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Government Contract Process: Analyzing Causes of Bid Protests and the Reduction Possibilities Through "Smart Contract" Automation

September 2023

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ACQUISITION RESEARCH PROGRAM
DEPARTMENT OF DEFENSE MANAGEMENT
NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

This paper reviews protests filed against the U.S. Department of Defense to the Government Accountability Office (GAO) and the Naval Surface Warfare Center Philadelphia Division (NSWCPD) identifying trends in order to evaluate the common causes and negative effects upon procurement. Ultimately, the paper analyzes areas of concern and provides suggestions for improvement.

The methodology involves analysis of commonalities in protests, focusing on cost impacts and time delays to the government. The research includes an evaluation of the common factors found in protests won and protests lost. It was found that the areas of concern within protests could be attributed to two major factors: 43 percent were attributed to technical evaluation and 27 percent to contract set-asides. As dictated by the Federal Acquisition Regulation (FAR), the acquisition process relies on the judgment of the Contracting Officer when reviewing protests. The causality of protests, however, relies on more adjudicating parties to make a fair and reasonable determination.

This paper reviews literature on recent technological advances in cryptography and computer science, namely blockchain technology. The use of blockchain locked smart contracts is described as the future of government contracting to mitigate or reduce a multitude of popular trends in complaints against the contract bid process.

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TABLE OF CONTENTS

I. INTRODUCTION....1
A. PROJECT BACKGROUND AND SUBJECT....1
B. RESEARCH OBJECTIVES....2
C. RESEARCH QUESTIONS....2
D. REPORT ORGANIZATION....3

II. LITERATURE REVIEW....5
A. OVERVIEW....5
B. DEFENSE ACQUISITION EXPLAINED....5
C. WHAT IS A CONTRACT....6
1. Definition of a Contract....6
2. Contract Characteristics....6
3. Types of Contracts....7
D. WHAT IS A PROTEST....7
1. Definition of a Protest....7
2. Purpose of a Protest....8
3. Origins of (Bid) Protest....8
4. Rules for Filing a Protest....9
5. GAO Protest History....10
6. Key Parties in a Bid Protest....10
E. SUMMARY....11

III. RESEARCH METHOD....13
A. OVERVIEW....13
B. PROTEST RISK....13
1. Reasons for Increased Protest Likelihood....13
2. Methods to Reduce Protest Likelihood....14
C. BID PROTEST RESEARCH....15
D. SUMMARY....29

IV. ANALYSIS AND RESULTS....31
A. OVERVIEW....31
B. LEDGERS AND CENTRALIZATION "TRUST"....32
C. BLOCKCHAIN EXPLAINED: BASELINE STRUCTURE....33
1. Bitcoin: The Beginning of Monetizing Blockchain....36
2. Ethereum: Bitcoin 2.0 Gives Way to Smart Contracts....37
D. SMART CONTRACTS....37

E. GOVERNMENT USE OF SMART CONTRACTS 38
1. Eliminate the Complaint – Ambiguity 39
2. Blockchain and Smart Contracts Provide Accuracy in Bid Submissions 41
3. Built-in Trust in Documentation Submission 43
4. Smart Contracts Provide Security 43
5. Efficiency: Removal of Arduous Government Process Steps 43
6. Benefits of Decentralized Applications 45
F. BARRIERS TO GOVERNMENT USE 45
1. Legal Status of Smart Contracts 46
2. The Military Lacks Speed and Adaptability 47
3. Barriers 47
G. SUMMARY 49

V. SUMMARY, CONCLUSION, AND RECOMMENDATIONS 51
A. SUMMARY 51
B. CONCLUSION 52
C. LIMITATIONS AND RECOMMENDATIONS 53
D. AREAS FOR FUTURE RESEARCH 54

APPENDIX. MAJOR CONTRACT TYPES 55

LIST OF REFERENCES 57

LIST OF FIGURES

Figure 1. DOD Procurements Protests at GAO, FYs 1989 – 2016. Source: Arena et al. (2018). 16

Figure 2. Corrective Actions Taken at the Agency Level. Adapted from PIEE EDA (personal communication, March 12, 2021). 23

Figure 3. Most Common Reasons for Contractor Protest to NSWCPD. Adapted from PIEE EDA (personal communication, March 12, 2021) 24

Figure 4. Visual Illustration of Blockchain Construction. Source: Bhosale (2020). 33

Figure 5. Blockchain Hash Relationship and Linking Mechanism. Source: Eremenko (2018). 33

Figure 6. Peer-to-Peer Network Makeup for Blockchain. Source: Дергунов (2022). 35

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LIST OF TABLES

Table 1. Percentage of Protests, Spending, and Contracts by DOD Agency at GAO, FYs 2008 – 2016. Source: Arena et al. (2018, p. 50). 18

Table 2. Five Year Period of Bid Protest to the GAO, FYs 2016–2020. Adapted from U.S. GAO (2020, p. 4) 21

Table 3. Bid Protest Time to Resolution (in days). Adapted from PIEE EDA (personal communication, March 12, 2021). 25

Table 4. Comparison of Major Contract Types. Adapted from DSMC (2014). 55

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LIST OF ACRONYMS AND ABBREVIATIONS

ACUS	Administrative Conference of the United States
ARP	Acquisition Research Program
ARS	Acquisition Research Symposium
AWS	Amazon Web Services
COFC	US Court of Federal Claims
DL	digital ledger
DLA	Defense Logistics Agency
DLT	distributed ledger technology
DSMC	Defense Systems Management College
DOD	Department of Defense
FAR	Federal Acquisition Regulation
FY	fiscal year
GAO	Government Accountability Office
IBM	International Business Machines Corporation
JEDI	Joint Enterprise Defense Infrastructure
LPTA	lowest price technically acceptable
NCMA	National Contract Management Association
NDAA	National Defense Authorization Act
NPS	Naval Postgraduate School
NSWCPD	Naval Surface Warfare Center, Philadelphia Division
P2P	peer-to-peer
RAND	Research and Development (Corporation)
RFP	request for proposals
U.S.	United States

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I. INTRODUCTION

A. PROJECT BACKGROUND AND SUBJECT

The procurement of materiel products and services is a key function of the Department of Defense (DOD). Defense acquisition serves as a basis for the majority of DOD activities in terms of production, services, and supporting warfighter needs in their efforts to maintain national security. Given that DOD contracting activities function as stewards of taxpayer funds, rules have been put in place to govern the expenditure of tax dollars and to help ensure the integrity of an impartial and fair process for the competition and selection of awardees for government contracts. These rules are codified within Federal Acquisition Regulation (FAR).

Despite the goals of having an impartial and fair acquisition process, it is possible that acquisitions are not always managed properly. With the idea of maintaining integrity in mind, there is a method in place for interested parties to officially object to acquisition decisions. Such an objection is called a protest. FAR Part 33.101 states that any interested party may file a protest when their "direct economic interest would be affected by the award of a contract or by the failure to award a contract" (FAR 33.101, 2022).

In general terms, a protest against a contractual agreement acts as a system of checks and balances that helps to ensure the acquisition process remains neutral, objective, and fair. When a protest is filed, however, that particular acquisition most often stalls until the bid protest is decided, dismissed, or withdrawn. As such, protests can directly affect the acquisition process negatively, regarding cost and schedule objectives.

This paper reviews available research and data on bid protests. Specifically analyzing protests filed with Naval Surface Warfare Center Philadelphia Division (NSWCPD) to identify trends and outcomes to evaluate the common causes and negative effects related to Navy procurement. This paper to present an overview of smart contracts and how blockchain technology-based contracts could be implemented to reduce protest likelihood and/or decrease the negative effects of protests upon project costs and schedules. This paper aims to identify and analyze these areas of concern and provide suggestions for

how smart contracts and blockchain technology could lend themselves to process improvement and increased efficiency with the goal of reducing protests and their negative impacts should they occur.

B. RESEARCH OBJECTIVES

The primary objective of this paper is to review the available research and data on bid protests and evaluate how smart contracts could be utilized to reduce protest likelihood and impacts.

Secondary objectives of this paper include examining the effects of protests on the conduct and availability of the Navy to offer contracts for bid to the public, to review and evaluate data relating to protests filed specifically with NSWCPD, and to investigate smart contracts under the lens of their applicability to government contracting and their potential to reduce bid protests.

C. RESEARCH QUESTIONS

This paper seeks to answer:

- What is a bid protest?
- What are the key drivers behind bid protests?
- What are the common (negative) impacts of bid protests?
- What could have been done to decrease the likelihood of a protest?
- What do bid protests at NSWCPD look like?
- What is a smart contract?
- How can smart contracts be utilized to reduce bid protest likelihood and impact(s)?

D. REPORT ORGANIZATION

This study is broken down into chapters for clarity and rational flow. Chapter I is a brief introduction to the topic, background of the paper's subject, and an overview. Next, the literature review discussion in Chapter II defines all terms and functions of the system in place. Chapter III introduces and analyzes a string of research to identify common trends, patterns and recommendations. A technological advancement is introduced in Chapter IV as a possible deterrent for the discoveries amplified in Chapter III. Finally, Chapter V presents the summary, study limitations, and recommendations for future expansion.

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II. LITERATURE REVIEW

A. OVERVIEW

This section seeks to provide the basis needed for understanding bid protests. It begins with a very high-level explanation of how defense acquisition works. It then defines what a contract is before going into an overview of contract characteristics and the distinct types of contracts. With that foundation, it goes on to describe where protests originated, and what they signify regarding defense contracting. This section also describes different venues for filing a protest, along with the relationship between protests and contracts, while briefly discussing the importance of bid protests. Overall, Section II aims to give the background and foundational knowledge for Section III.

B. DEFENSE ACQUISITION EXPLAINED

The United States (U.S.) military obligates billions of dollars every fiscal year to acquire physical assets and services (Bureau of the Fiscal Service, 2022). These procurement actions are typically accomplished through formal contracts. Such contracts are governed under federal procurement statutes and regulations, most notably the Federal Acquisition Regulation or FAR (FAR 1.1, 2022). The FAR is a regulation that applies government-wide to all the executive agencies and puts in place consistent policies and methods that establish how government agencies obtain services and materials.

These standards serve to direct the acquisition system to, as the FAR states, "deliver on a timely basis the best value product or service to the [government], while maintaining the public's trust and fulfilling public policy objectives" (FAR 1.102, 2022). It is under these federal laws that there is a mechanism provided for contractors, bidders, or other interested parties to object to (or protest) contract actions for not complying with federal law (FAR 33, 2022).

C. WHAT IS A CONTRACT

1. Definition of a Contract

The Federal Acquisition Regulation (FAR) provides the following definition for a contract, "a mutually binding legal relationship obligating the seller to furnish the supplies or services (including construction) and the buyer to pay for them" (FAR 2.101, 2022). The National Contract Management Association (National Contract Management Association [NCMA], 2019) defines a contract as "a mutually binding, legal relationship obligating the seller to furnish supplies or services and the buyer to provide consideration in exchange for them" (NCMA, 2019, p. 2).

The definitions given by FAR and NCMA can be summarized as a legal agreement among two (or more) parties, typically a buyer and a seller, where one party agrees to provide something (a product or service) in exchange for something from the other party (consideration or payment).

2. Contract Characteristics

Official contracts are characterized as valid and binding. Valid contracts are those whose terms are detailed, and with agreement indicated by both parties. One party submits the terms, and a second party accepts within a reasonable (or stipulated) period. Only the agreed-upon terms expressed in the contract are enforceable. Overtures, innuendo, unreasonable assumptions, and secret intentions are not recognized (NCMA, 2019). For a contract to be binding it must be for a legal purpose and can only be made by competent parties (NCMA, 2019). Competencies and authority can be defined by law (such as age of consent) or corporate privileges (such as job title or rank).

> The common components of a binding contract according to the NCMA include:
>
> - two or more parties who possess the capacity to contract,
> - show agreement including offer, acceptance, and assent,
> - show something of value exchanged between the contracted parties to or inducement to make a party,
> - be for legal purpose and be in the correct form. (NCMA, 2019, p. 2)

3. Types of Contracts

Every contract is distinctive and oriented with detail, which explains why there are over twenty different contract types described in Part 16 of the FAR. Each service and product output calls for close examination of the best contract variation to use to serve government procurement purposes (FAR 16.103, 2022). While many factors are weighed in the selection process, a few staples remain at the top of the list. High consideration is given to the risk level each party involved is willing to accept in balance with the incentive (FAR 16.101, 2022). Requirements, ranging from meticulously defined all the way down to vaguely stated, influence which contract type may produce the best results (FAR 16.103, 2022).

