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USE OF FLEET AVIATION ELECTRONIC ATTACK SQUADRONS FOR OPERATIONAL TEST AND EVALUATION OF NEXT GENERATION JAMMER MID-BAND (ALQ-249) PROGRAM

Duran, Gabriel P.

Monterey, CA; Naval Postgraduate School

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USE OF FLEET AVIATION ELECTRONIC ATTACK SQUADRONS FOR OPERATIONAL TEST AND EVALUATION OF NEXT GENERATION JAMMER MID-BAND (ALQ-249) PROGRAM

June 2022

By: **Gabriel P. Duran**

Advisor: **Robert F. Mortlock**

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13. ABSTRACT (maximum 200 words)

The purpose of this research is to analyze the potential advantages, disadvantages, and risks to cost, schedule, and performance of shifting the role of operational test and evaluation (OT&E) of the Next Generation Jammer Mid-Band (NGJ-MB) program from a dedicated OT&E squadron at Air Test and Evaluation Squadron Nine (AIRTEVRON NINE; VX-9) to a fleet aviation electronic attack squadron. The operational constraints of the modern Naval Aviation Enterprise (NAE) squadron to deploy as part of the warfighting force against a peer adversary is examined to identify the risks to the successful OT&E of the NGJ-MB program. My methodology includes examining fleet operational tempo and the Navy's Optimized Fleet Response Plan scheduling, resourcing, training, proficiency, tactical expertise, and administration. A strengths, weaknesses, opportunities, and threats analysis, followed by a cost-effective analysis, are used to analyze the risks to test execution and reporting compared to VX-9. In the research conclusion, I recommend the more beneficial, efficient, and effective path to execute OT&E for the NGJ-MB program. The consequences to cost, schedule, and performance to the NGJ-MB program give high confidence that fleet aviation squadrons should not be tasked to perform OT&E. VX-9 should be properly resourced, funded, and supported by the Navy to assess the operational effectiveness and suitability of the NGJ-MB pod.

14. SUBJECT TERMS operational test and evaluation, OT&E, Air Test and Evaluation Squadron Nine, AIRTEVRON NINE, VX-9, follow-on operational test and evaluation, FOT&E, initial operational test and evaluation, IOT&E, naval aviation, optimized fleet response plan, OFRP, Naval Aviation Enterprise, NAE, Next Generation Jammer Mid-Band, NGJ-MB, ALQ-249, electronic attack, electronic warfare, EW, VAQ, VX, adjunct testers	**15. NUMBER OF PAGES** 109
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Gabriel P. Duran, Lieutenant Commander, United States Navy

Submitted in partial fulfillment of the
requirements for the degree of

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Approved by: Robert F. Mortlock
Advisor

Robert F. Mortlock
Academic Associate, Department of Defense Management

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ABSTRACT

The purpose of this research is to analyze the potential advantages, disadvantages, and risks to cost, schedule, and performance of shifting the role of operational test and evaluation (OT&E) of the Next Generation Jammer Mid-Band (NGJ-MB) program from a dedicated OT&E squadron at Air Test and Evaluation Squadron Nine (AIRTEVRON NINE; VX-9) to a fleet aviation electronic attack squadron. The operational constraints of the modern Naval Aviation Enterprise (NAE) squadron to deploy as part of the warfighting force against a peer adversary is examined to identify the risks to the successful OT&E of the NGJ-MB program. My methodology includes examining fleet operational tempo and the Navy's Optimized Fleet Response Plan scheduling, resourcing, training, proficiency, tactical expertise, and administration. A strengths, weaknesses, opportunities, and threats analysis, followed by a cost-effective analysis, are used to analyze the risks to test execution and reporting compared to VX-9. In the research conclusion, I recommend the more beneficial, efficient, and effective path to execute OT&E for the NGJ-MB program. The consequences to cost, schedule, and performance to the NGJ-MB program give high confidence that fleet aviation squadrons should not be tasked to perform OT&E. VX-9 should be properly resourced, funded, and supported by the Navy to assess the operational effectiveness and suitability of the NGJ-MB pod.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAF	Adaptive Acquisition Framework
ACAT	Acquisition Category
ACTC	Air Combat Training Continuum
AEA	Airborne Electronic Attack
ALQ	Airborne Countermeasures Multipurpose/Special Equipment
CBT&E	capabilities-based test and evaluation
CBTRM	Capabilities-Based Training and Readiness Matrix
CEA	cost-effectiveness analysis
CNAP	Commander, Naval Air Force, U.S. Pacific Fleet
COA	course of action
COMOPTEVFOR	Commander, Operational Test and Evaluation Force
CVI	crew-vehicle interface
CVW	carrier air wing
CVN	aircraft carrier
DAS	Defense Acquisition System
DOD	Department of Defense
DON	Department of the Navy
DOT&E	Director, Operational Test and Evaluation
DT	developmental test
DT&E	developmental test and evaluation
FOT&E	follow-on operational test and evaluation
GAO	Government Accountability Office
IOT&E	initial operational test and evaluation
IT	integrated test
JCIDS	Joint Capabilities Integration Development System
LFE	large force exercise
MAP	Master Aviation Plan
MCA	Major Capability Acquisition
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program

MOSA	modular open system approach
MRTFB	Major Range and Test Facility Base
NAE	Naval Aviation Enterprise
NEC	Navy Enlisted Classification Code
NGJ	Next Generation Jammer
NGJ-MB	Next Generation Jammer Mid-Band
NTTR	Nevada Test and Training Range
OFRP	Optimized Fleet Response Plan
OPTEMPO	operational tempo
OTA	Operational Test Agency
OTD	Operational Test Director
OT&E	operational test and evaluation
PM	Program Manager
PMA	Program Manager Air
RDTA	research and development test article
SDTA	system demonstration test article
SECDEF	Secretary of Defense
SEP	systems engineering process
T&E	test and evaluation
TMS	type/model/series
VAQ	Electronic Attack Squadron
VCD	verification of correction of deficiencies
VX	Air Test Squadron

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I would like to thank my wife, Tiffany, for providing encouragement, dedication, and support to complete this thesis. Without her patience and love, I would not be able to pursue my educational goals. To my hardworking coworkers in the Airborne Electronic Attack Branch and Leadership at VX-9 who inspired me to pursue this research, your dedication to your craft and country is very much appreciated by me. Thank you to my advisor, Dr. Robert Mortlock, for your advice, direction, and expertise to keep me along the right path. This thesis is dedicated to the memory of my brother, Frank.

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I. INTRODUCTION

The United States is woefully behind in fielding advanced technology to challenge a peer adversary. China can quickly field advanced technology that meets or exceeds U.S. capability in weapons, platforms, sensors, and automation. Our ability to disrupt their kill chain lessens by the day. In response, the chief of naval operations is favoring an approach to "Speed to the Fleet" capabilities that have a "bias for getting things done, rather than a bias for studying them yet again before we get them done" (Maucione, 2019, p. 1).

The Department of Defense (DOD) has recently updated its acquisition strategy to rapidly prototype, test, and field new technology with the Adaptive Acquisition Framework (AAF). The goal is to "deliver solutions to the end user in a timely manner" (Government Accountability Office [GAO], 2021, p. 1) by providing the program manager (PM) with the flexibility to "tailor, combine, and transition between pathways based on program goals and risks associated with the weapon system being acquired" (p. 2). Despite the new initiative, PMs must consistently balance "opportunities to improve cost and schedule outcomes" (p. 3) with "product knowledge" (p. 3) to minimize risk to the performance of the product. Finding efficiencies in product delivery is a struggle the program office must conquer before the battle starts overseas.

A. PROBLEM

To keep pace with China's ability to rapidly acquire military technology, the U.S. Navy is looking to streamline its process and reduce the cost to provide America's warfighters with advanced technology by disestablishing Naval Aviation's operational test squadrons. The task of operational test and evaluation (OT&E) squadrons to responsibly recommend the fielding of operationally suitable and effective weapons under realistic combat conditions is in danger of becoming inadequately assumed by fleet aviation units.

B. RESEARCH QUESTIONS

Does the course of action (COA) to have fleet aviation squadrons assume the role of operational testers help drive down the time it takes for the warfighter to receive the

Next Generation Jammer Mid-Band (NGJ-MB) pod, and does this COA effectively manage the costs and risks to product performance to "Speed to the Fleet?"

C. WHY THIS RESEARCH IS IMPORTANT

The purpose of this research is to analyze the potential benefits, costs, and risks of shifting the role of OT&E of Naval Aviation's air-to-ground weapons, air-to-air weapons, sensors, electronic warfare systems, and mission software upgrades to aircraft and weapon systems to fleet aviation squadrons.

The concept to put the Navy's most advanced technology in the hands of the warfighter as quickly as possible is tempting in the eyes of the operational commander and national decision-maker. As stated in *Naval Aviation Vision: 2014–2025*, "Capability is the key to sustaining our warfighting supremacy. Naval Aviation forces will arrive on station with the means—the capability—to prevail in combat" (Naval Aviation Enterprise [NAE], 2014, p. 3). However, ensuring this "capability" is field-tested in an operationally relevant environment is essential to guaranteeing the weapon's maintainability, reliability, and availability during sustained combat operations in a contested battlespace. "Increasing the speed of capabilities delivered to the fleet" (NAE, 2014, p. 7) must never accept the compromise of a system tested and verified to meet or exceed performance thresholds.

D. SCOPE

The original intent of this analysis was to take a broad look at how Navy acquisition integrates most of its advanced technology into Naval Aviation and discuss the ramifications of eliminating operational test squadrons as a whole. However, the task of analyzing the multitude of technology-spanning weapons, software, hardware, communications, surveillance, intelligence, and electronic warfare with distinctive acquisition strategies across several type/model/series (TMS) is daunting.

Instead, this analysis focuses on Naval Aviation's electronic attack squadrons (VAQ) and the planned development, production, testing, and fielding of the ALQ-249 Next Generation Jammer Mid-Band (NGJ-MB). Narrowing the focus of analysis provides a specific example of a major defense acquisition program (MDAP) that is essential to face a peer adversary and "too large to fail" when considering the time and cost already devoted to the program.

E. METHODOLOGY

A literature review examines DOD reports and previous Naval Postgraduate School (NPS) master's theses involving best practices for test and evaluation. Additionally, an effort by a deployed electronic attack squadron (VAQ) to operationally test and evaluate two acquisition programs is reviewed.

A strengths, weaknesses, opportunities, and threats (SWOT) analysis examines the advantages or disadvantages to the speed, cost, and performance of the Next Generation Jammer (NGJ) program with consideration of fleet operational tempo (OPTEMPO) and the Optimized Fleet Response Plan (OFRP). Additionally, the SWOT analysis assesses the operational constraints of the modern fleet squadron to deploy as a "preeminent warfighting force" (NAE, 2014, p. 4) handling the resourcing, VAQ readiness standards, training, aircrew tactical expertise, and security administration with potentially assuming the role as operational testers of an acquisition category (ACAT) Level I program.

Then, a cost-effective analysis (CEA) is performed to compare the relative costs and outcomes of the operational test of the NGJ-MB program with a fleet aviation squadron versus an air test squadron performing the duties of operational test.

An additional source of information included in the methodology is the author's practical experience as the Airborne Electronic Attack (AEA) branch head for AIRTEVRON NINE (VX-9).

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II. BACKGROUND

In 2019, the AEA community experienced a "Speed to the Fleet" success story with the implementation of the Batwing antenna on its aging ALQ-99 jamming pods. VAQ-138, an operational electronic attack squadron, managed to aid in the "maturation of a major aircraft software upgrade, [and] a 3D-printed device that significantly multiplies the Growler's jamming power" (Bowman & DiMarco, 2019, p. 1). In addition to upgrading the EA-18G's software and hardware, VAQ-138 could integrate the new technology during a large force exercise (LFE) in an operationally relevant scenario. VAQ-138 was proving a sought-after "proof of concept" for naval aviation acquisition that operational squadrons can aid in the technical development, maturity, and implementation of new upgrades.

This example of "Speed to the Fleet" was successful because the Navy and acquisition community thought through the challenges associated with rapidly prototyping and fielding a new capability. From the acquisition managers for PMA-234 Airborne Electronic Attack Systems Program Office down to the "adjunct operational testers" inside the Growler, all stakeholders had to address the issue of rapidly engineering a capability, producing and manufacturing a prototype, and—finally—testing and evaluation (T&E). The risk to program success was high, but it was an achievable innovation given the modular open system approach (MOSA) to the ALQ-99 tactical jamming system.

A. MAJOR CAPABILITY ACQUISITION

It is essential to distinctly acknowledge the more stringent requirements of an MDAP with congressional statutes and oversight, DOD policy, and T&E requirements. The example of the Batwing antenna represents a leap in technology for the AEA community, but the NGJ represents an even more considerable expansion of technology and capability for the warfighter. Understanding the underlying bureaucracy, accountability, and rigor of the process the NGJ-MB must undergo is essential to analyzing the prospects of a VAQ unit undertaking an operational test.

The DOD Acquisition Process is one of three processes in "Acquisition, Requirements, and Funding" (Figure 1), as implemented by DOD Instruction 5000.02, *Operation of the Adaptive Acquisition Framework*, which "provides the policies and principles that govern the Defense Acquisition System (DAS) and forms the management foundations for all DOD programs" (AcqNotes, 2022a). The "specific statutory and regulatory reports and information requirements for each milestone review and decision point," otherwise known as an "event-based process," are included (AcqNotes, 2022a).

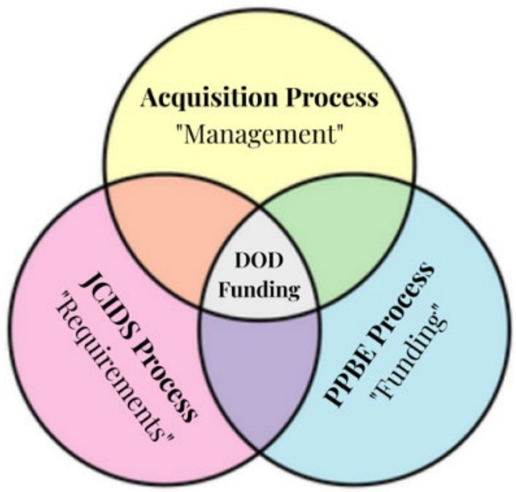

Figure 1. The Defense Acquisition System. Source: AcqNotes (2022a).

The characteristics of a major capability acquisition (MCA), as illustrated in Figure 2 and per Department of Defense Instruction (DoDI) 5000.02, typically follow

> a structured analyze, design, develop, integrate, test, evaluate, produce, and support approach. This process is designed to support major defense acquisition programs, major systems, and other complex acquisitions. Acquisition and product support processes, reviews, and documentation will be tailored based on the program size, complexity, risk, urgency, and other factors. Software-intensive components may be acquired via the software acquisition pathway, with the outputs and dependencies integrated with the overall major capability pathway. (Office of the Under Secretary of Defense for Acquisition and Sustainment [OUSD(A&S)], 2020)

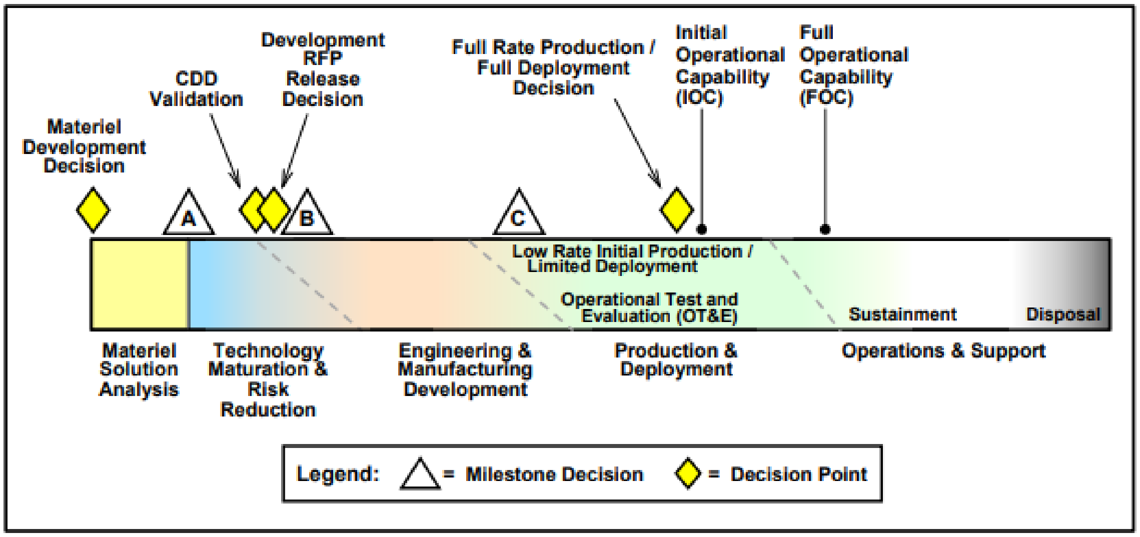

Figure 2. Major Capability Acquisition Model. Source: AcqNotes (2022a).

How an acquisition program is characterized depends upon its ACAT. ACATs are categorized by their funding level and overall importance to the national security of the United States. ACAT level is based on anticipated cost, a particular interest, and milestone decision authority (MDA), which determines the level of review, decision authority, and applicable procedures (Defense Acquisition Visibility Environment [DAVE], 2022). For more information on ACAT levels, see Appendix A.

The guidance included in DOD instructions offers PMs more flexibility than previously dictated. The DOD has issued guidance in DoDI 5000.85 that pushes the momentum of fielding capabilities that are "operationally effective, suitable, survivable, affordable, secure, and supportable solutions to the end-user in a timely manner" (OUSD[A&S], 2021). Speed of delivery is an essential tenet of the PM's "triple constraint" when considering cost, schedule, and performance. However, the PM does not have carte blanche to prioritize speed when there is a correlative detriment to either cost or performance (Figure 3).

Figure 3. The "Pick Two" Model of the "Triple Constraint." Source: Microsoft (2021).

B. T&E IN THE SYSTEMS ENGINEERING PROCESS

T&E is essentially a feedback loop, in the systems engineering process (SEP) to verify performance, detect deficiencies, and validate requirements (Mortlock et al., 2019), as illustrated in Figure 4. Verification and validation are critical accomplishments when testing the functions of the SEP. T&E seeks to answer two fundamental questions: "Was it built according to its specifications?" and "Was the right product built?" (Mortlock et al., 2019, p. 124).

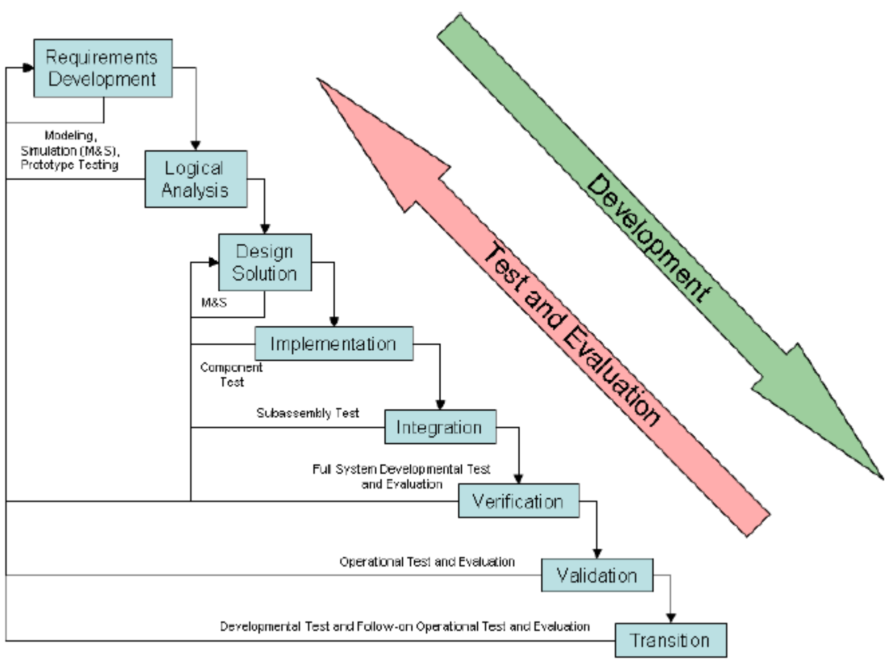

Figure 4. T&E in the SEP. Source: Barrett (2009, p. 12).

