Earned Value Management as a Means to Mitigate DoD Contract Fraud

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Earned Value Management as a Means to Mitigate DoD Contract Fraud

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Abstract

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Anthony S. Maggert

Under the Supervision of Dr. Cheryl Banachowski-Fuller

Statement of the Problem

Currently there are no legislative requirements for surveillance of contract cost spending on DoD contracts. The Department of Defense (DoD) faces vulnerabilities to contracting fraud, waste, and abuse in five key areas: sustained senior leadership, capable acquisition workforce, adequate pricing, appropriate contracting approaches and techniques, and sufficient contract surveillance (Contract Management, 2006). The purpose of this study is to assess if the implementation of earned value on all performance contracts will provide a means to lessen contract fraud on DoD contracts. It is proposed that the implementation of earned value on all performance contracts; contract fraud will be mitigated. Fraud is mitigated because current legislative requirements required for oversight and insight into the United States Government according to the Office of Management and Budget spent $430 Billion in contracts in 2008 (fedspending, 2008). Of these contracts, there is no mention of mechanisms to prevent contractors from fraudulently charging egregious charges on DoD contracts. If the Governments plan is to [e]nsure early-on designation of properly trained contracting officer representatives and identification of appropriate performance

metrics (Contract Management, 2008), then there is a great need for a system that captures exactly where the problem originates in cost data.

Method of Approach

The methods of approach *prima facie* appear exhaustive. However, a methodological approach is necessary to embrace the broad scope of a contract which ultimately lead to the legally binding of a contract between parties. Contracts embrace prodigious concepts within law, applying elementary formulized applications of a contract means of demonstrating the foundation of a contracts objective principles and the pragmatism of contractual functionality associated with earned value management as it is applied to a contract. A procedural approach will be used to validate the conceptual framework of a contract, drawing upon the discrete details that define a contract. The approach here is to segway the flow of the argument from the genesis of negotiating a contract to the legally binding execution of a contract. This provides the greatest culminative understanding of contract processes. The cradle to grave undertaking of the life cycle of a contract is most easily palletized when the abstract functions are complimented with those subsets of methods that facilitate the construct of a contract.

How costs are captured, will be presented in a three-tiered approach producing the chronological procedures of a contract in an ordinal scheme. First, the MIL-HDBK-881 represents guidelines for effectively preparing, understanding, and presenting a Work Breakdown Structure (WBS) for both the U.S. Government as well as the contractor. Upon development of the WBS the

resultant actions between the parties or players is a Cost Performance Report (CPR). The CPR represents the second stage of collecting performance data where the performance is based on qualitative as well as quantitative means; within the explanation of the CPR, the five formats as well as the 32 criterion will be explained. The third and final process of collecting performance data is an Earned Value Management System (EVMS). EVMS plays the most central role of collecting cost data. Equally juxtaposed to the Earned Value is the Scheduling. Cost is captured in EVMS where cost represents the y scale and Schedule represents the y scale on a Cardinal plane. An Earned Value (Gold Card) model will represent a visual application of how Earned Value works as well as all of the discrete definitions within EV that comprise how performance is measured. This extensive explanatory functional arrangement of a contracts cost data will provide an inclusion and elucidation of contracts functional composition that affords transitioning from a parochial theoretical framework to a praxis that can be used in a pragmatic form that upon its declaration results in courses of action (of player). It is these very courses of action that inevitably result on contract fraud. The player's actions that consequently precipitate fraud are best explained in "Game Theory."

The application of Game Theory will be used in order to validate the logic in the application that contractors will choose to commit crime vs. not commit crime. Game Theory aims to help understand situations in which decision-makers interact and produce results in an ordinal fashion (Osborne, 2004). The Nash Equilibrium will be established in order to provide the baseline for the players

within a contract. Bayesian Games will be used to substantiate the delta of the strategic Nash Equilibrium and affording the uniqueness of the different states, actions and signals unitary to contractors and the Government in relation to contractor's actions which result in contract fraud. Rational Choice will be implored centrally because rational choice evokes a strong correlative relationship with criminal justice and contract fraud. It is the foundation of Game Theory validates that contractors will choose crime verse not crime. Game Theory will be followed by the means contractors use to discretely commit contract fraud. This will be the detailed reference to the manipulation of the WBS, falsification of performance metrics, and schedule derivations. Contract theory conjoins Game Theory, and Bayesian Statistics. Contract Theory is the ultimate means understanding the least common denominator of the argument of earned value management as a means to mitigate DoD contract fraud because the "contract" is the corpus of why contractors commit contract fraud.

Research will be to provide recommendations for the implementation of Earned Value Management System (EVMS) as a means to identify fraudulent charges, over runs, and misuse of performance metrics on all Department of Defense contracts regardless of contract cost. Secondary research and statistics will be used to justify the argument for the implementation of EVMS. The target population is the contractors who actively engage in DoD contracts. The means for measurement are the application of earned value (EV) where the delta of either over or under performing is based on a percentage of the contract. A

detailed explanation of how the United States Government conducts contracts will be explained in order to validate the argument.

The specific contributions to the research will provide a systematic application of earned value theory in order to explain actual contract deviations through identification of egregious variation to contract cost.

Results of the Study

In order to provide validity to the argument and to establish evidence to the adoption or rejection of the Argument, recommendations will be provided for the pros and cons of implementing EVMS. This will be accomplished by presenting corroborative evidence within the American National Standards Institute (ANSI) 748, references to the Sarbanes Oxley Act, General Accountability Office (GAO, 2008) reports, Defense Acquisition University literature. This list of data validates the empirical findings of earned value as a means to mitigate DoD contract fraud.

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Common Acronyms used through out

Acronym	Definition
ANSI	American National Standards Institute
C/SCSC	Cost/Schedule Control Systems Criteria
CFR	Code of Federal Regulations
CLIN	Contract Line Items
CPR	Cost Performance Report
DAU	Defense Acquisition University
DCAA	Defense Contract Audit Agency
DCMA	Defense Contract Management Agency
DFARS	Defense Federal Acquisitions Regulations Supplement
DID	Data Item Description
DoD	Department of Defense
DOJ	Department of Justice
DOT	Department of Transportation
EOP	Executive Office of the President
EPL	Excluded parties List
EPLS	Excluded Parties List System
EV	Earned Value
EVM	Earned Value Management
EVMS	Earned Value Management System
FAR	Federal Acquisition Regulation
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FM	Financial Management
GAO	General Accountability Office
IG	Inspectors General
IMPAC	International Merchant Purchase Authorization Card
IPT	Integrated Product Team
IRS	Internal Revenue Service
NASA	National Aeronautics and Space Administration
NRO	National Reconnaissance Office
OMB	Office of Management Budget
RAM	Responsibility Assignment Matrix
SOX	Sarbanes Oxley Act 2002
USC	United States Code
WBS	Work Breakdown Structure

I. INTRODUCTION: EARNED VALUE MANAGEMENT AS A MEANS TO MITIGATE DOD CONTRACT FRAUD

Research suggests that "DoD lacks a plan that coordinates initiatives or provides a road map for future cost control efforts" (GAO-03-935). Current DoD contract spending is higher than any other point in U.S. history (Keller, 2006), yet there is no Federal entity to investigate contract spending tendencies to ensure DoD contract fraud does not occur. The United States Department of Defense is made up of 17 agencies that awarded over $1.3 Trillion dollars in contracts between 2002 and 2006. Department of Defense contract spending increased over 27% between 2002 and 2003, and then remained relatively steady for the following two years before increasing by 26% between 2005 and 2006. A majority of the increases can be attributed to contracts awarded in aircraft and other transportation. In 2006, the U.S. Department of Defense awarded $311 Billion in contracts, compared to $163 Billion in 2001 (Missouri Economic, 2008).

In 2007, at $439.3 Billion, the overall FY 2007 Defense budget provides for a 48% increase over the FY 2001 total Defense budget. The percentage of Defense to Total contracts also increased from 68% in 2001 to 73% in 2006. According to the office of Management and Budget, the United States spent $430 Billion in contracts in 2008 (fedspending, 2008). Of these contracts, there is no mention of mechanisms to prevent contractors from fraudulently charging egregious charges on DoD contracts. If the Governments plan is to "[e]nsure early-on designation of properly trained contracting officer representatives and identification of appropriate performance metrics" (Contract Management, 2008), then there is a great need for a system that captures exactly where the problem originates in cost

data.

Without an early warning device to detect contract fraud, the ability to control deviations in contract spending becomes enforceable only after contract fraud occurs. It is therefore vital to establish processes that prevent contract fraud from happening prior to contract fraud occurring. "Look…no matter what, we've got to cut spending… I (Senator John McCain) think that we have to return; particularly in defense spending, which is the largest part of our appropriations, we have to do away with cost-plus contracts. We now have defense systems [for which] the costs are completely out of control" (John McCain, 2008, p. 2). Congress recognizes that DoD contract costs are out of control, but there still are no systems that provide quality fiscal data (Benito, 2007). Public Law 100-679 (41 U.S.C. 422) requires certain contractors and subcontractors to comply with Cost Accounting Standards (CAS) and to disclose in writing and follow consistently their cost accounting practices (48 CFR, 2008). One centralize mechanism specifically designed to identify cost outlays prior to contract fraud occurring is a well established earned value management system (EVMS).

The purpose of this study is to assess if the implementation of earned value on all performance contracts is a viable means to lessen contract fraud on all DoD contracts. Due to the fact that this research assesses the theoretical nature of contract fraud as a crime, this research is not to implicate *who* commits contract fraud, but *how* contract fraud can be committed.

As a caveat, this research is not intended as an all inclusive tutorial on *how* to commit crime; rather the research presents an academic approach to

substantiate the necessity for more quality controls against earned value crime by presenting the modus operandi of earned value. The objective nature of this research is based on the assessment that the Department of Defense (DoD) faces vulnerabilities to contracting fraud in five key areas: sustained senior leadership, capable acquisition workforce, adequate pricing, appropriate contracting approaches and techniques, and sufficient contract surveillance (Contract Management, 2006).

A major assumption is that the implementation of earned value on all performance contracts, contract fraud will be mitigated. "Recently, major acquisition activities have received significant attention due to failure to achieve desired outcomes, such as meeting cost and schedule goals and delivering desired outcomes" (Gilbreth, 2008, p. 133). Second, a well defined template does not exist that can be used throughout the DoD so that Government cost analyst can more easily identify and prevent fraudulent charges on Government contracts. By Using earned value to model the interactions between a government agency (DoD) as games of risk, information disclosure using Game Theory, Bayesian Statistics, and Contract Theory as a means to identify contract fraud have not been used (Umehara, 2009).

These limitations spawn from false assessments of earned value management systems which are often viewed as parochial business statistics gizmos employed incorrectly where the true pragmatic nature of earned value (as a tool to reduce risk associated with Governmental contracts) is often never met.

The provided research will explain the indispensable use of earned value

and *how* EV works. This is accomplished by providing systematic methods of approach to this research. Methods of approach will include the application of theoretical, empirical, and practical data to provide the essential tools in fulfilling the strategic relevance of the pragmatic use of earned value as a means to mitigate DoD contract fraud.

II. LITERATURE REVIEW IDENTIFYING CONTRACT FRAUD CASES, CONTRACTING FRAUD IS AN ISSUE, WHY MORE HELP IS NEEDED TO CONTROL CONTRACTING ISSUES AND THE LACK OF CONTROL OVER CONTRACT FRAUD

This section is broken up into four parts. The first section focuses on Identifying contract fraud cases. Often times, contract fraud is thought of as an issue far removed from common man. However, DoD contract fraud threatens National Security and the security of all Americans. The second section focuses on *why* contracting fraud is an issue. By recognizing *why* contracting fraud is an issue, the ability to formulate a plan to resolve contract fraud is established. The third section identifies *why* more help is needed to control contracting issues. Once contracting issues are established, the rationale for *why* there are few controls is apparent in the fourth section which identifies *why* there is a lack of control over contract fraud.