Some of the more common contract types listed in FAR Part 16 include:

1. Fixed Price (FAR 16.2, 2022)
2. Cost Reimbursement (FAR 16.3, 2022)
3. Incentive (FAR 16.4, 2022)
4. Indefinite Delivery (FAR 16.5, 2022)
5. Time and Materials (FAR 16.6, 2022)

Refer to Table 4 in the appendix for information on the most commonly used contract types and a comparison of the risks, restrictions, typical usage, etc. It should be noted that while included in FAR 16, agreements (as described in FAR Part 16.7) are not considered contracts (FAR 16.7, 2022).

D. WHAT IS A PROTEST

1. Definition of a Protest

According to Part 33.101 of the FAR, a protest is:

a written objection by an interested party to any of the following:

- A solicitation or other request by an agency for offers for a contract for the procurement of property or services.

- The cancellation of the solicitation or other request
- An award or proposed award of the contract
- A termination or cancellation of an award of the contract, if the written objection contains an allegation that the termination or cancellation is based in whole or in part on improprieties concerning the award of the contract. (FAR 33.101, 2022).

Simply put, a protest is a formally submitted objection to a government agency for its conduct or actions in acquiring supplies and or services (FAR 33.101, 2022). These objections are often for perceived violations of laws or regulations regarding solicitation, evaluation, award, or cancellation of a contracting action.

2. Purpose of a Protest

According to the Joint Analysis Team (JAT), the system utilized for federal procurements, due in large part to Congressional design, seeks to attain the greatest public benefit with limited taxpayer dollars. It does this via "three guiding principles: competition, integrity, and transparency" (JAT, 2009, p.1). The JAT reminds us that the goal of bid protests being allowed within the federal procurement system is to "play an important role in ensuring integrity in the federal procurement system while … enhancing transparency and accountability" (JAT, 2009, p. 1). The GAO sums up protests as a formal method for resolving disputes related to federal contract awards (U.S. GAO, 2021).

3. Origins of (Bid) Protest

The heart of the ability to protest a government action (such as protesting a bid or contract decision) can be found in the first amendment of the U.S. Constitution, which reads in part "Congress shall make no law… abridging… the right of the people… to petition the Government for a redress of Grievances." (U.S. Const. amend. I, 2022) Despite this fact, the U.S. government is immune from lawsuits, the U.S. government chooses to honor the spirit of the first amendment and has created avenues to allow involved parties to express their grievances relating to source selections (Maser & Thompson, 2010). Moving past the Constitutional ties, bid protests can be traced back to the Tucker Act of

1887, where the United States government relinquished its absolute immunity and in turn opened itself up to litigation for particular contract-related matters (Hawkins, 2019).

Although many people may have mixed feelings about the U.S. government allowing protests, there are many countries that have procedures allowing for challenges to be made regarding their procurement decisions (Yukins, 2021). For example, the European Union (EU) utilizes a process for Remedies of procurement issues, the World Bank similarly allows for Complaints to be brought to them by interested parties, and the term Reviews is used comparatively by the United Nations (U.N.) Convention Against Corruption. Prior to the advent of bid protests, courts often treated such complaints as simply remedies for bid grievances (Yukins, 2021).

4. Rules for Filing a Protest

Bid protests are authorized by Congress to be filed with three distinct groups: the Government Accountability Office (GAO), the Procuring Agency, and the U.S. Court of Federal Claims (COFC) (FAR 33, 2022). Where a protest is filed is considered the protest venue. It should be noted that these are the only three allowable venues and the U.S. District Courts have no legal jurisdiction with regard to bid protests (28 U.S.C. § 1491(b)(1)). While these venues share some common features, the legal procedures and potential resolutions vary between them. These differences are often carefully considered when a party decides where to file a protest (FAR 33, 2022).

Unlike the COFC, protests filed with the GAO and the Procuring Agency are subject to specific timetables for resolutions and therefore are often resolved quicker than those filed with the COFC (United States (US) GAO, 2018a). In addition to being faster, due to the less formal nature of GAO and Procuring Agency proceedings, protests filed with these venues are typically less costly than if filed with the COFC (U.S. GAO, 2018a).

Another advantage of filing a protest with the GAO or Procuring Agency is the likelihood of gaining an automatic stay, which often serves to inhibit the protested contract from being awarded or implemented while the protest is ongoing (Manuel & Schwartz, 2016). There is one key difference with protests filed with the COFC however, unlike the

other two venues, the COFC has the potential to issue legally binding decisions (FAR 33, 2022).

5. GAO Protest History

The Government Accountability Office is an independent, politically neutral, agency that reports to Congress. The GAO works to examine how government funds (tax-payer dollars) are expended and reports back to federal agencies (most notably Congress) with objective, reliable information to assist the federal government in working more effectively and efficiently (U.S. GAO, 2021).

The GAO was created in 1921 and is often referred to as the "congressional watchdog" (Hawkins, 2019). In 1925, the GAO received complaints that officials at the Panama Canal had allegedly furnished a solicitation where the specifications were skewed toward a specific product (in this case, a particular brand name of truck) (Gordon, 2013). The complaint alleged that these skewed specifications unfairly caused the complaining firm to be precluded from consideration for award. In 1926, the first recorded bid protest decision was issued by the GAO. In this decision, it ruled that the disputed solicitation was indeed skewed to a specific vendor and in turn unlawful (Gordon, 2013). Today, protests fall under the purview of the GAO's Office of General Counsel, which provides legal decisions and formal opinions concerning bid protests to the government (U.S. GAO, 2022).

6. Key Parties in a Bid Protest

In a bid protest system, there are commonly two distinct players: the government and a dissatisfied bidder. There are also some commonly overlooked stakeholders beyond the dissatisfied bidder, such as additional bidders, those who could be negatively affected by the bid result, the end-user that is reliant upon the outcome, and the taxpayers whose funds are ultimately used for the procurement (Melese, 2018).

Another view is explained by Gordon which outlines four key parties affected by a bid protest: the potential offeror who was not included in the competition or the dissatisfied offeror who is not awarded a contract, the procuring agency, the taxpayer or general public

(and respective elected representatives), and the eventual award recipient or intervening offeror (Gordon, 2006).

> Each of these four key parties is driven by a different objective to rectify a protest. Gordon breaks down each player as follows:
>
> - The dissatisfied offeror seeking a manner with which to bring up their complaints, and with which to gain as much information as feasible as to why they did not receive the award, with the end goal of gaining some form of consolation.
> - The procuring agency which strives to conclude the protest in such a way as to reduce any negative influence on the efficiency or usefulness of the procurement process.
> - The taxpayer or general public that looks for a resolution which maintains the tenets of transparency, accountability, and integrity of the overall procurement process.
> - Finally, the successful recipient of the award which strives for a resolution where the original award is upheld (Gordon, 2006).

E. SUMMARY

Starting with the basic explanation of defense acquisition according to the FAR, this section went on to define what a contract is according to the FAR and NCMA, summarizing it as a legal agreement between two parties. An overview of contract characteristics according to NCMA and the contract types as described by FAR Part 16 was provided. It then defined a protest per the FAR, outlining it as a formal written objection to a government agency for its conduct or actions regarding a contract, and provided a brief description of the purpose of protests. A short background of where bid protests originated was then laid out. The three protest venues were described with background provided for the GOA's start in protest resolution. Lastly, the key parties involved in a protest were explained.

Building off the background and definitions provided in section II, section III will go on to describe protest risk, and evaluate the cost vs. benefit of protests. It will also analyze data collected relating to protests at NSWCPD and available GAO protest data.

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III. RESEARCH METHOD

A. OVERVIEW

This section examines protest risk, while summarizing the likelihoods of increased protest and methods to decrease protest. It then explores in detail the bid protest research conducted and discussed in the 2017 Research and Development (RAND) Corporation report along with its findings. The bid protest system is then considered, with several perspectives on the topic laid out. Next, historical data regarding bid protests submitted to the GAO and primarily protests submitted to NSWCPD is presented and analyzed in depth. Lastly, the examples of the Joint Enterprise Defense Infrastructure (JEDI) contract and Amazon Web Services (AWS) protest are discussed.

B. PROTEST RISK

Protest risk can be considered as the "probability of receiving a bid protest" combined with the "magnitude of the consequences" from the protest (Hawkins, 2019, p. 10). Agencies are more likely to be cognizant of inherent programmatic risks when protests occur due to the length of time during which a protest can potentially sideline an acquisition.

1. Reasons for Increased Protest Likelihood

There are both positive and negative factors that can affect the likelihood of a protest. According to Hawkins, the ensuing are a few of the more common contributors to increased protest risk:

- Protests are more likely when the incumbent is an unsuccessful offeror to a follow-on contract, and the incumbent has revenue at stake.
- Protest likelihood increases as the contract value compared to the offeror's total revenue increases.
- Criticality or importance of the good or service. If the good or service is considered critically important, it is not unreasonable to assume the acquiring entity is likely to have a recurring need for the good or service. Thus, it is not just risking the lost profit or earnings of the current acquisition but also losing future repeat procurements.

- Protests are more likely when the "product of the probability of receiving a bid protest and the magnitude of the consequences of receiving a protest" are substantial (Hawkins, 2019, p.10)
- Insufficient planned procurement lead time can cause increased protest fear. That is to say, when there is not enough time and the procurement is rushed, the likelihood of mistakes increases, which in turn increases the likelihood of a protest. Additionally, short lead times may cause bidders to suspect that their offers may not have been properly or fully evaluated (Hawkins, 2019).

Additional factors that can increase protest likelihood, according to Maser, include more bidders, smaller bidders, long delivery time contracts (extended lockouts), high contract value as a percentage of the bidders' overall revenue, acquiring services, and international winners (Maser Thompson, & Subbotin, n.d.).

2. Methods to Reduce Protest Likelihood

Hawkins (2019) postulates several common measures may be utilized to help reduce the risk of a protest, these include:

- Including additional layers of reviewers or legal counsel to evaluate documents and document changes included in the source selection record.
- Adding additional time to the procurement lead time.
- Performing additional discussions to allow offerors opportunities to address weaknesses and/or deficiencies in their offer instead of eliminating them from the competitive range.
- Retaining offerors in the competitive range when not necessary.
- Awarding additional contracts beyond what was intended.
- Searching for existing contracts to modify instead of pursuing full-and-open competition.
- Evaluating existing contracts for potential task order awards instead of pursuing full-and-open competition.
- Selecting more objective methods such as lowest-price-technically-acceptable (LPTA) over a full trade-off.
- Adding additional personnel to the acquisition team.
- Performing more detailed debriefings. (Hawkins, 2019 p.4)

While avoiding the factors for increased protest likelihood or implementing one or more of the measures listed can help lessen the likelihood of a protest, there is no guaranteed way to eliminate the risk of a protest being filed (Hawkins, 2019). Bid protests are an inherent part of the government acquisition process (Arena et al., 2018). Also, not

all protests are filed out of perceived injustice. Sometimes, protests may be filed for business strategy reasons (such as an incumbent looking to extend an existing service contract), to expand the chances of gaining a business opportunity that would have otherwise been lost, or to in some manner disadvantage a competitor (Hawkins, 2019).

C. BID PROTEST RESEARCH

The lack of recent data revolving around bid protests was an area of concern for Congress leading up to 2017, so much so that the 2017 National Defense Authorization Act (NDAA) mandated that a direct study on bid protests be conducted as part of the budget (National Defense Authorization Act [NDAA], 2016). This report was the responsibility of the DOD to contract out and was completed by the RAND (Research and Development) Corporation (Arena et al., 2018).

Under this study conducted by RAND, Congress requested fourteen (14) specific study areas of data to be collected (Arena et al., 2018). While the study brought attention to certain types of contracts, it only had partial data involving time. The study was not fully able to capture the minutiae details involving the specific protest and the length of time consumed; therefore, it was not conclusive to provide any suggestions involving speeding up the process of a protest (Arena et al., 2018). Despite attempts to record the most important metric of time involved with a protest, there was no data available for the following study group. There was practically no data on the "analysis of the time spent at each phase of the procurement process attempting to prevent a protest, addressing a protest, or taking corrective action in response to a protest, including the efficacy of any actions attempted to prevent the occurrence of a protest" (Arena M.V. et al., 2018, p. 4). For our efforts, time was the most important metric that we wanted to analyze (Yukins, 2022).

The study conducted by the RAND Corporation analyzed the impact of bid protests on the acquisition of U.S. Department of Defense projects from Fiscal Year (FY) 2008 to FY 2017. It found that there were over 20,000 actions related to protests in public docket records (Arena et al., 2018). The study analyzed all government agencies that engaged in the protest jurisdiction of the Government Accountability Office (GAO). It also tracked various characteristics of the protests, such as their size, disposition, and value (see Figure

1). The data collected by the study was used to evaluate the trends in the bid protest movement (Arena et al., 2018).

