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USING CHALLENGE-BASED ACQUISITIONS TO SUPPORT ARMY MODERNIZATION AND ACHIEVE REVOLUTIONARY CHANGE THROUGH EVOLUTIONARY, INCREMENTAL STEPS

June 2020

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MODERNIZATION AND ACHIEVE REVOLUTIONARY CHANGE THROUGH
EVOLUTIONARY, INCREMENTAL STEPS**

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from the

**NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

This project identifies strategic objectives of the United States Army's aviation modernization efforts and explores the use of Challenge Based Acquisitions (ChBA) as an effective approach to efficiently capture innovation which can transition into capabilities that support the Warfighter. This research investigates if a ChBA procurement approach can be effectively applied to Army's Aviation Modernization priorities, permitting continuous iterative access to DOD and commercial industry innovations. The goal is to achieve fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary technology. Methodology examines the United States Army's strategic objectives in its efforts to modernize aviation and conduct a qualitative comparative analysis between ChBA and other Federal Acquisition Regulation (FAR)-based procurement approaches on their ability to stimulate the intended market. This project proposes a conceptual framework under which the U.S. Army might employ ChBA to effectively pursue innovative aviation concepts that can be used to bridge the technology gap and transition aviation capabilities to the Warfighter.

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TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	OVERVIEW.....	1
B.	BACKGROUND	2
1.	Understanding Innovation	3
2.	Understanding ChBA	4
C.	OBJECTIVE OF STUDY	7
D.	METHODOLOGY	8
E.	ORGANIZATION.....	8
F.	BENEFIT	9
G.	SUMMARY.....	9
 II.	 LITERATURE REVIEW	 11
A.	FOUR PROBLEMS ARMY FUTURES COMMAND NEEDS TO SOLVE	11
B.	ADOPTING INNOVATION	13
1.	Driving in the Dark: Ten Propositions About Prediction and National Security	13
2.	Diffusion of Innovation.....	14
C.	ATTRACTING INNOVATIVE INDUSTRY PARTNERS	16
D.	CHALLENGED BASED ACQUISITION (CHBA) USAGE IN THE DEFENSE ACQUISITION MANAGEMENT SYSTEM (DAMS)	18
E.	TRANSITION FROM CHBA TO FOLLOW-ON PROCUREMENTS.....	23
1.	From Incentive Prize and Challenge Competitions to Procurement	23
2.	10 USC § 2373—Procurement for Experimental Purposes	27
F.	XTECHSEARCH.....	28
G.	SUMMARY	29
 III.	 METHODOLOGY	 31
A.	CHBA EFFECTIVENESS METHODOLOGY	32
B.	CHBA ACCESSING INNOVATION METHODOLOGY	32
 IV.	 FINDINGS AND ANALYSIS	 35
A.	CHBA EFFECTIVENESS ANALYSIS.....	35
1.	xTechSearch Challenges.....	35
2.	xTechSearch COVID-19 Challenges.....	39

3.	XPRIZE Overview	40
4.	ChBA Assessment Table.....	40
5.	ChBA Effectiveness Analysis Summary	42
B.	CHBA ACCESSING INNOVATION ANALYSIS	43
1.	Procurement Method Comparison.....	43
2.	Contract Type Comparison	45
3.	Procurement Acquisition Lead Time Comparison.....	46
4.	Follow-On Contract Comparison.....	47
5.	Summary.....	49
C.	COMPARISON OF 15 U.S. CODE § 3719 AND 10 U.S. CODE § 2374A.....	49
D.	XTECHSEARCH ASSESSMENT	50
V.	CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH.....	53
A.	CONCLUSIONS AND RECOMMENDATIONS.....	53
B.	AREAS FOR FURTHER RESEARCH.....	55
	APPENDIX A. CONTRACTING STRATEGIES RELATED TO CHBA ATTRIBUTES.....	57
	APPENDIX B. 10 U.S. CODE § 2374A.....	61
	APPENDIX C. 15 U.S. CODE § 3719	63
	APPENDIX D. XTECHSEARCH COMPETITION 1.....	71
	APPENDIX E XTECHSEARCH COMPETITION 2.....	75
	APPENDIX F XTECHSEARCH COMPETITIONS 3 AND 4 FINALISTS	79
	LIST OF REFERENCES	81
	INITIAL DISTRIBUTION LIST	85

LIST OF FIGURES

Figure 1.	Four Types of Innovation. Source: Satell (2017).....	4
Figure 2.	Innovation-Decision Model. Adapted from Rogers (2003).....	15
Figure 3.	xTechSearch Competition Overview. Source: Army Research Laboratory (2020).	29
Figure 4.	xTechSearch Timeline. Source: Army Research Laboratory (n.d.).....	38
Figure 5.	Suggested Approach for FVL ChBA.....	54
Figure 6.	xTechSearch 3 Finalists. Source: Army Research Laboratory (n.d.).	79
Figure 7.	xTechSearch 4 Finalists. Source: Army Research Laboratory (n.d.).	79

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LIST OF TABLES

Table 1.	Acquisition Consideration, ChBA Compatibility, and Benefits. Source: Weatherly et al. (2013)	6
Table 2.	U.S. Army Innovation Framework. Adapted from Long (2019).	12
Table 3.	Attracting Industry Partners that Provide Innovation. Adapted from Ozarem et al. (2017).	17
Table 4.	ChBA Uses. Adapted from Weatherly et al. (2017).	20
Table 5.	DAMS and ChBA. Source: Weatherly et al. (2013).....	22
Table 6.	ChBA Transition to Sole Source Follow-On Acquisition. Adapted from Arendt and Novak (2016).....	24
Table 7.	ChBA Transition to Competitive Follow-On Evaluation Factors. Adapted from Arendt and Novak (2016).	25
Table 8.	xTechSearch Overview. Adapted from Army Research Laboratory (n.d.).	37
Table 9.	xTechSearch COVID-19 Overview. Adapted from Army Research Laboratory (n.d.).	39
Table 10.	ChBA Comparison Assessment.....	41
Table 11.	Comparison of ChBA and Grants/OTAs	44
Table 12.	PALT of New Contracts. Adapted from U.S. Army (2020).	47
Table 13.	Non-Competitive Follow-On Approval Thresholds	48
Table 14.	Comparison of Prize Competition Authorities	49
Table 15.	Contracting Strategies Related to Acquisition Attributes. Source: Roe et al. (2019).....	57
Table 16.	xTechSearch 1 Vendors. Source: Army Research Laboratory (n.d.).	71
Table 17.	xTechSearch 2 Vendors. Source: Army Research Laboratory (n.d.).	75

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LIST OF ACRONYMS AND ABBREVIATIONS

ACC	Army Contracting Command
AFC	Army Futures Command
BAA	Broad Agency Announcement
CAB	Combat Aviation Brigade
ChBA	Challenge-Based Acquisition
CFT	Cross Functional Team
D & F	Determination and Findings
DAG	Defense Acquisition Guide
DAMS	Defense Acquisition Management System
DARPA	Defense Advance Research Project Agency
DASA(P)	Deputy Assistant Secretary of the Army for Procurement
DFARS	Defense Federal Acquisition Regulation Supplement
DOD	Department of Defense
FAR	Federal Acquisition Regulation
FARA	Future Attack Reconnaissance Aircraft
FFRDC	Federally Funded Research and Development Center
FLRAA	Future Long Range Assault Aircraft
FTUAS	Future Tactical Unmanned Aerial System
FVL	Future Vertical Lift
FVL CFT	Future Vertical Lift Cross Functional Team
HCA	Head of Contracting Activity
IDIQ	Indefinite Delivery/Indefinite Quantity
IP	Intellectual Property
J & A	Justification and Approval
MOSA	Modular Open Systems Approach
NPS	Naval Postgraduate School
OFPP	Office of Federal Procurement Policy
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
OTA	Other Transaction Authority

OTAP	Other Transaction Authority for Prototype
RFP	Request for Proposal
SCO	Senior Contracting Officer
TIA	Technology Investment Agreement
TRL	Technology Readiness Level
UON	Urgent Operational Need

EXECUTIVE SUMMARY

1962 CH-47 Chinook. 1979 UH-60 Black Hawk. 1986 AH-64 Apache. 1969 OH-58 Kiowa. The first three helicopters are still in use by Army Combat Aviation Brigades (CAB). The last (OH-58 Kiowa) has since been retired after three unsuccessful attempts to replace it. Perhaps the most famous example of the attempts at replacement is the RAH-66 Comanche program.

The intent of this research is to explore ChBA as an approach which can be used to develop a culture of continuous innovation. While it is understood that a ChBA approach will not be the single solution to the Army's Acquisition woes with regard to Aviation Modernization, this research will focus on effective implementation of a procurement process which supports the ChBA approach and allows recurring opportunity for demonstrating innovations that can increase the Army's current capability. This research will analyze the Army's xTechSearch as a platform to implement a ChBA approach and analyze methods to allow seamless transition to follow-on procurement.

Qualitative research methods will be used to evaluate the effectiveness of ChBA to create a pipeline of continuous innovation which can be leveraged to support the Modernization of Army Aviation. The first step of this analysis will be to compare the construct of prize competitions conducted in the public and private sectors. The second step will be a comparative analysis between ChBA and other FAR and non-FAR based procurement methods used to access innovation.

The benefit of this research is the exploration of approaches which can be effectively applied to Army's Aviation Modernization priorities while permitting continuous iterative access to innovations which may not have otherwise been discovered. When technically viable, innovations and capabilities can be transitioned more rapidly to the warfighter and the operational environment while the technology is still useful and relevant. The goal will be to achieve fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary

technology while affording the flexibility needed to react to changing priorities within Army Aviation Modernization.

After fully analyzing the xTechSearch program, it is believed that this program should provide the foundation of any ChBA efforts performed to support Army Aviation Modernization. The program provides a solid foundation for market stimulation and attracting innovative startups. Conversely, the characteristics displayed during the COVID-19 challenge illustrate the flexibility and adaptability of xTechSearch to fulfill UONs and efforts that support Army Aviation Modernization requirements generation. Furthermore, while the xTechSearch program has focused, thus far, on immature technologies, it is recommended that a competition be created which focuses on the Army's Modernization Priority #3—FVL. While the determination of which authority to exercise is dependent upon the overall requirement, it is believed that issuing a challenge in support of Army Aviation Modernization under 10 USC § 2374a would provide the broadest coverage across all companies and access to all technologies across the TRL spectrum.

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I. INTRODUCTION

A. OVERVIEW

1962 CH-47 Chinook. 1979 UH-60 Black Hawk. 1986 AH-64 Apache. 1969 OH-58 Kiowa. The first three helicopters are still in use by Army Combat Aviation Brigades (CAB). The last (OH-58 Kiowa) has since been retired after three unsuccessful attempts to replace it. Perhaps the most famous example of the attempts at replacement is the RAH-66 Comanche program.

Famed Acquisition Professional Dan Ward recounts the history of the Comanche program. He states that the helicopter was supposed to be a “super-stealthy light attack helicopter, bristling with advanced sensors and communication gear, was going to perform loads of armed reconnaissance and surveillance missions. Its planned ferry range would even allow it to cross an ocean” (Ward, 2012). The Comanche program was started in 1982, under the presidency of Ronald Reagan when the U.S. and Soviet Union were engaged in the Cold War. The Request for Proposal (RFP) was issued six years later (1988) and contract award occurred another three years later (1991). Comanche was eventually canceled after 22 years (in 2004) spending \$6.9 billion and producing ZERO helicopters. Subsequent case studies of the Comanche program have identified a variety of reasons for its lack of success. For starters, many “aspects of Comanche’s technology were deemed too risky (i.e., immature i.e., hadn’t actually been developed i.e., didn’t exist)” (Ward, 2012). He states that “[t]his reliance on imaginary technical components reflects an obese requirement set that had only a passing acquaintance with reality” (Ward, 2012). It should also be noted that the world changed enormously between 1982 and 2004 and that “this stealthy super chopper suddenly had limited relevance to real-world mission needs” (Ward, 2012). Lessons learned are summarized by noting that “military tech programs should exercise design restraint, establish strict budget and schedule constraints, and rely on proven technologies to deliver necessary capability on operationally relevant timelines” (Ward, 2012).

Challenge-based acquisition (ChBA) is a method used to demonstrate innovative and cost-saving technologies which can be incorporated into acquisition programs by conducting prize competitions (i.e., challenges), which can be incorporated within the procurement framework of the Federal Acquisition Regulation (FAR). Issuing challenges allow industry partners to demonstrate their innovative solutions in real world/operational environments. The results of these challenges/prize competitions can then serve as the core evaluation in the Government's source selection. This shifts the focus of evaluations from industry partners who may be good at writing proposals to those whose provide solutions by demonstrating the ability to close a capability gap.

The intent of this research is to explore ChBA as an approach which can be used to develop a culture of continuous innovation. While it is understood that a ChBA approach will not be the single solution to the Army's Acquisition woes with regard to Aviation Modernization, this research will focus on effective implementation of a procurement process which supports the ChBA approach and allows recurring opportunity for demonstrating innovations that can increase the Army's current capability. This research will analyze the Army's xTechSearch as a platform to implement a ChBA approach and analyze methods to allow seamless transition to follow-on procurement.

B. BACKGROUND

On 1 July 2018, in an attempt to change its culture and align their vision, the United States Army established Army Futures Command (AFC) to "lead a continuous transformation of Army modernization in order to provide future warfighters with the concepts, capabilities and organizational structures they need to dominate a future battlefield." (US Army, 2020) AFC chartered Cross Functional Teams (CFTs) to focus on its modernization priorities—1) Long Range Precision Fires; 2) Next-Generation Combat Vehicle; 3) Future Vertical Lift; 4) Mobile and Expeditionary Network; 5) Air and Missile Defense; and 6) Soldier Lethality.

Sydney Freeburg describes the current dilemma of Army officials when he says, "The Army Chief of Staff [Milley] wants revolutionary new weapons. The Army Secretary [Esper] wants affordable technology fast. How can they reconcile these opposites? By

building systems with off-the-shelf tech but leaving room to upgrade them with radically new tech when it's ready...Call it evolutionary revolution" (Freeburg, 2018).

AFC's Future Vertical Lift Cross Functional Team (FVL CFT) is the group which has been organized to lead the modernization of Army aviation capabilities. The FVL CFT has a commitment to "staying on schedule and exercising disciplined requirements development based on known, proven technologies" (US Army, 2020). The FVL CFT is "postured to develop and acquire Army Aviation's next generation of aircraft and unmanned systems with revolutionary increases in reach, protection, lethality, and agility at the objective allowing FVL to fly, fight and prevail in any environment. (US Army, 2020)" The FVL CFT has structured its focus around four Signature Efforts (SE)—1) Future Attack Reconnaissance Aircraft (FARA) (intended to modernize the Army's Scout helicopter capability); 2) Future Long Range Assault Aircraft (FLRAA) (intended to modernize the Army's Assault helicopter capability); Future Tactical Unmanned Aerial Systems (FTUAS) (intended to modernize the Army's UAS capability); and Modular Open Systems Approach (MOSA) (intended to allow the three previously mentioned platforms to be rapidly modernized as new technologies emerge)—and four supporting efforts—Affordability; Lethality; Reach; and Survivability. This structure is supportive of the evolutionary revolution approach previously referenced. However, a culture of evolutionary revolution will require a pipeline that allows industry partners to continuously demonstrate innovative technologies which can be added incrementally.

1. Understanding Innovation

The Harvard Business Review provides that there is "no one 'true' path to innovation" (Satell, 2017). This is because there are many types of problems—of varying complexity—which need to be solved. Thus, innovation, just like other business disciplines, should be treated with a portfolio of strategies designed to attain specific objectives. This set of tools is outlined in Figure 1.

