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An Analysis of Construction Contractor Performance Evaluation System

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AN ANALYSIS OF CONSTRUCTION CONTRACTOR PERFORMANCE EVALUATION SYSTEM

THESIS

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AFIT/GEM/ENV/09-M01

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Abstract

A rigorous system for rating construction contractor performance does not exist for the USAF as identified by the Air Force Civil Engineer (USAF CE), Major General Del Eulberg (Eulberg, 2007). The United States Army Corp of Engineers (USACE) uses DD Form 2626 for contractor performance evaluation and contractor selection. The objective of this research is to strengthen the USAF contractor rating system by exploring USACE's use of DD Form 2626.

Using data from DD Form 2626, statistical analysis was conducted to determine if the measured performance sub-items reflect their respective performance elements, whether the resulting performance elements relate to the overall contractor performance rating, and finally, if a relationship exists between the overall contractor performance rating and the overall project schedule performance. Two hundred-fifteen finalized DD Form 2626 were evaluated using various statistical analyses. A relationship between the performance elements and the contractor's overall performance rating was identified. Two of nine identified performance elements are predictive of the contractor's overall rating. The DD Form 2626 represents a good starting point to meet the USAF CE intent. However, it needs standardized instructions and formatting to align performance items and elements into a more rigorous system for rating contractor performance.

To every Commander I've ever worked for…

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AN ANALYSIS OF CONSTRUCTION CONTRACTOR PERFORMANCE EVALUATION SYSTEM

I. Introduction

Ancient armies to present day defense services all have at least one thing in common—they all required logistical support. In the early Iron Age the first military contractors emerged as merchants who organized their business around providing military supplies to the local armies on a regular basis (Gabriel & Metz, 1992). The same basic mechanism applies to today's military procurement programs. However, as the demand for contractor-provided goods and services has grown, the process that guides the solicitation, evaluation, and selection of contractors has matured. The Federal Acquisition Regulations (FAR) System specifies the procedures and policies that guide the procurement of services and materials for the modern United States military. The FAR System exists to ensure that cost, schedule, and quality requirements are fulfilled. Key to this procurement effort is the process of selecting a contractor.

> Contractor selection is a decisive event for project success. It corresponds to an interface between a variety of construction industry clients and an equally varied array of construction companies. For that reason, the success or failure of the project depends on this interface, because it is the magnifying glass used to look for the contractor who satisfies the project objectives in the best way (Alarcon & Mourgues, 2002).

The current criteria used by the United States Air Force (USAF) to select a contractor is termed *best value source selection* and is based on mission capability, cost, past performance, and proposal risk (SAF/AQCP, 2008). Put simply, the Government selects the contractor that is expected to provide the greatest overall benefit in response to the defined requirement (Department of Defense, 2005). With the exception of cost, all the criteria evaluated are rated using a subjective system designed to indicate the USAF's overall confidence in the contractor's future performance. Past performance is considered a predictor of future performance (Wright,

1999). The current system is not without its challenges; subjective criteria can be non-linear, uncertain, and imprecise (El-Sawalhi, Eaton, & and Rustom, 2007).

A rigorous system for rating a contractor's performance for use in best value source selection does not yet exist for the USAF. This deficiency was specifically identified by the Air Force Civil Engineer, Major General Del Eulberg, with respect to military construction projects and source selection. As the Air Force Civil Engineer, General Eulberg is responsible for the installation support functions at 166 Air Force bases worldwide with an annual budget of more than $17 billion. General Eulberg identified 35 initiatives in an effort to transform the civil engineering career field into a more efficient and effective enterprise (Eulberg, 2007). One such initiative is Transformation Project A-4. The purpose of this initiative is to:

- strengthen the USAF rating system of contractor performance
- standardize performance criteria and eliminate inconsistencies between USAF MAJCOMs and bases
- ensure best value is achieved for the government by establishing a system of rewards and penalties for good and bad contractor performance respectively

Research Objective

The objective of the present research is to strengthen the USAF rating system of contractor performance by exploring DD Form 2626 Construction Contractor Performance Evaluation used by the United States Army Corp of Engineers. The Army Corp of Engineers uses DD Form 2626 to evaluate and rate construction contractor performance and then uses the evaluations for future source selections. The rest of the chapter provides a historical review of source selection and the evolution from lowest bid to the current practice of best value source

selection. This chapter focuses on the motivation behind the research in this thesis, the problem statement and associated research questions, as well as the methodology employed in this thesis research; finally, this chapter will address the limitations of this study as well as the implications of the research.

Background

Historical Problems of Lowest Bid Source Selection

Prior to the 1990s, the United States Government selected contractors based solely on lowest bid price (Gransberg & Ellicott, 1996). Lowest bid contracting assumed that project plans and specifications that were complete and unambiguous, allowed for the price to be the sole competitive factor between contractor proposals. Ultimately, only construction costs are considered, excluding the costs incurred through procurement, project management, lost opportunities, or other such abstract expenses. It became clear that while lowest bid contracting was simple and straight forward to implement, it often resulted in higher costs, longer completion time, and poorer quality (Feldman, 2006). According to many in the field, awarding a contract solely on lowest price “poses a high risk to the client because there is an increased possibility of financial collapse of contractor, bad performance, delay in completion, time and cost overruns and so on (Wong, Holt, & Harris, 2001).” For instance, in 1992 the US Army Corp of Engineers Europe District (EUD) analyzed four problem contracts that were all awarded based on lowest bid price (Gransberg & Ellicott, 1996). All four projects were behind schedule – project completion times were between 14 months to two years after the originally scheduled completion date; all were above the US Congress authorized program amount – each experiencing between a 10% up to a 30% cost growth; quality deteriorated during construction;

and all the low bids were submitted by marginal firms – firms with long histories of financial problems, lack of experienced and skilled management, and reputations for "buying-in" to contracts. Buying-in is defined by the Federal Acquisition Regulation (FAR) as "submitting an offer below anticipated costs, expecting to increase the contract amount after award (Department of Defense, 2005)." Another firm lacked experience and suffered from employment of unskilled managers and workers. According to a Gransberg & Ellicott study, an investigation of each successful offer revealed information that may have been grounds for disqualification from the source selection had a different procurement strategy been employed by the district. "EUD's experience indicated that minimum levels of contractor performance rarely met customer expectations. Increases in quality were generally worth a corresponding increase in cost (Gransberg & Ellicott, 1996)."

In a separate document, Marcos Feldman identified low-bid contractor selection as the source for construction failure in the Miami-Dade County (Feldman, 2006). The low-bid contracting in Miami-Dade County resulted in construction delays and cost overruns, shoddy workmanship, and poor construction worker health and safety.

> Low-bid contracting is *false economy* as the initial savings from price-based competition are erased over the long-term because of inferior performance leading to additional costs. Low-bid contracting makes flawed assumptions, encourages cost-cutting and underperformance, and does nothing to screen out unscrupulous contractors. (Feldman, 2006)

Lowest bid acquisition encourages underperformance by the contractors who are in competition with other low-bid contractors. Historically, under the low-bid acquisition methods, contractors would underbid a contract in order to win the contract. To recover their lost profits, contractors would then use substandard materials, poor workmanship, and take great risks to the health and safety of their laborers. Lowest bid contracting also

fails to account for contractor performance criteria such as safety records, worker training, schedule compliance, and work quality.

Low-bidding is not only a problem for the United States, but is a global issue. In their article, *Predicting Project Performance Through Neural Networks*, Cheung, Wong, Fung, and Coffey address the impact of the 1997 Asian financial crisis and the affect it had on the region's construction industry. They concluded that this type of financial environment promotes the submission of suicidal bids in order to capture work opportunities, especially for new entrant construction firms (Cheung, Wong, Fung, & Coffey, 2006). Such suicidal bids can result in poor quality construction. For instance, in Hong Kong, prior to tenant occupation, two newly constructed multi-storied housing blocks were demolished due to defective foundation work. While it is not conclusive low-tender value caused the poor construction quality, it does support the argument that contractors must be considered both on their technical merit as well as their financial solvency.

The analyses of contractor performance conducted by the EUD, Marcos Feldman, and Cheung et al. demonstrated that lowest bid methods for acquisition do not meet traditional project success requirements of cost, schedule, and quality (Ling & Liu, 2004). In response to demands from the activist procurement policy office and a new Pentagon acquisition reform operation, Congress passed the 1994 Federal Acquisition Streamlining Act (FASA) and the 1996 Clinger-Cohen Act. The intent of these acts was to streamline acquisition processes and reduce administrative burdens suffered by contracting authority offices (Burman, 2000). The acts transitioned the government from lowest bid procurement to best value source selection.

Best Value Source Selection

Following the FASA and Clinger-Cohen legislation, the FAR was revised Part 15 to promoted best value procurements over lowest bid price and reshaped the way government does business with contractors (Burman, 2000). Government agencies created partnerships with contractors, thus streamlining the acquisition process that is focused on the product verses the process. One of the first statements provided in the FAR is the Federal Acquisition System vision. It states:

> The vision for the Federal Acquisition System is to deliver on a timely basis the best value product or service to the customer, while maintaining the public's trust and fulfilling public policy objectives. Participants in the acquisition process should work together as a team and should be empowered to make decisions within their area of responsibility. (Department of Defense, 2005)

"Best value contracting is a method of awarding construction contracts in which bidders compete on the basis of technical and managerial merit, past safety and performance records, qualification of craftsmen, technical innovation, financial health, or other factors, in addition to price (Feldman, 2006)." In an effort to provide best value to the customer, USAF contractor source selection processes consider mission capability, cost, past performance, and proposal risk when evaluating contract proposals (Wright, 1999). Special attention is paid towards a contractor's past performance. Section 1091 of FASA considers the past performance of a contractor to be "one of the relevant factors that a contracting official of an executive agency should consider in awarding a contract." The FAR requires contracting officers to consider past performance for all competitively negotiated acquisitions exceeding $100,000 (Department of Defense, 2005). For contracts exceeding $100 million a Performance Confidence Assessment Group (PCAG) conducts a comparative past performance evaluation in order to "identify the degree of performance risk associated with each competing offeror (SAF/AQCP, 2008)."

The methods for rating contractors' past performance however, are very subjective (Wright, 1999). Decision makers that are responsible for source selection and who are bound to subjective rating systems as those found in the AFFAR, may find themselves in situations where they are unable to effectively defend their integrity when their source selection decisions are questioned**.** In fact, integrity of the source selector is so important that on 1 January 1997 the Procurement Integrity Act went into effect which placed restrictions on government employees involved with the selection of contractors for specified government programs. For example, an employee who has left the DoD may not accept compensation from the affiliated contractor on a $10 million+ DoD contract for which the former DoD employee performed designated services (48 C.F.R. 3.104-4(d)). In addition, subjective rating systems create skepticism regarding the federal government's best value procurement process. This skepticism has caused some companies to question whether fair evaluations will be made during source selection. "The Best Value process has also caused them to revisit bid decisions in the context of return-on-investment and risk (Mickaliger, 2001)." When selection process is not rigorous or is highly subjective, and when decision makers deliberately compromise their integrity leading to fairness concerns from participating contractors, the overall process of best value source selection is negated. Rather than selecting the best contractor for the best value, the government is likely to hire an unqualified contractor—a decision that can result in an over-budget, over-schedule executed project.

Motivation for this Research Effort

Best value is continually encouraged as a means for federal acquisition of products and services; defining "best value" is subjective, vague, and non-standardized throughout the

government. A contractor's past performance is a primary consideration in best value source selection. Past performance is considered a predictor of future performance. The method used to identify the USAF's overall confidence in a contractor's future performance is a subjective rating system (Wright, 1999). However, subjective criteria are non-linear, uncertain, and imprecise, making the task of contractor selection challenging (El-Sawalhi, Eaton, & and Rustom, 2007). A rigorous system for rating or determining a contractor's future performance does not exist for the USAF.

The United States Army Corp of Engineers (USACE) is an organization comprised of military and civilian engineers, scientists and other professions whose mission is to provide quality, responsive engineering services to the nation. They are responsible for design and construction management support for Defense and federal agencies, to include the USAF. As part of their construction management process, the USACE completes a contractor performance evaluation on all construction projects. The performance evaluations are captured and standardized on DD Form 2626 (see Appendix A). Once this evaluation is finalized and approved, it is stored in a centrally managed, Department of Defense database called CPARS. CPARS stands for Contractor Performance Assessment Rating System. The contractor performance evaluations are then available for reference when USACE project managers are making determinations about a contractor's qualification for future construction projects. The obvious question that arises is whether the construction performance evaluation process used by the USACE constitutes a reliable and defensible method for rating a contractor. Can the contractor performance evaluation data collected on DD Form 2626 predict a contractor's future performance? If the construction performance evaluation process used by the USACE is reliable

and valid, can it be adopted by the USAF civil engineers as a method for rating and predicting contractor performance?