A. Identifying Contract Fraud Cases

Department of Defense contract fraud is becoming a major issue in criminal justice today. DoD contracting fraud is alluring from a criminal justice perspective because contract fraud is not a new type of white collar crime, but it is a white collar crime that often goes relatively unnoticed and yields the highest dollar threshold of any monetary crime (Martin, 1998). In fact, a person would have to rob thousands of liquor stores to equal the amount of dollars associated with the millions of dollars associated with DoD contract fraud. United States Attorney Paul J. McNulty is spearheading a procurement fraud initiative to promote the early detection and prevention of procurement fraud associated with the increase in contracting activity for national security and other Government programs (Paul,

2005). Governmental fraud comes in many shapes and forms. Here are a few examples of contract fraud and corruption cases:

- Darlene Druyun, a senior executive with DoD who obtained jobs with Boeing for her daughter, her daughter's fiancé, and herself while negotiating a contract with Boeing on behalf of the Air Force. Druyun gave Boeing a "parting gift" by agreeing to a higher price than she believed appropriate for Boeing's tanker aircraft. Boeing's chief financial officer, Michael Sears, also pleaded guilty for his role in this scandal.
- Robert Lee Neal, Jr., and Francis Delano Jones, Jr., were convicted of extortion, bribery, money laundering, and other crimes in 2003. Neal and Jones were DOD officials who used their official positions to obtain bribes, extortion payments, and gratuities.
- Kevin Hawkins, who accepted over $47,000 in bribes for his participation in a scheme to use DOD "IMPAC" credit cards to make over $200,000 in fictitious purchases for the Pentagon.
- Bobby Gilchrist, who received over $200,000 in bribes for his participation in a credit card scheme, resulting in $400,000 in Government losses.
- The Ebersole dog case, which focused on fraudulent procurements involving untrained bomb detection dogs used by Internal Revenue Service (IRS), State, Federal Reserve, and Federal Emergency Management Agency (FEMA).

- The case against Jeffrey Bochesa and several others that involved $300,000 in gratuities and a $1.33 million fraud committed by Bochesa and his company in connection with a National Reconnaissance Office (NRO) subcontract.
- The Dutta case involving more than $800,000 in overcharging on USAID contracts. The Photogrammetrics case that involved more than $500,000 of overcharges on major DOT road projects in Northern Virginia.
- Northrop Grumman paid $60 million in connection with defective pricing on a major DoD contract in Norfolk (Defense & Military, 2009).

These are just a few of the cases that involve contracting fraud. What these cases precipitate is the breeding ground for the need to further establish laws directed at controlling contract fraud.

B. Contracting Fraud is an Issue

An investigation of bribery at the Pentagon in 1988 led Congress to pass the Major Fraud Act of 1988, which created a new offense of procurement fraud for any Government contract fraud in excess of $1 million (18 USC § 1031, 2009). Those convicted of procurement fraud are subject to fines of up to $1 million or imprisonment for up to 10 years, or both. Several entities in the executive branch are responsible for combating procurement fraud. Nineteen Federal agencies have Inspectors General, and additional audit and investigation responsibilities are carried out by the Defense Contract Audit Agency (DCAA), the Department of Justice (DOJ), the United States Attorney's Office, and the Federal Bureau of Investigation (FBI). Targeted conduct such as defective

pricing, mischarging, bid collusion, and product substitutions are discussed in detail, as are bribes, gratuities, and conflicts of interest (Malarkey, 1989).

Following a review of the offenses of defective pricing; mischarging; bid collusion; product substitution; and bribes, gratuities, and conflicts of interest, focus turns to the variety of statutes under which the Federal Government prosecutes cases of procurement fraud, procedural developments, and industry self-governance as an approach to prevention. Recognition of the need for self-governance is an important step in reducing procurement fraud. Also needed is a determined effort to ensure that employees are familiar with these standards and are aware of their importance and effective systems of internal auditing and compliance reviews are implemented (Babcock et.al, 1991). The U.S. Government legislate a number of measures to detect, prosecute, and prevent Government contractor fraud. Because of the increased risk of exposure to criminal or civil sanctions, Government contracting corporations must become adept at detecting fraud committed by their employees and controlling its damage. Fraud in the pre-award stage can occur in the provision of false statements, during bidding and negotiations, in the submission of cost or pricing data under the Truth in Negotiations Act (10 USC § 2306), as kickbacks, and as a lack of procurement integrity. Criminal and civil false claims acts, fraud in cost accounting or certification of claims, violations of the Program Fraud Civil Remedies Act, or submission of unallowable costs are ways companies can defraud the Government during the actual contract performance. Government remedies for contract fraud are primarily access to a contractor's records, the ability to bring simultaneous

proceedings, and administrative suspension or disbarment. Contractors must take preventive and responsive measures both before and as a result of Government investigations (Otto, 1990).

C. More Help is Needed to Control Contracting Issues

Contract fraud investigations are tedious, sometimes taking years to complete. Provided is a citation from the General Accountability Office (GAO), who is the oversight organization for Congress to oversee and inspect Government agencies:

> "Because of the limited time available to conduct our work, we relied heavily on a review of GAO and DOD Office of the Inspector General (DOD IG) reports issued over the past 5 years (listed in app. I) supplemented by interviews with senior acquisition policy, general counsel, and investigative service officials at the Office of the Secretary of Defense level and within each of DOD's military departments. We also reviewed relevant studies prepared by or for DOD, the most notable of which is the report written by the Defense Science Board, a panel of high-level outside experts that conducts analyses and advises DOD's top leadership on such areas as scientific and technical issues and acquisition processes" (Contract Management, 2008, p. 1-2)

To prepare agents to handle the many aspects of economic crime, a demanding training program has been initiated with emphasis in contracting, logistics, and fraud investigation (Gracia, 2008). About 430 of 1,100 military agents are trained to work in some aspect of economic crime, and the number is on the rise (Levisohn, 2009). More than 200 of these specialize in economic crime cases. In fighting contracting fraud, however, some perceptions had to change within the DoD. One of these is that the military has no choice but to accept at least some amount of contractor fraud. Another is that stamping out

contractor fraud is someone else's responsibility. Perhaps one of the toughest perceptions to change is the notion that contractor fraud is a victimless crime. Economic crime (involving contracts) is not only a crime against the taxpayer, but against the soldier who depends on the equipment and goods the Government buys (Miles, 1989). Types of fraud include misappropriation of assets, understatement of liabilities or overstatement of assets, siphoning assets through transactions with affiliated companies, and kickbacks or other improper transactions. Collusion among officers, among employees, or with outsiders is the most common way of perpetrating or covering up fraud. Defense Contract Audit Agency (DCAA) is most concerned with internal controls related to costs of materials and services charged to the Government. Controls involve labor recording, purchasing, receiving, and accounting entries to transfer costs. Management should have an adequate accounting system and appropriate internal accounting controls on all transactions. When management is involved in the fraud, however, the auditor may have difficulty detecting it (Hotlines, 2008). The contract audit manual outlines DCAA's responsibility for detecting fraud. Internal controls related to electronic data processing include controls over access to equipment and data files, procedural controls, documentation procedures, and controls over input, processing, and output. Computer audit software is the most important tool available for detecting computer fraud. DCAA auditors use two such packages, as well as flowcharting, mapping, test data generators, tagging and tracing, integrated test facility, and system review. Reviews include items like a“[s]hould-cost review. “Should-cost reviews are a specialized from of cost

analysis. Should-cost reviews differ from traditional evaluation methods because they do not assume that a contractor's historical cost reflect efficient and economical operation" (FAR 15.407-4, 2008). System reviews should detect and report unscheduled runs, separation of duties, and program verification. Situations encountered by contract auditors include improper labor distribution, overcharges for materials, fraud in unit pricing, over-reimbursement of progress payments, and altered travel expense documents (Newman, 1978). On the surface, it appears that DCAA is one of the watch-dogs who identify contract fraud. However, DCAA lacks the ability to forecast contract fraud prior to it happening, thus preventing contract fraud from happening.

DCAA has discovered abuses through regular audits and reports from outside sources. Congress, Federal agencies, and professional auditors are concerned with improving internal controls to detect and discourage fraud, as evidenced in the foreign corrupt practices act and public law 95-452, in which the mission statement of the Inspector General (IG) states:

> "[T]o conduct and supervise audits and investigations relating to the programs and operations of the establishments…to provide leadership and coordination and recommend policies for activities designed...to promote economy, efficiency, and effectiveness in the administration of, and…to prevent and detect fraud and abuse in, such programs and operations; and…to provide a means for keeping the head of the establishment and the Congress fully and currently informed about problems and deficiencies relating to the administration of such programs and operations and the necessity for and progress of…corrective action; Internal auditing controls are particularly important where automatic data processing is employed" (Inspector General, 1978, p. 2).

No where does it mention how agencies like the IG or DCAA actually gather the data needed to identify fraud. It has been noted that many DCAA cases involve mischarged labor costs which cannot be detected unless internal controls are instantaneous and rigid. Since DCAA cannot examine every transaction of contractors, it must depend on evaluations of their internal control systems and monitor activities when weaknesses are discovered. Large companies should establish a permanent internal control audit staff before a substantial fraud occurs. Auditors also need training in areas of fraud detection, such as unusual transactions, concealed payments, consultants' fees, and company histories. Internal controls and detection training are useless unless an effective reporting system exists. The profession must insist that internal and external auditors be permitted to issue independent reports without fear of censure or reprisal (Nocera, 1980).

D. Lack of Control Over Contract Fraud

The U.S. Government is attempting to gain control of contract fraud, but many of these efforts do not address the discreteness of the problems associated with contract fraud. In fact, the House of Representatives Bill 5712 requires the Federal Acquisition Regulation (FAR) to require Federal contractors to provide timely notice to their contracting agency of any violations of Federal criminal law or overpayments received in connection with Federal contracts for over $5,000,000 and lasting more than 120 days for contracts performed inside or outside the U.S. The legislation requires these regulations to be incorporated into FAR within 180 days of the enactment of H.R. 5712 (Legislative Digest 2008).

The Congressional Budget Office estimates that implementing H.R. 5712 would have no significant impact on agencies' spending (Congressional Budget, 2008). If there is no control over spending, then there is no control over contract fraud. Within the DoD, as budgets continue to be strained by smaller appropriations the Army, Navy, Air Force and Marines continue to hone domination of the pocket book by emphasizing the "Fiscal Triad" providing critical synchronization between resource management, finance, and contracting operations in order to "get the most bang for the buck" (FM 1-06).

The most recent congelation of the fiscal triad was the Secretary of the Army establishing an independent Commission on Army Acquisition and Program Management in Expeditionary Operations to review the lessons learned in recent operations and provides forward-looking recommendations to ensure that future military operations achieve greater effectiveness, efficiency, and transparency (Urgent, 2007). The Commission assessed process (including internal controls), personnel, organization, training, policy and regulation, as well as explored legislative solutions, to ensure that the Army is properly equipped for future expeditionary operations

The Commission found that:

- The expeditionary environment requires more trained and experienced military officers and non-commissioned officers (NCOs). Yet, only 3 percent of Army contracting personnel are active duty military and there are no longer any Army contracting career General Officer (GO) positions.
- The Army's acquisition workforce is not adequately staffed, trained, structured, or empowered to meet the Army needs of the 21st Century deployed war fighters. Only 56 percent of the military officers and 53

percent of the civilians in the contracting career field are certified for their current positions.