4 Types of Innovation

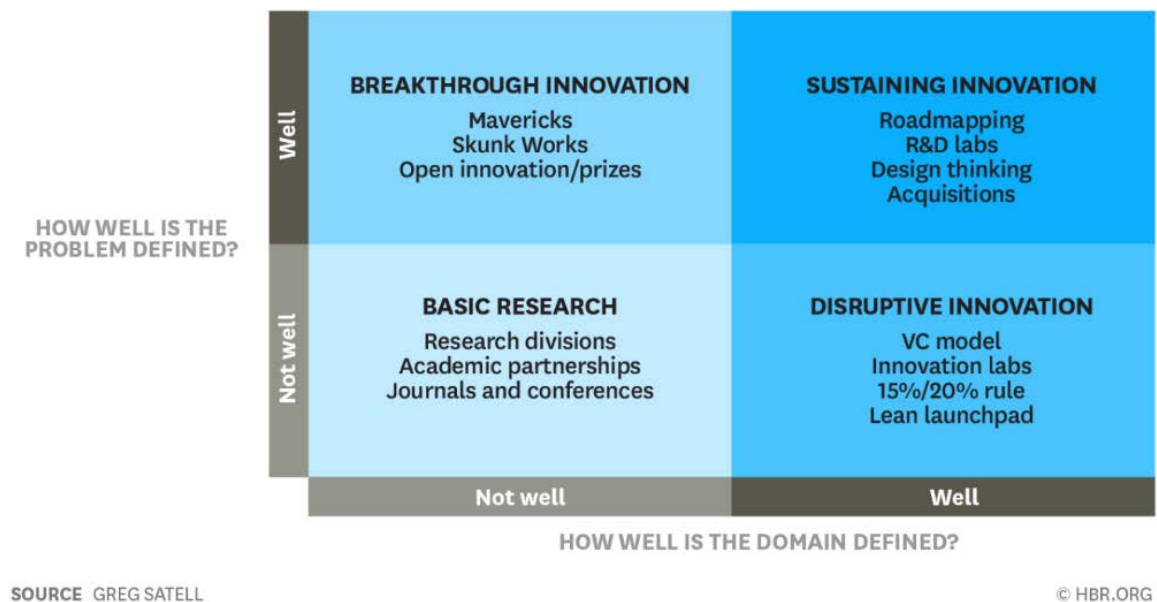


Figure 1. Four Types of Innovation. Source: Satell (2017).

This framework is important to developing an understanding of effectively attract innovation solutions. This framework also highlights the use of prize competitions (i.e., ChBA) as a methodology to be used when the problem set is well defined and the field of study may not be as well defined.

2. Understanding ChBA

The MITRE Corporation's Handbook on ChBA provides an in-depth overview as to why it is an effective method for the Army to use in support of its goal of Aviation modernization.

Most contracts are awarded using Government source selection evaluations based on industry paper proposals rather than actual product performance. This creates an incentive for industry to produce flawless documents with highly optimistic cost, schedule, and performance projections that meet RFP requirements. As a result, performance during program execution often falls short of the Government's expectations, and cost and schedule overruns become nearly inevitable.

Challenges and prize contests differ from traditional development activities that fund participants for their time and materials. Federal resources are instead devoted to developing an infrastructure and/or awards that incentivize external parties to devote their own resources to overcoming the stated problem or addressing the capability sought. When developed and managed properly, challenges and prize competitions can stimulate significantly more innovation than would be possible through the implementation of traditional acquisition strategies and approaches. The concept is not new, but its usage within innovation programs and as part of the federal acquisition process has rapidly increased over the past several years. (Roe, Arendt, & Novak, 2019)

MITRE outlines three procurement methods that can best suited to implement ChBA-1) A Broad Agency Announcement (BAA); 2) A Multiple Award Indefinite Delivery/Indefinite Quantity (IDIQ); 3) An Other Transaction Authority (OTA). While these procurement methods are recognized as effective methods to implement the initial ChBA, it is more important to consider the actions which need to occur after the prize competition has concluded. These subsequent actions should provide a smooth transition to procure quantities needed for further testing, experimentation, and production. Appendix A outlines contracting strategies related to ChBA Attributes.

While soldiers are good at improvising solutions which address shortcomings encountered on the battlefield, they may find it difficult to imagine innovative solutions without first seeing a proposed solution's demonstrated capability. ChBA provides soldiers the opportunity to assess the likely success of incremental improvements to battlefield capability. Table 1 highlights several attributes and benefits of using ChBA prize competitions. "They include expanding user involvement, leveraging technology, reducing the risk through proof of delivery rather than paper-based proposals, accommodating the full life cycle of a fielded system or product, utilizing the most appropriate contracting methods, and engaging industry to obtain competitive advantage" (Weatherly et al., 2013).

Table 1. Acquisition Consideration, ChBA Compatibility, and Benefits.
Source: Weatherly et al. (2013)

Acquisition Priority	ChBA Attribute	ChBA Benefits
Urgent Warfighter Mission Needs / Accelerated Fielding Timeline	ChBA is well suited to meeting urgent and high-priority requirements. These needs are often very specific and amenable to description as acquisition challenges. Additionally, the urgency of the need relaxes most of the DOD Instruction 5000.02 constraints. (FAR 6.302-2 Urgent and Compelling Need).	ChBA allows rapid development of advanced technology, including both military and commercial variants. It can result in fielding the correct solution the first time and avoiding additional costs of rework and schedule slippage—ideal for meeting urgent warfighter needs.
Technological Maturity	By definition, ChBA requires vendors to offer mature technology in order to participate in a challenge event.	ChBA allows new functionality and interoperability to be tested in a concurrent environment, ensuring a more operationally ready product and thus reducing testing costs and timelines.
System Life-Cycle Support / Upgrade Considerations	ChBA is best suited for technology-intensive acquisitions, which are likely to be short lived given the rapid pace of technology evolution.	ChBA fits well into short-duration programs, where constraints in the Operations and Support phase of the Defense Acquisition Management System process become irrelevant.
Efficient Contracting Processes	ChBA can be executed using Broad Agency Announcements (BAAs), Indefinite Delivery / Indefinite Quantity (ID/IQ) contracts, Single Awards, Blanket Purchase Agreements (BPAs), or Multi-Award Contracts (MACs).	ChBA can employ a flexible, streamlined contracting process suited to a variety of contracting vehicle types. This enables the program manager to leverage the contracting type that best suits the program's needs and individual tolerance for risk.
Enhanced Industry Competition	ChBA is structured to encourage a diverse range of industry members (including nontraditional defense suppliers), to participate, thus making for a highly competitive environment.	Because ChBA lowers market entry barriers to nontraditional DOD suppliers, it provides enhanced opportunities for competition that may not normally arise within the traditional defense marketplace.

Prize competitions supporting ChBA are typically performed under one of the two authorities—10 U.S. Code § 2374a (full text shown in Appendix B) or 15 U.S. Code § 3719, better known as the America COMPETES Act (full text shown in Appendix C).

While these two authorities are similar in that they both provide provisions for prize competitions, the legislation provided in Title 10 is specific only to the DOD vice the entire

Federal Government in Title 15. Furthermore, digging deeper into the language used provides additional insight. Note that Title 15 states “award prizes competitively to stimulate innovation that has the potential to advance the mission of the respective agency” whereas Title 10 states “award cash prizes and other types of prizes that the Secretary [Defense] determines are appropriate to recognize outstanding achievements in basic, advanced, and applied research, technology development, and prototype development that have the potential for application to the performance of the military missions of the Department of Defense.” The distinction between these two phrases is significant. The reference to stimulation in Title 15 is indicative of low Technology Readiness Level (TRL) initiatives while the language used in Title 10 suggests wider coverage across the TRL spectrum.

In summary, the Army recognizes these past failures and have established a Four-Star Command to organize and lead their modernization efforts. While this is a positive first step in fostering a culture of change, additional analysis on improved procurement methods is necessary. It is also important to understand that accessing innovative solutions that support the modernization of efforts is a complex procedure which requires strategic investment across a portfolio of innovation types. ChBA is an approach which is used to develop a foundation which incentivizes industry partners to “devote their own resources to overcoming the stated problem” (Roe et al., 2019) and demonstrates solutions to the capability sought.

C. OBJECTIVE OF STUDY

The primary objectives of this research are to:

1. Investigate if a ChBA procurement approach can be effectively applied to Army’s Aviation Modernization priorities, permitting continuous iterative access to DOD and commercial industry innovations. The goal will be to achieve fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary technology.
2. To conduct a qualitative comparative analysis between ChBA and other FAR-based procurement approaches on their ability to stimulate the intended market, while increasing access to innovative technologies that can be

rapidly delivered to the Warfighter. The goal will be to discover an approach that provides the flexibility needed to react to changing priorities within Army Aviation Modernization.

D. METHODOLOGY

Qualitative research methods will be used to evaluate the effectiveness of ChBA to create a pipeline of continuous innovation which can be leveraged to support the Modernization of Army Aviation. The first step of this analysis will be to compare the construct of prize competitions conducted in the public and private sectors. Restrictions placed on the public sector by the FAR, may constrain the effectiveness of ChBA when compared to private sector prize competitions. Analysis will assess the depth and breadth of public and private competitions to access innovative technologies of industry partners. This will be done by comparing the number of participants in each sector as a measure of stimulating the market. The diversity of participants will be examined to assess the viability of competitions to uncover partners which may not have otherwise been considered.

The second step will be a comparative analysis between ChBA and other FAR and non-FAR based procurement methods used to access innovation. Analysis will include the evaluation of the return on investment of these methods by comparing the expected results of different procurement methods and assessing their capability to develop innovative solutions. ChBA will also be compared to the two contract types—fixed price and cost reimbursement—to assess the assumption of risk at the appropriate time. Further analysis will include the comparison of Procurement Acquisition Lead Time (PALT) between ChBA and other FAR and non-FAR procurement methods. Finally, methods of procurement will be analyzed for smooth and efficient transition after the prize competition has ended.

E. ORGANIZATION

Chapter II consists of a literature review that examines topics needed to perform analysis and arrive at conclusions in the subsequent chapters. Documents reviewed include reports from the Modern War Institute and the Center for a New American Society; a review of Rogers' Five Factors; Boston Consulting Group—Why Startups Don't Bid on Government Contracts; a report from the NPS Acquisition Symposium on how ChBA can be used to

support DOD Acquisition; and a resource from the MITRE Corporation that examines the transition from incentive prize challenge competitions to procurements.

Chapter III identifies the methods and models used perform to analysis of this research. Qualitative research methods will be used to evaluate the effectiveness of ChBA to create a pipeline of continuous innovation which can be leveraged to support the Modernization of Army Aviation. A comparative analysis between ChBA and other FAR and non-FAR based procurement methods used to access innovation will be performed.

Chapter IV applies the analysis frameworks previously developed to requirements necessary to support the Modernization of Army Aviation. Chapter V finalizes this report by summarizing the results of the research conducted, providing additional recommendations, and presenting topics for further research.

F. BENEFIT

The benefit of this research is the exploration of approaches which can be effectively applied to Army's Aviation Modernization priorities while permitting continuous iterative access to innovations which may not have otherwise been discovered. When technically viable, innovations and capabilities can be transitioned more rapidly to the warfighter and the operational environment while the technology is still useful and relevant. The goal will be to achieve fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary technology while affording the flexibility needed to react to changing priorities within Army Aviation Modernization.

G. SUMMARY

This chapter discussed the overview and scope of the research, provided background information into why this research is necessary, defined the methodology used to conduct this research, and provided the organization for presentation of results in future chapters. Lastly, potential benefits are discussed with the assumption that the proposed approach can be successfully implemented.

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II. LITERATURE REVIEW

This chapter provides a literature review of initiatives, regulations, and guides that apply to this research. These include reports from the Modern War Institute and the Center for a New American Society; review of frameworks provided in Rogers’ Diffusion of Innovation; Boston Consulting Group—Why Startups Don’t Bid on Government Contracts; a report from the NPS Acquisition Symposium on how ChBA can be used to support DOD Acquisition; a resource from The MITRE Corporation on transitioning from Incentive Prize Challenge Competitions to Procurements, and reviews of 10 U.S. Code § 2373 and the Army’s xTechSearch program

A. FOUR PROBLEMS ARMY FUTURES COMMAND NEEDS TO SOLVE

The Modern War Institute applies Satell’s framework when discussing some of the challenges AFC will face in its effort to “streamline and consolidate, and bring unity of command and purpose to the Army for the development of our future capabilities” (Long, 2019). It continues to state that the “first challenge in institutional innovation is balancing investments and priorities to create a comprehensive innovation portfolio targeting organizational needs” (Long, 2019). Table 2 further defines Satell’s framework as it applies to the U.S. Army’s Modernization priorities.

Table 2. U.S. Army Innovation Framework. Adapted from Long (2019).

Innovation Type	Definition	Examples
Basic research	Raw conceptual work feeding later development, often associated with university research	Developing a physics theorem that applies to microchip development
Sustaining innovation	Develops existing organizational capabilities,	Increasing weapon ranges or processing speed, often through acquisition or incremental improvement
Breakthrough innovation	Focuses on easily defined problems with complex and multidisciplinary solutions ideal for collaborative events like hackathons	Excess carbon dioxide and potential impact on climate change
Disruptive innovation	Deals with emerging technologies that begin as unsophisticated prototypes, which evolve and replace established technologies by meeting previously unserved needs	Drones or artificial intelligence

Long notes that “while quadrant priorities vary by industry, one element is constant: failure to diversify and balance investment invariably creates vulnerabilities. (Long, 2019)“ The CFTs, by upgrading existing Army capabilities, are placed squarely in the sustaining innovation quadrant. The Army can acquire basic research by collaborating with groups like Defense Advanced Research Projects Agency (DARPA), Federally Funded Research and Development Centers (FFRDCs), and academia. It is imperative that AFC enhances its innovation portfolio “with aggressive investment in the remaining two quadrants: breakthrough and disruptive innovation” (Long, 2019).

This article expands on Satell’s framework and further defines the expectations of the Army in maximizing the innovation discipline. It also notes that the Army needs to

invest more in two of the quadrants—breakthrough and disruptive. Investment in innovation requires a strategic approach that evolves the portfolio through market stimulation and provides access to technologies that will improve pursuits in Army Aviation Modernization.

B. ADOPTING INNOVATION

History shows that the process of delivering innovation to end users can be ineffective if not done properly. The resources reviewed in this section will explore factors critical to end users adopting innovation. Furthermore, the factors outlined will be used to assess the Army’s ChBA program, xTechSearch, and further structure components in the design of challenges that will support the adoption of innovation.

1. Driving in the Dark: Ten Propositions About Prediction and National Security

Richard Danzig, of the Center for a New American Security, explains how many of the DOD’s acquisition programs are “driving in the dark.” That is, they are relying on “prediction to forecast needs and influence the design of major equipment” (Danzig, 2011). The report provides a listing of propositions that can be used to “better design processes, programs and equipment to account for the likelihood of predictive failure” (Danzig, 2011). They are:

- **Accelerating decision tempo and delaying some decisions—**
“dramatically narrow the time between the initiation of a concept and its realization” (Danzig, 2011).
- **Increasing the agility of our production process—**“using adaptive manufacturing techniques that generate the ability to switch products and modify models quickly as new circumstances arise” (Danzig, 2011).
- **Prioritizing adaptability—**“the requirements process should be modified to place a premium on operational flexibility” (Danzig, 2011).

- **Building more for the short term**—“seek to acquire more equipment for the short term, as is done in the consumer environment” (Danzig, 2011).
- **Nurturing diversity and creating competition**—“competition and diversity produce a valuable range of potential responses when unpredicted challenges and difficulties arise” (Danzig, 2011).

This article is important to this research because it provides insights into how the Army can access innovations that will advance the culture of change. Furthermore, the propositions outlined can be useful to provide a foundation of values when implementing ChBA. Specifically, ChBA can be a mechanism used to build for the short term and accelerate decision tempos while nurturing diversity and creating competition. Similarly, prioritizing adaptability (i.e., operational flexibility) would serve as an excellent evaluation factor when assessing technologies demonstrated during prize competitions employed when conducting ChBA. Lastly, while the increased agility of production processes serves as a “driving” force for innovation, it can also be demonstrated in tailored ChBA competitions.

