THE AIR RESERVE COMPONENT'S IMPACT ON MODERNIZING LEGACY AIRCRAFT TO COMPLEMENT THE ADVANCED BATTLE MANAGEMENT SYSTEM: KC-135 RTIC AND THE GLADIATOR POD

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David Rodriguez, Major, USAF
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DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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David Rodriguez, MS

Major, USAF

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David Rodriguez, MS
Major, USAF

Committee Membership:

Dr. William Cunningham, Ph.D.
Chair

Abstract

This research project explores the ARC and AMC collaborative efforts to rapidly prototype, field, and fund KC-135 Real Time Information in the Cockpit (RTIC) and High Value Airborne Asset (HVAA) GLADIATOR pods. With the need for rapid prototyping and rapid fielding to compete against China's technological wave, this study focuses on the ARC's impact on modernizing the KC-135 with RTIC and pods to complement the Advanced Battle Management System (ABMS). Through content analysis methodology and NVivo software, interviews from subject-matter-experts and literature were analyzed for themes and sentiment relating to the ARC, AMC, the National Guard and Reserve Equipment Appropriations (NGREA), KC-135 RTIC, and HVAA GLADIATOR pods. Overall, seven actionable recommendations were produced for AMC, NGB, AFRC, and AFLCMC to review.

Acknowledgements

I would like to sincerely thank my faculty chair, Dr. William Cunningham, for his outstanding support through this academic journey. At the same time, I would like to express my sincere gratitude to Col Joseph "Jacko" M. Vanoni for sponsoring this research and providing the crucial support. Furthermore, I also want to recognize Lt Col Jeffrey "Padre" Gould for providing the critical data behind the ARC's efforts for modernizing the KC-135 with RTIC and the GLADIATOR pod. Finally, I want to thank all the experts for partaking in this research project.

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THE AIR RESERVE COMPONENT'S IMPACT ON MODERNIZING LEGACY AIRCRAFT TO COMPLEMENT THE ADVANCED BATTLE MANAGEMENT SYSTEM: KC-135 RTIC AND THE GLADIATOR POD

I. Introduction

Background

The 2018 National Defense Strategy (NDS) highlights that the United States is "…emerging from a period of strategic atrophy…", a clear admission of the decline of American military might (Mattis, 2018). General Mattis' acknowledgment underscores the end of an era of uncontested American dominance. This revelation has become more evident by the recent emboldened "…acts of great powers and aspiring great powers…" seizing the advantage of America's geopolitical overreach, political dysfunction, and budget restraints that have stymied its longstanding military edge (Kagan, 2021). The recent aggression against American national interests has been Russia's illegal annexation of Crimea, Russia's massive military buildup at the Ukrainian and Crimean borders, China's unlawful claims and militarization of the Paracel and Spratly island chains in the South China Sea, and China's consistent violations of Taiwan's sovereignty (Grant, 2015; Roth, 2021; Shinkman, 2021; *South China Sea Dispute: China's Pursuit of Resources "Unlawful", Says US - BBC News*, 2020). Based on these ongoing threats by adversarial nations, the United States finds itself in an intensified race for military technological advancements to counter and deter those real-world threats (Kagan, 2021; Mattis, 2018).

With the growing instabilities worldwide Combatant Commanders now rely more on the Air Reserve Component (ARC) to alleviate shortfalls and execute operational missions. This

reliance consequently stems from the tragedies of September 11, 2001, a pivotal point in American history that catapulted the ARC from a traditional reserve force to an expeditionary one. With over twenty years of ARC operational support, the active component's dependence is a seismic shift from the old Cold War mindset of a traditional reserve posture. Despite the cultural changes and stereotypes, the ARC has proven to be a valuable extension of the United States Air Force (USAF). This assertion has been evident with their continuous high-level execution in various large-scale operations like Operation Enduring Freedom, Operation Iraqi Freedom, and Operation Odyssey Dawn. Regardless of the historical contributions, modernizing the ARC forces is still problematic today.

In the meantime, while the USAF and the ARC are grappling with aging aircraft, China is making record-breaking military advancements while Russia is not too far behind with its latest Su-57 fifth-generation stealth fighter (Airforce Technology, 2021). Consequently, the need to rapidly modernize both the active and reserve components are critical to national security. However, the current acquisition framework is too slow and rigid to keep up with the adversarial competition. The USAF cannot reform this framework alone; it will require Congressional support to change the bureaucratic process.

Addressing bureaucracy, speed, change, and competition, the Chief of Staff of the Air Force (CSAF), General Charles Q. Brown, Jr., published his strategic action orders titled *Accelerate Change or Lose* in August 31, 2020 (Brown Jr., 2020). In his action orders, General Brown recognizes that the United States lives "…in a world that is driven by rapidly changing technology and an environment that includes aggressive and capable global competitors" (Brown Jr., 2020). Moreover, he discusses how all members of the USAF must understand their connection to the mission and how their contributions help facilitate competition (Brown Jr.,

2020). He also challenges his Airmen by expressing that through the acceleration of understanding their global competitors, specifically China and Russia, the USAF can drive competition and exploit their adversaries' vulnerabilities. General Brown was trying to convey that if the USAF fails to understand their adversaries, they will show up to the fight with the wrong capability, at the wrong place, and at the wrong time (Brown Jr., 2020).

Furthermore, General Brown supports the warfighter through his *Accelerate Change or Lose* policy. This study references the CSAF's policy to assess the existing relationship between the ARC and Air Mobility Command (AMC). Specifically, this research focuses on how that partnership moves the strategic ball forward to complement the Advanced Battle Management System (ABMS). At the same time, the question of whether AMC should broaden its scope and capitalize on the ARC's successes in incorporating rapid prototyping into acquisition is also addressed.

To understand how the ARC can rapidly prototype and field capabilities, in this study, the researcher methodically discusses the various measures used to equip the ARC and the controversial issues related to it. Specifically, the active component controls the ARC's equipment procurement, and consistently, the ARC criticizes that they receive a small portion of the Department of Defense (DoD)'s budget for aircraft modernization. The trend of ill-equipping the reserve component has been a heated debate for years, but with the renewed great power competition, the requirement to level the playing field has taken center stage. One powerful tool that continues to address the ARC's equipment shortage concerns is Congress' establishment of the National Guard and Reserve Equipment Appropriations (NGREA). NGREA is a detached procurement appropriation exclusively for the reserve components equipment needs (*National Guard Fiscal Law Guidebook*, 2019). Consequently, to win the next

future war will require the ARC to be adequately equipped and trained as their active counterparts.

Having the same equipment quality in terms of relevancy, compatibility, interoperability, modularity, and lethality is necessary for the ARC to operate in or near contested-degraded environments. NGREA has been a helpful tool for modernizing the ARC, but it is not the answer for long-term planning and sustainment. NGREA is unpredictable and highly vulnerable to political forces. Controversially, the Office of the Secretary of Defense (OSD) reprogrammed the Fiscal Year 2020 NGREA funds to finance the border wall without Congressional approval. With the inability to truly depend on NGREA, the ARC and AMC share an equal disadvantage in implementing the CSAF's *Accelerate Change or Lose* policy.

AMC has highlighted that using NGREA is highly effective for rapidly procuring and fielding commercial and government-off-the-shelf technologies, but past resolutions regarding sustainment responsibilities have complicated the relationship. For instance, in the Lead Command certification of the C-130H Real-Time Information in-the-Cockpit (RTIC) AF Form 1067-Control #AMC 09-093, Headquarters (HQ) AMC Configuration Control Board designated the following: "HQ NGB and HQ AFRC will be responsible for planning, coordinating, programming, and funding for all resources required for development, testing, production, installation, and life cycle management/support required for the RTIC configuration on all aircraft undergoing this modification" (AMC/A4, 2010). Thus, the ARC agreed to absorb the life cycle sustainment of the C-130H RTIC modification, which recently failed (NGB, 2021).

Unfortunately, the ARC's inability to sustain the C-130H RTIC program is a snapshot of their limitations. The sustainment collapse is not solely an ARC problem but an AMC issue too.

AMC's difficult task of balancing priorities of sustaining existing platforms while addressing new costly modernization initiatives is a real challenge. The purpose of this paper is to explore the extent to which the ARC and AMC collaborate to develop, test, field, and fund KC-135 RTIC and High-Value Airborne Asset (HVAA) GLADIATOR pods. With the need for rapid prototyping and rapid fielding to compete against China's and Russia's technological surge, this study focuses on the ARC's impact on modernizing the KC-135 with RTIC and HVAA GLADIATOR pods to complement ABMS.

More specifically, this study will highlight the challenges that need to be addressed for fielding and sustaining KC-135 RTIC and HVAA GLADIATOR pods for ABMS. A content analysis methodology with interviews will feature recommendations from subject-matter experts (SME) of the following organizations: AMC, Air Force Lifecycle Management Center (AFLCMC), Air Force Reserve Command (AFRC), and the National Guard Bureau (NGB). By exploring the ARC's use of NGREA to complement ABMS, RTIC, HVAA GLADIATOR pods, and the major stakeholders' priorities, it may reveal new measures that may improve rapid prototyping and rapid fielding to modernize legacy aircraft that can counter peer threats like China and Russia.

Gap in Literature

There is only one formal academic study written in 2002 that strictly concentrated on the modernization of the reserve component. The study titled, "The Transformation of Reserve Component (RC) Modernization: New Options for DoD?" (LTC Rick Alford, LTC Rafael O'Ferrall, Lt Col Carl Rehberg, 2002) was a National Security Fellowship paper written by four RC senior leaders. The research paper focused on all service agencies within the RC and

provided policy options that are still relevant today. Other sources which provide modernization efforts using NGREA are the annual financial report prepared by the DoD's Office of the Assistant Secretary of Defense for Readiness, the annual Weapons Systems Modernization Priorities published by the Air National Guard, and a 2007 report prepared by the Federal Research Division of the Library of Congress under an Interagency Agreement with the Commission on the National Guard and Reserves. However, despite the limited options to learn about NGREA, there is no formal study on the ARC's use of NGREA to modernize the KC-135 with RTIC and pods to complement ABMS. This research project collected NGREA and ARC modernization information from limited literature and through interviewing the NGB, AFRC, AMC, and AFLCMC.

Problem Statement

Decision-makers in the DoD and the USAF need to ensure that ABMS within the Combined Joint All Domain Command and Control (CJADC2) infrastructure succeeds for all the Services. Part of mission success is to expeditiously provide the right capability in the hands of the warfighter. Delivering enhanced communications and situational awareness is critical to winning any high-end conflict. In January 2008, AMC established the Advanced Situational Awareness and Countermeasures System Capabilities Development Document (ASACMS CDD) that created the requirement to develop situational awareness tools and defensive systems for the Mobility Air Force (MAF) (NGB, 2021). As a result, RTIC became one of the developments to deliver beyond-line-of-sight (BLOS) communications and battlespace situational awareness.

Currently, the ARC is in partnership with AMC to upgrade its KC-135 fleet with RTIC. However, the ARC claims that the RTIC baseline modification will not be adequate to fight a

war with a peer adversary. China and Russia have developed technologies that deny access to airspace, which hampers offensive, defensive, and mobility effectiveness. Therefore, to remain competitive, RTIC needs to evolve beyond the baseline level of Tactical Data Link (TDL). Ultimately, the ARC envisions RTIC to be the crew interface for all MAF aircraft.

To demonstrate the effectiveness of RTIC and HVAA GLADIATOR pods at different modification stages, the ARC has created an RTIC/HVAA GLADIATOR Strategic Roadmap that describes the importance of RTIC and GLADIATOR pods when comparing China's 2049 strategic goal of having a world-class military (Office of the Secretary of Defense, 2020). The roadmap illustrates that RTIC and GLADIATOR pod upgrades will allow MAF aircraft to operate closer to denied areas instead of the baseline configuration. Recognizing the need to operate at "…the same level of compatibility, survivability, lethality, mobility, and network connectivity as the Joint Force they are fighting alongside…", the ARC is pushing the envelope for legacy aircraft survivability through RTIC and GLADIATOR pods while attempting to complement the ABMS concept (Cook, 2019).

This topic is critical to explore because in the ARC A5/A8's opinion, AMC's strategic vision is not developed and limited to the Five Year Development Plan, consequently restricting their ability to solve the tanker survivability problem against China and Russia. Additionally, they claim AMC is consumed with parts obsolescence versus taking the risk to modernize its tanker fleet for the ever-growing peer threat. The balance of sustaining existing priorities with investing in new endeavors is the hot debate between the ARC and AMC.

Furthermore, NGREA is an essential source of procurement funding for the ARC. Although it has existed since 1981, the process of how it is used is still not widely understood by

AMC. This study helps bridge the gap in knowledge on the ARC's ability to incorporate rapid prototyping and rapid fielding to legacy platforms. The research topic examines the strengths and weaknesses of NGREA while attempting to modernize legacy aircraft with evolutionary systems like RTIC and GLADIATOR pods. So, a closer look at the relationships between AMC, the system program office managers (SPOs), and the ARC is crucial to learning who is responsible for funding sustainment, training, and maintenance for the lifecycle of the modification.

Purpose Statement

The purpose of this paper is to explore the ARC's impact on modernizing legacy aircraft for ABMS. The study centers on ABMS, rapid prototyping, rapid fielding, KC-135 RTIC, GLADIATOR pods, NGREA, and sustainment responsibilities. Rapid prototyping and rapid fielding are a niche the ARC has mastered for decades. This research project helps identify the advantages of those methods, the NGREA appropriation account's strengths, weaknesses, and how ARC modernization initiatives can benefit ABMS. Currently, the Planning, Programming, Budgeting, and Execution (PPBE) process for allocating resources is too slow to keep up with advancing technologies and adversarial technological surge.

From AMC's perspective, the ARC is an essential "operational force," but it has historically strained the relationship by not aligning priorities. For ABMS to succeed, communications need to improve, and priorities need to merge. The major challenge is how to balance sustaining existing priorities while trying to invest in new endeavors. The researcher touched a nerve with all parties by questioning the modernization disparities, priorities, funding policy, and sustainment responsibilities. This study provides the sentiment and perspective of

the subject-matter-experts (SME). A comprehensive literature review and detailed content analysis methodology with interviews feature recommendations from SMEs of the following organizations: AMC, AFLCMC, AFRC, and the NGB. Using this qualitative approach allows for a complete thematic analysis and an opportunity to explore findings that may not have been apparent to all parties.

Research Question

This study explores four investigative questions to aid in answering the research question.

Research Question: What impact will the ARC's use of NGREA have on the modernization of KC-135s for ABMS?

Investigative Questions:

1. What challenges need to be addressed to ensure RTIC and GLADIATOR pods on KC-135s are sustained for the modification's life cycle?
2. Since RTIC is a federated system and meant to be evolutionary, what are the limitations of NGREA?
3. What are the sentiments of NGREA only modifications to legacy aircraft?
4. What is the sentiment of AMC and the ARC collaborating for the modernization of MAF aircraft?

Assumptions

This research is based on three assumptions. The first assumption is that the inclusion criteria of the sample are suitable and, as a result, ensures that the participants have undergone the same or similar experience of the study (Wargo, 2015). The second assumption presumes the

participants have a genuine interest in this study and do not have any other intentions (Wargo, 2015). The final assumption is that the sample population and the general population will be similar, allowing for generalizable results (Vogt et al., 2014).

Limitations

This research is limited to unclassified and open-source information. The participant's memory of events, processes, feelings, and situations could be problematic (Wargo, 2015). Errors and mistakes from open source information regarding the relevant topics may exist. This research is limited to AMC, AFRC, NGB, and AFLCMC with addressing the following topics: ABMS, NGREA, KC-135 RTIC, and HVAA GLADIATOR pods. In addition, the narrow pool of SMEs and the limited time for research, contributed to a sample size of 15 participants.