- Notwithstanding a seven-fold workload increase and greater complexity of contracting, the Institutional Army is not supporting this key capability.
- Notwithstanding there being almost as many contractor personnel in the Kuwait/Iraq/Afghanistan Theater as there are U.S. military, the Operational Army does not yet recognize the impact of contracting and contractors in expeditionary operations and on mission success.
- What should be a core competence—contracting (from requirements definition, through contract management, to contract closeout)—is treated as an operational and institutional side issue (Urgent Reform, 2007).

The Army, one of the largest sectors within the DoD not only realizes that there is a lack of experience, but that if the Army does not receive relief, issues the concern DoD contract fraud will only increase. This is due to the fact that there is no regulatory agency within the U.S. Army to identify contract fraud issues. The majority of the support the Army receives comes from the IG, GAO, DCMA or DCAA which have already been identifies as lacking the ability to control DoD contract fraud.

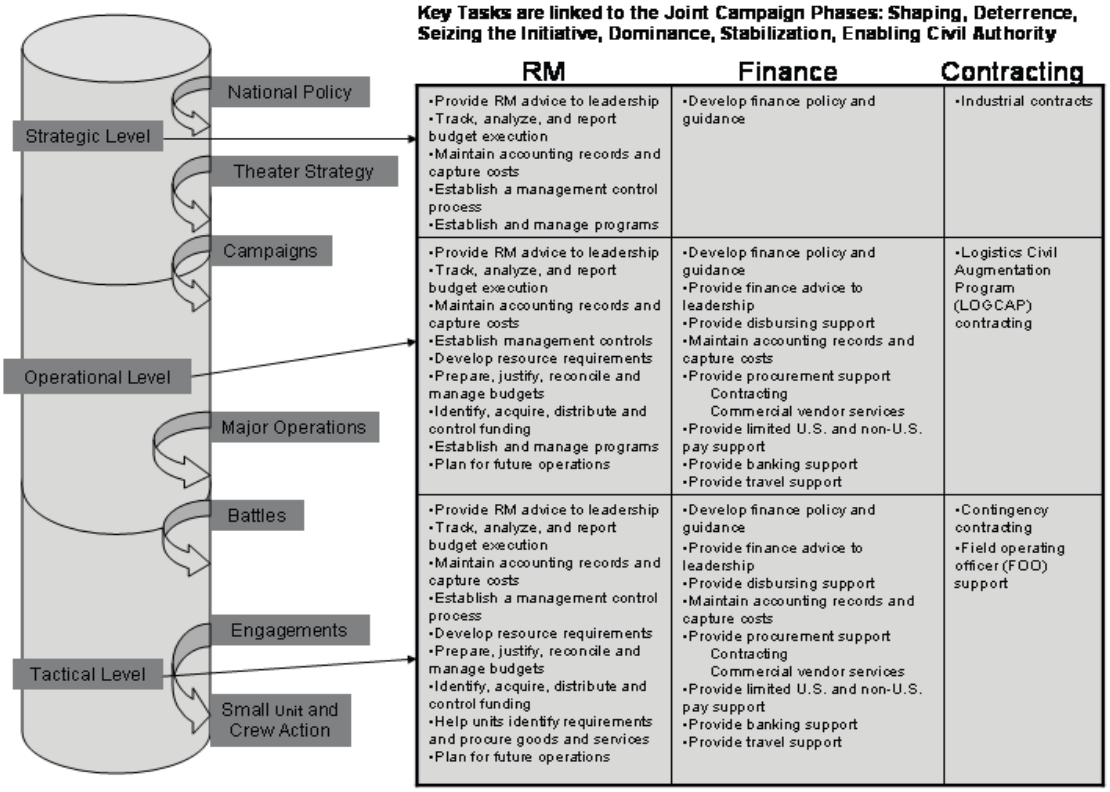


Figure 1. Presents the three different levels from tactical, operational, and strategic levels of operations of a fiscal triad (FM 1-06, p 14).

Figure 1 represents a stoiciometeric application of the fiscal triad which comprises a system that fulfills the full spectrum of required fiscal support, from acquisition of funds to expenditure of funds. The requirements are fulfilled by the following steps:

• The commander/staff validates each requirement.

• Resource management certifies the funds.

• The item or service is acquired by contracting.

• Finance disburses the funds.

Each element of the triad is interdependent, and works closely with the other elements to obtain products or services to meet the commander's needs.

Reconciliation of requirements is a joint effort and must be synchronized within the Triad (FM 1-06, 14). Conceptually, the Fiscal Triad is utilized contiguously in the U.S. Air Force and U.S. Navy under the same concept of operations. The utilization of the fiscal triad as a system that conjoined facilitates the ability to identify DoD contract fraud is best extrapolated in the theoretical framework of earned value.

III. THEORETICAL FRAMEWORK: THE APPLICATION OF EARNED VALUE, GAME THEORY, BAYESIAN STATISTICS, AND CONTRACT THEORY

This section provides the necessary theoretical framework that outlines the brief history of earned value, the body of a contract that facilitates Earned Value, the theoretical relevance of using earned value management on all performance related contracts is a five tiered ordinal approach, as an illustrative explanation of Earned Value. Lastly, how Game Theory provides credence to *why* a contractor would commit fraud against the Government.

A. Earned Value a Brief History

The genesis of EVM was in industrial manufacturing at the turn of the 20th century, but the idea took root in the United States Department of Defense in the 1960s. The original concept was called PERT/COST, but it was considered overly burdensome (not very adaptable) by contractors who were mandated to use it, and many variations of it began to proliferate among various procurement programs. In 1967, the DoD established a criterion-based approach, using a set of 35 criteria, called the Cost/Schedule Control Systems Criteria (C/SCSC). With C/SCSC, the data must be aggregated, filtered, analyzed, or otherwise tailored to the decision problem and to the decision-maker to transform it into information (Christensen, 1989). In 1970s and early 1980s, a subculture of C/SCSC analysis grew, but the technique was often ignored or even actively resisted by project managers in both Government and industry. C/SCSC was often considered a financial control tool that could be delegated to analytical specialists.

In the late 1980s and early 1990s, EVM emerged as a project management methodology to be understood and used by managers and executives, not just EVM specialists. In 1989, EVM leadership was elevated to the Undersecretary of Defense for Acquisition, thus making EVM an essential element of program management and procurement. In 1991, Secretary of Defense Dick Cheney canceled the Navy A-12 Avenger II Program due to performance problems detected by EVM (Holweg, 2006). This demonstrated conclusively that EVM mattered to secretary-level leadership. In the 1990s, many U.S. Government regulations were eliminated or streamlined and EVM not only survived the acquisition reform movement, but became strongly associated with the acquisition reform movement itself. Most notably, from 1995 to 1998, ownership of EVM criteria (reduced to 32) was transferred to industry by adoption of ANSI EIA 748-A standard. The Federal Acquisition Regulations, usually referred to as the FAR (or sometimes F.A.R.), are a series of regulations issued by the U.S. Federal Government that concern the requirements of contractors for selling to the Government, the terms under which the Government obtains ownership, title and control of all cost issues.

EVM has been adopted by the National Aeronautics and Space Administration, United States Department of Energy and other technology-related agencies (McKinlay). The construction industry is an early commercial adopter of EVM. Closer integration of EVM with project management profession accelerated in the 1990s.

The United States Office of Management and Budget began to mandate the use of EVM across all Government agencies and for the first time, for certain internally-managed projects (not just for contractors). OMB Circular A-11 states "EVMS is to be applied to both Government and contractor efforts and regardless of contract type (OMB Circular A-11). EVM also received greater attention by publicly traded companies in response to the Sarbanes-Oxley Act of 2002. AACE International now offers an Earned Value Professional (EVP) certification based on the ANSI/EIA 748-A standard (Dhaliwal, 2009). The United States Department of Energy (DOE) is a Cabinet-level department of the United States Government responsible for energy policy and nuclear safety.

The Office of Management and Budget (OMB) is a body within the Executive Office of the President of the United States (EOP) which is tasked with coordinating United States Federal agencies.

The Sarbanes-Oxley Act of 2002 (107 H.R. 3763), signed into law on 30 July 2002, is considered the most significant change to Federal securities laws in the United States since the New Deal.

B. The Body of a Contract that Facilitates Earned Value.

The scope of the argument here is concerned with specifically "performance based contract types". Performance-based acquisition (or contracts) means structuring all aspects of an acquisition around the purpose of the work to be performed as opposed to either the manner by which the work is to be performed or broad and imprecise statements of work (FAR 37.101). The legal definition of a contract is a promise or set of promises which, if breached,

the law will remedy; the law will recognize a duty to carry out the promise (Merriam, 2008). A contract spells out the duties and responsibilities of each party to the contract. If a party fails to perform, the law will step in and provide to the party that is harmed a remedy. The definition of a contract recognizes the duty of both parties and thus, the court will fashion an appropriate remedy for the failure. Contracts may consist of a single promise by one person to another or it may involve any number of persons and any number of promises (Introduction, 2008).

The Data Item Description (DID) provides the guidance for exactly what the roles and responsibilities of the parties and the schedule as to the frequency of contract data review as well as specific data requirements, which may include the format of a report used to display the data (Data, 2009).

Prior to being able to extract data a discrete structure is put into place that allows for the calculation of work what is known as a Work breakdown Structure (WBS). The Program WBS is intended to structurally illustrate a clear understanding of the technical objectives and the end item(s) or end product(s) of the work to be performed by the contractor. In order to use the Program WBS as a valuable framework for the technical objectives, it must be product oriented. Its elements should represent identifiable work products, whether they are equipment, data, or related service products. A WBS is a product structure, not an organizational structure, providing the complete definition of the work to be performed by all participants and the required interfaces between them (Department, 2008). Policy guidance WBS structures are outlined in Department

of Defense Handbook Work Breakdown Structures (Department, 2008). There are no officially sanctioned methods for how to construct a WBS although; the Defense Federal Acquisition Supplement provides additional guidance on *what* must be in the WBS. Within a contract, the WBS represents job descriptions where work is actually performed. The contract itself should contain, at a minimum, a Work Breakdown Structure (WBS), a WBS dictionary, product definition or Statement of Work (SOW), a SOW/WBS cross-reference, a CLIN/WBS cross-reference, proposal instructions and assumptions, a responsibility assignment matrix (RAM) (Buonanno, 1999). As parties agree upon terms and conditions within a contract, the WBS is agreed upon as the means to collect cost on the contract. The WBS construct is based upon Contract Line Items (CLINS). Defense Federal Acquisitions Regulations Supplement (DFARS) subpart 204.71 outline(s) the [c]riteria for establishing "([c]ontract line items) and states: [c]ontracts shall identify the items or services to be acquired as separate contract line items *unless* it is not feasible to do so." The language used in (DFARS 204.7103-1, 2008) *unless* is one area where contractors use loopholes in order to manipulate cost on a contract as will be shown later (Defense, 2008). Policy Guidance and Instruction states that for established the numbering procedures.

> (a) Contract line items shall consist of four numeric digits 0001 through 9999. Do not use numbers beyond 9999. Within a given contract, the item numbers shall be sequential but need not be consecutive.
> (b) The contract line item number shall be the same as the solicitation line item number unless

there is a valid reason for using different numbers.
(c) Once a contract line item number has been assigned, it shall not be assigned to another, different, contract line item in the same contract (PGI 204.7103-2).