Problem Statement

The objective of this research is to analyze DD Form 2626, the USACE's method for evaluating construction contractors, in order to determine if the form is reliable, valid, and appropriate for implementation by the USAF civil engineers for evaluating and rating contractor performance. The research will analyze data from DD Form 2626 to determine if any of the performance items are correlated to a contractor's overall performance rating. The research will determine if a relationship exists between the project schedule performance and the contractor's overall performance.

Research Questions

A thorough analysis of construction contractor performance evaluations will focus on answering the following specific research questions:

1. Do the DD Form 2626 performance elements reflect their respective performance items?
2. Do the performance items as they are appropriately aggregated into performance elements predict the contractor's overall performance rating?
3. Is the contractor's overall performance rating and the overall project schedule performance related?

Figure 1 is a conceptual model of the performance relationships that will be evaluated in this research.

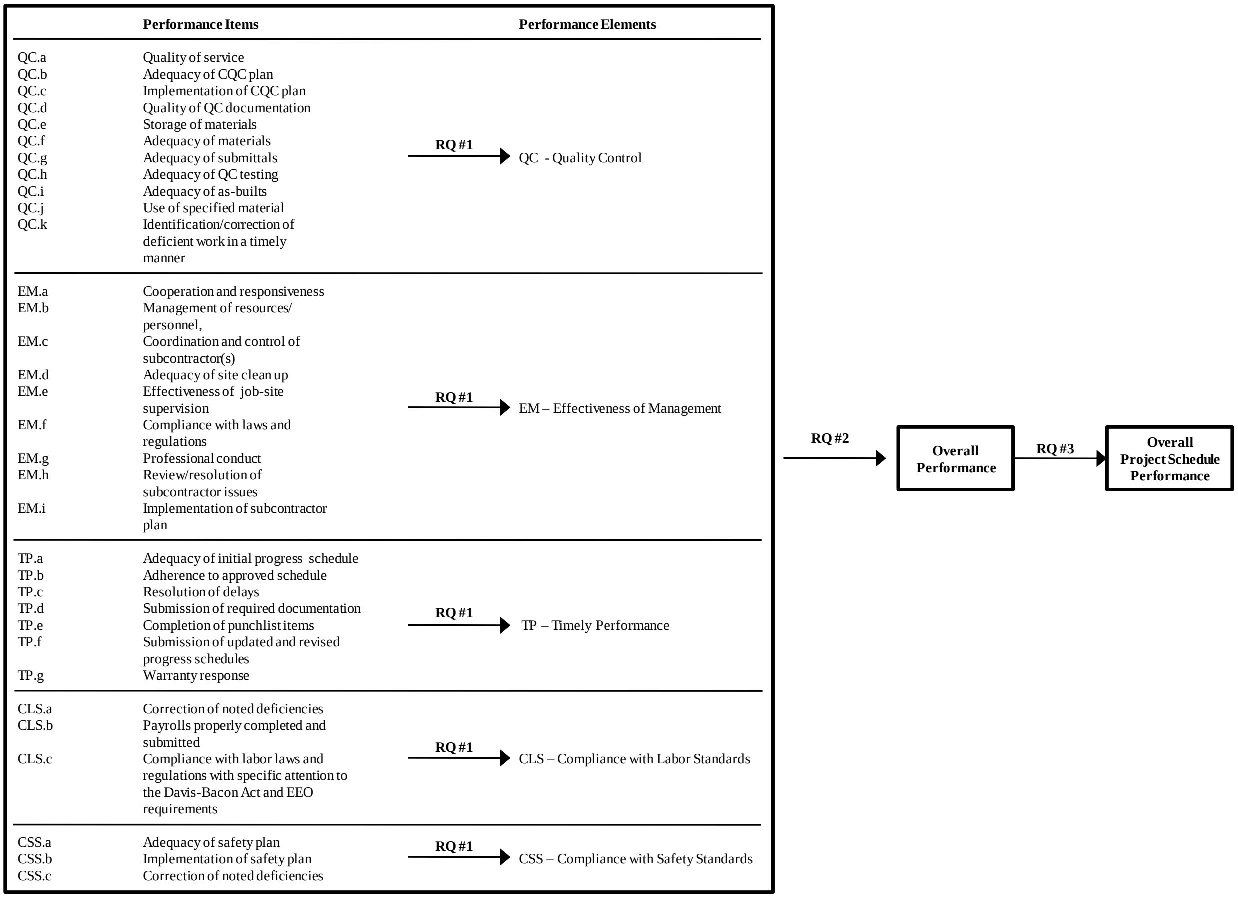

Figure 1. Relationship Conceptual Model

Methodology

Project performance data was collected from finalized DD Forms 2626 Performance Evaluation (Construction) for Fiscal Year (FY) 1998 to FY 2008. Only finalized, completed, and approved DD Forms 2626 were used in this research. All DD Forms 2626 used in this research are from a regional USACE office with construction projects ongoing in five states.

A principle component analysis was conducted on the thirty-three performance items from the DD Form 2626. The principle component analysis was used to determine if the observed variables are condensable into a smaller set of variates (factors) with minimal loss of information (Hair, Black, Babin, Anderson, & Tatham, 2006). After condensing each of the thirty-three performance items into performance factors, logistical regression was used to

identify which performance factors correlated with the overall performance rating. The data set was divided into two random groups. The first group of data was used to determine the relationship the performance factors have with the overall performance rating. The second group of data was used to test the ensuing model for validity. Finally, using the first group of data, the overall performance rating was correlated with the overall project schedule performance to determine if a relation exists.

Limitations

The use of DD Form 2626 data placed several unavoidable limitations on this research that must be identified. First, the sample size used to analyze the data on DD Form 2626, while by definition is a large sample size it is not large enough to perform statistical analysis on each performance item. The second limitation is that it is a cross sectional study; the evaluations are all completed at the end of the construction project – one point in time. Rater anonymity of each DD Form 2626 is the third limitation of this study. According to a resident engineer for the USACE, the name identified on each DD Form 2626 as the evaluator is the name of the resident engineer. The resident engineer has oversight on all projects within his or her office. The project manager will complete the DD Form 2626 and the resident engineer will review the evaluation for correction before signing his or her name to the final evaluation. Therefore, since it isn’t possible to identify each rater for each data point, calculation of individual rating differences between raters is not possible. The fourth limitation to this study is the time period for sampling. The USACE has been involved with construction project management since its inception 16 March 1802; the data analyzed in this research covers a period between the years

2000 to 2008. The fifth limitation of the data is its inability to be generalized; all 215 DD Form 2626 attained from the USACE were from a regional office that supports the mid-west region.

Implications

The results of this study will identify if relationships exist between the performance items, the contractor's overall performance rating, and the overall schedule performance of a contractor as evaluated using the DD Form 2626. If a relationship exists between the performance items and the overall contractor rating, the data analysis will provide project managers and contracting officers a mathematical model for predicting contractor performance that can be employed during the interim evaluation of construction contractors. The predictor model will provide the government's project managers the ability to identify deficient contractors early in the construction phase and possibly prevent schedule delays and budget overruns that would result in below satisfactory contractor performance. Additionally the performance predictor model could enhance the existing rating system of construction contractors. The results should identify objective project indicators that quantitatively identify a contractor's future performance as either above average (good) or below average (poor).

If relationships do not exists between the performance items, the contractor's overall performance rating, and the overall cost and schedule performance, then this research will help identify deficiencies in the current contractor evaluation process and the application of DD Form 2626.

Thesis Organization

Chapter 1 establishes the framework for the study by describing the impacts of lowest-bid source selection, the subsequent implementation of best value source selection, and the consequences of selecting contractors based on subjective criteria. A brief history of government source selection is described starting with lowest-bid source selection and followed by best value source selection. The problem statement and research questions identify the focus of this study: to determine if relationships exist between the performance items, the contractor's overall performance rating, and the overall schedule performance. If a relationship exists between the overall contractor's rating and the performance items, a statistical model can then be constructed for predicting contractor performance using available construction contractor performance evaluation data. Chapter 2 examines the literature on best value source selection, current USAF source selection practices, USACE's construction contractor evaluation process, existing methods for predicting contractor performance, and project performance measures and criteria. Chapter 3 describes the statistical methodology used to identify correlations between the overall contractor's performance and the individual evaluations of a contractor's performance items and to develop a linear regression model for predicting contractor performance. It identifies the performance items and how the each item is consolidated into performance elements. Chapter 4 outlines the results and analysis of the study. Chapter 5 provides the discussion and conclusions gained from the study along with recommendations for future research.

II. Literature Review

Chapter Overview

This chapter investigates the current literature and research regarding contractor performance predictor models. The purpose is to understand the framework that governs contractor selection and has led to the development of various construction contractor predictor models. The following topics will be investigated here: best value source selection; the current contractor selection methods employed by the United States Air Force (USAF); United States Army Corp of Engineer's (USACE's) construction contractor evaluation process; contractor performance predictor models; and study performance metrics. This will build the foundation for the methodology used to test the reliability and validity of DD Form 2626 as an appropriate tool for rating and predicting construction contractor performance.

Best Value Source Selection

Best value source selection is the framework that governs contractor selection for the U.S. Government. Source selection is "the process wherein the requirements, facts, recommendations, and government policy relevant to an award decision in a competitive procurement of a system/project are examined and the decision made (Defense Acquisition University, 2005)." Otherwise stated, source selection is the process of "choosing an offeror for the contract award on the basis of integrated assessment of non-cost factors as well as cost or price (Wright, 1999)." Best value source selection is the process of acquisition that, in the Government's estimation, provides the "greatest overall benefit in response to the requirement

(Department of Defense, 2005)." The FAR encourages contracting officers to use best value source selection.

When the government employs best value source selection, it provides itself with the opportunity to select a higher priced proposal as a tradeoff for other important non-cost factors such as quality, safety record, or past performance to name a few. A tradeoff is defined by the Acquisition Glossary as **"s**election among alternatives with the intent of obtaining the optimal, achievable system configuration. Often a decision is made to opt for less of one parameter in order to achieve a more favorable overall system result (Defense Acquisition University, 2005)." According to FAR 15.101-1(c), paying additional cost for an acquisition is merited with the decision maker(s) perceive higher benefits to the Government with the higher priced proposal.

One such benefit is the satisfactory or above average past performance of a contractor. For source selection purposes, past performance information is considered relevant and important information. Under the FAR, subpart 42.15 Contractor Performance Information, typical criteria used to evaluate a contractor's past performance includes

- the contractor's record of conforming to contract requirements and to the standards of good workmanship
- the contractor's record of forecasting and controlling costs
- the contractor's adherence to contract schedules
- the contractor's history of reasonable and cooperative behavior and commitment to customer satisfaction (Department of Defense, 2005)

The evaluation of a contractor's past performance includes the ability of the contractor to meet cost, schedule, and quality requirements that are satisfactory to the customer.

The source selection process can be broken down into six steps. In the first step of source selection, the government identifies technical differences between proposals measured against the criteria established in the Request for Proposal (RFP) or Statement of Work (SOW). In the second step of the selection process, the selection officials determine the potential impact to agency operations of each technical difference. "The government assigns a positive or negative impact statement on economic benefits clearly attributable to increased productivity, service delivery to the public, mission effectiveness, and/or other unique approaches (Mickaliger, 2001)." In the third step, similar technical differences are consolidated and those with limited impact on source selection are eliminated. In the fourth step, source selection officials apply predetermined weight factors for each remaining discriminator relative to their favorable, neutral, or unfavorable influence on the impact areas. Documentation of analytical methodology applied and its associated rationale occurs in step five. This includes documentation of data used for required calculations as well as identifying and defining all assumptions used in the analysis. The final step in the source selection process is to document the tradeoff process used to determine the "quantified proposal discriminators and the relative value of the proposal by considering the non-quantified discriminators (Mickaliger, 2001)." Using their analytical process for determination, selecting officials make their final decision and award the contract to the 'most successful' offeror. The development of contractor performance predictor models are a result of steps four through six of the contractor selection process. By employing rigorous mathematical models, decision officials attempt to identify the most qualified, technically-acceptable, construction contractor using the least subjective, but most standardized and fair system of elimination. The intent of this research is to identify a method the United States Air Force (USAF) decision makers can use when rating and predicting construction contractor

performance. The six-step contractor selection process identified by Mickaliger serves as the foundation that governs current USAF source selection practices. The next section discusses in detail the specific methods employed by the USAF for source selection.

Current USAF Source Selection Practices

To support the Civil Engineer Transformation Initiative A-4, the intent of this research is to strengthen the USAF rating system of contractor performance, standardize performance criteria and eliminate inconsistencies between USAF MAJCOMs and bases, and to ensure best value is achieved for the government by establishing a system of rewards and penalties for good and bad contractor performance respectively. Research into the current USAF source selection practices must be conducted to identify a more rigorous USAF contractor performance rating system that can be used to predict future contractor performance.