The validation process determines whether the system answers the question, "Was the right product built?" Usually, test readiness reviews are conducted to ensure that the transition from developmental test (DT) to operational test (OT) is synchronized and system knowledge is baselined between stakeholders. For example, an "operational test readiness review (OTRR) is conducted to ensure a system is ready with reasonable assurance of testing success, alignment of test resources, and completeness of [DT] to enter critical operational testing" (Mortlock et al., 2019, p. 127).

> OT may [also] be accomplished early-on through combined DT and OT or Integrated Test (IT) in order to give the operational tester an early look at the system and maximize efficiencies gathering data that both DT and OT testers have an interest in. OT is normally performed by the end-user of the system on a production representative test article in a realistic operational environment where the system must interact with the environment, personnel, threat, interoperable systems, doctrine and tactics to validate that the user's requirements are met. The results of OT feed back into the requirements development and design solution processes if and when deficiencies are discovered. (Barrett, 2009, p. 11)

> Finally, additional DT and Follow-on Operational Test and Evaluation (FOT&E) is conducted during transition to full operation to test system components that could not be fully tested during verification and validation and to test new upgrades to the system. DT and FOT&E is also used to test future increments, modifications, and upgrades and help refine doctrine, tactics, techniques, and training programs. (Barrett, 2009, p. 12)

Figure 5 and Appendix B summarize the typical activities that separate DT and OT.

	DT&E	OT&E
Managed by	Developer (contractor or government PM)	Independent government test agency
Primary objectives	• Test to specification requirements • Precise performance against threshold measurements	• Test to operational requirements • Performance measurement of operational effectiveness and suitability
Testing assets	Developmental test articles or prototypes	Production representative systems
Conducted by	Trained, experienced operators aided by technicians with contractor involvement	Typical users with normal training and restricted contractor involvement
Environment	Highly controlled	Realistic/combat conditions with operational scenarios

Figure 5. Developmental Test and Evaluation to OT&E Comparison. Source: Mortlock et al. (2009, p. 132).

C. T&E IN THE MAJOR CAPABILITY ACQUISITION PROCESS

Before analyzing the merits of placing fleet aviation squadrons into OT&E, it is vital to examine how T&E is integrated into an MCA as the NGJ-MB program. The fundamental purpose of T&E has not changed with the release of the AAF, as it still represents the "knowledge to assist in managing risks; to measure technical progress; and to characterize operational effectiveness, operational suitability, interoperability, survivability (including cybersecurity) and lethality" (OUSD[A&S], 2021, p. 7).

The focus of T&E and its implementation into the AAF can be summarized in Figure 6 from DoDI 5000.89 "Test and Evaluation":

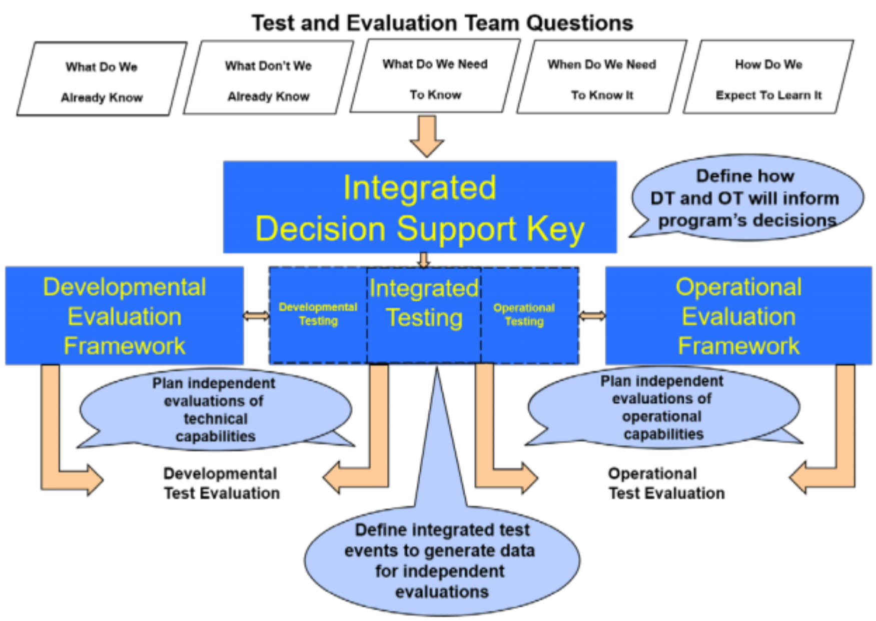

Figure 6. Integrated T&E Framework. Source: OUSD(A&S, 2020).

An overview of key procedures emphasizes that

> Integrated testing and independent evaluation are part of a larger continuum of T&E that includes DT&E (both contractor and government), OT&E, and LFT&E. Integrated testing requires the collaborative planning and execution of test phases and events to provide shared data in support of independent analysis, evaluation, and reporting by all stakeholders. Whenever feasible, the programs will conduct testing in an integrated

> fashion to permit all stakeholders to use data in support of their respective functions. (OUSD[A&S], 2020, p. 7)
>
> Programs will incorporate integrated testing at the earliest opportunity when developing program strategies, plans with program protection, documentation, and T&E strategies or the TEMPs. Developing and adopting integrated testing early in the process increases the effectiveness and efficiency of the overall T&E program. (OUSD[A&S], 2020, p. 7)
>
> To ensure T&E focuses on informing the program's decision-making process throughout the acquisition life cycle, the TEMP will include the program's key decision points and the T&E information needed to support them. These decisions may be made by leaders ranging from the program manager (PM) to the MDA, and should represent major turning or decision points in the acquisition life cycle that need T&E information in order to make an informed decision. (OUSD[A&S], 2020, p. 7)

Integrated testing moves to the forefront as procedural guidance to encourage "the early identification of concerns," "sharing of test resources," "informing decisions that are not addressed in Title 10, USC," and "improving system design" (OUSD[A&S], 2020, p. 7).

When the focus is narrowed to the MCA pathway, it becomes apparent that "these acquisitions typically follow a structured analysis, design, develop, integrate, test, evaluate, produce, and support approach" (OUSD[A&S], 2020, p. 23). Therefore, when trying to use an integrated test (IT) framework, the planning and execution of tests needs to be meticulous. For instance,

> for programs under T&E oversight, the DOT&E [Director of Operational Test & Evaluation] will provide the MDA with milestone assessments … [and] programs on T&E oversight may not conduct operational testing until DOT&E approves the adequacy of the plans in writing per Section 2399(b)(1) of Title 10, USC. (OUSD[A&S], 2020, pp. 22–23)
>
> The DOT&E is accountable to state
>
> 1. Whether the test and evaluation performed were adequate.
> 2. Whether the results of such test and evaluation confirm that the items or components actually tested are effective and suitable for combat. (OUSD[A&S], 2020, p. 30)

This research project accounts for T&E oversight, the adequacy of test plans, execution, and final reporting.

Service operational test agencies (OTAs) are charged with conducting OT on all programs to "support development, fielding decisions, and warfighter understanding of capabilities and limitations" (OUSD[A&S], 2020, p. 24), as well as testing any upgrades and alterations that change system performance. The general process for planning, executing, and reporting on operational test events is shown in Figure 7.

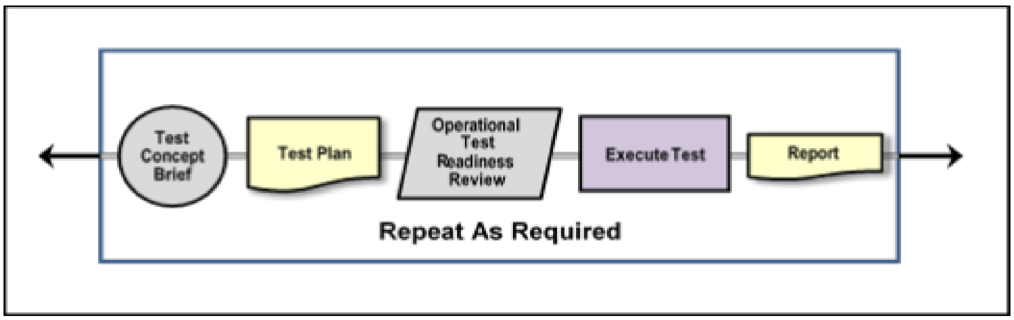

Figure 7. Typical Activities for OT. Source: OUSD(A&S, 2020).

D. OT STATUTORY AND REGULATORY REQUIREMENTS

Exploring alternatives to executing OT in naval aviation needs the knowledge of the organizational and regulatory requirements associated with the task. The fact that OT is required by law and an essential function of oversight for Congress leads to healthy friction between the congressional and executive branches of the U.S. government. Despite the speed at which the DOD wants to acquire capabilities, Congress intends to confirm capabilities are money well spent for the warfighter.

1. Congressional OT&E Guidance

Title 10 of U.S. Code § 2399 dictates the necessity for conduct and oversight of operational testing. Section 139 defines "operational test and evaluation" as

> the field test, under realistic combat conditions, of any item of (or a key component of) weapons, equipment, or munitions for the purpose of determining the effectiveness and suitability of the weapons, equipment, or

munitions for use in combat by typical military users. (Operational Test and Evaluation of Defense Acquisition Programs, 1989)

Additionally, Section 139 establishes the

office of Director Operational Test and Evaluation (DOT&E) to serve as the principal adviser to the Secretary of Defense (SECDEF) and the Under Secretary of Defense for Acquisition, Technology, and Logistics on Operational Test and Evaluation (OT&E) within senior management of DOD. (Barrett, 2009, p. 13)

Important to note is that the DOT&E reviews and makes recommendations to the SECDEF on "all budgetary and financial matters relating to OT, including OT facilities and equipment" (Operational Test and Evaluation of Defense Acquisition Programs, 1989). Figure 8 provides an overview of DOD T&E organizations.

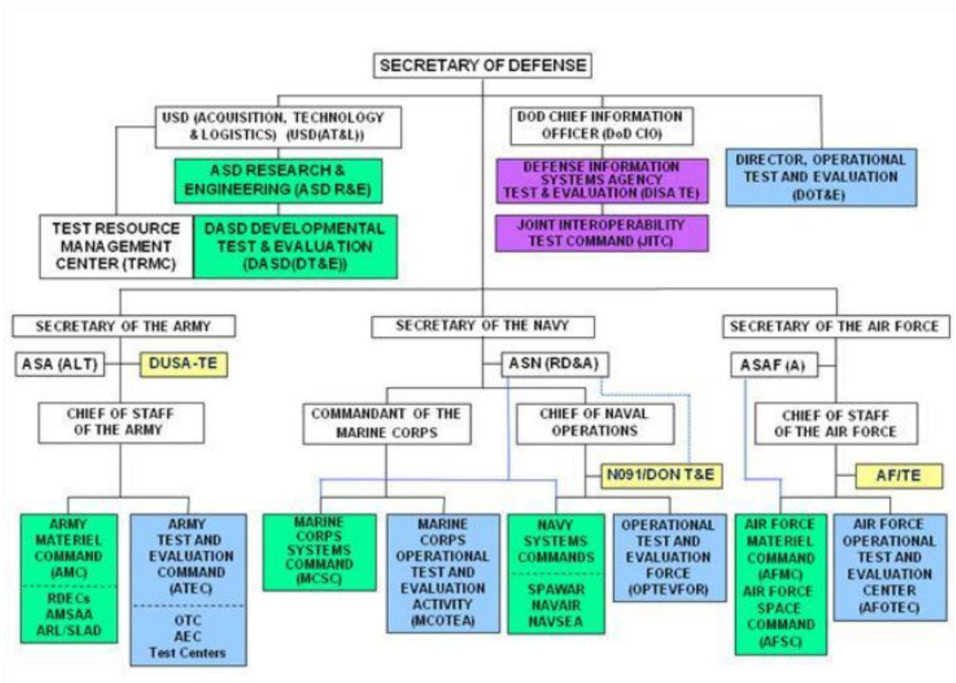

Figure 8. DOD Test and Evaluation Organizations Source: Claxton et al. (2005).

Title 10 of U.S. Code § 2399 highlights that MDAPs (which include ACAT I and DOD oversight programs) "may not proceed to low-rate initial production until initial operational test and evaluation of the program, subprogram, or element is completed" (Operational Test and Evaluation of Defense Acquisition Programs, 1989), based on the opinion of the director as to "whether the test and evaluation performed were adequate; and whether the results of such test and evaluation confirm that the items or components actually tested are effective and suitable for combat" (Operational Test and Evaluation of Defense Acquisition Programs, 1989).

Tests cannot be based exclusively on "computer modeling, simulation or an analysis of system requirements, engineering proposals, design specifications, or any other information contained in program documents" (Operational Test and Evaluation of Defense Acquisition Programs, 1989).

Congress ensures accountability and its "power of the purse" with Section 2399 by stipulating that "the costs for all tests required shall be paid from funds available for the system being tested" (Operational Test and Evaluation of Defense Acquisition Programs, 1989). Essentially, Congress—through the DOT&E—will only fund MDAPs if there is an adequate OT plan in place.

2. DOD OT&E Guidance

The 5000 series of DOD T&E guidance has been reviewed with updates for the AAF, but two essential policies regarding T&E emphasize the following: "First, [DOD OT&E Guidance] requires that each military branch establish an independent OTA to plan and conduct operational tests, report results, and provide evaluations of effectiveness and suitability" (Barrett, 2009, p. 14). Second, T&E shall be integrated early and continuously during the defense acquisition process. It gives direction to the purpose of T&E in the defense acquisition process, stating,

> Test and evaluation shall be structured to provide essential information to decision-makers, assess attainment of technical performance parameters, and determine whether systems are operationally effective, suitable, survivable, and safe for intended use. The conduct of test and evaluation, integrated with modeling and simulation, shall facilitate learning, assess technology maturity and interoperability, facilitate integration into fielded forces, and confirm performance against documented capability needs and adversary capabilities as described in the system threat assessment. (Barrett, 2009, p. 14)

3. Department of the Navy T&E Guidance

Secretary of the Navy Instruction (SECNAVINST) 5000.2F prescribes Department of the Navy (DON) "acquisition policies and procedures to supplement [DOD instructions and congressional statute] to provide for integrated, efficient, and successful operation of the JCIDS and DAS within the DON" (Secretary of the Navy [SECNAV], 2019). T&E policies of the DON are contained in Enclosure 5 of the instruction. Important to OT are the following policies:

> The Department of the Navy Test and Evaluation Executive/Director, Innovation, Technology Requirements and Test and Evaluation (DON T&E/OPNAV N94) is the DON lead for acquisition T&E policy development and implementation, T&E resources and infrastructure, OSD T&E oversight coordination and management of the T&E acquisition workforce. (SECNAV, 2019, p. 41)

When taking into consideration the funding aspect of OT&E, the PM is not required to fund "fleet operating costs for RDT&E support; fleet travel for training; non-program-related OTA travel and administrative costs; and major range and test facility base (MRTFB) institutional costs" (SECNAV, 2019, p. 47).

Further, fleet commanders shall plan and budget for "fleet travel for training; operating costs for RDT&E support provided by fleet units; all costs associated with routine operational expenses except procurement costs of the systems tested and OTA costs" (SECNAV, 2019, p. 48).

SECNAV instruction defines OT&E as

> testing conducted by an independent OTA using production-representative articles and with an approved test plan. DON OTAs include Commander, Operational Test and Evaluation Force (COMOPTEVFOR) and Director, Marine Corps Operational Test and Evaluation Activity (MCOTEA) for ACAT I, IA, II, III, and IVT programs. (SECNAV, 2019, p. 49)

Essential to the purpose of OT&E is that

> operational testing shall evaluate the SUT's effectiveness, suitability and survivability in a cyber-contested environment, identify system deficiencies and map them back to kill chains and mission effects, and examine the system of systems (SOS) integration in the system under test (SUT) mission. (SECNAV, 2019, p. 49)

OPNAVINST 5450.332 provides guidance on the missions, functions, and tasks of COMOPTEVFOR. In the instruction, COMOPTEVFOR will

> Independently test and evaluate capabilities (weapon capabilities, platforms, networks, etc.) in the anticipated operational environment against the anticipated threats, using anticipated procedures, and employing typical operators and maintainers. Additionally, COMOPTEVFOR will support development and validation of initial procedures and tactics, assisting developing agencies as needed in the accomplishment of their developmental test and evaluation. (Chief of Naval Operations [CNO], 2020, p. 1)

Specific to COMOPTEVFOR's relationship to Naval Aviation's test squadrons,

> COMOPTEVFOR maintains independent authority over the conduct of operational testing on any unit and received direct support from … Air Test and Evaluation Squadron ONE (VX-1); Air Test and Evaluation Squadron NINE (VX-9); Marine Helicopter Squadron ONE (HMX-1); COMOPTEVFOR Detachment Nellis Air Force Base; and their respective detachments in the planning and conduct of test and evaluation of new or improved air warfare weapon capabilities. (CNO, 2020, p. 3)

E. OT PERIODS

Throughout a program's acquisition milestones there will be multiple event-driven entry criteria for opportunities for OT. An analysis on when to schedule a fleet aviation unit to support will be conducted in this research project. According to COMOPTEVFOR planning guidance, an OT plan that falls under DOT&E oversight and requires approval will be built initially from the integrated evaluation framework (IEF; Commander, Operational Test Force [COMOPTEVFOR], 2020c). There are five general types of dedicated OT periods that will be executed in an MDAP. Each test period is outlined within the program test strategy by the test evaluation and master plan (TEMP), resulting in a test report (COMOPTEVFOR, 2020c).

The nature of these reports, their content, and the decision they inform are summarized from COMOPTEVFOR planning guidance. The first formal assessment in a major acquisition program is the early operational assessment (EOA).

> This assessment occurs before the start of the Engineering and Manufacturing Development phase of the acquisition program. Most programs will have only a single EOA. Generally, this is limited to a review

> of the design documentation, preliminary manning and training plans, and, potentially, a demonstration of technology. The goal of the EOA is to identify system enhancements, as well as risks towards the successful completion of IOT&E. Each risk identified is categorized and documented with a "Blue" or "Gold" sheet. Blue sheets refer to the SUT risks, while Gold sheets address risks outside the SUT that impact mission accomplishment. These risk sheets are tracked through the life of the system until they are verified as corrected. (COMOPTEVFOR, 2020d, p. 15)

The second formal assessment period is the operational assessment (OA).

> This assessment occurs post–milestone B, during the Engineering and Manufacturing Development phase. The scope of the OA is most often determined by the maturity of the development program. As with EOAs, OAs identify system enhancements, as well as risks towards the successful completion of the IOT&E. Each identified risk is categorized and documented with a Blue or Gold sheet. Large complex programs will often have multiple OAs during the Engineering and Manufacturing Development phase. Major Defense Acquisition Programs typically require the results of an OA to support milestone decisions and other program reviews. (COMOPTEVFOR, 2020d, p. 15)

The third type of OT period is initial operational test and evaluation (IOT&E). IOT&E is the focus of my analysis and currently the phase that the NGJ-MB program is preparing to execute.

> This is the statutorily required, independent evaluation of the operational effectiveness and operational suitability of the SUT. This test is conducted on production-representative test articles during the Production and Deployment phase of an acquisition program. Specific deficiencies identified during test are documented as individual Blue or Gold sheets. Based on the results of IOT&E, COMOPTEVFOR makes a determination of the operational effectiveness, operational suitability, and cyber survivability of the SUT, as well as the operational effectiveness, operational suitability, and cyber survivability of the SUT within the overall context of the SOS in which it functions. The Commander makes a recommendation to the CNO on the Fleet introduction (or full fielding in the case of joint/multiservice programs). The results of IOT&E are a prerequisite for the Full-Rate Production (FRP) Decision (FRPD) Review. (COMOPTEVFOR, 2020d, p. 15)

The fourth type of OT period is the verification of correction of deficiencies (VCD). This type is included in my analysis as a potential phase to execute based on the success of test accomplished during IOT&E.

> Typically, this is not a preplanned phase of testing, but is inserted into the test program after a formal phase of OT to verify that certain deficiencies have been corrected. This provides the Milestone Decision Authority (MDA) with the independent assurance the deficiencies cited as corrected by the PM from a previous phase of OT have actually been corrected. When deficiencies are verified as corrected, the corresponding Blue or Gold sheet is closed. If the deficiency is not fully corrected, the results are reviewed to determine if the correction or mitigation to date has changed the risk to successful IOT&E, which may warrant a change in the deficiency categorization. (COMOPTEVFOR, 2020d, p. 15)

The final category of OT period is follow-on operational test and evaluation (FOT&E).