As work is completed on a contract, each CLIN has "[s]eparate identifiable…contract line items that must be identified separately from any other items or services on the contract (DFARS, 204.7103-1, 2008). As work is performed on a contract, effort is earned. The word *earned* is by definition to receive as return for effort and especially for work done or services rendered. The definition of *value* is a numerical quantity that is assigned or is determined by calculation or measurement (Merriam, 2003). Thus, earned value (EV) is the output of the process of the system which extracts data employing the definitions above to earn, and the value associated with what is earned. Earned Value Management (EVM) is a project management technique for measuring project progress in an objective manner. EVM has the unique ability to combine measurements of scope, schedule, and cost in a single integrated system. Earned Value management System (EVMS) is an actual integrated systematic approach to compile data. When properly applied, EVM provides an early warning of performance problems. Additionally, EVM promises to improve the definition of project scope, prevent scope creep, communicate objective progress to stakeholders, and keep the project team focused on achieving progress (Wikipedia, *EVM*). The data produced from an EVMS results in a Cost Performance Report (CPR) which is reviewed on a routine basis (as outlined by the DID and contract) to assess the contracts performance as a whole. This CPR

consists of five formats containing data for measuring contractors' cost and schedule performance on Department of Defense (DoD) acquisition contracts. Format 1 provides data to measure cost and schedule performance by product-oriented Work Breakdown Structure (WBS) elements, the hardware, software, and services the Government is buying. Format 2 provides the same data by the contractor's organization (functional or Integrated Product Team (IPT) structure). Format 3 provides the budget baseline plan against which performance is measured. Format 4 provides staffing forecasts for correlation with the budget plan and cost estimates. Format 5 is a narrative report used to explain significant cost and schedule variances and other identified contract problems and topics.

CPR data is used by DoD system managers to: (1) integrate cost and schedule performance data with technical performance measures, (2) identify the magnitude and impact of actual and potential problem areas causing significant cost and schedule variances, and (3) provide valid, timely program status information to higher management (Watts, 2006). Once the contract structure is established and a contract is ready for operational execution, as a contract is executed it is reviewed routinely to ensure that the contract is being executed as it was agreed upon. The contract is reviewed subjectively and objectively as to how the contract is performing which is measured against criteria established by the parties prior to contract execution. The criterion is used as means to assess contracts performance.

There are a variety of commercial contracts substantiating how earned value is implemented where cost over runs have resulted in not only contract

fraud, but abuse of contract power (Graves, 2008). The ability to manipulate earned value is via the content of what makes up how the data is extracted. Conceptually, all EV is developed from raw data output from a contractor's performance.

The application of CLINs and the WBS are rationale of how information is derived within a contract. The data explained in an Earned Value Gold Card provides a visual application of EV. All earned value data is rationalized using the five formats within the CPR. And, once all five formats are rationalized during a program management review, a program's cost and efficiency are explained via EV metrics (Rossi, 2004). As these criterions are met, the validity of manipulation of data becomes implicit.

The numerical data used in earned value comes from a work breakdown structure (WBS). As (DFARS 203.7103, 2008) is enforced, the WBS represents work packages and sub-manufacturing roles. Rationally, all child relationship should roll up to each parent, however, slight deviations to cost allocations result in major dollars as the efforts are rolled-up. In order to provide clarity to this issue, Figure 2 represents an image of what a WBS structure could look like for a project.

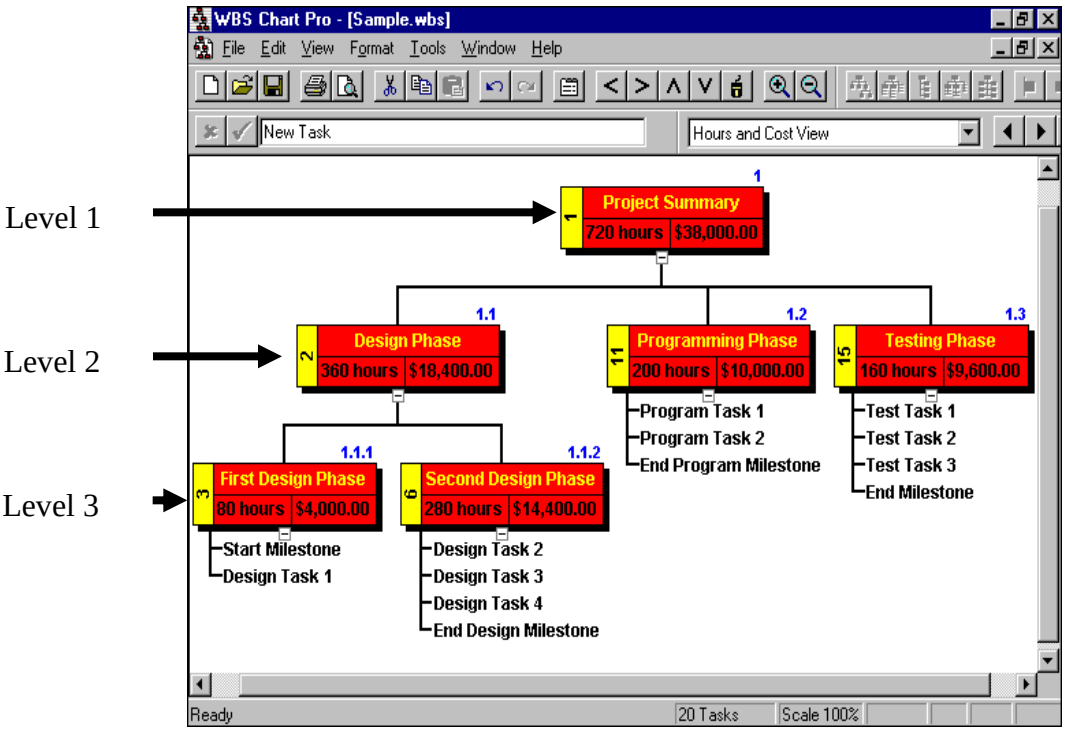


Figure 2. What a Work Break Down Structure (WBS) might look like showing the different levels of a WBS (Work, 2009).

The number one (1) in the WBS represents the first or parent element which here is the "Project Summary" and is level I of the WBS. The child or children that fall under a parent are represented as 1.1, 1.2, and 1.3 which represent level II of the WBS; these elements are subordinate to CLIN 1. Likewise, elements 1.1.1 and 1.1.2 represent the children of the parent 1.1 where 1.1.1 and 1.1.2 represent level III of the WBS. Therefore, the rationale application here is that there is a corresponding relationship between the parent and child where all children are subordinate to each parent. The parent child relationship is designed to illustrate the relationship between activities and correspondent hierarchical activities.

There are various and unlimited means to illustrate a WBS. On a contract in order to capture cost on a CPR, the method in Figure X illustrates how codes are used to identify efforts on a contract.

Table 1

The provided CODE captures to level three in a WBS

Level 1	1	Project Summary
Level 2	1.1	Design Phase
Level 3	1.1.1	First Design Phase
Level 3	1.1.2	Second Design Phase
Level 2	1.2	Programming Phase
Level 1	2	Testing Phase
Level 2	2.1	First Test Phase

The examples in Figure 1 and 2 merely represent what a WBS structure could look like. Most contracts for major acquisitions have hundreds of CLINS and work packages. Therefore, on any work efforts above 9999, the efforts are rolled up into the next higher parent of the numbering system. As work efforts are rolled up, the level of detail to the origination of effort on CLINS is lost due to collective grouping of cost allocations. Or more simply, children are rolled up into parent CLINs.

As cost is allocated according to the WBS structure, the numerical codes associated with the CLIN must be represented as prescribed by (DFARS 204. 7103-2, 2008). Complications begin when the contractor possesses a WBS used to collect cost, and the Government possesses a WBS for identifying the methods used to collect cost from the contractor yet the two WBS structures do not line up exactly. These two WBS structures can be separate and distinct, yet they attempt

to quantify the same cost allocation. Often times, the Government will adopt the cost methods outlined by the contractor's WBS as the means to collect and identify cost. So, in the provided example from Figure 2, a 1, 1.1, 1.1.1 method is used to identify the parent child relationship of an effort. However, (DFARS 204. 7103-2, 2008) requires a CLIN structure of 1-9999. The question arises, does level 1 according to the Governments cost methods correspond with the contractor's level 1? The answer is maybe. If the efforts according both WBS structure are allocated for work effort associated with level 1, then maybe the efforts are the same. If the contractor does work effort *X* on CLIN 1, then the Government should recognize that *X* is in fact being accomplished. However, if effort *X* also has some effort *Y* associated with it, then is the contractor really only allocating monies solely to effort *X*, or are they additionally allocating monies (cost) to effort *Y*? The answer is yes, the contractor can and does attempt to allocate effort *Y* on an effort *X* CLIN. Misallocation is one area that affords for misrepresentation of effort. The usage of Earned value provides the means for detecting variances out of tolerance with the contracts cost and schedule.

C. Illustrative Explanation of Earned Value

Introduction: Earned value is a management technique that relates resource planning to schedules and to technical cost and schedule requirements. All work is planned, budgeted, and scheduled in time-phased "planned value" increments constituting a cost and schedule measurement baseline. There are two major objectives of an earned value system: to encourage contractors to use effective internal cost and schedule management control systems; and to permit

the customer to be able to rely on timely data produced by those systems for determining product-oriented contract status.

Baseline: The baseline plan in Table 1 shows that 6 work units (A-F) would be completed at a cost of $100 for the period covered by this report.

Table 2

Baseline Plan Work Units

	A	B	C	D	E	F	Total
Planned value ($)	10	15	10	25	20	20	100

Schedule variance: As work is performed, it is "earned" on the same basis as it was planned, in dollars or other quantifiable units such as labor hours. Planned value compared with earned value measures the dollar volume of work planned vs. the equivalent dollar volume of work accomplished. Any difference is called a schedule variance. In contrast to what was planned, Table 2 shows that work unit D was not completed and work unit F was never started, or $35 of the planned work was not accomplished. As a result, the schedule variance shows that 35 percent of the work planned for this period was not done.

Table 3

Schedule Variance Work Units

	A	B	C	D	E	F	Total
Planned value ($)	10	15	10	25	20	20	100
Earned value ($)	10	15	10	10	20	-	65
Schedule variance	0	0	0	-15	0	-20	-35 = -35%

Cost variance: Earned value compared with the actual cost incurred (from contractor accounting systems) for the work performed provides an objective measure of planned and actual cost. Any difference is called a cost variance. A negative variance means more money was spent for the work accomplished than was planned. Table 3 shows the calculation of cost variance. The work performed was planned to cost $65 and actually cost $91. The cost variance is 40 percent.

Table 4

Cost Variance Work Units

	A	B	C	D	E	F	Total
Earned value ($)	10	15	10	10	20	-	65
Actual cost ($)	9	22	8	30	22	-	91
Cost variance	1	-7	2	-20	-2	0	-26 = -40%

Spend comparison: The typical spend comparison approach, whereby contractors report actual expenditures against planned expenditures is not related to the work that was accomplished. Table 4 shows a simple comparison of planned and actual spending, which is unrelated to work performed and therefore not a useful comparison. The fact that the total amount spent was $9 less than planned for this period is not useful without the comparisons with work accomplished.

Table 5

Spend Comparison Approach Work Units

	A	B	C	D	E	F	Total
Planned spend ($)	10	15	10	25	20	20	100
Actual spend ($)	9	22	8	30	22	-	91
Variance	1	-7	2	-5	-2	20	9 = 9%

Use of Earned Value Data: The benefits to project management of the earned value approach come from the disciplined planning conducted and the availability of metrics which show real variances from plan in order to generate necessary corrective actions (Illustrative, 2009).