2. **Diffusion of Innovation**

Everett Rogers was a Distinguished Professor Emeritus in the University of New Mexico’s Department of Communication and Journalism who originated theory of the diffusion of innovation. Rogers notes that “innovations require a lengthy period of many years from the time when they become available to the time when they are widely adopted” and that a common problem of many organizations is “how to speed up the rate of diffusion an innovation” (Rogers, 2003). To tackle this conundrum, Rogers has developed a model to guide the Innovation-Decision process as shown in Figure 2.

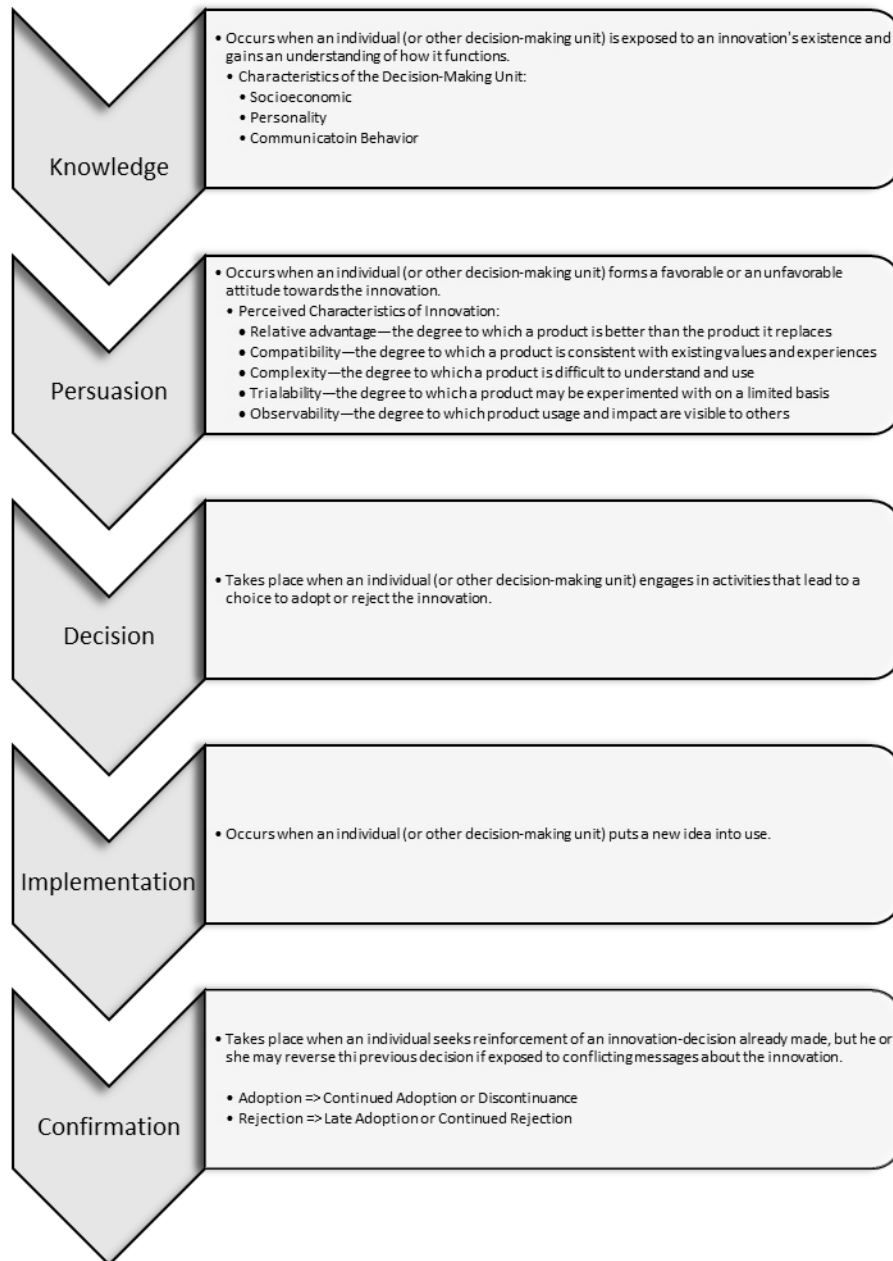


Figure 2. Innovation-Decision Model. Adapted from Rogers (2003).

This literary source is important to the research of implementing ChBA as a method to advance the modernization of Army Aviation because it outlines a process and provides several factors which, when accounted for, can favorably support the adoption of new technologies and innovations. When implemented correctly, it is believed that ChBA can combine the knowledge and persuasion steps into a single decision point. Likewise, the

factors of persuasion should be accounted for in ChBA prize competitions Participation during demonstration can provide relevant users (i.e., Soldiers) the “trialability” and “observability” needed to successfully deploy new and innovative technologies. Moreover, the “relative advantage,” “compatibility,” and “complexity” can be incorporated into challenges as evaluation factors and assessed during demonstration.

C. ATTRACTING INNOVATIVE INDUSTRY PARTNERS

Historically, the public sector has served as the hub for innovation, capturing technologies that have led to air travel, space travel, and the invention of the internet. However, as time has passed and the number of businesses has continued to expand, the tables have turned as businesses prefer to share innovative techniques in the private sector. The Boston Consulting Group conducted an analysis as to why startups do not bid on government contracts. This analysis was based on a survey of 109 organizations consisting of startups, venture capital firms, and angel firms. Orazem et al. (2017) summarized the results of this survey into a list. Table 3 highlights the steps that government agencies can use to better attract industry partners which harbor innovation.

Table 3. Attracting Industry Partners that Provide Innovation. Adapted from Ozarem et al. (2017).

Recommended Action	Recommendation for Implementation
Push opportunities through private-sector channels	Do not wait on industry to come to government. Go where they go (e.g., TechCrunch, Wired, and TheFunded)
Focus on outcomes, not approaches	Avoid “overly prescriptive RFPs” to allow for maximum opportunities for new and innovative approaches
Model government procurement after private-sector procurement	Provide greater access to lessons learned, capability building and content development
Provide startups with more feedback	“Startups are eager to understand how customers want to use their product or discover customer pain points that the product could address”
Streamline contracting	“Deploy a wide array of fast, flexible contracting mechanisms that induce engagement” by: • Employing off-ramp clauses—short assessments which provide an exit every two or three months • Deploying Simplified Acquisition Procedures • Using Other Transaction Authorities • Awarding Grants
Increase the use of challenges	“Many agencies run challenges that award \$10,000 to \$50,000 to companies with early-stage technology solutions that meet an agency need. The challenges usually take one to three months to complete. They have simple application processes. To increase the impact of government challenges, we recommend applying best practices from private-sector challenges:” • Ensure that all participating companies receive some value by publicizing their capabilities and giving them robust feedback. • Clearly communicate all information about the challenge, adhere to announcement schedules, and ensure that participants are aware of major milestones. • Mirror the applications and processes of commercial events so that startups don’t have to spend time creating new documents. • Advertise through channels that are likely to reach startups (not only challenge.gov and the internal Small Business Administration channels.
Treat startups as investments	“Think of each startup as a long-term investment and work toward offering progressively larger contracts that will deepen the government’s engagement. By creating and curating a pipeline of startups, the government will likely spend less money and gain access to more innovative products over the long run.”

Recommended Action	Recommendation for Implementation
Align requirements generation and product development	“Several innovative startups now combine the two phases into one, cycling between product development and requirements generation in a continuous and iterative way,” which allows the startup “to deploy usable products and capabilities to market much more rapidly than with the traditional approach.”
Use large defense contractors as allies	“Rely on the traditional defense contracting community to provide startups with access to projects.” (i.e., Mentor/Protégé)

This article is important to this research because it provides a critical assessment as to why the government (and DOD, in particular) has failed to attract start-ups and other companies which provide the innovations necessary to advancing the Army’s capabilities. Specifically, the list highlights that the DOD should increase the use of challenges and provides several best practices which should be accounted for when implementing this practice. Likewise, it is suggested that innovative partners should be seen as long-term investments by cultivating a pipeline which provides greater opportunities in the long run. The actions outlined in this article should be accounted for when creating a ChBA process and (hopefully) an attractive environment with maximum participation and access to new and relevant technologies.

D. CHALLENGED BASED ACQUISITION (ChBA) USAGE IN THE DEFENSE ACQUISITION MANAGEMENT SYSTEM (DAMS)

Excerpts from the Naval Postgraduate School’s Tenth Annual Acquisition Research Symposium provides critical information on how ChBA can be used to demonstrate solutions to problems which spans the entire life cycle of the Defense Acquisition Management System (DAMS). It is also notable that “[g]overnments and industry have long used challenges to spur technology advances in areas that include agriculture, aviation, energy, medicine, and navigation” (Weatherly et al., 2013). With specific regard to Army Aviation, it is important to note that ChBA has been used since the beginning. “As a result of their [the Wright Brothers’] airplane’s performance in the 1909 U.S. Army flight trials, they received a contract that strongly incentivized speed, with a 10% bonus for every full mile per hour above 40. The average speed of the Wrights’ aircraft was 42.5 miles per hour, earning the inventors a \$5,000 bonus and bringing the

final purchase price of the airplane to \$30,000” (Weatherly et al., 2013). The aviation industry continued to leverage ChBA when power plant makers were challenged to “deliver performance in terms of thrust, weight, and efficiency” (Weatherly et al., 2013) when “General Electric’s Jack Welch conceived the idea of performance-based logistics” (Weatherly et al., 2013). If ChBA was an effective technique in 1909 when Army Aviation was born and has been used to successfully demonstrate efficient practices in sustainment, it is logical to assume that it can be used to support any challenges with Army Aviation today.

Table 4 provides several scenarios in which ChBA can be used. Most of purposes highlighted are relevant to the pursuit of achieving fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary aviation technology.

Table 4. ChBA Uses. Adapted from Weatherly et al. (2017).

Purpose	Use
Research and Development	A Broad Agency Announcement (BAA) procedure provides a competitive acquisition process. If the challenge involves seeking innovative solutions, then it almost certainly falls within the area of early exploration or development
Components, Sub-systems, or Items	The smaller an acquisition, the easier it is to adapt to the acquisition process without the multi-layered FAR or DOD provisions or constraints
Urgent Capability	Field commanders who require rapid action express their urgent wartime needs in Joint Urgent Operational Needs Statements or similar documents. These needs are often very specific and amenable to description as acquisition challenges
Short Life cycle	Technology-intensive acquisitions are likely to be short lived given the rapid pace of technology evolution. This makes the complex guidance regarding the importance of reducing long life-cycle costs during the Operations and Support phase of the Defense Acquisition Management process essentially irrelevant.
Mandate Affordability	Challenges can be used to mandate affordability by requiring that all solutions meet a specific price target as a condition of participation in the challenge and subsequent procurement. For example, a challenge may specify that the chosen solution shall not cost more than X dollars. Challenge participants may automatically become ineligible for a final contract award unless their solutions meet the unit cost and/or total cost requirements. This approach ensures that all solutions that the government procures using ChBA will meet pre-defined program affordability targets
Reduce Program Cost and Risk	The government can use challenges to reduce risk through “actual” demonstrated performance before the government commits itself to a long-term contract. Furthermore, the DOD can build testing and certification criteria into the challenge event, thereby ensuring that accepted solutions will meet testing requirements and required performance objectives before they are purchased by the government, thus reducing risk, delivery timelines, and cost.
Rapidly Incorporate Innovation into Production	Challenges can spur industry productivity by guiding efficient application of research and development resources to meet specific requirements for a concrete capability. Furthermore, because the technology purchased must be nearly production ready at the time the challenge takes place, this mechanism provides an additional incentive for industry to establish an efficient production process that drives down costs and promotes efficiency.
Emphasize Competition Strategies to Create/ Maintain Competitive Environment	ChBA directly supports creation of a competitive acquisition environment because it encourages a wide range of solution providers to participate. Challenges must be open to the greatest possible number of potential participants, since traditional requirements for entering the defense market do not apply in the ChBA environment. For example, in a challenge focused on current performance requirements, previous experience may be irrelevant when it comes time to make a contract award. This key difference enables organizations and even individuals who have little/no defense experience to participate, thus enlarging the competitive landscape
Enforce Open Systems Architectures and Manage Technical Data Rights	The DOD can also use challenges effectively to support the introduction of open system architectures (OSAs) across the DOD. Challenges can be used to develop adaptable technology for key components of open systems. ChBA also permits flexible intellectual property arrangements and opportunities for licensing negotiations that support effective management of technical data rights over the program life cycle

Since ChBA is focused on requirements development and the acquisition process can be an evolutionary approach which recognizes the need for future capability improvements that can be delivered incrementally, ChBA is an effective approach to be used through all phases of the acquisition life cycle. Increments can be “managed through repeated application of the Technology Development and Engineering and Manufacturing Development phases. ChBA applies in these early phases of the DAMS and in the general evolutionary approach” (Weatherly et al., 2013). Specific opportunities for ChBA application within the DAMS are further described.

Table 5. DAMS and ChBA. Source: Weatherly et al. (2013)

DAMS Phase	Applicability of ChBA
Materiel Solution Analysis—Assess potential materiel solutions and perform an Analysis of Alternatives. This phase begins when an Initial Capabilities Document is approved that contains an analysis of current mission performance and potential concepts from across the DOD. It ends when the Analysis of Alternatives is complete and materiel solution options, identified in the Initial Capabilities Document, are recommended.	The Analysis of Alternatives enumerates the critical elements needed by each proposed materiel solution. ChBA supplements this step because industry provides the technology needed to create a capability prior to participation in the challenge. If the government does become involved in selecting and maturing technologies, a challenge, based on the needed capability, could be used to explore the range of candidate technologies and assess their maturity.
Technology Development—Determine and mature the appropriate technologies needed for the full system. Critical technology elements, identified in the previous phase, must be demonstrated using prototypes. The Technology Development phase requires the creation of a Technology Development Strategy. For an evolutionary acquisition, the Technology Development Strategy is to include a preliminary description of how the materiel solution will be divided into acquisition increments based on mature technology and an appropriate limitation on the number of prototype units.	A ChBA approach to the Technology Development Strategy is to design a challenge that proves the maturity of each needed technology. The challenge may or may not require a prototype, but will place emphasis on attainment of the technological capability rather than the delivery of a prototype. The acquisition increment requirement of the Technology Development Strategy can be served by a standing challenge that persists through time as multiple challengers demonstrate a range of solutions. A standing challenge gives industry a chance to improve on existing solutions. It also encourages the discovery of game-changing solutions to challenges that have already been solved with more pedestrian technologies.
Engineering and Manufacturing Development— Develop the full system or some increment of the full system capability. This includes full system integration and creation of an affordable and executable manufacturing process.	ChBA potentially eliminates the need for this phase because the technology needed to create a capability is already at or near full capability as a prerequisite for challenge participation. Further, the challenge may specifically require that participants (or their partners) produce fully operational versions of the submissions by a certain point in time following the challenge event.
Production and Deployment—Achieve an operational capability that satisfies mission needs. This includes low rate production for evaluation of major systems and full production or procurement of smaller systems.	Technology acquired using ChBA is by definition nearly production ready; therefore, ChBA can be used to accelerate the LRIP portion of the acquisition process. Furthermore, if operational testing and evaluation criteria are already built into the challenge construct, technology will have met T&E requirements before the government makes a buy decision—again accelerating the IOT&E part of the acquisition process.
Operations and Support—Execute a support program that meets readiness and operational requirements and sustains the system, in a cost-effective manner, over its total life cycle. This phase also includes disposal of the system at the end of its life.	Challenges can be designed to ensure that operations and support requirements are built in from the beginning. As such, a challenge-based demonstration can reenact operational requirements for readiness and sustainment to demonstrate capability before the government makes a commitment to purchase.

This resource is incredibly valuable to this research. It provides a wealth of information on how ChBA can be implemented in a variety of ways to develop an iterative and evolutionary process that demonstrates relevant technologies to advance modernization of all Army Aviation efforts. This article provides justification that ChBA should be fully leveraged to drive down cost and schedule across the Acquisition Life Cycle.