> Because it nominally encompasses all OT conducted after IOT&E, it can take many different forms. In its original construct, FOT&E included completion of deferred or incomplete testing from IOT&E, as well as validation of the operational effectiveness and suitability of the actual production systems. In practice, FOT&E is often used to support the development of incremental improvements to systems that are in production. These improvements can range from minor hardware changes to periodic software system updates to major engineering changes that require extensive development. Given the variations in scope, FOT&E may be structured to resemble a subset of IOT&E, confirming production performance, or it may take the form of an OA, identifying risks to successful implementation of a major engineering change. Based on the focus of the test, Blue and Gold sheets may be closed as fixes are incorporated into the production articles or new Blue and Gold sheets may be created to document risks associated with the new development. (COMOPTEVFOR, 2020d, p. 16)

Figure 9 summarizes the milestones and phases of OT&E.

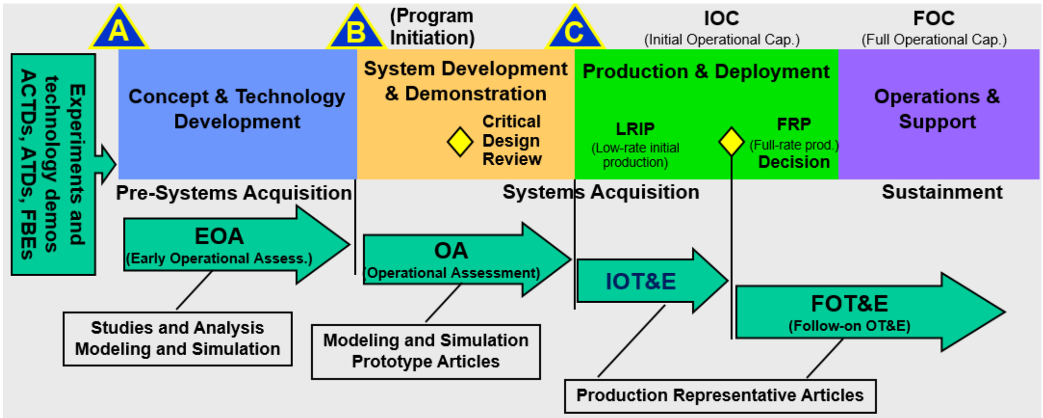

Figure 9. Phases of OT&E. Source: D. Muehlbach (Class presentation August 9, 2021).

F. VX-9'S ROLE AND RESPONSIBILITIES

Three main components define the mission of Air Test and Evaluation NINE (VX-9): "To conduct operational test of weapons systems including strike aircraft, conventional warfare equipment, and electronic warfare equipment; to develop tactics and procedures for weapons systems employment; and to support the Fleet" (Global Security, 2022a). VX-9's operational command is under COMOPTEVFOR and administratively under Commander, Naval Air Force, U.S. Pacific Fleet (CNAP; Global Security, 2022a). CNAP provides aircraft and parts support, while most test funding is supplied by the Program Manager Air (PMA) or other joint programs (Global Security, 2022a).

VX-9 is based at Naval Air Weapons Station China Lake, CA. VX-9 will typically have around 40 to 50 officers serving as operational test directors (OTDs) and filling maintenance, supply, and administrator roles at full manning. Close to 250 enlisted personnel may be assigned to support administrative and maintenance functions on aircraft, including the F/A-18E/F Super Hornet and EA-18G Growler. Aircrew from the F/A-18 community are Level IV tactically proficient and first sea tour complete aviators. After completing their first sea tour, officers from the Growler community are tactically qualified as Level III mission commanders. Aircrew may be qualified in both the F/A-18 and EA-18G, "increasing their versatility and providing broader expertise to be applied to each project" (Global Security, 2022a).

The heart of VX-9's role and responsibilities to support Navy acquisition is the OTD. An OTD is a Navy lieutenant who is fresh from an operational sea tour and entrusted with the primary responsibility to "ensure all necessary operational and T&E expertise are engaged, and sufficient statistical and analytical rigor is employed to conduct test and to produce a clear and accurate test report" (COMOPTEVFOR, 2020d, p. 151). The role and responsibility of an OTD at VX-9 surpass the amount of engagement, time, and commitment a typical collateral duty common in the fleet (e.g., coffee mess, legal officer, scheduling officer). In addition to maintaining tactical proficiency while flying, expectations are that the OTD be the squadron's subject matter expert (SME) for their program, manage all program funds properly, and be responsible for "all phases of test planning, approval, execution analysis, and reporting" (COMOPTEVFOR, 2020d, p. 151). The OTD also communicates regularly with program offices and government entities (e.g., DOT&E, test ranges, laboratories, and contractors) to facilitate OT.

In addition to facilitating OT, OTDs also coordinate with the fleet and Navy weapons schools "to communicate tactical guidance … in conjunction with a given test period" (COMOPTEVFOR, 2020d, p. 16) in the form of OPTEVFOR tactics guides (OTG). The upgrade of aircraft hardware or software brings new capabilities. The VX-9 OTD is at the forefront as an operational user to provide tactical lessons learned to the Naval Air Warfare Development Center (NAWDC) for inclusion in their tactical guidance (COMOPTEVFOR, 2020d).

G. NEXT GENERATION JAMMER MISSION DESCRIPTION

The ALQ-99 is the AEA community's legacy jammer successfully employed in every conflict from Vietnam to the Global War on Terror. Fielded since 1971, it is now facing reliability, availability, flexibility, and maintainability issues that the Navy's OPTEMPO cannot sustain and depend upon in the fight against a peer adversary. The ALQ-249, Next Generation Jammer (NGJ), is the Navy's solution to replace the ALQ-99 and provides the Navy with longer standoff ranges with greater Effective Isotropic Radiated Power (EIRP). The NGJ is being acquired in three separate acquisition programs:

Mid-Band (MB), Low-Band (LB), and High-Band (HB) (Director, Operational Test and Evaluation [DOT&E], 2020).

The NGJ-MB (Figure 10), contracted with Raytheon and Boeing, consists of a pair of pods that will work with the ALQ-218 receiver system and off-board assets. Integral to the advanced operations of the EA-18G Growler, the NGJ-MB will be added as part of its H16 Software Configuration Set (SCS) Block Upgrade (DOT&E, 2020). NGJ-MB will address "AEA capability and sufficiency gaps against enemy threats operating in the middle-frequency bands of the electromagnetic spectrum" (Office of the President, 2020 p. 1). The primary capability of the NGJ will be against Integrated Air Defense Systems (IADS), but it also can "improve capability against modern, advanced radio frequency (RF) threats; communications; datalinks; and non-traditional RF targets" (DOT&E, 2020, p. 159).

The mission of the NGJ is to "ensure kill chain wholeness against growing threat capabilities, and capacity, keep pace with enemy threat weapon systems' advancements, and support the continuous expansion of the AEA mission areas that exceed [the ALQ-99]" (Office of the President, 2020, p. 1). Therefore, it was designed to utilize "Open Systems Architecture that supports software and hardware updates to rapidly counter emergent and evolving threats" as a "key enabler and force multiplier for operations across the spectrum of missions defined in the Defense Strategic Guidance, including strike warfare, projecting power despite anti-access/area-denial challenges, and counterinsurgency/irregular warfare" (Office of the President, 2020, p. 1).

Figure 10. NGJ-MB On Board the EA-18G Growler. Source: DOT&E (2020).

H. NGJ-MB PROGRAM SUMMARY AND STATUS

The NGJ-MB program is an MDAP with an MDA at the Navy Component Acquisition Executive Level (Office of the President, 2020). For the President's Budget of 2022, the program is focusing on the

> Engineering and Manufacturing Development (EMD) phase completing the design of the pod and building fifteen EDM pods for DT and six System Demonstration Test Article (SDTA) Pod shipsets (2 pods per shipset) for final DT, OT, tactics development, and Initial Operational Capability (IOC). (Office of the President, 2021, p. 3)

The NGJ-MB passed its Milestone C decision review on June 28, 2021, giving the Navy the "green light to enter the Production and Deployment phase and proceed with Low-Rate Initial Production (LRIP)" (Wilcox, 2021). Previously, the NGJ-MB faced delays due to COVID-19 reducing personnel at test facilities and entities responsible for producing and shipping system components (DOT&E, 2020). Other than COVID-19 delays, the program does have a history of "late pod deliveries, the complexity of test equipment integration, and initial manufacturing and quality issues discovered with the flight test deliveries" (DOT&E, 2020, p. 160).

Testing has been completed at the Air Combat Environment Test and Evaluation Facility (ACETEF) and the High-Power Electronic Attack Technique Radiation (HEATR) chamber to evaluate the hazard of electromagnetic radiation to personnel, along with pod functionality and performance tests (DOT&E, 2020). The chamber portion of the electromagnetic environmental effects (E3) testing, "in support of airworthiness certification of the NGJ-MB, was completed in Summer 2020" (DOT&E, 2020, p. 160).

Further, DT will focus on executing "trial developmental runs for NGJ-MB in the ACETEF along with its jammer technique generation testing in the HEATR chamber" (DOT&E, 2020, p. 160). Preliminary EIRP testing will also be accomplished in the ACETEF chamber (DOT&E, 2020). The Navy has not yet conducted any OT on the NGJ-MB because of program delays mentioned and a

> design problem preventing the NGJ-MB's Ram Air Turbine Generator (RATG) from safely rotating full speed. A redesigned RATG will be implemented in the delivery of the SDTA in 2021 to support the completion of developmental and operational testing and demonstrate full power operation in flight. (DOT&E, 2020, p. 160)

OTRR and IOC updates are set to occur beyond fiscal year (FY) 2022 (Office of the President, 2021).

I. NGJ'S PLAN FOR T&E

The NGJ-MB's T&E strategy reflects the Navy's guidance to use capabilities-based test and evaluation (CBT&E) as a basis for integrating NGJ into the fleet earlier. CBT&E aims to combine

> the employment of the prospective system into the design at the very earliest stages; this approach of "beginning with the end in mind" has strong potential to lower both acquisition costs and time-to-deploy, resulting in more capability sooner to the field [encompassing] a broad focus on system design to satisfy a particular operational effect spanning the breadth of all phases of T&E. (Lednicky, 2011, p. xv)

Additionally, CBT&E "incorporates advanced scientific and statistical methods, such as Design of Experiments (DOE) and Modeling and Simulation (M&S) techniques, throughout the design process" (Lednicky, 2011, p. xvi).

Figure 11 is a visual summary of the NGJ’s T&E milestones and phases from the presidential budget of FY2021. It is not current because of the already mentioned program delays, but it reflects the program’s initial intent to integrate CBT&E throughout the T&E process.

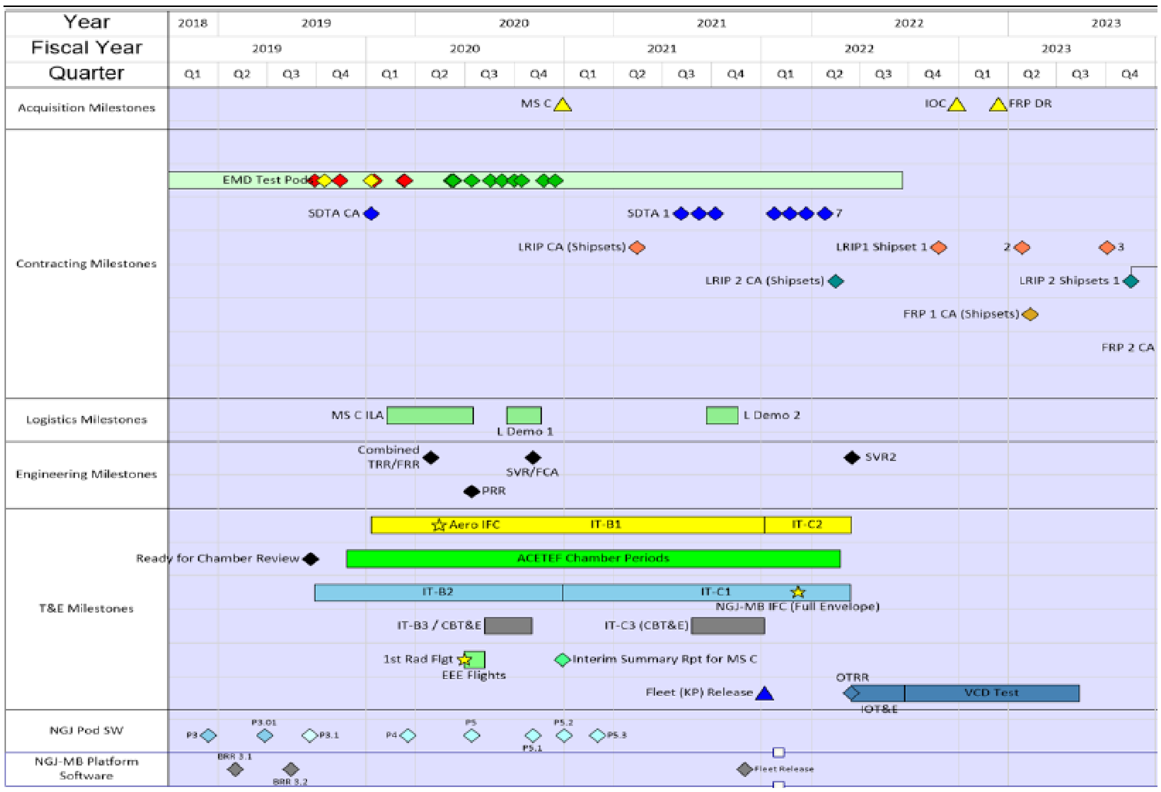

Figure 11. NGJ-MB T&E Summary. Source: Office of the President (2020).

Included in the president’s budget for 2022 is a releasable summary of the immediate intent of T&E. The most current plan is reflected in Figure 12.

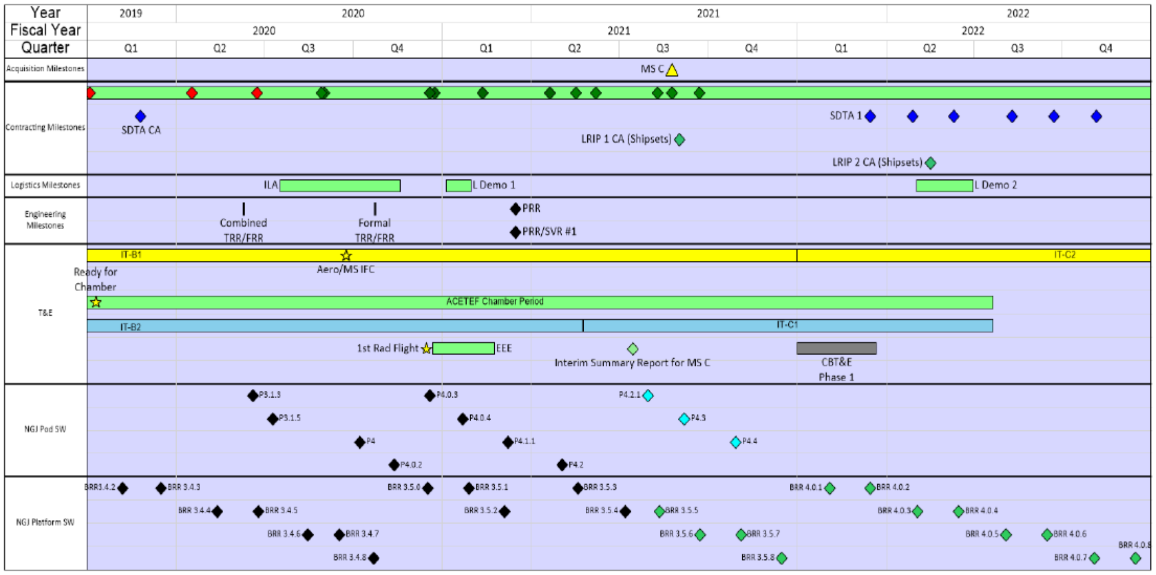

Figure 12. Most Current NGJ-MB T&E Strategy, FY2022. Source: Office of the President (2021).

Airworthiness (IT-B1) testing from FY2021 will continue to assess the existing research and development test article (RDTA) pods with the introduction of the SDTA pods at the start of FY2022. IT-B1 will not include any OT but focus on “loads pod calibration, cantilever ground vibration test (GVT)” and flying qualities, stability and control, and performance flight testing (Office of the President, 2020, p. 5). IT-C2 phased testing in FY2022 will reflect further aeromechanical testing, finalizing store flying qualities, stability and control, performance, separation, and jettison flight testing (Office of the President, 2021).

IT-C1 testing reflects the start of verification of advanced mission system functionality and design reference mission (DRM) analysis in the ACETF and advanced jamming technique characterization in the HEATR and finalizes reliability and antenna pattern testing at electronic attack test and evaluation systems (EATES; Office of the President, 2021). In FY2022, there are plans to complete demonstrations and collection of data necessary to support verification of system performance specification (SPS) and integration requirements document (IRD) items.

The start of CBT&E will likely be the first introduction of OT into the T&E process with the finalization of the SDTA pods. CBT&E Phase 1 will include advanced mission systems flight testing to include jammer effectiveness with advanced AEA mission scenarios and initial tactics, techniques, and procedures (TTPs) development (Office of the President, 2021). PMA-234 and COMOPTEVFOR plan to integrate VX-9 into the CBT&E process to complete this phase of testing.

J. FISCAL YEAR 2022 NATIONAL DEFENSE AUTHORIZATION ACT AND THE NAVY'S UPDATE TO FORCE STRUCTURE

The Navy's "Speed to the Fleet" by delivering capabilities to the fleet sooner does not tell the whole story behind eliminating aviation operational test squadrons. Due to operational commitments worldwide, the Navy is in a deficit across aviation, surface, and subsurface communities with readiness, training, and maintenance. It is no surprise that the "Navy's effort to squeeze $40 billion in savings from its budget is linked to the size and shape of the future force" (Werner, 2020, p. 1), as Secretary of the Navy Modly said in February 2020. Modly continued to emphasize that "the Navy has a mandate to grow the Fleet while digging out of a readiness hole at a time the Pentagon anticipates flat budgets for the next several years" (Werner, 2020, p. 1). Modly's aim was for $8 billion in savings per year from a $200 billion budget, focused on eliminating some personnel costs (Werner, 2020).

In the FY2022 "Justification of Estimates" for the Navy's operational and maintenance budget, the Navy marked $11,468,000 to be eliminated from Air Operations within the DON. The Reform Oversight Council (ROC) recommended this initiative to disestablish dedicated operational test squadrons (Department of the Navy, 2021). The ROC was commissioned by the secretary of the Navy in 2018 following the 2017 collision of U.S. Navy surface vessels in the Pacific. The ROC is charged with assessing DON efforts' overall health and effectiveness to reform and improve readiness (United States Naval Institute [USNI], 2019).

In a response from Congress, the FY2022 National Defense Authorization Act (NDAA, 2021) explicitly "prohibits the Secretary of the Navy from taking actions to reduce aviation operational testing capacity and requires [DOT&E] to assess the Navy's future planned reductions and mitigation strategy" (p. 74).

More information is contained in H.R. 4350 from the Subcommittee on Tactical Air and Land Forces. In H.R. 4350, the House Armed Services Committee prohibits the Secretary of the Navy from reducing any of the following:

> 1. The aviation-related operational testing and evaluation capacity of the Department of the Navy.
> 2. The billets assigned to support such capacity.
> 3. The aviation force structure, aviation inventory, or quantity of aircraft assigned to support such capacity, including rotorcraft and fixed-wing aircraft. (NDAA, 2021)

A report from the DOT&E (2020) would assess

> 1. The design and effectiveness of the testing and evaluation infrastructure and capacity of the Department of the Navy, including an assessment of whether such infrastructure and capacity is sufficient to carry out the acquisition and sustainment testing required for the aviation-related programs of the Department of Defense and the naval aviation related programs of the Department of the Navy
> 2. The plans of the Secretary of the Navy to reduce the testing and evaluation capacity and infrastructure of the Navy with respect to naval aviation in fiscal year 2022 and subsequent fiscal years, as specified in the budget of the President submitted to Congress on May 28, 2021.
> 3. The technical, fiscal, and programmatic issues and risks associated with the plans of the Secretary of the Navy to delegate and task operational naval aviation units and organizations to efficiently and effectively execute testing and evaluation master plans for various aviation-related programs and projects of the Department of the Navy. (p. 74)

K. SUMMARY

The amount of policy and guidance promulgated by entities external to a naval aviation OT squadron is bountiful. Their complexity lies in the decades of political and financial wrangling the DOD's acquisition system represents today. Also included is a fundamental planning, execution, and reporting process heavily ingrained with systems engineering principles. All these intricacies of the execution of OT&E may be overwhelming to a fleet aviation squadron focused on the operational realities of maintaining a state of readiness for combat.