Since Earned Value uses statistical methods in order to explain the activity of a contracts performance. These statistical methods are based on percentages of effort complete as represented by a (.) rather than (%); mathematically the results are the same. Therefore, .99 is equal to 99%. With earned value, anything greater than 1 is over performing and anything less than 1 is under performing. As the

statistics are plotted on a graph, the nature of cost vs. time is better understood.

Cost represents the *X* axes and Time represents the *Y* axes. Thus, as time moves along the *Y* axes costs tend to increase on the *X* axes. Figure 3 represents typical program where cost are high (usually during research and development) and then cost tend to level out towards to middle of a project and towards the end of a contract, cost rise again in order to complete the project.

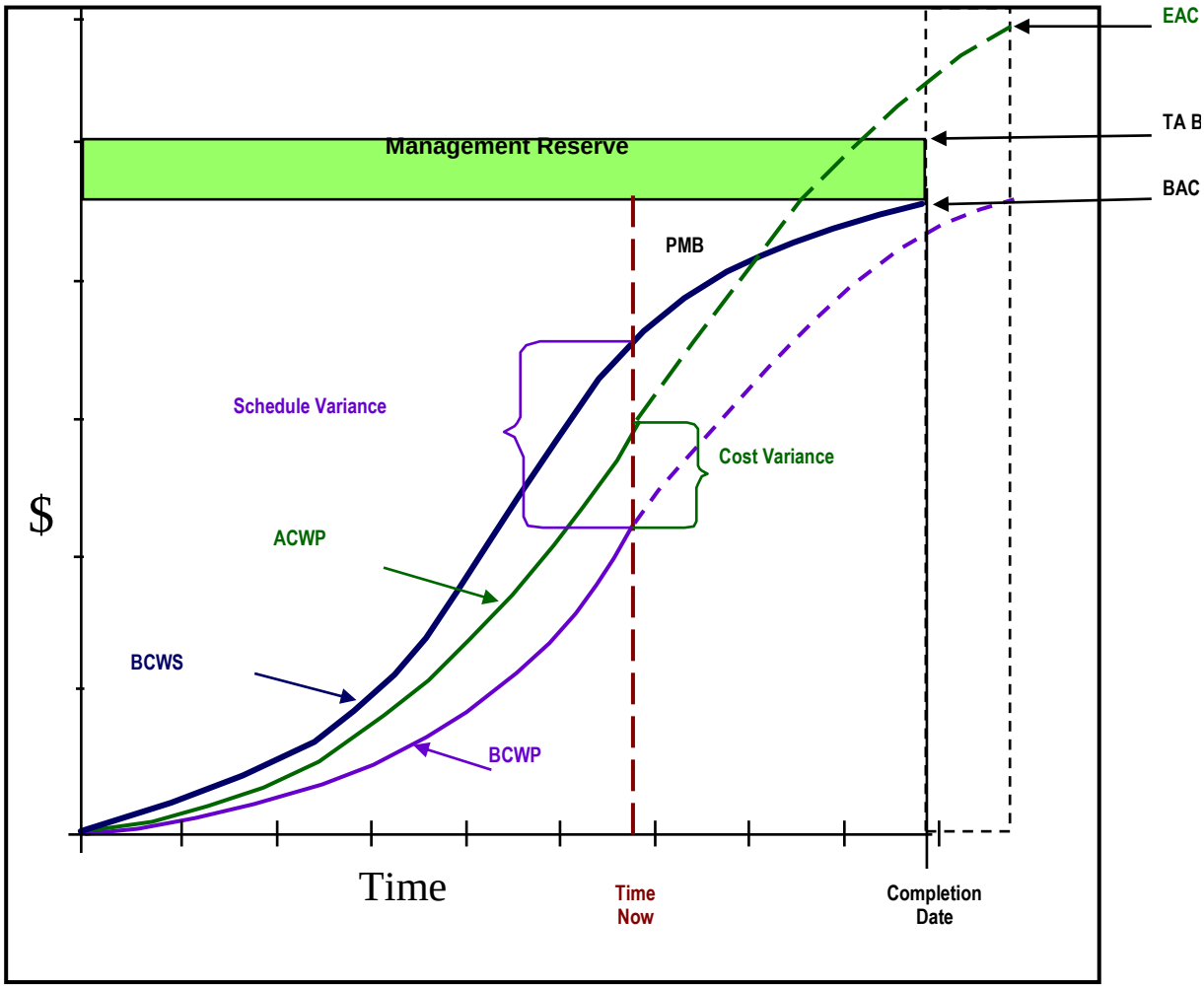
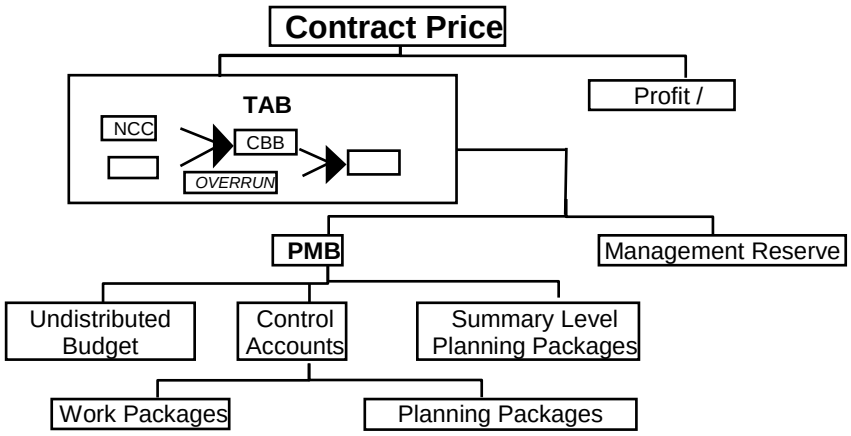


Figure 3. Presents what a program or project would look like statistically; employing earned value management techniques to identify cost and schedule data on a Cartesian plane depicting cost as the *Y* axis range and *X* axis as schedule activities.

Figure 4. represents the definitions used to explain the definition of those elements in Figure 2: also called an Earned Value Gold Card



TERMINOLOGY

NCC	Negotiated Contract Cost	Contract price less profit / fee(s)	
AUW	Authorized Unpriced Work	Work contractually approved, but not yet negotiated / definitized	
CBB	Contract Budget Base	Sum of NCC and AUW	
OTB	Over Target Baseline	Sum of CBB and recognized overrun	
TAB	Total Allocated Budget	Sum of all budgets for work on contract = NCC, CBB, or OTB	
BAC	Budget At Completion	Total budget for total contract thru any given level	
PMB	Performance Measurement	Baseline Contract time-phased budget plan	
MR	Management Reserve	Budget withheld by Ktr PM for unknowns / risk management	
UB	Undistributed Budget	Broadly defined activities not yet distributed to CAs	
CA	Control Account	Lowest CWBS element assigned to a single focal point to plan & control scope / schedule / budget	
WP	Work Package	Near-term, detail-planned activities within a CA	
PP	Planning Package	Far-term CA activities not yet defined into WPs	
BCWS	Budgeted Cost for Work Scheduled	Value of work planned to be accomplished	= PLANNED VALUE
BCWP	Budgeted Cost for Work Performed	Value of work accomplished	= EARNED VALUE
ACWP	Actual Cost of Work Performed	Cost of work accomplished	= ACTUAL COST
EAC	Estimate At Completion Estimate of total cost for total contract thru any given level; may be generated by Ktr, PMO, DCMA, etc.		= **$EAC_{Ktr\ /\ PMO\ /\ DCMA}$**
LRE	Latest Revised Estimate Ktr's EAC or EAC_{Ktr}		
SLPP	Summary Level Planning Package	Far-term activities not yet defined into CAs	
TCPI	To Complete Performance Index	Efficiency needed from 'time now' to achieve an EAC	

EVM POLICY: DoDI 5000.2, Table E3.T2 . EVMS in accordance with ANSI/EIA-748 is required for cost or incentive contracts, subcontracts, intra-Government work agreements, & other agreements valued ≥ $20M (Then-Yr $). EVMS contracts ≥ $50M (TY $) require that the EVM system be formally validated by the cognizant contracting officer. Additional Guidance in Defense Acquisition Guidebook and the Earned Value Management Implementation Guide (EVMIG). EVMS is discouraged on Firm-Fixed Price, Level of Effort, & Time & Material efforts regardless of cost.

EVM CONTRACTING REQUIREMENTS:

Non-DoD FAR Clauses – Solicitation – 52.234-2 (Pre-Award IBR) or 52.234-3 (Post Award IBR)
– Solicitation & Contract – 52.234-4

DoD(≥ $20M) DFAR Clauses - 252.234-7001 for solicitations and 252.234-7002 for solicitations & contracts
Contract Performance Report – DI-MGMT-81466A * 5 Formats (WBS, Organization, Baseline, Staffing & Explanation)
Integrated Master Schedule – DI-MGMT-81650 * (Mandatory for DoD EVMS contracts)
Integrated Baseline Review (IBR) - Mandatory for all EVMS contracts

EVM Home Page = https://acc.dau.mil/evm eMail Address: EVM.dau@dau.mil
DAU POC: (703) 805-5259 (DSN 655)
Revised April 2008

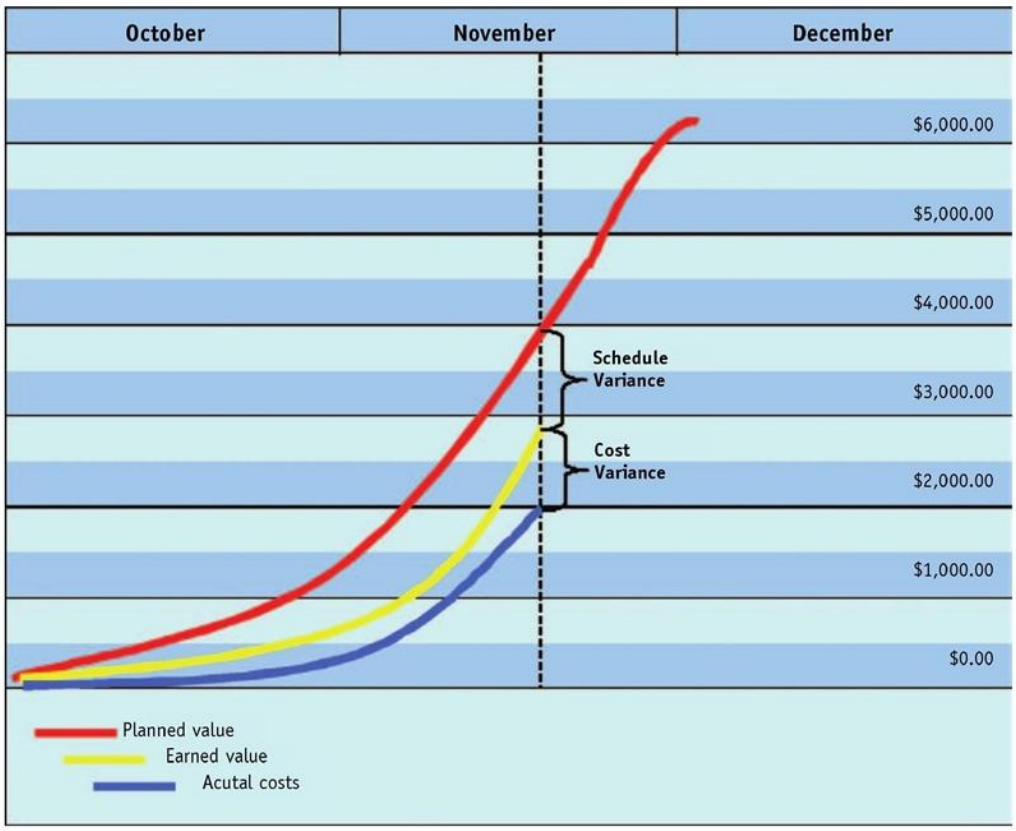


Figure 5. Presents a depiction of cost and schedule used during business management reviews to identifying performance where showing schedule as a red line, value is earned as a yellow line, and cost as a blue line.