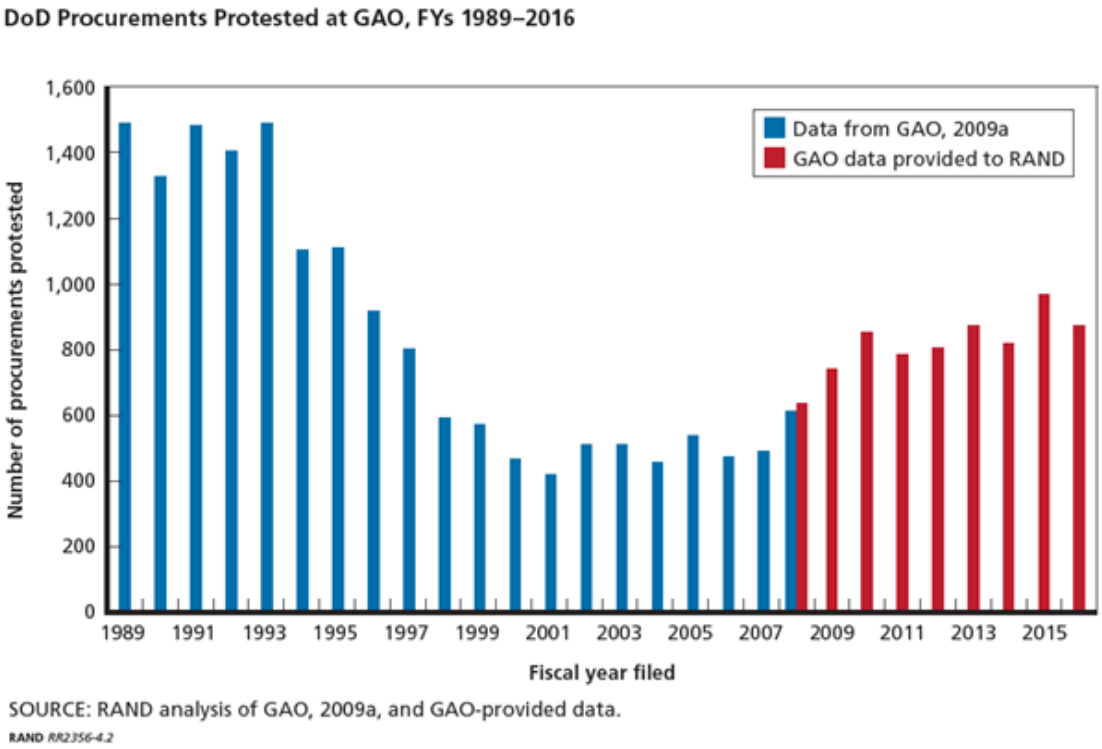


Figure 1. DOD Procurements Protests at GAO, FYs 1989 – 2016. Source: Arena et al. (2018).

RAND interviewed multiple DOD officials to find out what they think about the current system for bid protests. They noted that they are unhappy with the way it works, as it allows contractors to delay the awarding of projects due to protests. Contract fulfillment start dates are held hostage by the number of weak allegations made by the protestors and the length of time it takes to resolve them (Arena et al., 2018).

The RAND assessment discovered protest activities steadily increased at a rate where they would double from FY 2008 to FY 2017. However, the total quantity of contracts along with the value of contract expenditures dropped in the same period. The report showed a significant number of protests (over half) filed came from small businesses (Arena et al., 2018). Admittedly, predicting the outcome of individual case results, solely

based on typical features, is not feasible. Every protest is unique and the different details associated with it influence the conclusion. With that in mind, the RAND research concluded with the following general recommendations:

- Enhance the quality of post-award debriefings.
- Be careful in considering any potential reduction to GAO's decision timeline.
- Be careful in considering any restrictions on task-order bid protests at GAO.
- Consider implementing an expedited process for adjudicating bid protests of procurement contracts with values under $0.1 million.
- Consider approaches to reduce and improve protests from small businesses. (Arena et al., 2018, pp. 87–90).

The study focused on the degree of which the bid protest system has a negative impact on the acquisition process. It analyzed a range of contributing influences affecting the "quality and number of discussions of proposals, post-award debriefings, decisions to use LPTA procurement methods, to make multiple awards or use of sole-source awards," and any protests on existing contracts (Arena et al., 2018, p. 24). A key aspect the RAND assessment explored is the degree and method in which the existence of the bid protest system affects the procurement process and the procedures related to them by rewarding the avoidance of protest over the improvement of the acquisition process (Arena et al., 2018).

In addition, the RAND report evaluated GAO protests by specific DOD agencies and found there was a significant disparity in the share of protest actions skewed to the Army's detriment (refer to Table 1) (Arena et al., 2018). About 43% of all DOD Protest Actions came directly from Army contracts, which constituted only 25% of all DOD Contracts in the time between FY 2008 to FY 2016 (Arena et al., 2018). Comparatively the assessment showing the agency with the highest share of DOD Contracts in that same period, the Defense Logistics Agency (DLA), had only a mere 12% of DOD Protest Actions while accounting for 44% of all DOD contracts (Arena et al., 2018).

Table 1. Percentage of Protests, Spending, and Contracts by DOD Agency at GAO, FYs 2008 – 2016. Source: Arena et al. (2018, p. 50).

Percentage of Protests, Spending, and Contracts by DoD Agency at GAO, FYs 2008–2016

Agency	% of DoD Protest Actions	% of DoD Protested Contracts	% DoD Contract $	% DoD Contracts
Army	43	41	34	25
Air Force	18	18	19	9
Navy	19	19	28	19
DLA	12	16	11	44
Other DoD	8	7	9	3

SOURCE: RAND analysis of GAO and FPDS-NG data.

NOTE: Columns may not sum to 100% due to rounding.

According to JAT, the "federal procurement system was designed by Congress to leverage maximum public benefit from scarce taxpayer funds through three guiding principles: competition, integrity, and transparency" (JAT, 2009, p. 1). JAT explains the "aim of allowing bid protests is to play an important role in ensuring integrity in the federal procurement system while … enhancing transparency and accountability" (JAT, 2009, p. 1).

In a bid protest system, there are commonly only two players: the government and a disappointed bidder. Additional notable stakeholders that are typically glossed over besides a "disappointed bidder" are those that are directly affected as a result such as other bidders, the end user that will rely on the procurement outcome, and the American taxpayers who ultimately bear the costs. Gordon (2006) analyzes four principal parties: "the disappointed offeror who is denied a contract award or the potential offeror who is excluded from competition, the acquiring agency, the public at large along with their elected representatives, and an intervening offeror or successful awardee" (p. 4).

His analysis places an emphasis that each of the principal parties have different intentions to close the protest. Gordon (2006) breaks down each player, starting with the unsuccessful offeror all the way to the public as each member desires an outcome that exemplifies the purpose, integrity and function of the acquisition system. While his analysis provides a more in-depth view than the RAND report earlier, it brought to our attention that

the impact of a protest carries a specific individual weight amongst each stakeholder. One protest will have time impacts on more than just the government and the disappointed bidder as only briefly scoped out in the previous report (Gordon, 2006).

Melese (2020) poses yet another perspective on protest systems, which starts with the assumption that a firm bidding on a government contract is a profit-maximizing and strategic group that answers to its shareholders. With this assumption in mind, it can be shown that systems designed to allow protests, despite being well-intentioned, can unintentionally incentivize bidders and/or public acquisition officials toward less efficient or even possibly fraudulent behavior (Melese, 2020). Such an incentive toward inefficient or fraudulent behavior could either hinder or increase competition.

The risks brought about by bid protest systems, including inadvertent consequences and associated increases in transaction costs, should motivate officials to further evaluate the cost/benefit of protest systems and review other potential options. In instances where the cost of protests exceeds the benefits, it may be reasonable to look for ways to minimize protests. While there are multiple ways through which to accomplish this, Melese suggest increasing the costs related to filing a protest, decreasing the benefit realized by the dissatisfied bidder, or providing alternative methods for the protester to reach their desired result (2020).

Protests are often brought by dissatisfied vendors to challenge government procurement decisions (Yukins, 2021). Currently, they can only be brought before an independent agency or court. Although protests are not normally favored, many countries have procedures that allow for challenges to be made in procurement decisions. For example, parties may bring "complaints" to the World Bank, the U.N. Convention Against Corruption uses the term "reviews," and the European Union (EU) "remedies" its procurement system with a second look. Prior to the advent of bid challenges, courts have often treated them as mere remedies for bid injuries" (Yukins, 2021).

The GAO became known as the first to make a bid protest decision. In 1926, it ruled against the U.S. Army citing the requisition requirements for vehicles as too strict and therefore unlawful (U.S. GAO, 1926). Bid protests can also be lodged at the Court of Federal Claims (COFC) (USCOFC, 2022). The COFC has heard less than two hundred bid protests

each year (USCOFC Statistical Reports FY2012 through FY2021). The court noted that individuals who are disappointed with how the government has treated them are the ones who will most likely bring suit against perceived or legitimate illegal actions (Yukins, 2021).

Using agency-level bid protests, dissatisfied bidders could protest without formally filing a complaint (Yukins, 2021). The process remains on the agency-level, lacking access to the administrative record, which leaves bidders doubtful they will receive fair treatment. This uncertainty makes the bid protest process appear less likely to provide relief (Yukins, 2021).

Through its study, the Administrative Conference of the United States (ACUS) sought to improve the participation of agency-level bid protesters (Yukins, 2021). It also identified best practices that can be used by other agencies. The study shows the use of bid protests has made them more effective at monitoring internal processes. Some government agencies have also named individuals to look into bid protests and the failure of their processes. Others have created internal systems to help identify problematic bids (Yukins, 2021).

Following a report released by the RAND Corporation in 2018, the DOD is studying its contracting process in 2021. The report noted that a mere 0.3 percent of the contracts were protested (Arena et al., 2018). Analyzing and re-thinking bid protests can help avoid many legal issues including those brought forward due to legitimate concerns (Arena et al., 2018). If a contractor's protest has grounds for merit, then a stay of procurement is important to preserve his or her chances of being awarded. Otherwise, if the contractor's protest is merely to challenge the government's decisions for their own claims of injury, then the stay of procurement creates further strain on the acquisition process (Manuel & Schwartz, 2016).

Although DOD officials "were concerned that the process incentivized protests, potentially preventing the timely award of contracts," private sector actors are documented in the report who "viewed bid protests as a way to hold the government accountable" (Yukins, 2021, para. 15). Protests may also be shifted to highlight the potential risks posed by government procurement. The ACUS study has helped guide a new approach to bid protests that is focused on reducing risk in the procurement process, "treating bid challenges as risk-reduction measures that ultimately can benefit the government" (Yukins, 2021, para. 19).

In most cases, the contract award is the penultimate binding document that commits the government to obligation of taxpayer dollars in exchange for the goods or service(s) purchased. A bid protest that impedes this progress, slows down the acquisition process to a grinding halt (Manuel & Schwartz, 2016). Bid protests take away from the continuity of services and may cause delays to the relevant program(s) in a domino effect that can gradually build up (Manuel & Schwartz, 2016). In a worse case, the effect can balloon the acquisition costs as additional funding and time beyond the scope of the original intent of the contract may be required to support contingent operations. What we know about bid protests on a national scale via GAO decisions only shows one side of the story on a macro scale as they are limited to acquisitions over $25 million (DFARS 233.104(b)). Protests filed amongst agencies are privately tracked and resolved.

Table 2 summarizes the previous five-year period of all bid protests to the GAO according to the GAO's 2020 Bid Protest Annual Report to Congress.

Table 2. Five Year Period of Bid Protest to the GAO, FYs 2016–2020. Adapted from U.S. GAO (2020, p. 4)

	FY2020	**FY2019**	**FY2018**	**FY2017**	**FY2016**
Cases Filed YOY Change	2149 (down 2%)	2198 (down 16%)	2607 (<1% increase)	2596 (down 7%)	2789 (up 6%)
Cases Closed	2137	2200	2642	2672	2734
Merit (Sustain + Deny) Decisions	545	587	622	581	616
Number of Sustains	84	77	92	99	139
Sustain Rate	15%	13%	15%	17%	23%
Effectiveness Rate	51%	44%	44%	47%	46%

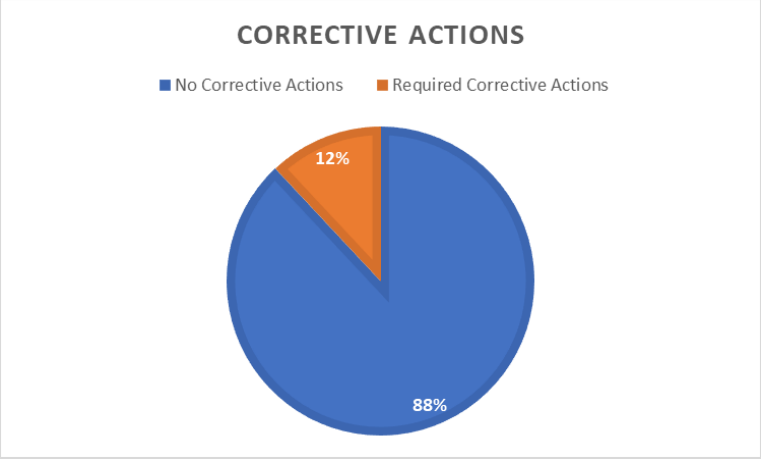
Contrary to the GAO, agency-level protest lack the paper trail necessary for reviews since there is no requirement to file a report or produce documentation, nor provide comments on the agency's churn and operating procedures or incur an adjacent agency protest (Yukins, 2021).