The NGJ-MB program represents one of the most advanced leaps of technological progress in the field of electronic warfare to happen in over 60 years. The successful fielding of the NGJ-MB program will be required to defeat a peer adversary in the future. Besides World War II, there's no other time in the history of the Naval Aviation Enterprise (NAE) when it has been so important and necessary to get their force structure right. VX-9 may seem like an entity that can be cut to free some liquidity for other resources. However, their purpose for existing is grounded in statute, regulations and necessity. The VX-9 mission to assess whether a multimillion-dollar piece of technology is operationally effective and suitable can mean the difference between life and death for the warfighter. In Chapter III, I delve into research related to a fleet aviation squadron assuming the role of operational testers.

III. LITERATURE REVIEW

A search of the literature involving OT&E has mostly failed to specifically address the issue of having fleet aviation squadrons assume the role as operational testers for an aviation-related operational test. While there is NPS research and contracted studies to investigate the systems engineering process and how it relates to test and evaluation, no research investigates *who* should be operationally testing for Naval Aviation. Some tangentially related research conducted by researchers at NPS and government contractors brings some excellent practices to operational test in training and experience of OTDs and the rigor of test planning.

A. JOURNAL ARTICLE

A brief article from the Defense Acquisition University (DAU) entitled "Full Speed to the Fleet" does a great job of explaining two specific technologies that could be operationally tested using a fleet aviation squadron. Though the technologies were not ACAT I programs, validating the Batwing antenna on the ALQ-99 and the interoperability of the long-range anti-ship missile (LRASM) demonstrated a proposed "repeatable process" of completing "testing and tactics development using Fleet resources" (Bowman & DiMarco, 2019, p. 1). Additionally, the article emphasizes that over the course of a year, VAQ-138 was able to support acquisitions while completing a "pre-deployment training cycle, six major large-force exercises, a 6-month Global Reaction Force rotation, and the first four months of a deployment" (Bowman & DiMarco, 2019, p. 3).

The "Full Speed to the Fleet" article mentions that aircrew with previous operational test director and test pilot experience was essential to facilitate the tests. The article does not address the barriers that would be present if those aircrews were not trained while stationed at an aviation test squadron like VX-9. Forming partnerships is emphasized in the article as an essential bridge to addressing Joint Urgent Operational Needs (JUONs) for the fleet and minimizing risk to address squadron capacity during deployment. Notably, the partnerships between tactics weapons schools, developmental test, engineering at Naval Air Warfare Center, and industry as the essential links to meeting successful requirements

(Bowman & DiMarco, 2019). Overall, the article offers anecdotal evidence that the two capabilities tested through an operational squadron reduced the amount of time they reached the fleet. Missing is an exhaustive analysis of cost and risk to product performance given the operational deployment of two immature technologies.

B. GOVERNMENT REPORTS

From the advent of the industrial–military complex, the DOD has been looking for efficiencies in cost, schedule, and performance to compete against the adversary and deliver dominant technology to the warfighter. In a report to the SECDEF from 1978 entitled *Follow-on Operational Testing and Evaluation of Weapons Systems*, by the director of the Procurement and Systems Acquisition Division, a survey addresses when operational test should be integrated into the procurement process to assure weapons systems perform adequately and suitably for deployment (Stolarow, 1978). Overall, the beliefs have not changed that independent agencies should conduct operational test, be representative of the environment they are to be employed, and have results that inform decision-makers on whether to buy and deploy weapons (Stolarow, 1978).

Addressing *who* should be performing operational test, the survey mentions that the Air Force uses

> typical military personnel that are expected to operate and maintain the systems. However, during the Air Force's combined testing (integrated testing), the systems are operated and maintained by either contractor representatives or specially trained military personnel. Only after production has begun do typical military personnel engage in the testing. (Stolarow, 1978, p. 4)

Additionally, the Air Forces advised that "during combined testing, personnel with above-average qualifications are needed to estimate a system's operational effectiveness and suitability. They stated that typical operational (including maintenance) personnel cannot make these initial estimates" (Stolarow, 1978, p. 4). Therefore, qualitatively the assessment is that specially trained operational testers are better suited to conduct operational test.

In a RAND study from 2004 entitled *Test and Evaluation Trends and Costs for Aircraft and Guided Weapons*, the study addresses the desire by PMs to reduce the scope and duration of testing significantly, citing such initiatives as modeling and simulation and commercial off the shelf (COTS) technology (Boito et al., 2004). Additionally, the study focused on analyzing the nature of T&E costs related to aviation, identifying key cost drivers, and developing methodologies for estimating T&E (Boito et al., 2004).

Specific to the research question is the idea of IT combining the test forces of DT and OT to help

> identify operational effectiveness and suitability issues early, when corrective measures are generally less disruptive and less expensive [and] maximizing the ability of the OT community to use data developed during DT has the potential to reduce or eliminate redundant dedicated OT. (Boito et al., 2004, p. 41)

The study emphasizes that IT was essential to drive down costs over the life cycle. Therefore, if the Navy were to eliminate VX operational test squadrons, does the fleet have the capacity to be involved in IT? This is an important question to address, given the IT plans of the NGJ program and multiple other ACAT I programs. Additionally, as the survey highlights, programs' potential net savings for T&E are often offset by the growing "system complexity, higher test standards, and increased test charges to programs" (Boito et al., 2004, p. 89) that need specialized personnel to assess.

A 2008 study by the Defense Science Board (DSB) for the Under Secretary for Acquisition, Technology & Logistics (USD AT&L), entitled *Report of the Defense Science Board Task Force on Developmental Test & Evaluation*, recommends that an IT team of contractors and developmental and operational testers be "established as early as possible in the program, preferably during the concept refinement phase, to effectively identify test parameters, data and resources required for the DT and OT plans and other required certifications" (Defense Science Board, 2008, p. 39). One critical recommendation is to "make available a cadre of operational personnel to support DT for Acquisition Category I and special interest programs, as a minimum" (Defense Science Board, 2008, p. 40).

C. PREVIOUS THESIS

Specialization and training are considered when analyzing the merits of fleet aviators conducting operational test. Does a one-week crash course in OT and acquisition give the fleet tester enough context, training, and knowledge to conduct test? A 1992 NPS thesis comparing ship OT&E between the United States and Australia emphasizes that OT&E is a "specialized discipline, with its own philosophy and methodology, and so requires a specialist approach with knowledge and experience to make it effective" (Joseph, 1992, p. 34). COMOPTEVFOR, back in 1992, like it still does today, offers a 3-day OTD course to initiate all Navy personnel into OT (Joseph, 1992). The thesis also adds that to "be effective, OT&E requires experienced and knowledgeable personnel with high professional credibility within their field of expertise. To achieve this requires selection of suitable personnel, adequate training and good guidance documentation" (Joseph, 1992, p. 35). Giving OT&E to fleet aviation squadrons could result in a "get what you get" mentality in that scheduling takes precedence on conducting OT as opposed to quality, experienced, and knowledgeable VX operational testers.

A 2009 NPS thesis, titled *Integrating Test and Evaluation into the Acquisition Process for Naval Aviation*, recommended that the 3-day course was inadequate to train OTDs and "additional formal training to OTDs and support personnel to prepare them for the tasks of OT planning, supervision of test execution, and documentation of test results" (Barrett, 2009, p. 70) was needed. The consequences of undertrained OTDs are profound in that what

> they write will be seen as the final report card for an acquisition program, recommending whether or not a system should be fielded. These tests and test reports have very high visibility, having great political and public relations impact for the program under test. (Barrett, 2009, p. 64)

Having fleet aviators receive a "crash" course in OT&E has grave consequences, given that OT&E, by "law and policy must be performed independently from and uninfluenced by development organizations" (Barrett, 2009, p. 65). The difference between a U.S. naval test pilot (USNTPS) that attends a 48-week course in "academics, flight test preparation, flight test conduct, data collection, data reduction, and test report preparation"

(Barrett, 2009, p. 65) and a fleet aviator will lead to a more significant disparity between the conduct of DT and OT, with weight contingent on DT results if fleet aviators try to do OT&E. Barrett's research presupposes that VX OT squadrons are here to stay and that the on-the-job training they receive as members of a VX squadron are likely adequate for the future. However, the research misses integrating T&E in the Naval Aviation acquisition process with "Speed to the Fleet" and the force reduction future of 2021.

"Speed to the Fleet" emphasizes "getting it right the first time" for OT&E to keep costs down and deliver capability sooner (Bodmer, 2003). However, as the NPS thesis titled *T&E in the United States Navy, and How it Must Evolve to Support Future System Acquisition* states, "True affordability cannot be measured in the test infrastructure costs, but rather, weapons system life-cycle costs. Affordable T&E should be measured by the degree total weapon system life-cycle costs are minimized and reduce associated risks" (Bodmer, 2003, p. 97). OT conducted effectively is essential to driving down total life-cycle costs. One of the critical enablers of having a solid T&E organizational foundation is that it is "meaningful and [provides] measurable metrics" (Bodmer, 2003, p. 95) to help decision-makers assess risk and program progress. The need to have established and consistent test infrastructure in personnel, facilities, and resources is essential to delivering capability at an effective cost.

D. COST-EFFECTIVE ANALYSIS

Most of the modern research found in using cost-effective analysis (CEA) is used in health services. In the realm of health services, it serves as a "way to examine both the costs and health outcomes of one or more interventions. It compares an intervention to another intervention (or the status quo) by estimating how much it costs to gain a unit of a health outcome, like a year gained or a death prevented" (Centers for Disease Control, 2021, p. 1). Relative to defense acquisition, if the outcome of choosing a technology based on its specifications were the same (radius, top speed, rate of fire, etc.), the primary determinant would be if the technology was cheaper from another vendor.

In a Naval Personnel Research and Development Center thesis from 1976 entitled *Guidelines for Cost-Effectiveness Analysis for Navy Training and Education*, the authors write that a CEA is appropriate "when a market evaluation or value cannot or should not be placed on the outputs of the alternatives, but the resources (inputs) of the alternatives can be evaluated or measured in market prices (dollars)" (Doughty et al., 1976, p. 25). Therefore, the resources involved with each alternative path need to be identified and analyzed to choose the most cost-effective solution.

E. CONCLUSION

There is no shortage of information related to the good practices of T&E. Most government research expresses the critical need of having a trained workforce that is knowledgeable and integrated early in the test process. Finding efficiencies early allows the prospect of a shortened IOT&E and FOT&E, with capabilities hitting the fleet sooner. The theses reviewed provided meaningful views on training, the substantial implications of OT&E, and the specialization of OTDs. Most of the research reviewed contains recommendations that stand the test of time when reducing life-cycle costs in the modern era of the AAF. The journal article from Bowman and DiMarco opens up and supposes a new opportunity to find efficiencies with the acquisition process by using fleet aviation units to conduct operational test. Literature on the CEA provides a valuable method to analyze the resources involved to choose between alternatives that accomplish the same outcome. I now analyze the cost and risk to program success if the stakes are higher with an ACAT I program and whether there are potential benefits in the schedule.

IV. ANALYSIS

In the previous chapters, I discussed the foundation for the policy, instructions, and good practices for executing OT&E in DOD acquisition. The management of T&E is ever-evolving as new technology is designed, developed, and implemented for fielding to the fleet. Choosing the best efficiencies in meeting the program office's goals of cost, schedule, and performance are key contributors to why change often needs to happen to OT&E. For the following analysis, I chose to specifically address the NGJ-MB program as an example of a program with significant developmental goals for software and hardware to meet an essential national security need.

The T&E strategy related to NGJ-MB was reviewed as part of the president's FY2022 budget submission. The strategy is likely to change for the next several months as new issues are discovered in developmental tests. The finished product will morph into an acceptably mature product ready to test operationally. For this analysis, I use the latest strategy included in the president's FY2022 budget and the newest information on the NGJ-MB program releasable to the public. Most of the other data used for analysis are based on a fictional scenario where current law, policy, practice, and operational requirements are used to answer the following questions:

1. Does the COA to have fleet aviation squadrons assume the role as operational testers help drive down the time it takes for the warfighter to receive the NGJ-MB pod?

2. Does the COA to have fleet aviation squadrons assume the role as operational testers effectively manage the costs and risks to product performance to "Speed to the Fleet?

A. ASSUMPTIONS

The following assumptions are used as a basis for a strengths, weaknesses, opportunities, and threats (SWOT) analysis on a fleet aviation squadron assuming the role of OT&E for the NGJ-MB program:

VX-9 is entirely disestablished, including civilian flight test engineers (FTE) and military aircrew/OTD, officer/enlisted maintenance personnel, civilian security personnel, administrative support, and all operational test aircraft assigned at Naval Air Weapons Station China Lake.

All OT&E stakeholders are required to conduct OT per FY2021 law and policy.

COMOPTEVFOR assumes the responsibility for test management of the NGJ-MB program, including test planning, coordination, and scheduling of test assets for OT&E. Continuous coordination will be conducted with the VAQ TYPEWING staff and a VAQ unit to maintain tactical and operational validity and expertise.

CNAP and VAQ TYPEWING will identify a carrier-based VAQ unit in maintenance phase to conduct OT&E of NGJ-MB at the start of IOT&E testing. Fleet release was moved by the program to coincide with IOT&E.

Assume that CBT&E Phase 1 was conducted primarily by DT squadrons at VX-31 and VX-23 and received input by VX-9 before the squadron was disestablished. Data obtained from CBT&E Phase 1 will not be scored for IOT&E to preserve the independence and integrity of the fleet's testing during IOT&E.

The VAQ unit's personnel and assets will be reflective of those expected to be assigned during the maintenance phase of the Navy's OFRP model.

Operational tasking in support of worldwide contingencies takes precedence over scheduling fleet units for OT.

The carrier-based VAQ unit will be responsible for executing OT&E and, in coordination with COMOPTEVFOR, report on OT results conducted during the test period. The VAQ unit will also evaluate maintenance procedures and technical publications during the test period.

B. STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS (SWOT) ANALYSIS ON A FLEET AVIATION SQUADRON ASSUMING THE OT&E OF THE NGJ-MB PROGRAM

The primary objective of the following SWOT analysis is to help the Navy develop a full awareness of the factors involved in deciding to have a fleet aviation squadron perform OT&E for the NGJ-MB program. *Strengths* and *weaknesses* refer to the internal factors of the decision. Internally, this may include factors that can be influenced by resources available to the NGJ-MB program. *Opportunities* and *threats* refer to the external factors that influence and affect the decision, typically policies, plans, and operations that are out of the control of the NGJ-MB program.

Before delving into the analysis, it is essential to state the mission of PMA-234 as being "responsible for acquiring, delivering, and sustaining AEA systems, providing combatant commanders with Electronic Warfare capabilities that are critical enablers to operational mission success" (Naval Air Systems Command [NAVAIR], 2022, p. 1). To decide the "right" size and shape of this analysis, I focus my efforts on the NGJ-MB program, focusing on the success to deliver, and sustaining the NGJ-MB pod over its life cycle. Proving its viability for future success occurs during OT&E before it is supposed to be employed more widely by the combatant commander.

As Michael Tippins (2019) noted in his article "Revisiting SWOT Analysis: A Widely Misused Decision-Making Tool," the SWOT analysis is not meant to be taken as a linear tool to which one "should first identify internal characteristics (i.e., strengths and weakness) and then unconnectedly identify external factors (i.e., opportunities and threats)" (p. 2). The mission of PMA-234 helps "limit [our] attention to those opportunities and threats that are truly relevant" (p. 2). Then one can "look inside and classify internal characteristics (e.g., competencies, capabilities, etc.) as strengths and weaknesses" (p. 2). First, I look at the threats and opportunities to gain context properly, and then attempt to tie strengths and weaknesses of the fleet testing NGJ-MB to specific external factors.

1. Threats

The threats section will delve into the factors external to the NGJ-MB program that represent pressures or risks to program success.

a. Congressional Scrutiny

The congressional reaction in the FY2022 NDAA to the Navy's proposal to eliminate aviation operational test squadrons was quick and direct. This is unsurprising when taking into consideration that the most significant T&E-related legislation "reflects both Congress' dissatisfaction with the adequacy of the DOD's and contractors' past testing and its corresponding desire to exercise more control and oversight to ensure adequate testing in the future" (Mortlock et al., 2019, p. 129). The successful completion of IOT&E using a fleet aviation squadron for the NGJ-MB program will undoubtedly be under more scrutiny as VX-9 is disestablished and DOT&E's oversight function is more imperative to Congress.

The first hurdle to clear would be to have DOT&E, and COMOPTEVFOR as the OTA, come to an agreement on the path forward as VX-9 is disestablished and the DOT&E-approved test plan is altered. Changes to a TEMP or operational test plan may take months of bureaucratic wrangling for approval. By law, DOT&E must approve a test plan before the start of OT.

Additionally, 10 U.S.C. § 2399 gives DOT&E the ability to affect the number of LRIP items for IOT&E and determine whether testing is adequate for an FRP decision to be made (Defense Acquisition University, 2022). Cost to the NGJ-MB program may increase, and the schedule may extend. DOT&E holds the final approval on test adequacy and results.

b. Optimized Fleet Response Plan and Test Scheduling

The Navy started implementing the OFRP in 2014 as a remedy to meet heavy operational demands that resulted in increased ship deployment lengths and reduced or deferred ship maintenance (GAO, 2016). The goal is to "maximize employability while preserving maintenance and training with continuity in ship leadership and carrier strike group assignments, and restoring operational and personnel tempos to acceptable levels" (Global Security, 2022). While the Navy meant to provide a predictable schedule for operational employment, the Navy's intentions had the opposite effect.

The Navy planned to use a 36-month cycle (Figure 13) broken into four phases. In the maintenance phase, usually lasting 7 months, ships get fixed and maintained before entering a deployment work-up cycle (Larter, 2020). Sailors enter the basic phase for 7.5 months to "start qualifying for various shipboard functions such as fighting a major fire, operating the combat system correctly and safely navigating the ship" (Larter, 2020, p. 4). Then ships enter an advanced and integrated phase within those 7.5 months to learn "high-end warfighting tactics and bring the strike group together to fight as a unit" (Larter, 2020, p. 4). Deployment should last 7 months, followed by 14 months of readiness called the "sustainment phase" (Larter, 2020).

Figure 13. Aircraft Carrier Optimized Fleet Response Plan. Source: GAO (2016).

Carrier-based aviation squadrons mirror ship availability along with the same four phases of the OFRP. A Master Aviation Plan (MAP) is used to assign carrier air wings (CVW) to aircraft carriers (CVN) and carrier-based squadrons to CVWs (Madson, 2010). The MAP (Figure 14) is updated twice a year to assign CVWs to CVNs along a projected time frame of up to 10 years (Madson, 2010). Automated software helps the N40 Office at Commander, Naval Air Forces Atlantic (CNAL) assign squadrons using a set of "business rules" to manage the long-term consequences of scheduling fleet aviation squadrons (Madson, 2010).

There are currently nine carrier-based VAQ units operational today. One carrier-based VAQ unit is assigned per CVW. It is important to add that squadrons may shift OFRP cycles as their CVW is assigned to a different ship if there is expected to be a long period of ship unavailability due to maintenance. This shift usually happens during the maintenance phase for the CVW and CVN. This adds to an element of unpredictability when trying to identify a fleet squadron to conduct OT&E.

