petross (2010) examined software maintenance for the P-8 Poseidon aircraft. They identified that the P-

8A acquisition would be software-intensive and proposes three different software support management options (Naegle & Petross, 2010, pp. 22–24). Naegle and Petross proposed that the only practical software-support structure would be a combination of organic and contractor logistics support (CLS; p. 27) The researchers recommended that the Navy control software support management in addition to working out access to all software for both Navy and contractor support prior to further contracting actions (Naegle & Petross, 2010, pp. 27–28). This research also serves to support the analysis since the program's software management systems are now in place and available for more in-depth examination.

Finally, another piece of research focused on program development was Vignola's (2006) research on implementing airline pilot training curricula into the P-8A Fleet Replacement Squadron (FRS) training curriculum in order to realize cost savings in areas such as fuel, maintenance, and training costs (pp. 27–37). Vignola addresses the fact that the primary method of flight training used in the commercial airline industry is simulator-based and may have very important cost savings implications for P-8A training (pp. 17–21). This research plays well in the analysis of current P-8A training curricula at the FRS. Each of these pieces of research is useful in the eventual comprehensive analysis of the P-8A program as it relates to program development.

B. PROGRAM LOGISTICS AND SUSTAINMENT

In addition to the research on program development, some studies have focused on program logistics and sustainment. Calamug and Trout (2010) pointed out that the P-8A will require a heavy increase in logistics support and planning to perform its expeditionary mission (pp. 28–30). With that in mind, they recommended establishing partnerships and memorandums of agreement with military logistics support, creating a Poseidon expeditionary maintenance and logistics cell, establishing support billets, and developing and investing in a prepositioned fly-away kit (Calamug & Trout, 2010, p. 34). This research is relevant, especially in a conflict with China, as the P-8A will almost certainly be employed in an expeditionary capacity and must be prepared for that challenge.

Complementing the research by Calamug and Trout (2010), the U.S. Army Corps of Engineers Engineering Research and Development Center performed an in-depth analysis on constructing Naval expeditionary runways with a focus on requirements for the P-8A. The authors identified that the P-8A presents a unique challenge for military airfield pavements due to having greater gear loads than fighter aircraft along with greater tire pressures than cargo aircraft (Robinson et al., 2023, p. 1). Robinson et al. (2023) were able to identify minimum pavement thicknesses for multiple pavement types as well as the need for certain base layer thicknesses to support sustained P-8A operations (p. 146). Published in March 2023, this research is very recent and has implications regarding how the P-8A program handled predictions for runway requirements.

In another piece of logistics-based research focused on analyzing contractor logistics support for the platform, Tallant et al. (2008) explored the cost benefits of sole-source CLS with analytical comparisons to similar aircraft procurements (pp. 24–34). Ultimately, the researchers found that original equipment manufacturer (OEM) CLS was the most cost-effective option for logistics support of this type (Tallant et al., 2008, p. 76). However, similar to Naegle and Petross's (2010) recommendation for software management, the researchers recommended that Naval Air Systems Command (NAVAIR) adopt both an organic (to the Navy) and CLS blended option for the highest achievable cost savings (Tallant et al., 2008, p. 76).

Complementing this research regarding P-8A logistics support structure comes a Department of Defense Inspector General (DODIG) report identifying deficiencies in P-8A aircraft availability. The report noted that the P-8A fleet was not meeting the mission-capable rate of 85% set by Commander, Naval Air Forces Instruction (COMNAVAIRFORINST) 4790.2 and was rather at a rate of only 75% (Deputy Inspector General for Evaluations, 2021, p. 5). This report also identified causes behind these failures such as delays in identifying and receiving spares, lack of detailed maintenance procedures and technical data, and shortages in consumable spare parts such as O-rings, valves, bolts, and rivets while deployed (Deputy Inspector General for Evaluations, 2021, p. i).

An additional report by the GAO (2022) found that the P-8A met its mission-capable rate goal for only 2 out of 11 years examined (2011–2021; p. 45) This research has been helpful in the analysis of the sustainment plan and issues within the P-8A program to date. The various pieces of research regarding sustainment, logistics, and the expeditionary mission contribute well to analyzing how these processes have changed throughout the program and what lessons are to be learned from this.

C. FUTURE MISSION SETS AND INTEROPERABILITY

Finally, Leeds (2019) presented a case for pairing the P-8A with the B-1B Lancer for a reintroduction of patrol bombing for sea control. Leeds proposed a future mission set for the P-8A especially as it relates to a conflict with China. Leeds proposed bringing back this WWII-era capability as a way of filling a sea control gap and to match China's war-at-sea capabilities more closely (pp. 6–8). Leeds concluded, "the Air Force should keep the B-1 operational, refocused primarily in the maritime strike role, in close coordination with the Navy" (p. 22). This research is helpful in showcasing just how versatile and capable the P-8A is and its interoperability with other U.S. Armed Forces assets.

In addition to Leeds' (2019) proposal, the Distributed Maritime Operations (DMO) concept has implications for the P-8A as well. Vice Admiral Jim Kilby defines DMO operations as "many units in a distributed fashion, concentrating their fires and their effects" (Filipoff, 2023, para. 27). With the P-8A already being capable, interoperable, and multi-mission, its use within the DMO framework is likely to expand to fill key gaps other aircraft may not be equipped for or effective at completing. As DMO concepts expand and change, so too will the P-8A's role within, and these changes will certainly have an effect on sustaining P-8A operations.

IV. METHODOLOGY

This chapter provides details on the primary method of analysis (SWOT) and the secondary method of analysis (root cause analysis). This chapter serves to define both methods and clarify the use of each as well as how they will interrelate.

A. SWOT ANALYSIS METHODOLOGY

The SWOT analysis, at its most basic, is an examination of an organization's (or, in this case, acquisition program's) strengths, weaknesses, opportunities, and threats. This methodology emerged in strategic planning literature in the 1960s and started around the same time as strategic planning began to be used in the field of business management (Gürel, 2017, p. 1001). SWOT additionally is central to the "Design School Model," which primarily focuses on an organization's internal and external circumstances (Gürel, 2017, p. 1001).