Research Implications

The implications of this research could contribute the following:

- Establish a clear understanding to AMC about the Congressional limitations of NGREA funding capabilities and best utilize the capabilities within the total force.
- Establish a clear understanding of the ARC's sustainment capability and responsibility when using NGREA for modernization initiatives.
- Propose to AMC to consider using the ARC to lead in rapid prototyping and fielding before committing to investing in the entire fleet.
- Propose to AMC to establish a serious partnership with the ARC to learn about their best practices on operational testing capabilities, rapid prototyping and

fielding, and how they manage a robust industry network for quick modernization initiatives.

- Propose to AMC to provide a limited workforce (1-2 individuals) to support a Total Force Integration test detachment and ensure AMC's perspective is provided in future modernization efforts.
- Propose to AFLCMC, AMC, AFRC, and the NGB to develop a Tactical Data Link (TDL) SPO to manage all data link related parts, funding, and sustainment issues.

Research Overview

This research begins with an overview of the relevant literature that applies to the ABMS, NGREA, KC-135 RTIC, and HVAA GLADIATOR pods. Next, it will describe the literature review and content analysis methodology to include the meticulous process of acquiring primary data through interviewing. Through thematic analysis using NVivo software, the researcher will focus on discovering relationships that will assist in answering the research question. A conclusion will be formulated through the responses provided by the SMEs. Their assistance will help the DoD and Air Force leadership identify the best courses of action to maximize on the ARC's established rapid prototyping and rapid fielding best practices.

II. Literature Review

Chapter Overview

The purpose of this chapter is to establish an understanding of how the ARC and AMC prioritize and collaborate to modernize the KC-135 with RTIC and HVAA GLADIATOR pods for ABMS. This chapter begins with the description ABMS, then shifts to the funding policy of NGREA, followed by KC-135 RTIC, HVAA GLADIATOR Pods, and the ARC's RTIC/HVAA GLADIATOR Strategic Roadmap.

Advanced Battle Management System

In 2018, the USAF moved to cancel the E-8C Joint Surveillance Target Attack Radar System (JSTARS) recapitalization efforts to support a new command and control (C2) approach called ABMS (Uppal, 2020). ABMS is the United States Air Force's (USAF) approach to realizing the DoD's CJADC2 concept. CJADC2 is supposed to replace the existing C2 infrastructure with a digital capability "…that connects the existing sensors and shooters and distribute the available data to all domains (sea, air, land, cyber, and space) and forces that are part of the U.S. military" (*Joint All-Domain Command and Control (JADC2)*, 2020). Namely, the goal is to rapidly deliver critical information to target the enemy before the enemy can target the shooter through a digital network (Barnett, 2020). To pursue CJADC2 requires the USAF to construct a cloud-based digital design that enhances the speed of information sharing, situational awareness, and decision-making (*Advanced Battle Management System*, 2021).

ABMS utilizes a nontraditional DoD acquisitions methodology for onboarding, assessing, and incorporating new technologies that emulate DevSecOps (*Advanced Battle Management*

System, 2021; Chaillan, 2019). DevSecOps is "…an organizational software engineering culture and practice that aims at unifying software development (Dev), security (Sec), and operations (Ops)" (Chaillan, 2019). Furthermore, "DevSecOps is a cultural shift in the software industry that aims to bake security into the rapid-release cycles that are typical of modern application development and deployment…" (Constantin, 2020). Notably, the USAF is trying to counter its obsolete waterfall software approach that delivers upgrades every 3 to 10 years which impedes the ability to keep up with technology and adversarial competition (Chaillan, 2019).

2020 Government Accountability Office Findings

While the USAF has adopted ABMS's efficient DevSecOps approach, ABMS is not without problems. To demonstrate, the 2020 Government Accountability Office (GAO) report stated that the USAF took a nontraditional approach to construct a digital infrastructure through short-term endeavors that involved rapid fielding (GAO-20-389, 2020). Due to this methodology, ABMS requirements are susceptible to frequent changes as the development evolves (GAO-20-389, 2020). The report identified that the USAF had not designated the program as a major defense acquisition program, nor did it declare it a middle-tier acquisition program (GAO-20-389, 2020). Not to mention, the USAF initiated ABMS without critical elements of a business case like firm requirements, such as a plan to attain mature technologies, a cost estimate, and an affordability analysis (GAO-20-389, 2020).

Congressional Ramifications

The findings of the GAO report had congressional ramifications. Specifically, the ABMS program received $172 million through the fiscal year 2020, but the program suffered a severe budget cut when "…the 2021 spending bill passed by Congress and signed by President Donald

Trump Dec. 27 slashed the Air Force's ABMS budget in half: to $159 million from the requested $302 million" (Hitchens, 2021). The congressional report cited defects and "poor justification materials" (Hitchens, 2021). In response to the magnitude and impact of the budget cut, acting Air Force acquisition czar, Darlene Costello stated, "But the exact answer of how much of an effect, we don't have that yet…We're doing everything in our power to keep efforts going, because we believe…it's the right way to help design our future force" (Hitchens, 2021). Despite the consequences of the GAO report, the USAF is not deterred and is pushing forward with ABMS.

Equipping the ARC

Before discussing how the ARC complements ABMS, an understanding of the history, processes, and resources of how the ARC is equipped is imperative. There are three processes for equipping the ARC: Procurement Appropriations, Redistribution (Cascading), and Congressional Provisions, including NGREA and Directed Appropriations (Cook, 2019).

Procurement Appropriations

Procurement Appropriations is the first method of equipping the ARC. During Procurement Appropriations, the equipment purchasing determinations are governed by each parent Service (Cook, 2019). Since the ARC Chiefs cannot serve as the appropriation sponsor, their requests are presented by the active duty during the President's Budget (PRESBUD) submission (Cook, 2019). The PRESBUD signifies the combined active component and reserve component equipment requests for the DoD (Cook, 2019). According to the ARC, the current procurement structure creates an absence of representation and a lack of transparency in the

processes (see Figure 1). As a result, prioritizing ARC modernization occurs at the latter point of the fielding and funding cycles (see Figure 2) (Cook, 2019).

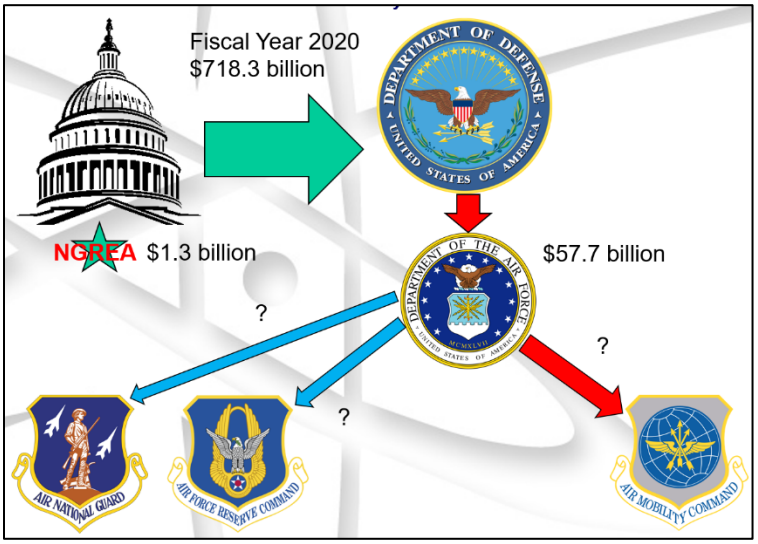

Figure 1. Procurement Appropriations Flow-Limited Transparency (Source: Author)

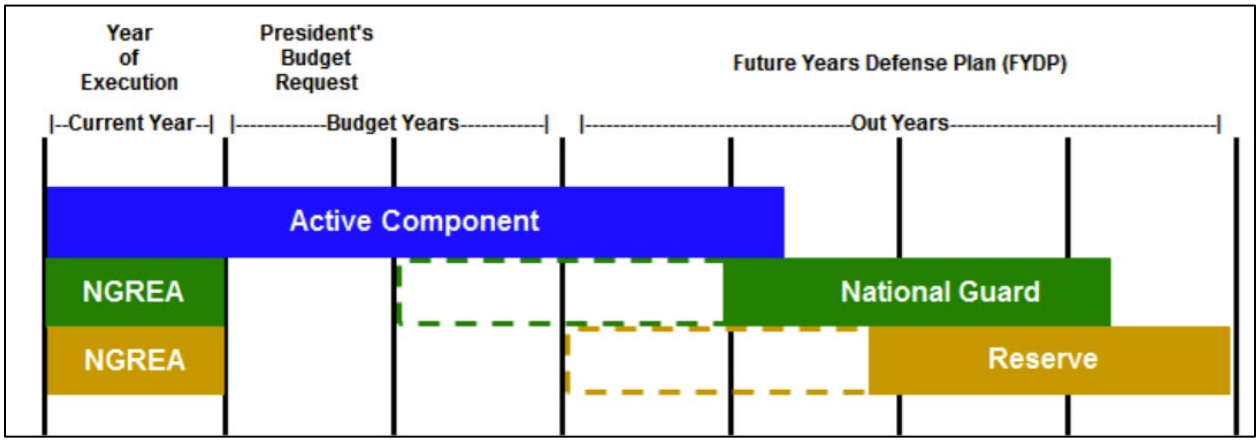

Figure 2. Conceptual Illustration of Reserve Component Equipping Trends-Procurement Prioritization (Cook, 2019)

Associated Problems

Critically, the ARC says transparency is still a serious problem impacting funding and procurement for modernization efforts (Cook, 2019). Although the combined effort for procuring equipment adds justification for Total Obligation Authority (TOA), the utilization of one procurement line for both the active duty and the ARC does not enable transparent tracking during execution (Cook, 2019). Moreover, a subset of the PRESBUD (P-1R) is for the ARC, but since this process is not binding, "…there is no requirement for the parent Service to account for adjustments to the P-1R once funds have been appropriated" (see Figure 3) (Cook, 2019).

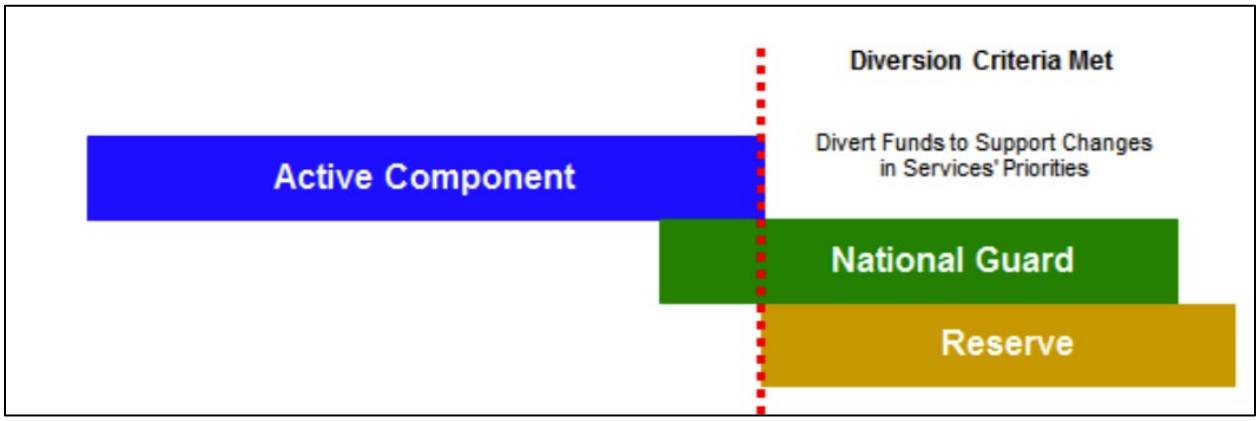

Figure 3. Conceptual Illustration of Reserve Component Equipping Trends- Procurement Appropriations and Reprogramming (Cook, 2019)

Redistribution (Cascading)

The second method of equipping the ARC is through redistribution. Redistribution or cascading is the act of the active component redistributing their older legacy platforms or equipment to the Guard or Reserve while obtaining new equipment in its place (see Figure 4) (Cook, 2019). Cascading older aircraft into the ARC and attempting to maintain aging systems creates many challenges, including compatibility and interoperability between the ARC and

active components (Cook, 2019). For example, cascaded aircraft are not maintained or logistically supported, making deployments and fleet management a serious problem. As a result, the ARC has advocated for modernizing "…in a concurrent and balanced manner" (Cook, 2019).

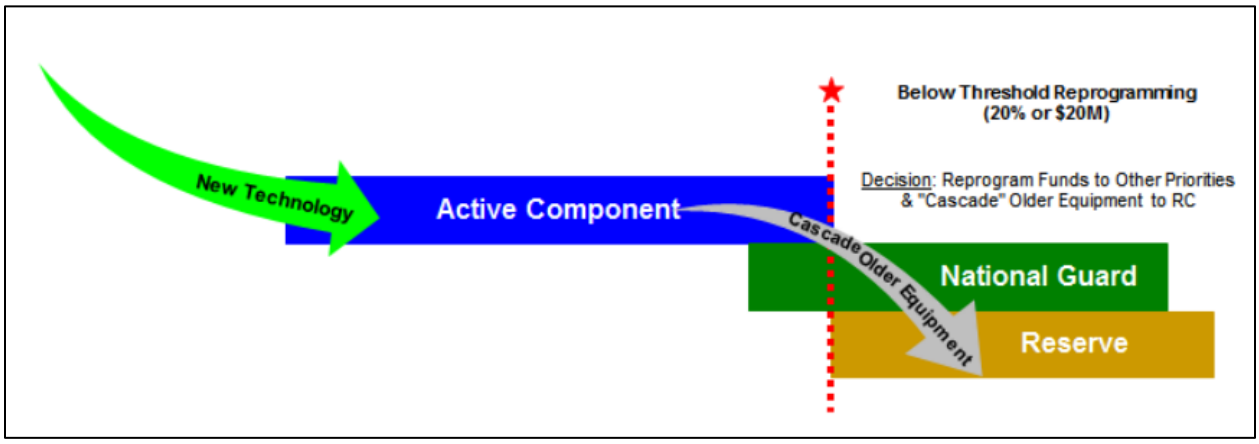

Figure 4. Equipment Redistribution Flow to the Reserve Component (Cook, 2019)

Congressional Provisions-NGREA

The third method for equipping the ARC is through congressional provisions like NGREA. Before diving into NGREA, a brief description of the annual defense appropriations act is essential. The annual defense appropriations act is segmented into nine sections called "Titles" (*NGB Fiscal Law Guidebook 2019*, 2019). Titles in the defense appropriation act are not the same as Titles inside the U.S. Code (i.e., Title 10) (*NGB Fiscal Law Guidebook 2019*, 2019). Within the defense appropriations, NGREA falls under Title III-Procurement (*NGB Fiscal Law Guidebook 2019*, 2019). NGREA is a separate appropriation outside of the normal DoD budgeting process. Congress created it in 1981 to focus on the equipment demands of the reserve component (NGB, 2021).

Idiosyncrasies of NGREA

In addition to describing the annual defense appropriations act is the importance of learning the idiosyncrasies of NGREA. First, the ARC cannot simply ask Congress for a specific amount of funding. Technically, anything the ARC requests is inside the PRESBUD P-1R covered by USAF procurement budgets. Secondly, NGREA is a lump sum of money divided amongst the reserve components (i.e., ARNG, ANG, USAR, USAFR, USNR, and USMCR). Interestingly, the actual language inside the bill is usually returned with the defense bill after Congress votes. Unfortunately, the ARC has to search for the allocation at the back of that budget. Once the allocation is discovered, the funds can be distributed for rapid prototyping and rapid fielding to commence.