In 1998, Expert Choice, Inc. and Battelle Memorial Institute wrote a report addressing protest proof source selection. Expert Choice, Inc. is a software and technology services company that focuses on providing collaborative decision support solutions. "The company's products allow users to structure and measure objectives and alternatives, perform sensitivity analysis, identify funding levels, align resources, source and select vendors, identify and prioritize risks, and perform gap analysis (BusinessWeek, 2008)." Battelle Memorial Institute is a non-profit organization dedicated to the furthering international science and technology. Their key areas of concern are energy, health and life sciences, national security, laboratory management, and education. In their 1998 report, they state that "choosing the winning contractor, selecting the best product, or picking a new supplier involves an assessment of how well each alternative contractor, product, or supplier satisfies the objectives or criteria being

considered (Expert Choice, Inc., 1998)." When selecting contractors for acquisitions valued at one million dollars or greater, the USAF employs a color rating system which indicates how well the evaluation standards are met by each offeror. Acquisitions using the simplified acquisition procedure are exempt from applying this procedure (SAF/AQCP, 2008). The color ratings are summarized in Table 1.

Table 1. USAF Contractor Performance Color Rating System (Expert Choice Inc., 1998)

COLOR	RATING	DEFINITION
Blue	Exceptional	Exceeds specified performance or capability in a beneficial way to the Air Force and has no significant weakness
Green	Acceptable	Meets evaluation standards and any weaknesses are readily corrected
Yellow	Marginal	Fails to meet evaluation standards; however, any significant deficiencies are correctable
Red	Unacceptable	Fails to meet a minimum requirement of the RFP and the deficiency is uncorrectable without a major revision of the proposal

Evaluation teams are discouraged from using numerical weights because it implies it is possible to detect small differences in technical merit that would allow an evaluation team to differentiate between solicitations (AFFARS, AA-304(b)(c)). However, according to an article provided by Expert Choice, Inc., "…it is, in fact, possible for a team to differentiate between small differences on any factor being judged if the right measurement method is used. It does not matter whether the factor is tangible or intangible, whether the data is soft or hard (Expert Choice, Inc., 1998)." The document highlights how difficult it is to summarize a bidder's performance and determine 'best value' when the results look like Table 2.

Table 2. Sample USAF Bidder Rating (Expert Choice Inc., 1998)		
CRITERION	BIDDER A	BIDDER B
1	Blue (Exceptional)	Green (Acceptable)
2	Green (Acceptable)	Yellow (Marginal)
3	Yellow (Marginal)	Yellow (Marginal)
4	Yellow (Marginal)	Green (Acceptable)

Expert Choice, Inc. argued that "numbers are required to explain how much better one value is than another (Expert Choice, Inc., 1998)." In the event of an audit, both narrative and numeric arguments for source selection are required to justify any and all contractor selections.

This color approach is widely used in source selection, performance evaluation, site selection, and funds allocation. Though it appears systematic, logical, and rational, the reality is that the color system can be misleading, inappropriate, or even wrong resulting in sound bases for source selection protests. A weighting system is typically employed to combat the inequality of numeric ratings scales when evaluating various performance factors. However, "assigning weights is as unreliable as assigning scores on a 1-10 rating scale. It is difficult, if not impossible, to force all evaluators to use the same scale the same way (Expert Choice, Inc., 1998)." Consider Gary D. Holt, et al.*'s* survey of factors that influence a construction client's choice of contractors. Of the 30 factors surveyed, none received 100% congruent ratings and weighting by the 53 clients surveyed (Holt, Olomolaiye, & Harris, 1994). Their survey demonstrated that every person involved in contractor selection not only prioritizes various contractor performance factors differently, but they also place varied values on each of those performance factors. Hence, rather than trying to develop a standardized contractor performance rating system, many researchers instead looked into models that would predict contractor performance. Identifying contractor performance predictor models aligns with the intent of this research which is to identify a method for use by USAF decision makers when rating and

predicting construction contractor performance. Rather than developing a rating system or predictor model from scratch, this research will examine the USACE's construction contractor evaluation process for reliability and validity. If reliability and validity exists with their process, then the USACE's construction contractor evaluation process will be recommended to the USAF civil engineer community as a means for strengthening the USAF rating system of contractor performance, standardizing performance criteria and eliminating inconsistencies between USAF MAJCOMs and bases, and ensuring best value is achieved for the government by establishing a system of rewards and penalties for good and bad contractor performance respectively.

United States Army Corp of Engineer's Construction Contractor Evaluation Process

The USACE comprises approximately 34,600 civilian and 650 military members. With its staff of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals, the USACE's mission is to provide "quality, responsive engineering services to the nation (US Army Corp of Engineers, 2000)." This mission includes:

- Planning, designing, building, and operating water resources and other civil works projects (Navigation, Flood Control, Environmental Protection, Disaster Response, etc.)
- Designing and managing the construction of military facilities for the Army and Air Force. (Military Construction)
- Providing design and construction management support for other Defense and federal agencies. (Interagency and International Services)

Just as the USAF contractor selection method is governed by the Federal Acquisition Regulation (FAR), so is the United States Army Corp of Engineer (USACE). In accordance with FAR, subpart 36.201 Evaluation of contractor performance, "contracting activity shall evaluate

contractor performance and prepare a performance report using the SF 1420 (see Appendix B), Performance Evaluation (Construction Contracts), for each construction contract of $550,000 or more or more than $10,000 if the contract was terminated for default (Department of Defense, 2005)." Defense Federal Acquisition Regulation Supplement (DFARS) 236.201 Evaluation of Contractor Performance, requires the use of DD Form 2626 (see Appendix A), Performance Evaluation (Construction) instead of SF 1420 (Department of Defense, 2006).

USACE Regulation ER 415-1-17, Contractor Performance Evaluation, establishes the procedures for evaluating construction contractor performance for all headquarter (HQ) USACE elements and Major Subordinate Commands (MSC) that are responsible for military and civil construction contracts. Prior to source selection, USACE contracting officers are required to retrieve all performance evaluations on file that pertain to all prospective awardees and "make a determination of responsibility regarding the contractors' previous performance on DoD construction contracts (U.S. Army Corps of Engineers, 1993)." According to a USACE resident engineer only the contractor's overall performance score on previous contracts is provided to the decision team during the source selection process. Those contractors who receive an unsatisfactory performance evaluation report may be barred or excluded from Government contracting or Government subcontracting for a reasonable, specified time period (Department of Defense, 2005)." Conversely, those contractors who receive an outstanding performance evaluation report are considered for USACE recognition and Division awards.

DD Form 2626 is used for both interim and final contractor performance evaluations. Interim ratings serve as a valuable tool for identifying unsatisfactory performance from a contractor. The interim evaluation provides the contractor the feedback necessary to improve their performance, correct deficiencies, and avoid a final unsatisfactory rating. The performance

report is typically prepared by the project manager and then reviewed for accuracy and fairness by the resident engineer. Once the contractor has had the opportunity to review and refute any portion of the DD Form 2626, the form is sent to the district USACE office. It is the district office manager who is responsible for approving a finalized copy of DD Form 2626, which is then transmitted to the USACE, North Pacific Division (NPD) central database system (CCASS).

CCASS stands for Construction Contractor Appraisal Support System; it is a web-enabled application that supports the "completion, distribution, and retrieval of construction contract performance evaluations (DD Form 2626) (Naval Sea Logistics Center , 2008)." The evaluations of a contractor's performance provide either a positive or negative record on a given contract. "Each evaluation is based on objective facts and supported by contract management data, such as contract performance elements that evaluate quality, timely performance, effectiveness of management, and compliance with contract terms, labor standards, and safety requirements (Naval Sea Logistics Center , 2008)."

The method used by the USACE for evaluating and selecting construction contractors has been in place for at least 15 years. If, through thorough statistical analysis, the data collected on DD Form 2626 is both reliable and valid for evaluating contractor performance, then this method can be adopted by the USAF in their effort to strengthen the USAF rating system of contractor performance. It could be used to standardize performance criteria and eliminate inconsistencies between USAF MAJCOMs and bases, and ensure best value is achieved for the government by establishing a system of rewards and penalties for good and bad contractor performance respectively. The next section explores various models that have been developed using data, similar to the data collected on DD Form 2626, to predict contractor performance.

Predicting Contractor Performance

The objective of this research is to evaluate and recommend standardized parameters for evaluating qualified USAF contractors and predicting contractor performance. "Contractor selection is a decisive event for project success (Alarcon & Mourgues, 2002)." It requires complex communication between an array of construction industry clients and various construction companies. "For that reason, the success or failure of the project depends on this interface, because it is the magnifying glass used to look for the contractor who satisfies the project objectives in the best way (Alarcon & Mourgues, 2002)." When considering the weaknesses and limitations of source selection practices, Holt, et al., in their article *A Review of Contractor Selection Practice in the U.K. Construction Industry,* identified four major selection deficiencies. First, and foremost, there is no universal approach to contractor selection; secondly, confidence in the results of the prequalification declines over time; third, there exists too much reliance on the contractor's bid price during final the stages of selection; and finally, there is an overreliance on subjective analysis of contractor's past performance (Holt, Olomolaiye, & Harris, 1995).

Many contractor predictor models exist in the available literature. In his article *Which Contractor Selection Model?*, Dr. Gary Holt considers seven different selection models over five characteristics: known usage, degree of subjectivity, nature of input data, nature of output, and future scope to problem. Table 3, on page 25, summarizes Holt's findings for each of the seven selection models.

The Bespoke approach to contractor selection is typically an ad hoc evaluation/selection method that is developed by the particular contractor source selector. The initial stages of the Bespoke approach includes an "investigation of contractors' submissions for preliminary

conforming criteria, often referred to as ‘cut-off points’ or ‘musts’ (Holt, 1998).” The conforming criteria are usually in the form of a binary decision (YES/NO), such that non-conforming tenders are instantly rejected. There exists potential risk for rejecting a ‘good’ contractor by employing this method of contractor selection. An important consideration of the Bespoke approach is that it does not compare contractors relative to each other; instead by employing a systematic reject method developed internally by the construction client’s project management team, a final tender is selected which may or may not be the overall “best” contractor. This approach is commonly used in the industry. Though, there is little research to support that this is a practicable method for selecting “good” contractors. Holt recommends a numeric measure or score for improving the Bespoke Approach. A numeric score would allow decisions makers a means for comparing contractors relative to each other.

“Multi-attribute analysis considers a decision alternative with respect to several of that alternative's attributes (Holt, 1998).” Attributes are characteristics that can be measured; attributes are measured against objectives – “a contractor attribute represents one aspect of a decision option with respect to a client objective (Holt, 1998).” It is important to note that some attributes may be qualitatively measured therefore not all attributes are quantifiable. Like the Bespoke Approach, multi-attribute analysis is commonly used in industry and like the Bespoke Approach, there is limited literature available to support the use of multi-attribute analysis as a successful method for selecting “good” performing contractors. Using multi-attribute analysis, Minchin and Smith propose a quality based contractor rating model for qualifying and selecting contractors. Through a series of interviews and questionnaires administered to contractors and owners, Minchin and Smith developed the following three part contractor rating and qualification model.