According to the dataset provided by the Naval Surface Warfare Center, Philadelphia Division (NSWCPD), during the 12-year period encompassing fiscal year 2008 to fiscal year 2020, there were a total of thirty-four agency specific bid protests filed (Procurement Integrated Enterprise Environment [PIEE] Electronic Data Access [EDA], personal communication, March 12, 2021). These protests occurred at various points during the acquisition process, from pre-solicitation, solicitation, award, and post-award phases. For the purposes of this analysis, the companies involved have not been identified and are only referred to as the "Protestor." Of the thirty-four bid protests filed with NSWCPD, 19 were denied, 13 were withdrawn or dismissed and only 2 were sustained (PIEE EDA, personal communication, March 12, 2021). A sustainment rate of 5.9% is lower than the 15% sustainment rate as reported by the GAO most recently in fiscal year 2020 (U.S. GAO, 2020).

For the purposes of this analysis, we examined the details that are available within the PIEE EDA dataset to uncover trends that may occur with bid protests that include time of protest submission, average days in protest, and value of the total proposed contract action. According to the dataset, 25 bid protests were filed after an award was made to a Contractor and the Protestor is protesting the award decision (PIEE EDA, personal communication, March 12, 2021). As we know from reports, any protest that occurs post award provides the greatest risk to the Government in terms of cost, schedule, and performance delays (U.S. GAO, 2020).

As understood by the Gordon report, there are multiple stakeholders to be aware of besides just the specific agency and the disappointed bidder (Gordon, 2006). As such, the magnitude of the procurement must be kept in mind when reviewing these numbers. Considering the average bid protest takes 48 days to resolve, multiple protests represent a large gap of potential work (PIEE EDA, personal communication, March 12, 2021). The number of corrective actions required to be taken at the agency level (post protest

evaluation) shows the lack of merit for the Protestors' bid protest. After thirty-four protests at NSWCPD, only four (4) required corrective action adaptation by the agency, demonstrated in Figure 2 (PIEE EDA, personal communication, March 12, 2021).



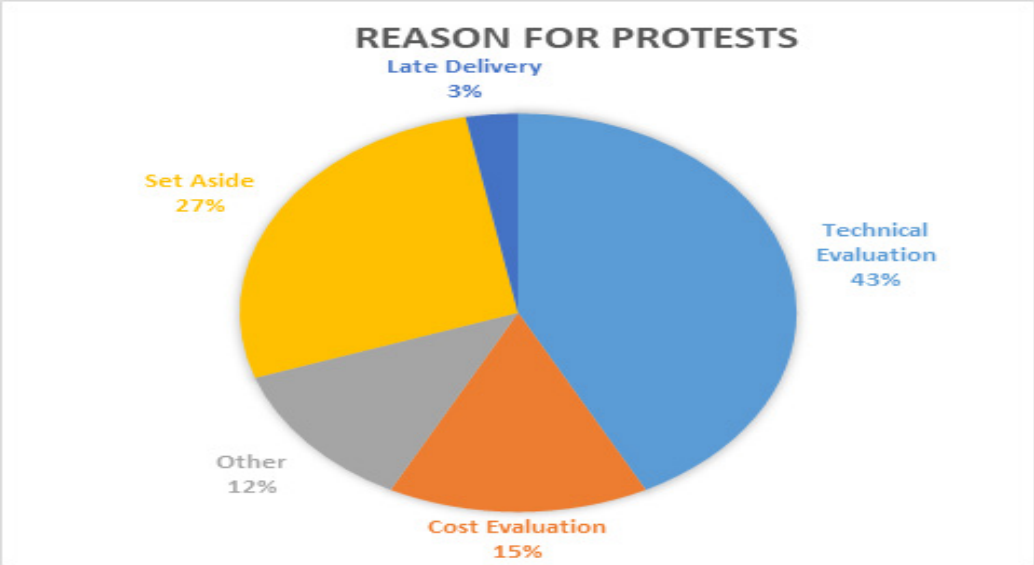
Note. NSWCPD Protest based on the 34-protest filed in FYs 2008–2020.

Figure 2. Corrective Actions Taken at the Agency Level. Adapted from PIEE EDA (personal communication, March 12, 2021).

Writing the technical requirements for programs of an overly complex nature is difficult, and the technical evaluation becomes just as difficult when reviewing the requirements. As many of today's programs are legacy programs with incumbents from the vast Military-Industrial Complex, acquisition professionals have to ensure the requirements are not written in a way that unfairly limits competition. Although the number of corrective actions may seem miniscule, the analysis was further broken down by categories of protest and mean time elated per protest, keeping in mind how one protest may affect the acquisition process for the multiple stakeholders within and outside the agency.

The reason for the protests, as depicted in Figure 3, clearly identifies the major reasons that Contractors submit a protest. Almost half of the agency bid protests were filed on the grounds of technical evaluation, with the second most common reason for a protest being a cost evaluation (PIEE EDA, personal communication, March 12, 2021). In the bid

review process, there are both technical and cost evaluation teams that are tasked with evaluating each element of a Contractor's proposal. The technical evaluation consists of evaluating the technical requirement criteria of the request for proposals (RFP) against the Contractor's proposal (FAR 15.305, 2022). This evaluation is normally completed simultaneously and separately from the cost evaluation. The cost evaluation is an evaluation for cost realism and comparison analysis of other proposals (FAR 15.404-1, 2022).



Note. NSWCPD Protest based on the 34-protest filed in FYs 2008–2020.

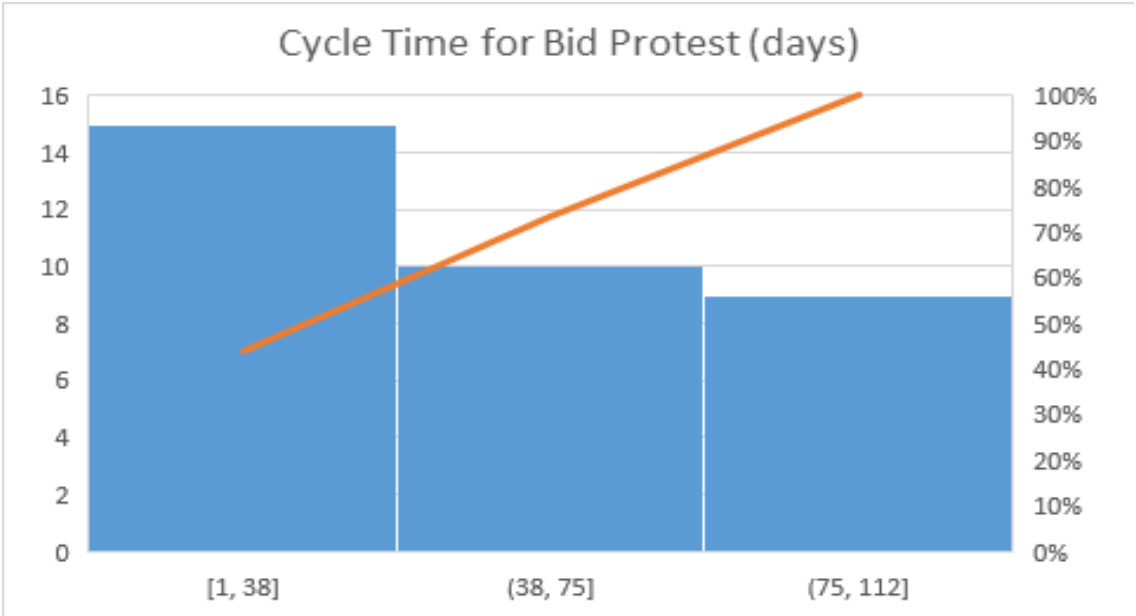
Figure 3. Most Common Reasons for Contractor Protest to NSWCPD. Adapted from PIEE EDA (personal communication, March 12, 2021)

To resolve a technical or cost evaluation protest, the agency's council will review and be asked to provide documentation to show the content of the evaluation and accuracy of the evaluation without divulging sensitive information of the winning bidder (FAR 33.103, 2022). Essentially, this additional process slows down productivity by pulling personnel from other projects or contract evaluations which halts work and puts start time on a standstill. In NSWCPD's case, a council member most likely an In-Service Engineering Agent (ISEA) has to answer to an entity that is outside of the engineering agency, who is tied to this project as the financial stakeholder.

A Pareto chart analyzes data in process improvement to identify the most needed areas of focus. Once populated with the frequency of many problems or causes of those problems, the chart will identify the most significant deficits. The Pareto chart (Table 3) depicts the cycle time for bid protests, measured in days. For the purposes of this evaluation, we focused on the frequency of when a bid protest reached a conclusion, defined as a denial, withdrawal, dismissal, or sustainment. The parameters for the resolution are divided between Day 1 through Day 38, Day 38 through Day 75, and finally any bid protests that lasted over 75 days, representative of the 25th, 50th and 75th percentage quartile of the dataset (PIEE EDA, personal communication, March 12, 2021).

While it is hard to quantify exactly how much in value (i.e., labor hours, schedule delays, cost revisions, e.g.) is lost as a result of the bid protests, as it depends on a case-by-case basis, this chart allows us to show the impact long bid protest procedures may have on agencies. For instance, over 19 of 34 (56%) of bid protests were resolved in over 38 days.

Table 3. Bid Protest Time to Resolution (in days). Adapted from PIEE EDA (personal communication, March 12, 2021).



Note. NSWCPD Protest based on the 34-protest filed in FYs 2008–2020.

For the 10 bid protests that took over 75 days to come to a resolution, we looked specifically at the description of the protests in order to uncover any trends (PIEE EDA, personal communication, March 12, 2021). Five (5) bid protests were filed on the grounds of an improper or flawed technical evaluation. Three (3) bid protests were filed on the grounds of an improper or flawed cost evaluation. The remaining two (2) bid protests were processed on the grounds of restrictive competition (PIEE EDA, personal communication, March 12, 2021). While there were instances of similar protests resolved in significantly lower time periods, it comes as no surprise that the more complex the procurement, the more elements and sub factors that are required to be evaluated by the contracting and technical evaluation teams. There does not appear to be a correlation between the total value of the contract and the protest time elapsed. In fact, four (4) of the 10 bid protests that elapsed over seventy-five days were before a contract was even awarded; therefore, the data is inadequate to measure a relationship between contract value and time (PIEE EDA, personal communication, March 12, 2021).

In these four (4) cases of a pre-award protest, the Protestor was contesting set-aside determinations that occur at the RFP stage, which limits competition based upon the regulations as set by the FAR (PIEE EDA, personal communication, March 12, 2021). FAR Part 19.5 provides the requirements for setting aside acquisitions exclusively for small businesses. These set aside determinations can be either totally or partially set aside under a class of acquisitions or a single acquisition. Besides small business set-asides, the FAR also provides for other types of set-asides (FAR 19.5, 2022).

For example, FAR Part 6.302-1 provides the guidelines for when "only one responsible source and no other supplies or services will satisfy agency requirements" (sole source) (2022). Typically, set-aside determinations are required for applying small business set-asides or sole source procurements in which only a single entity may be able to provide these services (FAR 6.302-1, 2022). Limiting competition in this manner may allow contracting officials to speed up the process to narrow down to a select few contractors and expedite contract award. Issues involving technical evaluations may range from a variety of shortfalls such as unclear or ambiguous instructions. Issues resulting from

a cost evaluation may range from a variety of problems such as a flawed cost realism, unfair competitive pricing advantages, and potential application of arithmetic errors.

In acquisition news, the DOD's Joint Enterprise Defense Infrastructure (JEDI) contract award was protested delaying project progress for years (Carberry, 2022). The JEDI program requires cloud computing and related cybersecurity functions for the entire DOD enterprise. On 25 October 2019, the 10-year, $10 billion contract was awarded to Microsoft Corporation, beating out other offerors International Business Machines Corporation (IBM), Oracle, and Amazon Web Services (AWS) (AWS, 2020). Large omnibus contracts like the JEDI contract are uncommon in the DOD, and as such must be treated with proper care (AWS, 2020).