The strengths portion of the SWOT analysis includes an examination of what an organization does well, what their advantages are, their important capabilities, and what, if anything, that organization does better than a competitor (Gürel, 2017, p. 997). Additionally, strengths, in regard to the SWOT framework, are characterized as internal circumstances or characteristics (Gürel, 2017, p. 997). In relation to the other portions of the framework, strengths are important, as they allow an organization to capitalize on opportunities as well as respond to threats to the organization (Gürel, 2017, p. 997).

The weaknesses portion of the SWOT analysis includes an examination of what an organization does not do well or what is disadvantageous to the organization (Gürel, 2017, p. 997). Weaknesses are internal to the organization, highlight areas in which an organization may be weaker than other organizations, and identify areas of inefficacy and inefficiency (Gürel, 2017, p. 997). An analysis of the weaknesses of an organization is important to solve existing problems and improve inefficacies and inefficiencies in order to address "difficulties and limitations for long-term plans and strategies" (Gürel, 2017, p. 997).

The opportunities portion of the SWOT analysis includes an examination of "the convenient time or situation that the environment presents to the organization to achieve its goals" (Gürel, 2017, p. 998). Opportunities are external to the organization, but understanding strengths and managing weaknesses are key to taking advantage of opportunities (Gürel, 2017, p. 998).

The threats portion of the SWOT analysis includes an examination of anything "that makes it difficult or impossible to reach the organizational goals" (Gürel, 2017, p. 998). Further, "threats are the situations that come out as a result of the changes in the distant or the immediate environment that would prevent the organization from maintaining its existence or lose its superiority in competition" (Gürel, 2017, p. 998). It is again important for an organization to monitor its strengths and weaknesses to effectively address and manage threats.

The SWOT analysis is a useful tool for analyzing an organization (or, in this case, an acquisition program) and has more than a few advantages. These advantages include things such as presenting a general perspective and general solutions, being an interactional technique that makes macro evaluations, helping an organization uncover opportunities to take advantage of, promoting group discussion about strategy issues and development, and being able to be applied to multiple levels of an organization (from the smallest teams to the organization as a whole; Gürel, 2017, p. 1003). However, the SWOT analysis model also has certain limitations and weaknesses. These may include bias (especially when examining strengths), a high time cost to an organization relative to results, and a lack of comparison with and to competitors (Gürel, 2017, p. 1004). In the framework of this research, bias is possible, but conjectures are formed based on fact, the time cost is irrelevant to the research, and comparisons may be made but are not a central part of the research design.

B. ROOT CAUSE ANALYSIS METHODOLOGY

Root cause analysis is used as a tool to complement the SWOT analysis that is the basis for the analysis portion of the research. Anderson and Fagerhaug (2006) define root cause analysis as "a structured investigation that aims to identify the true cause of a problem and the actions necessary to eliminate it" (p. 17). This research utilizes the root cause identification portion of the root cause analysis framework.

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V. P-8A PROGRAM ANALYSIS

The analytical basis for this research, as described in the Methodology chapter, is the SWOT analysis. Table 2 depicts the SWOT analysis performed for the P-8A program. This Analysis chapter expands on each SWOT identified. To supplement the strengths and weaknesses portions, a root cause analysis is performed to further illustrate the relationships therein.

Table 2. P-8A Program SWOT Diagram

Strengths	Weaknesses
• Early prioritization of systems engineering (SE) • Iterative development • Evolutionary/upgradeable platform • Use of proven COTS airframe and engines • Interoperability • Multiple mission sets • Open architecture • Early systems integrated using GOTS systems from the P-3C • Robust integrated software • Focus on Human Systems Integration (HSI) • Robust training environment • Met or exceeded APB criteria	• Program cost and schedule slips • Product support requirements • Tactical open mission system (TOMS) issues stopping missions
Opportunities	**Threats**
• Software focus • Leverage artificial intelligence • Containerize software • Further integration into DMO	• Budget • Availability • Survivability • HSI issues related to software upgrades

A. STRENGTHS

This section details each of the strengths identified in the P-8A program. The P-8A program exhibits a wide variety of strengths evident in a well-planned, successful program. These strengths provide key takeaways for other programs to learn from, such as systems engineering (SE) prioritization, use of iterative development methods, COTS and GOTS use, open systems architecture, a robust software suite, focus on human systems integration (HSI), as well as strict adherence to the APB. All of these measures contributed in various ways to lower costs, schedule adherence, and satisfaction of performance requirements. Programs that can create value through these efforts and manage them early and often are more likely to exhibit similar levels of success.

1. Early Prioritization of Systems Engineering

One of the strengths of the P-8A program came early in the development stages, and that was the prioritization and early integration of SE. In a 2016 report, the GAO identified that programs that produce detailed SE plans prior to product development tend to position programs for greater levels of success. This same report identified that the P-8A program completed detailed SE in conjunction with an incremental, evolutionary acquisition approach focusing on "providing a first increment of capability to users in the quickest and most cost efficient manner" possible (GAO, 2016, p. 20). Additionally, due to concerns with the maturation of some of the technologies to be used in the Increment I aircraft, the Navy and prime contractor "identified mature backup technologies" to be used if the aforementioned critical technologies did not mature enough to be included in Increment I (GAO, 2016, p. 21). This analysis also served to reduce some of the program's technology risk (GAO, 2016, p. 21). This presents an important lesson learned to be leveraged by other programs; one of the major keys to successful product development (and programs as a whole) is prioritizing SE planning and integration early and revisiting often.

2. Iterative Development

The implementation of iterative development put the P-8A program on track to utilize the most modern acquisition methods, furthering the early and continued success of the P-8A program. The P-8A has been produced in multiple iterations, starting with the initial Increment I iteration, moving to the Increment II iteration, and finally arriving at the Increment III iteration. The current production model of the P-8A is the Increment III Block 2, which was contracted for in 2019 (Adamczyk, 2019). This enabled the Navy to quickly acquire a replacement platform for the P-3C that from the start was of equivalent capability in some areas and was superior in many others. Additionally, the platform underwent further development contracted in Increments II, III, and III Block 2, enabling further development in a cost-, schedule-, and performance-effective manner. Other programs could leverage this iterative development process to gain similar efficiencies and reduce risk in similar ways.