E. TRANSITION FROM ChBA TO FOLLOW-ON PROCUREMENTS

As has been mentioned previously, attracting industry partners who provide innovation requires the cultivation of a pipeline which provides opportunities for long term relationships and recurring revenue streams. If ChBA is to be effectively implemented, transition from the completion of a prize competition to a follow-on procurement is critical. The following resources provide essential research on this subject.

1. From Incentive Prize and Challenge Competitions to Procurement

The MITRE Corporation has established a resource that discusses options for what happens after a prize competition has ended. If structured incorrectly, inefficient transitions from ChBA to procurement can occur due to differing interpretations of the Federal Acquisition Regulation (FAR), Agency Specific Regulations, and/or Other Transaction Authority (OTA) by contracting officers, lawyers, and program managers. Smooth and efficient transition from prize competitions to follow-on procurements can be a critical component to attracting industry partners which harbor innovations that produce revolutionary change.

It is important to note that the FAR, as currently written, “supports the use of incentive prize and challenge competitions, demonstrations, and ChBA in the source selection process as part of a sole source justification, technical evaluation, past performance evaluation, and/or Intellectual Property (IP) strategy” (Arendt & Novak, 2016). Table 6 provides information on efficient transition from ChBA to a non-competitive follow-on procurement. Table 7 provides information on efficient transition from ChBA to follow-on procurements by including competition results in evaluation factors.

Table 6. ChBA Transition to Sole Source Follow-On Acquisition. Adapted from Arendt and Novak (2016).

From ChBA to a Follow-On Sole Source	
FAR Reference	Implementation
Should the circumstances exist, FAR 6.302-2 Unusual and Compelling Urgency and 6.302-6 National Security may also be considered as valid justifications for a follow-on sole source award. Furthermore, if the winner of the incentive prize or challenge competition is an educational or non-profit institution, FAR 6.302-3(b)(2) may be used, and FAR 6.302-7 may be worth discussing as a possible exception due to the Public Interest of furthering the goals of such statutes as the COMPETES Act.	Current FAR definitions permit the interpretation that a sole source procurement after the execution of an incentive prize or challenge competition may be fully justified. If the incentive prize or challenge competitions terms and conditions have clearly stipulated that the intent of the effort is to identify a single, unique solution (e.g., not more than one) that does not exist within the current marketplace, then a sole source justification for only one responsible source may be considered.

Table 7. ChBA Transition to Competitive Follow-On Evaluation Factors.
Adapted from Arendt and Novak (2016).

From ChBA to Full and Open Competition Planning Full and Open FAR-based follow-on acquisitions in parallel with ChBA can streamline the follow-on by including prize and challenge results in the source selection evaluation		
Approach	FAR Reference	Implementation
Design ChBA to Support FAR Full and Open Competition Requirements	Per FAR 6.1, full and open competition means that all sources deemed responsible are permitted to compete and submit a bid or proposal on the Government's requirements. Furthermore, FAR 6.1 states that full and open competition (with certain exceptions) should be promoted, maximized, and utilize for soliciting offers and awarding contracts.	Meeting full and open competition requirements of FAR 6 for an incentive prize and challenge competition, and articulating the intent to use this same competition in a parallel solicitation, may support the streamlined award of a follow-on contract directly with the prize or challenge winner. The incentive prize or challenge competition environment may be designed in such a manner as to support streamlined and efficient competitive procedures for the follow-on acquisition.
ChBA Environment and Pre-Award In-Use Evaluation	Per FAR 11.801, "Supplies may be evaluated under comparable in-use conditions without a further test plan, provided offerors are so advised in the solicitation. The results of such tests or demonstrations may be used to rate the proposal, to determine technical acceptability, or otherwise to evaluate the proposal."	Setting the right prize and competition environment is important in the transition to a follow-on acquisition. Conducting the incentive prize or challenge competition event and evaluating competitor's results under realistic operational conditions will help to expedite the Government's proposal evaluation process for the follow-on acquisition. In other words, if the incentive prize or challenge competition environment meets this standard, the follow-on acquisition could use the winner's (or all challenger's) results from the competition to augment or potentially substitute for the requirement of submitting a full technical proposal.
ChBA Results and Follow-on Proposal Evaluation	Per FAR 15.305(a), "Proposal evaluation is an assessment of the proposal and the competitive proposals and then assess their relative qualities solely on the factors and sub-factors specified in the solicitation."	Agencies must define the incentive prize and challenge competition's scoring factors and sub-factors in a way that is easily translated into evaluation factors and sub-factors for the follow-on acquisition. Thus, if structured appropriately and communicated in the incentive prize or challenge competition terms and conditions and solicitation for the follow-on acquisition, then the results of the incentive prize or challenge competition may become part of the offeror's proposal. These results may serve as a major evaluation factor(s) for the follow-on contract, ultimately streamlining the proposal evaluation and contract award process.

From ChBA to Full and Open Competition Planning Full and Open FAR-based follow-on acquisitions in parallel with ChBA can streamline the follow-on by including prize and challenge results in the source selection evaluation		
Approach	FAR Reference	Implementation
ChBA Results and Follow-On Technical Proposal	Per FAR 15.102, “Oral presentations by offerors as requested by the Government may substitute for, or augment, written information. Use of oral presentations as substitute for portions of a proposal can be effective in streamlining the source selection process.”	The results of a full and open incentive prize or challenge competition may be considered analogous to oral presentations and may be used to substitute for, or augment, an offeror’s proposal for the follow-on acquisition. If the Government intends to use the results in this manner, it should clearly communicate this in the incentive prize and challenge competition terms and conditions. Using the incentive prize or challenge competition results as part of an offer’s technical proposal would not only streamline the acquisition process, but also provide an opportunity to produce evidence-based and previously evaluated offeror performance for use in a subsequent source selection evaluation and decision.
ChBA Results in Advisory Multi-Step Process	Per FAR 15.202(b), “The agency shall evaluate all responses in accordance with the criteria stated in the notice, and shall advise each respondent in writing either that it will be invited to participate in the resultant acquisition or, based on the information submitted, that it is unlikely to be a viable competitor.”	The terms and conditions of the incentive prize or challenge competition should stipulate that the agency may use the results of a challenger’s participation as a basis for inviting the offeror to participate in a follow-on acquisition. The results of the incentive prize or challenge competition may augment this “information submitted” by the offeror for acquisition as part of the Advisory Multi-Step Process. Thus, the use of incentive prize or challenge competition in combination with the Advisory Multi-Step Process for the follow-on acquisition streamlines the acquisition process by economizing the evaluation and award process as only offerors who have participated in the incentive prize or challenge competition may be considered satisfactory in the evaluation.
ChBA and Follow-On Past Performance Evaluation	FAR 13.305(a)(2)(i) focuses on the assessment of past performance information as “one indicator of an offeror’s ability to perform the contract successfully.”	The use of incentive prize or challenge competition results as a source of past performance information for the follow-on acquisition can help to establish the “currency” and “relevance” of the offeror to meet the agency need. Participation in an incentive prize or challenge competition that uses a consistent and repeatable evaluation process with supporting documentation for factors such as relative strengths, deficiencies, significant weaknesses, and risks in addition to competitor’s overall

From ChBA to Full and Open Competition		
Planning Full and Open FAR-based follow-on acquisitions in parallel with ChBA can streamline the follow-on by including prize and challenge results in the source selection evaluation		
Approach	FAR Reference	Implementation
		evaluated performance, may provide current and relevant past performance information and thus be used to substantiate the offeror's ability to deliver results in the follow-on effort. Using incentive prize or challenge competition results as source of established past performance information for the follow-on acquisition streamlines the acquisition process because it exists in the desired format and has already been evaluated by the Government.

This resource outlines several methods which can be used to smooth the transition to a follow-on instrument once a prize competition has concluded. The major takeaway from this source is that transition will be smoother when follow-on procurement is planned and accounted for prior to the onset of a prize competition. The next section examines an additional authority which can be used to non-competitively procure quantities to be used for the purpose of additional testing and experimentation.

2. 10 USC § 2373—Procurement for Experimental Purposes

a. Authority

The Secretary of Defense and the Secretaries of the military departments may each buy ordnance, signal, chemical activity, transportation, energy, medical, space-flight, telecommunications, and aeronautical supplies, including parts and accessories, and designs thereof, that the Secretary of Defense or the Secretary concerned considers necessary for experimental or test purposes in the development of the best supplies that are needed for the national defense.

b. Procedures

Purchases under this section may be made inside or outside the United States and by contract or otherwise. [Chapter 137 of this title](#) applies only when such purchases are made in quantities greater than necessary for experimentation, technical evaluation, assessment of operational utility, or safety or to provide a residual operational capability.

Further analysis of 10 USC § 2373 shows that, if the quantities purchased support testing/experimentation, this statute has tremendous utility in DOD procurement; particularly, in relation to ChBA. Because the FAR and Defense Federal Acquisition Regulation Supplement (DFARS) are not applicable in this statute, formal competitive procedures are not required and efforts can be awarded, competitively or non-competitively, under any contract or agreement. More importantly, the follow-on contracts or agreements can be written using commercial terms. This is an especially important in attracting industry partners who are not yet familiar with Federal Government terms and conditions.

Contracts or agreements awarded under this authority require a Determination & Finding (D&F) outlining a description of the item(s) to be purchased, the dollar amount of the purchase, a description proposed test/experimentation, the quantity necessary to support testing/experimentation, and a statement that use of this authority is determined to be appropriate for this acquisition. The efficiency of this technique will be further analyzed in Chapter III in comparison to the Sole Source Justification & Approval (J&A) typically used to perform this type of procurement.

To summarize, whether performed under one of the approaches outlined by The MITRE Corporation or 10 USC § 2373, the concept of follow-on acquisition is a critical aspect of this research. While understanding the foundation and successful scenarios for implementation of ChBA is profoundly important, ensuring that demonstrated technologies can be quickly transitioned to a follow-on procurement is critical to attracting industry partners who can provide revolutionary innovation.

F. xTechSearch

The Army is currently using ChBA to investigate technologies under a program called xTechSearch. This program was launched in June 2018 as a way to “revolutionize the way the Army attracts and encourages innovation. The xTechSearch competition engages the non-defense business sector and start-up technology companies, with the Army Science and Technology ecosystem to leverage cutting edge technologies in support of the Army of the Future” (Army Research Laboratory, 2020). Figure 3 below provides a brief

overview of the Army’s prize competition, including the phases and prize amounts of each phase.



Figure 3. xTechSearch Competition Overview. Source: Army Research Laboratory (2020).

G. SUMMARY

In summary, this section reviewed a number of resources which assisted in outlining strategic investment in AFC’s portfolio of innovation, understanding how can be favorably adopted, outlined better methods to attract innovative industry partners, reviewed a number of uses for ChBA, how to successfully transition from ChBA prize competitions to follow-on procurements, and provided an overview of the Army’s ChBA program, xTechSearch. Chapter III will establish a framework which will used to analyze this data and Chapter IV will report the findings from this research and subsequent analysis.

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III. METHODOLOGY

The first two chapters introduced the problem under analysis and reviewed several applicable sources. This chapter describes the methodology used to analyze the objectives of this research. The first objective of this research is to investigate if a ChBA procurement approach can be effectively applied to Army's Aviation Modernization priorities, permitting continuous iterative access to DOD and commercial industry innovations. The goal of this analysis will be to determine if this method can achieve fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary technology. Analysis will be done to compare the construct of prize competitions conducted in the public against those performed in the private sector. Effectiveness of ChBA in the public sector may be hamstrung due to restrictions required by the FAR, which does not need to be followed by the private sector. Analysis will continue with an assessment of public and private competitions capability to access innovative technologies of industry partners. This will be done by comparing the number of participants in each sector as a measure of market stimulation. The diversity of participants will also be examined to assess the viability of competitions to uncover partners which may not have otherwise been considered.

An additional objective is to conduct a qualitative comparative analysis between ChBA and other FAR-based procurement approaches on their ability to stimulate the intended market, while increasing access to innovative technologies that can be rapidly delivered to the Warfighter. The goal of this analysis will be to discover an approach that provides the flexibility needed to react to changing priorities within Army Aviation Modernization. A comparative analysis will be performed between ChBA and other FAR and non-FAR based procurement methods used to access innovation. Analysis will include the evaluation of the return on investment of these methods by comparing the expected results of different procurement methods and assessing their capability to develop innovative solutions. ChBA will also be compared to the two contract types—fixed price and cost reimbursement—to assess the assumption of risk at the appropriate time. Further analysis will include the comparison of Procurement Acquisition Lead Time (PALT)

between ChBA and other FAR and non-FAR procurement methods. Finally, methods of procurement will be analyzed for smooth and efficient transition after the prize competition has ended.

A. ChBA Effectiveness Methodology

The first objective of this research is to investigate if a ChBA procurement approach can be effectively applied to Army's Aviation Modernization priorities, permitting continuous iterative access to DOD and commercial industry innovations. The goal of this analysis will be to determine if this method can achieve fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary technology.

Analysis will be done to compare the construct of prize competitions conducted in the public against those performed in the private sector. Specifically, a comparison will be done between the Army's xTechSearch standard prize competition, xTechSearch's COVID-19 prize competition, and XPRIZE, a prize competition in the private sector. Factors to assess the diversity of ChBA prize competitions include the number of participants and the number of countries represented in prize competitions. Further analysis will focus on the ability to attract and nurture companies that provide innovation by examining whether the public sector prize competitions used private communication channels to announce competitions, whether feedback was provided to the participants, the process time, and whether the challenges are outcome focused rather than pigeon holed and overly prescriptive expectations. Public sector ChBA will also be analyzed to assess the differences between challenges issued under 15 U.S. Code § 3719 and 10 U.S. Code §2374a.

B. ChBA Accessing Innovation Methodology

Another objective of this research is to compare ChBA and other FAR-based procurement approaches on their ability to stimulate the intended market, while increasing access to innovative technologies that can be rapidly delivered to the Warfighter. It is impossible to be able to analyze every procurement scenario which leads to the acquisition of innovation. However, it is believed that innovation is most procured through Grants and

OTAs. Therefore, analysis will focus on the comparison of these three procurement methods. Assessment of market stimulation will include the evaluation of the return on investment of these procurement methods by understanding their ability to increase investment in the pursuit of innovative solutions that fill capability gaps. ChBA prize competitions will also be analyzed against the other procurement methods to assess their ability to demonstrate complete solutions as opposed to advancement and development of concepts. Assumption of risk is an important factor in the procurement of innovative solutions. ChBA will be compared to the two contract types—fixed price and cost reimbursement—to analyze the ability to assume the appropriate amount of risk at the most optimal time. This methodology will also include analysis of the Procurement Acquisition Lead Time (PALT) between ChBA and other FAR and non-FAR procurement methods. Comparison of this metric will be critical to understanding the ability of the procurement method to rapidly deliver capabilities to the Warfighter.

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IV. FINDINGS AND ANALYSIS

This Chapter will apply the methodology discussed in Chapter III and present the results discovered during this analysis. The overwhelming opinion regarding Army (and the DOD, at large) Acquisition is that it has continuously failed to deliver relevant technology within applicable operational timelines. In other words, technological upgrades are provided late to the fight. For this narrative to change, and to support modernization of Army Aviation, the timelines for delivery of capabilities to the Warfighter must become shorter. While not the only cause for delays in acquisition timelines, the procurement function can be instrumental in constructing a framework that allows innovations to be demonstrated and (if desired) transitioned into quantities needed for additional testing/experimentation and subsequent production. It is believed that ChBA, when properly structured and coupled with appropriate follow-on contracting methods, provides this opportunity.

A. ChBA Effectiveness Analysis

Analysis was done to compare the construct of prize competitions conducted in the public against those performed in the private sector. Specifically, analysis will compare the basic xTechSearch challenge, the xTechSearch COVID-19 challenge, and the private sector's XPRIZE. Analysis will consider the effects of the FAR in restricting ChBA prize competitions when compared to prize competitions in the private sector. Analysis continued with an assessment of public and private competitions capability to access innovative technologies of industry partners. This was done by comparing the diversity and number of participants in each sector as a measure of market stimulation. Market stimulation is an important factor to assess the viability of competitions to uncover partners which may not have otherwise been considered.