> The protest filed on behalf of AWS against the award of the JEDI contract explains the reasoning behind their grievance(s):
>
> When the DOD announced the initial JEDI contract award on the evening of Friday, October 25, 2019, we tried repeatedly to seek clarity around the evaluation errors that affected all six technical factors. We tried doing this through the debriefing process, which is a fundamental part of government procurements. Our team worked around the clock that weekend in order to meet the DOD's deadline for responses and submitted 265 questions, only to see the DOD refuse to provide a single meaningful response. Most of these questions remain unanswered nearly a year later…. In February, the Court of Federal Claims stopped performance on JEDI. The Court determined AWS's protest had merit, and that Microsoft's proposal likely failed to meet a key solicitation requirement and was likely deficient and ineligible for award. (AWS, 2020, para. 6–7)

Furthermore, AWS (2020) argues "that the JEDI contract creates a dangerous precedent that threatens the integrity of the federal procurement system and the ability of our nation's warfighters and civil servants to access the best possible technologies" (AWS, 2020, para. 8).

As a result of the bid protests, the Pentagon announced on 06 July 2021 that the DOD reportedly called off the JEDI contract, but it is also soliciting proposals from both firms for a new one (AWS, 2020). Despite the decision to provide an injunction to reassess the evaluation factors, the Pentagon stated that it still needs cloud computing capabilities

for its warfighters. It also announced a new multi-vendor contract for the Joint Warfighter Cloud Computing Program (AWS, 2020).

The agency said it plans to ask for proposals from Microsoft and Amazon for the contract (AWS, 2020). It noted that these two companies are the only ones that can meet its requirements. The U.S. Inspector General said in a report released in April 2020 that it did not receive enough cooperation from the White House to complete its investigation into ethical misconduct. The Pentagon is expecting the Joint Warfare Center to be a bridge to its longer-term strategy (AWS, 2020). The Pentagon said its next cloud computing vendor will have to meet several criteria, such as having access to all three classified levels and having top-tier cybersecurity controls. In response to the Pentagon's decision to terminate the JEDI contract, Microsoft noted that the fight over the contract highlighted the need for reforms (AWS, 2020).

This is not the first time that the government has been involved in a bid protest involving Amazon. In a 2013 article for FCW, Frank Konkel reports on how the Central Intelligence Agency (CIA) picked Amazon Web Services to build a cloud-based system to aid the agency and other intelligence agencies with analyzing the vast amounts of information they collect. The year prior, the CIA was forced to cancel a related cloud service procurement in August 2012 after AT&T and Microsoft protested the decision. The agency then changed its bid specifications in January 2013 (Konkel, 2013).

The decision to award Amazon the contract to provide cloud computing services was based on the company's superior technical solution, which was selected by the source selection authority (SSA). The CIA's final evaluation of IBM's proposed risk rating was high, with the agency classifying the company's cloud as low and the ability to auto-scale its applications as dubious. Konkel (2013) explains, "the GAO did sustain IBM's protest on two grounds: That the CIA did not evaluate prices comparably, and materially relaxed a solicitation term for AWS during post-selection negotiations" (para. 6). The agency also noted that the terms of the contract were not as favorable as they should have been.

According to Konkel (2013), the full ruling went as follows, the GAO stated that the CIA used test scenarios to adjust the pricing that simulated the amount of processing

power required to manage large datasets. The GAO stated that the CIA's attempt at assessing the performance of other bidders, in Lockheed Martin and Boeing, was unreasonable. In addition, the agency sided with IBM on its exception to the CIA's selection process, which required the agency to provide a type of software only Amazon would be able to furnish, giving an unfair advantage to Amazon. The statement noted that the lack of a written amendment to the terms of the RFP significantly eased the requirements in favor of Amazon without giving the additional bidders an opportunity to suggest changes (Konkel, 2013).

In the end, Konkel (2013) summarizes how the GAO has recommended the CIA reopen negotiations with the bidders and consider a new selection process, if necessary. In response, the CIA claimed that Amazon Web Services was its preferred vendor due to its technological platform, which the agency said would allow it to quickly innovate (Konkel, 2013). Regardless of the claims, this contract, which represents the government's growing importance of cloud services, underscores the efforts of many firms to secure their share of the cloud computing market.

D. SUMMARY

Upon peer review of the primary and secondary research sources on protests, it was shown that a large share of agency protests were written on the grounds of either a technical evaluation, a cost evaluation, or a set aside determination. Our research of protests relating to NSWCPD, revealed the cycle time for the longest protest resolution saw almost 30% of protests being resolved in over 75 days. While the contracts and subsequent protests handled at the agency level paint only a small subset of the vast majority of those managed at upper echelons of the DOD, the microcosm to macrocosm relationship is evident.

In national news related to the future of government business structures, the timeline required for the DOD to acquire much needed technological services continues to accelerate. However, protest delays will continue to halt progress furthering the technological gap between private industry and government entities. JEDI and the CIA cases are prime examples of the ongoing, multi-year long, protests that plague contracts with billion dollar valuations.

Ultimately, the nature of protests is dealing with a winner take-all scenario, where the higher the stakes, the more scrutinized an award will be in potentially one of the three major categories: technical, cost, or set aside. These evaluations are conducted in a collaborative, subjective human environment with no Standard Operating Procedures attached. Therefore, the justification for protests is inevitable as there exists a lack of trust in the evaluation process within the "high-stakes" environment. A better alternative would be to allow stakeholders in larger procurements to compete for these services via alternative avenues. This idea and forward thinking evolved our research into locating new selection technologies. While examining literature on the expansion of blockchain technology and cryptography, such alternatives and potential solutions were illuminated to level the protest environment "playing field" as created by the FAR, GAO, and COFC.

IV. ANALYSIS AND RESULTS

A. OVERVIEW

As outlined throughout this paper, a fair amount of research has been performed to review bid protests, their causes, and potential ways to mitigate them. Here, an in-depth analysis ranges from this paper's review of one individual command's past bid protests (NSWCPD) to the RAND report described earlier that reviewed GAO public docket records yielded multiple methods and strategies suggested over the years to lessen the likelihood of a bid protest. While potentially beneficial, these suggestions are more best practices, and in essence, a call for acquisition professionals to do better at what they are already doing. None of these suggestions represent any notable change in the contracting process. The approach proposed in this chapter is to eliminate the major factors contributing to the requisite for protests in the acquisition process. By introducing a new method of operation, the goal is to reduce or remove the standard practice objections.

This chapter provides an overview of the future of contracts implementation and execution using a new technological development in cryptocurrency called smart contracts. Blockchain technology is broken down by definition and required mechanisms needed to create and operate the system. Blockchain, as a distributed ledger, is introduced in its infancy as the basis for the most popular cryptocurrencies, Bitcoin and Ethereum, but intentionally matured into the higher functional application referred to as smart contracts.

With the advent of blockchain technology and the growing field of smart contracts, the possibility of leveraging technology to improve the contracting process is here. This chapter introduces smart contract implementation as the way for DOD acquisition professionals to remove the threat and inconvenience of government contract protests. Governmental use of this technological platform will not only create an environment of trust and transparency among bidders but also eliminate the ambiguity surrounding awarding contracts, resulting in reduced protest activities. Barriers to governmental adoption are also described with suggested steps to possible resolutions identified.

B. LEDGERS AND CENTRALIZATION "TRUST"

Ledgers have been used over time for record keeping of the movement (and transactions) of property, money, inventory, etc. Think back to the checkout slip inside the cover of a library book showing the dates of its last activities as a paper ledger. These types of records have matured from paper to digital forms such as shared spreadsheets or a bank record of transactions on your account. Those databases have one centrally controlled copy that can be altered by anyone with access. This centralized system's security and integrity are then dependent on the trust level given to one central authority or central storage location in charge of the master copy (Horowitz, 2018).

Centralized systems require high levels of user trust but also create a single point of failure (Nakamoto, 2008). While it is easy to say that most transactions today are rarely done in person, and usually done digitally through a complex system of network operators, the only reason payments can be processed in this manner is due to a trusted network of intermediaries which carry the burden of protecting everyday citizens from bad actors infiltrating the system. A high level of trust is bestowed to these intermediaries to ensure that these transactions can occur digitally with the highest level of cybersecurity measures in place (Nakamoto, 2008). In servers around the world, these intermediaries are tasked with protecting currency on their platforms to ensure that every transaction is valid (Horowitz, 2018). Therefore, all transactions are centralized within their domains which in turn gives bad actors, such as hackers, a dedicated single target to maliciously infiltrate for their own gains.

By contrast, distributed ledger technology (DLT) is a cryptography protocol used to synchronize multiple identical copies of a digital ledger (DL)stored on multiple computers in the network (Bhosale, 2020). Blockchain, Bitcoin (BTC), and Ethereum (ETH) are all distributed ledgers created to circumvent this need for a trusted intermediary (Horowitz, 2018). This is accomplished by creating a trustless system, in a decentralized nature, which all users can verify with 100% authenticity where a currency resides, where it is transferred to, and who the proper recipient of the transaction should be. By removing the people factor from the system, you improve the fairness and acceptance of verdicts

while reducing the chances of human error and protest against favoritism or opinion-based decisions.

C. BLOCKCHAIN EXPLAINED: BASELINE STRUCTURE

Blockchain is a secure method of storing data using cryptography. In Figure 4, each chain consists of blocks of data added one at a time and linked together in sequential order by location (Bhosale, 2020). In Figure 5, every block is made special by being assigned its own fingerprint called a cryptographic "hash"; this is the unique address of the block (Eremenko, 2018). Any kind of data can be stored in each block. At a minimum, a block must contain 3 major elements: (1) the data of transactions it is meant to hold, (2) its own unique hash, and (3) the hash of the previous block (Bhosale, 2020).

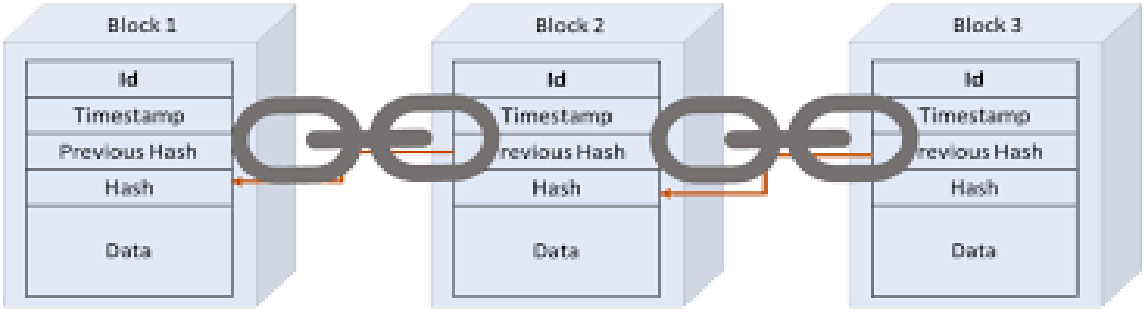


Figure 4. Visual Illustration of Blockchain Construction. Source: Bhosale (2020).

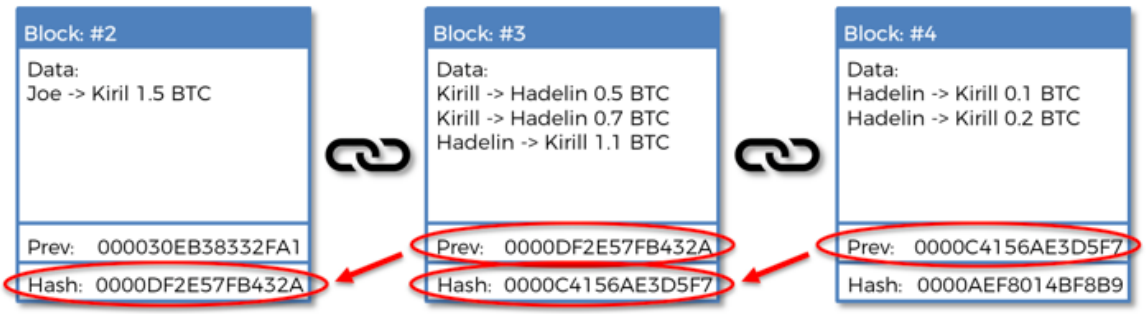


Figure 5. Blockchain Hash Relationship and Linking Mechanism. Source: Eremenko (2018).

When a new block is created, the hash is generated based on the contents of the block (Eremenko, 2018). Altering the contents of a block will change the hash each time the data in the block is changed; this allows the user to track updates. New blocks are linked to the previous block by pointing to its hash, therefore adding the new block to the end of the chain (Nakamoto, 2008). Once a block is added to the chain, its contents are frozen in time. Any attempt to alter a previously linked block will break the block-to-block link since the linking hash (Figure 5, pointing to PREV hash) holding the chain together will be different and the attached block cannot update its link (Eremenko, 2018).