3. Evolutionary and Upgradeable Platform

The P-8A was designed from the beginning to be both evolutionary and upgradeable to meet both the challenges of the present day as well as those of the future. As mentioned, the P-8A program elected, somewhat out of necessity, to utilize an incremental development strategy. This strategy also assisted in the evolution and upgradeability of the platform. From Increment I to the current Increment III Block 2, the P-8A has evolved from a platform roughly equivalent in capability to the P-3C to one that is far more advanced in each mission area, has much more capable mission software, and is far more interoperable and proficient. However, there is still plenty of room for further evolution and upgrades. As technology progresses, the P-8A has been designed to take advantage of those developments and continue to integrate new technologies to remain the premier MPRA platform. Other programs can use this success to consider the evolution and upgradeability of their own platforms to maintain relevance in an ever changing threat environment.

4. Use of Proven Commercial Off-the-Shelf Airframe and Engines

The use of a proven COTS airframe and engines, with its built-in cost savings, reliability, and sustainment, has advantages from source selection on. The P-8A has 86% commonality with the 737NG, which has meant lower production costs for the aircraft as well as savings on aircraft parts in addition to other savings (Boeing, 2004). Additionally, the platform has an anticipated 25-year, 25,000-flight-hour service life in the harshest of environments (Boeing, 2023). Many aircraft programs, especially ones that have little to no reasonable COTS systems to leverage in development, are forced to take on risk developing both airframe technology and systems technology at the same time. This often leads to ballooning costs and large schedule slips, as it is incredibly hard to mature all of the technologies at once. In the case of the P-8A, utilizing a proven COTS system allowed for much of the airframe risk to be reduced from the beginning and for the focus to be on the capabilities within. Other programs that can reasonably leverage COTS capabilities can learn from this example and employ effective COTS systems in their own program development.

5. Interoperability

The P-8A has already proven to be a very effective platform in terms of interoperability, and that can be traced back to forward-looking decisions early in the program's development. Due to the versatility of the P-8A, the platform is expected to operate in a variety of environments and take part in numerous mission sets. Additionally, the advanced sensors and communications aboard the P-8A have already proven to be capable of operating in conjunction with various other platforms, services, and even partners around the globe. This interoperability has been demonstrated with other manned systems as well as unmanned systems (Naval Air Systems Command, n.d.). As Leeds (2019) mentions, the P-8A has the necessary capabilities and communications infrastructure to work closely with other assets in the U.S. arsenal, namely the U.S. Air Force B-1B bomber (pp. 7–8). This is in addition to working with other U.S. land- and sea-based assets as well as allies and partners. The P-8A, due to its state-of-the-art sensors coupled with advanced, secure communications, can take on the additional role of command-and-control aircraft able "to collect and disseminate tactical situation information to fleet forces," a further testament to the interoperability of the platform (Office of the Director, Operational Test and Evaluation, 2016, p. 306). This type of interoperability is incredibly important in an age where information dominance and sharing are crucial to the success of all military operations. Other programs can look to the P-8A program as a case study in platform interoperability and how to design for that interoperability.

6. Multiple Mission Sets

One of the major tenets of the P-8A program was the idea of the aircraft being multi-mission capable. The P-8A is already demonstrating this capability in the fleet. As mentioned, the P-8A has ASW, ASuW, search and rescue, ISR, and advanced communication capabilities. This is all in addition to its ability to deploy a variety of weapons and collection devices. These capabilities have been demonstrated across the globe during operations in the Middle East, South China Sea, Atlantic Ocean, Mediterranean Sea, South America, and various other places across the globe. This has included combat operations, exercises, freedom of navigation operations, and humanitarian assistance, among other roles. It is this versatility that has been essential to the success of the P-8A platform. Having too many capabilities can oftentimes lead to producing a platform that is not effective in its intended capacity, but the P-8A has proven to be extremely effective at its primary ASW and ASuW missions while also being capable in many other roles. Other programs can look to the P-8A when looking to design platforms with multiple mission sets while preserving the platform's efficacy at its primary mission.

7. Open Architecture

The P-8A showcases its modern acquisition approach through the utilization of an open architecture methodology. This open architecture approach goes hand-in-hand with the iterative development and evolutionary and upgradeable nature of the platform. The open architecture design allows for seamless transitions between current systems and services within the aircraft and upgrades to new ones when the operator requires them. This is especially important for the upgrades that occur between increments. In a more recent development, the P-8A has adopted a newer applications based architecture (ABA) software using software as a service (SaaS) concepts in Increment III Block 2 that allows for seamless incorporation of new capabilities with little to no modification of the mission software needed (Naval Air Systems Command, 2019). Additionally, this ABA software "deploys an advanced suite of cyber security technologies and makes those technologies available to all sub-systems," further embedding cyber security into the platform (Naval Air Systems Command, 2019, para. 1). Not only is this showcasing the P-8A's use of cutting-edge software integration, but it is also showcasing the use of an innovative COTS system developed by a small business (Naval Air Systems Command, 2019). Though this software acquisition predates the new *Department of Defense Software Modernization Strategy*, it actually satisfies many of the objectives given in that guidance, such as delivering "Resilient Software Capability at the Speed of Relevance" and utilizing commercial partnerships, SaaS approaches, and more robust security methods (Deputy Secretary of Defense, 2021, pp. 1, 7–9). In this sense, it was as if P-8A program leadership was peering into the future when integrating these new software approaches, which have now become major objectives for all programs within the DOD. This bold foresight is paying off in the success of the P-8A program and will be especially relevant to other acquisition programs of all types moving forward as the DOD shifts to incorporate innovative, secure software acquisition into all programs.

8. Early Systems Integrated Using Government Off-the-Shelf Systems from the P-3C

One of the reasons for the P-8A's easy integration into the fleet was the incorporation of multiple GOTS systems directly from the P-3C into the P-8A during the early phases of production. This was largely due to the need for a quick replacement because of red stripe test failures in the P-3C that grounded many of the aircraft and revealed that there was less life left on the aircraft than anticipated (Jacobs, 2009). The first increment of the P-8A largely incorporated existing technology from the P-3C, but in a way, which integrated that technology much more effectively due to the Tactical Open Mission System (TOMS) and advanced software onboard the P-8A (Office of the Director, Operational Test and Evaluation, 2010). This served to significantly burn down risk on the systems side, allowing for more focus to be placed on ensuring the aircraft part of the procurement did not face delays. For many programs, especially those with a predecessor, it is an important lesson to consider leveraging existing technology on the newly developed platform in order to burn down some of the total risk. This in conjunction with an architecture to support upgrades would allow more advanced systems to be incorporated later into the program as those technologies mature to a suitable level. Other programs should consider leveraging existing GOTS technology when possible to reduce program risk in the early stages of development.