1. xTechSearch Challenges

Since its inception in June 2018, the Army has used the xTechSearch program to attract multiple small businesses to display their innovations and their ability to fulfill Army capability gaps. Thus far, the Army has initiated five competitions through

xTechSearch, all under 15 U.S. Code § 3719 and limited to U.S. based small businesses. To date, most of the xTechSearch competitions initiated have been broadly focused to cover all of the Army's Modernization Priorities-- 1) Long Range Precision Fires; 2) Next-Generation Combat Vehicle; 3) Future Vertical Lift; 4) Mobile and Expeditionary Network; 5) Air and Missile Defense; and 6) Soldier Lethality. Table 8 expands on the previously referenced Figure 3 to analyze the competition phases in further detail against previously discussed factors for adoption of innovation.

Table 8. xTechSearch Overview. Adapted from Army Research Laboratory (n.d.).

Phases	Description	Rating Information
<u>Concept White Paper</u>	The concept white paper invites all eligible entities to submit a white paper outlining their technology, the potential impact on the Army, the scientific viability of their approach, and the dual-use technology applications for both the commercial and defense space. Technology focus areas are topic suggestions for where to focus technology solutions. Participants can submit white papers on additional technical areas if they align to an Army need. Each concept white paper will be reviewed by a panel of Army subject matter experts from the Army science and technology ecosystem, including Warfighter, acquisition, and research and development subject matter experts. Up to 60 small businesses with the highest-ranking white papers will receive a prize of \$5,000 and a written invitation to Part 2: Technology Pitches.	Concept White Papers will be ranked using the following scoring criteria (further details on each scoring dimension can be found on the xTechSearch registration page): ● Potential for Impact/ Revolutionizing the Army - 35% ● Scientific and Engineering Viability - 35% ● Dual-use - 20% ● Proposal Quality - 10%
<u>Tech Pitches</u>	The technology pitches invite the selected participants to conduct an in-person pitch to a panel of Army subject matter experts at location across the United States. Participants will pitch their technology concept and team ability to a representative Army panel from the Army science and technology ecosystem. Each participant will have 15-minutes to pitch followed by 10-minutes for questions and answers with the Army panel. Up to 20 participants with the highest-ranking pitch will receive a prize of \$10,000 and a written invitation to attend the semifinals.	Technology pitches will be ranked using the following scoring criteria (further details on each scoring dimension can be found on the xTechSearch registration page): ● Potential for Impact/ Revolutionizing the Army - 30% ● Scientific and Engineering Viability - 30% ● Dual-use - 20% ● Team Ability - 10% ● Presentation Quality - 10%
Semi-finals -	The semifinals will provide the invited participants with Army-sponsored exhibit space at the Innovators' Corner at the AUSA Annual Meeting, October 12–14, 2020, in Washington, D.C. Semifinalists will leverage the exhibit space and conference attendance to engage with Department of Defense (DOD) customers, Army leadership, industry partners and academia in attendance.	In addition to the opportunity to showcase the participants' technology, semifinalists will present a business pitch to a panel of subject matter experts on the Innovators' Corner stage at the AUSA Annual Meeting. Detailed instructions and evaluation criteria will be provided to semifinalist companies. Up to ten participants with the highest-ranking pitches will receive a prize of \$120,000 and will advance to the

Phases	Description	Rating Information
		xTechSearch finals.
Finals -	The finals are an opportunity for finalists to demonstrate their technology solution and present their transition plans to experts at the AUSA Global Force Symposium and Exposition in March 2021, in Huntsville, AL. In addition, finalists will be provided Army-sponsored exhibit space at the AUSA Innovators' Corner to engage with Department of Defense (DOD) customers, Army leadership, industry partners, and academia in attendance.	Detailed instructions and evaluation criteria will be provided to finalist companies. A single grand-prize winner will be selected by a panel of Army subject matter experts and be awarded a prize of \$250,000. All other finalists will receive a \$10,000 prize.

Figure 4 shows the timeline of competition phases as they relate to the individual challenges. This information will be summarized into a table later in this section to provide a side by side comparison between competitions held in the public and private sectors.

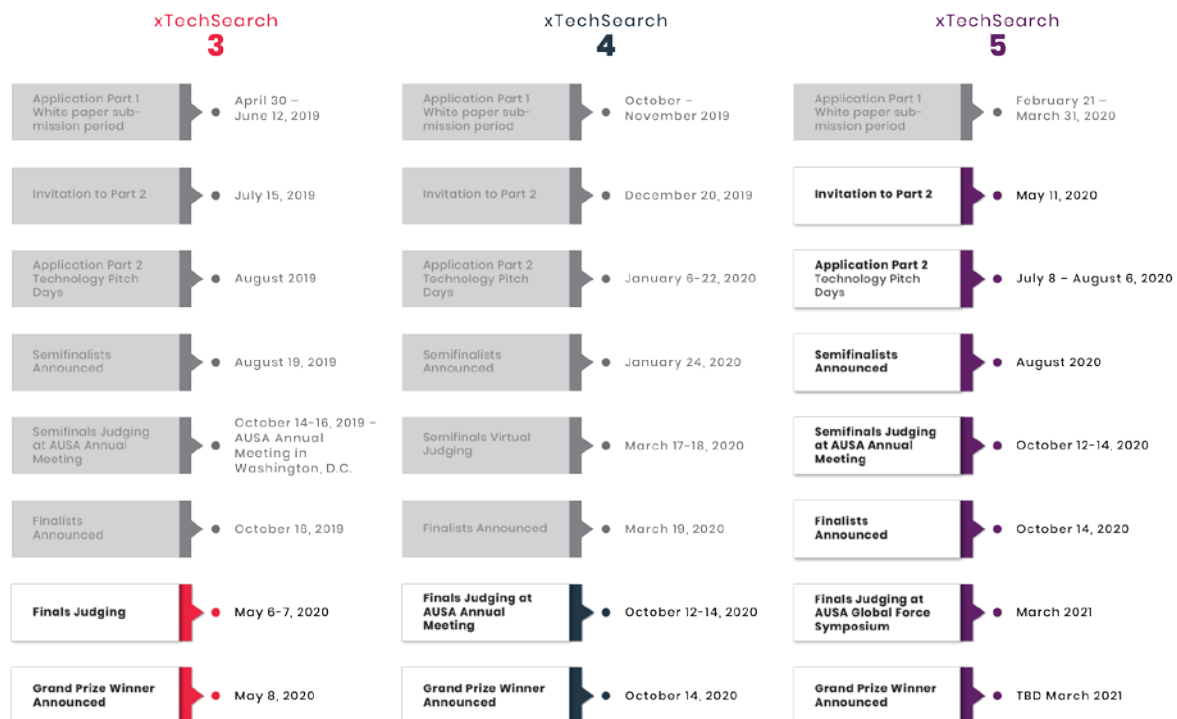


Figure 4. xTechSearch Timeline. Source: Army Research Laboratory (n.d.).

2. xTechSearch COVID-19 Challenges

As a response to the COVID-19 pandemic, xTechSearch issued the COVID-19 Ventilator Challenge. This instance is interesting in that was issued with some differences from the previous challenges and provides further analysis applicable to other dilemmas facing the efforts of Army Aviation Modernization. Opposed to the previous challenges, the COVID-19 Ventilator challenge was issued under 10 U.S. Code § 2374a and open to all industry partners, foreign and domestic, large and small. Furthermore, since the COVID-19 pandemic forced the U.S. to shut down all non-essential business, the entire competition was conducted virtually.

Table 9. xTechSearch COVID-19 Overview. Adapted from Army Research Laboratory (n.d.).

Competition Phases	Description	Rating Information
Part I: <u>Concept Quad Chart and Video</u> -	A concept quad chart and accompanying video up to 3 minutes in length outlining their technology, the technical viability of their approach, human and clinical risk, and speed to production. Each application will be reviewed by a panel of experts from the Army, medical, and manufacturing communities.	Applications will be evaluated and ranked using the following Scoring Criteria: • Requirements Alignment – 30% • Technical Viability – 20% • Regulatory – 20% • Speed – 30% Applicants selected to support the requirements of this posted solicitation will receive a prize of \$5,000 and advance to Part 2: Technology Pitches.
Part 2: Prototype Proposals	A virtual pitch to the Ventilator Challenge panel of Army, medical, and manufacturing experts. Virtual pitch schedules are dependent on submission date and will be scheduled with selected submitters. Applicants should be prepared to deliver a virtual pitch of their concept within 1 week of submitting the application.	Selected participants will conduct a virtual pitch to the Ventilator Challenge panel of Army, medical, and manufacturing experts. Detailed pitch instructions and evaluation criteria will be provided to selected applicants. Technology pitches selected to meet the requirements of this posted solicitation will receive a prize of \$100,000 and will be invited to develop and demonstrate a concept prototype to potentially receive follow on contracts for additional production and deployment.

3. XPRIZE Overview

The XPRIZE Foundation is a nonprofit 501(c)(3) which was established in 1994. To date, they have completed 17 competitions seeking innovative solutions in the areas of Space, Oceans, Learning, Health, Energy, Environment, Transportation, Safety and Robotics. The first competition was “the \$10 million Ansari XPRIZE for private spaceflight, spurred an industry and created exponential breakthroughs” (XPRIZE Foundation, 2020). Subsequent competitions, with prizes totaling over \$140 million, include “the \$15 million Global Learning XPRIZE, the \$10 million Qualcomm Tricorder XPRIZE, and the \$1.4 million Wendy Schmidt Oil Cleanup XPRIZE” (XPRIZE Foundation, 2020)■

4. ChBA Assessment Table

Combining many of the factors detailed in Chapter II—Literature Review into a table provides a concise view of important considerations compare the construct of prize competitions conducted in the public against those performed in the private sector. Table 10 serves as comparison of the xTechSearch basic Challenge, the xTechSearch COVID-19 Challenge, and XPRIZE.

Table 10. ChBA Comparison Assessment

Background Info				Health		Challenge Process			
Challenge	Subject	USC Authority (only applicable to)	Prize Amount	Creating Competition (i.e., # of participants)	Nurturing Diversity	Use of Private Channels (only applicable to GOV)	Feedback Provided	Process Time	Outcome-Focused
xTechSearch	Army Modernization	15 U.S. Code § 3719	60 @ \$4K; 25 @ \$10K; 12 @ \$120K; 1 @ \$250K	340	Not known	Not Known	Yes	1 Year	Broadly focused on Modernization priorities
xTechSearch COVID-19	Ventilators	10 U.S. Code § 2374a	TBD @ \$5K; TBD @ \$100K	100	Not known	Not known	Yes	5 Weeks	Narrow focus on specific objective
Ansari (XPRIZE)	Suborbital Spaceflight	n/a	1 @ \$10M	26	Ranged from hobbyists to large corps	n/a	Not known	8 Years	Specifically defines 2 missions in 2 weeks
Progressive Insurance (XPRIZE)	Super-Efficient Vehicles	n/a	1 @ \$5M 1 @ \$2.5M 1 @ \$2.5M	111	10 countries	n/a	Not known	3 Years	Specific objectives provided (100 mpg; 200 grams/mile CO ₂ emissions)
Wendy Schmidt (XPRIZE)	Oil Cleanup	n/a	1 @ \$1M, 1 @ \$300K 1 @ \$100K	350 pre-registered; 37 official	Not known	n/a	Not known	15 Months	General objective of speeding the pace of cleaning oil from seawater.
Northrup Grumman (XPRIZE)	Vertical Take-Off Vertical Landing Rocket	n/a	Multiple Levels Multiple Prizes	8	Not known	n/a	Not known	3 Years	Broadly stated objectives complicated FAA regs and location
Nokia (XPRIZE)	Sensors monitoring personal well-being	n/a	\$2.25M total	At least 12	Not known	n/a	Not known	2 Years	Broadly stated
Wendy Schmidt (XPRIZE)	Ocean Health	n/a	\$2M total	Not known	Winner from Montana	n/a	Not known	2 Years	Broadly stated
Qualcomm (XPRIZE)	Mobile Device Health Diagnosis	n/a	1 @ \$7M, 1 @ \$2M, 1 @ \$1M	10	7 countries	n/a	Not known	6 years	Specific criteria on weight and 13 conditions diagnosed
Google (XPRIZE)	Lunar Landing	n/a	1 @ \$20M; 1 @ \$5M; \$5M in bonus	32	Yes, at least 18 country or Int'l Teams	n/a	Not known	11 years	Specific objectives provided. No team fulfilled objectives
Anu & Naveen (XPRIZE)	Women's Safety Emergency Alert Device	n/a	1 @ \$1M	Not known	Not known	n/a	Not known	2 Years	Unclear

5. ChBA Effectiveness Analysis Summary

Further exploring the results of this analysis, provides some interesting assertions. The private sector ChBA, XPRIZE, was able to attract a more diverse range of participants. Information about companies participating in Federal Government acquisitions is safeguarded to protect the integrity of the process and results of diversity in public competitions were unclear. However, there are two factors—15 USC 3719 and the Buy American Act (both of which restrict procurement to U.S. based entities)—which allows logical conclusion of greater diversity in the private sector. This brings to light an important difference between capturing innovation in the public and private sector. Prizes competitions in the private sector have the underlying motivation to do things which have never been done before. While the public sector is also motivated to find technology, which has never been done before, it must also safeguard intelligence and capability from getting into the hands of adversaries with ill-conceived intentions. This is an advantage of the private sector which cannot and will not ever be reconciled. Furthermore, on the topic of diversity, special attention should be focused on XPRIZE’s Wendy Schmidt Ocean Health challenge, which was won by Sunburst Sensors, a small business from Montana. This is a significant because Montana is a landlocked state. Under ‘normal’ procedures, it is highly conceivable to conclude that any written proposal from a company Montana would find the trash can in a challenge on ocean health because of an assumption that a company from a land locked couldn’t possibly know about anything related to the ocean. However, because the challenge was open to all who could demonstrate capability, a solution which might not have been found was discovered from an unlikely source. This produces a profound advantage, which is transferrable to public sector, that exists with prize competitions in comparison to ‘normal’ procurement procedures.

Prize competitions in public sector, when compared to those in the private sector, did not indicate any restriction by the FAR. While the FAR has provided heavy oversight and guidance on the construct of evaluation factors for competitively awarded source selections, this focus has not been applied to prize competitions. Thus, while it is recognized that the FAR will affect follow-on procurements, it can be concluded that the FAR does not inhibit any advantages provided by the initial prize competition. However,

the comparison of public and private sector challenges highlighted fiscal restrictions which may affect the public sector. For the most part, the challenges issued in the private sector focused on extraordinarily complex problems—space travel; oil spills; ocean health that spanned many years. A challenge spanning multiple years in the public sectors is likely to invoke questions of the Bona Fide Need rule. In other words, when does the bona fide need occur? In the year the challenge was issued? Or in the year the solution was provided? In the former, the challenge could span beyond an appropriation's availability for obligation. In the latter, there could also be questions about the need arising during an appropriation's availability for obligation. This factor would seem to limit the public sector's ability to tackle overly complex problems through ChBA and focus only on challenges which can be solved within a specific appropriation's availability of obligation.

B. ChBA Accessing Innovation Analysis

A comparative analysis was performed between ChBA and other FAR and non-FAR based procurement methods used to access innovation. While it is possible that innovation can be procured through a multitude of procurement methods, it is believed that Grants and OTAs are most used to procure innovation. Analysis included the evaluation of the return on investment to measure the ability of the procurement method to increase investment in pursuit of innovative solutions. ChBA was also compared to the two contract types—fixed price and cost reimbursement—to assess the assumption of risk at the appropriate time. Further analysis compared the PALT of the procurement methods to assess the speed of ChBA prize competitions.

The truest test to analyze access to innovation is determining whether an innovation would have been captured had a specific procurement path not been followed. However, there is no test which can measure this effect. Thus, analysis must be performed based on logical conclusions which can be drawn based on comparison of various procurement methods.