Moreover, "NGREA is a special pot of money that is closely controlled and is tied to the NGREA "buy list" that is ultimately submitted to Congress" (*NGB Fiscal Law Guidebook 2019*, 2019). Surprisingly, the ARC answers directly to Congress and almost nobody in between. Next, the "buy list" channels through the Assistant Secretary of Defense for Reserve Affairs, and then to the House and Senate Armed Services Committees (HASC) and Senate and House Defense Appropriations Subcommittees (SASC) (*NGB Fiscal Law Guidebook 2019*, 2019). Lastly, the DoD Financial Management Regulation prohibits NGREA from being used for anything but what is on that "buy list."

Color of Money and Legal Limitations

Understanding the idiosyncrasies of NGREA provides the groundwork for discussing the color of money and its legal limitations. For the color of money, the fund citation for NGREA is 97*0350 (*NGB Fiscal Law Guidebook 2019*, 2019). The ARC does not receive organic Title IV-

Research, Development, Test, and Evaluation (RDT&E) appropriation or 57*3600 dollars (*NGB Fiscal Law Guidebook 2019*, 2019). So, it is imperative to understand that the ARC cannot use NGREA for RDT&E endeavors because it will violate the Purpose Statue and potentially create an Antideficiency Act violation (*NGB Fiscal Law Guidebook 2019*, 2019).

The Fiscal Year 2019 Allocations

For the Fiscal Year 2019, the reserve component received $1.3 billion in NGREA 97*0350 money to modernize its forces (*FY19 NGREA Memorandum from the Office of the Assistant Secretary of Defense*, 2019). More specifically, the Air National Guard was awarded $421 million while the Air Force Reserve received $200 million (*FY19 NGREA Memorandum from the Office of the Assistant Secretary of Defense*, 2019). As stated earlier, the law appropriates the funds, and it requires the Chiefs of the National Guard and Reserve components to respond to the congressional committees within 30 days after ratification (*FY19 NGREA Memorandum from the Office of the Assistant Secretary of Defense*, 2019). A 2019 example of the fiscal, legal language in the appropriations act for the NGREA account is:

> For procurement of rotary-wing aircraft; combat, tactical and support vehicles; other weapons; and other procurement items for the reserve components of the Armed Forces, $1,300,000,000, to remain available for obligation until September 30, 2020: *Provided*, That the Chiefs of National Guard and Reserve components shall, not later than 30 days after enactment of this Act, individually submit to the congressional defense committees the modernization priority assessment for their respective National Guard or Reserve component: *Provided further*, That none of the funds made available by this paragraph may be used to procure manned fixed wing aircraft, or procure or modify missiles, munitions, or ammunition: *Provided further*, That such amount is designated by the Congress for Overseas Contingency Operations/Global War on Terrorism pursuant to section 251(b)(2)(A)(ii) of the Balanced Budget and Emergency Deficit Control Act of 1985. (*NGB Fiscal Law Guidebook 2019*, 2019)

ARC Organic Appropriations and Regulatory Thresholds

Understanding the color of money, its limitations, and how the Fiscal Year 2019 was distributed helps establish a foundation for discussing ARC organic appropriations and regulatory thresholds. Like the active component, the ARC manages the following organic appropriations: Military Personnel, Operation and Maintenance (O&M), and Military Construction (*NGB Fiscal Law Guidebook 2019*, 2019). The only difference is that the ARC manages NGREA as an additional organic appropriation.

Furthermore, identifying the regulatory threshold determines which appropriation must pay for a specific modification. For instance, since NGREA is a procurement appropriation, it must be used "…for "investments" and O&M appropriations are for "expenses"" (*NGB Fiscal Law Guidebook 2019*, 2019). For every defense appropriations act, Congress approves a provision that "allows" DoD to procure investments that do not exceed a specific threshold (*NGB Fiscal Law Guidebook 2019*, 2019). The amount may vary, but it is typically a $250,000 threshold for O&M. If the ARC wants to spend more than $250,000, they must use NGREA. If not, then they must use O&M dollars. For timing, O&M has one-year availability while NGREA has three; therefore, once the funds exceed the period, it goes into a five-year expired status with limited capability (*NGB Fiscal Law Guidebook 2019*, 2019). With a foundational background on NGREA, the subsequent section discusses RTIC and how it was born out of operational necessity.

Real-Time Information in the Cockpit (RTIC)

RTIC is an ARC-led modification effort funded by NGREA to complement ABMS and formed out of operational mission necessity in the wars in Afghanistan and Iraq. The

requirement for airborne networks on MAF aircraft has highlighted the technological and strategic gap in airborne networks. However, the recent push for CJADC2 and ABMS has accelerated that requirement. For missions to be effective in a high-end conflict, MAF aircraft must communicate and operate in the same airspace with the same level of situational awareness to support joint and coalition partners (Guard, 2019). Fortunately, TDL airborne networks have matured and progressed, allowing MAF aircrew to trade information through digital means.

C-130H RTIC

In conjunction with advancements in technology, MAF aircrews can now have the capacity to effectively coordinate and execute missions in a rapidly changing environments (Guard, 2019). Possessing that capability will dramatically enhance decision-making, increase survivability, and assist in exploiting the enemy's weaknesses (Guard, 2019). To bridge that technological gap, the ARC led the integration of the baseline C-130H RTIC. The baseline consisted of line-of-sight (LOS) communications and displayed information obtained from Situational Awareness Data Link (SADL) and Joint Range Extension Applications Protocol (JREAP-A) Version Alpha (Lamar, 2010). Furthermore, Northrop Grumman Corporation also included the ARC-210 for "…two-way voice and data communications…" (Lamar, 2010). Overall, C-130H RTIC became the template for the KC-135 RTIC program.

KC-135R RTIC

With C-130H RTIC already established and the tanker slated to continue to be operational for the next twenty years, ARC A5/A8 stated that RTIC was critical for MAF survival in a high-end conflict. As a result, in 2018, the Air National Guard led the way by choosing Rockwell Collins to modify the KC-135 with RTIC. The RTIC package consisted of

LOS Link-16 communications through the Multifunctional Information Distribution System (MIDS) J radio, secure BLOS through the ARC-210 radio, and LOS communications over the SADL network. (Guard, 2019; *Rockwell Collins to Implement RTIC System for USAF's KC-135R Tankers*, 2018). The intent was to provide connectivity for command, control, and communications (C3) purposes versus the traditional voice communications heavily relied upon by KC-135 aircrew (Guard, 2019; *Rockwell Collins to Implement RTIC System for USAF's KC-135R Tankers*, 2018).

In addition, KC-135 RTIC added BLOS Integrated Waveform (IW) using JREAP-A protocols (*Airborne Networking Live-Virtual-Constructive Environment | Airborne Networking Live-Virtual-Constructive Environment*, 2021; *Rockwell Collins to Implement RTIC System for USAF's KC-135R Tankers*, 2018). Also, Joint Tactical Information Distribution System (JTIDS) and the MIDS terminals were incorporated to provide a secure, anti-jam, LOS information distribution capability (Guard, 2019). JTIDS and MIDS work combined with a network protocol that avoids electronic message disparity and data loss (Guard, 2019).

Additionally, from the flight deck perspective (see Figure 5), KC-135 crews will now have near-real-time intelligence and situational awareness at the tip of their fingers (*Rockwell Collins to Implement RTIC System for USAF's KC-135R Tankers*, 2018). With RTIC, KC-135 crews become force-multipliers by supporting warfighters in the air, land, and sea domains. Even more, RTIC allows aircrews to become active participants with the ability to share time-sensitive information quickly. Moreover, Figure 6 shows a KC-135 RTIC-equipped aircraft participating as a node on both a Ultra-high Frequency (UHF) Satellite Communications (SATCOM) BLOS data network and a LOS UHF SADL network using standard J-series message sets.

Figure 5. KC-135R RTIC Block 45 Electronic Engine Instrument Display (EEID) and moving map (*Rockwell Collins to Implement RTIC System for USAF's KC-135R Tankers*, 2018)

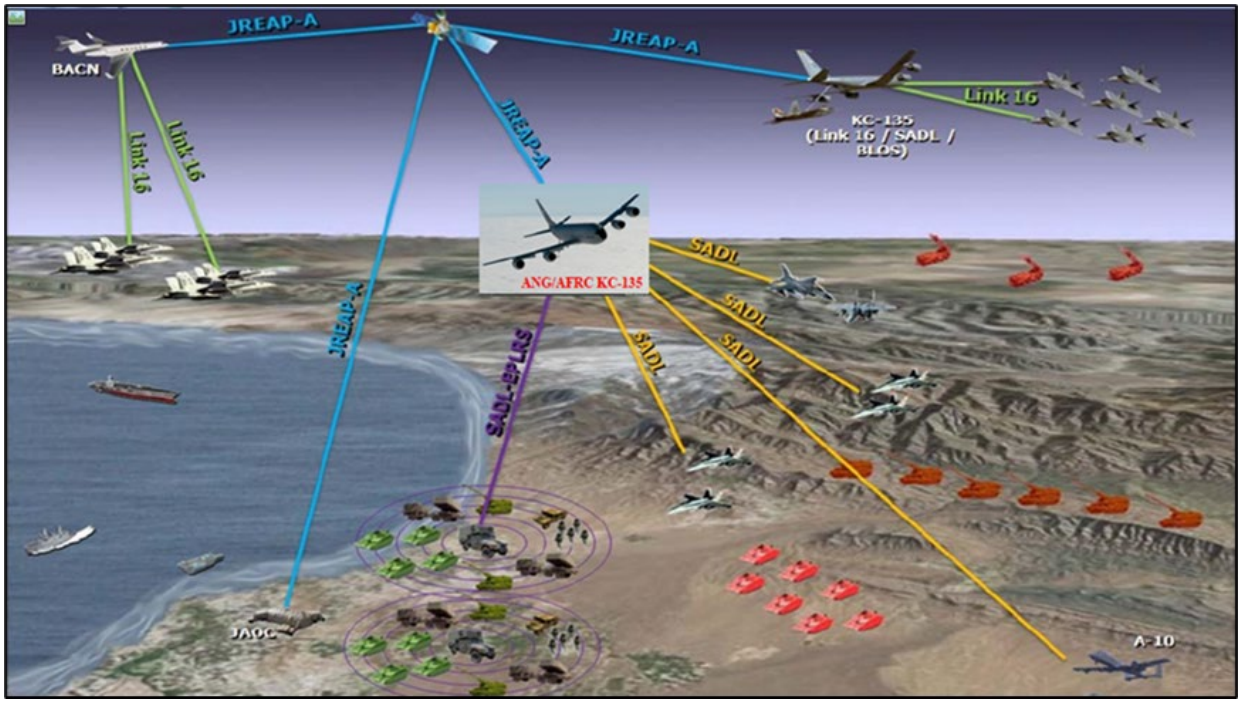

Figure 6. KC-135 RTIC/HVAA GLADIATOR Pod Airborne Network (NGB, 2021)

Future RTIC Upgrades and Plans

The ARC has proposed to upgrade RTIC to include LOS Link-16, Tactical Targeting Network Technology (TTNT)-IP based network, and Enterprise Waveform (L3Harris-LPI/LPD means of communication) (NGB, 2021). For BLOS capabilities, it will employ JREAP-C using Ku/Ka-band receivers for getting high-speed data from Viasat or Starlink satellites into the jet (NGB, 2021). Currently, the plans are to upgrade 243 ARC Block 40/45 KC-135Rs and 50 AMC Block 40/45 KC-135Rs with RTIC (Guard, 2019).

Recent Progress

In addition to proposed upgrades and plans, in July 2020, the Utah Air National Guard's 151st Air Refueling Wing became the first to modify the KC-135 with RTIC (Sutherland, 2021). Brig Gen Daniel Boyack, commander of the Utah Air National Guard, said, "The RTIC program provides the pathway and baseline for the KC-135 to support the Advanced Battle Management System" (Sutherland, 2021). In addition, Lt Col Jeffery Gould, KC-135 Test Director of the Air National Guard Air Force Reserve Test Center, is the lead pioneer in the ARC for KC-135 RTIC and pod initiatives. Lt Col Gould acknowledged:

> For years, I have relied on AWACS or receiver aircraft, a grease pencil and a laminated chart to build a real-time combat picture. With RTIC, my ability to gain situational awareness is near instantaneous and much more accurate. (Sutherland, 2021)

In November 2020, before being named the KC-135 Test Detachment, the Utah Air National Guard supported the SkyDog Unmanned Aerial Vehicle program, better known as the Kratos Unmanned Tactical Aerial Platform-22 (UTAP-22) (see Figures 7 and 8) (Newdick, 2021; Sutherland, 2021). The objective was for the KC-135 to receive data from the UTAP-22. Lt Col Gould also stated:

> We were able to successfully receive off-board data from the UTAP-22 that we normally would not get through Link 16. Full-motion video, along with a host of sensor information, was pushed to our crew. The KC-135 is expected to play a critical role as a node with ABMS and JADC2. This is the first step in supporting the future of warfare. Gathering, correlating and fusing off-board aircraft data is critical to creating former Assistant Secretary of the Air Force for Acquisitions Dr. Roper's 'military internet of things'. (Sutherland, 2021)

This proof of concept demonstrated that the KC-135 could play a significant role with manned and unmanned weapon systems in a contested-degraded environment (Newdick, 2021). Next, a discussion on KC-135 RTIC life cycle sustainment plan will establish the support infrastructure and sustainment responsibilities for the modification.

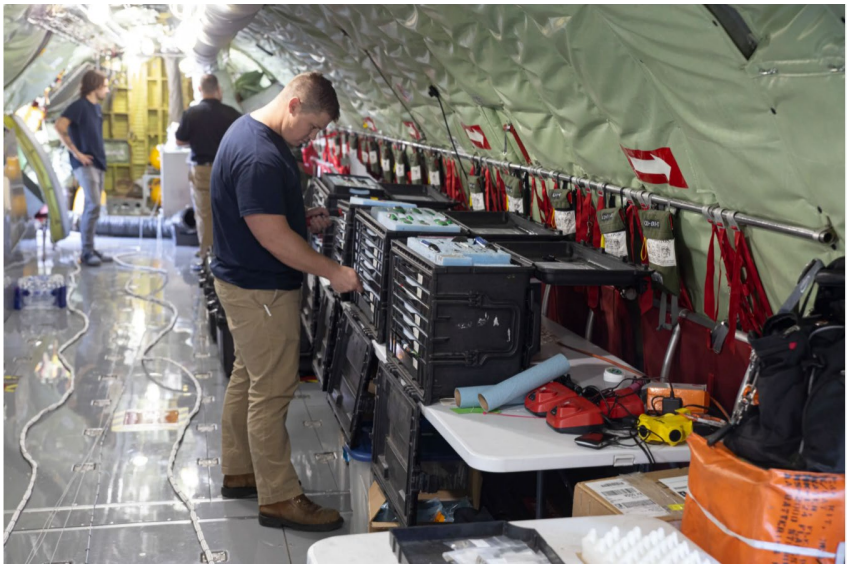

Figure 7. Utah Air National Guard KC-135 Test Detachment testing RTIC (Newdick, 2021)

Figure 8. F-15C with UTAP-22 Drone attached to the left pylon (Newdick, 2021)

KC-135 RTIC Life Cycle Sustainment Plan

The KC-135 RTIC Life Cycle Sustainment Plan (LCSP) classifies the support approach for the RTIC system on KC-135s. The LCSP supports the Milestone (MS) C Decision in the Integrated Defense Acquisition, Technology, and Logistics Management System (Acquisition/Logistics, 2020). It also contains system performance from operational and maintenance viewpoints. For the lifecycle of the modification, the LCSP includes strategies and guidance metrics (Acquisition/Logistics, 2020). The LCSP also has the responsibility to provide sustainment support and monitor funds for expense management (Acquisition/Logistics, 2020). AMC HQ is the lead MAJCOM for the KC-135 and the RTIC modification (Acquisition/Logistics, 2020; NGB, 2021). For the KC-135 RTIC program, the Deputy Air Force Program Executive Officer (PEO) for tankers is the Milestone Decision Authority, and the KC-135 SPOs directly report to that authority (Acquisition/Logistics, 2020). Next, the following sections present the ARC's pod initiative and its strategic roadmap.