9. Robust Integrated Software

The P-8A features a robust, integrated software suite that combines mission data from various sensors into one easy-to-use system that contributes to ease of use for the operator and overall efficacy of the platform. This TOMS software combines mission data from each sensor and station into an easy-to-use interface that allows collaboration between operators, the Tactical Officer, and the flight crew. This enables lightning-speed decision-making, quick weapons and buoy deployment, as well as efficient aircraft repositioning to take advantage of new information coming in from the various sensors. The TOMS system comes as a welcome update to the federated nature of the older P-3C mission systems, which did not allow for this type of efficiency and information to be at the disposal of the entire mission team (Military & Aerospace Electronics, 2011). As the DOD moves forward in mandating the use of cutting-edge software in future platforms, the P-8A showcases the use of this technology with the ability to upgrade at the speed of relevance and remain a capable platform far into the future.

10. Focus on Human Systems Integration

The ease of use and implementation of the P-8A platform into the MPRA community is evidence of clear prioritization of HSI concepts during the development and design of the aircraft. It is evident that the systems were designed and developed with the operator in mind. The integration of the various mission systems into an easy-to-use and collaborative mission software enables operators to make well-informed, effective decisions more quickly and to seamlessly coordinate between the operators, Tactical Officer, and pilots. This type of coordination was much more difficult in the more federated P-3C, and these types of HSI upgrades were not present. By recognizing the human aspect of the P-8A acquisition, the Program Management Activity (PMA)-290 team set up operators for success from the very beginning. Other programs can look to the P-8A program as an example of effective HSI practices.

11. Robust Training Environment

A robust training environment enabled by significant up-front investment as well as contractor support enabled the P-8A to be flawlessly integrated into the MPRA community. The P-8A program prioritized putting in place a complete training environment prior to the delivery of the first batch of P-8A aircraft (Boeing, n.d.). When the first P-8A was delivered to the fleet, there was already a complement of simulators (for both pilots and Naval Flight Officers) housed in dedicated training spaces (Boeing, 2023; Reynolds et al., 2023). This is an incredibly important lesson for other programs to learn from, as oftentimes the training environment is not on the same level of priority as developing and fielding the platform itself. However, without the necessary training, the platform may be able to be fielded, but it may not be deployable, or it may not be as effective due to the lack of training for the operator. Programs must prioritize the training aspect of the program early on in order to have the tools in place when the platform is ready to be fielded.

12. Met or Exceeded Acquisition Program Baseline Criteria

One of the greatest demonstrations of the strength of the P-8A program as a whole is how the program has met or exceeded virtually all of the APB thresholds and many of the objectives. When comparing the original APB objectives and thresholds established during the outset of the program in 2004 to the APB estimates in the final 2022 SAR report, the results are outstanding. In terms of cost, the 2022 SAR report identified that the PAUC unit cost decreased by 4.83% to date and APUC unit costs decreased by 13.38%. Overall program costs did increase, but that is due to an increase in the number of aircraft ordered, from 108 to 128 (DON, 2021, p. 11). In addition, the program exceeded the threshold for mission radius and met the threshold for endurance, far exceeded even the objective value for loadout, far exceeded the threshold for initial on-station altitude, achieved 100% force protection, and met requirements for net-readiness and ability to employ ASuW weaponry, as shown in Table 3. Finally, as shown in

Table 4, the P-8A program met all threshold dates established for key events and milestones in the original APB. This is evidence of an extremely successful program by all APB metrics, and these data points clearly show the cost-, schedule-, and performance-based success of the P-8A program.

Table 3. APB P-8A Performance Data. Source: DON (2021, p. 7).

Performance

Performance Characteristics					
Development APB Objective	**Current APB Development Objective/Threshold**		**Demonstrated Performance (include Date of Demonstration)**	**Current Estimate/Actual**	**Deviation**
Mission Radius/Endurance Subsurface attack (nm)					
>=1,600/>=4	>=1,600/>=4	1,200/4	1,262/4	1,262/4	
Mixed Stores Loadout (ASW) (lbs)					
12,500	12,500	10,000	13,275	25,000	
Initial On-station Altitude (ft)					
49,000	49,000	25,000	39,000	39,000	
Operational Availability (ASW)					
.8	(O = T) .8	.8	TBD	.8	
Force Protection (%)					
100	(O = T) 100	100	100	100	
Net-Ready					
Fully support execution of joint operational activities	Fully support execution of joint operational activities	Fully support execution of joint critical operational activities	Met initial NR KPP compliance per MS-B exit criteria. Demonstration of full NR compliance is TBD	Fully support execution of joint critical operational activities by Increment 3 IOC	
Net Enabled ASUW Weapon					
N/A	Capability to act in the CC and 3PS roles in the NEW architecture including launching the weapon, in-flight control of the weapon, terminal guidance of the weapon, transferring/receiving control to/from another platform, and designating or acting as a 3PS	Capability to act in the CC role in the NEW architecture Including launching the weapon, inflight control of the weapon, and terminal guidance of the weapon	Capability to act in the CC and 3PS roles in the NEW architecture including launching the weapon, inflight control of the weapon, terminal guidance of the weapon, transferring/receiving control to/from another platform, and designating or acting	Capability to act in the CC and 3PS roles in the NEW architecture including launching the weapon, in-flight control of the weapon, terminal guidance of the weapon, transferring/receiving control to/from another platform, and designating or acting	

Table 4. APB P-8A Schedule Data. Source: DON (2021, p. 6).