Table 3. Matrix of methodology characteristics with respect to the contractor selection (Holt, 1998)

	Characteristics				
Methodology	**Known Usage**	**Degree of subjectivity**	**Nature of input data**	**Nature of output**	**Future scope to problem**
Bespoke methods	Prolific amongst industry practitioners	Input & output very subjective	Descriptive, binary, linguistic subjective	Binary/descriptive	Limited in terms of being quantitative
Multi-attribute analysis	Simple scoring models used by industry, some usage by academia	Input reliant upon subjective evaluation of attributes	Interval and ordinal but of ten subjective	Numeric score and hence rank amongst alternatives	Limited in terms of being quantitative
Multi-attribute utility theory	Evidence of academic usage	Input converts qualitative data to quantitative	Raw data is often qualitative, utility achieves interval data	Numeric score and hence rank amongst alternatives	Good if representative utility curves are derived; needs research
Multiple regression	Evidence of academic usage	Achieving interval data prone to subjective evaluation	Interval predictive	Numeric; further value	Good; scope for research
Cluster analysis	Limited	None if raw multivariate data is used	Multivariate	Group membership and group characteristics	Excellent; scope for future research
Fuzzy set theory	Evidence of academic usage	Scope for development of attribute profiles	Descriptive/qualitative converted to interval	Group membership	Good; but may be too complex for easy acceptance by industry
Multivariate discriminate analysis	Previous usage	Quantitative	Multivariate	Group membership/group characteristics	Previously used but broader scope possible; needs research

Part I includes a questionnaire that is completed by the project manager on the contractor's performance. Using a series of "yes-no" questions summarized under five project managements factors, an overall project performance factor from the questionnaire (PPF_q) is determined. The following equation (equation 1) is used to determine a contractor's overall project performance factor from the questionnaire score:

$$
\begin{aligned}
PPF_q = {} & .30(\text{Project Personnel}) \\
& + .20(\text{Project Management/Control}) \\
& + .20(\text{Schedule Adherence}) \\
& + .20(\text{Contractor Organization}) \\
& + .10(\text{Plant and Equipment})
\end{aligned}
$$

"The weights in equation 1 were determined from input from the focus groups, surveys, and investigators' experience (Minchin Jr. & Smith, 2005)." Using tests performed by project managers on materials and workmanship of the project, an overall project performance factor from data (PPF_d) is determined. Combining the PPF_q and PPF_d scores results in the overall project performance factor score. The follow equation (equation 2) is used to determine the overall project performance score (PPF):

$$PPF = 0.2(PPF_d) + 0.8(PPF_q)$$

The second part of the model is to determine a company's performance rating (CF) using the PPF score. A contractor's performance rating is a cumulative score that changes as they complete additional projects over time. The following equation (equation 3) is used to determine the contractor's performance rating (CF):

$$CF = \frac{\sum PPF}{N}$$

"where N = the number of projects completed by the contractor during the rating period (Minchin Jr. & Smith, 2005)." The third part of the model uses the contractor's performance rating for qualification and bid selection. In their example, Minchin and Smith calculate a "C" factor by multiplying CF by some monetary amount and subtracting that amount from the contractor's bid amount (Bid Amount – (CF x $/CF)). Table 4 summarizes a hypothetical bid process which incorporates the "C" factor for selection.

Table 4. Effect of "C" Factor (Minchin Jr. & Smith, 2005)

Contractor	**Bid Amount**	**CF**	**$/CF**	**"C" Factor**	**Total Bid**
A	$2,175,000	91	$10,000	$910,000	$1,265,000
B	$2,200,000	88	$10,000	$880,000	$1,320,000
C	$2,225,000	97	$10,000	$970,000	$1,255,000

From the example, from initial analysis, Contractor A has submitted the lowest bid. However, by incorporating the contractor's performance rating, Contractor C's high CF score results in a lower overall bid. This is an example of how a contractor's past performance is rewarded in future contract selections.

The next method Holt addresses is multi-attribute utility analysis. Similar to multi-attribute analysis, multi-attribute utility theory examines many attributes associated with various decision alternatives when making a decision. Multi-attribute utility theory takes multi-attribute analysis a step further by quantifying subjective components through application of utility. Utility is a measure of desirability or satisfaction with respect to a characteristic (attribute) of an alternative (contractor) and it takes values from zero to 1.0 (Holt, 1998). It is a means weight each attribute being considered for each alternative. It allows the decision maker to quantify both tangible and intangible characteristics during

the contractor selection process. Multi-attribute utility theory takes subjective criteria and objectively scores it. The application of multi-attribute utility theory has mostly been academic because each organization that would apply multi-attribute utility theory in their selection processes requires their own unique utility curve. Little to no research exists supporting the actual application of multi-attribute utility theory as a successful tool for selecting "good" performing contractors.

The next approach Holt describes in his paper on contractor selection is multiple regression. "Multiple regression is a statistical technique whereby an equation is constructed to observe and ultimately predict the effect of several independent variables upon a dependent variable (Holt, 1998)." The outcome of multiple regression is a numeric value 'Y' that is dependent on several independent variables typically represented in a regression equation as either 'V' or 'X'. Through statistical analysis of several scenarios a multiple regression equation is developed. The equation is expressed as follows:

$$Y^* = C_O \sum_{i=1}^{n} C_i X_i$$

where:

Y^* = dependent variable

X_i = independent variables

C_i = partial regression coefficients

C_O = a constant; the point on the y axis the regression line crosses

n = the number of attributes considered in the analysis

R^2 is a term used to identify the 'goodness of fit' of the regression line. For instance, an R^2 value of 0.8 indicates that for the given equation, 80% of the movement in Y* can be attributed to movement in X_i. "The larger the R^2 is, then the more accurate a predictor is the equation based on the input data upon which it was built (Holt, 1998)." One such equation for prediction contractor performance has been proposed as follows:

$$Y^* = 0.311 + 0.151X_1 + 0.035X_8 + 0.154X_9 - 0.159X_{19} - 0.031X_{20} + 0.232X_{21}$$

where:

Y^* = prequalification score

X_1 = size of contractor organization

X_8 = quality of bank reference

X_9 = quality of creditor references

X_{19} = past performance (time overruns)

X_{20} = past performance (cost overruns)

X_{21} = past performance (quality achieved)

R^2 = 0.96

Given an R^2 of 0.96, one would conclude that this model for predicting contractor performance is highly accurate. Using clients' tender evaluation criteria, Wong developed a multiple regression model to predict contractor performance. Wong's model was validated with 75% accuracy using 20 independent cases of contractor performance (Wong, 2004). Though the model has a high predictability, it has not been field tested for accuracy and industrial application.

The fifth approach to contractor selection Holt discusses is cluster analysis. Cluster analysis provides a means for dividing a large pool of potential contractors into

small, manageable subsets of similar character. These small subsets of characteristics can then be analyzed and the best contractor subset identified as a means of prequalification for future bid invitation. There are three primary benefits of approaching contractor selection with cluster analysis. First, using a limited number of controlling criteria to the entire original set of contractors facilitates effective investigation of all members. Second, cluster analysis reduces the risk of rejecting 'good' contractors during the early stages of contractor selection. Third, by committing more time resources for information gathering during the selection phase of construction the selection body maximizes the potential of selecting the best alternative (contractor). To employ the cluster analysis method, the decision makers describe each contractor by using a set of numerical attribute scores. These scores are then used in "a classification algorithm to group the contractors into a number of clusters such that contractors within classes are similar and unlike those from other clusters (Holt, 1998)." In cluster analysis, the most discriminating selection factors are identified and typically only significant discriminators are considered when deciding between two alternatives. Because there is limited use of cluster analysis to date little to no research exists supporting the use of cluster analysis as a successful tool for predicting and selecting "good" performing contractors.

The sixth contractor selection model addressed by Holt is Fuzzy set theory. Uncertainty is a function of imprecision, randomness, and ambiguity. Probability theory addresses randomness as it attempts predict future events based on past events. However, it is difficult to fit contractor selection in this type of predictor model. Given this difficulty, the Fuzzy set theory is designed to "model human judgment and cope with

uncertainty (Holt, 1998)." Like the Bespoke approach to contractor selection, Fuzzy set theory incorporates 'conforming criteria' to contractor selection. However, unlike the Bespoke approach, rather than identifying contractors as either completely meeting conforming criteria or not (binary decision), Fuzzy set theory allows for partial membership in a set of conforming criteria. The degree of membership is measured with a membership value M_v where $0 < M_v < 1.0$ and 1.0 equals maximum strength of membership.

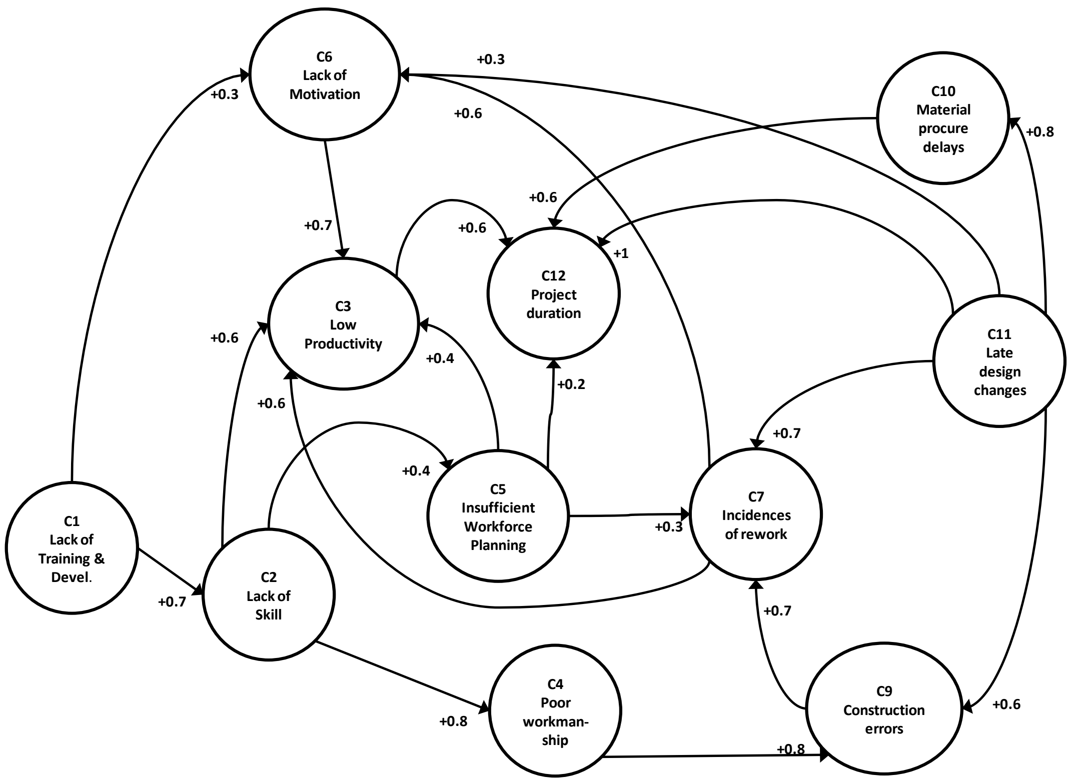

Figure 2: Causal Model (Dissanayake and AbouRizk , 2007)

Fuzzy set theory was further developed into cognitive maps by Manjula Dissanayake and Simann AbouRizk in 2007. "A cognitive map is a representation of an individual's (or group of individual's) knowledge of their spatial environment. Kosko

(1986) developed the fuzzy extension of the cognitive map, namely Fuzzy cognitive maps, to represent causal reasoning (Dissanayake & AbouRizk, 2007)." Figure 2 is an example of a Fuzzy cognitive map developed by Dissanayake and AbouRizk and incorporates eleven construction performance concepts. Seventeen construction performance concepts were originally identified in their study and categorized as either external, internal, or goal concepts. According to Dissanayake and AbouRizk, the construction project management team can perform construction performance concept identification and should carry it out on a project by project basis. Due to the its complexity, Fuzzy set theory has limited use in the industry and therefore, little to no research exists supporting the use of Fuzzy set theory as a successful tool for predicting and selecting "good" performing contractors.

The final contractor selection method discussed by Holt is multivariate discriminate analysis. "Multivariate discriminate analysis studies the differences between two or more objects with respect to several variables, simultaneously (Holt, 1998)." By examining several variables such as contractors past performance, decision makers can identify which attributes are discriminators, how the attributes can then be used in an algorithm to predict performance, and the accuracy of the derived equation. Multivariate discriminate analysis is useful in identifying the most powerful discriminators between contractors. Multivariate discriminate analysis begins with the identification of the most discriminating variable. By combining this variable with each of the other variables, the next most discriminating factor is identified. This process is continued until "very little discrimination is gained by inclusion of any further variable (Holt, 1998)." This method

was applied to predict future performance of Hong Kong contractors. The resulting discriminating function is as follows:

$$Z_t = C_O + C_1X_1 + C_2X_2 + \cdots + C_6X_6$$

where:

Z_t = predictive contractor performance index

C_O = constant

$C_{1\text{-}6}$ = discriminating coefficients

X_1 = complexity of project

X_2 = percentage of professionally qualified staff

X_3 = project leaders experience

X_4 = contractor's past performance or image

X_5 = origin of the company

X_6 = construction owner's control

In their PhD thesis, *A Methodology for Predicting Company Failure in the Construction Industry*, Adnan Fadhil Abidali and Frank Harris developed a Z-score model for vetting construction companies during source selection prequalification. The Z-score model was developed to predict construction contractor solvency. Ratio models were developed for application in construction in order to "minimize risk for client organizations and corporate lending institutions that usually have a direct business relationship with construction companies (Edum-Fotwe, Price, & Thorpe, 1996)." Such ratio models can provide early warning to construction company clients, thus serving as a monitoring tool for avoiding poor corporate performance or possible insolvency. Insolvency is used as a broader term which includes liquidation, receivership, and

administration of a company by bankers or others with a financial stake (Langford, Iyagba, & Komba, 1993). The seven-variable model developed by Abidali and Harris produces a Z-score that can be used to predict a construction company's long term solvency. The model is expressed as follows:

$$Z = 14.6 + 82.0X_1 - 14.5X_2 + 2.5X_3 - 1.2X_4 + 3.55X_5 - 3.55X_6 - 3.0X_7$$

In this model X_1 represents the ratio of profit after tax and interest to net capital employed. "This is a profitability measure and takes into account all the net assets plus the short-term loans used to finance the company. This ratio is a valuable guide to the profitability of companies. The value appears positive in solvent companies and tends towards the negative in failed companies (Abidali & Harris, 1995)." X_2 represents the ratio of current assets to net assets and measures the financial leverage of a construction company. Firms that have failed consistently have fewer current assets than non-failed firms. "The ability of a firm to meet its short-term financial obligations without having to liquidate its long-term assets is an important factor in the consideration of lenders; the extreme case of such an inability is bankruptcy (Abidali & Harris, 1995)." X_3 represents the ratio of turnover to net assets; it's a measure a company's efficient use of its productive capacity. X_4 represents the ratio of short term loans to profits before tax and interest and measures the company's liquidity. X_5 represents the tax trend over three years. "The tax trend tends toward the negative in failed companies. As a company becomes "better off" the trend increases (Abidali & Harris, 1995)." X_6 represents the profit after tax trend over three years. "The earnings after tax trend towards the negative in failed companies. Again, as a company becomes better off the trend increases; whereas failed companies' tax trend decreases (Abidali & Harris, 1995)." X_7 represents

the short term loan trend over three years and measures the liquidity over several years. "Generally, failed companies are highly dependent on short-term loans more than non-failed firms. As a company becomes worse off the trend increases, reaching crisis level before collapse (Abidali & Harris, 1995)." According to Abidali and Harris a Z-score of 2.94 or greater predicts long term solvency for a construction company.