Pods

With a foundation of ABMS, NGREA, and RTIC, this section ties into to the ARC's pod initiative and the motivation behind it. Specifically, in 2015, a Guard SME from the Utah Air National Guard was recalled to AMC to assess the threat vulnerabilities to the KC-135. It was determined that the tanker was the least capable of surviving a threat. The assessment contributed to the existing threat matrix and push for a podded solution. At the time, KC-135s were the only MAF platform requesting this option. Today, the idea has been expanded to the entire MAF fleet to include the KC-46.

The ARC has been told that the KC-46s will be the pathfinder for everything ABMS. Consequently, the ARC A5/A8 contended that the KC-46 is beholden to Boeing, and it will cost 10 to 15 times the amount of money that it would take for them to accomplish a podded solution. Both AMC and the ARC envision the pod to provide mobile communications and data transfer capability to provide additional capacity outside the traditional mission set. The significant difference in that undertaking is the ARC A5/A8 wants to complement the GLADIATOR pod with RTIC for the KC-135 and all MAF platforms.

Dr. Will Roper, former Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics, and AMC Commander General Jacqueline Van Ovost both echoed that the KC-46 and KC-135 will play a significant role with ABMS and podded solutions (Everstine, 2020; Underwood, 2021). However, General Van Ovost stated that AMC is accelerating change by progressing the KC-46 due to the aging KC-135 and KC-10 fleet (Underwood, 2021). The general further specified, "That platform, when fully developed and capable, it's going to give us a lot of advantages over our current legacy fleet, especially with respect to its agility, the

multiple missions it can do, and its ability to have additional battle space awareness, which we don't have right now" (Underwood, 2021).

In contrast, the ARC strongly believes that they will prototype and field a podded solution before AMC. Currently, the ARC is 18-24 months ahead with prototyping and fielding plans. The ARC A5/A8 further stated that the KC-46 is actually at a disadvantage because of Boeing's major manufacturing setbacks. (Underwood, 2021). In the meantime, AMC has actively discussed pods, mounts, pylons, and hardpoints with the ARC, the Air Force Research Laboratory, and within the command. In addition, AMC is directly working with and being funded by the Rapid Capabilities Offices' (RCO) to seek a podded solution for the KC-46.

The ARC A5/A8 has some concerns with the KC-46 pod initiative because they believe the data the RCO declares they will collect or be pushed to the pod from some other sensor will not be integrated with the KC-46. In other words, the KC-46 aircrew will not see the pod's information. However, AMC refuted that claim and stated that they are most likely not going to integrate through Boeing's Tactical Situational Awareness System (TSAS) software because of the proprietary costs. Instead, they plan to design a means for data to be transferred and displayed to the aircrew.

Primarily, the ARC's push for the KC-135 pod solution is that RTIC uses a government-based software that the industry understands will belong to the government when they write the code. One of the biggest problems with military acquisition is propriety rights versus open architecture. With the ARC's RTIC pod solution, they believe they have eliminated that risk; but AMC has learned an expensive lesson by paying Boeing for the right to change code in the C-17.

As a result, they will no longer pursue integration or recoding of proprietary property. As an alternative, they will make all upgrades inside the pod.

The specific debate is that the ARC says RTIC and its pod is a federated system compared to the KC-46 TSAS software. TSAS uses the integration of Link-16, ALR-69A, which is inherent to the KC-46, and other capabilities beyond the classification of this paper. The ARC believes problems exist with TSAS software because it is Boeing-owned, Boeing-proprietary, and the government has zero rights at any point in time to add additional sensors or additional information from the pods to the KC-46. Consequently, AMC would have to pay Boeing to open their code to modify the TSAS program. Whereas the ARC owns the Tactical Airlift Mission Software Suite (TAMSS), the RTIC infrastructure, they make daily changes to TAMSS, and they are seeking to own the data rights to the other federated systems. As a result, the ARC claims faster upgrades because the USAF will not be paying the prime, a tax to use the proprietary system. Once again, AMC countered by stating they will not integrate with the TSAS software and will design a means for the data to be transmitted to the flight deck for the crew to assess.

ARC's HVAA GLADIATOR Pod

With a historical background and the passionate debate between AMC's and the ARC's podded solution, this section looks at how the ARC collaborated with research universities to achieve its prototype pod for the KC-135. The research universities that sought to help transform the Multiple Point Refueling System (MPRS) pod into the HVAA GLADIATOR pod were John Hopkins University and Georgia Tech Research Institute (GTRI). John Hopkins Applied Physics Laboratory is the primary designer of the GLADIATOR pod. They took 3-D scans of

the MPRS pod's aerodynamic mold with the pylon attached (see Figures 9 and 10). The government provided the aerodynamic information. Using their laboratory's computer-aided design or CAD equipment, they created a giant version of the pod to plug and play different communications and defensive systems line-replaceable units.

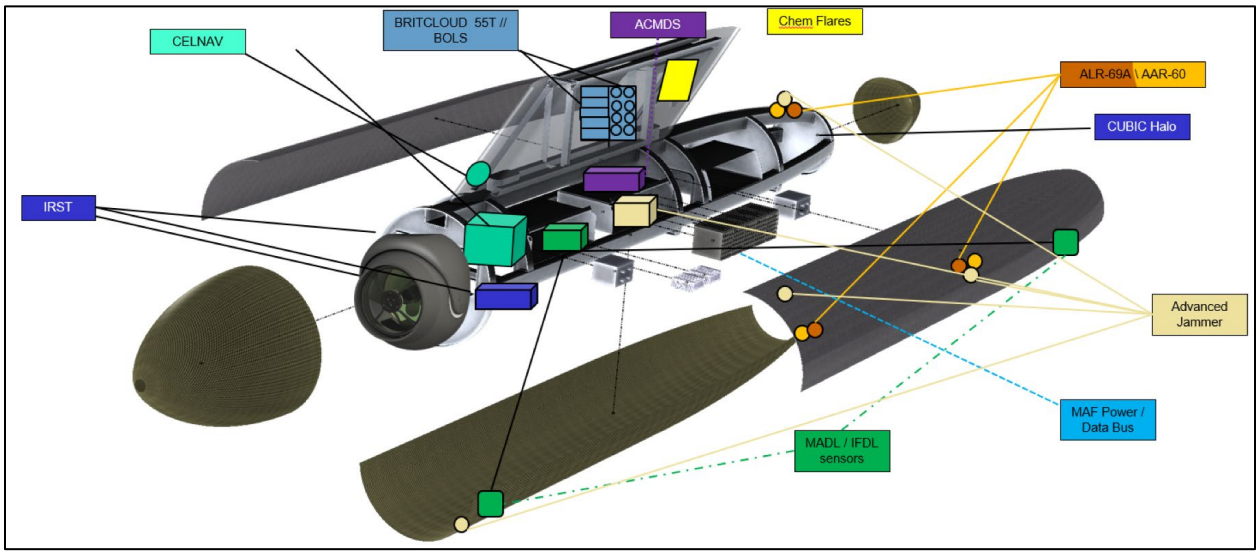

Figure 9. Multiple Point Refueling System (MPRS) RTIC/ HVAA GLADIATOR Pod Conceptual Diagram (NGB, 2021)

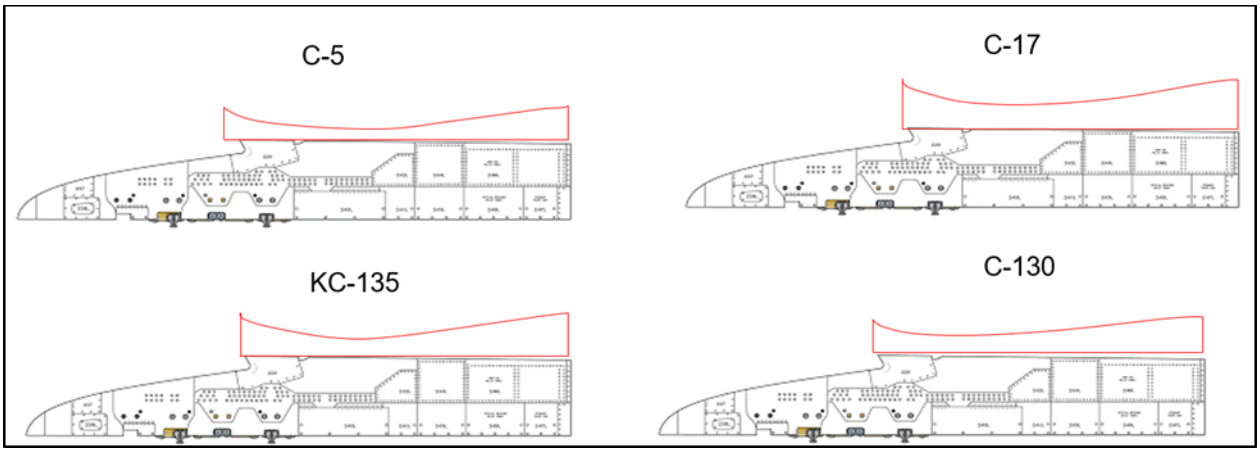

Figure 10. GLADIATOR Pod Interface to Pylon (Not to scale) (NGB, 2021)

At the same time, GTRI is the integrator for the ALR-69A and the software that goes along with it. The ARC's recommendation to AMC is that GTRI already has the Certificate Arbitrator Module (CAM) software developed for the C-130 RTIC program. With CAM software developed in the Airborne Infrared Countermeasure Evaluation System (AICES) program, the ALR-69A can be integrated into the KC-135 just like the C-130H. The ARC intends to have AICES implemented to all MAF weapon systems. The ARC is currently pushing to make AICES the baseline software for RTIC. This change will allow for easy modification to add new applications to increase capabilities. AICES will be the first asset that the ARC will be adding to the TAMSS software. AICES gives the ALR-69A integration the ability to be upgraded to include a larger aperture field to the system, allowing for future software upgrades. Next, the following section discusses ARC's AF Form 1067 approval and the current state of the GLADIATOR pod.

Rapid Prototyping and Rapid Fielding Phases

In 2018, AMC granted the ARC the AF Form 1067 (18-0066) for the GLADIATOR pod initiative, which allowed them to prototype two pods for the KC-135 (NGB, 2021). At this time,

the ARC's GLADIATOR pod is in the rapid prototyping phase. Once the pod is completed, they will transition to the rapid fielding phase. The ARC mentioned that it would take time to make that pod structurally sound, and it must be operationally tested. At the same time, they also mentioned that the advantage of utilizing the NGREA funding is that it will be faster than the traditional POM acquisition process.

Contracting Issues

Furthermore, the GLADIATOR pod initiative was not without drama. Initially, the ARC ran into some issues with NGB contracting. Contracting stated that the pod was not an integration of existing technology but instead new technology development. The claim was problematic because NGREA cannot be used for new technology or developmental initiatives. Fortunately, the ARC resolved the dilemma by ensuring they took the existing technologies within the actual pod itself, the existing technologies on the end-data capabilities, and utilizing existing open architecture standards. According to the ARC, AMC is supportive of the ARC's RTIC GLADIATOR pod solution because they do not need to spend money for research and integration. The ARC provided a book of options for AMC to determine what capabilities they desire to POM for 3600 funds to modify the active duty tanker fleet. The following section shifts to discussing the ARC's strategic roadmap for KC-135 RTIC and GLADIATOR pods effectiveness based on upgrade configuration.

RTIC/HVAA GLADIATOR Strategic Map

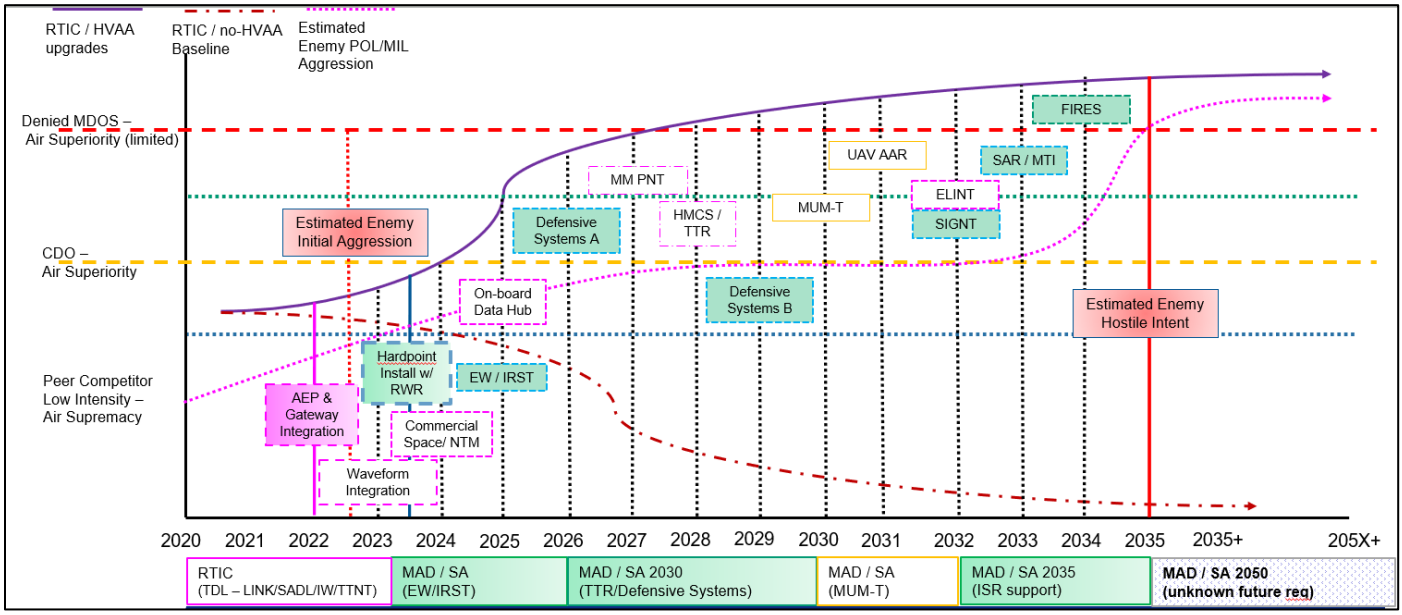

Figure 11. KC-135 RTIC/HVAA GLADIATOR Strategic Map (Gould, 2021)

The ARC considers RTIC to be more than just a TDL. Instead, RTIC is the aircrew's interface to technology in a federated system. RTIC is government-owned, open architecture hardware and software. In Figure 11, the green boxes represent the anticipated equipment to be stored in the pod. The pink boxes are internal to the aircraft and can improve from the baseline configuration. The yellow/orange boxes represent manned-unmanned teaming or software that can be added to the RTIC program (Gould, 2021; NGB, 2021).

"RTIC no upgrades," which is the dark red dashed line represents TDL only with no GLADIATOR pod. Essentially, this means that while situational awareness can increase for the aircrew, in a high-end peer conflict, the adversary can negatively impact Link-16 communications. Only weapon systems with dedicated sensors or advanced waveform

communications can counter the threat and maintain situational awareness (Gould, 2021; NGB, 2021). "RTIC no upgrades" is the baseline for MAF aircraft (Gould, 2021; NGB, 2021).

"RTIC with upgrades" is the threshold where upgrades can allow MAF aircraft to operate closer to denied airspace. Each upgrade represents effectiveness and moves the line closer to the Denied Operations line. The further away from the Denied Operations line means the system is not as effective. The purpose of upgrading RTIC and GLADIATOR pods is to allow fighters to get closer to the front end of the battle area. The upgrade means fewer fuel requirements, fewer tankers loitering, little defensive counter air (DCA) support with defensive systems, and more DCA with no defensive systems (Gould, 2021; NGB, 2021).