Schedule

Schedule Events

Schedule Events					
Events	**Development APB Objective**	**Current APB Development Objective/Threshold**		**Current Estimate/Actual**	**Deviation**
Milestone B	May 2004	Jun 2004	Jun 2004	May 2004	None
Design Readiness Review (DRR)	Jul 2007	Sep 2007	Sep 2007	Aug 2007	None
Interim Program Review (IPR)	Apr 2009	Apr 2009	Apr 2009	Apr 2009	None
Milestone C	May 2010	Aug 2010	Aug 2010	Aug 2010	None
Initial Operational Test & Evaluation (IOT&E)					
Start	Apr 2012	Sep 2012	Sep 2012	Sep 2012	None
Complete	Feb 2013	Mar 2013	Mar 2013	Mar 2013	None
IOC	Jul 2013	Nov 2013	Nov 2013	Nov 2013	None
Full Rate Production (FRP)	Apr 2013	Jan 2014	Jan 2014	Jan 2014	None

13. Strengths Root Cause Analysis

Why was the P-8A program successful? The program was able to produce an incredibly capable multi-mission PATRECON aircraft on time and at a great value to taxpayers. This was because the program was properly funded, requirements were well-established and achievable, and the Navy, program office, and contractors worked together effectively. The Navy was in need of a P-3C replacement in a timely manner, and Boeing was under economic pressure to make additional sales due to declining commercial sales at the time. This led to an excellent Boeing proposal of a COTS system that could meet cost, schedule, and performance goals that impressed Navy officials and allowed for various cost savings throughout development and into sustainment. The Boeing 737–based concept showed better aircraft performance and greater ability to evolve and leveraged the cost savings and access to parts associated with one of the most successful commercial airliners on the planet. Finally, and most importantly, the root of the success of the P-8A program was a competent program office that met or exceeded all of the key APB metrics established at the outset of program development.

B. WEAKNESSES

This section provides details on each of the weaknesses identified in the P-8A program. The P-8A program exhibited more limited weaknesses, largely due to the excellent program planning and execution efforts. However, the program did experience certain cost and schedule slips, issues in relation to product support requirements, and issues with the TOMS system delaying or stopping mission execution. Issues of this nature are prevalent throughout DOD acquisition programs, but each program lends unique lessons on how to avoid these mistakes in the future. In the case of the P-8A program, that would look like more complete sustainment planning earlier in the program with more frequent reviews of that plan in addition to encouraging program teams to take accountability when mistakes are made and to learn from those mistakes and recover quickly.

1. Program Cost and Schedule Slips

The P-8A program experienced both cost and schedule slips during development. The GAO (2016) identified that, as of February 2016, the program's cost estimate increased by 14% and the acquisition cycle time had increased by 4 months (p. 21) In terms of schedule slips, 4 months is certainly not extremely debilitating. However, a cost increase of 14% is definitely cause for concern in a multibillion-dollar program. This cost slip is far lower than those experienced by a multitude of other government programs, but it is still important to be mindful of good stewardship of taxpayer money. In this case, the P-8A program might have further utilized fixed-price contracting or incentives to keep program costs in line with initial estimates. Additionally, further systems engineering efforts may have served to reduce these cost increases and schedule slips. However, it is important to note that economic conditions and other factors may have played a part in the cost increase. Additionally, as mentioned in the APB analysis, the program did come in under budget per unit produced. This cost increase may also be somewhat distorted by the procurement of additional aircraft adding to total program cost. For programs with many well-defined requirements and mature technologies, it is important to keep costs in check through smart contracting and good program planning and execution. As evidenced by the response from the sustainment team at PMA-290, program managers took these issues seriously, learned from mistakes made, and made improvements where necessary to alleviate these concerns.

2. Product Support Requirements

Product support requirements for the P-8A present a variety of challenges for the program that have revealed weaknesses. These challenges have become evident in the sustainment issues the P-8A program has been experiencing, and these sustainment issues are multi-faceted. One of the issues identified is a lack of spare consumable parts such as O-rings, valve assemblies, bolts, and rivets while deployed (Deputy Inspector General for Evaluations, 2021). Deficiencies identified in the DODIG report prompted action at the PMA-290 program office, and work was done to put together an updated Life Cycle Sustainment Plan that mitigated the issues identified by the DODIG (PMA-290, 2021). This quick transition by the PMA-290 sustainment team demonstrates a highly effective program office with a willingness to recognize and learn from mistakes in order to strengthen the overall P-8A program. This is best illustrated by the sustainment team receiving the Supply Chain Acquisition Team of the Year award as well as Product Support Manager Matthew Cosgrove receiving the 2022 Secretary of Defense PSM of the Year (Major Defense Acquisition Programs/Acquisition Category I Program) award (Naval Air Systems Command, 2022, 2023b). Despite issues with the product support requirements, the PMA-290 team has stepped up and demonstrated a level of efficacy and professionalism that has been highly recognized in the DOD.

3. Tactical Open Mission System Issues Stopping Missions

The reliance on *media*, the term for the integrated systems displays and their databases within the aircraft, directly contributes to aircraft being unable to go on mission. Aircraft are typically unable to go on mission due to discrepancies in media loads between the Tactical Operations Center (TOC) and the aircraft and/or TOMS issues preventing proper media display, which has, as of 2013 accounted for more than 75% of critical mission failures (Office of the Director, Operational Test and Evaluation, 2013). Operators are often left to reload the media, reboot the TOMS system, or a combination of the two in order to get the aircraft mission-ready. This can take varied amounts of time and, if the issue persists, can lead to a mission being cancelled. All of this in addition to the multiple versions of TOMS software onboard different aircraft can further complicate these issues. While the TOMS system enables operators to execute missions effectively and has already proven its efficacy in military operations, the P-8A program must focus on continually evaluating and increasing the reliability of the system.

4. Weaknesses Root Cause Analysis

Why did these weaknesses present themselves in the P-8A program? Most of the weaknesses identified could not have been accurately planned for in the early stages of program development. This is due to certain unknowns that exist at the beginning of program development and, potentially, the inability to rectify the issues quickly enough throughout program development. This inability to rectify the issues quickly may simply be due to more pressing issues in program development at the time or lack of resources to correct deficiencies as they come in. The root of these weaknesses is that certain risks either weren't sufficiently mitigated during the early stages of the program or couldn't be effectively mitigated at the time due to lack of information.