When the Z-score model was tested, 90% of the firms were correctly classified into the non-failed group and 100% of the failed companies were correctly classified. On its own, the Z-score cannot predict failure; it merely provides a snapshot of a company's financial solvency under the current management and compares it to similar companies. Instead the model indicates the likelihood of failure; non-financial analysis for companies is necessary to reinforce the predictive capacity of the model. "There can be little doubt about the usefulness of financial ratios as a management evaluation tool for the construction industry. They serve as early warning systems by indicating whether an organization is in good financial standing or exhibits characteristics of already failed companies (Edum-Fotwe, Price, & Thorpe, 1996)." More specifically, the ratios are "indicators of past events and the trend may continue if managers of the company do nothing to change the situation (Langford, Iyagba, & Komba, 1993)." The information required to use multivariate discriminant analysis, such as a Z-score model for predicting and selecting "good" contractors, is detailed and not easily attained because the contractor must provide it. This makes industrial application limited to non-existent. Therefore, little to no research exists supporting the use of multivariate discriminant analysis as a successful tool for predicting and selecting "good" performing contractors.

This research will use statistical analysis to test the reliability of DD Form 2626

and then apply multiple regression to develop and validate a contractor performance predictor model using the DD Form 2626 data. As noted by Holt, multiple regression shows evidence of academic usage, the nature of the input data is predictive, and the nature of the output is numeric or quantitative. As discussed in Chapter 1, the current method used to identify the USAF's overall confidence in a contractor's future performance is a subjective rating system (Wright, 1999). A rigorous system for rating or determining a contractor's future performance does not exist for the USAF. If a numeric value can be determined for predicting contractor performance using multiple regression on the data from DD Form 2626, then the USAF could have a more rigorous system for rating and predicting a contractor's performance. The next section of this chapter will discuss the performance metrics used in the statistical analysis of data supplied by DD Form 2626.

Study Performance Metrics

This research will compare a contractor's overall contractor performance rating to the individual performance item ratings and the contractor's overall schedule. Construction researchers and practitioners have paid close attention to contractor evaluation methods. Most of the research conducted on contractor evaluations indicates that the evaluation criterion has remained unchanged over the years. Researchers known in the field of contractor evaluation criteria studies generally study a contractor's performance as it relates to financial, managerial, technical, health and safety, quality, and past performance aspects (Wong, Holt, & Cooper, 2000). Therefore, it is not surprising that the contractor performance evaluation tool used by the USACE, DD Form

2626, is divided into five performance elements. The five performance elements are quality control, effectiveness of management, timely performance, compliance with labor standards, and compliance with safety standards. The contractor's overall performance rating, which is also provided on DD Form 2626, should reflect their ratings in each of the five performance elements. This method of using performance elements (or facets) to measure overall performance is the same method used by Judge, et al. when measuring overall job satisfaction to identify relationships between job satisfaction and overall job performance. In their study, Judge, et al. measured overall job satisfaction by measuring specific facets of the job situation to include supervision, coworkers, opportunity for advancement. These facets were combined to form a measure of overall job satisfaction (Judge, Thoresen, Bono, & Patton, 2001).

DD Form 2626 consists of an overall contractor performance rating and 33 performance items that are each assigned to one of five performance elements; performance items are considered a sub-measure of performance elements. Each of the 33 performance items are rated as either outstanding, above average, satisfactory, marginal, or unsatisfactory. The first performance element, *Quality Control*, is measured by the following eleven performance items: Quality of Workmanship, Adequacy of the Construction Quality Control Plan, Implementation of the Construction Quality Control Plan, Quality of the Quality Control Documentation, Storage of Materials, Adequacy of Submittals, Adequacy of Quality Control Testing, Adequacy of As-Builts, Use of Specified Materials, and Identification/Correction of Deficient Work in a Timely Manner. According to USACE Regulation ER 415-1-17 Contractor Performance Evaluations, "Quality of Work reflects the contractor's management of the quality control program, as

well as the quality of the work which is placed (U.S. Army Corps of Engineers, 1993)." The USACE is not the only government organization that emphasizes quality control as a sub-measure of a contractor's overall performance. Utah's Department of Transportation uses a standardized form for evaluating construction contractor's performance. Quality control is measured by five performance items to include adequacy of materials. Ten percent of the contractor's overall performance rating is based on quality control. In addition, the City of Los Angeles evaluates a construction contractor's performance on "organization, procedures, competence of personnel, and effectiveness of the contractor's quality control on the project (City of Los Angeles, 2004)."

The second performance element, *Effectiveness of Management*, is measured by the following nine performance items: Cooperation and Responsiveness, Management of Resources and Personnel, Coordination and Control of Subcontractor(s), Adequacy of Site Clean-Up, Effectiveness of Job-Site Supervision, Compliance with Laws and Regulations, Professional Conduct, Review and Resolution of Subcontractor's Issues, and Implementation of Subcontracting Plan. Research has shown that site management is a crucial factor to a successful project outcome (Holt, Olomolaiye, & Harris, 1994). In addition to quality control, Utah's Department of Transportation considers effectiveness of management when rating a contractor's performance. They value adequate support of subcontractors, resolution of delays quickly and efficiently, and project supervision that results in a positive impact on the project.

The third performance element, *Timely Performance,* is measured the following seven performance items: Adequacy of Initial Progress Schedule, Adherence to Approved Schedule, Resolution of Delays, Submission of Required Documentation,

Completion of Punchlist Items, Submission of Updated and Revised Progress Schedules, and Warranty Response. In the state of Connecticut, annual performance ratings are conducted on all contractors and subcontractors. One of the five elements in Connecticut's performance questionnaire is adherence to project schedule. The Utah Department of Transportation (UDOT) also rates timely performance as an important element when evaluating a contractor's performance (Minchin Jr. & Smith, 2001). In an article dated June 1999, researchers Chee H. Wong, Gary D. Holt, and Patricia A. Cooper surveyed construction clients' preferred contractor attributes used in the tender selection process. The survey required respondents to rank order 37 various contractor performance criteria. Of the 86 completed surveys, the ability for a contractor to complete a project on time was consistently ranked as either a number one or number two priority in a list of 37 contractor performance criteria (Wong, Holt, & Cooper, 2000).

The fourth performance element, *Compliance with Labor Standards*, is measured by the following three performance items: Correction of Noted Deficiencies, Payrolls Properly Completed and Submitted, and Compliance with Specific Attention to the Davis-Bacon Act and Equal Employment Opportunity (EEO) Requirements. In the state of West Virginia, before a contractor can qualify for work, they must first obtain a license from the Secretary of State. There are five criteria that must be met in order to obtain a license, one of which is adherence to Davis-Bacon pay scales. The Utah Department of Transportation rates a contractor's compliance with EEO as part of the performance evaluation (Minchin Jr. & Smith, 2001). In addition, the City of Los Angeles construction contractor's performance evaluation includes compliance with labor standards.

The fifth performance element, *Compliance with Safety Standards*, is measured

by the following three performance items: Adequacy of Safety Plan, Implementation of Safety Plan, and Correction of Noted Deficiencies. According to a report published by R. Edward Minchin Jr. and Gary R. Smith titled, *Quality-Based Performance Rating of Contractors for Prequalification and Bidding Purposes*, "safety is an integral part of project quality (Minchin Jr. & Smith, 2001)." Evaluation of safety is not unique to the USACE's contractor performance measurement tool – DD Form 2626. The Missouri Highways and Transportation Commission (MHTC) use a questionnaire for evaluating construction contractor performance. The questionnaire is broken down into four categories: quality, prosecution and progress, contract compliance, and safety. In a contractor's overall performance score, safety accounts for 20% of the total score. The Virginia Department of Transportation (VDOT) uses a performance questionnaire to determine a contractor's bidding capacity. The final report is divided into four categories: prosecution of work, project communication, safety, and environmental (Minchin Jr. & Smith, 2001). In addition, the City of Los Angeles construction contractor's performance evaluation includes compliance with safety standards.

While some information exists in the literature to support the current categorization of performance items as they appear on the DD Form 2626, the information is limited and fails to give construct validity to the performance elements. Therefore, face validity will serve to support maintaining each performance item with its respective performance element when performing statistical analysis on the research data.

Traditionally, a contractor's overall project performance is based on quality, schedule, and cost (Ling & Liu, 2004). Quality refers to the performance of the product that is delivered by the contractor. In the construction industry, quality refers to the

contractor's ability to deliver a civil works project as specified by the customer. Quality, as a performance measure, is not captured on DD Form 2626 and therefore, will not be included in this research. In addition, DD Form 2626 does not provide enough data to perform a cost performance analysis for each project. Therefore, this research will specifically focus on schedule with respect to traditional measures of project success. Schedule refers to a contractor's ability to conform to the agreed upon project delivery timeline. Project schedule growth is a measure of a contractor's overall schedule performance (Lee, Thomas, Mackens, Chapman, Tucker, & Kim, 2005). The equation for determining project schedule growth is:

$$\frac{\text{Actual Total Project Duration} - \text{Initial Predicted Project Duration}}{\text{Initial Predicted Project Duration}}$$

For government contracts it is very important that the contractor meets or exceeds schedule performance. Generally, government construction projects support mission requirements; delays in construction completion can have adverse affects in the government's ability to execute mission requirements. Former Chief of Staff of the Air Force, General T. Michael Mosley, echoed this sentiment when addressing members of the House Appropriations Committee Subcommittee on Military Construction and Veterans Affairs. He informed the members that "sound investment in our installations postures the Air Force to support our priorities of winning the global war on terror, developing and caring for our Airmen and their families, and recapitalizing and modernizing our force (Buzanowski, 2007)." The final portion of the data analysis will determine if a relationship exists between the contractor's overall performance rating and the overall project schedule performance.

Summary

The first sections of this chapter discussed best value source selection and the current selection methods used by the USAF for contractor selection. Best value source selection is the framework that governs contractor selection for all United States government organizations, to include the USAF. By studying the current USAF source selection practices, the research identified the limitations of the selection methods, suggesting the need for a more rigorous USAF contractor performance rating system that can be used to predict future contractor performance. This is one of the transformation initiative items requested by the USAF Civil Engineer, General Del Eulberg. Rather than inventing a new method for evaluating and predicting contractor performance, this research examined the current contractor evaluation and selection methods employed by the USACE.

The next section of this chapter then discussed in detail the various existing contractor performance predictor models. Through this research, the methodology for analyzing the USACE's contractor evaluation form, DD Form 2626, for reliability and validity was discovered. By employing statistical analysis this research will attempt to validate DD Form 2626 as a reliable tool for evaluating contractors. If the evaluation data—specifically the performance items provided on DD Form 2626 are determined to be valid—then through the use of linear regression, a model for predicting contractor performance will be developed and tested for reliability and validity.

Before testing the contractor performance elements for reliability and validity, an investigation into previous research was conducted in order to determine if the performance elements identified by DD Form 2626 were supported as reliable and valid

tools for evaluating contractor performance. The last section of this chapter, study performance metrics, discussed the results of this investigation and supports the use of the performance elements provided by DD Form 2626 as appropriate contractor evaluation tools.