In an ideal setting, if true earned value is earned on a contract, there would never be deviation of cost or schedule of a performance-based contract in an idealized perfect contract setting; cost would always be on schedule. However, as cost and schedule do deviate when graphically depicted as earned value metrics; the variance is observable on a Cartesian plane (see Fig. 4). "Performance-base contracting" means structuring all aspects of an acquisition around the purpose of the work to be performed as opposed to either the manner by which the work is to be performed or broad and imprecise statements of work (FAR 37.101).

Contract fraud arises when a contractor applies the fundamentals of earned value in order to achieve better results than actually performed. The contractor manipulates EV data in order to increase profit. Contract fraud occurs when the contractor provides false data, data that is misallocated, data that is egregious, or data that is misleading from the intent of the contract (Pasztor, 1994).

As parties enter into a contract, each party wants to achieve the maximum result of the returns on the risk associated with entering into a contract. It is however plausible that one party in their strategy creates actions that favor their position over their opponent. These actions can and do result in criminal actions. The reasoning to *why* a contractor would defraud the Government in a contract is provided in Game Theory, Bayesian Statistics, and Contract Theory (Brams, 1983).

D. Game Theory

The application of Game Theory is used in order to validate the logic in the application that contractors will choose to commit crime vs. not commit crime. Game Theory aims to help understand situations in which decision-makers interact and produce results in an ordinal fashion (Osborne, 2004). Game theory is the study of the ways in which *strategic interactions* among *rational players* produce *outcomes* with respect to the *preferences* (or *utilities*) of those players, none of which might have been intended by any of them (Game, 2009). A contract represents the reason for strategic interactions and the rational players represent a contractor and the Government. No other players will be mentioned.

Each player presents actions that result in outcomes. As players engage in

a contract, the contractor's objective is profit; the Government's objective is keeping the contract on cost and schedule without exceeding the original contract price. Profit is the excess of returns over expenditure in a transaction or series of transactions (Merriam, 2008). Prior to delving into Game Theory, a base line must be established. This base line ideologically called Nash equilibrium, named after John Nash, is a set of strategies, one for each player; such that no player has incentive to unilaterally change her action. Players are in equilibrium if a change in strategies by any one of them would lead that player to earn less than if she remained with her current strategy. For games in which players randomize (mixed strategies), the *expected* or average payoff must be at least as large as that obtainable by any other strategy (Nash, 2008). With contract fraud, as a CPR is reviewed, and numbers are inevitably rolled up, efforts at lower tiers of a CLIN are absorbed under a parent CLIN according to the WBS. Therefore, Nash Equilibrium seeks to explain the strategy of the Government that assumes the contract is on cost and schedule unless a variance is identified. Once a variance is identified, the resultant action would be for the Government to alter its natural strategy to make corrections to the strategy which results in an imbalance to the Nash Equilibrium. The contractor can and will alter their strategy in order to direct efforts outside of a Nash Equilibrium as the base line in order to achieve profit. Nash Equilibrium represents a significant philosophical rationalization that creates the beginning of the true application of Game Theory. The actions of both the contractor and the Government correspond to steady states of an idealized situation in which each player in the game represents the actions of the whole.

This notion of steady state allows the players' choices to vary, as long as the patterns of choices remain constant. Once wither player chooses to alter their strategy, they in turn deviate from the Nash Equilibrium. The only way that a Nash Equilibrium can be achieved is if no player has an alternative strategy that increases the payoff given the other players strategy. The payoff for the contractor is profit and the payoff for the Government is to keep the contract on cost and schedule. As with any strategic game there must be three elements:

1. a set of players
2. for each player, a set of actions
3. for each player, preferences over the set of action profiles.

The payoff for each player, the contractor and the Government result in monetary benefits. Therefore, it should be said that the payoff for each player is money. The situation of a contract may be modeled as a strategic game:

Players Contractor, Government

Actions Each player's set of actions is {no contract deviation, contract deviation}

Preferences Player 1 ordering of the action profiles. From best to worst, is (contract deviation, no contract deviation) (Player 1 deviates the contract and Player 2 does not deviate the contract), (no contract deviation, no contract deviation) (Player 1 receives payoff of 1), (contract deviation, contract deviation) (Player 1 receives 1/2 payoff), (no contract deviation, contract deviation) (Player 1 receives 0 payoff), Player 2 ordering is (no contract deviation, deviation), (no

contract deviation, no contract deviation), contract deviation, contract deviation), (contract deviation, no contract deviation).

This type of game can be represented in a table. First, the payoff functions represent the players preference orderings. For player 1 the function u_1 (contract deviation, no contract deviation) = 3, u_1 (no contract deviation, no contract deviation) = 2, u_1 (contract deviation, contract deviation) =1, and u_1 (no contract deviation, contract deviation) = 0. For Player 2 the function u_2 for which u_2 (no contract deviation, contract deviation) = 3, u_2 (no contract deviation, no contract deviation) = 2, u_2 (contract deviation, contract deviation) = 1, and u_2 (contract deviation, no contract deviation) = 0 Using these representations, the game is illustrated in Figure X. In this figure the two rows correspond to the two possible actions of player 1, and the two columns corresponds to the two possible actions of player 2, and the number in each box are the players payoffs to the action profile to which the box corresponds, with player 1's payoff listed first. Table 6. Matrix of a simple game involving the GOVERNMENT and a CONTRACTOR

		GOVERNMENT	
		No contract deviation	Contract deviation
CONTRACTOR	No contract deviation	2,2	0,3
	Contract deviation	3,0	1,1

This model represents a situation where there are gains from cooperation (each player prefers that both players choose no contract deviation rather than both players choosing contract deviation. In this example, each player where No

contract deviation corresponds to Q and contract deviation corresponds to R, player 1 prefers (R,Q) to (R,R) to (Q,Q) to (Q,R), and player 2 prefers (Q,R) to (Q,Q) to (R,R) to (R,Q). Thus it is ultimately better for players to cooperate and no deviate from the contract, however, it still substantiates that the payoff for the contractor is still in the contractors favor in order to achieve a greater payoff from the Government. The Government's payoff is incentivized by no contract deviation where the payoff to simply maintain the position and to not deviate from the contract provides the greatest payoff. The illustration substantiates that it is still better for the contractor to deviate from the contract. In any game such as the one provided the best action for any given player depends, in general, on the other players' actions. So, when choosing an action a player must have in mind the actions the other player will choose. That is, the player must form a *belief* about the other players' actions (Martin, 2004). The answer to *why* a contractor would choose to commit contract fraud is that Game Theory substantiates that given the profile and actions of a player; it would be ultimately a higher payoff function for the contractor to choose contract deviation, rather than no contract deviation. The cooperativeness of Game Theory suggests that cooperation increases the pay off function, but the relationship could suffer if the greatest payoff function is chosen.

E. Bayesian Statistics

It is Bayesian Statistics that correlates earned value with contract fraud. The premise of Bayesian statistics (within the context of life data analysis) is to incorporate prior knowledge, along with a given set of current observations, in

order to make statistical inferences. The prior information could come from operational or observational data, from previous comparable experiments or from engineering knowledge. This type of analysis can be particularly useful when there is limited test data for a given design or failure mode but there is a strong prior understanding of the failure rate behavior for that design or mode. By incorporating prior information about the parameter(s), a posterior distribution for the parameter(s) can be obtained and inferences on the model parameters and their functions can be made (Bayesian, 2008).

When there is limited test data for a set of *actions* from Game Theory, Bayesian Statistics provides the framework for combining prior information with sample data. In this reference, Bayes's rule for combining prior information on the assumed distribution's parameter(s) θ with sample data in order to make inferences based on the model. The prior knowledge about the parameter(s) is expressed in terms of a *pdf* $f(\theta)$, called the prior distribution. The posterior distribution of θ given the sample data, using Bayes rule, provides the updated information about the parameters θ. This is expressed with the following posterior:

$$f(\theta|Data) = \frac{L(Data|\theta)\varphi(\theta)}{\int_{\zeta} L(Data|\theta)\varphi(\theta)d\theta}$$

where:

- θ is a vector of the parameters of the chosen distribution,
- ζ is the range of θ,
- $L(Data|\theta)$ is the likelihood function based on the chosen distribution and data,
- $f(\theta)$ is the prior distribution for each of the parameters.

The most general explanation for the equation is that the likely hood of the contractor choosing to commit contract fraud is based on the parameters given by the contract. If the contractor has not achieved the obligations of the parameters of the contract, then he will not fulfill the obligations of the contract. This is the reason why it is better for a contractor to commit fraud, because the parameter is defined by the schedule. If the contractor cannot achieve the contractual obligations according to the schedule, then he must choose to commit contract deviation in order to maintain good standing with the Government. A contractor has a finite ability to achieve payoff within a contract, this is given by the function of the schedule. According to the contracts terms and conditions, a Cost Performance Report is delivered to the Government from the contractor. The contractor provides the Government with the charges of how many hours were attributed to an effort. All efforts are correspondent with the Work Breakdown Structure. This is a good faith deliverable item from the contractor to the Government, so any variances must be explained. Given the line of reasoning from Bayesian Statistics, and the theoretical application of earned value, it is highly improbable that a contractor can make up time in order to achieve the maximum profit if the contract is currently behind schedule. Bayesian statistics substantiates that it should be believed that if a contractor is somehow overachieving, that this over achievement is contract deviation. Bayesian Statistics validates that prior relations solidify the argument that a contractor cannot make up time in order to achieve milestones according to EV methodologies. The question then arises what if the contractor is not behind

schedule how then is the argument validated? The posterior probability of a random event or an uncertain proposition is the conditional probability that is assigned after the relevant evidence is taken into account.

The posterior probability distribution of one random variable given the value of another can be calculated with Bayes' theorem by multiplying the prior probability distribution by the likelihood function, and then dividing by the normalizing constant, as follows:

$$f_{X|Y=y}(x) = \frac{f_X(x) L_{X|Y=y}(x)}{\int_{-\infty}^{\infty} f_X(x) L_{X|Y=y}(x)\, dx}$$

gives the posterior probability density function for a random variable *X* given the data $Y = y$, where:

> $f_X(x)$ is the prior density of *X*,
> $L_{x|y=y}(x) = f_{x|y=}{}_x(y)$ is the likelihood function as a function of *x*, $\int f_x(^x) L_{x|y} = {}_y(x) dx$
> $f_{x|y} = {}_y(x)$ is the normalizing constant, and is the posterior density of *X* given the data $Y = y$.