C. OPPORTUNITIES

This section details opportunities identified for the P-8A program. There are countless opportunities for the P-8A program going forward due to its multi-mission nature, ability to evolve, and demonstrated success. The P-8A program is still relatively young and opportunities for platform growth are likely to present themselves throughout the life cycle of the platform. These opportunities may present themselves in various ways, such as showcasing how to procure software the right way and continuing that success, being on the forefront of leveraging artificial intelligence (AI) for various purposes in operations and sustainment, as well as taking on new roles within Navy and DOD strategic planning and tactical execution. The P-8A was built with evolution in mind, and evolve it must to maintain its preeminence as the premiere PATRECON aircraft in the world.

1. Software Focus

Given the advanced nature of the TOMS software onboard the P-8A, there is certainly an opportunity to perfect the development and release of continual updates and improvements to make the platform more efficient and mission-effective. As the P-8A is now fully into the operations and sustainment phase of the program, focusing on the software suite, and making more substantial financial commitments in that space, is necessary moving forward. As most DOD programs now have more focus placed on software development, the P-8A program is even more software-intensive, as without the mission software, the P-8A would just be an airliner. This necessitates a transition in thinking and in practice to recognize the software-intensive nature of the P-8A program and to invest more heavily in software development and implementation.

2. Leverage Artificial Intelligence

Similar to other current DOD programs, the P-8A program may have room to leverage AI and/or machine learning in various aspects of sustainment, such as maintenance, software development, training, and other areas as appropriate. Just this year, the U.S. Air Force has designated their Predictive Analytics and Decision Assistant (PANDA) system as a System of Record for maintenance (Hardin, 2023). This PANDA system leverages artificial intelligence to gather maintenance data and predict maintenance intervals on U.S. Air Force platforms (Hardin, 2023). Other companies, such as C3 AI (2023), offer AI systems to monitor asset health, increase availability, and increase mission capability. These tools can provide valuable maintenance insight and will be able to identify and resolve issues before they even arise. This will keep aircraft more available and ready whenever called upon. As AI continues advancing at a seemingly exponential pace, the P-8A program, in conjunction with the Navy, must recognize the importance of these systems and begin making the financial commitments to utilize them whenever feasible.

3. Containerize Software

The integrated software system onboard the P-8A enables operators to accomplish the mission effectively and efficiently. However, there may still be an opportunity to containerize various microservices more effectively within the larger user interface. The current state of P-8A software systems is good and enhances an already capable platform. However, in line with larger DOD initiatives to implement a more agile software strategy, there is still room for improvement in the P-8A software suite. The most major improvement would be a financial commitment to fully integrating agile principles and a development, security, and operations (DevSecOps) approach to software updates and development aboard the platform. This will require a more significant software investment, but the efficiencies would pay off quickly and would put the program in line with larger DOD objectives.

4. Further Integration into Distributed Maritime Operations

One of the major opportunities for the P-8A program is expanded integration into the larger DMO strategy. As the P-8A is an incredibly capable and versatile aircraft, opportunities for further integration into DMO will almost certainly arise. This will certainly challenge the aircraft and its resources but may also create opportunities for additional funding and evolution of the platform. Further integration into DMO may take a variety of forms. For instance, given the P-8A's advanced sensors and communications suite, the P-8A may take on a collateral role as a command-and-control aircraft. Another opportunity may come in the form of a patrol bombing role, as Leeds (2019) identified. Given DMO's focus on concentrated fires and effects and the P-8A's extensive combination of payload, sensors, and communications, the platform is well positioned for further use within the DMO framework.

D. THREATS

This section details threats identified for the P-8A program. These threats are not all necessarily realized currently but are nevertheless introduced, as they may present themselves at some point in the future. These threats include reduced budgetary support, lack of aircraft availability, problems with survivability in the operating environment, as well as potential HSI issues related to the software suite. Identifying these threats is necessary to begin taking preventive action to curtail or avoid the threats if possible. Many of these threats are not unique to the P-8A program, as budget, survivability, and availability concerns are common to almost all DOD programs, and HSI issues are also common to many. Other programs may examine the threats to the P-8A program and find commonality and may further use the analysis of these threats to aid in planning to mitigate threats of this type.

1. Budget

One potential threat to the P-8A program is continued budgetary support. This competition is experienced by nearly every program in the DOD, as there are simply not enough funds to support every budgetary requirement to 100% capacity. This competition is DOD-wide and within the Department of the Navy as well as Naval Aviation. For PMA-290 to properly sustain and continue the evolution of the P-8A platform, the program must receive adequate funding. A variety of factors, both internal and external, will affect the program's level of funding, but the program office must paint a clear picture as to the necessity of a fully funded P-8A program. Without sufficient funding, other threats will only be exacerbated and opportunities for the program and platform diminished.

2. Availability

With current availability issues already identified, continued failure to meet mission-capable thresholds may introduce multiple risks for the program. The GAO (2022) identified that P-8A mission-capable rates were consistently below the 80% threshold value. This is certainly concerning, and this threat can have implications on multiple areas of the program. However, as identified in the Life Cycle Sustainment Plan, the P-8A is already seeing greater availability numbers and meeting other availability metrics at an increasing rate. This may, in part, be due to realization of optimizations that only time in service allows. For every new weapons system, there is a learning curve, and this is no less the case for a highly advanced PATRECON aircraft like the P-8A. It will be extremely important for the program office to work closely with warfighters to achieve and sustain availability at or above the 80% threshold through proper planning and resourcing.

3. Survivability

Being a rather large, slow target (in comparison with other naval aviation assets), the P-8A is likely to face greater survivability threats. As the Navy only has plans to procure 128 P-8As (10 short of the Navy's validated operational requirement), preventing these assets from being damaged or lost to enemy fires is of paramount concern (Thompson, 2023). However, the program has already incorporated a host of survivability enhancements, according to the Director, Operational Test and Evaluation. These survivability enhancements include "integrated infrared missile detection system, flare dispenser, and directed infrared countermeasure system;" additionally, "off-board sensors and datalink systems are used to improve tactical situational awareness of expected threat systems;" and finally, "fuel tank inerting and fire protection systems reduce aircraft vulnerability" (Office of the Director, Operational Test and Evaluation, 2016, p. 305). Efforts have already been made to make the aircraft more survivable, but with changing technology and tactics, the P-8A will need to evolve to keep pace with threats to the platform's survivability when in combat. This may look like more advanced countermeasures, further platform hardening, changes to P-8A tactics, or a combination thereof.