Identifying methods for accurately predicting contractor performance is a topic of research that has been around for decades. While many predictor models and tools exist for selecting a "good" contractor, many of these models have not been field tested—their reliability and validity are non-existent. Therefore, use of any contractor predictor model is limited to academic application and research. Chapter 3 will discuss in detail the methodology used in this research. Through the use of statistical analysis and logistical regression, this research will attempt to validate the method used by the USACE for contractor performance evaluation.

III. Methodology

Chapter Overview

This chapter describes the methodology used to analyze the construction contractor evaluation method employed by the US Army Corp of Engineers (USACE), specifically DD Form 2626. The procedures used by this study are organized into three sections: data source, data collection, and data analysis. Each section will explain the definitions, decisions, and criteria used for the study data analysis.

Data Source

The first step of data analysis was to identify a data source that contained consistent and representative project information for construction projects. This research analyzed the data provided on DD Form 2626 Construction Contractor Performance Evaluation. While not all of the construction projects included in the data analysis were military specific, they were all managed and evaluated by the USACE – an organization that is a major command under the US Army. The data collected on each project is more standardized than data that might be available through the public or private sector (Pocock, 1996). All finalized and approved copies of DD Form 2626 are transmitted to the USACE, North Pacific Division (NPD) central database system (CCASS).

CCASS stands for Construction Contractor Appraisal Support System and is a centralized, web-enabled, database for managing construction contract performance evaluations. It is a subset of CPARS, the Contractor Performance Assessment Reporting System, which is a collection of Past Performance Information on all contractors that

have been employed by the Department of Defense (DoD). A series of "checks and balances" are employed to ensure the accuracy of the data provided in CCASS. Government officials are responsible for evaluating and rating a contractor's performance on a given project for a specified period of time. The contractor then has the opportunity to review the evaluation and provide comments "regarding the Government's assessment and to indicate concurrence or non-concurrence with the overall evaluation (Naval Sea Logistics Center , 2008)." Finally, if there is a disagreement between the Government and the Contractor, a senior official reviews the report to ensure that it reflects a fair evaluation. CCASS was used as the data source to retrieve construction contractor performance evaluation information for this study.

Data Collection

The USACE Construction Division, Louisville Division was instrumental in the collection of project information from CCASS. Contractor Performance Evaluations were downloaded in portable document format (PDF) for all construction projects that were executed in the Louisville Division area of jurisdiction. All projects were awarded between Fiscal Year (FY) 2000 and 2008. Only finalized and approved evaluation report were used in this data analysis. A total of 215 construction project evaluation reports were downloaded and manually transcribed into an excel spreadsheet. Columns were added into the excel spreadsheet to compute overall schedule performance for each project as detailed in chapter 2 and the data analysis section of this chapter. Finally, in order to test the contractor performance predictor model, finalized construction contractor evaluation reports must be available for model validation. The 215 construction project

evaluation reports were randomly divided using the random number generator function in excel. A total of 50 reports were set aside for model validation (Appendix C), the other 165 reports were used in the data analysis (Appendix D). This procedure models the linear regression procedure Wong used when developing his contractor performance model. His model was derived from 48 construction projects and tested by 20 independent cases using the logistical regression technique (Wong, 2004).

Data Analysis

Performance Metrics

The literature identified performance metrics used by USACE construction project managers and previous studies to evaluation and rate construction contractor performance. Thirty-five performance metrics were used by this study and include: overall contractor performance rating, overall project schedule performance, and thirty-three performance items. This method of using performance elements (or facets) to measure overall performance is the same method used by Judge, et al. when measuring overall job satisfaction to identify relationships between job satisfaction and overall job performance. In their study, Judge, et al. measured overall job satisfaction by measuring specific facets of the job situation to include supervision, coworkers, opportunity for advancement. These facets were combined to form a measure of overall job satisfaction (Judge, Thoresen, Bono, & Patton, 2001).

Performance Elements and Performance Items

DD Form 2626 is divided into five performance elements. The five performance elements are quality control, effectiveness of management, timely performance,

compliance with labor standards, and compliance with safety standards. The contractor's overall performance rating, which is also provided on DD Form 2626, should reflect their ratings in each of the five performance elements.

Each performance element is supported by a various number of performance items. Each performance item is rated as either outstanding, above average, satisfactory, marginal, or unsatisfactory. The first performance element is quality control and it is divided into the following eleven performance items: quality of workmanship, adequacy of the construction quality control plan, implementation of the construction quality control plan, quality of the quality control documentation, storage of materials, adequacy of submittals, adequacy of quality control testing, adequacy of as-builts, use of specified materials, and identification and correction of deficient work in a timely manner. The second performance element is effectiveness of management and it is divided into the following nine performance items: cooperation and responsiveness, management of resources and personnel, coordination and control of subcontractor(s), adequacy of site clean-up, effectiveness of job-site supervision, compliance with laws and regulations, professional conduct, review and resolution of subcontractor's issues, and implementation of subcontracting plan. The third performance element is timely performance and it is divided into the following seven performance items: adequacy of initial progress schedule, adherence to approved schedule, resolution of delays, submission of required documentation, completion of punchlist items, submission of updated and revised progress schedules, and warranty response. The fourth performance element is compliance with labor standards and it is divided into the following three performance items: correction of noted deficiencies, payrolls properly completed and

submitted, and compliance with specific attention to the Davis-Bacon Act and equal employment opportunity (EEO) requirements. The fifth performance element is compliance with safety standards and it is divided into the following performance items: adequacy of safety plan, implementation of safety plan, and correction of noted deficiencies. According to the resident engineer at a local USACE construction office, the contractor's overall performance rating should be a reflection of the ratings he or she received in each of the various performance elements.

Contractor Overall Performance Rating

Traditionally, a contractor's overall project performance is based on quality, schedule, and cost (Ling & Liu, 2004). Quality, as a performance measure, is not captured on DD Form 2626 and therefore, will not be included in this research. In addition, DD Form 2626 does not provide enough data to perform a cost performance analysis for each project. Therefore, this research will specifically focus on schedule with respect to tradition measures of project success. The overall contractor performance rating is indicated on the first page of the DD Form 2626. The contractor's performance rating is measured on a five-point scale using the following descriptors: outstanding, above average, satisfactory, marginal, and unsatisfactory.

Overall Project Schedule Performance

Schedule refers to a contractor's ability to conform to the agreed upon project delivery timeline. Project schedule growth is a measure of a contractor's overall schedule performance (Lee, Thomas, Mackens, Chapman, Tucker, & Kim, 2005). The equation used for determining project schedule growth is:

$$\frac{\text{Actual Total Project Duration} - \text{Initial Predicted Project Duration}}{\text{Initial Predicted Project Duration}}$$

Statistical Analysis

This research used multivariate analysis to validate the use of DD Form 2626 for evaluating and rating construction contractor performance. Multivariate analysis refers "to all statistical techniques that simultaneously analyze multiple measurements on individuals or objects under investigation (Hair, Black, Babin, Anderson, & Tatham, 2006)." The ultimate goal of this research was to identify a relationship with the variate value, or the Overall Contractor Performance Rating, and the observed variables, or the performance items' measurements. In addition, this researched identified a relationship with the Overall Contractor Performance Rating and the Overall Cost and Overall Schedule Performance.

The variate is the building block of multivariate analysis. It represents a single value resulting from a combination of observed variables. The variate value can be stated mathematically as:

$$\text{Variate value} = w_1X_1 + w_2X_2 + w_3X_3 + \ldots + w_nX_n$$

where X_n is the observed variable and w_n is the weight determined by the multivariate technique (Hair, Black, Babin, Anderson, & Tatham, 2006). By design, the DD Form 2626 implies that quality control, timely performance, effectiveness of management, compliance with labor standards, and compliance with safety standards are all indicators of a construction contractor's overall performance. The purpose of this research was to

determine if in fact these five performance elements and associated 33 performance items are both reliable and valid indicators of a contractor's overall performance.

In this research the variate, or the Overall Contractor Performance Rating, and the observed variable, or Performance Sub-elements, were measured on an ordinal scale where the construction contractor's performance is rated as 'outstanding', 'above average', 'satisfactory', 'marginal', or 'unsatisfactory'. For the purpose of data analysis, each rating was represented numerically where '5' = 'outstanding', '4' = 'above average', '3' = 'satisfactory', '2' = 'marginal', and '1' = 'unsatisfactory'.

Measurement Error

Measurement error is "the degree to which the observed values are not representative of the "true" values (Hair, Black, Babin, Anderson, & Tatham, 2006)." Sources for measurement error in this research include data entry errors that occurred when manually transferring data from the contractor performance evaluation form to the excel spreadsheet. The use of an imprecise measurement tool may also be a source of error; specifically, imposing a 5-point rating scale for performance measurement when maybe some categories of performance can only be accurately measured by a 3-point rating scale can cause errors in the data. "Thus, all variables used in multivariate techniques must be assumed to have some degree of measurement error (Hair, Black, Babin, Anderson, & Tatham, 2006)." Measurement errors were considered in this research as they can mask the "true" effects, resulting in weakened correlations and less precise means.

Statistical Analysis Basic Assumptions

Before statistical analysis was conducted on the contractor performance data, a few statistical assumptions had to be met. The statistical analysis that was conducted in this research is generally classified as parametric tests. Using a parametric test when the data does not meet four basic assumptions can cause the results to be inaccurate. Before any parametric test was conducted on the research data in this study, the assumptions were checked. According to Andy Field, author of *Discovering Statistics Using SPSS*, for standard parametric tests, the following assumptions must be met:

Assumption 1: Normally Distributed Data. Normally distributed data is "a probability distribution of a random variable that is known to have certain properties; it is perfectly symmetrical (has a skew of 0), and has a kurtosis of 0 (Field, 2005)." When plotted on a two-dimensional graph, where the horizontal axis represents all possible values of the variable and the vertical axis represents the probability of those values occurring, data that is normally distributed will be clustered around the mean in a symmetrical, unimodal pattern. This pattern is commonly referred to as a bell-shaped curve or normal curve (Hair, Black, Babin, Anderson, & Tatham, 2006). Since the research conducted in this study involves more than two variables, multivariate normality must be considered. "Multivariate normality (the combination of two or more variables) means that the individual variables are normal in a univariate sense and that their combinations are also normal….Thus, a situation in which all variables exhibit univariate normality will help gain, although not guarantee, multivariate normality (Hair, Black, Babin, Anderson, & Tatham, 2006)."

Using statistics software, SPSS version 16.0, an analysis was conducted on each variable to determine normality. The results are summarized in Table 6. A copy of the full analysis for each variable is located in Appendix E. In order for data distribution to be perfectly normal, the following criteria must be met (Field, 2005):

- Skewness Statistic = 0
- Kurtosis Statistic = 0
- Kolmogorov-Smirnov Test: If test is non-significant ($p > 0.05$) then the distribution of the sample data is not significantly different from a normal distribution; if test is significant ($p < 0.05$) then the distribution of the sample is significantly different from the normal distribution
- Shapiro-Wilk Test: If test is non-significant ($p > 0.05$) then the distribution of the sample data is not significantly different from a normal distribution; if test is significant ($p < 0.05$) then the distribution of the sample is significantly different from the normal distribution

Table 5. Test for Normal Distribution

	Skewness		Kurtosis		Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistic	Significance	Statistic	Significance	Statistic	Significance	Statistic	Significance
Overall Contractor Performance Rating	0.838	0.189	-0.188	0.376	0.357	0.000	0.747	0.000
Project Schedule Growth	3.034	0.189	13.908	0.376	0.287	0.000	0.665	0.000
Quality Control	0.038	0.189	0.612	0.376	0.161	0.000	0.949	0.000
Adequacy of As-Builts	-0.612	0.189	-1.121	0.376	0.359	0.000	0.763	0.000
Effectiveness of Management	0.446	0.189	-0.873	0.376	0.184	0.000	0.912	0.000
Management of Subcontractors	-1.146	0.189	2.729	0.376	0.257	0.000	0.854	0.000
Timely Performance	-0.866	0.189	0.633	0.376	0.245	0.000	0.908	0.000
Warranty Response	-0.251	0.189	-1.322	0.376	0.295	0.000	0.812	0.000
Compliance with Labor Standards	-0.950	0.189	0.062	0.376	0.369	0.000	0.768	0.000
Correction of CLS Noted Deficiencies	1.083	0.189	1.240	0.376	0.402	0.000	0.719	0.000
Compliance with Safety Standards	0.313	0.189	0.305	0.376	0.261	0.000	0.881	0.000

As show in Table 6 no variable meets the criteria for normality. However, “size has the effect of increasing statistical power by reducing sample error; the larger samples sizes reduce the detrimental effects of non-normality. In small samples of 50 or fewer

observations, significant departures from normality can have a substantial impact on results (Hair, Black, Babin, Anderson, & Tatham, 2006).” This research was conducted on 165 data observations; it is assumed that while the data has a non-normal distribution, the potential detrimental effects of error have been reduced by the large sample size.