1. Procurement Method Comparison

It is recognized that ChBA prize competitions are unique and there is no other method for direct comparison. However, the procurement methods which are most used to

procure innovation are grants and cooperative agreements. Therefore, this analysis will compare ChBA prize competitions to grants with the assumption that this comparison can be extrapolated to other methods of procurement. Since OTAs and ChBA both can exist outside of the FAR, they will also be compared. Table 11 compares key characteristics of ChBA, Grants, and OTAs.

Table 11. Comparison of ChBA and Grants/OTAs

Factor	ChBA Prize Competitions	Grants	OTAs
Relationship	One to Many	One to One	One to One
Outcome	Multiple Proven Solutions	Best Effort	Single Solution
Return on Investment	10 to 40 times of the original investment	Original investment	Original investment

Further exploring the information in Table 11, it is important to understand the relationship. Typically, when the Government has a requirement, the result is a single contract between one vendor to fulfill a single need. In short, standard procurement practice is to develop the capability of a single vendor (i.e., a one to one relationship). However, under prize competitions used to support ChBA, the Government can view and invest in multiple technologies—some of which that may not have been thought of as viable solutions. This effect can also be used to explain the rationale in the ‘Outcome’ factor. Typically, grants are issued to a single entity to advance and develop a single capability. Notably, a grant may conclude without a viable solution to the problem; but, rather with progress toward meeting an objective. OTAs, when issued under a consortium, are similar in the ability to develop vendor capability. While there may be multiple solutions proposed to fulfill the requirement, the result is usually one agreement with one vendor. ChBA prize competitions are different in that they can allow the development of multiple capabilities under a single challenge. For example, consider Lumineye Inc., who won the xTechSearch 2.0 competition with a device that can sense movement through walls. Lumineye, Inc. participated in the inaugural xTechSearch 1.0 and made it to Phase II of the competition.

“Instead of giving up, Lumineye used the feedback from the judges and applied for xTechSearch 2.0 with an improved pitch and a prototype they created with the funds they received from xTechSearch 1.0” (Stillman, 2020). More simply, \$1,000 investment in 2018 produced a technology that the government was willing to pay \$384,000 for in 2019. Due to the singular focus of grants and OTAs, it is unlikely that this result would have occurred under these procurement methods.

Regarding the figure for return on investment, this was reported in ‘Innovative Contracting Case Studies’ issued by the Office of Management (OMB) Office of Federal Procurement Policy (OFPP) and the Office of Science and Technology Policy (OSTP) when they stated that “well-structured prizes can drive cumulative competitor investment totaling 10–40 times the prize purse” (OFPP and OSTP, 2020). Further, consider the words of Peter Diamandis, executive chairman of the XPRIZE Foundation, when he said that the ANSARI XPRIZE competition’s “\$10 million initial investment led to \$100 million in spending by teams, which in turn led to a \$1.7 billion investment by private industry” (Olson, 2020). The singular, one-to-one relationship in effect with grants, OTAs, and other procurement methods restricts the return on investment to that of the initial investment with little to nothing more. Thus, the ability of ChBA prize competitions to provide exponential returns on investment make it an attractive option to stimulate market innovations.

2. Contract Type Comparison

Another important consideration when analyzing the flexibility provided by a ChBA approach is in consideration of the contract types available for other procurement methods and their ability to allocate risk to an acceptable level. At the simplest level, government contracts are issued as either fixed price or cost reimbursable. Generally, the contractor accepts most of the risk in a fixed price arrangement as they are required to deliver a solution at a given price, regardless of the circumstances. In a cost reimbursement arrangement, the government accepts most of the risk by reimbursing the contractor for their cost in providing a solution. In general, fixed price contracts are used when the effort can be easily defined and there is little expectation of variation. Cost reimbursement contracts are used when requirements are not easily defined and there is greater expectation of

variation. It is also important to note that a fixed price contract can be used in the scenario described for cost reimbursement (i.e., unknown requirement, great variation). However, this will likely lead to the Government paying more as the contractor will attempt to account for all anticipated risks in its price. Now, consider these notions when exploring the procurement methods in Table 10. A grant, even if procured under a fixed price, is more akin to a cost reimbursement effort in that the outcome may not be a fully developed solution. The government is buying ‘best effort’ to advance an idea. An award under an OTA will most likely be under cost reimbursement due the uncertainties in developing innovative solutions. Furthermore, in an OTA, the government is likely to award a contract desiring a complete solution and providing a large initial investment to procure long lead items and begin development. Under the ChBA prize competitions, the price is certainly fixed. The prize purse is the prize purse. No exceptions. Furthermore, as demonstrated in the previous Lumineye example, the Government only pays for viable solutions which they believe fill a capability gap when the solution presents less risk. In other words, the Government can shift the risk to the contractor (as in a fixed price arrangement) for minimal investment and without having to overpay for the acceptance of unknown risks. This factor of ChBA shows the ability for the Government to buy down risk while also controlling costs.

3. Procurement Acquisition Lead Time Comparison

The comparison of PALTs can be complicated in that each procurement action has unique characteristics. Thus, it is not always an apples to apples comparison. This is also true when comparing PALT to the Army’s ChBA program, xTechSearch. However, examining the PALT time of comparable dollar values can provide insight into the efficiency (or lack thereof) of XTechSearch. The Army Contracting Command (ACC) provides a baseline metric against which to measure PALT. “In FY17, ACC achieved a total average PALT of 174 days” (Army, 2020). The source continues to provide PALT metrics for various actions as adapted in Table 12.

Table 12. PALT of New Contracts. Adapted from U.S. Army (2020).

Dollar Value	Acquisition Type	PALT (in days)
<\$25K	All	45
>\$25K to <\$1M	Competitive	65
>\$25K to <\$1M	Non-Competitive	90
\$1M to <\$10M	Competitive	150
\$10M to <\$50M	Competitive	190
\$1M to <\$50M	Non-Competitive	200
\$50M to \$100M	Competitive	400
\$100M to \$250M	Competitive	425
\$50M to \$100M	Non-Competitive	475
\$100M to \$250M	Non-Competitive	400

It is believed that the most comparable category for evaluating ChBA would be non-competitive actions in the greater than \$25K up to \$1M category and \$1M up to \$50M category. These two categories report 65 and 200 days, respectively. Thus, the metric against which to baseline ChBA prize competitions is between 65 and 200 days. Recalling the xTechSearch process timeline from Figure 4, the basic xTechSearch is completed in ~365 days. However, to maximize publicity for the participants, the final stages are scheduled to coincide with major Army events (e.g., AUSA Conferences). More simply, the basic competition moves slower than its capability intentionally. To illustrate the speed at which xTechSearch can operate, consider the challenge issued to explore COVID-19. This challenge was able to be completed in ~45 days. In comparison, a competitive award in the amount of \$100K carries a PALT of 65 days. Moreover, there were five winners in the xTechSearch COVID-19 challenge, meaning that there would have been five awards and, likely, the inability to meet the 65-day PALT when processing five congruent actions.

4. Follow-On Contract Comparison

Previously referenced, Table 6, discussed options for follow-on contracts, which included how to include the results of ChBA competitions in FAR-based contracts as well

as awarding a follow-on contract non-competitively with an SSJ. The authority granted under 10 USC §2373 further enables the ability to award a follow-on action non-competitively. This analysis will highlight some of the key differences between a FAR-based SSJ and the D&F required under 10 USC §2373.

The Sole Source Justification (SSJ) is governed by FAR 6.303 and must be justified by one of the seven exceptions to full and open competition provided in FAR 6.302. Furthermore, the approval of an SSJ is governed by FAR 6.304, which provides approval authorities as noted in Table 13

Table 13. Non-Competitive Follow-On Approval Thresholds

Value	SSJ Approval	Value	D&F Approval
<=\$700K	Contracting Officer	<=\$50M	Senior Contracting Officer
>\$700K to \$13.5M	Competition Advocate	\$50M to \$100M	Head of Contracting Activity
>\$13.5M to \$93M (for DOD)	Head of Contracting Activity	>\$100M	Senior Procurement Executive of the Agency
>\$93 M	Senior Procurement Executive of the Agency		

Also, noted in Table 11 are the approval levels of a D&F exercising the authority provided in 10 USC §2373. While D&Fs are regulated by FAR 1.7, approval authority is as determined by the agency official.

In summary, since the entirety of an SSJ is governed by FAR Part 6, completion of the justification can be tedious. The D&F, which is less regulated, can provide an alternative route to a non-competitive follow-on contract. Obviously, this is somewhat threshold dependent. If the follow-on effort is less than \$700K, it would seem more practical to procure using an SSJ. However, for any follow-on over \$700K, a D&F should be examined for expedient approval and signature.

5. Summary

In summary, analysis compared the differences between ChBA, Grants, and OTAs in their ability to access innovation. Further analysis compared return on investment of these methods by comparing the expected results of different procurement methods and examining the potential of the procurement instrument to develop innovative solutions across the entire market. ChBA was examined against the two contract types—fixed price and cost reimbursement—to assess the assumption of risk at the appropriate time. Further analysis will include the comparison of Procurement Acquisition Lead Time (PALT) between ChBA and other FAR and non-FAR procurement methods. Finally, methods of procurement were analyzed to examine the differences between an SSJ and 10 USC §2373 D&F.

C. COMPARISON OF 15 U.S. CODE § 3719 AND 10 U.S. CODE § 2374A

Table 14. Comparison of Prize Competition Authorities

	15 U.S. Code § 3719: America Competes Act	10 U.S. Code § 2374a: Prizes for Advanced Technology Demonstration
Prize Authority	\$50,000,000.00	\$10,000,000.00
Contractor Pool	Limited to U.S. based businesses	No limitations
Follow-On Possibility	Can be used in conjunction with other authorities	Use in conjunction with other authorities is encouraged

The biggest differences between the two authorities are the amounts of the prize purses and where the companies providing the innovation are based. Therefore, determination of which authority to reference when constructing a prize challenge would depend on the market. If the number of innovative partners is expected to be relatively and/or contain foreign entities, 10 U.S. Code § 2374a should be referenced to include the foreign competitor. If the market shows that innovation only resides in US-based firms and there are expected be many competitors, the higher authority granted by 15 U.S. Code § 3719 appears to be optimal. Moreover, none of the xTechSearch challenges thus far have

held a purse higher than \$3,000,000.00. So, the higher prize authority appears to insignificant.

Thus far, all the basic xTechSearch challenges have been conducted under 15 U.S. Code § 3719 and been limited to US-based small businesses. As will be detailed in the next section, this supports market stimulation of innovative technologies. However, it appears that most of the technologies demonstrated under this authority would have lower TRLs. Creating challenges under the authority of 10 U.S. Code § 2374a would open prize competitions to all companies—large and small, foreign and domestic.

D. xTechSearch Assessment

Overall, the xTechSearch program appears, thus far, to have been successful as a procurement approach which can be effectively applied to Army Aviation Modernization priorities, permitting continuous iterative access to DOD and commercial industry innovations that provide fast, inexpensive, and simple capability improvements that capture innovation and support incremental modernization of revolutionary technology. Recalling the details of xTechSearch 1.0 in Table 9, 340 participants competed for a grand prize of \$250K out of a \$2.18M total purse. Recalling our return on investment metric (10 to 40x initial investment) from Table 10, this yields an estimated \$21.8M to \$87.2M that the Army has infused into innovations that support its six Modernization priorities. Digging deeper into the details provides insight specific to support of Army Aviation Modernization. If an assumption is made that, during xTechSearch 1.0, the number of participants and prize money was evenly distributed (with the exception of the winner which not Aviation related) amongst the six Modernization priorities, it assumed that the Army Aviation innovation community grew by 56 (340/6) participants who received ~\$322K (\$1.93M/6). This estimates that the Army Aviation Modernization innovative industry partners are infused with \$3.22M to \$12.88M in each of the basic xTechSearch. If the xTechSearch COVID-19 challenge is used as an example to structure a specific challenge focused on Army Aviation Modernization, market stimulation can be estimated to show access to as many as 100 additional companies and \$10M to \$40M per challenge. Naturally, increasing the purse amount would increase the level of market stimulation.

While the xTechSearch COVID-19 challenge, necessarily, pushed the envelope in terms of the speed to complete a competition, it is recognized that this pace cannot be effectively implemented on a recurring basis. But it is certainly reasonable to conclude that as many four challenges specifically focused on Army Aviation could be comfortably conducted within a year. This could serve to stimulate the market with \$40-160M and provide access to as many as 400 (not counting returning participants) companies per year. All for a mere (in Government terms) \$4M per year.

Likewise, xTechSearch's COVID-19 Ventilator Challenge showed the utility of the ChBA approach to support Army Aviation UONs. Recall that this challenge had two parts: 1) Concept Submission Quad Chart and Video and 2) Technology Pitches. The rules of the challenge noted that "upload submission [would] be accepted beginning 5 April 2020 and [would] be reviewed upon receipt" (Army Research Laboratory, 2020). "Submissions that are approved by the Ventilator Challenge judging panel [would] be invited to deliver a virtual pitch to a panel starting on 13 April 2020" with the "[v]irtual pitch schedule dependent on the submission date" (Army Research Laboratory, 2020). The applicants should have been prepared to deliver a virtual pitch within 1 week of submitting their initial application. This challenge also noted that, in addition to a monetary prize, participants would "be invited to develop and demonstrate a concept prototype to potentially receive follow on contracts for additional production and deployment" (Army Research Laboratory, 2020). The 'follow-on contract' reference is significant because it had not been included in any of the previous challenges issued by xTechSearch. On, May 12, 2020, the Army announced five winners to this challenge and has entered into follow-on contracts for engineering and manufacturing development. The challenge was conducted in 37 days and attracted 100 participants. Again, all for \$1,000,000.00.

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V. CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH

Chapter I of this research provided the background, objective, and scope of this research by reviewing some of the “lessons learned” from previous acquisition programs and reviewing current intentions of Army Aviation modernization. Chapter II provided a literature review of initiatives, regulations, and guides that apply to this research. Chapter III provided analysis the data discovered during the literary review. Chapter IV focused on the findings and results discovered during data analysis. This Chapter will conclude research and discuss areas for further research.

A. CONCLUSIONS AND RECOMMENDATIONS

After fully analyzing the xTechSearch program, it is believed that this program should provide the foundation of any ChBA efforts performed to support Army Aviation Modernization. The program provides a solid foundation for market stimulation and attracting innovative startups. Conversely, the characteristics displayed during the COVID-19 challenge illustrate the flexibility and adaptability of xTechSearch to fulfill UONs and efforts that support Army Aviation Modernization requirements generation. Furthermore, while the xTechSearch program has focused, thus far, on immature technologies, it is recommended that a competition be created which focuses on the Army’s Modernization Priority #3—FVL. While the determination of which authority to exercise is dependent upon the overall requirement, it is believed that issuing a challenge in support of Army Aviation Modernization under 10 USC § 2374a would provide the broadest coverage across all companies and access to all technologies across the TRL spectrum.

While xTechSearch is more than capable of handling a challenge specific to the modernization of Army Aviation, the most critical aspect is the development of a pipeline which can demonstrate innovation over the long run and quickly transitioning relevant technologies to the battlefield. It is believed that issuing challenges under 10 USC § 2374a can provide expedience in a follow-on contract. This authority does not permit direct follow-on as is provided in OTA authority. However, it does encourage follow-on contracts

in conjunction with other authorities. Simply put, once a challenge has been completed and a technology presents an innovative approach, it will likely need to undergo further experimentation and militarization. These quantities can be procured non-competitively under 10 USC § 2373. This would allow the time and opportunity needed to initiate a long-term procurement for production.