4. Human Systems Integration Issues Related to Software Upgrades

It is promising that the P-8A is seeing continuous and frequent software updates and improvements, but this may be a double-edged sword, as if the updates are too frequent (and possibly too complex), this could introduce complications in regard to HSI. The threat to HSI posed by software releases occurring too frequently would be realized in magnifying human error when operating the system and increased training workloads needed to keep operators up to date on system changes, especially in regard to the user interface. This threat necessitates a balance between software updates and crew training that can be achieved by less user interface changes, increased training time between releases, and more process automation to alleviate potential human error when interacting with the software.

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VI. CONCLUSION

Concluding this research is a discussion of the interrelationships between the elements of the previous SWOT analysis. Then implications for other and future programs are presented. Next, research limitations are outlined. After which considerations for future research are posited. Finally, the author gives final remarks to complete the research.

A. DISCUSSION

It has been established that the P-8A is an incredibly capable platform with a long list of strengths. Weaknesses and threats to the program do of course exist, and it is important to manage them accordingly. Also, the program has a multitude of opportunities in the future of PATRECON as well as DMO. Many of the considerations identified in the SWOT analysis are closely related, and this Discussion section serves to identify some of those connections specifically as they relate to identified threats and opportunities.

First, the continued budgetary support of the P-8A program is obviously essential to the success of the program. As the P-8A moves further into the sustainment and operations phase of the program, a sufficient budgetary commitment will enable corrections to deficiencies and threats as well as the realization of further opportunities. If the P-8A is to be further integrated into DMO, improve the software suite onboard, or leverage AI, proper budgetary support is of paramount importance. Additionally, that budgetary support will be necessary to achieve increased availability, improve aircraft survivability, as well as address any HSI issues that may arise as software continually gets upgraded and improved. The budget may be the single most important factor in all of the improvements and opportunities identified in the SWOT analysis, as without funding, none of these things are possible for the P-8A program.

Second, availability issues pose a variety of threats to the program. If the aircraft cannot achieve, at a minimum, the established 80% mission-capable rate, this can begin to translate to other areas, exacerbate other threats, and limit opportunities moving forward. For instance, if the aircraft cannot achieve mission-capable goals, this may pose a threat to the budget moving forward. The converse may also be true in that the availability issues may prompt more funding to achieve a resolution, which is also worth noting. Additionally, lack of availability may lead to more limited or less robust opportunities to further integration into DMO. These availability issues may also be closely related to any software issues that present themselves, in addition to the maintenance issues aforementioned. In any case, continued availability issues will have effects on multiple program areas moving forward and must continue to be managed and improved.

Third, the software suite and TOMS system aboard the P-8A is already extremely advanced and contributes to the software-intensive nature of the P-8A program. At a time when the DOD is becoming more software-focused, the P-8A program is perfect for showcasing successes already achieved and paving the way for continued improvement of an already capable software suite. Moving forward, the P-8A program may transition to a more agile approach to the mission software, focusing on constant, incremental improvements and possibly making the transition to a DevSecOps framework. This would be in line with DOD software development expectations as the entire DOD transitions to agile development and DevSecOps. Continually improving the software suite will also be essential to giving warfighters in the aircraft the edge they need by making the system even more user-friendly, processing information faster and more effectively, and allowing for in-air troubleshooting, to name just a few possible improvements. These software improvements may have a direct effect on availability rates, the budget, and will improve the overall capabilities of the aircraft. The software suite aboard the P-8A is essential to the mission of the aircraft and must be prioritized and continually improved to maintain the preeminence of U.S. maritime PATRECON.

Fourth, the P-8A program should place an emphasis on leveraging AI tools in the program where feasible. As mentioned, various other DOD programs already leverage AI tools for a variety of reasons. The P-8A program could likely utilize AI for predictive maintenance, operational efficiency, problem diagnosis, and a variety of other areas. Capturing efficiencies introduced by the utilization of AI can enable cost savings, increase availability, reduce human error, and identify trends humans may not have seen. Initially, this may lead to some budget strain in order to acquire the AI tools, but the savings and efficiencies realized through the use of those tools will justify the cost. AI is increasingly becoming commonplace in all areas of daily life, and the P-8A program should look to incorporate AI tools to truly move at the speed of relevance.

Fifth, the continued integration of the P-8A into DMO may place new demands on the aircraft and stretch existing resources. The program office will have to monitor these developments and revise current sustainment and operations planning to support additional aircraft demands as they come to fruition. This, of course, is going to have an effect on budgetary requirements, as increased operations and mission sets will mean, at a basic level, more flight hours, more maintenance, and more money needed to support those increases. It may also mean acquiring more aircraft, as there may not be enough in the current inventory to support increased demand. Increased demand will also place additional demands on product support requirements and may require the incorporation of new systems or weapons aboard the aircraft, which could potentially be incorporated in another block upgrade. The P-8A was designed from the beginning to evolve and grow with the threat environment. This may be put to the test in DMO, as the P-8A's multi-mission capabilities are likely to be essential to the success of future operations.

Finally, the APB touches every part of the P-8A program. The success demonstrated by the P-8A program in meeting or exceeding every APB threshold is evidence of a remarkably successful program. This is a truly commendable achievement and is evidence of a highly effective organization with a dedication to producing the best maritime PATRECON aircraft in the world. As previously mentioned, the PMA-290 team has received various awards in the near past for sustainment performance and has demonstrated excellence in program development and execution.

B. IMPLICATIONS FOR OTHER PROGRAMS

One important implication for other programs is the P-8A program's success in software acquisition. The TOMS system aboard the P-8A is uncharacteristically advanced when compared to most other DOD software. This software is integral to the success of the P-8A platform, and both the program office and contractors worked together to create a software suite that makes the P-8A both effective and lethal operationally. Various systems aboard the aircraft are integrated seamlessly into the overall TOMS user interface, allowing for rapid, critical decision-making by the Tactical Officer on board. As the DOD places an increased emphasis on the importance of effective, modern software acquisitions, other programs can turn to the P-8A program's success as an example of how to get software right.