Assumption 2: Homogeneity of Variance. Homogeneity of variance assumption means “that as you go through levels of one variable, the variance of the other should not change (Field, 2005).” For this assumption of normality to be met, on a scatter plot cross plot of the regression standardized predicted values and the regression standardize residual should look like a random array of dots evenly dispersed around zero. Figure 3 is a scatter plot of the values used to determine the relationship between the contractor’s overall performance rating and the performance elements. While the random array of dots are dispersed around zero, it may not be appropriate to say they are evenly dispersed around zero. Figure 4 is a scatter plot of the values used to determine the relationship between the contractor’s overall performance rating and the overall project schedule performance. The random array of dots on this scatter plot are dispersed around zero, but again, not necessarily evenly dispersed around zero. For the purpose of this research, it is assumed that this assumption for normality is generally met.

Assumption 3: Interval Data. Interval data simply means that the distance between points on a scale is equal at all parts along the scale (Field, 2005). The data in this research is interval data. Specifically, the overall contractor performance rating and all other ratings associated with performance sub-elements is given on a 5-point satisfaction scale. It is assumed that the change in score from 2 to 3 is the same as that represented by a change in score from 4 to 5.

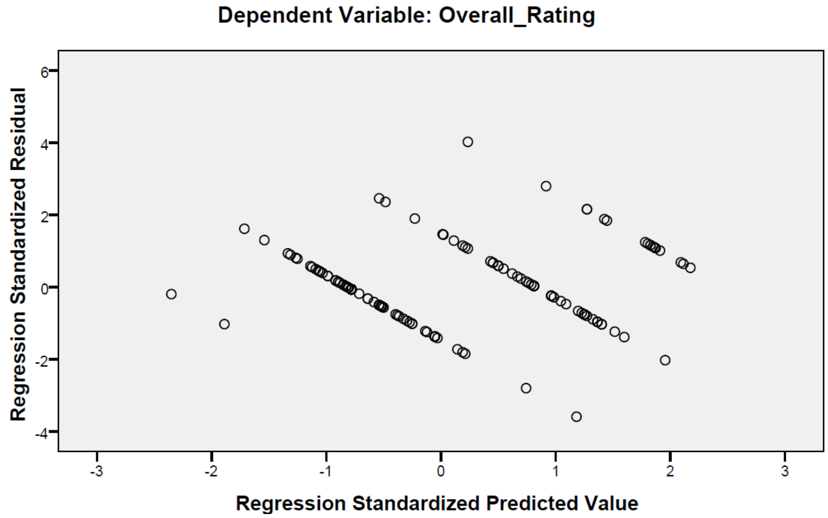

Figure 3. Scatter Plot 1

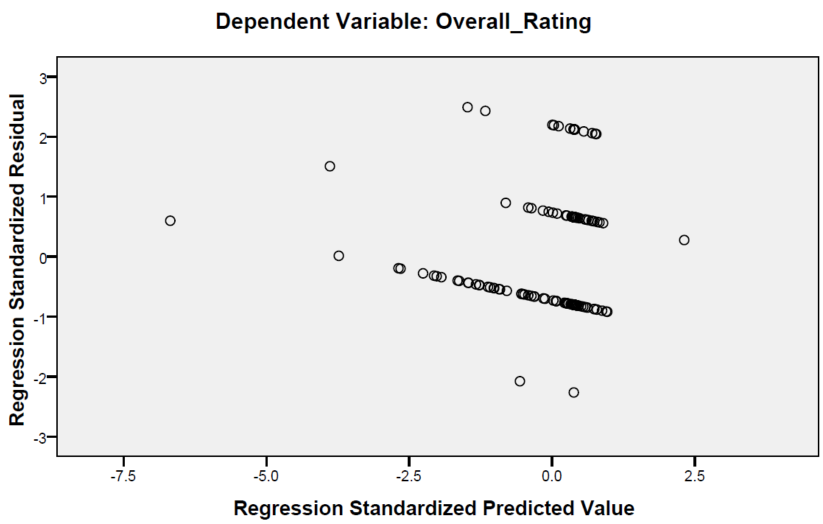

Figure 4. Scatter Plot 2

Assumption 4: Independence. Independence simply means that the behavior of one participant does not affect the behavior of another participant (Field, 2005). In relation to the data observations in this research, the evaluation by a project manager for project A does not affect or influence the evaluation by a project manager for project B.

As all four assumptions for conducting parametric tests were met for the data in this research, each of the research questions was tested using multivariate analysis. Research question 1 was tested using principle component analysis, research question 2 was tested using correlation analysis and linear regression, and research question 3 was tested using correlation analysis. The next section details principle component analysis.

Principle Component Analysis

This research strived to have the most representative and parsimonious set of factors possible to reduce measurement error and thus increase the strength and accuracy of the multivariate analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). To reduce the number of independent variables used in this research, a principle component analysis was conducted for each performance element and corresponding performance items. The principle component analysis is used to determine if the observed variables are condensable into a smaller set of variates (factors) with minimal loss of information (Hair, Black, Babin, Anderson, & Tatham, 2006). For instance, to determine if 'correction of noted deficiencies', 'payrolls properly completed and submitted', and 'compliance with labor laws and regulations' are all performance items of the performance element 'compliance with labor standards', a principle component analysis is used.

A detailed explanation behind the theory of principle component analysis can be found in Andy Field's book, *Discovering Statistics Using SPSS*, section 15.3.4. Simply stated, principle component analysis starts with a matrix that represents the relationship between variables. By determining the eigenvalues of the matrix, the variates, or linear components, of that matrix are then calculated. Eigenvectors, "the elements of which

provide the loading of a particular variable on a particular factor (Field, 2005)," are calculated using the eigenvalues.

The first step in interpreting results of a principle component analysis is determining if multicollinearity is a problem for the data set. Multicollinearity exists when two or more predictor variables are highly correlated (correlation value greater than 0.8) and are indistinguishable in a linear relationship. The output of a principle component analysis conducted using SPSS 16.0 includes a correlation matrix. At the bottom of this matrix is the determinant of the correlation matrix. If the determinant value is greater than 0.0001 then multicollinearity is not a problem to the dataset (Field, 2005). If, however, the determinant value is less than 0.0001, then the correlation matrix needs to be examined for variables that correlate very highly (R>0.8). If any items highly correlate, then it is recommended that one of the items be removed from the principle component analysis before proceeding. Once the correlation matrix determinant value passes the multicollinearity test, it is then necessary to determine how strongly the factors group together. Following the correlation matrix on an SPSS principle component analysis output is the KMO and Bartlett's Test. KMO or Kaiser-Meyer-Olkin measure of sampling adequacy is used to identify if a set of variables, when factored together, yield distinct and reliable factors (Field, 2005). KMO statistics vary between values of 0 to 1. Kaiser suggests that accepting values greater than 0.5 is barely acceptable; values between 0.5 and 0.7 are mediocre; values between 0.7 and 0.8 are good; values between 0.8 and 0.9 are great; and values greater than 0.9 are superb (Field, 2005). The next output from SPSS for a principle component analysis is a component matrix. This component matrix is used to determine which factors group into each specific

component. Every factor included in a principle component analysis will carry a loading on every resulting component. Each factor aligns best with the component for which it has the highest loading (Field, 2005). For instance, Table 6 is an example of a component matrix resulting from a principle component analysis. Interpretation of this table indicates that there are two components that resulted from the principle component analysis of nine factors. Based on the rules for grouping factors, all the factors, with the exception of QC.i are grouped into component 1; factor QC.i is grouped into component 2.

Table 6. Example Principle Component Analysis - Component Matrix

Factor	Component	
	1	2
QC.a	0.639	-0.303
QC.b	0.732	-0.385
QC.c	0.751	-0.430
QC.d	0.723	-0.344
QC.e	0.619	0.365
QC.f	0.743	0.044
QC.g	0.754	0.173
QC.h	0.666	0.366
QC.i	0.331	0.650
QC.j	0.688	0.179
QC.k	0.584	0.131

Research Questions

The objective of this research was to determine if the performance elements and performance items listed on DD Form 2626 represent the overall performance of the construction contractor. Therefore,

Research Question 1: Do the DD Form 2626 performance elements reflect their respective performance items?

Figure 5 is a conceptual representation of research question 1.

	Performance Items		Performance Elements
QC.a	Quality of service		
QC.b	Adequacy of CQC plan		
QC.c	Implementation of CQC plan		
QC.d	Quality of QC documentation		
QC.e	Storage of materials		
QC.f	Adequacy of materials		
QC.g	Adequacy of submittals	RQ #1 →	QC - Quality Control
QC.h	Adequacy of QC testing		
QC.i	Adequacy of as-builts		
QC.j	Use of specified material		
QC.k	Identification/correction of deficient work in a timely manner		
EM.a	Cooperation and responsiveness		
EM.b	Management of resources/ personnel,		
EM.c	Coordination and control of subcontractor(s)		
EM.d	Adequacy of site clean up		
EM.e	Effectiveness of job-site supervision	RQ #1 →	EM – Effectiveness of Management
EM.f	Compliance with laws and regulations		
EM.g	Professional conduct		
EM.h	Review/resolution of subcontractor issues		
EM.i	Implementation of subcontractor plan		
TP.a	Adequacy of initial progress schedule		
TP.b	Adherence to approved schedule		
TP.c	Resolution of delays		
TP.d	Submission of required documentation		
TP.e	Completion of punchlist items	RQ #1 →	TP – Timely Performance
TP.f	Submission of updated and revised progress schedules		
TP.g	Warranty response		
CLS.a	Correction of noted deficiencies		
CLS.b	Payrolls properly completed and submitted		
CLS.c	Compliance with labor laws and regulations with specific attention to the Davis-Bacon Act and EEO requirements	RQ #1 →	CLS – Compliance with Labor Standards
CSS.a	Adequacy of safety plan		
CSS.b	Implementation of safety plan	RQ #1 →	CSS – Compliance with Safety Standards
CSS.c	Correction of noted deficiencies		

Figure 5. Conceptual Model of Research Question 1

Principle component analysis was conducted on the five performance elements and respective performance items using SPSS 16.0. Limited information is available in the literature to support the current categorization of sub-performance elements as they appear on the DD Form 2626. Face validity will serve to support maintaining each performance sub-element with its respective performance element when executing the initial principle component analysis. “By default, SPSS uses Kaiser’s criterion for extracting factors (Field, 2005).” Kaiser’s criterion recommends that all factors with eigenvalues greater than 1 be retained. Results of the principle component analysis are discussed in Chapter 4 of this research.

Research Question 2: Do the performance items as they are appropriately aggregated into performance elements predict the contractor’s overall performance rating?

Figure 6 is a conceptual representation of research question 2. Using the results from the component analysis, the performance elements and the overall contractor performance rating were individually correlated to determine if a relationship exists. Once relationships were established, logistical regression analysis was conducted using SPSS 16.0 to determine the combination of specific performance elements that result in predicting the contractor’s overall performance rating. SPSS 16.0 also facilitated specification of a stepwise procedure for the selection of independent variables (from the performance elements developed in the principle component analysis) and goodness-of-fit statistics for the developed contractor performance prediction model.

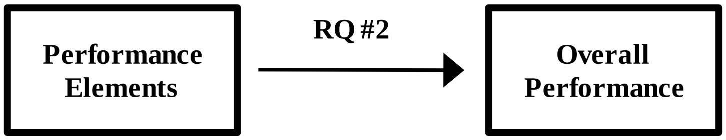

Figure 6. Conceptual Model of Research Question 2

As mentioned earlier, a contractor's overall project performance is based on quality, schedule, and cost (Ling & Liu, 2004). To test if this statement is true, the Overall Contractor Rating was compared to the Project Schedule Growth to determine if a correlation exists between a contractor's performance and schedule compliance. If USACE project managers truly value schedule performance, then the contractor's overall performance rating should decrease as the project schedule growth increases. Therefore,

Research Question 3: Is the contractor's overall performance rating and the overall project schedule performance related?

Figure 7 is a conceptual representation of research questions 3.

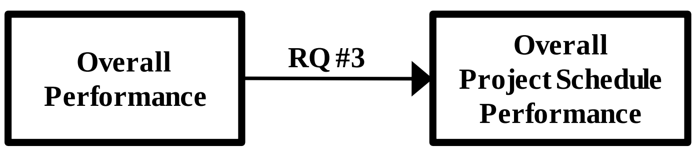

Figure 7. Conceptual Model of Research Questions 3

Study Significance Level

Significance level (alpha) refers to the risk the researcher is willing to take that the estimated coefficient is not statistically different from zero (Hair, Black, Babin, Anderson, & Tatham, 2006). This is referred to as a Type I error. Typically, a value of .05 is used for comparing the level of significance with the p-value (or observed

significance). For this study, a one-tailed test statistic that produces a p-value less than 0.05 will be considered statistically significant and highly significant if less than 0.01 (Hair, Black, Babin, Anderson, & Tatham, 2006).