In terms of a procurement vehicle to be used for the long run and gain access to quantities of production, it is believed that a BAA is the most optimal because of its flexibility. For starters, BAA's can exist in perpetuity. Secondly, the scope of the BAA can be generally stated to provide broad coverage across the spectrum of challenges. Furthermore, a BAA is not restricted to any pool of contractors. There are also a variety of contracts which can be issued from a BAA—a Technology Investment Agreement (TIA); OTA for Prototype (OTAP); FAR-based contract, etc. This aspect of the BAA offers flexibility to the government to reduce risks specific to the FVL xTechSearch competition and leverage specific terms and conditions required by the competition winner. Most likely, there is already a BAA in existence which can be utilized in support of FVL and other Modernization efforts. However, if there are BAAs which are not accessible, one can be created specifically to encompass the entire xTechSearch. Figure 5 further details the recommended path to production.

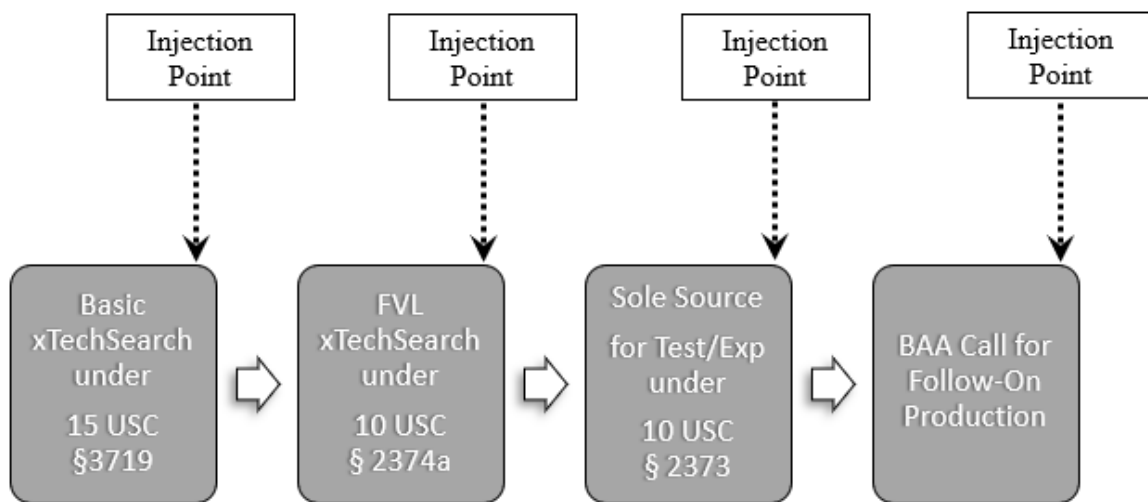


Figure 5. Suggested Approach for FVL ChBA

The approach suggested for FVL in Figure 5 is unique in the flexibility that it provides in execution. As outlined, it can be executed in serially. It also provides opportunities for streamlining through parallel processing. Furthermore, it provides multiple injection points where technology, as appropriate, can be acquired accordingly. In other words, the approach suggested can adjust to all factors pertinent to the situation (i.e., timeline, TRL, etc.). The injection points noted in the suggested approach are not mutually exclusive to an FVL xTechSearch competition. For example, if a known capability exists and does not need to be demonstrate in a prize competition, it can proceed directly to 10 U.S. Code § 2373 to procure quantities for testing and experimentation. The suggested approach would provide the flexibility and modularity to adapt to changing priorities in Army Aviation Modernization. Regardless of how the recommended process is executed, it is imperative that there is forethought to the next stage (actually, as many future stages as possible) to ensure that appropriate measures can be taken in the next step of execution.

In summary, the xTechSearch program, has substantial name recognition and foundation to support challenges issued to advance Army Aviation Modernization. This is particularly true when challenges are issued under the authority of 10 USC § 2374a. This construct would be most effective when follow-on procurements are issued under 10 USC § 2373.

B. AREAS FOR FURTHER RESEARCH

Perhaps the biggest opportunity for further research is in 10 USC § 2374a. Similar to how the OTA authority has been granted authority to create the option of follow-on production, a direct linkage between challenges and procurement of quantities for experimentation and follow-on production would be greatly beneficial and provide additional flexibilities in the ability to expedite the process.

Additionally, an opportunity exists to explore the possible creation of an appropriation category to specifically allocated to incentive prize competitions. This fund would need the ability to span an indeterminant amount of time. This would allow the Government to issue complex challenges, like XPRIZE, while alleviating any concerns on the Bona Fide Need Rule.

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APPENDIX A. CONTRACTING STRATEGIES RELATED TO CHBA ATTRIBUTES

Table 15. Contracting Strategies Related to Acquisition Attributes. Source: Roe et al. (2019)

	Evaluation of multiple participants to support a final procurement (IDIQ)	Technology creation leading to competitive procurement (BAA)	Rapid acquisition of a prototype or demonstrated capability (OTA)	IP creation for Government procurement (other)
Degree of Capability Understanding—Describes the level of understanding the Government and industry have of the desired capability outcome.	Best when moderate to high understanding of sought capability exists.	Best when little is known about how the sought capability may be supplied. Suited for acquisitions where considerable technology development is needed.	Best when little is known about how the sought capability may be supplied.	Best when the program is unsure whether the sought capability even exists.
Acquisition Scope—Defines the acquisition in terms of the level of development required and the expectations for production and delivery of IP or products.	Imposes few scope restrictions.	The program's scope should be defined as seeking the art of the possible and procuring the discovered solution.	Scope restrictions are a function of the OTA consortium to be used for the challenge.	If standing up a new consortium, scope restrictions can be minimized. The program must have RDT&E funding since the approach seeks early research resulting in IP. An advantage to this strategy is that it allows acquisition of IP under the BAA without a second contracting action.
Available Time—Establishes the flexibility of the schedule for the overall effort.	Saves lead time through the initial IDIQ award versus undertaking individual contract competitions.	May not be appropriate if the program is on a compressed schedule. The BAA process addresses technological uncertainty but even if technology development is rapid, this strategy requires time for a separate conventional procurement to acquire solutions.	Most rapid ChBA approach of all if OTA is used in conjunction with existing consortium.	Could be completed quickly depending on the speed of challenger IP development and its value to the Government. The challenge can end whenever the Government finds a useful portion of the desirable solution.

Challenger Pool Size—Identifies those industry partners that display an ability to perform within a challenge with the potential to achieve the desired outcome.	Requires a competitive pool size at each step of the process. If the initial pool size is uncompetitive the IDIQ strategy should be abandoned.	Uses an initial pool of challengers that are selected by a peer or scientific review of the initial proposals.	Initial challenger pool size is a function of the size of the consortium.	Uses an initial pool of challengers that are selected by a peer or scientific review of the initial proposals.
Financial Compensation—The Government’s use of monetary compensation to incentivize challenger participation.	The IDIQ contract allows an indefinite number of task orders to be issued within scope of the original contract. These task orders can be used to conduct compensated challenge events throughout the evaluation process, and to procure solutions.	While BAAs allow the compensation of challengers for challenge participation only, the primary method of compensation may be the potential award of a follow-on production-quantity contract.	The OTA agreement permits maximum flexibility in providing financial compensation to consortium members.	Can be used to create multiple contracts to compensate challengers for challenge participation and for IP creation. At the program’s discretion, a follow-on contract may be awarded for use of IP based on conventional procurement methods.
Evaluation—The Government’s expected use of challenges to support contract decisions.	Once the competitive range (challenge pool) is created at IDIQ award, all subsequent evaluations use best value based on evidence revealed through challenge performance and price information.	Proposals and challenge results are evaluated “through a peer or scientific review process.”	The Government has maximum flexibility in evaluation criteria to support OTA initial agreement awards. Follow-on production contract award criteria would be similar to those used during the IDIQ evaluation	After the BAAs are awarded, each vendor may take part in one or more challenge events. Challenges can help keep the BAA focused in promising directions by directing funds to successful participants until the sought IP is available to the Government.

			process.	
Procurement –The final decision parameters of whether the acquisition effort will result in a procurement and of what (e.g., product or IP).	Allows production quantities of a solution to be procured under the original IDIQ contract as a task order. If the scope and ceiling of the original contract are respected, more than one part of Government can use the same IDIQ for solution procurement.	Using a BAA does not permit procurement. The completed BAA may inform the Government about the range of viable solutions and can strengthen the RFP generation process. Technology developed under the BAA may be made available to industry if the appropriate IP licenses were purchased or included as part of challenge participation.	Allows production quantities of a solution to be procured via a follow-on FAR-based production contract without further competition required per Section 815 of the FY16 NDAA.	Can be augmented by using a conventional procurement as a separate contracting action for IP licenses if delivery of licenses were not included as part of the original BAA challenge process.

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APPENDIX B. 10 U.S. CODE § 2374A

Source: Prizes For Advanced Technology Demonstration (2019).

10 U.S. Code § 2374a. Prizes for advanced technology achievements

(a) Authority. —

The Secretary of Defense, acting through the Under Secretary of Defense for Research and Engineering, the Under Secretary of Defense for Acquisition and Sustainment, and the service acquisition executive for each military department, may carry out programs to award cash prizes and other types of prizes that the Secretary determines are appropriate to recognize outstanding achievements in basic, advanced, and applied research, technology development, and prototype development that have the potential for application to the performance of the military missions of the Department of Defense.

(b) Competition Requirements. —

Each program under subsection (a) shall use a competitive process for the selection of recipients of cash prizes. The process shall include the widely advertised solicitation of submissions of research results, technology developments, and prototypes.

(c) LIMITATIONS. —

(1) No prize competition may result in the award of a prize with a fair market value of more than \$10,000,000.

(2) No prize competition may result in the award of more than \$1,000,000 in cash prizes without the approval of the Under Secretary of Defense for Research and Engineering.

(3) No prize competition may result in the award of a solely nonmonetary prize with a fair market value of more than \$10,000 without the approval of the Under Secretary of Defense for Research and Engineering.

(d) Relationship to Other Authority. —

A program under subsection (a) may be carried out in conjunction with or in addition to the exercise of any other authority of an official referred to in that subsection to acquire, support, or stimulate basic, advanced and applied research, technology development, or prototype projects.

(e)Acceptance of Funds. —

In addition to such sums as may be appropriated or otherwise made available to the Secretary to award prizes under this section, the Secretary may accept funds or nonmonetary items from other departments and agencies of the [Federal Government](#), from State and local governments, and from the private sector, to award prizes under this section. The Secretary may not give any special consideration to any private sector entity in return for a donation.

(f)Use of Prize Authority. —

Use of prize authority under this section shall be considered the use of competitive procedures for the purposes of [section 2304 of this title](#).

APPENDIX C. 15 U.S. CODE § 3719

Source: America Competes Act (2017).

15 U.S. Code § 3719. Prize competitions

(a) Definitions In this section:

(1) Agency

The term “[agency](#)” means a [Federal agency](#).

(2) Director

The term “[Director](#)” means the [Director](#) of the Office of Science and Technology Policy.

(3) Federal agency

The term “[Federal agency](#)” has the meaning given under [section 3703 of this title](#), except that term shall not include any [agency](#) of the legislative branch of the Federal Government.

(4) Head of an agency

The term “[head of an agency](#)” means the head of a [Federal agency](#).

(b) In general

Each [head of an agency](#), or the heads of multiple agencies in cooperation, may carry out a program to award prizes competitively to stimulate innovation that has the potential to advance the mission of the respective [agency](#).

(c) Prize competitions For purposes of this section, a prize competition may be 1 or more of the following types of activities:

(1) A point solution prize that rewards and spurs the development of solutions for a particular, well-defined problem.

(2) An exposition prize competition that helps identify and promote a broad range of ideas and practices that may not otherwise attract attention, facilitating further development of the idea or practice by third parties.

(3) Participation prize competitions that create value during and after the competition by encouraging contestants to change their behavior or develop new skills that may have beneficial effects during and after the competition.

(4) Such other types of prize competitions as each [head of an agency](#) considers appropriate to stimulate innovation that has the potential to advance the mission of the respective [agency](#).

(d) Topics

In selecting topics for prize competitions, the [head of an agency](#) shall consult widely both within and outside the Federal Government, and may empanel advisory committees.

(e) Advertising

The [head of an agency](#) shall widely advertise each prize competition to encourage broad participation.

(f) Requirements and registration For each prize competition, the [head of an agency](#) shall publish a notice on a publicly accessible Government website, such as www.challenge.gov, announcing—

- (1) the subject of the prize competition;
- (2) the rules for being eligible to participate in the prize competition;
- (3) the process for participants to register for the prize competition;
- (4) the amount of the cash prize purse or non-cash prize award; and
- (5) the basis on which a winner will be selected.

(g) Eligibility To be eligible to win a cash prize purse under this section, an individual or entity—

- (1) shall have registered to participate in the prize competition under any rules promulgated by the [head of an agency](#) under subsection (f);
- (2) shall have complied with all the requirements under this section;
- (3) in the case of a private entity, shall be incorporated in and maintain a primary place of business in the United States, and in the case of an individual, whether participating singly or in a group, shall be a citizen or permanent resident of the United States; and
- (4) may not be a Federal entity or Federal employee acting within the scope of their employment.

(h) Consultation with Federal employees

An individual or entity shall not be deemed ineligible under subsection (g) because the individual or entity used Federal facilities or consulted with Federal employees during a prize competition if the facilities and employees are made available to all individuals and entities participating in the prize competition on an equitable basis.

(i) *Liability*

(1) *In general*

(A) *Definition*

In this paragraph, the term “[related entity](#)” means a contractor or subcontractor at any tier, and a supplier, user, customer, cooperating party, grantee, investigator, or detailee.

(B) *Liability*

Registered participants shall be required to agree to assume any and all risks and waive claims against the Federal Government and its related entities, except in the case of willful misconduct, for any injury, death, damage, or loss of property, revenue, or profits, whether direct, indirect, or consequential, arising from their participation in a prize competition, whether the injury, death, damage, or loss arises through negligence or otherwise.

(2) *Insurance* Participants shall be required to obtain liability insurance or demonstrate financial responsibility, in amounts determined by the [head of an agency](#), for claims by—

(A) a third party for death, bodily injury, or property damage, or loss resulting from an activity carried out in connection with participation in a prize competition, with the Federal Government named as an additional insured under the registered participant’s insurance policy and registered participants agreeing to indemnify the Federal Government against third party claims for damages arising from or related to prize competition activities; and

(B) the Federal Government for damage or loss to Government property resulting from such an activity.

(3) *Waivers*

(A) *In general*

An [agency](#) may waive the requirement under paragraph (2).

(B) List

The [Director](#) shall include a list of all of the waivers granted under this paragraph during the preceding fiscal year, including a detailed explanation of the reason for granting the waiver.

(4) Exception

The [head of an agency](#) may not require a participant to waive claims against the administering entity arising out of the unauthorized use or disclosure by the [agency](#) of the intellectual property, trade secrets, or confidential business information of the participant.

(j) Intellectual property

(1) Prohibition on the government acquiring intellectual property rights

The Federal Government may not gain an interest in intellectual property developed by a participant in a prize competition without the written consent of the participant.

(2) Licenses

As appropriate and to further the goals of a prize competition, the Federal Government may negotiate a license for the use of intellectual property developed by a registered participant in a prize competition.

(k) Judges

(1) In general

For each prize competition, the [head of an agency](#), either directly or through an agreement under subsection (l), shall appoint one or more qualified judges to select the winner or winners of the prize competition on the basis described under subsection (f). Judges for each prize competition may include individuals from outside the [agency](#), including from the private sector.

(2) Restrictions A judge may not—

(A) have personal or financial interests in, or be an employee, officer, [director](#), or agent of any entity that is a registered participant in a prize competition; or

(B) have a familial or financial relationship with an individual who is a registered participant.

(3) Guidelines

The heads of agencies who carry out prize competitions under this section shall develop guidelines to ensure that the judges appointed for such prize competitions are fairly balanced and operate in a transparent manner.

(4) Exemption from FACA

The [Federal Advisory Committee Act \(5 U.S.C. App.\)](#) shall not apply to any committee, board, commission, panel, task force, or similar entity, created solely for the purpose of judging prize competitions under this section.

(l) Administering the competition

The [head of an agency](#) may enter into a grant, contract, cooperative agreement, or other agreement with a private sector for-profit or nonprofit entity or State or local government [agency](#) to administer the prize competition, subject to the provisions of this section.