For example, in Figure 5, if the hash number for Block #2 changes due to hackers or corruption, Block #3 will no longer map back to the changed hash of Block #2. Every block after #3 will be broken off from the blockchain (Eremenko, 2018). This flags the system for bad actors, making it impossible to alter past data. Acceptance of the new hash number for the changed Block #2 would break the connection to the following linked blocks. This is by design one of blockchain's most important security features to detect and deter bad actors who may try to alter the data inside a blockchain. Blockchain is a permanent ledger of immutable data meaning blocks are never changed, deleted, or removed from the chain. A completely new block is created to record any updates to old data leaving the past transactions fully intact for all current and future readers to review (Nakamoto, 2008).

Blockchain uses distributed ledger technology to remove the centralization factor in its security. While most databases have one centrally controlled copy, in blockchain multiple copies exist for all iterations of the chain. Blockchain creates transparency by replicating a full copy of the digital ledger on every computer, aka node, in the network. An open network, called a peer-to-peer (P2P) network, allows anyone running the DLT software to join and all newcomers receive a full copy of the blockchain (Дергунов, 2022). Figure 6 is a depiction of P2P network all running the same DLT programming on their individual node (computer). Each node in the network holds a single, identical copy of the blockchain (Дергунов, 2022).

Before any new block is added to the chain each node receives the block, verifies it has not been tampered with and can be added to their blockchain, in an authentication

process (Cointelegraph, n.d.). All the matching nodes in the P2P network create a "consensus" and verify their identical distributed ledger is still secure (Horowitz, 2018). Cross-network verification is the built-in 'trust system' for the stored data. Decentralization removes the single entity control and transfers it to everyone in the network, thus, removing the power dynamic, and the chance of a single point of failure (Horowitz, 2018). In blockchain, the whole network has a copy of the distributed ledger rendering the centralized system's "Trust" factor obsolete. Nodes do not need to know each other to be a member of the verifying network eliminating the implied trust system requirement altogether (Дергунов, 2022).

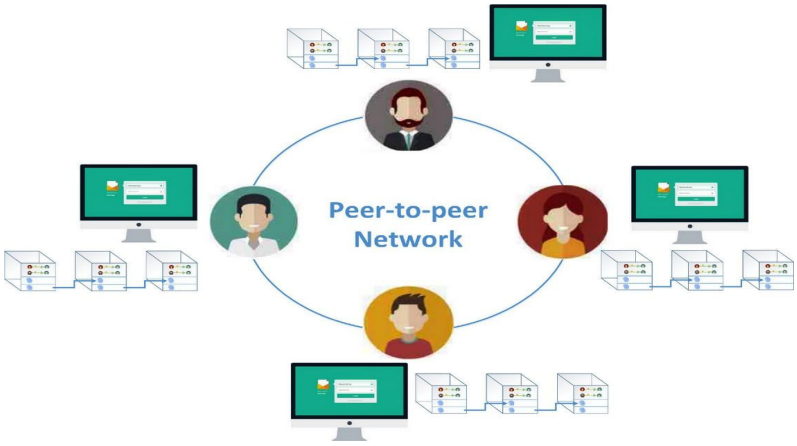


Figure 6. Peer-to-Peer Network Makeup for Blockchain. Source: Дергунов (2022).

The P2P network provides security with shared visibility and the authentication process (Horowitz, 2018). Returning to the previous example of a hacker changing Block #2 data and breaking the chain, the P2P consensus would detect the single mismatch blockchain since any tampering of an old block in one node (on one computer) will not change the network information. For a hacker to be successful, all following hashes after Block #2 would require recalculation to reconnect each block one by one; in addition, the now completed hacked blockchain must be implanted on at least 51% of the P2P nodes before detection of this full alteration leads to rejection of the hacked ledger (Cointelegraph, n.d.). Once detected in the authentication process, the tampered ledger will

be flagged as invalid and not accepted by the P2P network as a viable update (Nakamoto, 2008).

To summarize, blockchain is a digital ledger (DL) of transactions recorded by all the nodes of a network of processing computers that participate in the software. For the purposes of this discussion, what is important is what blockchain aims to solve which is the decentralization of public goods that are not governed by one specific source or act of characters. Blockchain technology provides coordination efforts in order to facilitate this freedom of exchange. This permanent record keeping ability makes it difficult, if not impossible to cheat, alter, or hack the system. Nodes in the P2P network perform these transactions, which is recording the DL over again until the next series of the blockchain is identified as accurate.

1. Bitcoin: The Beginning of Monetizing Blockchain

One popular version of blockchain technology—and a digital asset—is known as Bitcoin (BTC). In its DLT software and cryptographic algorithms, BTC is the first form of digital cash (Horowitz, 2018). It created a new currency as a way to monetize blockchain as a coin with a set value to be traded between countries and nations without necessary conversions for the equation of value, such as changing the American dollar to a euro. This voluntary system is used globally and has created new opportunities for individuals and nation-states to transfer, exchange, and deliver digital assets that are recorded and broadcast over a public ledger, which are immutable, providing it with a credible store of value ($) (Horowitz, 2018).

Ammous (2018) explains if an immutable software can create a decentralized, indisputably accurate record of currency, the value would not only be protected from inflation but also transferable via the internet to perform traditional monetary functions without relying on or trusting any institution or third-party authorities. This store of value, essentially, makes Bitcoin an asset the same way one places value in the currencies we use today. Despite there being many alternatives to digital assets besides Bitcoin, its popularity has made it synonymous with what is known today as cryptocurrency (Ammous, 2018).

2. Ethereum: Bitcoin 2.0 Gives Way to Smart Contracts

In December 2013, a white paper for an alternative cryptocurrency known as Ethereum, ETH, was developed by Vitalik Buterin, a Russian-Canadian programmer. Buterin thought the Bitcoin project was too simple in nature and envisioned using blockchain technology to create far more complex applications (Buterin, 2014). As a result, Ethereum, Bitcoin 2.0 (the upgrade), was founded not only to transfer money, but also to incorporate it for more advanced applications, most notably the execution of a coded program to automatically exchange property, goods, or services for compensation upon the completion of agreed upon terms by the parties involved, giving life to the concept of smart contracts (Buterin, 2014).

D. SMART CONTRACTS

A smart contract is more akin to a piece of software than a written contract, in a legal sense. It is in essence a contract embedded into code that automatically executes when predetermined conditions are met (Schatsky, 2019). The most common and popular method of implementing this is through blockchain technology thanks to its shared database. This results in a contract where all the parties can agree upon the specific conditions or terms and know that the execution will occur automatically, in turn reducing risks associated with manipulation and human error. An additional benefit of smart contracts' automatic execution is the reduced time for review and execution (Schatsky, 2019). Given that the DOD frequently processes thousands of contract actions every year, with each subject to strict regulation and open to the potential for protests (as outlined in the FAR), there are obvious advantages to the implementation of smart contracts within the DOD.

The idea of smart contracts can be viewed as an entity to process the distribution of currency incoming and outgoing, in an automated procedure, based on the criteria in the code of a program (Accenture, 2019). Simply put, an agreement (the equivalent of a paper contract) defined by two parties where the terms of their exchange are converted to an executable code residing at an address on the Ethereum blockchain, using ETH cryptocurrency in an Ethereum account to transfer payments (Buterin, 2014). This results in a paper contract now being executed by software code and warranted the new

nomenclature of a "smart contract" where instructions are broadcast on a P2P network to run a function without human intervention (Accenture, 2019).

Terms of the contract are defined and enforced by the code programmed to execute the exchange of fees for goods electronically. Smart contracts can be written by anyone who can code the language and deploy it to the network. Once deployed, smart contracts are indelible, immutable, and irreversible (Morgan et al., 2021). A smart contract operating on a blockchain is one of the original design goals of Ethereum. Ethereum's many P2P networks track currency, transfer funds, and store data where each node is running the Ethereum client and recording every transaction (Horowitz, 2018).

E. GOVERNMENT USE OF SMART CONTRACTS

A smart contract can work like a service contract by automating the process of delivering and receiving services between parties. Much like how a service contract has the basic elements of: an offer, acceptance, consideration, legal purpose, capacity, and consent; a smart contract can emulate these elements in a digital format (Horowitz, 2018). Although a smart contract is written and enforced via software code, it contains a definition of terms of which the parties agree on the terms and conditions of the service contract and codify it in the smart contract (Accenture, 2019). The contract includes the scope of the service, the terms of payment, and the timeline for delivery.

This process would allow for payment terms for the service to be set up to be made automatically via the smart contract, based on the terms agreed upon (Accenture, 2019). This ensures that payment is made on time and in accordance with the terms of the contract. The smart contract can be programmed to track the delivery of the service, using data from sensors or other Internet of Things (IoT) devices. Once the service is delivered, the smart contract automatically releases payment to the service provider.

Smart contracts can also include dispute resolution mechanisms. If a dispute arises, the smart contract can automatically trigger a dispute resolution process, such as mediation or arbitration, based on the terms of the contract.

Overall, a smart contract can simplify the process of service delivery, streamline payments, and provide a transparent and secure mechanism for the parties to enforce the terms of the contract.

Research has been conducted on whether or not public procurement contracts will eventually utilize distributed ledger technology (DLT) in order to provide a more open, transparent, and collaborative acquisition process. While the contracting process as it stands touts an open process, there is no doubt about the reliance on arbitration, such as protests, in order to provide a system of checks and balances to the process. As shown previously in this thesis, this process can be long and arduous. The potential of smart government contracts utilizing DLTs may be an enticing option to reduce or eliminate the need for third-party arbitration (Horowitz, 2018).

1. Eliminate the Complaint – Ambiguity

In the DOD Acquisition process, Contracting Officers prepare a request for proposals (RFP), the document released to the public describing the project, the requirements the solution must meet, and the evaluation criteria, in order to solicit bids from qualifying contractors to complete the project. Once bid packages from each participating contractor are received, the contract selection committee must review and choose a winning bid using the evaluation criteria previously described in the RFP.

Some of the major problems expressed in government contract award protests are linked to vagueness, ambiguity, and lack of transparency during the bid selection process. Protests are largely based on contract language and selection criteria leaving room for arguments. The opinion or judgment of the bid package reviewer or reviewing team is often challenged by losing contractors claiming unfair advantages were given or favoritism to the winner. Smart contracts can combat the source of these complaints and fix this problem with the sheer nature of their design. By requiring explicit terms for programming and operating on a secure distributed ledger the smart contract alleviates the major cause for protest action, preventing the effect.

a. Smart Contracts Require Very Specific Terms for Programming

The change from paper contracts to smart contracts alters the manner in which the drafting process is accomplished for an RFP. Terms and conditions in standard paper contracts are long-winded, arduous, and at times vague on purpose to allow parties flexibility without legal repercussions. Smart contracts on the other hand are well-defined, explicit, and direct; their terms are written to fulfill a criterion, and in turn an executable is accomplished (Levi & Lipton, 2018). Smart contracts are written in Boolean language in terms of "if this happens, then do this." Every scenario requires a programmed response.

In a smart contract, those measures and terms are worked out in advance by the contract specialist to spell out the requirements before programming begins (Accenture, 2019). This amount of detail will force the language of the RFP to directly correlate to the actions in the selection process. With the explicit parameters laid out for each bidder to see, little room is left for claims of malfeasance, limiting the number of valid protests that can be filed with provable grounds.

The following is a very simplified example, but for illustration's sake try to imagine an RFP to build a prototype for a military tank. A smart contract is built to receive the data on the bidder's prototype design and calculate a numerical winner based on submitted figures. Each tank requirement is given a numerical scale for major parameters from threshold to objective values (similar to the list below).

- Speed: 20–30 mph is rated at 1 point, 31–40mph = 2 points, 41–50mph = 3 points
- Weight: 100 tons >= 1 point, 90–99 tons = 2 points, 80–89 tons = 3 points
- Cruising range: 150 miles <= 1 point, 151–200 miles = 2 pts, 201–250 mi = 3 pts

All important measurements are assigned a value based on the level of prototype achievement. After bidders/contractors enter all requested prototype data into their secure blockchain submission area for each parameter, a final calculation is done giving each

bidder an assigned score. All scores are secret until the end of the submission process leaving no room for claims of government official impropriety by bidders. After the submission deadline ends, all companies' names and scores are published showing the company with the highest score as the winner. Smart contacts force the evaluation criteria to be clearly defined and concise while also removing the human element (of judgment and opinion) from the selection process, eliminating the justification language used in many protest cases.

b. Blockchain Provides Transparency

Another potential benefit of utilizing blockchain technology is the ability to create trust in contracting. Having bidder eligibility and qualifications requirements, along with contract review and decision process, recorded in secure but open digital ledger (DL) would provide transparency of the process to bidders. An open DL has the potential to reduce protests by allowing those less familiar with the government contracting process (such as small businesses) to more clearly follow contract submission, evaluation, and decision processes. Displaying the process in a trusted, contract-specific blockchain could serve to reduce bidders' questions about fairness in their evaluation since all submissions are judged equally by a programmed numerical algorithm. It would also serve to provide some additional accountability and reduce the potential for favoritism by clearly displaying the bid evaluation, decision process, and any Q&A about the contract received and answered for the public to review, ensuring all information is shared and available to all involved or interested.