For the roadmap, there are three concepts: RTIC is not just a TDL, Upgraded Airborne Executive Processor (AEP)/Gateway, and Hardpoints (NGB, 2021). The ARC says to think of RTIC in terms of TAMMS software and the hardware crew interface to all defensive systems, advanced communications, and sensor data (NGB, 2021). Upgrading beyond the baseline configuration is important because it avoids limiting RTIC to TDL only and it provides the capability to counter the adversary. Both AMC and the ARC concur that upgrading beyond the baseline configuration is imperative, but nothing has transpired beyond that discussion yet. More closely, the current AEP supports TDL only. If no modifications are made, then the RTIC will become obsolete.

Hardpoints and Pylon Status

In addition to the strategic roadmap is addressing hardpoints and pylons. According to the ARC A5/A8, hardpoints will be modified into the test KC-135s in 2023 (NGB, 2021). The initial step is to establish the digital backbone design awaiting AMC commander approval (NGB,

2021). The pod and pylon will be available in 2022 (NGB, 2021). Furthermore, the GLADIATOR pod outer mold line can be the MAF pod program of record to interchange on MAF platforms (see Figure 10 above). The ARC's goal is to have data processing at the forward edge (NGB, 2021).

III. Methodology

Chapter Overview

This chapter will describe the qualitative research method and data analysis technique chosen. The main objective will be to detail and clarify the steps used to answer the research question. The careful explanation and justification of the chosen methodology will allow other researchers to duplicate the study.

Research Design

Literature Review and Content Analysis

The literature review is a comprehensive and precise method that aids the researcher in understanding big swaths of data by uncovering, analyzing, and linking the existing data to the research question (Khirfan et al., 2020). Content analysis is the study of communications and documentation in the forms of text, audio, visual, or pictures (Bell, 2011). It is used to explore patterns in communication in a repeatable and methodical manner (Bell, 2011). The advantages of content analysis are it directly examines the data using text, it allows closeness to data, the coded data can be statistically evaluated, the analysis can be accomplished unobtrusively, it can provide insight to convoluted models of human thinking and language, and the when properly executed, it "…is considered a relatively "exact" research method" (Columbia-Public-Health, 2021)

Preparation

Before beginning the research study, the researcher must have a strong understanding of the process of content analysis and literature review. A thorough outline of the study and vital insight into the research goals are essential for success.

Instrumentation

The researcher is the key instrument who will collect the data through interviewing, documentation, E-Mail, focus group, and audiovisual (i.e., Zoom).

Interview

The interview will utilize a one page questionnaire, consisting of four semi-structured investigative questions with space to record open-ended responses. The questions will focus on NGREA, sustainment, RTIC, HVAA GLADIATOR pods, and sentiment. Moreover, no demographic information will be taken. The interview will be face-to-face and will take approximately twenty minutes to complete. The questions will be semi-structured with "…open-ended questions that are few in number and intended to elicit views and opinions from the participants" (Creswell et al., 2018). The disadvantage of face-to-face interviews will be the possibility of introducing biased responses because of the researcher being physically present. If the interview is accomplished in a designated area versus the natural field setting of the office, it could possibly degrade the interview process. Before the interview, the researcher will request permission from the interviewee if videos, photographs, or recordings can be permitted.

Setting

The researcher will plan to interview experts at AMC Headquarters, AFRC Headquarters, the National Guard Bureau, and the KC-135 SPO office.

Sample Size Determination

According to Creswell et al. (2018), the ideal number of participants in this study should be 20-30. However, only 15 participants were interviewed.

Population

The study will focus on A4, A5, A8, and SPO SMEs from AMC, AFRC, NGB, and AFLCMC.

Sampling Strategy

For this study, purposive sampling will be adopted because the intent is to immediately seek experts in the field of interest before conducting the research. Since the researcher does not know the likelihood of the selection, they will not know if the sample represents a more significant population or not (*7.2 Sampling in Qualitative Research*, 2020). Although the sample does not represent a larger population, that does not mean "…that they are drawn arbitrarily or without any specific purpose in mind…" (*7.2 Sampling in Qualitative Research*, 2020). Furthermore, sampling bias will be alleviated by the careful construction of the question context and format.

Data Collection

Several qualitative data collection methods will be used, such as interviews and audiovisual (Creswell & Creswell, 2018). The interviews will be face-to-face with the option of using E-Mail, audiovisual (i.e., Zoom), or phone. The researcher will go line-by-line verbatim to read, record, and code (Vogt et al., 2014). The coding will be built on repeated words and

phrases (Vogt et al., 2014). The processing of the survey data will be exposed to automated editing and imputation. For this study, the researcher's goal is to collect, filter, code, and sort the data under the appropriate categories. An Excel spreadsheet will be used to prevent recording errors. The researcher will code the responses and classify them into themes. No personally identifiable data will be documented. Finally, the data will be stored in a secure database or server.

Klaus Krippendorff's Content Analysis Guide

This research project will use Krippendorff's (2004) six-question content analysis guide with the use of the NVivo software to help answer the research question:

1. Which data are analyzed?
2. How are the data defined?
3. From what population is data drawn?
4. What is the relevant context?
5. What are the boundaries of the analysis?
6. What is to be measured?

NVivo Software

The researcher transcribed the interview recordings using NVivo's version 12 transcription tools. The researcher then grouped the responses to each question, then found and cataloged the themes to make sense of the information (McNiff, 2016). Through thematic

analysis, the researcher "…read through each interview…" and coded the emerging themes (McNiff, 2016). The thematic analysis involved choosing interesting comments and putting them into categories called 'nodes' (McNiff, 2016). Primarily, this allowed the researcher to open any node to see the references (McNiff, 2016). NVivo allowed for rapid coding processing. With NVivo, the researcher made links between themes and shifted in the direction of making analytical insights (McNiff, 2016). The researcher could open the node to view all the information compiled and could run queries to retrieve data (McNiff, 2016).

Furthermore, the researcher chose to compare interview participants based on their expertise (McNiff, 2016). As a result, the researcher was able to create cases in NVivo (McNiff, 2016). Moreover, it is conceivable to get lost in the data, but NVivo can "…gather your material into theme nodes…" and organize those nodes to make a rational hierarchy that will assist in organizing (McNiff, 2016). "Keeping an audit trail of your challenges, assumptions, decisions and epiphanies…" was beneficial when attempting to assess a connection between AFRC and AMC relationship and processes (McNiff, 2016).

Reliability and Validity

Since humans are susceptible to mistakes, the researcher attempted to minimize errors by focusing on stability, reproducibility, and accuracy (Columbia-Public-Health, 2021). For stability, the researcher coded consistently the same data in the same manner of the entire duration of the research. In terms of reproducibility, the researcher enlisted two independent coders to classify the data. The group of coders produced similar outcomes. As for accuracy, the researcher ensured the interviews and literature were transcribed correctly.

In terms of validity, the researcher focused on closeness of categories, conclusions, and generalizability. For closeness of categories, the researcher applied multiple classifiers to arrive at a consensus point. For conclusion, the researcher ensured the implications and findings correctly followed the data. Finally, for generalizability, this study could be generalizable to the Combat Air Force. The same approach for this research project can be applied to different MAJCOMs in the USAF.

IV. Analysis and Results

Chapter Overview

Chapter IV explores the responses of the interviews and literature review by using NVivo software. Findings through thematic analysis and interviews emerged and are presented for review. Finally, the researcher invested over 40 hours in learning the NVivo software and how to apply it to the research.

Data Analysis and Results

To answer the research question, this section will address the investigative questions followed by the findings revealed in the interview process. There were 15 participants total representing each stakeholder: AMC, AFLCMC, AFRC, and the NGB. The interviews were designed to be 20 minutes, but most interviews averaged 45 minutes. The longest interview was 90 minutes and the shortest was 15 minutes. There were times the researcher interviewed the same individual more than once. Overall, there were 36 total interviews which stemmed off the four investigative questions and continued to expand with unstructured questions.

Addressing the Investigative Questions

Investigative Question #1: What challenges need to be addressed to ensure RTIC and GLADIATOR pods on KC-135s are sustained for the modification's life cycle?

All the stakeholders have acknowledged that the lead MAJCOM, AMC, has the authority to approve a modification proposal that is estimated to cost less than $100 million (A5R, 2020). If the cost exceeds $100 million, then Headquarters Air Force must review and approve in

addition to AMC (A5R, 2020). Once the requirement is approved with the AF Form 1067-Modification Proposal, the lead MAJCOM is responsible for planning and advocating "…for programming and budgeting for the life cycle of the systems, to include material modification requirements" (Acquisition/Logistics, 2020). Although, the ARC proposes a permanent modification to the aircraft, they are not technically responsible for funding sustainment, training, or maintenance for the life cycle of the system.

However, the ARC has in the past used NGREA to pay for sustainment for a period of eligibility of three years with a maximum of five with Congressional approval (*NGB Fiscal Law Guidebook 2019*, 2019). Since NGREA is not RDT&E money, it cannot be used by AMC to fund RDT&E efforts. Therefore, the ARC is bounded by law to use NGREA on non-developmental items that exists in the military supply chain. As a matter of fact, all the ARC KC-135s that will be modified by RTIC will be sustained by NGREA for that short period. It is when AMC completes modifying their KC-135s with RTIC that the expectation is for AMC to pay for all the sustainment, training, and maintenance for the entire KC-135 fleet.

Additionally, NGREA's fiscal year 2020 $1.3B budget compared to the USAF's $57B budget is not designed for sustainment. Actually, the $1.3B budget must be divided between the different Services within the RC. NGREA has been vulnerable to politics and budget cuts for years. According to the ARC and Congress, OSD's border wall reprogramming left the RC with zero dollars for Fiscal Year 2020 and has been cited as a direct violation of Congress's constitutional authority (NGB, 2021; *Pentagon Reprogramming Hits Guard Modernization Programs Hard*, 2021). Defense Secretary Mark Esper defended the decision to divert funds to the border wall by stating:

> Border security is national security and national security is our mission. The action we took is legal under the law, and so it should be no surprise, and I'll just leave it at that for now. (*Pentagon Reprogramming Hits Guard Modernization Programs Hard*, 2021)

Retired Brigadier General J. Roy Robinson, the National Guard Association of the United States president, argued:

> The services have historically underfunded the National Guard. They have done so more recently knowing that Congress will make up some of the difference. In fact, this gives the services something of an excuse as to why they don't pay more attention to Guard equipment modernization. (*Pentagon Reprogramming Hits Guard Modernization Programs Hard*, 2021)

Representative, Mac Thornberry, Republican from Texas, and ranking member of the House Armed Services Committee, said:

> Congress has the constitutional responsibility to determine how defense dollars are spent. We take the Pentagon's recommendations seriously during our deliberations, but the final decisions are contained in the bills passed by Congress and signed into law. Once those choices have been made, the Department of Defense cannot change them in pursuit of their own priorities without the approval of Congress. Attempts to do so undermines the principle of civilian control of the military and is in violation of the separation of powers within the Constitution. (*Pentagon Reprogramming Hits Guard Modernization Programs Hard*, 2021)

The 2020 OSD overreach directly impacted the RTIC program delaying progress for both the ARC and AMC. Now the program has resumed and aircraft being modified with RTIC. Protecting and preserving NGREA is paramount to the ARC but ensuring NGREA survivability should be in AMC's best interest too. Particularly, the ARC has already alleviated the upfront cost by investing NGREA dollars to prototype RTIC and GLADIATOR pods. The cost for RTIC is $400k without TTNT and $900k with TTNT (NGB, 2021). Also, the cost for a pair of GLADIATOR pods is $1.1 million, but the ARC asserted the price could be brought down given the scale of economy (NGB, 2021). With the ARC's commitment to pay upfront costs for research, prototyping, testing, and fielding already saves AMC time, manhours, and millions of dollars trying to achieve similar results.

Furthermore, since the concern in AMC was battling weapon system sustainment costs, the interviews revealed that the core problems of those issues were stemmed from aging aircraft like the KC-135 and the impact of a 20-year war. Consequently, all the SMEs believe it is challenging to mitigate the sustainment problem. According to President Joseph Biden, all U.S. forces will withdraw from Afghanistan by September 11, 2021 (DeYoung, 2021). The shift from wartime operations to peacetime will decrease the sustainment costs attributed to those contingency operations. However, as for aging aircraft like the KC-135, sustainment costs will continue to rise regardless of war or peacetime operations. As a result, the SMEs believe those conditions are beyond the control of AMC.

Despite the historical equipping trends for the ARC and the contentious relationship between the ARC and AMC, the researcher will propose to AMC to strongly consider employing the ARC to rapidly prototype and field non-developmental modifications using NGREA. As mentioned earlier, leaning on the ARC for that rapid capability will meet the CSAF *Accelerate Change or Lose* policy and save AMC substantial resources. Trust, communication, and leadership need to be in the forefront of ensuring projects like RTIC and GLADIATOR pods are supported.

Investigative Question #2: Since RTIC is a federated system and meant to be evolutionary, what are the limitations of NGREA?

Since RTIC is expected to evolve beyond the baseline configuration, NGREA funding can be shut down if the USAF proceeds to invest and integrate developmental technology. SPO SME 2 also stated:

> RTIC was designed to be evolutionary, so as MIDS-JTRS program developed TTNT or different technologies. The Guard just wants to grab them and integrate. The Guard, I

> think, would be happy having 10 versions of RTIC in an evolutionary fast fashion. But, the active force has not bit off on that yet. So, I would say using NGREA to fund ABMS, you will have real problems if you're developing new stuff. Secondly, that evolution amongst platforms, amongst capability providers has to be integrated or else we'll be putting something on too old. You know, we'll be left behind or someone else will be left behind. (SPO, 2021)

To mitigate the limitations of NGREA on an evolutionary system, the ARC has also proposed that in the next ARC WEPTAC, it will request to swap out the existing airborne executive processor (AEP) to a version that can handle more complex algorithm computations. The strategy to upgrade AEP with a non-developmental version that exists in the supply system, will allow for NGREA funding.

Investigative Question #3: What are the sentiments of NGREA only modifications to legacy aircraft?

Figure 12. Overall NGREA Sentiment (Source: Author)

To understand the findings for investigative questions #3 and #4, please reference Table 1 in Appendix A. The table explains the theme, the frequency of the coded references, the meaning behind the investigative question, and a specific evidence example that reinforces the finding.

In the meantime, the general sentiment of NGREA only modifications investigative question was Negative. Using a hierarchy chart in NVivo helped visualize the sentiment hierarchy. With the hierarchy chart, the researcher was able to compare the number of coded sources and identify which source had the most references. In this case, the coding referenced 152 direct references and 240 aggregated references for Negative which was the discriminator (see Figure 12 and see Table 1 in Appendix A). For Very negative, the coding referenced 80 direct references and 80 aggregated references. For Moderately negative, the coding referenced 8 direct references and 8 aggregated references.

For Positive, the coding referenced 154 direct references and 206 aggregated references. For Very Positive, the coding referenced 36 direct references and 36 aggregated references. For Moderately Positive, the coding referenced 16 direct references and 16 aggregate references. The overall sentiment was very close between Positive and Negative, but the visual depiction as well as the statistical findings identified a negative trend (see Figure 12). To support the analysis, AMC and SPO participants explicitly balked at the idea of NGREA only modifications because it would cause significant challenges for fleet management and accountability.

What is the sentiment of AMC and the ARC collaborating for the modernization of MAF aircraft?