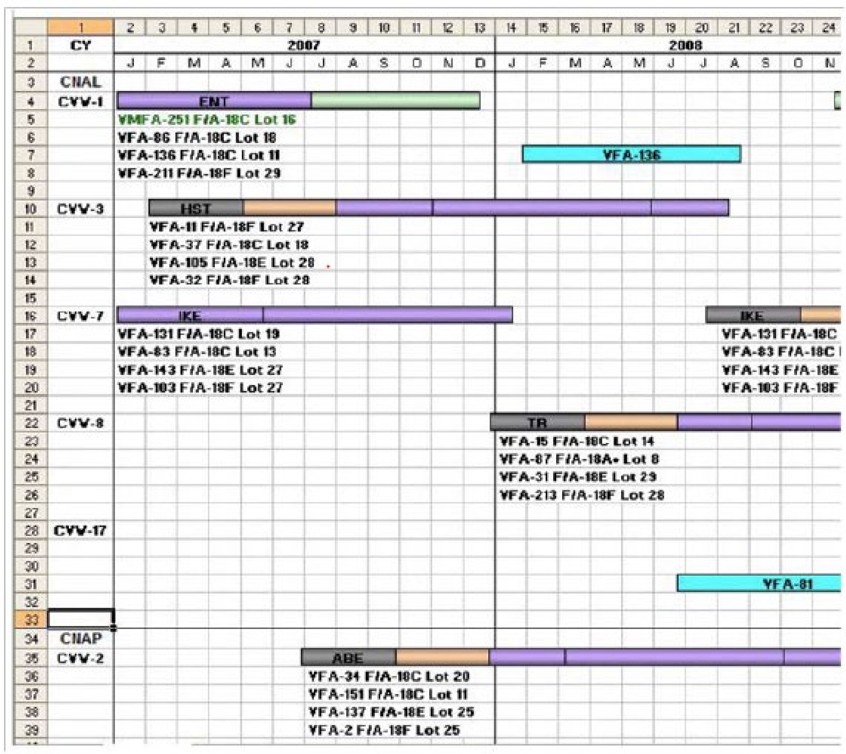

Figure 14. Example of a Master Aviation Plan (2007). Source: Madson (2010).

The threat to schedule is the assignment of a fleet aviation squadron to conduct OT&E amid these external factors related to real-world tasking. A critical assumption is that the Navy is capable of planning and executing maintenance "in a way that will get all the ships [and aircraft] in a carrier strike group to both start and finish their maintenance cycles simultaneously" (Larter, 2020, p. 8). As CNO Admiral Michael Gilday lamented, "We are getting 35 to 40 percent of our ships out of maintenance on time; that's unacceptable" (Larter, 2020, p. 8).

> Additionally, OFRP has a poor track record of getting CVWs back home as scheduled. The recent 9-month deployment of the Lincoln Strike Group in the middle of a crisis with Iran is a prime example (Fuentes, 2020). Rear-Admiral Michael Boyle, Carrier Strike Group (CSG) 12 Commander, poignantly remarked, "As we become a more dynamically maneuverable force … the plans become a little bit more uncertain. What we need to do is set the expectations … that we're just not going to have the luxury of knowing where we're going to go anymore. We can plan for great power competition and near-peer competitors like China and Russia, but the world gets a vote. We have to set the expectations for our sailors that we're not going to be able to give them a predictable schedule." (Fuentes, 2020, p. 5)

The sustainment phase, meaning "the period of time after a ship deploys that it maintains a high state of readiness" (Larter, 2020, p. 5), fares no better at maintaining schedule as the sustainment phase lacks the prolonged ability for funding as means to conduct training to keep a CVW proficient. As a result, fleet squadrons attached to CVWs end up dropping in-flight hours, proficiency, and qualifications at the tail end of their OFRP cycle and head back into the maintenance phase.

c. Test Range Scheduling/Availability

Another factor that the NGJ-MB program needs to consider is lining up the scarce availability of the nation's test facilities according to schedule. Overall, the program needs to identify a fleet aviation squadron available during the maintenance phase, align OTRR with the start OT, and manage to book flight test ranges on an average time line of 4 to 6 months before execution. Ranges typically ask for test objectives, test aircraft involved, threat simulation, and planned execution dates 4 months before actual execution. If the schedule is not met on time, funding deposits may be held for the rest of the fiscal year or surrendered to the test range in its entirety. Additionally, the program's credibility may suffer because the range may lose out on business to other higher priority events with other programs.

The Test Resource Management Center (TRMC), which manages a collection of more than 20 test facilities (Figure 15) classified as major range and test facility bases (MRTFBs), may be able to assist with leverage for the ACAT I program. However, the long list of test ranges does not replicate modern threats or provide the best OT data as the

Nevada Test and Training Range (NTTR). Taking an advanced EA pod as NGJ-MB is essential to use with the "most realistic integrated threat simulator environment in the world [with a] wide assortment of SAMS, AAA, and acquisition radars operated by Range Squadron personnel from 39th Intelligence Squadron" (Global Security, 2022b). OT&E missions are supported by "upgraded Television Ordnance Scoring Systems (TOSS), Kineto Tracking Mount documentation and Time Space Position Information (TSPI) data" (Global Security, 2022b). The NTTR is undoubtedly the most expensive to operate and perform test. However, no other range in the United States offers the most value to achieving OT&E.

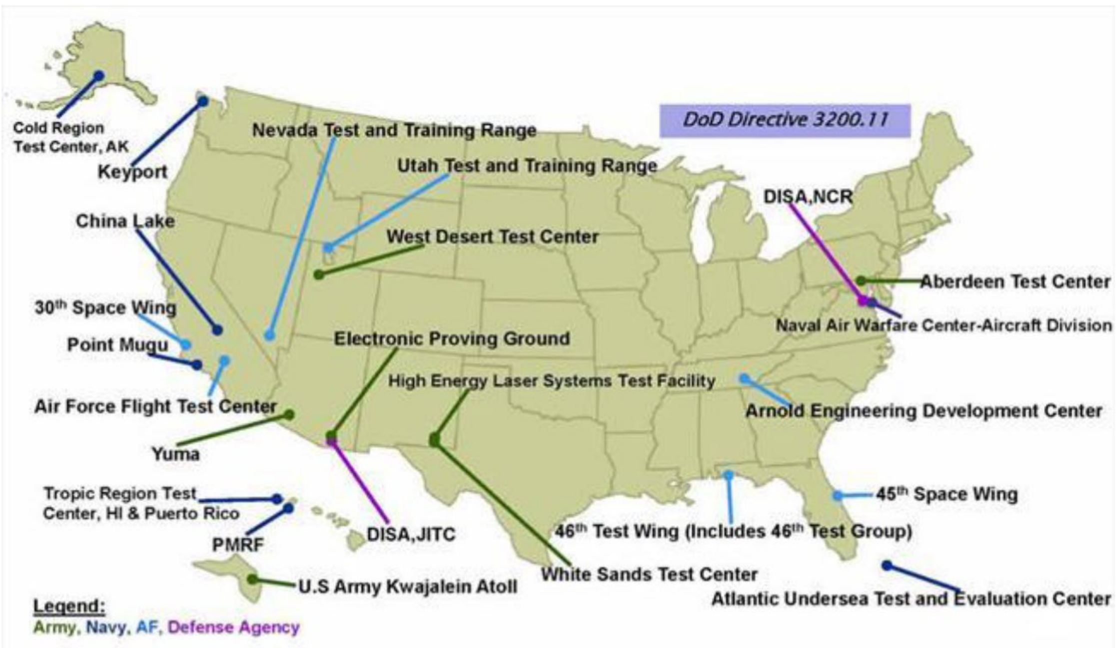

Figure 15. DOD MRTFBs by DOD Component. Source: Claxton et al. (2005).

Range availability is an external factor that may have a consequence of delaying the start of OT. Costs may increase if programs book a range, a cancellation is involved, and the deposit is either held until the end of the fiscal year or is surrendered in its entirety. Choosing a range other than the NTTR may result in retesting objectives as the data acquired may not correctly evaluate the EA produced by the NGJ-MB pod. Credibility to the program may suffer because it may book time on the range, potentially interfering with an LFE like RED FLAG or higher priority test programs like Joint Strike Fighter (JSF). An additional factor to consider is the ability to execute an OT shot of a live-fire weapon with the employment of the NGJ-MB pod. The list of available ranges gets shorter due to competition with other programs, conflict with deploying fleet squadron live-fires, and availability of test targets.

d. Manning (Maintenance, Aircrew)

Manning shortfalls related to choosing a fleet aviation squadron to conduct OT&E are based on "operational reality." Like the difficulties already discussed with the schedule, finding the right people to properly run OT is a workforce issue that will affect analyzing the pod's performance. This is mainly if a fleet squadron is tasked to perform OT during their maintenance phase of the OFRP cycle. Highlighted from previous NPS research, aircrew and maintenance manning is "incrementally funded and sourced with operational target funding (OPTAR or flight-hours) and personnel (fit-fill) to meet the phase of training it is in" (Bartolf & D'Antonio, 2019, p. 60). The OFRP emphasizes fiscal responsibility "to resource squadrons to a reduced level of readiness. This occurs when squadrons are transitioning out of the deployment and sustainment phases, then back into the maintenance phase" (Bartolf & D'Antonio, 2019, p. 60).

Focusing on the manning of the maintenance department, "Squadrons will lose many of the qualifications that were attained over the previous OFRP cycle along with the departing personnel" (Bartolf & D'Antonio, 2019, p. 60). Qualifications are lost as Navy enlisted classification codes (NECs) are not represented in billet architectures for demand-to-activity manpower managers (Bartolf & D'Antonio, 2019). One of the critical NECs that are typically lessened during the maintenance phase is the safe-for-flight (SFF) qualification. A maintainer who is qualified SFF is entrusted by a fleet squadron to "maintain a complete and accurate list of all of the squadron's aircraft discrepancies and mission capability for each" (Bartolf & D'Antonio, 2019, p. 58). If Sailors with this qualification have the potential to be transferred at the end of a deployment, a fleet squadron has a deficiency in conducting flight operations and test effectively.

Another maintenance manning phenomenon to be aware of is the fact that enlisted maintenance personnel are "assigned to billets based on NEC, rating, and paygrade [which] can result in assignment of personnel to a squadron who have no experience in the squadron's type of aircraft" (Bartolf & D'Antonio, 2019, p. 60). For example, an "AD2 who worked on MH-60 Seahawk helicopters for eight years can be assigned to an EA-18G power plant's work center. The problem is exacerbated when that AD2 is assigned to a billet where their career development requires a position as a work center Leading Petty Officer" (Bartolf & D'Antonio, 2019, p. 60). This undoubtedly creates a mismatch of experience and proficiency in assessing suitability for OT&E. Additionally, the fleet squadron's focus will be directed more towards preparing this AD2 to lead the work center and attain qualifications for operational deployment than to performing OT&E.

Manning can also be an issue in obtaining the right personnel with the proper security clearance. Programs have specific access requirements in the form of compartmentalized sources of information that have limited access. VX maintainers and aircrew obtain higher levels of security clearance to maintain aircraft and systems, handle post-flight data, or operate aircraft during test events. Additionally, there are security requirements to operate aircraft in the vicinity or in test events with another type/model/series (TMS) like fifth-generation aircraft. Having the proper maintainers and even aircrew with sufficient security clearance to effectively conduct OT during the maintenance phase is essential. Delays to the schedule may persist if one must wait for security clearances to operate on test ranges or integrate with other aircraft programs.

Aircrew manning for Navy fleet squadrons is based on specific TMS. Specific to the VAQ community, the commander of the Electronic Attack Wing Pacific (COMVAQWINGPAC) produces an electronic attack community capabilities-based training and readiness matrix (CBTRM) that is derived from Guidance for Employment of the Force (GEF), Required Operational Capability/Projected Operational Environment (ROC/POE), and the Navy Mission Essential Task List (NMETL). It also includes requirements from theater operational plans (OPLANS), contingency plans (CONPLANS), NSAWC publications, and operational lessons learned (Commander, Electronic Attack Wing Pacific [COMVAQWINGPAC], 2015).

The CBTRM specifies for a VAQ carrier-based unit of five planned authorized aircraft (PAA), the number of crews that are minimally funded to meet training and readiness (T&R) skilled crew requirements is nine. Based on operational reality, squadrons in maintenance phase may not have that many crews available, as aircrew rotate to a shore assignment following an operational deployment. What is more important to distinguish is the level of tactical experience and proficiency resident in a fleet squadron during the maintenance phase. Fleet squadrons in the maintenance phase are usually flooded with fresh faces of aircrew from the Fleet Replacement Squadron (FRS). This will undoubtedly affect test sufficiency and quality of reporting desired for an ACAT I program.

In comparison, all VX-9's VAQ aircrew are second-tour assignment and fleet deployment experienced aircrew with an Air Combat Training Continuum (ACTC) Level III qualification. Before their disestablishment, VX-9 was also able to provide nearly 17 dual-qualified pilots (F/A-18 and EA-18G) during test execution. A VAQ unit in the maintenance phase will usually have eight at their lower limit.

e. ACTC Priority

COMVAQWINGPAC Instruction 3500.6B highlights the training and readiness program associated with the OFRP deployment cycle. Fleet squadrons are regimented in their resourcing, training, and readiness for operational deployment. Principal to a fleet squadron's implementation is the ACTC, which is a "five-level program comprised of academics, simulators and flight events known as the Growler Weapons and Tactics Program (GWTP) within the VAQ Community" (COMVAQWINGPAC, 2015, p. 5). The definitions below are central to building a fleet squadron ready to deploy:

1. Level I: Fleet Replacement Graduate
2. Level II: Tactical Aircrew/Tactical Wingman
3. Level III: Mission Commander
4. Level IV: Suppression of Enemy Air Defenses (SEAD) Mission Commander
5. Level V: Growler Tactics Instructors (GTIs)

The ACTC program is priority number one for every fleet squadron. Assigning a fleet squadron to conduct OT&E is counterintuitive to the Navy's core mission of deploying tactically proficient and lethal warfighting capability. Taking what may be more than a month out of a fleet squadron's ACTC program will hinder the development and production of Level III mission commanders. An external factor to consider is the threat to schedule if CNAP does not want to assume a higher risk to approve fleet aircrew during their ACTC progression.

The CBTRM will require at least four Level III qualified mission commanders to a fleet VAQ unit at the start of the maintenance phase. That's enough to make two jets worth of OT&E-worthy crews if you can resource the right pilot-to–electronic warfare officer (EWO) ratio. The number is tied to be incrementally resourced to be as high as nine Level III qualified mission commanders during an operational deployment. A threat to performance is possible as a fleet squadron likely would not have the experienced aircrew available to sufficiently plan, execute, and report on NGJ-MB.

For an overview of the required flight mission training that may be conducted before attainment of each ACTC level, see Appendix C.

f. Aircrew Training/Proficiency/Test Execution

An external factor that faces a compressed timeline is the training involved with preparing for OT&E. Aircrew proficiency and tactical execution are risks because they will be in the maintenance phase at the time of execution. Most of the baseline knowledge and proficiency likely will be based on the events completed during training at the FRS, which does not offer the rigor and flexibility needed to conduct LFEs at unfamiliar airfields. The OPTEMPO jumping from the maintenance phase to execute flight operations in a realistic LFE environment might pose a safety concern. For more information on training completed at the end of the FRS for new aircrew, see Appendix D.

Like aircrew that just arrived from the FRS, experienced aircrew at ACTC Level III and Level IV will need training at simulators, briefs on changes in crew vehicle interface (CVI), and instruction on how to use new mission planning software. Simulators based in Naval Air Station Whidbey, WA, are full of FRS students and other fleet squadrons executing ACTC in preparation for deployment. The additional cost and time of transporting aircrew for at least one week to simulators at Boeing Headquarters in St. Louis, MO, must be considered. Additionally, most simulators in Whidbey will not be updated with the latest software and hardware. They may be prone to crashing if updates are rushed and operators do not know how to troubleshoot.

Aircrew training as an OTD is another external factor facing cost and schedule increases. Test execution is an entirely different requirement than performing daily flight operations or workups for deployment. COMOPTEVFOR publishes a 42-page manual on test execution and provides a 4-day OTD course in Norfolk, VA, to baseline knowledge. The impact for the program if an untrained OTD is placed to conduct OT&E is their understanding of the SUT, data collection requirements, and go/no criteria for each day of the test. If an OTD fails to comprehend the magnitude of their responsibilities, then the schedule will result in lost test days, and the OTD must retest to validate test objectives. Cost will increase if multiple detachments are executed to complete test events.

Figure 16 is a summary of the daily test brief that is being provided to all personnel involved in the operational test.

4.3.1 DAILY TEST BRIEF

At the beginning of each test day, the OTD should gather the OT team and Adjunct Testers in a central location to synchronize the day's testing. Testers at remote locations should be provided a means to teleconference for this meeting, and the attendance of any services coordinators should be mandatory to facilitate follow-on crew briefings. The OTD should review:

- The day's test objectives, the schedule, and applicable event cards
- Data collection sheets and data collection assignments
- Required test conditions and tolerances
- Hardware and software configurations
- Safety and Go/No criteria and the current status of those criteria
- Operational Risk Management considerations
- Emergency procedures and "What If?" scenarios
- Test limitations and restrictions
- SUT maintenance status, noting any impacts or delays
- Special test equipment, instrumentation, and data recording equipment status
- Internal and external communications plans and system status

The OTD should ensure each team member understands their role, where they will be, when they will be there, and what they will do. This is the opportunity to walk through the whole day to set the team up for success.

Figure 16. Daily Test Brief During OT&E Flight Events. Source: COMOPTEVFOR (2020b).

For a complete summary of OTD responsibilities during test execution, see Appendix E.

g. Test Reporting

My current analysis assumes that COMOPTEVFOR will be the lead for test reporting and will coordinate with the VAQ unit during the test reporting process. The risk to schedule to meet the next milestone of FRP is receiving the multiple elements in the test reporting process from COMOPTEVFOR as they try to maintain a schedule with a VAQ squadron. The VAQ unit will most likely struggle to balance training requirements for workups during the OFRP cycle and the multiple staff meetings it takes to produce the elements of a test report. It can also be expected that COMOPTEVFOR may lack the requisite number of analysts and supplemental staff aircrew to help write a test report as the FY2022 president's budget indicated a cut to OT overall.

As the COMOPTEVFOR (2020a) *Test Reporting Handbook* indicates, the end of IOT&E will include a "report letter signed by the Commander, (OPTEVFOR), a deficiency letter signed by the Warfare Division Director (50)/Air Warfare), and a data analysis summary memorandum signed by the Technical Director" (p. 11). Ultimately, a fielding recommendation is provided in the operational test agency evaluation report (OER) and the operational test agency follow-on evaluation report (OFER).

The Post-Test Iterative Process (PTIP) will drive the completion of the deliverables involved in OT&E. The process begins with a "series of scoring board(s) and Critical Operational Issue (COI) Evaluation Working Groups (CEWG) preceding an Analysis Working Group (AWG), a Blue and Gold Sheet (B&G) Peer Review, the System Evaluation Review Board (SERB), and the Flag-level Executive SERB (E-SERB)" (COMOPTEVFOR, 2020a, p. 57). Table 1 is a summary table of the working groups with their purpose.

Table 1. Summary Table of Operational Test Reporting Working Groups. Adapted from COMOPTEVFOR (2020a).

Event	**Purpose**
Scoring Board	Validates that OT data were collected per the approved test plan and under operationally representative circumstances.
Critical Operational Issue (COI) Evaluation Working Groups (CEWG)	Review the full breadth of COI data, risks or deficiencies, and results in a COI-by-COI division/squadron-led working meeting.
Analysis Working Group (AWG)	Conducts a data and analysis review of all effectiveness and suitability measures, including both quantitative and qualitative data, with a focus upon critical measures and data supporting risk/deficiency identification.
System Evaluation Review Board (SERB) and Executive SERB (E-SERB)	Examine test report letter containing executive summary, the COI results paragraphs, and any operational considerations (OPCON).
Operational Test Guide (OTG)	Communicates tactical guidance to the fleet in conjunction with a given test period. Tactical lessons learned are provided to the respective Warfighting Development Centers (WDC) for inclusion in their tactical guidance. Created primarily by test squadrons.

Table 2 summarizes the expected schedule of deliverables to be expected from COMOPTEVFOR and the VAQ unit.

As COMVAQWINGINST 3500.6B outlines, a carrier-based VAQ unit with a PAA of 2.8 aircraft will have the operational requirement to execute 687 flight hours within 6 months of the maintenance phase. The number of hours dedicated to testing will not fulfill the 687 flight hours, as those hours devoted to test are funded by the program office. Therefore, the requirement will still be there for a fleet squadron to execute to maintain currency, proficiency, and start ACTC production.

Table 2. Test Reporting Deliverables. Adapted from COMOPTEVFOR (2020a).