2. Blockchain and Smart Contracts Provide Accuracy in Bid Submissions

As previously stated, elimination or disqualification of bids for noncompliance to the submission rules cause protests. A recommendation to avoid these complaints was to allow for the resubmission of bid packages with qualified changes. This resubmission process is obviously problematic because it in itself is grounds for protest from a losing bidder whose victory is potentially stolen by the resubmitting company.

Combining the capabilities of the record keeping DL and a smart contract can work together to resolve this issue. Storing bidders' eligibility documentation in a government blockchain permanently for easy access and verifiability is one possibility. Bidders can prequalify this data for storage in exchange for a "code" to enter into a smart contract while submitting bids to different RFPs since many government bidders are repeat offerors. New bidders who are not prequalified can submit physical copies to the smart contract bid submission package.

With or without the prequalification, use of a smart contract to receive all qualification and eligibility documentation as a part of the bid submission process will eliminate the need for contracts personnel to disqualify any submissions. Programming in the smart contract can verify eligibility documentation by one of the following methods:

- checking the government distributed ledger used for stored data
- offering an option to enter a pre-qualification "code"
- scanning additional documents into the bid submission package containing verifiable license numbers (for new bidders)

For example, if active bonding and insurance documentation are required of all bidders, the smart contract can be programmed to receive a predetermined range of verification numbers confirming active licenses (i.e., license numbers 300- 500 are currently active and verified). A company putting in a bid with license number #259 would not be eligible, and automatically rejected by the program from participation. A completed, eligible package is accepted in the running for the contract while a rejected offeror cannot complete the process. This restriction only allows each company one valid submission; therefore, onus of an accurate bid package is shifted back to the offeror to complete by the deadline for as many retries of submission as needed.

Once the acceptance period ends, the winner is instantly displayed and selected. Smart contracts add a level of trust to the submission process for the bidders by confirming no bidders were able to change their submission package for a higher score or enter a bid package after the deadline.

3. Built-in Trust in Documentation Submission

Smart contracts using blockchain technology set the stage for a system to develop trust amongst multiple independent actors. While the implications of trusted information within a spread-out system or remote independent actors are many, there are benefits for government contracting. One such potential exists through decreasing review time of bid packages. For example, if all documents submitted in a contractor's bid were known to be true and trusted by the entity receiving the bid, no follow-up or manual verification would be required for references, bonding, insurance, past performance, etc. While the government currently uses digital signatures to in some way implement a level of trust amongst its employees and departments, the system is not universal. The adoption of smart contracts and blockchain technology allows the shared verification capability on a trusted network for secure utilization now.

4. Smart Contracts Provide Security

Cybersecurity is high on the list of requirements for all new electronic systems in development for the government. A secure P2P network for RFPs can consist of the government contracting specialist and the interested bidders. With tiers of secure access grantable inside the blockchain, the government can secure privacy and the intellectual property of each bidder. No two bidders would have access to see each other's prototypes or any parts of the submission for proprietary reasons. Each bid package received is secure and only visible to the government contract officials after a winner is selected. For added security of each bidders' proprietary designs, a smart contract can contain an option (for bidders to select at submission) to return all paperwork without being viewed by government officials if the bid is lost. All losing bid packages can be returned to their offerors unopened, if the bidder so desired and such an option was allowed and selected. Granted, there is often an incentive to share losing bid designs with the government in general for consideration for future sole source contracts or future need fulfillment.

5. Efficiency: Removal of Arduous Government Process Steps

Smart contracts allow immediate execution of agreed upon terms resulting in less delays, disputes, and downtime, increasing efficiency for both parties involved. Automatic

execution features will free up workers and save time on repetitive tasks. Upon necessary verification of job completion steps, sending and receiving of funds can be processed, tracked, and recorded on a DL without a full department of oversight for accounts and receivables. All parties with access can see work completed (data collected and confirmed), in addition to payments rendered and received.

Bank transfers that used to take days requiring authorizing officials from the government to approve a payment from the bank, then the bank authorizing official approving the transfer to the client, and finally the client (or contractor) waiting days for the fulfillment payment, can now be done in hours. The same bank transfer just requires confirmation receipt of services to activate a smart contract transfer from a secure account hold.

There is no doubt that automation is the future and blockchain technology provides the opportunity for automation to be recorded utilizing digital assets that have a monetary value. The monetary policy of the funding that is ordered by statute can automatically be recorded on a blockchain that is funded directly from the DOD budget and distributed properly to the warfare centers for use.

Under Maser's study of How Bid-Protest Mechanisms Mitigate Opportunism in Government Contracting (2012), they investigated transactional hazards in government contracting, specifically opportunism in the source-selection process on both the part of the government and that of third parties. Maser's (2012) study suggests that governmental opportunism could be addressed through third-party intervention but may lead to third-party opportunism. The author argues that the GAO's bid-protest mechanism helps alleviate the ramifications of opportunistic behavior, i.e the propensity of human nature to seek out and take advantage of situational opportunities, by making it an effective solution to these hazards (Maser, 2012). However, he agrees and concurs with several sources that there is no argument regarding bid protests being costly to both parties (agencies and to contract winners) (Maser, 2012).

6. Benefits of Decentralized Applications

Theoretically, a smart contract can be deployed which automates certain aspects, if not the entire Planning, Programming, Budgeting and Execution stage of the DOD acquisition process. Simulations can be run allowing stakeholders to collectively decide how best to plan out the future years. 7L International (n.d.) defines, "a decentralized application (dApp) is an application built on a decentralized network that combines a smart contract and a frontend user interface" (para. 1).

> The benefits for developing a dApp include "zero downtime, privacy, resistance to censorship, complete data integrity" and most importantly:
>
> Trustless computation/verifiable behavior. Smart contracts can be analyzed and are guaranteed to execute in predictable ways, without the need to trust a central authority. This is not true in traditional models; for example, when we use online banking systems, we must trust that financial institutions will not misuse our financial data, tamper with records, or get hacked. (7L International, n.d., para. 6

F. BARRIERS TO GOVERNMENT USE

Despite the potential benefits, numerous challenges exist to stunt the implementation of blockchain and smart contracts in government applications. The first major one is legislation. Since the foreign/digital currency is not owned by any one nation-state, little or silent language is written in terms of acceptance and regulations. The possibility of a central bank digital currency (CBDC) however, may overcome this concern. Secondly, the potential culture of resistance within the DOD as new digital smart contracts could potentially merge within the traditional paper method of contracting used today. Also, since blockchain technology and smart contracts are still in their infancy in the cycle of innovation, there is a pause for concern for immature systems. Finally, there is currently only a small subset of individuals with the skill sets required to build, research, develop, and test these smart contracts written in the blockchain.

1. Legal Status of Smart Contracts

Federal laws in the U.S. have not been enacted to govern smart contracts (Levi & Lipton, 2018). As with current contract law, the burden of regulation, enforcement, and interpretation falls to the state level (Levi & Lipton, 2018; Adock, 2020). The National Conference of Commissioners on Uniform State Laws has been pushing to standardize a basic consensus of principles and guidelines for universal state use, but each state possesses the power to adopt or deviate (Levi & Lipton, 2018). At least five states have passed legislation for use or legal recognition of smart contracts (Adcock, 2020).

Other countries have debated the legality of programmed contracts while some have already enacted their full acceptance as law, like the United Kingdom (Morgan et al., 2021). In the interest of progress, smart contract law is commonly being absorbed into and covered by existing basic (paper) contract law parameters. A report from the U.S. Senate Joint Economic Committee (JEC) (2018) concluded, "usually, the judicial system adjudicates contractual disputes and enforces terms, but it is also common to have another arbitration method, especially for international transactions. With smart contracts, a program enforces the contract built into the code" (p. 210).

New technology presents a challenge to old laws and standards (Morgan et al., 2021). Technological advancements contain new capabilities not encompassed in the existing legal language since it could not be considered before the start of its existence. Even the operational lawfulness of a longstanding company like Amazon is still being debated. Masters explains in an article for Forbes (2019), Amazon has fought numerous court battles for over a decade stemming from the company not collecting state taxes, which allows them to undercut identical product costs from local businesses. Amazon has been able to skirt billions in taxes and lawsuits in multiple states by simply labeling themselves as "marketplace" instead of a retailer (Masters, 2019). Smart contracts are no exception to the fear of the unknown. The legality of usage and avenues of recourse require further study, laws, and regulation before universal acceptance is more widespread (Morgan et al., 2021). First steps to inclusion encompass updating the FAR to cover governance on the use of smart contracts.

2. The Military Lacks Speed and Adaptability

The military industrial complex only evolves as quickly as the government will allow it to. Many times, the government is too slow to adapt and too rigid in its ways to make necessary swift changes. Capitalist tech companies, whose sole purpose is to capture as many technology users as possible, have flourished in their evolution thanks to Moore's law. In 1965, the CEO of Intel, Gordon Moore, predicted that the number of transistors held by an integrated circuit would double every year whilst the price of major users of the components (like computers) would decrease based on technological advancements and existing patterns (Corporate Finance Institute, 2020). The prediction, adopted as Moore's law, held for ten years before being amended by Moore to state the doubling process would continue every two years (Encyclopaedia Britannica, 2022). With silicon chip measurements changing from millimeters to nanometers, tech companies are moving at lightning speed compared to the government, which has always been attempting to play catch up (Encyclopaedia Britannica, 2022).

Government contracting programs still utilize tools considered ancient in today's digital world. The vast majority of paperwork and bureaucratic debate has stymied growth in this field and will likely continue with the loose regulations that Congress has on its public sector counterparts. While one can hope the military contractors today will help adopt and implement new technologies that ultimately change the acquisition landscape, it is up to the government to provide a rapid response that it sorely needs to stay competitive against potential adversaries.

3. Barriers

Smart contracts have become a case study within Scandinavian municipal policy. Smart contracts utilized for government processes were implemented and evaluated, highlighting the benefits and challenges involved as currently laid out. Within this, Krogsbøll (2019) raises concerns about using blockchain for government processes. The immutability of smart contracts on the blockchain means that mistakes cannot be easily fixed, which presents a major issue if the contract has access to government funds. Transaction latency and cost are also significant concerns. The municipal government

partner in this study believes that traditional IT systems are sufficient to support smart contract implementation and that the benefits of using blockchain based smart contracts do not outweigh the costs (Krogsbøll, 2019). While permissioned blockchains can address some concerns, they still leave control with the government and do not resolve the challenges related to updating processes when laws change.

Ultimately, the findings demonstrated that while such uses are possible, even with concerns about confidentiality requirements, there are notable benefits, including: integrity guarantees, direct cooperation, verifiability, and automated direct payments amongst the involved parties (Krogsbøll, 2019). The article concludes that using blockchain for government processes requires a balance between immutability and updatability and proposes this as a research challenge for the blockchain community (Krogsbøll, 2019). This challenge is one that is likely to carry over directly to DOD implementation of smart contracts.

Since this is a new area of technology, development experts are not plentiful. With that in mind, coders are required. Not only will the need for programmers and cryptography experts rise but the legal end will have to grow, adapt, and improve also for lawyers and forensic specialists. As this field is still developing, the number of qualified individuals is scarce. Tech companies are already recruiting and compensating the "best and the brightest" candidates away from even being government prospects in these disciplines. General schedule (GS) pay scale salaries cannot compete compensation-wise to recruit the talent the DOD needs for these types of initiatives.

As with every other challenge of aptitude deficiencies, the government will most likely have to "contract out" the initial job of smart contract sector creation to a knowledgeable company. In the past, the DOD has partnered with the likes of Google and Silicon Valley to improve national security for the greater good or for government contracts. A whole new business sector has already developed for this primary purpose. Companies like Accenture (2019), promise blockchain contracts hold "the potential to revolutionize the way contracts are prepared, transacted, amended, stored and complied with" (para. 10). Their website advertises their ability to draft new, or transfer existing paper contracts, and convert them to blockchain smart contracts. Accenture (2019) is

dedicated to providing all the benefits previously listed like high security, efficiency in processes, tamper proof records management, and full transparency which they refer to as "a single source of truth" since all parties involved can see the entire network of the blockchain data on demand (para. 6).

G. SUMMARY

This chapter introduces a new technological methodology for combating the common justifications used in defense acquisition contract protests. Pitfalls of the existing systems like 'record keeping' and 'centralized trust' justify the idea behind the development of distributed ledger technology and blockchain. This chapter defines smart contracts, exploring its origins from blockchain as a distributed ledger and the foundation of cryptocurrency. Herein, government contracting official use cases are explored to identify the specific problems solved by smart contract adoption, in addition to presenting barriers to the same end. The final chapter provides a summary, conclusion, and recommendations for future research.