This function describes that the function of a contractor deviating from the contract if a random sample is drawn reflects the whole. According to the parent child relationship, if a child is drawn at random and the value of the effort is less than 1, then the value of this item must be increased in order to make the parent equal to what its value was expected to be. Given this example, if the child makes up 5% of the whole of the entire CLIN, and this effort result in a performance of .78 or 78%, the delta of .22 must be made up or the result will be .22 times .05 which is a shortage of .011 of the entire CLIN. One percent is fractional according to the entire contract, however, if this line item represents only 5% of

the CLIN drawn at random, then according to Bayesian statistics given the belief that this effort is short of its potential, there must be more efforts that are not achieving their maximum potential given that a sample drawn at random represents the population. Given this line of reasoning, a contractor must fraudulently increase work hours within the CLIN somewhere to achieve 100% or else the maximum payoff will never be achieved. Given this, the contractor will not accept less than the payoff because they are not achieving the profit needed. Bayesian Statistics plays a vital role in *how* contractors valuate options in order to manipulate earned value as a means to increase payoff functions which result in increased profit margin.

F. Contract Theory

When delving into contract theory, the topics that encompass contract theory itself are moral hazard, asymmetric information, mechanism design and incomplete contracts with applications to theory of the firm, organizational design, and financial structure (Bolton, 2005).

Moral hazard is "[t]he risk that a party to a transaction has not entered into the contract in good faith, has provided misleading information about its assets, liabilities or credit capacity, or has an incentive to take unusual risks in a desperate attempt to earn a profit before the contract settles"(Capital, p. 8, 2009). Moral hazard represents increased risk valuation within a contract that precipitates a necessity to evoke alteration of EV data. This is valid because as stated, the end of any contract results in no more profit. Therefore, if moral hazard is undertaken, companies will gravitate towards a contract fraud option in order to preserve a contractor's inability to fulfill the contract.

Information Asymmetry or situations in which one party in a transaction has more or superior information compared to another can lead to two main problems:

> 1. Adverse selection- immoral behavior that takes advantage of asymmetric information *before* a transaction. For example, a person who is not being in optimal health may be more inclined to purchase life insurance than someone who feels fine.
> 2. Referring to the later, moral hazard or immoral behavior that takes advantage of asymmetric information *after* a transaction. Thus if someone has earned value information, or ways to manipulate earned value, they may be more likely to commit contract fraud to reap the benefits of the areas to increase profit position like insurance (Takashi, 2009).

Insurance here can and does refer to type insurances such as bonds to ensure contract completion. Here, a bond is a written instrument executed by an offeror or contractor (the principal) and the second party (the surety or sureties) to ensure fulfillment of the principal obligation to a third party (the oblige or the Government) identified in the bond (Nash, 1998). The offeror, or contractor does not want to use a bond in order to pay for work not accomplished, so, manipulation of earned value by altering work accomplished or complete reflects project progression, but still ultimately defrauds the actual work complete.

Mechanism design and incomplete contracts develop a theoretical framework for studying contracts and enforcement in setting of complete, but unverifiable, information. The consideration of renegotiation necessitates formal examination of other technological constraints, especially those having to do with the timing and nature of inalienable productive decisions where the main technical contributions include results that characterize of the sets of implementable state-contingent payoffs under various assumptions about

renegotiation opportunities, and a result establishing conditions under which, when trading opportunities are durable and trade decisions are reversible, stationary contracts are optimal. The analysis refutes the validity of the "mechanism design with ex post renegotiation" program, which demonstrates the validity of other mechanism design models in dynamic environments, and highlights the need for a more structured game-theoretic framework in order to validate actions of each player (Watson, 2002, p. 12). Renegotiation if a contract, or contract modifications are a means to manipulate the schedule portion of a contract in order to buy time. Money is manipulated through mechanism design and incomplete contracts by changing the scope of deliverable items. Modifications are any written changes in the terms of a contract (FAR 43.101, 2008). A contractor understands that incompleteness of data, changes, and variation are all mechanism where the construct of earned value will be changed based on contract change itself. Therefore, an bilateral contracts with multilateral exchange are written in such multilateral contract settings, any bilateral contract may impose an externality on the other parties. The equilibrium outcome of the contracting game may then be inefficient. Thus a central focus is a resultant inefficient outcome. Here, the very presence of a potential externality, an obvious concern is whether the bilateral contracting game has a well-defined equilibrium outcome. When moral hazard, asymmetric information, mechanism design and incomplete contracts with applications are employed the result of these actions is the actualization of externalities and the outcome is bilateral ill-defined equilibrium outcomes that facilitate efficient alteration of earned value data. As

variables that produce uncertainty in completion of a contract within contract theory are exposed, the probability of contract fraud is increased and contract non-fulfillment is actualized. To conclude the argument of contract theory as well and game and Bayesian statistics, suppose that performance, or output *q*, can take only two values: $q \in \{0,1\}$. When $q = 1$ the agent's performance is a "success," and when $q = 0$ it is a "failure." The probability of success is given by $\Pr(q = 1 | a) = p(a)$, which is strictly increasing the concave in *a*. Assume that $p(0) = 0$, $p(\infty) = 1$, and $p'(0) > 1$. Therefore, regardless of any type theoretical application, any choice that an agent performs must have a payoff greater than 0. Thus, crime and or contract fraud becomes a given path because employing a probability model, choices by an agent that yield a payoff greater than 0 are all acceptable because given actions that facilitate payoff functions greater than 0 are all acceptable. Rationally, following this logic, contractors will choose contract fraud vs. not contract fraud in order to achieve a payoff function greater than 0. Proving that contractor swill choose contract fraud vs. not contract fraud.

IV. INSTITUTIONS CURRENTLY USING EARNED VALUE

There are multiple users of earned value management in the corporate sector, however, of these users, some find good in the application of earned value on programs and projects while others find difficulty in applying earned value as a theoretical mechanism that produces real world results (Marshall, 2006). When corporations choose to use earned value, they are additionally accepting that is give chance, which contract deviation can occur simply by modifying earned value data to reflect less than true results.

A. Who Uses Earned Value

The theoretical underpinnings of the choice to choose contract fraud vs. not contract fraud establish that it is true that there are theoretical applications that prove crime vs. not crime in concern with contract fraud. However, earned value is a living application rather than a theoretical path and the institutional users of earned value can and do achieve great results from earned value application (Buhrkuhl, 2003).

Laurette Koellner of the Boeing Company stated "[a]s you know, at Boeing we strive to be a world leader in using program management "best-practice" tools and Earned Value Management methods, not only on our Government programs but on our commercial programs as well. Further, that [o]ur Chief Financial officer Mike Sears spoke to a group of employees in 1998 on many of the accomplishments of earned value. Mike Sears asked that employees institutionalize Earned Value ... modernize it ...and globalize it" (Koellner, 2001, p. 1). Boeing needed to integrate cost and schedule information

across multiple sites and programs in order to implement a common toolset and common process for program management. They also needed the capabilities to practice weekly earned value on a large scale. Boeing standardized on Deltek Open Plan™ and Deltek Cobra™ across all of IDS for program management, cost control, and earned value. Boeing now has truly integrated cost/schedule information and the capabilities to practice weekly earned value on thousands of projects each month (Babin, 2006).

Lockheed Martin according to the Under Secretary of Defense for Acquisition, Technology, was provided incentives for implementing and maintaining EVM Systems. For all new contracts include a contract clause for withholding up to 5-10 percent from supplier payments for failure to adequately implement and maintain a validated EVM System. For existing contracts, add a provision within the program award fee plan to establish similar incentives (DCMA, 2007).

Defense's Director of Defense Procurement, Acquisition Policy and Strategic Sourcing Shay Assad sent out a memo to the assistant secretaries of the Army, Air Force and Navy for acquisition as well as to the directors of Defense agencies, reminding them of the mandatory EVMS requirement for cost and incentive programs valued at or greater than $20 million. What prompted the memo, it seems, is that auditors found that program managers and contracting officers failed to include EVM requirements in contracts; incorrectly tailored the data item descriptions for the Contract Performance Report and Integrated Master Schedule; inappropriately modified EVM contract requirements; specified

contract requirements in special provisions and/or statements of work that were not consistent with EVM policy and EVMS guidelines; and/or used contract incentives that counter EVM's objectives (Charette, 2009). Lockheed Martin like many large Government organizations, the National Aeronautics and Space Administration (Audit, 1999) has been tightening its belt over the past several years. To drive a major reduction in space operation costs, NASA awarded Lockheed Martin a $3-billion-plus, 10-year contract to consolidate mission and data services operations, primarily by obtaining services from the commercial sector. Due to the complexity and sheer size of the contract, Lockheed Martin Space Operations contracted with Welcom's Cobra® for their cost control and earned value management system. Earned Value is not just a good idea any more, the U.S. Government is beginning to mandate the use of earned value on major contracts (Profile, 2002).

Non-DOD agencies like the National Aeronautics and Space Administration (NASA) have been using earned value for a number of years. In February 1997, the Government issued NASA Policy Directive (NPD) 9501.3, Earned Value Performance Measurement, to establish the basis for applying EVM to NASA contracts. Before issuance of the directive, NASA Centers used their individual policies on performance measurement systems. NPD 9501.3 requires NASA project managers to ensure implementation of criteria-based EVM[1] on all significant contracts (Audit, 1999). Significant contracts that require Earned Value are shown in Table 7.

Table 7

Matrix of Earned Value Thresholds for Government agencies

Federal Agency	**EVM Threshold**	**Comment**
DoD	$20Million+	EVM required
DoD	$50Million +	EVM implementation and process must be validated
EPA	$5Million+	EVM required
DoE	$5Million+	EVM required
NASA	$20Million+	EVM required
GSA	$20Million+	EVM required
FAA	Variable	Based on program manager's risk assessment

The Federal Acquisition Regulation 2006 was officially modified to include Earned Value Management Requirements that affect all bids for Government contracts awarded after October 1, 2006. These new Federal requirements establish Government award contract thresholds above which Government contractors must implement an Earned Value Management strategy or solution in order to be considered for the award. The bottom line: No EVM solution could mean no contract.

The Raytheon Company Missile Systems business recently completed an Earned Value Management Systems compliance review by the Defense Contract Management Agency. DCMA auditors found that Missile Systems passed all 32 guidelines.

Missile Systems is the first defense contractor of its size to achieve such success and is now a benchmark for the industry, Earning this award validates the thoroughness and integrity of our processes and reinforces our promise to always

meet our customer commitments with the best possible program management and performance."

During the past several months, Missile Systems achieved the following Earned Value milestones:

> -- Deployed an EV training and certification program - more than 900 Missile Systems employees are now EV certified
>
> -- Developed and deployed an integrated automated tool suite for all programs, which ensures data integrity
>
> -- Deployed an internal surveillance approach to assess and improve program schedules, which parallels DCMA criteria
>
> -- Licensed an automated scheduling tool to subcontractors, resulting in integrated Raytheon and subcontractor EV data
>
> -- Partnered with the DCMA and other customers to ensure EV is being used to help bring timely and affordable capabilities to the warfighter (Raytheon, 2008)

So, earned value management is working in some sectors of the industry, however, most of these type contracts have major dollar threshold. Truly, there are some companies that provide hands on software solutions for earned value customers.

The Honeywell Corporation has produced Micro Switch division which has introduced a cost-effective convergent-beam photoelectric sensor, the SAP Smart Value employing earned value management to track cost and schedule (Sensor, 2008).

The Deltek Company produces software packages the capture earned value for an entire organization and the business model states to assure continued success of a program, it is essential that customers understand Earned Value

Management and these new regulatory requirements. To help organizations quickly get the knowledge needed, Deltek has created a free Deltek EVM Guide. Offering insight as to what an organization needs in order to comply with Government regulations requiring earned value management. The EVM Guide includes a wealth of valuable information on Earned Value, Earned Value Management and Earned Value Management Solutions. Deltek is one of the leading business in EVMS software design for end users like Boeing and Lockheed Martin.