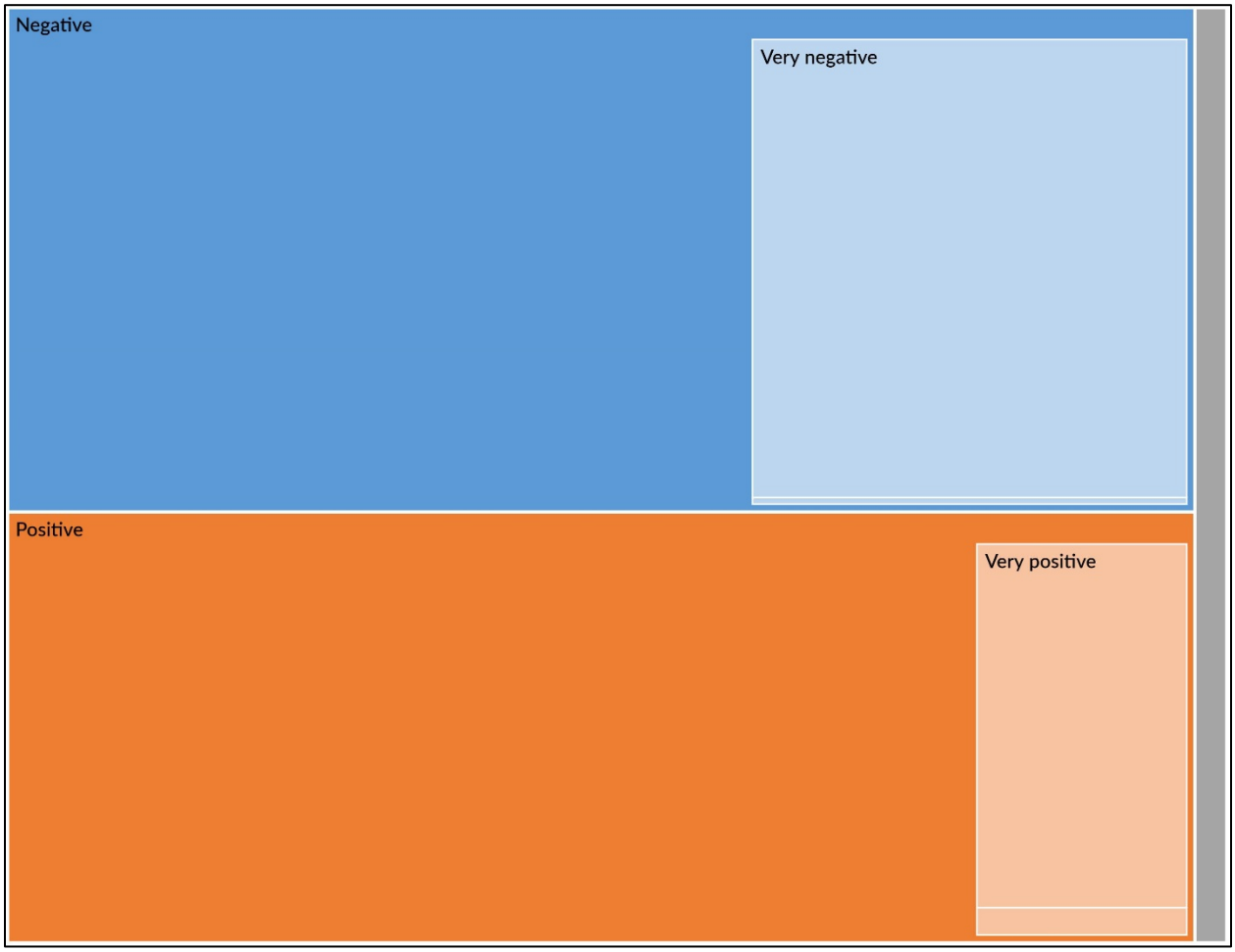

Figure 13. Overall Sentiment of AMC and the ARC Collaborating to Modernize Legacy Aircraft (Source: Author)

The general sentiment of AMC and the ARC collaborating to modernize legacy aircraft was Negative. According to Figure 13 (see Table 1 in Appendix A), the Positive coding referenced 138 direct references and 168 aggregated references which was the differentiator. The Very Positive coding referenced 28 direct references and 28 indirect references. The Moderately Positive coding referenced 2 direct and 2 aggregated references.

The Negative coding referenced 124 direct references and 197 aggregated references. The Very Negative coding referenced 72 Direct and 72 aggregated references. The Moderately Negative 1 direct and 1 aggregated reference. In the interviews, the SPOs were moderately against AMC and the ARC collaborating because they claimed they would end up becoming moderators trying to resolve issues. Conversely, the ARC and AMC both believed collaborating for ABMS was essential despite the negative sentiments. While they both conceded that the relationship needs to improve, the negative sentiment was based on lack of trust and misaligned priorities. The two examples that created negative sentiments were the C-130H Avionics Modernization Program (AMP) Increment I case study and the ARC's failure to sustain the C-130H RTIC program. Both examples demonstrated the misalignment of priorities and the lack of trust.

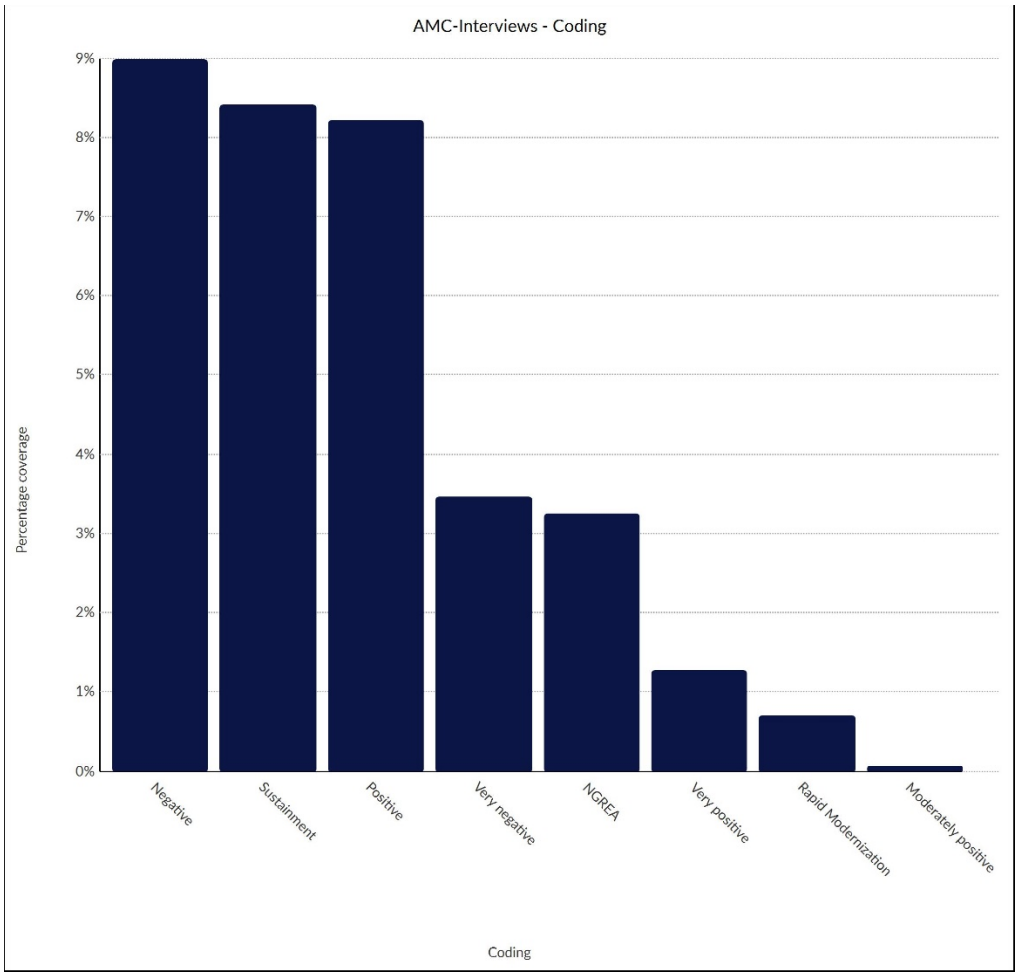

Figure 14. AMC Interviews: Sentiments and Most Frequently Mentioned Topic (Source: Author)

Figure 14 illustrates that the overall attitude in the AMC interviews was negative when discussing the ARC's impact of modernizing legacy aircraft for ABMS. Additionally, the word and topic of sustainment were central to all AMC SME interviews. Rapid modernization was least talked about because the AMC SMEs had limited exposure to using the Middle-Tier Acquisition process. Instead, they were accustomed to using the traditional POM process. Interestingly, all the AMC SMEs were highly negative or hostile toward the slow POM process. The reaction to the POM process was great frustration. They despised the bureaucracy, the

numerous checks and balances of the process, and AMC's inability to rapidly prototype and field new technologies.

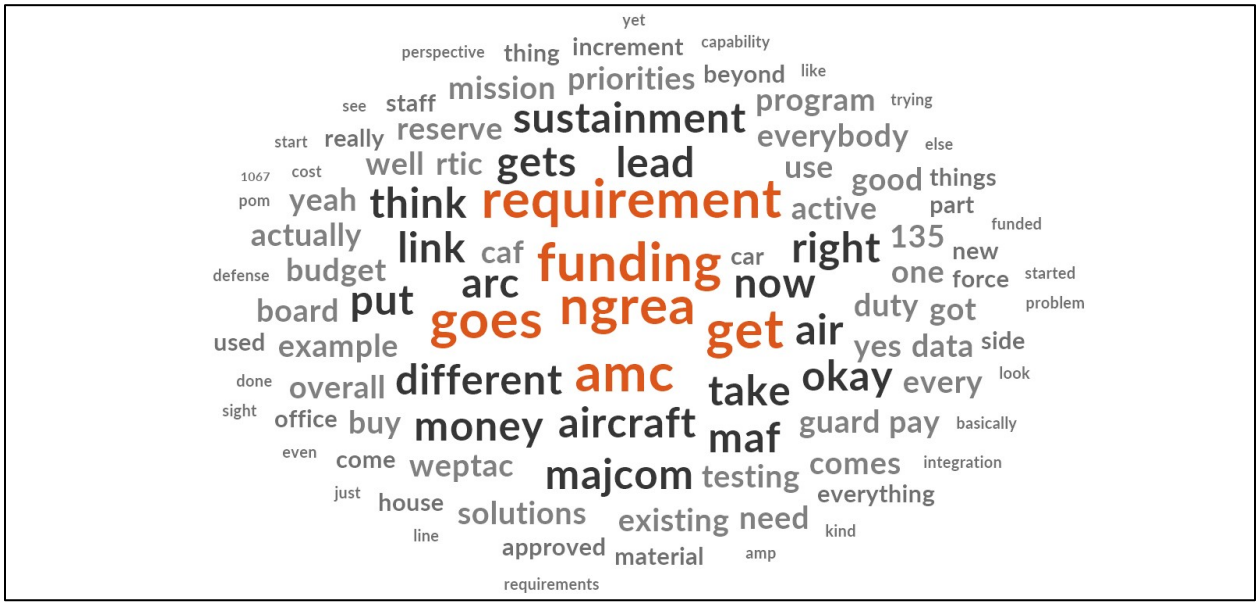

Figure 15. AMC Interviews Word Cloud (Source: Author)

Figure 15 illustrates that the most frequent words on AMC's mind when dealing with the ARC are NGREA, funding, requirement, AMC, goes, and get. The secondary words range from sustainment to money. The word clouds helped pinpoint themes that created connections.

Furthermore, Figure 16 is the ARC's perspective. The words NGREA, requirement, AMC, and funding were the same themes as the AMC interviews. Utilizing word clouds is powerful to identify commonalities because they help bridge the gap in differences or priorities. Overall, the word cloud is a tool for identifying ideas and cohesions between and within groups.

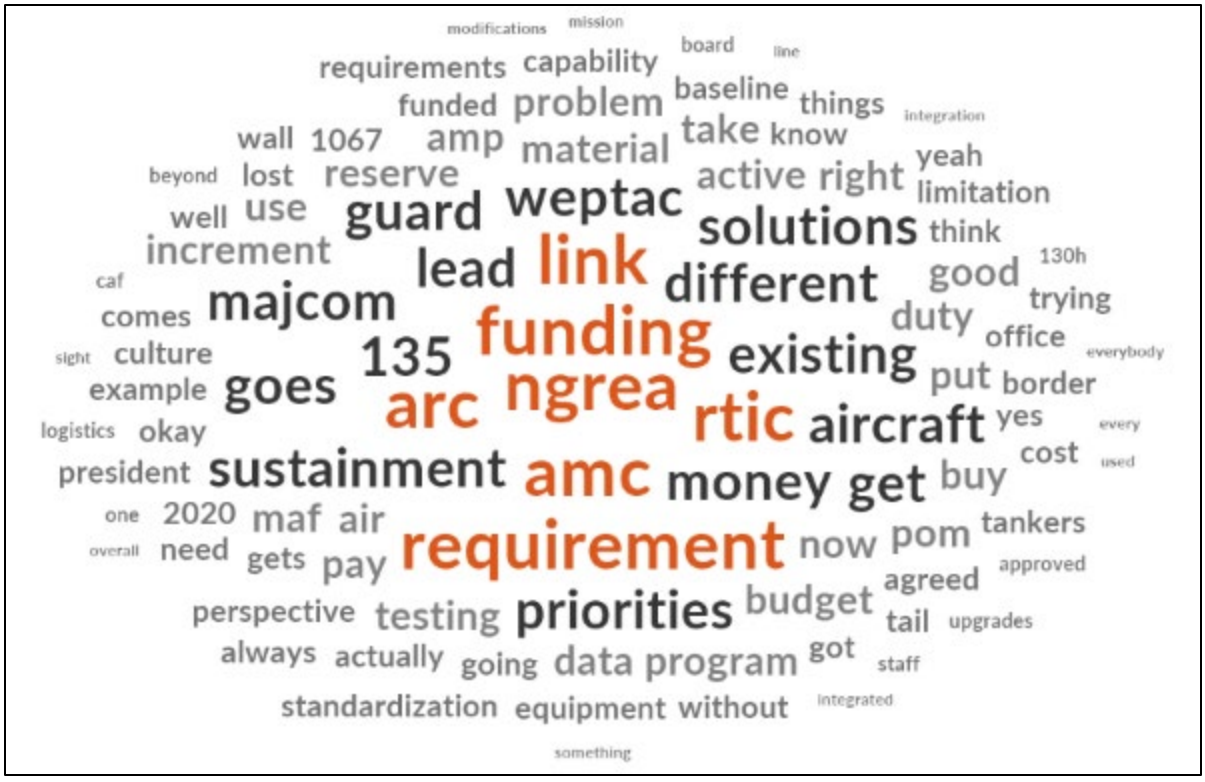

Figure 16. ARC Word Cloud (Source: Author)