Another implication to note is the importance of a highly functional program office willing to learn from mistakes made in the acquisitions process and to respond quickly and effectively to correct errors when they occur. This was demonstrated very effectively by the P-8A program in response to the sustainment issues identified by the DODIG (2021) and GAO (2016, 2022). The program office responded effectively with an updated Life Cycle Sustainment Plan that worked to remedy those issues. After this work was done, the sustainment team received multiple awards for their exceptional work, further evidence of a highly effective team and a good culture at the program office. Other programs should look to build cultures conducive to accountability, growth, innovation, proper stewardship of taxpayer dollars, and dedication to delivering a quality product to the warfighter. These traits are by no means exclusive to the P-8A program, but the P-8A program is certainly an example that exhibits these traits well.

A third implication to note is the P-8A program's prioritization of setting up training facilities and devoting resources to training prior to fielding the first platform. Many DOD systems are highly technical and can take myriad training hours to get the user to a sufficient level of proficiency operating the system. The P-8A is no different, both for the pilots in the front and for the Naval Flight Officers and Aircrewmen operating the systems in the back of the aircraft. Many programs fail to plan for and implement proper training systems prior to fielding new equipment and systems. The P-8A program demonstrates how to do that effectively in order to allow operators to gain proficiency from the very beginning.

A final implication to note is the nature of how the P-8A itself was acquired. The P-8A acquisition team used a couple of cutting-edge acquisition strategies, including an iterative development approach, open architecture design, and designing for evolution of the platform from the very beginning. This combination serves to enable the P-8A to continue to remain relevant, capable, and lethal well into the future as technology and geopolitics change the environments and mission sets in which the P-8A will be tasked with operating. These strategies have also enabled the P-8A to truly realize its multi-mission role as well as increased the interoperability of the platform, thereby making the P-8A even more essential in the battle space. It is worth noting that the early and continued focus on SE played a role in ensuring the success of such strategies by tracking system requirements and ensuring compatibility throughout evolution and upgrades of and to the platform. This is an important lesson to other programs that will need to design a system that can remain relevant in an ever-changing threat environment. Technology only continues to advance more rapidly, and the DOD and associated DOD programs must move at the speed of relevance to keep up with that advancement.

C. RESEARCH LIMITATIONS

As with any research, this research experienced limitations and challenges in a variety of areas. The first, and maybe the most significant, limitation was simply time. The timeline for conducting the research, writing, and editing was limited, and given more time, it is likely that more program documentation could have been obtained and communication with other offices concerning the program could have been done.

A second limitation was working within unclassified, unlimited distribution controls. The research could have included an exploration of other program documentation under the control of Controlled Unclassified Information (CUI) standards. Working under CUI controls would likely have allowed various additions to both the program background and analysis that would have served to make this research more comprehensive. Using this data, for example, would enable a future researcher to focus on more thoroughly analyzing the APB metrics throughout the program’s timeline and potentially draw further conclusions based on that data. This is being addressed due to the author knowing the documentation exists but being unable to use it due to the CUI controls. However, this was not within the scope or the intent of the research at the time.

A third limitation was the inability to conduct interviews with current and former program officials and operators of the P-8A. With approval to conduct interviews of this type, the research could have been greatly supplemented by the expertise of both program and operator subject matter experts. This could have provided more contextual information and additional resources for program analysis, again making the research more comprehensive.

A fourth and final limitation was the paucity of program data and documentation available through traditional databases and research channels. Some of this directly relates to the controlled nature of much of the program documentation. However, early program documentation was attainable (if not incomplete), but there were significant gaps in the availability of similar documentation throughout later stages of the program up to the present day. The original MMA website contained various data and reports, but that website only existed from around 2000 to 2004. The next iteration for the MMA website was an extension of the main NAVAIR website from roughly 2005 to 2007 and then to the current PMA-290 page located within the NAVAIR website. The earlier iterations of the website were only accessible through a digital archive website called the Wayback Machine, and those archived versions had limited accessibility. Nevertheless, those archives did enable the discovery of some useful documentation and data.

D. CONSIDERATIONS FOR FUTURE RESEARCH

Many of the suggestions for future research are based on the limitations identified in the previous section in addition to areas presented in this research that could be explored further in a more narrowly focused piece of research. One suggestion for future research regarding the P-8A program would be to perform research at either a controlled or classified level. This would enable more program documentation and data to be explored in further research. Another suggestion for further research would be to conduct interviews with various current and former program officials as well as operators of the P-8A and possibly the older P-3C. Yet another consideration for future research regarding the P-8A acquisition might be to specifically explore any one of the program areas or opportunities. This might look like a focused analysis of P-8A sustainment or perhaps further exploring any of the opportunities or threats to the program identified. A final consideration, or rather piece of advice, would be to contact the PMA-290 program office for assistance in accessing documentation or conducting interviews with program officials, or a combination thereof.

E. FINAL REMARKS

This research began with the broad questions, "What are the lessons learned from the P-8A acquisition program, and how can those lessons be applied more broadly to other programs?" Through the lens of SWOT analysis with associated root cause analyses, several important lessons learned were identified that may be applied to other acquisition programs. The P-8A program is heavily laden with strengths and opportunities, making it a stellar case of how to do acquisitions right. Certain weaknesses and threats to the program do exist, but many of them have already been addressed by the program office, and further mitigation efforts will serve to lessen the impact of, or even eliminate threats to, the program. Ultimately the P-8A program demonstrates how to effectively produce a platform capable of meeting the threats of the day with the ability to continually evolve to meet those of tomorrow.

Care was taken throughout the research process to acquire and present program data in an unbiased manner. The success of the P-8A program speaks for itself through the data. The data was obtained from various sources, including the program office, NAVAIR, prior academic works, the GAO, the DODIG, the press, Boeing, and others. This provided a well-rounded data set from which to extrapolate. However, as suggested in the Considerations for Future Research section, there is room for the employment of other data and analytical tools in research surrounding the P-8A program, and employing those would work well to expand both the overall field of acquisition research as well as research surrounding the P-8A program.

This research provides a comprehensive work analyzing the U.S. Navy P-8A program and contributes to both research surrounding the P-8A as well as the larger field of acquisition research. As noted, research specific to the P-8A program is somewhat pauce, and this addition serves to provide the comprehensive work that is currently missing in the field of acquisition research. Additionally, this work provides a baseline for future research on the P-8A program. This research serves to aid in future research surrounding these topics and to advance knowledge in the field of acquisitions research.

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