Deliverable	When it is Due
Review data analysis plan and post-test plan of action and milestones (POA&M)	30 days prior to test.
Initial post-test brief to include draft blue and gold sheets, POA&M for follow-on briefs, discussion of completed test events, future schedule for completion of test	10 days after completion of last test event.
Scoring board	Continuous throughout. Complete before end of test message.
End of test message	30 days following completion of last test event.
CEWG	Start after scoring board, completed before SERB.
AWG	Before completion of SERB.
SERB/E-SERB	Before completion of test report letter.
Test report letter	90 calendar days after the end of test, no later than 45 days before milestone decision.
OTG	120 days after completion of test.

Generally, the test reporting process will likely require the involvement of aircrew at the Level III and IV ACTC experience level, which will also be all the squadron's department heads, as well as the training officer, the executive officer, and the commanding officer. The requirement to complete test reporting, run a squadron administratively, and balance ACTC will undoubtedly be a drain on time dedicated to preparing for workups. The program may face risk from TYPEWING cutting a test period short if there is a perceived detriment to squadron training and proficiency for operational deployment. Additionally, if staff minimally operates COMOPTEVFOR, lacks the operational expertise of dedicated OTDs like those at VX-9, and depends heavily on fleet aircrew to write documents, the program can expect the quality of reports to decrease and the time required to complete increase.

h. Maintenance Training/Proficiency/Test Execution

Like the threats brought up with aircrew training for OT&E, a fleet maintenance department with no experience in executing tests faces similar challenges. The program can try to lessen any knowledge gaps in test by providing travel for program SMEs at China Lake and Patuxent River to go to Whidbey before the start of test. The focus would need to be on getting the fleet squadron familiar with technical/maintenance publications they have never utilized performing their jobs and procedures they have never been trained to do. That would have been an advantage if the program had VX-9 at China Lake to perform IT with VX-31.

Another factor is OPTEMPO. A maintenance department in the maintenance phase of the OFRP cycle will not be used to operating at an increased pace in a realistic mission environment. This could become a safety concern if a fleet squadron is pressed without the proper supervision, procedures, and qualifications during the maintenance phase. Experienced and proficient fleet maintainers are needed to assess "wear-out effects, set up and employ the system, as well as the complexity of user interfaces and the adequacy of training" (Defense Acquisition University, 2022, p. 21). Logistics supply chains for the NGJ pod will also be assessed for operational availability.

Like aircrew, the maintenance department will need to function as OT evaluators. Central to success is making sure the maintainers are versed in what the suitability assessments entail. For the NGJ-MB pod, with its unique software updates for the EA-18G, the suitability assessment must include the "availability, representativeness, and adequacy of their maintenance test environments, and regression testing procedures. The ability to reproduce failures observed in the actual system and patching process of the maintenance environment are components of the system's suitability determination" (Defense Acquisition University, 2022, p. 21). Fleet maintainers will have to be versed in uploading software procedures either to the aircraft or the pod to adequately assess if there is a performance issue with the software or a problem with the software loading procedure. The consequence for the program is that it could result in poor data capture, resulting in time dedicated to unnecessary rework and an increase in cost.

i. Test Assets

Fully mission-capable (FMC) aircraft is another scarce resource available due to OFRP cycles. During the maintenance phase, a VAQ carrier-based unit may have an allocation as low as 3.5 compared to a total allocation of 5.0 during deployment. The overall priority for the TYPEWING in allocating FMC aircraft is with squadrons either in workups at the start of basic phase or heading out for deployment. Program schedule is dependent on the effective management of test aircraft to complete test events as quickly and completely as possible. Having to cancel events because of a lack of FMC aircraft, parts supplies, or aircraft discrepancies involving any other issues besides the SUT is cost prohibitive.

j. Program Integration/Interoperability and Network Security

As of March 2021, COMVAQWINGPAC accepted their first H-16 modified Growler capable of carrying the NGJ-MB pod. The modification is part of a five-year process to modify all 160 Growlers to carry the NGJ-MB pod (Mangum, 2021). PMA-265 is the PM responsible for acquiring, delivering, and sustaining the EA-18G aircraft and delivering new builds of the Growler's system configuration set (SCS). An external factor to consider is PMA-265's ability to manage this process, so OT-ready aircraft are appropriately configured with the software and hardware already operationally effective and suitable for fleet use. Additionally, mixed configurations could potentially invalidate OT data if not managed correctly.

Managing software and hardware builds across a 160-jet flight line can be a monstrous task for COMVAQWINGPAC. VX units have the experience to manage, operate, and maintain multiple configurations within the squadron. This is a task that no fleet maintainer would have experienced on any other fleet tour. The training, publications, and clearances would need to be solid not only from within PMA-234 but a separate entity in PMA-265.

Additionally, the successful completion of test will also be contingent on the maturity of the software and hardware involved in PMA-281's Joint Mission Planning System (JMPS), which is at the core of enabling EA-18G mission planning. JMPS is responsible for inputting the software necessary for an EA-18G to be fully mission capable and extracting the data essential for post-flight mission data. This data will help feed the sufficiency of OT&E results in ALQ-218 signal identification, a missile shot validation of the APG-79, jamming validation of the NGJ-MB, and other parts of the SOS. Additional costs will likely have to be added to the program to contract and pay for a JMPS team of experts to support planning and reporting.

The authority to operate (ATO) process for JMPS is a critical process to manage for test as it is in the fleet. The tricky part of the process that may cause a delay to schedule would be obtaining the proper information assurance (IA) certification for the specific fleet squadron to utilize "test builds" at multiple security levels. It will be important to stay ahead of the latest information technology practices delineated by OPNAVINST 5239.1 to integrate fleet information technology personnel into the test process. Certifications for personnel, machines, and networks are external factors that will need to evolve and seek approval consistently.

k. Funding

The external funding factor stems from the calendar-driven nature of the Planning, Programming, Budgeting, and Execution (PPBE) process. I have reviewed the potential risks to schedule that may be faced by fleet squadrons assuming the role of OT. Properly assessing status from the program office as far as funding to execute OT&E is the final hurdle to pass before FRP.

The PM is responsible for funding T&E support to OT with items such as range support, analytical support, test weapons, and program-specific travel (COMOPTEVFOR, 2020d). Schedule slides involved with having a fleet squadron conduct OT along with the operational realities of real-world tasking can potentially increase the program's cost.

As the NGJ-MB program has passed Milestone C and is clear for LRIP, the budget activity will change and logically progress from RDT&E funding for operational system development to aircraft procurement appropriations. Aircraft Procurement, Navy (APN) money is available for three fiscal years. It is available for "project office and acquisition manager technical support services … integral to the execution of procurement program (e.g., production direct support costs such as production testing, quality assurance, production engineering, and equipment assembly)" (AcqNotes, 2022b). This change may work to the program's advantage if it can efficiently get a fleet squadron to complete OT&E. However, the significant risk, with the increased scrutiny in schedule, cost, and performance, is the consequences of one of the "4Rs" (resource, restructure, reengineer, and risk) being used on the NGJ-MB program (Candreva, 2019).

As the program's schedule slips, it faces a dilemma in the case of resourcing against other requirements for the Navy and the DOD. Programmers from the DOD may either choose to

> resource a program by taking funds from a lower-priority program, restructure the program by buying fewer items in total or buying them more slowly, reengineer the program seeking cost savings so that the same or similar can be acquired for less, or deliberately underfund the program and accept the risk to the success of the program. (Candreva, 2019, p. 245)

l. Frequency Allocation, Spectrum Management, and Location

Unique to utilizing EA for training and especially test is the coordination needed with federal entities like the Federal Aviation Administration (FAA). EA clearances are coordinated with regional federal agencies through the Navy and Marine Corps Spectrum Office (NMCSO) to allocate frequencies for tests or training, usually within one year (Morgan, 2008). This clearance is challenging to attain in the VAQ community's fleet concentration area of Whidbey Island because of the proximity to Seattle and the border with Canada. The program can expect frequency allocation for testing the NGJ-MB pod near the homeport of a VAQ unit to be minimal, and when considering the EIRP involved, downright impossible. Therefore, the detachment of a fleet squadron to ranges with more flexibility and dedicated spectrum clearances such as China Lake or the NTTR are essential for tests. This external factor will need to be in consideration when projecting the cost of detaching a fleet squadron and the time to travel from their home airfield.

2. Opportunities

The opportunities section will delve into the factors external to the NGJ-MB program that represent favorable prospects to program success.

a. Proof of Concept

If the NGJ-MB program at least tries to coordinate a fleet squadron to perform OT&E, the result could work dividends for the overall tactical aircraft program's enterprise. What may be achievable is a proof of concept that has fleet squadrons utilize targets of opportunity during their schedules to satisfy the requirements to conduct OT&E to validate a program. In the grand scheme of the organization, as part of the Program Executive Office for Tactical Aircraft Programs (PEO[T]), the NGJ-MB program run by PMA-234 is one of 10 program offices. This could be an opportunity for other programs to use PMA-234's model of success and potentially deliver "Speed to the Fleet" across multiple systems.

If the NGJ program identifies regularly scheduled LFEs such as Red Flag as a basis for completing events, it could make small strides of success. One potential external factor for an opportunity is using an expeditionary VAQ unit to conduct OT&E. Though an expeditionary squadron still follows the model of the ORFP cycle, their deployments are easier to predict and closely controlled by COMVAQWINGPAC and CNAP. Barring a real-world contingency, or request for forces (RFF) from a combatant commander (COCOM) that puts the schedule at risk, the NGJ-MB program could make strides in completing OT. On a smaller scale, PMA-234 has demonstrated this ability with VAQ-138 and the Batwing antenna on the ALQ-99, as referenced in the "Full Speed to the Fleet" article (Bowman & DiMarco, 2019). If the program takes a more significant effort to coordinate with all stakeholders ahead of schedule and assume more risk for product maturity to be declared, then it can use the concept of fleet OT for an ACAT I program.

b. Capability to Face the Peer Threat

The NGJ program may find an opportunity for incremental improvement to address the advanced threat in China. Finding a fleet squadron to OT the current iteration of the NGJ-MB pod at IOT&E will provide vital information and data for continuous technology maturity. Having a perfect product passing the "tailgate process" of OT&E is an unrealistic expectation of the NGJ-MB program. The NGJ program must accept more risk to initial performance to field this capability for the joint environment as soon as possible.

3. Weaknesses

The weaknesses section will delve into the factors internal to the NGJ-MB program that may stop the program from performing at an optimum level and inject risk.

a. Integrated Test

Some of the intrinsic knowledge VX aircrews develop in integrated test (IT) will be absent for fleet OT. VX-9 had the advantage of being co-located and included in IT event planning, preparation, training, and flight execution with VX-31 DT. Each iteration of fleet OT squadrons that may be integrated into an OT&E phase would have to be retaught updates on test execution methods, CVI, and improvements to software/hardware. Ideally, the program would want the same fleet squadron to be involved in IT, fly/train with the new software and hardware, and be ready to execute OT&E when the pod is mature. However, the unpredictability of the OFRP cycle does not allow consistent opportunities.

To avoid poor evaluations of operational suitability, the program will need to utilize early planning to include "any special needs for the number of operating hours, environmental testing, maintenance demonstrations, testing profiles, usability of DT&E data, or other unique test requirements" (Defense Acquisition University, 2022). Those "unique test requirements" are absent because the VAQ unit is located away from China Lake's Advanced Weapons Laboratory (AWL). The AWL had regularly interfaced with VX-9 throughout the integrated test process to provide best practices on everything involved, including maintenance procedures, uploading software, data collection, logistics supply lines, and cryptologic necessities.

b. Large Force Exercise Execution

Executing tests for tactical aviation usually requires the integration of the CVW into a realistic operational scenario. One of the disadvantages of using a VAQ unit to perform OT for the NGJ-MB program is that it will likely only have four to five jets to execute OT. Before VX-9 was disestablished, they had around seven F/A-18 Super Hornets for integration as well as F-35 stationed at Edwards Air Force Base, CA. As the NGJ-MB's mission is to act as a "component of carrier air wings" with the "primary capability of the NGJ [employing] against Integrated Air Defense Systems (IADS)," the use of fighter-based aircraft as "strikers" or "protected entities" inside a test range like the NTTR is essential to evaluating operational effectiveness (DOT&E, 2020, p. 1).

Additionally, the NGJ program will have to plan to either find a fleet squadron of F/A-18s or contracted services like "Tactical Air Support Inc." to provide "red air" to simulate airborne threats during test execution. The NGJ program will have to plan for an increase in cost to either detach a squadron of fleet strike fighter aircraft or contract the support. A potential slide in executing the schedule will occur if the program cannot find external entities to act as strikers or red air.

c. Flight Clearance Process

The flight clearance process (Figure 17), as stated in NAVAIR Manual 13034.1, is an

> independent engineering analysis … performed to provide assessment of airworthiness and safety of flight, and ensure that system safety risk has been identified and accepted at the appropriate level, within acceptable bounds for the intended mission, resulting in issuance of a flight clearance. (NAVAIR, 2016, p. 80)

The flight clearance process is not unfamiliar to the program, and the program may be confident it can be completed with the NGJ-MB after years of learning about the SUT. However, what will be difficult if the program must change fleet squadrons multiple times during test with the OFRP cycle, is that a new clearance is needed each time the program has a new fleet squadron start OT&E. Hardware and software updates, along with shifting aircraft bureau numbers (BUNOs) between squadrons, requires a specific clearance each time it is done.

Figure 17. Flight Clearance Process. Source: NAVAIR (2016).

During OT&E, an interim flight clearance (IFC) is promulgated as “configurations are not standardized and may change, requiring frequent airworthiness assessment” (NAVAIR, 2016, p. 23). IFCs are “valid until the specific expiration date or other conditions specified in the IFC are met” (NAVAIR, 2016, p. 19). Additionally, IFCs “are also the authoritative document that permits the use of a draft Naval Air Training and Operating Procedures Standardization (NATOPS) and/or Naval Aviation Technical Information Product (NATIP) product by OT units” (NAVAIR, 2016, p. 19). The frequent issue is that it can take up to 3 months to be approved. This process could affect schedule if PMA-234 must constantly update the IFC for the next squadron identified during their maintenance phase, and the program experiences configuration changes with hardware/ software leading into OT. For more information on the process, see Appendix F.

d. Need to Execute Multiple Detachments

With consideration of the multiple external factors balancing OFRP cycle, test range availability, training, asset availability, and manning, there will be the need to execute numerous detachments to complete OT&E. China Lake will likely remain the central test hub for a fleet squadron to operate due to its existing infrastructure, support from DT organizations, and proximity to the NTTR and Point Mugu Sea Range (PMSR).

The most significant movements to consider with the magnitude of the program would be executing LFEs in the NTTR, aircraft carrier suitability assessments, maritime employment scenarios, and live-fires of weapons in conjunction with NGJ-MB employment.

Re-flying events as part of range availability, maintenance fallout, or even weather cancellations can be expected with VX squadrons executing OT&E. The NGJ program schedule will be less flexible due to using fleet squadrons based on meeting the operational commitments I have already discussed. Additionally, I've addressed the risk involved with retesting events if maintainers and aircrew are not sufficiently trained, the expected increase in cost due to poor data collection, and test reporting that results in poor performance characterization of the NGJ-MB.

e. Verification of Correction of Deficiencies Planning

After IOT&E, there is a period of test in the NGJ-MB program that includes verification of correction of deficiencies (VCD). The specific purpose of this period will be to correct any deficiencies discovered by the VAQ unit during IOT&E. Based on the ACAT level of the NGJ program and DOT&E oversight, the program will likely need OPTEVFOR review and endorsement of corrective actions (COMOPTEVFOR, 2020d). The complexity of the program will most likely lend itself to an end-to-end test to conduct COI resolution (COMOPTEVFOR, 2020d).

Because of the time it takes to analyze data, produce a report, and coordinate deficiencies through DOT&E, the program will need a different VAQ unit to conduct VCD. There will be no continuity in reporting between the multiple VAQ units the program will use from IOT&E to VCD. This puts the program at risk for a mischaracterization of performance based on the various squadrons being involved, in addition to the extra cost it will take to shuffle squadrons into test during their OFRP cycles.

Integral to managing the schedule for the program would be determining the scope of this last period of test. Regression testing completed by DT may be required based on mission task decomposition, changes to the hardware or software, and available resources (COMOPTEVFOR, 2020d). A VCD test plan will need to be drafted, and the program will not expect the OTD involved in IOT&E to be involved in the test plan for VCD. Delays in schedule may persist if the need to continually train OTDs, coordinate with DOT&E and OPTEVFOR to come to a consensus about deficiencies, and change execution dates due to OFRP cycles.

4. Strengths

The strengths section will delve into the factors internal to the NGJ-MB program that describe what it excels at or may be favorable to program success.

a. Incremental Product Delivery

The NGJ program may find success in calling fleet release complete at IOT&E with a fleet squadron performing OT&E. Though the NGJ-MB pod may not pass all wickets for validation, the incremental advancements built into the pod allow meeting scheduled delivery to the fleet. PMA-234 has had success incrementally acquiring advancements with fielding the ALQ-99 tactical jamming system (TJS). The ALQ-99 was first fielded in the 1970s with the EA-6B Prowler to meet the threats from the Union of Soviet Socialist Republics. As time has passed and threat radars have advanced, the TJS has been modulated and improved during multiple OT periods to meet threat requirements (Sherman, 2022). The ALQ-99 has subsequently been involved in numerous conflicts involving suppression of enemy air defenses (SEAD; Desert Storm, Bosnia, Second Gulf War, and Libya). The NGJ-MB pod is also designed with a modular, open system architecture that can be improved in the future.

b. Developmental Test Program

When the NGJ-MB program meets the technical maturity and production readiness required to pass Milestone C then proceed to IOT&E, the program may have already mitigated the risk to meet FRP. Multiple years of verification testing involving chamber radiation, mission systems development in the lab and flight, aeromechanical flights, and model and simulation have taken place. Additionally, the flights the program planned to take place during CBT&E executed "advanced mission systems flight-testing," including "jammer effectiveness within advanced AEA mission scenarios; captive carriage, safe separation/jettison and test launches of missiles (ATM-88C/E and AIM-120C/D); and initial Tactics, Techniques and Procedures (TTP) development" (Office of the President, 2021). Despite the external factors involved with who is going to OT the pod, the GAO has concurred in its *Annual Weapon Systems Annual Assessment* that the NGJ-MB program is matching resources and requirements, and product design is stable (GAO, 2021). The NGJ program has a strong DT execution history to pass OT&E with minimal risk to schedule, cost, and performance.

Figure 18 summarizes the SWOT:

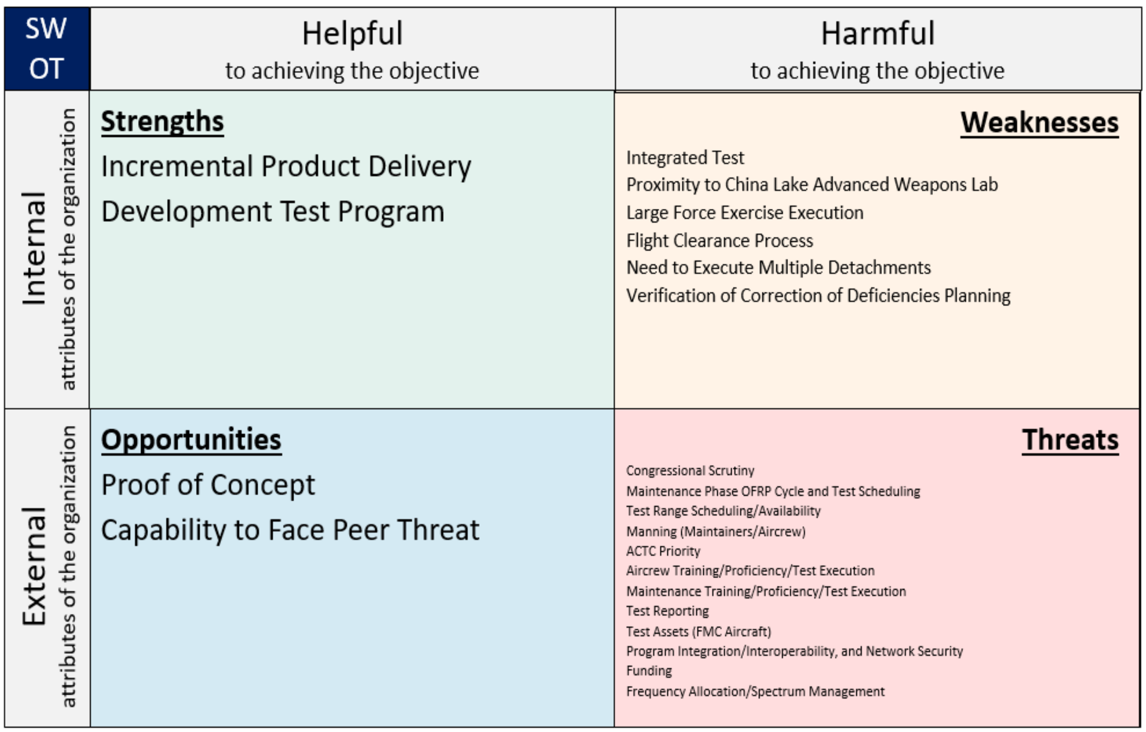

Figure 18. SWOT Analysis Summary

C. ANALYSIS OF COST-EFFECTIVENESS

In the previous section, I stipulated that one of the weaknesses of having a fleet squadron OT for the program was the likelihood of executing multiple detachments. I provide quantitative cost data to execute one detachment for my cost-effective analysis (CEA). My purpose is to use the CEA to compare the relative costs of achieving the same outcome using different COAs. The outcome is to complete a detachment to perform OT&E at the NTTR. I analyze the COA of a VAQ unit from Whidbey Island, WA, versus

VX-9 at their home base of China Lake, CA. The scope of the analysis will be for two weeks to complete four LFEs at the NTTR to assess the NGJ-MB's operational effectiveness and suitability to employ during a SEAD mission.