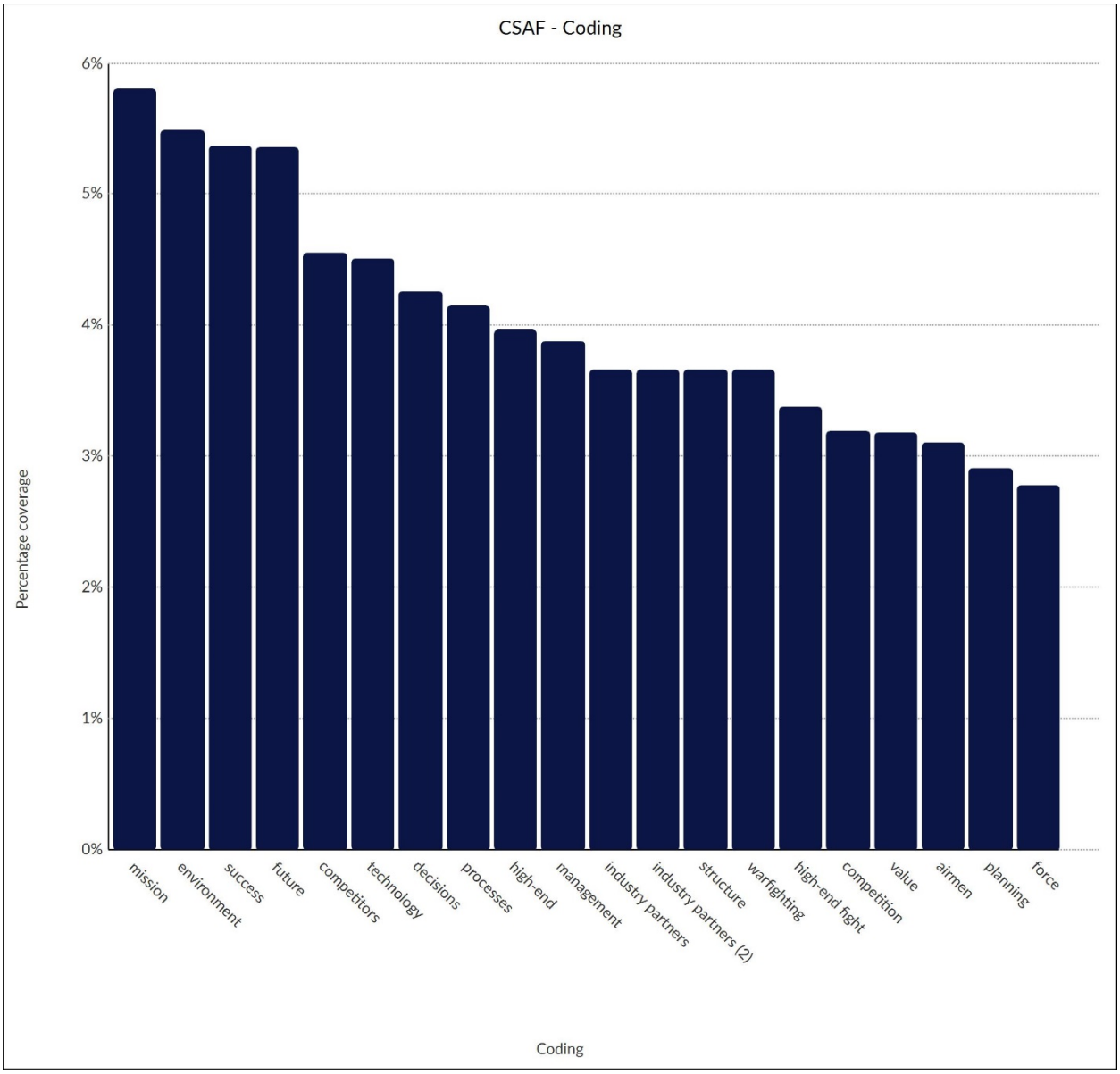

Figure 17. CSAF Most Frequent Topics (Source: Author)

Figure 17 demonstrates the CSAF's most frequently used words in his *Accelerate Change or Lose* policy, which translates to his overall messaging. In this case, the chart illustrates that the CSAF is concerned with mission success and the future environment. Understanding the CSAF's intent from a qualitative thematic analysis perspective, can assist AMC and the ARC on

whether collaboration is required to succeed. In this case, all the words are applicable to AMC and the ARC's priorities.

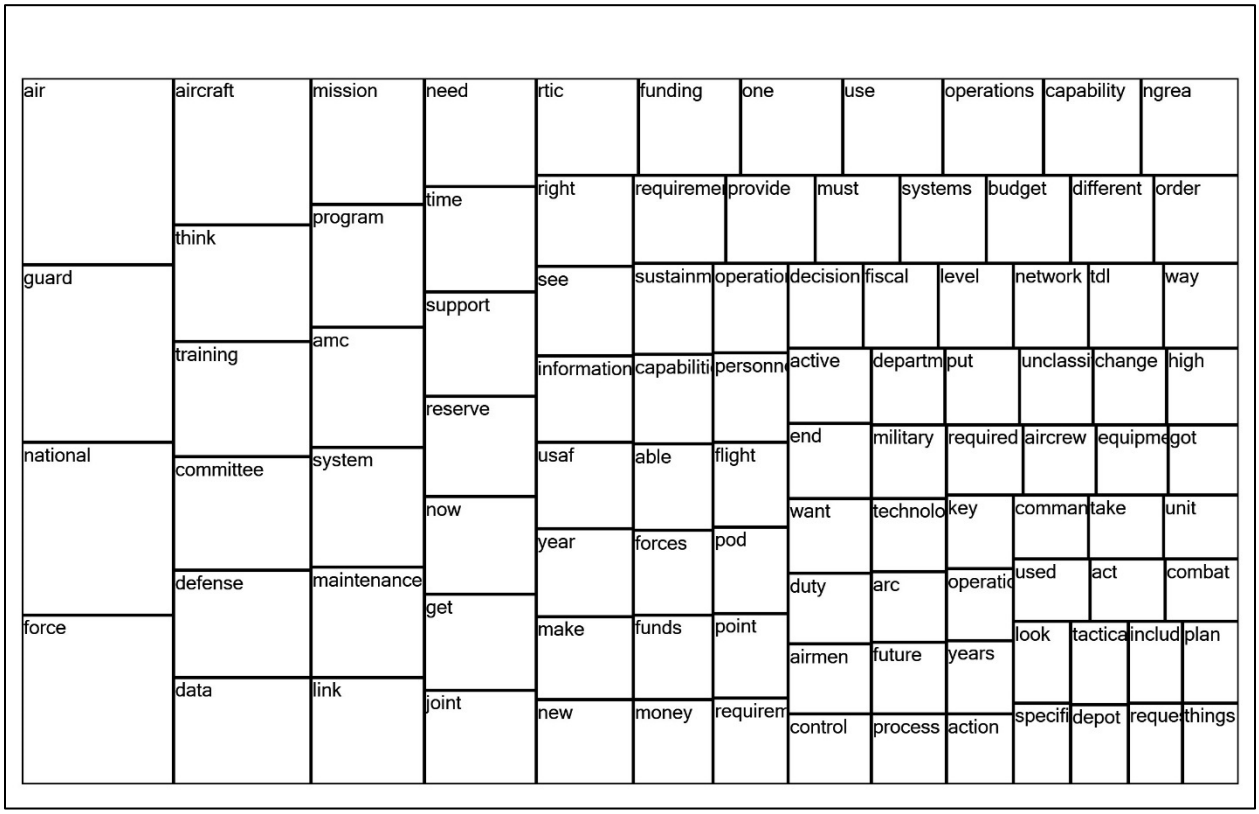

Figure 18. Consolidated Interviews Tree Map (Source: Author)

Moreover, the researcher used the tree map (see Figure 18) to show hierarchical data as a series of nested squares. The more references a specific word or theme received, the bigger the square. The tree map allowed the researcher to compare the number of coded sources, to identify the most coded, visualize leading themes in the research, and identify areas worthy of further investigation. By choosing a word on the left side, one can scroll across to create connections. This tree map emphasizes the Air Force, the Guard, AMC, the Reserve, datalink, RTIC, funding, and much more. Using this tool, aided the researcher in focusing on the key ideas to help answer the investigative and research questions.

Interview Findings

In addition to the NVivo analysis and results, this section discusses the interview findings worthy of discussion. At the same time, these findings helped identify strengths, weaknesses, sentiments, and direction of the stakeholders.

Slow Modernization Efforts

In 2018, AMC/A3D, now A3TW, created and employed the Threat Matrix Framework for the MAF fleet. In their assessment, they determined the KC-135 to be the least capable of surviving a threat. While there have been various defensive system upgrades to MAF aircraft like Large Aircraft Infrared Counter Measure (LAIRCM), Radar Warning Receiver (RWR), and new flare cocktails, it has taken nearly 12 years to be incorporated to very few aircraft. In a time where China is rapidly producing record numbers of aircraft, ships, and even airfields in less than a year, waiting over a decade for a single capability that will become obsolete is unacceptable.

ARC Out of Sync with AMC Resulted in Failed Sustainment Plan

AMC did not support upgrading the C-130H with RTIC because of their C-130J investment. However, AMC approved the requirement under the condition that the ARC pays for the sustainment. Consequently, the ARC failed to sustain the C-130H RTIC program in 2021. This setback demonstrated the ARC's overreach of their priorities and their limitations to fund and sustain large programs. The ARC does not have the resources or infrastructure to grapple with such a feat. Also, while NGREA has proven to be effective with its rapid prototyping acquisition process and fielding of non-developmental technologies on legacy

aircraft, it is not designed to provide funding for long-term sustainment, training, or maintenance for the commodity's life cycle.

ARC's Preference Is To Be Their Own Lead-MAJCOM

The ARC would prefer to be their individual lead-MAJCOM to receive and manage sustainment funds; however, they recognize that they do not have the infrastructure or manpower to make that possible. Instead, they intend to improve relations and merge priorities with AMC. Interestingly, AFRC is the lead-MAJCOM for WC-130s proving they can manage a small life-cycle sustainment plan.

No Standardization Resulted in Failure

The ARC used NGREA to fund C-130H AMP Increment I with no standardization plan resulting in delays and failures. When contractors hired by the USAF began to take apart C-130Hs to retrofit AMP Increment I, they had discovered that not one single C-130H was standardized, resulting in heavy delays and the threat of shutting down the program. Those discoveries created negative sentiments of NGREA. At the same time, it generated the threat of limiting future interoperability and compatibility efforts for programs like ABMS. The importance of this revelation in the interviews, highlights the need for the ARC to bridge the trust gap with AMC.

Fiscal Year 2020 NGREA Funding Reprogrammed for Border Wall

NGREA is highly vulnerable to outside forces, as demonstrated in the controversial OSD reprogramming to finance the border wall. The impact was immediately felt across the ARC, resulting in funding delays for KC-135 RTIC and HVAA GLADIATOR pods until spring of

2021. The OSD reprogramming intervention drew red flags and is being investigated by Congress.

No NGREA Only Modifications

The KC-135 SPOs do not like NGREA only modifications; instead, they prefer fleet-wide modifications for better fleet management. At the same time, the SPOs prefer AMC to be the centralized location to address legacy modernization. These preferences are necessary for the SPO because it avoids them being the moderator to AMC and ARC priorities.

NGREA Modernization Efforts Are Not To Blame

According to the SPO, while they do not like NGREA only modifications, they understand that NGREA is not why sustainment issues exist for AMC. Instead, they conceded that supply chain and funding are always an issue with a broad range of reasons despite the ARC's effort to modernize. They also stated that the expensive KC-46 acquisition and debacle has weakened AMC's ability to fund other projects.

The ARC Mastered Rapid Prototyping and Rapid Fielding

To achieve rapid prototyping and rapid fielding, the ARC focuses on cost-effective modernization to enhance the force's lethality and drive innovation to secure their future (NGB, 2021). Guard SME 1 said, "we always talk about trying to get 80% of the capability for 20% of the cost" (NGB, 2021). The Guard SME further stated that his question to Air Force leadership is whether that last 10-15% effectiveness really worth 5-10 times the cost?

During Dr. Will Roper's tenure as the former Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics, he had a vision that consisted of seven steps for incorporating rapid prototyping into acquisition: 1. Have an aggressive goal; 2. Bound your risks; 3. Be aggressive but not greedy; 4. Constrain time and budget, not the final performance; 5. It takes a team to go fast; 6. Get a signature from me; 7. GO FAST (NGB, 2021). According to the ARC, the active duty is still paddling to this vision as an attempt to reform the overall acquisition process. As for the Air National Guard, they try to stay in step with the Air Force Reserve on nearly everything they do. If differences exist, they are settled at the annual ARC Weapons and Tactics Conference (ARC WEPTAC) or at the three cross-tells per year.

ARC WEPTAC vs MAF WEPTAC

According to AMC SME 1, ARC WEPTAC is a highly effective forum compared to the MAF WEPTAC because the ARC produces material solutions while the active-duty generates non-material solutions like tactics, techniques, and procedures (TTPs). AMC SME 1 further stated that the Guard and Reserve have a sophisticated approach to rapid prototyping and rapid fielding, which directly involves industry and the implementation of commercial and government-off-the-shelf technologies. This modernization approach begins at ARC WEPTAC and ends up in the hands of the warfighter. During ARC WEPTAC, the CAF and MAF tacticians breakout into individual weapon systems to deliberate the modernization priorities for that specific year. The working groups identify critical capabilities and write a white paper justifying the requirement. In active-duty, the CAF and MAF do not collaborate in WEPTAC, but they do have a similar process of identifying critical gaps. The differentiator is the ARC tacticians take their weapon system critical capabilities and directly brief them to the Director of the Air National Guard and the Commander of the Air Force Reserve to generate material

solutions. Other stakeholders like AMC and Air Combat Command witness the onset of ARC's rapid modernization and weapon system transformation. Furthermore, the Air National Guard publishes a Weapons Systems Modernization Priorities Book (see Figure 19) that documents the capability priorities for the annual ARC WEPTAC. Congress heavily references the book to help justify NGREA funding. AFRC captures all the same information for their weapon systems but does not publish their numbers or progress. Instead, they meet during the spring during their annual Combat Planning Council to further discuss their capability needs, align their requirements within the command, and establish their strategic goals. Overall, the NGB and AFRC are usually in lockstep when it comes to requirements and priorities, a trait which is imperative for ABMS to succeed.

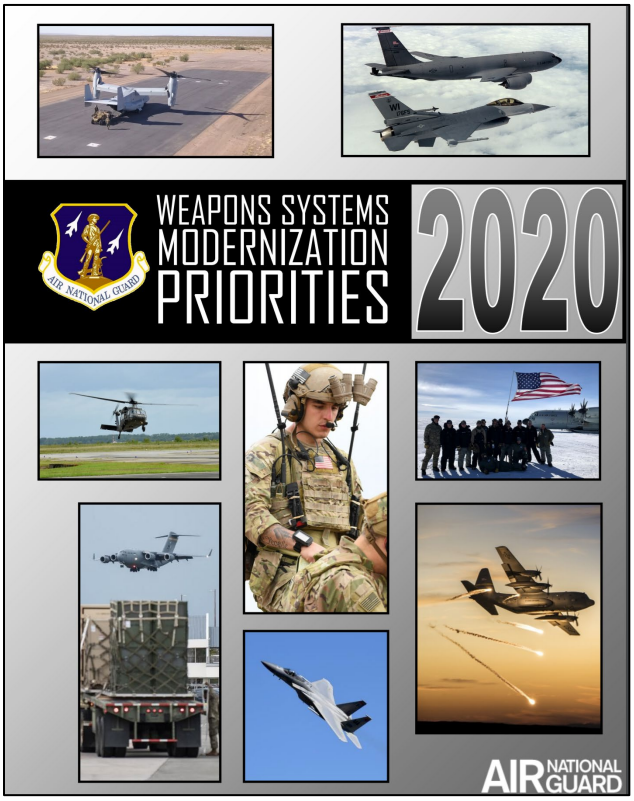

Figure 19. Air National Guard Weapons Systems Modernization Priorities Book (Guard, 2020)

Summary

Chapter IV explored the interview responses and literature review by using NVivo software's hierarchy charts, comparison charts, and word frequencies for thematic analysis. Consolidating the interview data and literature was a daunting task, but it made the analysis feasible once the information was organized and centralized. The analysis through NVivo helped determine the overall sentiment for the relevant research questions, and it provided validity and reliability to the study versus direct reporting. Finally, additional findings from the interviews were also highlighted.

V. Conclusions and Recommendations

Research Question and Summary of Graduate Research Project Conclusions

Research Question: What impact will the ARC's use of NGREA have on the modernization of KC-135s for ABMS?