Deltek offers a variety of earned value management options with their software packages [t]o assist with meeting the Government's new EVM requirements, Deltek delivers Deltek Cobra. Deltek Cobra is a world-class EVM solution that is completely compatible with Deltek Costpoint, Deltek GCS Premier and many other backend accounting packages. Its seamless integration with scheduling tools and unmatched flexibility in meeting standards such as ANSI/EIA 748 EVMS, provides a complete earned value management and reporting solution (Deltek, 2009).

Another provider of EVM software packages is, Dekker, Ltd. has been providing cutting edge Earned Value Management Solutions for Government Agencies and Government Contractors. Dekker iPursuitR (iPursuit) is an oversight and analysis tool meant for any organization responsible for receiving and analyzing project information, whether in the Public or Private Sector. The software provides powerful views into not only Earned Value Information, but also schedule, cost, resource, and technical performance metrics. The Executive

Digital Dashboard boasts a highly graphical view into customizable Key Performance Indicators for anything from a single project to an Enterprise Portfolio (Acquisition, 2009).

Primavera another provider of Earned Value Management software packages recognizes that Federal agencies are under increased pressure to use Earned Value Management (EVM) when planning and controlling capital investments and purchasing related products and services. At first glance, this insistence on EVM may seem a difficult burden. Yet it also presents an enormous opportunity, because EVM is a proven methodology for successfully managing projects and generating an appropriate return-on-investment. By integrating costs, schedules, and technical performance EVM provides early, detailed, and ongoing understanding of project progress (Earned, 2005).

V. RECOMMENDATIONS

Three recommendations presented in this paper are legislative action, creating an earned value template that identifies contract fraud, and greater academic credibility to earned value as a science.

A. What Legislation Can Do

The three central points this paper aims to achieve are to first provide a comprehensive frame-work so that legislation can examine how to use earned value to prevent DoD contract fraud. Second to create a template so that Government cost analyst can more easily identify and prevent fraudulent charges on Government contracts. And lastly, establish a stronger theoretical foundation for Earned Value conjoined with other theories such as Game Theory to give more scientific credibility to EV.

The U.S. Government by recommending several improvements, including: testing the operational effectiveness of approved project management policies and procedures before mandating their use; establishing a project management regulation for program area managed projects; establishing tracking and oversight controls for monitoring contractor performance; and implementing a cost-effective performance-based acquisition analysis process that complies with the Federal Acquisition Streamlining Act of 1994 (Securities, 2002). However, exercising mandates, establishing regulations, and tracking and oversight controls do very little if the right mix of personnel are able to understand the data produced by earned value as well as the projected results of inadequate earned value metrics. It is one thing to substantiate solutions for the U.S. Government to

fix earned value, it is quite another to understand the problem first then attempt to provide solutions. Why is earned value so easy to debunk? Because those who understand how to juke the system can and will. Provide are typical ways in which to juke the system with earned value from an article entitle *How to Lie with Earned Value*:

> - Pad the Schedule. It's the oldest trick in the book. If a project looks like it will take three months, tell management it will take four. If things go wrong, the manager can still beat expectations or at least hide the problems for a while, keeping up appearances.
> - Push Problem Tasks Forward. Putting the easiest tasks at the beginning of the project and the hardest tasks at the end can keep a project green for a long time.
> - Bump the Task Completion Percentages. What's the difference between a task that's 20 percent complete and one that's 80 percent complete? A project that's red and a project that's green. The longer the task, the larger the "benefit," but changing the completion percentage of any subjective task will help the earned value numbers.
> - Re-Baseline the Project. The project manager waits until a scope change or other change request, and uses that as an excuse to redo the project schedule. The project instantly turns green because actual progress now matches expected progress.
> - Late Integration. Most problems with IT projects emerge during integration and testing. By putting these tasks at the end and then marking them as partially complete, technical problems were hidden for the entire life of the project (Yates, 2005).

Those in the industry know how to use these methods in order to shape earned value to their advantage. The U.S. Government on the other hand does not ever get into the technicalities of how earned value really works. If legislators would take the time to really understand how industry leaders within their district pilfer American tax dollars through faulty progress on projects. Some law makers are taking earned value into their own hands. A series of failed information technology projects in Colorado in the past two years have generated front page

headlines and wasted millions of taxpayer dollars. Now Colorado legislators want to implement EVM to prevent money being wasted again (Pulley, 2006).

B. Tools for Cost Analyst

The starting point in order to more easily identify and prevent fraudulent charges is to think like the enemy. Not all contractors are enemies, however, in order to treat performance type contracts with equitable fairness, treating the good guys and the bad guys on an equal playing field often results in a balanced approach that produces consistent results.

In understanding the enemy; companies will attempt to undermine a contract with subversive techniques, the modus operandi of these techniques are the actual starting point for preventing fraud on Government contracts. "Tricky tactics can be divided into three categories: deliberate deception, psychological warfare, and positional pressure tactics" (Fisher, 1981, p. 17). Deliberate deception involves the blatant alteration of earned value data in order to achieve a greater payoff function. When "[e]xploring the psychological outcomes of a negotiation, resultant outcomes produce satisfaction, trust, rapport, self-impression" and pure mathematics (Lewicki, 2007, p. 153). In valuating a contract, psychological warfare embraces two distinct categories of value to a contract: qualitative as well as quantitative. Qualitative outcomes embrace the assumption that some relationships are regarded as more important than others, and companies strive to focus on fewer relationships with greater outcomes. (Weterlund, 2008, p. 86) suggests that "Social capital is a foundation for relationship value, and its identified elements differ among relationships."

Therefore, the outcome sought by a company will generate the prospect of a relationship with continued business if and only if contract fraud is not discovered. In the event that contract fraud is discovered within the DoD, businesses are entered on the Excluded Parties List (EPL). The Excluded Parties List System (EPLS) includes information regarding entities debarred, suspended, proposed for debarment, excluded or disqualified under the non-procurement common rule, or otherwise declared ineligible from receiving Federal contracts, certain subcontracts, and certain Federal assistance and benefits. This information may include names, addresses, DUNS numbers, Social Security Numbers, Employer Identification Numbers or other Taxpayer Identification Numbers, if available and deemed appropriate and permissible to publish by the agency taking the action (Excluded, 2009).

Parties can and will be excluded for committing contract fraud if the Government continues to provide legislation that increases the penalties for contract fraud. The most damming of contract fraud in reference to criminal penalties is quantitative results that prove fraudulent activity with earned value. Quantitative data provides definitive measurable results that discretely and mathematically measures contract fraud. Performance type contracts are service as well as deliverable items within a contract. How a service is performed is subjective and is qualitative. It has been stated how earned value is quantitative employing earned value matrix. The goal of any project is to identify quantifiable metrics that can track the absolute and relative quality of financial reporting over time (Quantitative, 2001). Which is exactly what earned value is designed to do,

track financial reported data over the course of time? Not just for high dollar performance type contracts, but for all performance type contracts.

C. Earned Value as a Scientifically Viable Research Tool

If legislators develop more strict requirements to establish earned value as a tool that can quantifiably track the status of all performance related contracts within the DoD, crime is ultimately mitigate. Thus, the last step in fully understand where the problem lies with identifying fraudulent earned value is establishing a stronger theoretical basis for Earned Value. A theoretical approach to earned value should not be considered a mechanism that only produces hypothetical data, but a pragmatic means to extrapolate quantifiable data in order to identify DoD performance related contract fraud.

If earned Value is to receive any kind of academic credibility, earned value must be viewed as a science that is studied the same way true science is studied in academia. If earned value is treated as a burdensome tool without credibility, users as well as legislators will treat earned value like as a colleague stated "earned value is like a soft serve ice-cream machine, I don't know how it works but I like it" (Caton, 2008). There is lot of end users in the world who are forced to use earned value, many do not know how it works, and others simply enjoy what is produced from earned value management systems. However, "[f]ederal agencies need systematic and effective ways to ensure their program execute contractual requirements on schedule and within budget. The objective translates universally to all projects regardless of contract type, size, or complexity. Poor planning, scope creep, ineffective risk management, and lack of

visibility into project status and overall health contribute greatly to project failure statistics. With ongoing and increasing pressure to justify spending and avoid costly project overruns, the Government acquisition community has revised policy to expand the use of Earned Value Management as a project management technique (Booz, 2008)…employing the necessary theoretical applications of earned value in order to produce valid, quantifiable data.

If Earned value management as a means to mitigate DoD contract fraud is too implemented, provide a comprehensive frame-work so that legislation can examine how to use earned value to prevent DoD contract fraud. so that Government cost analyst can more easily identify and prevent fraudulent charges on Government contracts. And establishing a stronger theoretical foundation for Earned Value conjoined with other theories such as Game Theory to give more scientific credibility to EV.

The argument that earned value management can be used as a means to mitigate DoD contract fraud is validated using symbolic logic. If applying earned value on performance related contracts, then DoD contract fraud is mitigated. If DoD contract fraud is mitigated, then DoD contracts will have no fraud. It is earned value that is needed in order to prevent DoD contract fraud:

A= Earned Value
B= DoD contract fraud
C= Crime

$(A \supset \neg B), (B \supset C), (\neg C \supset A), (A \supset \neg B, \neg C) \therefore$

$\supset$	If A, then B.
$\neg$	It is not the case that A. A: not.

Therefore, earned value management on any performance type contract prevents DoD contract fraud as a crime; thus earned value management should be used as a means to mitigate DoD contract fraud.

VI. SUMMARY AND CONCLUSION

In Summation, Earned Value as a means to mitigate DoD contract fraud presents an argument not approached by many academic scholars. However, the result of the lack of control over DoD contract fraud results in major losses of U.S. Dollars. United States president Obama announced his plan to make Government spending more accountable and efficient; Obama and Biden will ensure that federal contracts (which are performance type contracts) over $25,000 are competitively bid. Earned Value Management is the solution for being able to make Governmental spending more accountable.

A. In Summary

This paper has provided an introduction discussion of the problem which addresses that research suggests that DoD lacks a plan that coordinates initiatives or provides a road map for future cost control efforts (GAO-03-935). A comprehensive literature review identified contract fraud cases, and how contracting fraud is an issue plus how more help is needed to control contracting issues.

The theoretical framework provided a brief history of earned value, along with how the body of a contract that facilitates earned value. The illustrative explanation of earned value provided a visual explanation for what earned value looks like and how EV works.

The final and most relevant is how Game Theory, Bayesian Statistics, Contract Theory which aims to help understand situations in which decision-makers interact and produce results (Osborne, 2004). Of these results, this paper

has substantiated that contract fraud can and does occur. More importantly, earned value is a tool which greatly facilitates combating DoD contract fraud.

B. **Conclusion**

He central focus of this paper was to provide three recommendations to continue to bolster legislative action pushing for the use of earned value to prevent contract fraud, to provide a tool for analyst, and to give greater academic credibility to earned value as a science. In meeting these goals, it means realizing that Department of Defense (DoD) faces vulnerabilities to contracting fraud, waste, and abuse in five key areas: sustained senior leadership, capable acquisition workforce, adequate pricing, appropriate contracting approaches and techniques, and sufficient contract surveillance (Contract Management, 2006). Senator John McCain stated at a dinner on the introduction of the fiscal discipline, earmark reform, and accountability act January 6, 2009 "Mr. President, we, as Members, owe it to the American people to conduct ourselves in a way that reinforces, rather than diminishes, the public's faith and confidence in Congress" and DoD spending habits (McCain, 2009). The ultimate way to control spending habits is to enforce a standard. That standard for DoD performance related contracts must be earned value management. EVM is the key to mitigating DoD contract fraud.

Figures

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