The schedule will take place over two weeks. The assumptions are that both squadrons will have an early detachment to travel to Nellis to set up maintenance, security, and storage spaces for gear. There will be assumptions that some test support from China Lake, CA, will be provided for VX-9, including red air aircraft and flight test engineer support. The VAQ unit will be resourced as if they are in the maintenance phase and will need more external help to complete test.

Figure 19 is a schedule of events that will be used for the analysis:

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	01 *ADVON* *Maintenance Early Det* *Pack-out complete* *Trucks/Maintainers depart*	02	03 *Trucks / Maintainers arrive KLSV*	04 Ferry Jets to Nellis	05 Course Rules Brief Mission Planning **Event 0** Link Check P5 Pod Upload	06
07	08 **NGJ-MB VUL** 1930 Brief 2230 Take-off RANGE TIME 2300-0300	09 **NGJ-MB VUL** 1930 Brief 2230 Take-off RANGE TIME 2300-0300	10 **NGJ-MB VUL** 1930 Brief 2230 Take-off RANGE TIME 2300-0300	11 **NGJ-MB VUL** 1930 Brief 2230 Take-off RANGE TIME 2300-0300 Pod download	12 Ferry Jets to Home Base *Trucks/Maintainers Depart KLSV*	13

Figure 19. NGJ-MB Nellis Detachment Schedule

1. Resource Summary

Tables 3 through 6 define the required test personnel, equipment, and facilities to achieve a two-week detachment to NTTR to support IOT&E.

Table 3. Personnel Traveling to Nellis Air Force Base, NV

Resource	Requirement	VAQ	VX	Comments
Early Detachment (ADVON)	Maintainers and Officer in Charge	16	16	VAQ will travel from Seattle International Airport
Enlisted	Maintainers and Support Personnel	40	40	VAQ will travel from Naval Air Station (NAS) Whidbey Island on Navy Air Logistics Flight (NALO)
Officers	Support Personnel and Aircrew Duty Watchstanders	6	6	VAQ will travel from NAS Whidbey Island on Navy Air Logistics Flight (NALO)
Aircrew	Pilots and EWOs	8	10	All aircrew will ferry EA-18G
Flight Test Engineers (FTEs)	COTF Government Analytical Support, Data Base and Security Administration	12	12	All FTEs will travel from Norfolk, VA, for VAQ. VX FTEs will travel from China Lake, CA

Table 4. Aircraft Supporting Test/Travel to Nellis Air Force Base, NV

Resource	Requirement	VAQ	VX	Comments
EA-18G	2x EA-18G will be used during NGJ-MB test events. Extra EA-18Gs will be back-ups and/or dedicated to fulfill red air role.	4	5	VX is constantly resourced 5 PAA EA-18G. VAQ assumes 4 for maintenance phase. All EA-18G aircraft will detach to Nellis.
NALO	Transport personnel from home base.	1	0	VAQ is required to transport from NAS Whidbey Island, WA.
F/A-18 E/F Test Support	Aircraft fulfills the role of strikers.	4	4	VX will be able to resource two from China Lake. VAQ will outsource support from NAS Lemoore, CA.
F-35 Test Support	Aircraft fulfills the role as strikers and counter-air.	2	2	VX is resourced F-35 from DET Edwards VX-9. VAQ will outsource from NAS Lemoore, CA.
F/A-18 E/F Test Support Red Air	Aircraft fulfills the role as adversaries.	6	5	VX is constantly resourced with 7 F/A-18 from China Lake. VAQ will resource from NAS Lemoore, CA.
Tanker Support (KC-10)	Aircraft fulfills the role as airborne tankers for red air and blue air.	2	2	None.

Table 5. Facilities

Resource	Requirement	VAQ	VX	Comments
Ranges	NTTR, Hours	16	16	None.

Table 6. Surface Shipment

Resource	Requirement	VAQ	VX	Comments
Truck	Ship Equipment	1	1	None.
Car Rentals	Transport Personnel	20	21	Includes Total for Military and FTEs.

2. Cost Summary

I present a cost breakdown per category between VAQ and VX. VX will operate a portion of their support detachment from China Lake, CA. VAQ will travel from Whidbey Island, WA, to Nellis Air Force Base, NV.

Tables 7 through 12 provide a breakdown of costs.

Table 7. Military Temporary Duty Expenses

Expense	VAQ	VX	Comments
Meals and Incidentals	$43,815	$44,850	$69 per day/ $51.75 first and last day of travel
Lodging	$92,400	$95,040	$120 per day
Car Rentals	$5,746	$6,084	$169 per week
Commercial Air	$2,880	0	$180 round trip; VAQ is required to transport advanced detachment (ADVON) personnel from Seattle, WA
Fuel	$233	$1,274	$4.00 per gallon; 250 miles from China Lake to Nellis; 10 miles per day in Nellis

Table 8. Surface Shipment Cost

Expense	VAQ	VX	Comments
Truck Shipment (To/ From)	$13,623.38	$8,620.42	None.

Table 9. Flight Hour Expenses (Total Includes Fuel, Aviation Depot Level Repairable [AVDLR], Maintenance, Contract

Expense	VAQ	VX	Comments
EA-18G Ferry (To/ From)	$280,356.16	$50,063.6	$10,012.72 per flight hour
NALO (C-40)	$23,485	0	$4,697 per flight hour
EA-18G Test	$640,814.08	$801,017.60	$10,012.72 per flight hour
F/A-18 E/F Test Support	$781,802.88	$781,802.88	$12,215.67 per flight hour
F-35 Test Support	$126,049.60	$126,049.60	$ 3,939.05 per flight hour
F/A-18 E/F Test Red Air Support	$1,172,704.32	$977,253.60	$12,215.67 per flight hour
Tanker Test Support (KC-10)	$514,688	$514,688	$16,084 per flight hour

Table 10. NTTR Operating Expenses

Expense	VAQ	VX	Comments
Range Cost	$440,000	$440,000	$110,000 per flight hour

Table 11. Flight Test Engineer Expenses

Expense	VAQ	VX	Comments
Meals and Incidentals	$9,522	$9,522	$69 per day/ $51.75 first and last day of travel
Lodging	$15,840	$15,840	$120 per day
Car Rentals	$1,014	$1,014	$169 per week
Commercial Air	$4,560	0	$380 roundtrip; VAQ required to transport FTE from COMOPTEVFOR Headquarters, Norfolk, VA
Fuel	$70.85	$242	$4.00 per gallon; 250 miles from China Lake to Nellis; 10 miles per day in Nellis
Total Labor	$8,601	$8,601	COMOPTEVFOR government analytical support, database, and security administration; 64 hours of labor per person

Table 12. Totals

Expense	VAQ	VX
Total	$4,178,205.27	$3,881,962.70
Cost per LFE (4)	$1,044,551.32	$970,490.675
% Change in Cost	+7.63	−7.63

The totals from Table 12 show a two-week detachment performed with a VAQ unit have a total cost of $4,178,205.27. The planned number of LFEs for the two-week period is four. Per LFE, the cost is $1,044,551.32 for a VAQ unit. For VX-9, the total cost is $3,881,962.70 with a cost per LFE of $970,490.675. There was an increased cost of 7.63% for the two-week detachment performed by the VAQ unit. The 7.63% increase in cost is resource driven and does not include the potential cost of cancellations associated with maintenance fallout, weather cancellations, or range scheduling.

V. CONCLUSIONS AND RECOMMENDATIONS

In the previous chapter, analysis was conducted to identify the advantages, disadvantages, and risks to cost, schedule, and performance of shifting the role of OT&E of the NGJ-MB program from a dedicated OT&E squadron at VX-9 to a VAQ unit. This chapter first provides brief narratives to answer the two research questions. Next, recommendations are formed based on the answers to the research questions. Finally, questions in areas outside this thesis's scope, but that warrant further discussion and research, are provided.

A. CONCLUSIONS

The first research question asked was, "Does the course of action (COA) to have fleet aviation squadrons assume the role as operational testers help drive down the time it takes for the warfighter to receive the NGJ-MB pod?" The SWOT analysis shows that the weaknesses internal to the idea and the external threats far outweigh the potential benefits in the schedule of having a fleet aviation squadron conduct OT. The risk of schedule slips is higher primarily because of the OFRP demands for fleet squadron manning, training, and equipment. Fleet squadrons are minimally resourced at the maintenance phase, having limited capacity to surge their momentum and focus on meeting the acquisition system's timely demands. Additionally, schedule drivers with test range availability, assets, and the requirement of test sufficiency in reporting put the completion of IOT&E at risk. The NGJ-MB program will have to accept higher risk to schedule, with the greater likelihood that multiple VAQ units will have to perform OT&E throughout several detachments.

The second research question asked was, "Does the COA to have fleet aviation squadrons assume the role as operational testers effectively manage the costs and risks to product performance to 'Speed to the Fleet'?" The cost was analyzed in the CEA portion of the thesis to take a snapshot of the implications of having a fleet squadron detached from their home in Whidbey Island versus VX-9 in China Lake to perform OT in Nellis. For a two-week detachment, there was an increase of cost of 7% for OT to be performed with a VAQ unit. The 7% increase in cost is analyzed as if no events would be canceled or reflown at another time because of the operational realities of maintenance fallout, weather cancellations, or range scheduling. Having a VAQ unit detach from Whidbey Island to perform OT&E for the NGJ-MB increases risk to cost.

Product performance comes down to two fundamental requirements: effectiveness and suitability. The demands of the OTD in carrying out their duties to plan, execute, and report test results on weapons systems' effectiveness and suitability should be the ultimate differentiator. VX-9 consists of seasoned naval aviators with the tactical and operational experience to evaluate a weapon system ready for fleet release. An OTD must navigate the political demands of accountability, funding, and scrutiny associated with their projects as a full-time duty. Additionally, the technical knowledge of tests and assessing the validated requirements of a system from end to end necessitates specialized training. The fleet aviator cannot meet these demands if their primary focus should be preparing to deploy their squadron in combat. The sufficient characterization of product performance is a high risk with a fleet aviator tasked to perform OT&E.

B. RECOMMENDATION

The research and analysis of the idea that a VAQ unit assumes OT&E of the NGJ-MB pod shows value in continuing to fund VX-9. The consequences to cost, schedule, and performance to the NGJ-MB program give high confidence that fleet aviation squadrons should not be tasked to perform OT&E. VX-9 should be properly resourced, funded, and supported by the Navy to assess the operational effectiveness and suitability of the NGJ-MB pod.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

This research was narrow in scope with the program complexity and type. Some recommended areas for further research include:

How does fleet OT&E affect other program types, including kinetic weapons or software-intensive?

Can fleet OT&E satisfy smaller ACAT programs sufficiently?

Does a hardware- or software-intensive program make it easier or harder to execute fleet OT&E?

How does the Air Force conduct OT&E? Can the Navy learn to make their OT&E more efficient for Naval Aviation based on how the Air Force does it?

What policies, laws, and procedures need to change to have OT&E be effectively conducted by the fleet aviation squadron?

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APPENDIX A. ACQUISITION CATEGORY (ACAT)

ACAT		
ACAT I	• MDAP[1] (Section 2430 of Title 10, U.S.C.) ○ Dollar value for all increments of the program: estimated by the DAE to require an eventual total expenditure for research, development, and test and evaluation of more than $525 million in Fiscal Year (FY) 2020 constant dollars or, for procurement, of more than $3.065 billion in FY 2020 constant dollars ○ MDA designation • MDA designation as special interest[3]	ACAT ID: DAE ACAT IB: SAE[2] ACAT IC: Head of the DoD Component or, if delegated, the CAE
ACAT II	• Does not meet criteria for ACAT I • Major system (Section 2302d of Title 10, U.S.C.) ○ Dollar value: estimated by the DoD Component head to require an eventual total expenditure for research, development, and test and evaluation of more than $200 million in FY 2020 constant dollars, or for procurement of more than $920 million in FY 2020 constant dollars ○ MDA designation (Section 2302 of Title 10, U.S.C.)	CAE or the individual designated by the CAE[4]
ACAT III	• Does not meet dollar value thresholds for ACAT II or above • Is not designated a "major system" by the MDA	Designated by the CAE[4]

1. Unless designated an MDAP by the Secretary of Defense (SecDef), AIS programs[5], Defense Business System programs, and programs or projects carried out using rapid prototyping or fielding procedures pursuant to Section 804 of Public Law (PL) 114-92, do not meet the definition of an MDAP.

2. ACAT IB decision authority is assigned pursuant to Section 2430 of Title 10, U.S.C. Paragraph 3A.2.b. provides DoD implementation details.

3. The Special Interest designation is typically based on one or more of the following factors: technological complexity; congressional interest; a large commitment of resources; or the program is critical to the achievement of a capability or set of capabilities, part of a system of systems, or a joint program. Programs that already meet the MDAP thresholds cannot be designated as Special Interest.

4. As delegated by the SecDef or Secretary of the Military Department.

Footnotes

5. An AIS is a system of computer hardware, computer software, data or telecommunications that performs functions such as collecting, processing, storing, transmitting, and displaying information. Excluded are computer resources, both hardware and software, that are: embedded as an integral part of a weapon or weapon system; used for highly sensitive classified programs (as determined by the SecDef) or other highly sensitive information technology programs (as determined by the DoD Chief Information Officer; or determined by the DAE or designee to be better overseen as a non-AIS program (e.g., a program with a low ratio of research, development, testing, and evaluation funding to total program acquisition costs or that requires significant hardware development). An AIS that breaches the dollar thresholds in Section 2302d of Title 10, U.S.C., as adjusted, is a "major system."

Source: Defense Acquisition Visiblity Environment (2022).

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APPENDIX B. COMPARISON OF DEVELOPMENTAL TEST AND EVALUATION AND OPERATIONAL TEST AND EVALUATION

How Tests are Conducted	
DT&E testing is generally conducted: • In a controlled environment that minimizes the chance that unknown or unmeasured variables will affect system performance • By technical personnel skilled at "tweaking" to maximize performance • Against simulated threats tailored to demonstrate various aspects of specified system technical performance.	OT&E testing is generally conducted: • In an operationally realistic environment (e.g., high seas, temperature extremes, high density electromagnetic environments) under conditions simulating combat stress and peacetime conditions • With Fleet operators and maintenance personnel • Against threats which replicate, as closely as possible, the spectrum of operational characters • Using Fleet tactics.
Testing Subject/Topic	
DT&E is focused on evaluating the technical parameters of the weapon or system.	OT&E tests the performance of the SUT in the execution of a set of critical mission tasks. This generally puts the SUT into a larger SoS needed to deliver a required warfighting capability.
Evaluation Criteria	
DT&E – Technical criteria are measured to verify that the SUT performance meets its specification requirements.	OT&E – is focused on validating the contribution of the SUT to the CNO-specified warfighting requirements using a relevant fleet mission context and threat environment.
Measurement and Frequency	
DT&E • The tester generally knows what he/she wants to measure (some particular parameter: launch velocity; the number of *g's* pulled as the missile acquires; time to climb; etc.). • DT&E tests are structured to hold many things constant, isolate others, and allow measurement of one or two parameters of interest. • Special instrumentation is often installed to capture required data.	OT&E • An objective is to create conditions that replicate combat as closely as possible. • Using actual Fleet platforms in complex, time-compressed test events with high costs generally precludes an incremental experiment and test approach. • While every effort is made to identify the root cause of deficiencies, OT&E may not have the time or resources necessary to collect the data needed to isolate the cause of a failure. It is generally more important for OT&E to ensure that as many possible failure modes are identified prior to Fleet release.
General Note: Data collection instrumentation used for DT should be examined to determine applicability and use during OT&E. Additionally, data acquired during DT should be reviewed for use during OT&E.	

Source: Commander, Operational Test Force (2020).

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APPENDIX C. AIR COMBAT TRAINING CURRICULUM FLIGHT TRAINING TO TASK MAPPING PAGE

ACTC to Task Mapping Page

ACTC EVENT	ACTC MISSION TITLE	T&R TASKS ACCOMPLISHED
ACTC LEVEL 2		
2.1S	Section SEAD Medium	C2W 203
2.2S	EWCAS	ASU 203
2.3S	Counter targeting	C2W 208
2.4S	Surface Warfare: Localization and Neutralization	ASU201, ASU 202
2.5S	Battle Mangement	C2W 210
2.6S	Tactical Intercepts	AAW 208
2.1	Perch BFM	AAW 203
2.2	High Aspect BFM	AAW 204
2.3	2 v Unknown	AAW 206
2.4	Surface-to-Air Counter Tactics	STW 202
2.5	Section SEAD / Medium	C2W 203
2.6	Section SEAD / Low	C2W 202
2.7	EWCAS / CSAR	ASU 203, STW 206
2.8	Surface Warfare: Localization and Neutralization	ASU201, ASU 202
ACTC LEVEL 3		
3.1S	Tactical Intercepts	AAW 208
3.2S	Surface Warfare: Localization and Neutralization	ASU201, ASU 202
3.3S	Counter targeting	C2W 208
3.4S	Section EWCAS	MOB 209, ASU 203
3.5S	Section SEAD / Medium	C2W 203
3.1	Perch BFM	AAW 203
3.2	High Aspect BFM	AAW 204
3.3	2 v Unknown	AAW 206
3.4	Surface-to-Air Counter Tactics	STW 202
3.5	Section SEAD / Medium	C2W 203
3.6	Night Section SEAD	MOB 210, C2W 203
3.7	Section EWCAS	MOB 209, ASU 203
3.8	Surface Warfare: Localization and Neutralization	ASU201, ASU 202
3.9	LFE STAN EVAL	STW 205
ACTC LEVEL 4		
4.1	LFE	STW 205
4.2	2 v Unknown	AAW 206
4.3	LFE STAN EVAL	STW 205, MOB 206

Source: Commander, Electronic Attack Wing Pacific (2015).