This research aimed to comprehensively evaluate the level of impact the ARC's use of NGREA has on modernizing the KC-135 for ABMS. To determine the degree of impact required an analysis of 15 participants, 36 interviews, 4 commands, 40 hours of transcription, 2 Ph.D. student coders, communicating directly with the VJCS, HAF leadership, the AMC commander, and reviewing multiple sources ranging from published, unpublished, and peer-reviewed literature. The research project revealed that the ARC does have significant impact complementing ABMS when using NGREA to modernize the KC-135 with RTIC and the GLADIATOR pod.

The study also highlighted that the ARC had been successfully exercising rapid prototyping and rapid fielding for decades. More specifically, with NGREA funding, the ARC initiated and convinced AMC to invest in RTIC. The plan for upgrading all ARC and active duty tankers has been approved. However, the only serious hiccup was the reprogramming of the Fiscal Year 2020 NGREA funds to the border wall, which delayed the installation.

RTIC complements the ABMS concept by delivering enhanced communications and situational awareness directly to the warfighter. Based on the Strategic RTIC/HVAA GLADIATOR Roadmap, baseline RTIC is essential in turning the tide in a future high-end fight, but it cannot do it alone. Instead, it will require upgrades beyond the baseline level. Dr. Roper

and the RCO have pushed for a podded solution, and the ARC have delivered with HVAA GLADIATOR pod system. With John Hopkins University's ingenuity with transforming the MPRS pod and GTRI's ALR-69A integration, the KC-135 will now be a weapon system that can act as a node in the ABMS network with the ability to be defensive. With RTIC and the GLADIATOR, the KC-135 will be a complete package that can allow it to operate in contested airspace with increased survivability.

For the ARC to continue to be impactful, it needs to improve its communications and relationship with the lead-MAJCOM, AMC. The overall negative sentiment for NGREA was due to the C-130H RTIC and C-130H AMP Increment I breakdowns. The main finding was misaligned priorities between the ARC and AMC. Recovering the trust is imperative for all parties, especially if the USAF is trying to implement the CSAF's *Accelerate Change or Lose* policy.

Recommendations for Action

There are seven recommendations for action based on the interviews regarding the ARC's use of NGREA to modernize and integrate KC-135s with RTIC and GLADIATOR Pods:

1. AMC should strongly consider employing the ARC to use NGREA funds for rapid prototyping, rapid fielding, and short-term sustainment for at least one Guard and one Reserve aircraft. The intent is to determine if the non-developmental item achieves proof of concept before investing large sums of money for the entire fleet. This idea is not formalized but has proven to be effective various times in the past. With China outproducing the United States on many fronts, collaborating and maximizing great ideas within the USAF will

counter adversarial competition. The ARC is ready to move in this direction. At the same time, this effort supports the CSAF's *Accelerate Change or Lose* policy.

2. AMC should seriously collaborate with the ARC to learn about their best practices in rapid prototyping, rapid fielding, and how they manage a strong relationship with the industry. First, AMC should increase representation and participation at ARC WEPTACs, requiring sending AMC tacticians and weapons officers to include senior leaders. AMC and AFLCMC have had representation but very minimal. The importance of witnessing the ARC process of identifying capability gaps and producing material solutions with industry partners at the premises is what differentiates the ARC from the MAF WEPTACs. In essence, the ARC has mastered rapid acquisition and industry collaboration in research and prototyping. AMC needs to exploit those best practices. Lastly, AMC needs to participate in ARC cross-tells and Combat Planning Councils. These are the meetings where priorities are debated. Most importantly, the ARC welcomes the idea of AMC increasing its collaborative efforts.

3. AMC should get all legacy MAF aircraft on the same RTIC build, including hardware and software. Investing RTIC and GLADIATOR pods for all legacy MAF weapon systems will bring down sustainment and logistics costs. Simultaneously, investing in the entire legacy MAF fleet will improve interoperability, compatibility, lethality, and survivability.

4. AMC and the ARC should encourage AFLCMC to establish a Tactical Data Link (TDL) SPO that will manage all datalink-related parts, funding, and sustainment.

This duty position will support all MAF aircraft datalink needs. In January 2019 AMC established the AMC/A3CJ TDL Branch in response to the dire need for TDL support; however, there is no formal MAF TDL SPO attached. Therefore, AMC and the ARC should propose to AFLCMC to create a MAF TDL SPO and assign them to AMC/A3CJ. More specifically, Hanscom AFB is responsible for RTIC and DRC sustainment but they are not the formal MAF SPO. Based on the interviews, there is a strong consensus to support the idea.

5. In line with recommendation #4, AMC and the ARC should propose to AFLCMC to establish an RTIC SPO for all RTIC related support and sustainment. The RTIC SPO should also be attached to AMC/A3CJ TDL Branch.

6. Based on the RTIC/HVAA GLADIATOR Roadmap, AMC should upgrade the baseline RTIC to stay ahead of China and Russia's mitigation efforts. Currently, RTIC without TTNT costs $400k total. In contrast, investing in RTIC with TTNT will cost $900k. To complete the package, the GLADIATOR Pod will cost $1.1M per aircraft. By investing in RTIC and GLADIATOR Pods which are already designed, will save time, money and meet both the RCO and CSAF's intents.

7. AMC should invest and provide a limited workforce (1-2 individuals) to support a Total Force Integration test detachment and ensure AMC's perspective is provided in future modernization efforts.

Recommendation for Future Research

Recommendations for further researcher should involve determining what is required to provide cyber assurance of TAMSS software. Possibly adding an application-like functionality to the baseline software may provide cybersecurity. Another study to explore would be verifying what is required to create a genuinely federated system that will work across all MAF and possibly CAF platforms. The ability to accomplish C3 functions and disseminate information before the enemy sees you, is critical. So, designing a federated system would avoid compatibility and interoperability issues like in the F-35 and F-22 cases.

Appendix A: Table 1. Analyzing Investigative Questions Relating To Sentiment

Table 1. Analyzing Investigative Questions Relating To Sentiment

Telling the Story				
Theme	Frequency		Meaning	Evidence
	Direct References	Aggregated References		
1. Overall NGREA sentiment			The researcher used NVivo to consolidate sentiment responses of all parties regarding the ARC using NGREA for strictly modernizing ARC legacy aircraft.	"AMC definitely does not like that and I agree with them. We should be using NGREA to modernize and bring Guard/Reserve airplanes up to the standards of the active duty." (NGB SME 2)
Negative	152	240		
Very Negative	80	80		
Moderately Negative	8	8		
Positive	154	206		
Very Positive	36	36		
Moderately Positive	16	16		
2. Overall sentiment of AMC and the ARC collaborating to modernize legacy aircraft			The researcher used NVivo to consolidate sentiment responses of all parties regarding the AMC and the ARC collaborating to modernize legacy aircraft.	"I will tell you straight, that it is not healthy. And it's not, productive sometimes, and the SPOs get caught in the middle of that quite often, where the Guard Bureau wants to do one thing and AMC either doesn't support it or has a different view." (SPO SME 2)
Negative	124	197		
Very Negative	72	72		
Moderately Negative	1	1		
Positive	138	168		
Very Positive	28	28		
Moderately Positive	2	2		

Appendix B: List of Acronyms

ABMS	Advanced Battle Management System
AEP	Airborne Executive Processor
AF	Air Force
AFLCMC	Air Force Lifecycle Management Center
AFRC	Air Force Reserve Command
AICES	Airborne Infrared Countermeasure Evaluation System
ALR-69A	Radar Warning Receiver
AMC	Air Mobility Command
AMP	Avionics Modernization Program
ANG	Air National Guard
ARC	Air Reserve Component
ARNG	Army National Guard
AWACS	Airborne Warning And Control System
B	Billion Dollars
BLOS	Beyond-line-of-sight
C2	Command and Control

C3	Command, Control, and Communications
CAD	Computer Aided Design
CAF	Combat Air Force
CAM	Certificate Arbitrator Module
CJADC2	Combined Joint All Domain Command and Control
CSAF	Chief of the Air Force
DevSecOps	Software Development, security, and operations
DCA	Defensive Counter Air
DoD	Department of the Defense
GTRI	Georgia Tech Research Institute
HASC	House and Senate Armed Services Committees
HQ	Headquarters
HVAA	High Value Airborne Asset
IP	Internet Protocol
IW	Integrated Waveform
JADC2	Joint All Domain Command and Control
JREAP	Joint Range Extension Applications Protocol

JTIDS	Joint Tactical Information Distribution System
KC-135	KC-135R Stratotanker air-to-air refueling aircraft
KC-46	KC-46A Pegasus air-to-air refueling aircraft
LAIRCM	Large Aircraft Infrared Counter Measure
LCSP	Life Cycle Sustainment Plan
LOS	Line-of-sight
MAF	Mobility Air Force
MAJCOM	Major Command
MIDS	Multifunctional Information Distribution System
MPRS	Multiple Point Refueling System
MS	Milestone
NATO	North Atlantic Treaty Organization
NDS	National Defense Strategy
NGB	National Guard Bureau
NGREA	National Guard and Reserve Equipment Appropriations
O&M	Operation and Maintenance
OSD	Office of the Secretary of Defense

P-1R	Reserve subset of the President's Budget
PEO	Program Executive Officer
POM	Program Objective Memorandum
PPBE	Planning, Programming, Budgeting, and Execution
PRESBUD	President's Budget
RC	Reserve Component
RCO	Rapid Capabilities Office
RDT&E	Research, Development, Test, and Evaluation
RTIC	Real-Time Information in-the-Cockpit
RWR	Radar Warning Receiver
SADL	Situational Awareness Data Link
SATCOM	Satellite Communications
SASC	Senate and House Defense Appropriations Subcommittees
SME	Subject Matter Expert
SPO	System Program Office
TAMSS	Tactical Airlift Mission Software Suite
TDL	Tactical Data Link

TOA	Total Obligation Authority
TSAS	Tactical Situational Awareness System
TTNT	Tactical Targeting Network Technology
TTP	Tactics, Techniques, and Procedure
OSD	Office of the Secretary of Defense
UHF	Ultra-High Frequency
USAF	United States Air Force
USAFR	United States Air Force Reserve
USAR	United States Army Reserve
USMCR	United States Marine Corp Reserve
USNR	United States Navy Reserve
UTAP-22	Kratos Unmanned Tactical Aerial Platform-22
VCJS	Vice Chairman of the Joint Chiefs of Staff
WEPTAC	Weapons and Tactics Conference

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Curriculum Vita

May 2021

DAVID RODRIGUEZ, Maj, USAF
Student, Advanced Study of Air Mobility
United States Air Force Expeditionary Center
5656 Texas Avenue
Joint Base McGuire-Dix-Lakehurst, NJ 0864-5403
Email: david.rodriguez.68@us.af.mil
Voice: 609-754-7320 (DSN: 650-7320)
Security Clearance: Top Secret
linkedin.com/in/david-rodriguez-790206208

EDUCATION

Ph.D. Candidate in Aviation (Safety & Human Factors), Embry-Riddle Aeronautical University, 4.0 GPA, Dissertation Title "Career Path Choice and Job Satisfaction of Doctorate Recipients in Aerospace, Aeronautical, and Astronautical Engineering", 2016-Present
Air Command and Staff College (Correspondence), 2020
Advanced Tactics Aircrew Course Graduate, Advanced Airlift Tactics Training Center - Rosecrans ANGB & Ft. Huachuca, 2019
Basic RF Electromagnetic Warfare Concepts, Georgia Tech Research Institute, 2019
Reserve Officer Development Course, USAFA, 2014
Combat Aircrew Tactics Studies-Mobility Electronic Combat Officer Course, Advanced Airlift Tactics Training Center, 2014
Air Reserve Component Chief of Safety Course Graduate with Distinction, MacDill AFB, 2013
Squadron Officer School (Top Third Graduate/Residence), Maxwell AFB AL, 2012
Junior Officer Leadership Development Course, Nellis AFB NV, 2011
Aircraft Mishap Investigation Course, Kirtland AFB, 2010
Master of Science, Aeronautics, Embry-Riddle Aeronautical University, 2010
Bachelor of Science, Electronics Engineering, Thomas Edison State University, 2005
Associate of Applied Science Degree, Avionics Technology, Community College of the Air Force, 2003
Airman Leadership School (Correspondence), 2001

EXPERIENCE

2021 - 2022	Student, School of Advanced Air and Space Studies (SAASS); Maxwell AFB, AL
2020 - Present	Student, Advanced Study of Air Mobility (ASAM); USAF Expeditionary Center, JBMDL, NJ
2018 - Present	Air Reserve Technician; C-17A Instructor Aircraft Commander, GS-13, JBMDL, NJ
2019 - 2020	Chief, Wing Tactics; USAF Reserve 514 AMW, JBMDL, NJ
2018 - 2019	Chief, C-17A Tactics; USAF Reserve 732 AS, JBMDL, NJ
2017 - 2018	Chief of Scheduling; USAF Reserve 732 AS, JBMDL, NJ
2016 - 2017	Wing Executive Officer; USAF Reserve 514 AMW, JBMDL, NJ
2015 - 2016	Assistant Flight Commander; USAF Reserve 732 AS, JBMDL, NJ
2014 – 2015	Executive Officer; USAF Reserve 732 AS, JBMDL, NJ
2013 - 2014	Chief of Safety; USAF Reserve 732 AS, JBMDL, NJ
2012 - 2013	Safety Officer; USAF Reserve 732 AS, JBMDL, NJ
2011 - 2011	Student; C-17A, Altus AFB, OK
2010 - 2010	Deputy Director, Crisis Action Team; NJANG 108 ARW, JBMDL, NJ
2008 - 2010	OPLAN 8010 Instructor/Planner; Wing Plans & Programs; NJANG 108 WG, JBMDL, NJ
2007 - 2008	Training & Tactics Officer; NJANG 141 ARS, JBMDL, NJ
2007 - 2007	Student; KC-135, Altus AFB, OK
2005 - 2006	Student; Joint Specialized Undergraduate Pilot Training, Laughlin AFB, MS

2005 - 2005 Academy of Military Science Graduate; Knoxville ANGB, TN
1997 - 2005 Avionics Craftsman; TSgt, NJANG 108 ARW, JBMDL, NJ

AWARDS

Meritorious Service Medal (1 OLC)
Air Medal (1 OLC)
Air Force Commendation Medal
Air Force Achievement Medal (2 OLCs)
Meritorious Unit Award (1 OLC)
AF Outstanding Unit Award w/Valor (2 OLCs)
Combat Readiness Medal (1 OLC)
Air Reserve Forces Meritorious Service Medal (1 OLC)
514 OSS Innovation Team Award, 2019
4 AF Aircrew of Excellence (Aircraft Commander), 2016
385 AEG Top Aircrew of the Month (Aircraft Commander), May 2016
514 AMW CGO of the Year Nominee, 2014
732 AS Co-Pilot of the Year, 2012
AFA Outstanding Airman of the Year; 108 ARW, 2001
Rotary International Outstanding Airman of the Year; 108 ARW, 2001

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Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Way
Wright-Patterson AFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Col Joseph M. Vanoni
43d Air Mobility Operations Group
4520 Reilly Rd. Bldg 309
Pope Army Air Field, NC 28308
joseph.vanoni@us.af.mil

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14. ABSTRACT
This research project explores the ARC and AMC collaborative efforts to rapidly prototype, field, and fund KC-135 RTIC and HVAA Gladiator pods. With the need for rapid prototyping and rapid fielding to compete against China's technological wave, this study focuses on the ARC's impact on modernizing the KC-135 with RTIC and pods to complement the ABMS. Through content analysis methodology and NVivo software, interviews from subject-matter-experts and literature review were analyzed for themes and sentiment relating to the ARC, AMC, NGREA, KC-135, RTIC, and HVAA Gladiator pods.

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