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V. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

A. SUMMARY

This research project analyzed the common causes, trends, and contributing factors (including participant motivations) of contract bid protests in the DOD and Navy procurement process, while reporting popular suggestions on protest reduction and mitigation techniques. By examining data from various sources (RAND and NSWCPD), commonalities were identified that cost the government money and contribute to time-consuming delays on initial contract actions. The results show that the current protest system in government procurement is plagued by delays and inefficiencies, which can be improved upon by the implementation of emerging technologies in blockchain and cryptography. To navigate future contracts with efficiency and transparency, the use of blockchain locked smart contracts is explored as an area of growing interest and investment for government agencies and other stakeholders looking to modernize and streamline their procurement operations. The use of smart contracts could theoretically negate many delays that stem from contract bid protests actions relating to technical evaluation, cost evaluation, or set-aside determination.

Chapter I presented the overview, research questions, methodology used to do the research, and background of this study. Chapter II defines the foundation of the defense acquisition system, contract uses and types, bid protests, and players involved along with the governing agencies in charge of overseeing the official filings. Chapter III discusses the compilation of the relevant research on the topic to describe the detriment to the acquisition system overall while presenting protest risks, reasons, trends and suggested resolutions. The two major studies, the RAND report of 2018 and the NSWCPD review of 2008–2020 filings, are analyzed and findings are presented. Chapter IV introduced the origins, benefits, and barriers of implementing smart contracts as a solution to eliminate some of the known causes of defense acquisition contract protest actions. Lastly, this chapter (Chapter V) provides an overall summary, conclusion of the research, research limitations, and recommendations for future research.

B. CONCLUSION

This research answered the following questions:

- What is a bid protest?
- What are the key drivers behind bid protests?
- What are the common (negative) impacts of bid protests?
- What could have been done to decrease the likelihood of a protest?
- What do bid protests at NSWCPD look like?
- What is a smart contract?
- How can smart contracts be utilized to reduce bid protest likelihood and impact(s)?

The objective of this research was to examine protests filed against the U.S. Department of Defense to the Government Accountability Office (GAO) and to the Naval Surface Warfare Center Philadelphia Division (NSWCPD) to discover trends, in order to identify and analyze these areas of concern and provide suggestions for improvement and increased efficiency where gaps may exist. Specifically, trends in causality, contracting stage, schedule delays, cost overruns, agency challenges, and overall outcomes were reviewed in order evaluate the common causes and negative effects related to Navy procurement. Additional research was conducted to determine common contributors to increased protest likelihood and factors that contribute to reduced protest risk. The research identified two major factors that contribute to the areas of concern within protests: technical evaluation and contract set-asides. The reasons for protest were found to be attributed to technical evaluation 43 percent of the time and protest set-asides 27 percent of the time.

The research also looked for innovative solutions to reduce protest likelihood and potential negative impacts. Current literature on recent technological advances in cryptography and blockchain was reviewed for its use in smart contracts. The use of blockchain locked smart contracts was proposed as a solution to reduce protest likelihood

and decrease protest resolution time. It was noted that the use of smart contracts has the potential to eliminate the need for a third-party arbiter when it comes to contract protests. While further study is recommended, this highly technical and specialized program may be imperative for the future of handling government contracts.

C. LIMITATIONS AND RECOMMENDATIONS

While proceedings of the COFC are recorded and published, along with the records of protests with the GAO, the team noticed that there is no central database for protests filed with individual Procuring Agencies. In addition, the results of protests filed with procuring agencies are not even required to be published. As such, there is no reliable way to gather the protest data for all individual Procuring Agencies. This has several implications regarding research and evaluation of bid protests. For one, the data set is potentially severely limited, given the relatively low number of protests filed with the GOA and the COFC compared to the total number of Contracts, given the percentage of contract actions executed by individual Procuring Agencies.

There may be various biases, including protest vs. contract price, induced by only evaluating protests to the GAO and COFC. The potential of generating skewed data and inferences by basing research solely on GAO and COFC protests is potentially notable and worth future investigation. To aid in future research and improve future data collection, the team suggests that congress require Procuring Agencies to report protests and maintain a log of protests filed and their outcomes. The team also proposes that an existing system, such as beta.sam.gov, be amended to include additional features to enable easy reporting of protests and protest results by Procuring Agencies. These changes could be implemented as requirements in a future National Defense Authorization Act (NDAA).

The team would like to strongly encourage the further evaluation of smart contract applications within government contracting. The research conducted has led the team to believe that blockchain based smart contracts hold valuable potential to both decrease the likelihood of protests occurring and to reduce the time necessary to resolve protests when they may occur. Suggestions for future research necessary to aid in the implementation of smart contracts within government acquisitions is detailed in section D.

D. AREAS FOR FUTURE RESEARCH

The potential benefits of smart contracts in government acquisitions are clear, but there are still several areas that require further research before working towards implementation and adoption. By exploring the areas of research outlined in this paper, we can better understand the challenges and opportunities presented by smart contracts in government acquisitions and develop strategies for realizing their full potential.

1. Details regarding government application of smart contracts, how smart contracts can fit within the FAR, and how the FAR could be revised to better accommodate smart contracts.

2. Required methods, systems, and training needed to migrate government acquisitions from paper contracts to smart contracts.

3. Research into protest details and metrics from within other individual procuring agencies, and how these metrics compare and contrast to the data currently available from the COFC and GAO.

4. Barriers to implementation and acceptance of smart contracts have not been fully evaluated and are not well understood. The team suggest that further research be conducted into analyzing the factors that may contribute to resistance towards smart contract implementation and acceptance (such as lack of understanding, fear of job loss, and concerns over the security of the technology). Our research has led us to believe that addressing such barriers is important to promoting the implementation and adoption of smart contracts within government acquisitions.

We do not understand all the barriers to acceptance of smart contracts within the government acquisitions workforce and amongst bidders. The team suggests that further research be delved into analyzing the factors that may contribute to the resistance towards smart contracts, such as lack of understanding, fear of job loss, and concerns over the security of the technology. It is our recommendation that addressing these barriers and promoting the adoption of smart contracts in government acquisitions is important to mitigate any potential challenges.

APPENDIX. MAJOR CONTRACT TYPES

Table 4. Comparison of Major Contract Types. Adapted from DSMC (2014).

Comparison of Major Contract Types

	Firm-Fixed-Price (FFP)	Fixed-Price Economic Price Adjustment (FPEPA)	Fixed-Price Incentive Firm Target (FPIF)	Fixed-Price Award-Fee (FPAF)	Fixed-Price Prospective Price Redetermination (FP^{2}R)	Cost-Plus-Incentive-Fee (CPIF)	Cost-Plus-Award-Fee (CPAF)	Cost-Plus-Fixed-Fee (CPFF)	Cost or Cost-Sharing (C or CS)	Time & Materials (T&M)
Principal Risk to be Mitigated	None. Thus, the contractor assumes all cost risk.	Unstable market prices for labor or material over the life of the contract.	Moderately uncertain contract labor or material requirements.	Risk that the user will not be fully satisfied because of judgmental acceptance criteria.	Costs of performance after the first year because they cannot be estimated with confidence.	Highly uncertain and speculative labor hours, labor mix, and/or material requirements (and other things) necessary to perform the contract. The Government assumes the risks inherent in the contract, benefiting if the actual cost is lower than the expected cost, or losing if the work cannot be completed within the expected cost of performance.				
Use When . . .	The requirement is well-defined. •Contractors are experienced in meeting it. •Market conditions are stable. •Financial risks are otherwise insignificant.	The market prices at risk are severable and significant. The risk stems from industry-wide contingencies beyond the contractor's control. The dollars at risk outweigh the administrative burdens of an FPEPA.	A ceiling price can be established that covers the most probable risks inherent in the nature of the work. The proposed profit sharing formula would motivate the contractor to control costs and to meet other objectives.	Judgmental standards can be fairly applied by the fee determining official. The potential fee is large enough to both: •Provide a meaningful incentive. [1] •Justify related administrative burdens.	The Government needs a firm commitment from the contractor to deliver the supplies or services during subsequent years. The dollars at risk outweigh the administrative burdens of an FPRP.	An objective relationship can be established between the fee and such measures of performance as actual costs, delivery dates, performance benchmarks, and the like.	Objective incentive targets are not feasible for critical aspects of performance. Judgmental standards can be fairly applied. Potential fee would provide a meaningful incentive.	Relating fee to performance (e.g., to actual costs) would be unworkable or of marginal utility.	The contractor expects substantial compensating benefits for absorbing part of the costs and/or foregoing fee or the vendor is a non-profit entity.	No other type of contract is suitable (e.g., because costs are too low to justify an audit of the contractor's indirect expenses).
Elements	A firm-fixed-price for each line item or one or more groupings of line items.	•A fixed-price, ceiling on upward adjustment, and a formula for adjusting the price up or down based on: •Established prices. •Actual labor or material costs. •Labor or material indices.	•Ceiling price •Target cost •Target profit •Delivery, quality, or other performance targets (optional) •Profit sharing formula •120 % ceiling and 50/50 share are points of departure	•Fixed-price. •Award amount •Award fee evaluation criteria and procedures for measuring performance against the criteria	•Fixed-price for the first period. •Proposed subsequent periods (at least 12 months apart). •Timetable for pricing the next period(s).	•Target cost •A minimum, maximum, and target fee •A formula for adjusting fee based on actual costs and/or performance •Performance targets (optional)	•Target cost •Base amount, if applicable, and an award amount •Award fee evaluation criteria and procedures for measuring performance against the criteria	•Target cost •Fixed fee	•Target cost •No fee •If CS, an agreement on the Government's share of the cost.	•Ceiling price •A per-hour labor rate that also covers overhead and profit •Provisions for reimbursing direct material costs
Contractor is Obliged to:	Provide an acceptable deliverable at the time, place and price specified in the contract.	Provide an acceptable deliverable at the time and place specified in the contract at the adjusted price.	Provide an acceptable deliverable at the time and place specified in the contract at or below the ceiling price.	Perform at the time, place, and the price fixed in the contract.	Provide acceptable deliverables at the time and place specified in the contract at the price established for each period.	Make a good faith effort to meet the Government's needs within the estimated cost in the Contract, Part I the Schedule, Section B Supplies or services and prices/costs.				Make a good faith effort to meet the Government's needs within the ceiling price.
Contractor Incentive *(other than maximizing goodwill)* [1]	Generally realizes an additional dollar of profit for every dollar that costs are reduced.	Generally realizes an additional dollar of profit for every dollar that costs are reduced.	Realizes profit on cost by completing work below the ceiling price. May earn higher profit by incurring costs below the target cost or by meeting objective performance targets.	Generally realizes an additional dollar of profit for every dollar that costs are reduced; earns an additional fee for satisfying the performance standards.	For the period of performance, realizes an additional dollar of profit for every dollar that costs are reduced.	Realizes a higher fee by completing the work at a lower cost and/or by meeting other objective performance targets.	Realizes a higher fee by meeting judgmental performance standards.	Realizes a higher rate of return (i.e., fee divided by total cost) as total cost decreases.	If CS, shares in the cost of providing a deliverable of mutual benefit.	
Typical Application	Commercial supplies and services.	Long-term contracts for commercial supplies during a period of high inflation.	Production of a major system based on a prototype.	Performance-based contracts.	Long-term production of spare parts for a major system.	Research and development of the prototype for a major system.	Large scale research study.	Research study.	Joint research with educational institutions.	Emergency repairs to heating plants and aircraft engines.
Principal Limitations in FAR/DFARS Parts 16, 32, 35, and 52[2]	Generally NOT appropriate for R&D.	Must be justified.	Must be justified. Must be negotiated. Contractor must have an adequate accounting system. Cost data must support targets.	Must be negotiated.	MUST be negotiated. Contractor must have an adequate accounting system that supports the pricing periods. Prompt redeterminations.	The contractor must have an adequate accounting system. The Government must exercise surveillance during performance to ensure use of efficient methods and cost controls. Must be negotiated. Must be justified. Statutory and regulatory limits on the fees that may be negotiated. Must include the applicable Limitation of Cost clause at FAR 52.232-20 through 23.				D&F required (w/ HCA if over 3 years). Government MUST exercise appropriate surveillance to ensure efficient performance. Document any ceiling increases.
Variants	Firm-Fixed-Price Level-of-Effort.		Successive Targets (FPIS)		Retroactive Redetermination			Completion or Term.		Labor Hour (LH)

[1] Goodwill is the value of the name, reputation, location, and intangible assets of the firm. [2] Comply with any USD(AT&L), DPAP or other memoranda that have not been incorporated into the DFARS or DoD Directives or Instructions.

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