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APPENDIX D. EA-18G FLEET REPLACEMENT SQUADRON BASELINE (CAT 1) PILOT/EWO

EA-18G FRS BASELINE (CAT I) PILOT

MSN	MISSION TITLE	T&R EQUIVALENT
FFAM 101-P	Day Aerobatics	MOB 201
FFAM 102-P	Instrument Round Robin	MOB 201
FFAM 103-P	Instrument Round Robin	MOB 201
FFAM 104-P	Proficiency Check	MOB 201
FFAM 105-P	Solo	MOB 201
FFAM 106-P	FCLP Introduction	MOB 202
FFAM 107-P	Night Fam / Instrument Prog Ck	MOB 201, MOB 210
FFRM 101-P	Day Section Formation	MOB 209
FFRM 102-P	Night Section Formation	MOB 209, MOB 210
FFRM 103-P	Day Division Formation	MOB 208
FFRM 104-P	Night Division Formation	MOB 208, MOB 210
FAWI 101-P	Forward Quarter Intercepts I	AAW 208
FAWI 102-P	Night Intercepts	MOB 210, AAW 208
FAWI 103-P	Forward Quarter Intercepts II	AAW 208
FLAT 101-P	LL Intro/Sys Mgmt	STW 204
FLAT 102-P	Section LL	MOB 209, STW 204
FLAT 103-P	LATT/SACT	STW 202, STW 204
FSTK 102-P	Night Radar / HATA	MOB 210
FBFM 101-P	1 V 0 Advanced Handling Characteristics	MOB 201
FBFM 102-P	Scissors Maneuvering	AAW 204
FBFM 103-P	BFMC 1	AAW 204
FBFM 104-P	BFMC 2	AAW 203
FBFM 105-P	BFMC 3	AAW 203
FFWT 104-P	2 V 1 Section Engaged Maneuv/Pop Group	AAW 208, AAW 212
FFWT 105-P	2 V 2 Maneuvering Targets	AAW 208, MOB 209
FFWT 106-P	2 V 2 Into to Multi Group	AAW 208, MOB 209
FFWT 107-P	2 V 2 Reattack Mech	AAW 208, MOB 209
FFWT 108-P	2 V 2 Section Delouse	AAW 208, AAW 212
FAEA 112-P	Defensive Maneuvers	STW 202
FSFT 101-P	Receiver (6 Day plugs)	MOB 204
FSFT 102-P	Receiver (6 Night plugs)	MOB 204, MOB 210
FSFT 103-P	NVG Familiarization	MOB 201, MOB 211
FAEA 101-P	ES/C3I Mission	MOB 201
FAEA 102-P	Radar EA	C2W 201, MOB 209
FAEA 103-P	HARM	C2W 201, C2W 211
FAEA 104-P	MIDS/Link-16 Coordination/CCS	C2W 201, C2W 211, C2W 214, MOB 209
FAEA 105-P	Maritime Air Strike/SSC	ASU 201, ASU 202, MOB 209
FAEA 106-P	Section SEAD Employment I (SOY Profile / PP HARM)	C2W 201, C2W 211, MOB 209
FAEA 107-P	Section SEAD Employment II (Mod-Escort / Reactive HARM)	C2W 201, C2W 211, MOB 209
FAEA 108-P	Grad Flight 1 - EW/CEI/Comms EA	C2W 201, C2W 211, C2W 214
FAEA 109-P	Grad Flight 2 - SEAD SOJ	C2W 201, C2W 211, MOB 209
FAEA 110-P	Grad Flight 3 - SEAD Mod-Escort	C2W 201, C2W 211, MOB 209
FAEA 111-P	Grad Flight 4 - EW/CAS/RSEAD	C2W 201, C2W 211, MOB 209
FCQL 101-P	FCLP (Day)	MOB 202
FCQL 102-P	FCLP (Night)	MOB 202, MOB 210
FCQL 103-P	FCLP (Night)	MOB 202, MOB 210
FCQL 104-P	FCLP (Night)	MOB 202, MOB 210
FCQL 105-P	FCLP (Day)	MOB 202
FCQL 106-P	FCLP (Night)	MOB 202, MOB 210
FCQL 107-P	FCLP (Night)	MOB 202, MOB 210
FCQL 108-P	FCLP (Night)	MOB 202, MOB 210
FCQL 109-P	FCLP (Night)	MOB 202, MOB 210
FCQL 110-P	FCLP (Day)	MOB 202
FCQL 111-P	FCLP (Night)	MOB 202, MOB 210
FCQL 112-P	FCLP (Night) Case III	MOB 202, MOB 210
FCQL 113-P	FCLP (D) Degraded Approach	MOB 202
FCQL 114-P	FCLP (Night)	MOB 202, MOB 210
FCQL 115-P	FCLP (Night)	MOB 202, MOB 210
FCQL 116-P	FCLP (Day) Case I	MOB 202
FCQL 119-P	Day CQ	MOB 212
FCQL 120-P	Night CQ	MOB 213
FCQL 121-P	Day CQ	MOB 212
FCQL 122-P	Night CQ	MOB 213
SIMULATORS		
SFAM 112-P	Complex EP review	AAW101
SFAM 117-P	NATOPS Check	MOB 205, MOB 206
SFAM 114-P	NATOPS Instrument Check	MOB 207
SEA 104-P	ES/C3I Mission	C2W 201
SEA 105-P	Jammer Assignments/Adjustments	C2W 213
SEA 106-P	Radar EA	C2W 213
SEA 108-P	HARM Employment	C2W 201, C2W 211
SEA 111-P	Comms EA	C2W 201, C2W 214
SEA 114-P	Countertargeting/ASMD	C2W 208
SEA 115-P	RSEAD/EW CAS	STW 207, C2W 211
SEA 116-P	Grad Sim 1 - Sequential SEAD Rollback (SEAD SOJ)	C2W 201, C2W 211
SEA 117-P	Grad Sim 2 - Power Projection 1 (SEAD Mod-Escort 1)	C2W 201, C2W 211
SEA 118-P	Grad Sim 3 - Power Projection 2 (SEAD Mod-Escort 2)	C2W 201, C2W 211

TASK LIST	TASK NAME	# OF TIMES
MOB 201	AIRWAYS NAVIGATION	7
MOB 202	FCLP	16
MOB 203	INFLIGHT REFUELING (ORGANIC)	0
MOB 204	INFLIGHT REFUELING (NON-ORGANIC)	2
MOB 205	NATOPS CHECK*	1
MOB 206	ACT CHECK*	1
MOB 207	INSTRUMENT CHECK*	1
MOB 208	DIVISION FLIGHT	2
MOB 209	SECTION FLIGHT	14
MOB 210	NON-NVD NIGHT FLIGHT	15
MOB 211	NVD FLIGHT*	1
MOB 212	DAY CQ / EMBARKED OPERATIONS	2
MOB 213	NIGHT CQ / EMBARKED OPERATIONS	2
MOB 214	FAM / EP	1
AAW 201	AACT - 1	2
AAW 202	AACT - 2	2
AAW 203	A/A BASIC THREAT*	0
AAW 204	A/A ADVANCED THREAT*	0
AAW 205	TACINT*	7
AAW 206	COUNTER EA*	0
AAW 207	SECTION A/A COUNTERTACTICS*	2
AAW 208	VID	0
ASU 201	MARITIME EMPLOYMENT (LOCALIZATION)*	1
ASU 202	MARITIME EMPLOYMENT (NEUTRALIZATION)*	1
C2W 201	SEAD MEDIUM*	9
C2W 202	SEAD LOW*	0
C2W 203	COMMS EA FLIGHT*	1
C2W 204	NTISR / DT	0
C2W 205	NONKINETIC FORCE SUPPORT/CTTG*	1
C2W 206	EW RANGE FLIGHT	0
C2W 207	AEA MECH FLIGHT	2
C2W 208	ARM / CATM FLIGHT	14
C2W 209	EA AIR SERVICES / OPFOR	0
STW 201	SACT*	2
STW 202	REACTIVE SEAD	1
STW 203	LOW LEVEL*	2
STW 204	CSAR	0
STW 205	COORDINATED / CVW / JOINT STRIKE	0

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EA-18G FRS BASELINE (CAT I) EWO

MSN	MISSION TITLE	T&R EQUIVALENT
FFAM 101-E	Day Aerobatics/LL	STW 204
FFAM 102-E	Instrument Round Robin	MOB 201
FFAM 103-E	Flying Characteristics	MOB 201
FFAM 105-E	Crew Solo	MOB 201
FFAM 107-E	Night Fam / Instrument Prog Ck	MOB 201, MOB 210
FFRM 101-E	Day Section Formation	MOB 209
FFRM 102-E	Night Section Formation	MOB 209, MOB 210
FAWI 103-E	Forward Quarter Intercepts I	AAW 208
FAWI 104-E	Night Intercepts	AAW 208, MOB 210
FAWI 105-E	Forward Quarter Intercepts II	AAW 208
FLAT 102-E	Section LL	MOB 209, STW 204
FLAT 103-E	LATT/SACT	STW 202, STW 204
FSTK 101-E	Night Radar / HATA	MOB 105, MOB 112, C2W 210
FBFM 101-E	1 V 0 Advanced Handling Characteristics	MOB 201
FBFM 103-E	BFMC 1	AAW 204
FBFM 104-E	BFMC 2	AAW 203
FBFM 105-E	BFMC 3	AAW 203
FFWT 104-E	2 V 1 Section Engaged Maneuv/Pop Group	AAW 208, AAW 212
FFWT 105-E	2 V 2 Maneuvering Targets	AAW 208
FFWT 106-E	2 V 2 Into to Multi Group	AAW 208
FFWT 107-E	2 V 2 Reattack Mech	AAW 208
FFWT 108-E	2 V 2 Section Delouse	AAW 208
FAEA 112-E	Defensive Maneuvers	STW 202
FSFT 103-E	NVG Familiarization	MOB 201, MOB 211
FEA 101-E	ES/C3I Mission	MOB 201
FEA 102-E	Radar EA	C2W 201, MOB 209
FEA 103-E	HARM	C2W 201, C2W 211
FEA 104-E	MIDS/Link-16 Coordination/CCS	C2W 201, C2W 211, C2W 214, MOB 209
FEA 105-E	Maritime Air Strike/SSC	ASU 201, ASU 202, MOB 209
FEA 106-E	Section SEAD Employment I (SOY Profile / PP HARM)	C2W 201, C2W 211, MOB 209
FEA 107-E	Section SEAD Employment II (Mod-Escort / Reactive HARM)	C2W 201, C2W 211, MOB 209
FEA 108-E	Grad Flight 1 - EW/CEI/Comms EA	C2W 201, C2W 211, C2W 214
FEA 109-E	Grad Flight 2 - SEAD SOJ	C2W 201, C2W 211, MOB 209
FEA 110-E	Grad Flight 3 - SEAD Mod-Escort	C2W 201, C2W 211, MOB 209
FEA 111-E	Grad Flight 4 - EW/CAS/RSEAD	C2W 201, C2W 211, MOB 209
FCQL 101-E	FCLP (Day)	MOB 202
FCQL 102-E	FCLP (Night)	MOB 202, MOB 210
FCQL 103-E	FCLP (Night)	MOB 202, MOB 210
FCQL 104-E	FCLP (Night)	MOB 202, MOB 210
FCQL 105-E	FCLP (Day)	MOB 202
FCQL 106-E	FCLP (Night)	MOB 202, MOB 210
FCQL 107-E	FCLP (Night)	MOB 202, MOB 210
FCQL 108-E	FCLP (Night)	MOB 202, MOB 210
FCQL 109-E	FCLP (Night)	MOB 202, MOB 210
FCQL 110-E	FCLP (Day)	MOB 202
FCQL 111-E	FCLP (Night)	MOB 202, MOB 210
FCQL 112-E	FCLP (Night) Case III	MOB 202, MOB 210
FCQL 113-E	FCLP (D) Degraded Approach	MOB 202
FCQL 114-E	FCLP (Night)	MOB 202, MOB 210
FCQL 115-E	FCLP (Night)	MOB 202, MOB 210
FCQL 116-E	FCLP (Day) Case I	MOB 202
FCQL 119-E	Day CQ	MOB 203
FCQL 120-E	Night CQ	MOB 213
FCQL 121-E	Day CQ	MOB 203
FCQL 122-E	Night CQ	MOB 213
SIMULATORS		
SFAM 112-P	Complex EP review	AAW101
SFAM 110-E	NATOPS Check	MOB 205, MOB 206
SFAM 112-E	NATOPS Instrument Check	MOB 207
SEA 104-E	ES/C3I Mission	C2W 201
SEA 105-E	Jammer Assignments/Adjustments	C2W 213
SEA 106-E	Radar EA	C2W 213
SEA 108-E	HARM Employment	C2W 201, C2W 211
SEA 111-E	Comms EA	C2W 201, C2W 213
SEA 114-E	Countertargeting/ASMD	C2W 208
SEA 115-E	RSEAD/EW CAS	STW 207, C2W 211
SEA 116-E	Grad Sim 1 - Sequential SEAD Rollback (SEAD SOJ)	C2W 201, C2W 211
SEA 117-E	Grad Sim 2 - Power Projection 1 (SEAD Mod-Escort 1)	C2W 201, C2W 211
SEA 118-E	Grad Sim 3 - Power Projection 2 (SEAD Mod-Escort 2)	C2W 201, C2W 211

TASK LIST	TASK NAME	# OF TIMES
MOB 201	AIRWAYS NAVIGATION	7
MOB 202	FCLP	16
MOB 203	INFLIGHT REFUELING (ORGANIC)	0
MOB 204	INFLIGHT REFUELING (NON-ORGANIC)	0
MOB 205	NATOPS CHECK*	1
MOB 206	ACT CHECK*	1
MOB 207	INSTRUMENT CHECK*	1
MOB 208	DIVISION FLIGHT	0
MOB 209	SECTION FLIGHT	10
MOB 210	NON-NVD NIGHT FLIGHT	14
MOB 211	NVD FLIGHT*	1
MOB 212	DAY CQ / EMBARKED OPERATIONS	2
MOB 213	NIGHT CQ / EMBARKED OPERATIONS	2
MOB 214	FAM/EP*	1
AAW 201	AACT - 1	1
AAW 202	AACT - 2	2
AAW 203	A/A BASIC THREAT*	0
AAW 204	A/A ADVANCED THREAT*	0
AAW 205	TACINT*	8
AAW 206	COUNTER EA*	0
AAW 207	SECTION A/A COUNTERTACTICS*	1
ASU 201	MARITIME EMPLOYMENT (LOCALIZATION)*	1
ASU 202	MARITIME EMPLOYMENT (NEUTRALIZATION)*	1
C2W 201	SEAD MEDIUM*	15
C2W 202	SEAD LOW*	0
C2W 203	COMMS EA FLIGHT*	1
C2W 204	NTISR / DT	1
C2W 205	NONKINETIC FORCE SUPPORT/CTTG*	1
C2W 206	EW RANGE FLIGHT	0
C2W 207	AEA MECH FLIGHT	3
C2W 208	ARM / CATM FLIGHT	13
C2W 209	EA AIR SERVICES / OPFOR	0
STW 201	SACT*	2
STW 202	REACTIVE SEAD	1
STW 203	LOW LEVEL*	3
STW 204	CSAR	0
STW 205	COORDINATED / CVW / JOINT STRIKE	0

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Source: Commander, Electronic Attack Wing Pacific (2015).

APPENDIX E. OPERATIONAL TEST DIRECTOR RESPONSIBILITIES DURING TEST

4.3 OTD RESPONSIBILITIES DURING TESTING

The OTD should ensure:

- Tests are conducted per the approved test plan and supporting documentation such as the LOI or OPTASK. In addition to the pre-test brief, the OTD should conduct test briefs, as required, during testing to ensure test personnel and Adjunct Testers:
  - Understand their responsibilities with respect to data collection and control.
  - Know the critical tasks, measures, and data supporting those tasks and measures.
  - Understand the daily testing battle rhythm and the expectations for how and when to communicate with the OTD.
  - Immediately communicate any safety issues and any other issues preventing the proper collection of data supporting critical measures.
  - Are encouraged to identify potential deficiencies as they become known and draft Blue and Gold sheets on site during test. While a complete draft Blue or Gold sheet may be difficult to create, identifying the issue, the conditions under which the issue occurs, and the issue's impact on the mission should be encouraged.
- The OTD test narrative (see below) is maintained as a running account of how testing actually occurred. When in doubt, write it down!

CAUTION

Training and expecting all members of the test team to "write everything down" cannot be over-emphasized. Many post-test processes have been negatively impacted because the team could not remember "what" happened or "why" it happened several months ago while on test. Even seemingly trivial bits of data such as a 5 degree course change or an aircraft descent of 250 feet may be important during later data analysis. Data sheets cover all anticipated data requirements, but the unanticipated data requirements can be equally important. **Write everything down!**

Source: Commander, Operational Test Force (2020).

- Any deviations from the test plan or LOI are noted, their impact assessed, corrective action taken, and contingency plans implemented, as necessary. Unusual events during testing that may have some effect on test results should be noted. Be prepared to alter the test schedule if circumstances warrant, keeping the division/squadron leadership informed. For DOT&E Oversight programs, the OT plan has specific direction on deviations from the approved plan. The OTD will notify the ACOS/Squadron CO of any deviations from the approved test plan as soon as possible.
- The ACOS/Squadron CO is advised of any potential deficiencies that could result in a COI being unresolved or resolved unsatisfactorily. As test events and data collection progresses during test, and analysis indicates potential deficiencies with collected critical measures, the OTD should provide draft Blue and Gold sheets to division or squadron leadership.

OTDs may use scoring boards during test, referencing the conditions described in the test plan, to ensure the data were correctly collected and to make a quicker transition to the post-test process. Scoring boards on test also support investigating and accurately describing system failures or faults. While participation in a scoring board may be open to a wide audience, the independent assessment and characterization of any specific failure or fault as an Operational Mission Failure/Fault (OMF) and the association of the OMF to the SUT or SoS is the sole responsibility of the OTD and the OT team. See the Post Test Iterative Process (PTIP) Handbook for scoring board guidance.

Source: Commander, Operational Test Force (2020).

APPENDIX F. SUMMARY OF THE FLIGHT CLEARANCE PROCESS (NAVAL AIR SYSTEMS COMMAND)

Process Step	Responsible Party	Process Duties
Planning	APMSE and/or IPT Lead	Initiate planning; provide info about proposed flight clearance to all stakeholders, including TYCOM or applicable ACCs, or Program Office (in the case of CAS); determine flight clearance strategy (Interim Flight Clearance (IFC), Permanent Flight Clearance (PFC)); advise on existing data; come to consensus with Technical Area Experts (TAEs) on data requirements; document planning agreements (including Engineering Data Requirements Agreement Plan (EDRAP)); obtain supporting data prior to request; reinitiate additional planning as needed
	TYCOM, ACCs, or Contracting Program Office (in the case of CAS)	Coordinate requirements with APMSE; concur with flight clearance request resulting from planning activity
	National Airworthiness Team (NAT) Naval Air Systems Command Airworthiness and CYBERSAFE Directorate (AIR-4.0P)	Provide planning chop sheet; attend planning meeting and provide strategy and assessment guidance; update planning chop sheet as needed
	TAEs	Participate in planning activities; assess proposed flight clearance; provide necessary testing and/or data requirements, communicate technical risks and potential mitigations
	Deputy Warrant Officers	Empower TAEs for subject technical areas
	Test Team	Participate in planning activities; provide data

Source: Naval Air Systems Command (2016).

Process Step	Responsible Party	Process Duties
		and/or input, coordinate the development of test risk mitigations
Request	APMSE and/or IPT	Submit or cancel requests (with TYCOM, ACC, or Program Office (in the case of CAS) concurrence); determine need date; provide input for Test Clearance requests
	TYCOM, ACCs or Program Offices (in the case of CAS)	Submit requests or provide concurrence with requests; provide need dates; cancel requests if no longer needed
	NAT (AIR-4.0P)	Receive all flight clearance requests; deny requests if content not acceptable
	TAEs	Submit recommendations for changes to existing flight clearances
	Test Wing	Submit requests and/or cancel requests for ACC COMNAVAIRSYSCOM (AIR-5.0D) aircraft
	Fleet Squadrons and Units	Communicates flight clearance needs with TYCOM and/or applicable ACC for coordination with NAT (AIR-4.0P)
Scope of Review	APMSE and/or IPT	Recommend required reviewers
	Facilitators	Determine specific TAEs based on approved chop sheet
	NAT (AIR-4.0P)	Review request; determine required reviewers; create chop sheet
Review	APMSE and/or IPT	"First in" to review; develop draft clearance content; assess program and system safety risks; work disagreements up applicable NAVAIR chain of command; "last out" to review before Finalize Flight Clearance phase
	Facilitators	Format draft clearance
	NAT (AIR-4.0P)	Assist in reconciling review conflicts
	TAEs	Review draft clearance; provide timely input; approve, disapprove, or determine chop not required, and identify system safety risk for empowered technical area
	Deputy Warrant Officers	Prioritize workload for TAEs; reconcile TAE-IPT flight clearance content disagreements
Finalize Flight Clearance	NAT (AIR-4.0P)	Provide comprehensive engineering review of final clearance; ensure all required chops are completed, TAE comments are adjudicated, and system safety risks are clearly documented; ensure system safety risks are accepted at the appropriate level and/or mitigated via appropriate limits, procedures, warnings, cautions and notes; ensure clearance is coherent and executable
Release Flight	TYCOM, ACCs or Program Offices	Readdress flight clearance as required to subordinate activities for action
Clearance	(in the case of CAS)	
	NAT (AIR-4.0P)	Issue or deny flight clearance and post to website

Source: Naval Air Systems Command (2016).

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