(m) Funding

(1) In general

Support for a prize competition under this section, including financial support for the design and administration of a prize competition or funds for a cash prize purse, may consist of Federal appropriated funds and funds provided by private sector for-profit and nonprofit entities. The [head of an agency](#) may request and accept funds from other Federal agencies, State, United States territory, local, or tribal government agencies, private sector for-profit entities, and nonprofit entities, to be available to the extent provided by appropriations Acts, to support such prize competitions. The [head of an agency](#) may not give any special consideration to any [agency](#) or entity in return for a donation.

(2) Availability of funds

Notwithstanding any other provision of law, funds appropriated for cash prize purses or non-cash prize awards under this section shall remain available until expended. No provision in this section permits obligation or payment of funds in violation of [section 1341 of title 31](#).

(3) Amount of prize

(A) Announcement

No prize competition may be announced under subsection (f) until all the funds needed to pay out the announced amount of the cash prize purse have been appropriated or committed in writing by a private or State, United States territory, local, or tribal government source.

(B) Increase in amount The [head of an agency](#) may increase the amount of a cash prize purse or non-cash prize award after an initial announcement is made under subsection (f) only if—

(i) notice of the increase is provided in the same manner as the initial notice of the prize competition; and

(ii) the funds needed to pay out the announced amount of the increase have been appropriated or committed in writing by a private or State, United States territory, local, or tribal government source.

(4) Limitation on amount

(A) Notice to Congress

No prize competition under this section may offer a cash prize purse or a non-cash prize award in an amount greater than \$50,000,000 unless 30 days have elapsed after written notice has been transmitted to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives.

(B) Approval of head of agency

No prize competition under this section may result in the award of more than \$1,000,000 in cash prize purses or non-cash prize awards without the approval of the [head of an agency](#).

(n) General Services Administration assistance

Not later than 180 days after January 6, 2017, the General Services Administration shall provide government wide services to share best practices and assist agencies in developing guidelines for issuing prize competitions. The General Services Administration shall develop a contract vehicle for both for-profit and nonprofit entities and State, United States territory, local, and tribal government entities, to provide agencies access to relevant products and services, including technical assistance in structuring and conducting prize competitions to take maximum benefit of the marketplace as they identify and pursue prize competitions to further the policy objectives of the Federal Government.

(o) Compliance with existing law

(1) *In general*

The Federal Government shall not, by virtue of offering a prize competition or providing a cash prize purse or non-cash prize award under this section, be responsible for compliance by registered participants in a prize competition with Federal law, including licensing, export control, and nonproliferation laws, and related regulations.

(2) *Other prize authority*

Nothing in this section affects the prize authority authorized by any other provision of law.

(p) *Biennial report*

(1) *In general*

Not later than March 1 of every other year, the [Director](#) shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a report on the activities carried out during the preceding 2 fiscal years under the authority in subsection (b).

(2) *Information included* A report under this subsection shall include, for each prize competition under subsection (b), the following:

(A) *Proposed goals*

A description of the proposed goals of each prize competition.

(B) *Preferable method*

An analysis of why the utilization of the authority in subsection (b) was the preferable method of achieving the goals described in subparagraph (A) as opposed to other authorities available to the [agency](#), such as contracts, grants, and cooperative agreements.

(C) *Amount of cash prize purses or non-cash prize awards*

The total amount of cash prize purses or non-cash prize awards awarded for each prize competition, including a description of amount of private funds contributed to the program, the sources of such funds, and the manner in which the amounts of cash prize purses or non-cash prize awards awarded and claimed were allocated among the accounts of the [agency](#) for recording as obligations and expenditures.

(D) *Solicitations and evaluation of submissions*

The methods used for the solicitation and evaluation of submissions under each prize competition, together with an assessment of the effectiveness of such methods and lessons learned for future prize competitions.

(E) *Resources*

A description of the resources, including personnel and funding, used in the execution of each prize competition together with a detailed description of the activities for which such resources were used and an accounting of how funding for execution was allocated among the accounts of the [agency](#) for recording as obligations and expenditures.

(F) *Results*

A description of how each prize competition advanced the mission of the [agency](#) concerned.

(G) *Plan*

A description of crosscutting topical areas and [agency](#)-specific mission needs that may be the strongest opportunities for prize competitions during the upcoming 2 fiscal years.

APPENDIX D. XTECHSEARCH COMPETITION 1

The xTechSearch 1 winner Adranos, Inc. was announced at the Association of the U.S. Army's Global Force Symposium and Exposition in March 2019. The 12 small business finalists are listed below:

Table 16. xTechSearch 1 Vendors. Source: Army Research Laboratory (n.d.).

Company Name	Topic	Technology Description
Adranos, Inc.	High Performance, Clean Solid Rocket Propellant	A cost-effective solid rocket propellant called ALITEC that increases in ballistic missiles range against other propellant-based projectiles by up to 40 percent.
Aeronics, Inc.	Adsorbent-Enabled Portable Medical Gas Supply Systems	Lightweight and portable oxygen systems for defense systems. Their entry application is an oxygen supply for canine HALO units.
Blacksand Technologies	High-Performance Low-Cost Titanium for Army Transportation and Weapon Systems	Hydrogen Sintering and Phase Transformation (HSPT) that produces a Ti-6Al-4V alloy with wrought-like microstructures and mechanical properties, resulting in a near-net-shape (NNS) component fabrication processes for manufacturing structural components at large scale.
Cuberg, Inc.	Ultra-Lightweight and Safe Lithium Metal Batteries	Demonstrated performance and maturity of a battery technology by putting it through an extremely demanding use case. A flying quadcopter requires both exceptional specific energy and power, and a Cuberg-powered quadcopter will not only take off but fly for longer than one powered by the best lithium-ion batteries in the world.

Hivemapper	Automated Full Motion Video to Dynamic 3D Maps for Analytics	Technology that takes the wide variety of video formats and collection methodologies used across the DOD and ensuring that all collections can be fed into the Hivemapper platform for 3D mapping and analytics across mission sets to rapidly answer the questions posed by users around the world.
Hyperdyne	Hypernet: A decentralized data platform	Hypernet, a secure code/algorithm deployment platform and a highly scalable parallel programming API based on the principle of distributed average consensus. This platform can be leveraged to deploy ML/AI algorithms to in-network data to extract insights without the need for data centralization.
NODAR, Inc.	All-Weather, Solid-State LIDAR	A 3D sensor in that can perform in harsh weather conditions such as rain, snow, and hail. The sensor will significantly enhance autonomous operation of the Army's combat vehicles, supply vehicles, and other robotic platforms.
Notch Inc.	Tunable Notch panels and anti-jamming	A tunable Notch panel and anti-jamming protection.
Sempulse, Inc.	Sempulse Triage Solution	A non-invasive vital signs sensor that adheres to the back of the ear and acquires patients' 5 major vital signs. This is industry's first cuff-less tool for measuring blood pressure, pulse oximetry, heart rate, respiratory rate, and core body temperature, plus GPS and a wealth of additional information.
TangiTek, LLC	MF-RAM: Ultra-light, thin, tunable, and broadband magnetic flocked Carbon Fiber composite Radar Absorbing Materials	A project focused on utilizing an ultralight, thin, nonwoven, high performance, magnetically loaded flocked carbon fiber composite radar absorbing material MF-RAM for electromagnetic signature reduction of soldier operational equipment systems e.g., helmets, armor vest, and asset covers—to provide detection avoidance, tactical concealment,

		enhanced survivability, and improved soldier protection.
Wildspark Technologies, LLC	Propellerless Vertical Lift	A concept to enable drones and other small air vehicles to lift off and move without propellers. This eliminates the risk of propeller contact injuries and may have further applications in the emerging air taxi market.
Wiser Systems, Inc.	Situational Awareness with WISER RRLT	A system to translate granular local positioning into GPS coordinates, enabling continuous positioning, location, and asset visibility even in occluded environments where GPS would not ordinarily function. This system will support resilient mission command and navigation assurance by giving both remote and onsite commanders real-time visibility of any critical asset.

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APPENDIX E XTECHSEARCH COMPETITION 2

The xTechSearch 2 winner Lumineye, Inc. was announced at the AUSA Annual Meeting in Washington, D.C. on Oct. 16, 2019. The 12 Small Business finalists are listed below.

Table 17. xTechSearch 2 Vendors. Source: Army Research Laboratory (n.d.).

Company Name	Topic	Technology Description
AKHAN Semiconductor, Inc.	Diamond + FGO Protective Coatings for Army Aviation	AKHAN has developed its Miraj Diamond® technology for protective coatings intended for directed energy and electromagnetic weaponry applications, addressing future vertical lift Army modernization priorities. Diamond's multi-layer materials can broadly be applied for the protection of both optically transparent & opaque surfaces on aircraft canopies, sensor windows, & other sensitive structures.
Cogitari, Inc.	Secure Wireless Communications with RF Monitoring	The R-DAS has capabilities for delivering secure wireless communications while detecting and locating threats to network/data security.
Great Lakes Sound and Vibration, Inc.	Active Noise Control System for Ground Vehicles	Great Lakes Sound and Vibration (GLSV) has developed an active noise cancellation (ANC) system that provides noise reduction capabilities in military ground vehicles beyond current state of the art. The ANC system has been developed as an add-on feature, providing the unique ability to treat noise issues late in the vehicle development cycle, which is a critical asset to new vehicle programs.
Halomine, Inc.	Next Generation Wound Therapeutics	Halomine's products include next-generation wound management materials (dressings) that deliver these advantages: potent and safe antimicrobial agents that prevent biofilm

		formation and kill dangerous drug-resistant bacteria, hemostatic properties that stop bleeding quickly, and advanced material properties that promote faster and better wound healing.
Lumineye, Inc.	Man-Portable Wall Penetrating Radar	Lumineye's radar device detects moving and still people from more than 10 meters away. The device weighs less than a kilogram and is man packable.
MELD Manufacturing Corporation	Battlefield Deployable Additive Manufacturing Technology	A technology that can be used at the point of need: repair or build with MELD anywhere because it is open atmosphere, safe, low power, makes wrought fully dense material, and is the only metal additive process that lets you use practically any metal, in solid bar or powder form. These unique advantages are because with MELD, you don't melt the metal.
Novaa Ltd.	Anti-Jam, Anti-Spoof and Multipath-Resilient GPS Antenna	Antenna technology providing protected access to GPS. Uncontested access to GPS-based PNT cannot be assumed. Operators face near-constant threat of denial (jamming), degraded accuracy due to buildings or terrain (multipath), and manipulation with faked signals (spoofing). Novaa's antenna platform provides impervious access to GPS signals, suppressing unwanted jamming, spoofing, and multipath.
Olifant Medical	Improving Airway Management with Smarter Stylet Technology	Consistent and rapid first-pass success is essential during airway management in order to avoid life threatening complications, yet many clinicians still struggle to achieve this goal. Olifant medical has identified the anatomic and ergonomic factors that interfere with successful tracheal intubation and has designed a stylet technology that overcomes these barriers.

Spark Thermionics, Inc.	Silent, Lightweight, Multifuel Thermionic Generators	Thermionic devices, which form the core of Spark's generator. These devices directly convert heat to electricity for true fuel flexibility, relying on modern materials and wafer fabrication techniques to leap-frog competing approaches and enable novel capabilities.
United Aircraft Technologies, Inc.	Augmented Reality Monitoring System for Aircraft Wiring (ARMS)	A smart interconnecting clamp with a 3D visualization system to provide maintenance crews wiring fault localization. Uses wireless sensing technology to help expand the utilization of Augmented Reality to beyond all electrical wiring maintenance. The anticipated benefits will apply equally to aircraft weight savings and reduction of Repetitive Strain Injuries (RSI).
Valley Tech Systems, Inc.	Valley Tech Systems Active Nozzle Propulsion System Technology	Valley Tech Systems' innovative active nozzle concept applies controllable solid propulsion technology to modernizing Army rockets. This all-in-one axial propulsion system with integral thrust vectoring can extend range, improve precision and reduce cost. Initial trade studies for a sample application indicate a 53 percent increase in lethal range and a 70 percent decrease in turning radius.
Vidrov, Inc.	Large Scale Computer Vision Systems for Visual Intelligence	A high bandwidth, source agnostic machine-learning/computer-vision system to detect and link valuable intelligence from online, broadcast and other sources of PAI and FMV. It creates a knowledge-graph off these features which allows for various applications in 2nd generation machine inference. It is funded by the NSF, the Air Force and is a potential performer on DARPA SEMAFOR.

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APPENDIX F XTECHSEARCH COMPETITIONS 3 AND 4 FINALISTS



Figure 6. xTechSearch 3 Finalists. Source: Army Research Laboratory (n.d.).



Figure 7. xTechSearch 4 Finalists. Source: Army Research Laboratory (n.d.).

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LIST OF REFERENCES

- America Competes Act, 15 U.S.C. § 3719 (2017)
- Arendt, M., & Novak, R. (2016). *From incentive prize and challenge competitions to procurement*. The MITRE Corporation.
<https://www.mitre.org/publications/technical-papers/from-incentive-prize-and-challenge-competitions-to-procurement>
- Army Research Laboratory. (2020, 30 April). *About*. <https://www.arl.army.mil/xtechsearch/index.html>
- Danzig, R. (2011). *Driving in the Dark: Ten Propositions About Prediction and National Security*. Center for a New American Security.
- Freeburg, S. (2018, May 16). *Evolutionary Revolution: Esper's Army Modernization Philosophy*. Retrieved from Breaking Defense: <https://breakingdefense.com/2018/05/evolutionary-revolution-sec-espers-army-modernization-philosophy/>
- Long, J. (2019, January 4). *Four Problems Army Futures Command Needs to Solve*. Retrieved from Moder War Institute: <https://mwi.usma.edu/four-problems-army-futures-command-needs-solve/>
- OFPP and OSTP. (2020, May 31). *Innovative Contracting Case Studies*. <https://techfarhub.cio.gov/assets/files/innovative-contracting-case-studies-2014.pdf>
- Olson, S. (2020, May 31). *XPRIZE director describes incentive prizes in an interview with Sander Olson*. Nextbigfuture. <https://www.nextbigfuture.com/2011/06/x-prize-director-describes-incentive.html>
- Orazem, G., Mallory, G., Schlueter, M., & Werfel, D. (2017, August 22). *Why Startups Don't Bid on Government Contracts*. <https://www.bcg.com/en-us/publications/2017/public-sector-agency-transformation-why-startups-dont-bid-government-contracts.aspx>
- Prizes for advanced technology demonstration, 10 U.S.C. §2374a (2019)
- Roe, S., Arendt, M., & Novak, R. (2019). *Challenge-Based Acquisition*. The MITRE Corporation. <https://www.mitre.org/capabilities/acquisition-effectiveness/acquisition-initiatives/challenge-based-acquisition>
- Rogers, E. (2003). *Diffusion of Innovation, 5th Edition*. New York: The Free Press.

- Satell, G. (2017, June 17). *Harvard Business Review*. The 4 types of innovation and the problems they solve: <https://hbr.org/2017/06/the-4-types-of-innovation-and-the-problems-they-solve>
- Stillman, J. (2020, May 31). *Army ALT Magazine*. <https://asc.army.mil/web/news-alt-jfm20-seeing-through-walls/>
- U.S. Army. (2020, May 02). *Army Futures Command*. <https://armyfuturescommand.com/fvl/>
- Ward, D. (2012, May 25). Real Lessons from and Unreal Helicopter. *Time*, pp. <https://nation.time.com/2012/05/25/real-lessons-from-an-unreal-helicopter/>.
- Weatherly, R., Wydler, V., Way, M., Anderson, S., & Arendt, M. (2013). Challenge-Based Acquisition: Stimulating Innovative Solutions Faster and Cheaper by Asking the Right Questions. *Annual Acquisition Research Symposium*. Monterey: MITRE Corporation.
- XPRIZE Foundation. (2020, May 31). *Mission*. <https://www.xprize.org/about/mission>

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