Summary

Chapter 3, Methodology, described the data source, data collection, and data analysis methods that were used to analyze the methods employed by the USACE to evaluation and rate the performance of construction contractors. A principle component analysis was conducted on each performance item as they are grouped on DD Form 2626 to determine if the performance items represent their respective performance elements. The result of the principle component analysis identified more representative performance elements which were then used to identify if a relationship exists between the performance elements and the contractor's overall performance rating. Finally, the contractor's overall performance rating was compared with the overall schedule performance to determine if traditional measures of project success are actively used in the USACE's evaluation process. Chapter 4, Results, will present, analyze, and discuss the data in order to answer the research questions.

IV. Analysis and Results

Chapter Overview

This chapter provides the raw results of the study based on the methodology developed in Chapter 3. The results are presented graphically and in tables with discussions limited to the statistical analysis. Presentation of the research results follows the research questions developed in Chapter 1 and reiterated in Chapter 3. Additional interpretation, explanation, and speculation of the results will be addressed in Chapter 5: Conclusions.

Results

The objective of this research is to strengthen the USAF rating system of contractor performance by evaluating DD Form 2626 Construction Contractor Performance Evaluation. The United States Army Corp of Engineers uses the DD Form 2626 to evaluate and rate construction contractors' performance and then uses the evaluations for future source selections. The research analyzed DD Form 2626 to determine if any of the performance items are correlated to a contractor's overall performance rating. The research also determined that a relationship exists between overall schedule performance and a contractor's overall performance. Figure 8 summarizes the research into the relationships of this study.

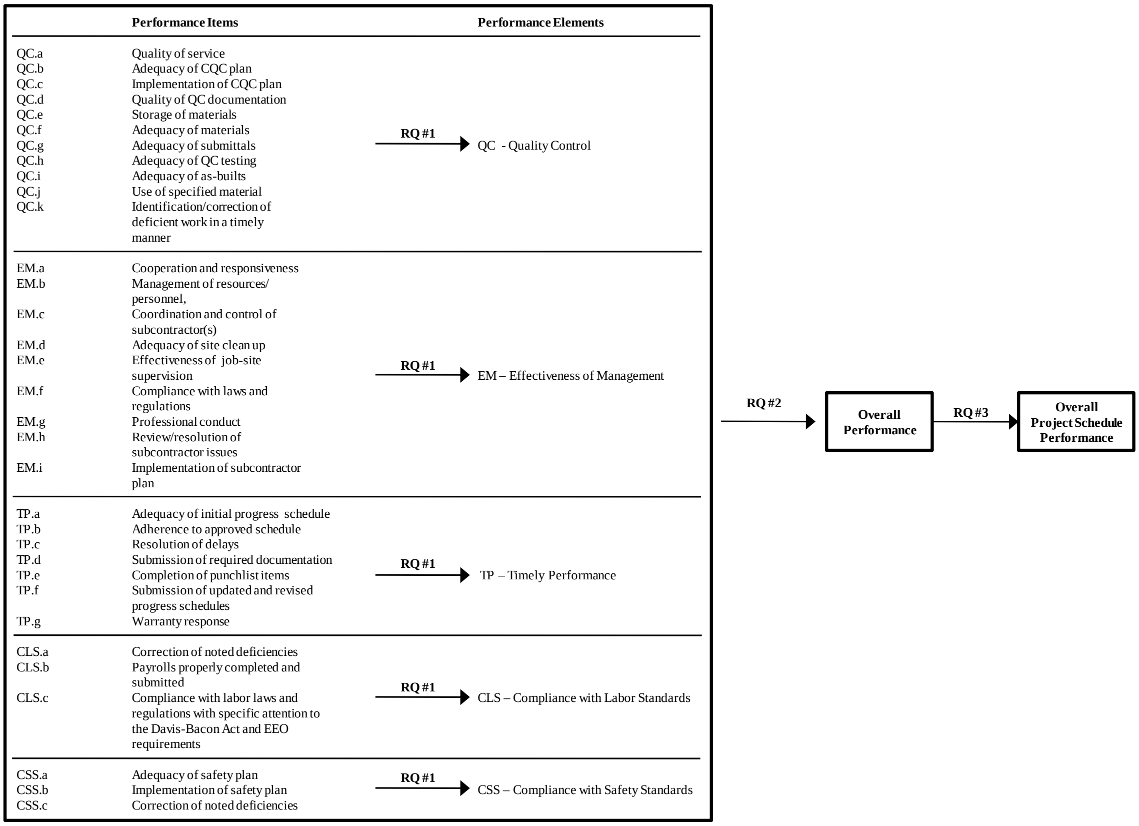

Figure 8. Relationship Conceptual Model

Research Question 1: Do the DD Form 2626 performance elements reflect their respective performance items?

Reliability of the measured data was first obtained using SPSS 16.0. The most common measure of scale reliability is Cronbach's alpha. Generally a value of 0.7 – 0.8 is an acceptable value for Cronbach's alpha (Field, 2005). The Cronbach's alpha values for each of the performance elements are as follows: Quality Control = 0.846, Effectiveness of Management = 0.839, Timely Performance = 0.810, Compliance with Labor Standards = 0.268, and Compliance with Safety Standards = 0.729. All the performance elements have acceptable Cronbach's alpha values except Compliance with Labor Standards. Reasons for this will be discussed in detail in Chapter 5. Results of the reliability analysis can be found in Appendix F.

A principle component analysis was conducted to test if the five performance elements provided on DD Form 2626 are represented by their respective performance items. Details on the method of principle component analysis can be found in Chapter 3. Recall: When conducting a principle component analysis, before factors are aggregated by component, it should first be determined if the data set is at risk of multicollinearity. If the determinant value is greater than 0.0001, then the dataset is ***not*** at risk of multicollinearity (Field, 2005). The KMO value will help determine if the set of variables, when factored together, yield distinct and reliable factors. KMO statistics vary between values of 0 to 1; Kaiser suggests that accepting values greater than 0.5 are barely acceptable; values between 0.5 and 0.7 are mediocre; values between 0.7 and 0.8 are good; values between 0.8 and 0.9 are great; and values greater than 0.9 are superb (Field, 2005).

A principle component analysis and confirmatory component analysis were conducted on all 33 items before each of the five performance element groupings were tested to see how each of the items would factor together. This analysis produced seven components. Table 7 summarizes the results of the principle component analysis. None of the performance items factored together with their respective performance element, as they are grouped on DD Form 2626. Additionally, the dataset as a whole suffers from multicollinearity with a determinate value of 1.17E-11 – a value that is seven orders of magnitude less than the threshold criteria. However, the KMO value is 0.856 indicating that factoring the variables together should yield "great" distinct and reliable factors. For the confirmatory factor analysis, five components were indicated for the factor analysis.

Table 7: Overall Principle Component Analysis

Performance Item	Component Number	Performance Item	Component Number
QC.a - Quality of Workmanship	1	EM.i - Implementation of Subcontracting Plan	2
QC.b - Adequacy of the CQC Plan		TP.f - Submission of Updated and Revised Progress Schedules	2
QC.c - Implementation of the CQC Plan			
QC.d - Quality of QC Documentation			
QC.f - Adequacy of Materials		CSS.c - Correction of Noted Deficiencies	3
QC.g - Adequacy of Submittals		CLS.a - Correction of Noted Deficiencies	3
QC.h - Adequacy of Testing			
QC.k - Identification/Correction of Deficient Work in		QC.e - Storage of Materials	4
EM.a - Cooperation and Responsiveness			
EM.b - Management of Resources Personnel		CLS.c - Compliance with Labor Laws and Regulations with Specific Attention to the Davis-Bacon Act and EEO Regulations	5
EM.c - Coordination and Control of Subcontract(s)			
EM.d - Adequacy of Site Clean Up			
EM.e - Effectiveness of Job-Site Supervision			
EM.f - Compliance with Laws and Regulations		QC.i - Adequacy of As-Builts	6
EM.g - Professional Conduct			
EM.h - Review/Resolution of Subcontractor's Issues		TP.g - Warranty Response	7
TP.a - Adequacy of Initial Progress Schedule			
TP.b - Adherence to Approved Schedule			
TP.c - Resolution of Delays			
TP.d - Submission of Required Documentation			
TP.e - Completion of Punchlist Items			
CLS.b - Payrolls Properly Completed and Submitted			
CSS.a - Adequacy of Safety Plan			
CSS.b - Implementation of Safety Plan			

While confirmatory factor analysis resulted in five components, none of the performance items factored together with their respective performance element, as they are grouped on DD Form 2626. Therefore, for the remaining principle component analyses, the performance items will be analyzed as they are grouped on DD Form 2626.

The first performance element analyzed was *Quality Control*. Figure 9 represents the analysis of the relationship between Quality Control and its respective performance items. Quality Control is represented by eleven performance items on DD Form 2626. The principle component analysis resulted in two components. The following performance items grouped into component 1 and therefore were found to be representative of performance element Quality Control 1: Quality of Workmanship,

Adequacy of the CQC Plan, Implementation of the CQC Plan, Quality of QC Documentation, Adequacy of Materials, Adequacy of Submittals, Adequacy of Testing, and Identification/Correction of Deficient Work in a timely manner. Component 2 captured three performance items – Storage of Materials, Adequacy of As-Builts, and Use of Specified Materials. For analysis of research question number two, eight of the performance items listed under Quality Control were averaged together to represent performance element Quality Control 1. Performance items Storage of Materials, Adequacy of As-Builts, and Use of Specified Materials were averaged together to represent performance element Quality Control 2. The initial and confirmatory results of the principle component analysis for Quality Control are located in Appendix H.

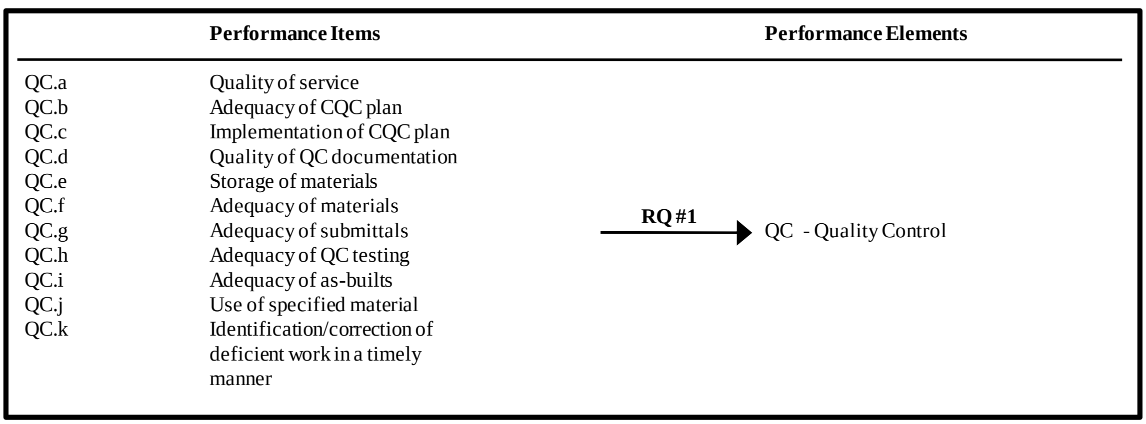

Figure 9. Conceptual Model of Research Question 1 - Quality Control

The second performance element analyzed was *Effectiveness of Management*. Figure 10 represents the analysis of the relationship between Effectiveness of Management and its respective performance items. On DD Form 2626, Effectiveness of Management is represented by nine performance items. The principle component analysis resulted in two components. The following performance items grouped into component 1 and therefore were found to be representative of performance element

Effectiveness of Management: Cooperation and Responsiveness, Management of Resources/Personnel, Adequacy of Site Clean-Up, Effectiveness of Job-Site Supervision, Compliance with Laws and Regulations, and Professional Conduct. The remaining three performance items listed under Effectiveness of Management grouped into component 2. They are Coordination and Control of Subcontractor(s), Review/Resolution of Subcontractor's Issues, and Implementation of Subcontracting Plan. It is not surprising that subcontractor performance items do not factor with the other effectiveness of management performance items. Of the 165 projects analyzed in this research, only 65% of the projects included subcontractors. It is appropriate that the subcontractor performance items factor together and are exclusive of the other Effectiveness of Management performance items. To address research question number two the performance items listed under Effectiveness of Management, excluding the three performance items mentioned, were averaged together to represent performance element Effectiveness of Management. Performance items Coordination and Control of Subcontractor(s), Review/Resolution of Subcontractor's Issues, and Implementation of Subcontracting Plan were averaged together to create a new performance element titled Management of Subcontractor(s). The initial and confirmatory results of the principle component analysis for effectiveness of management are located in Appendix I.

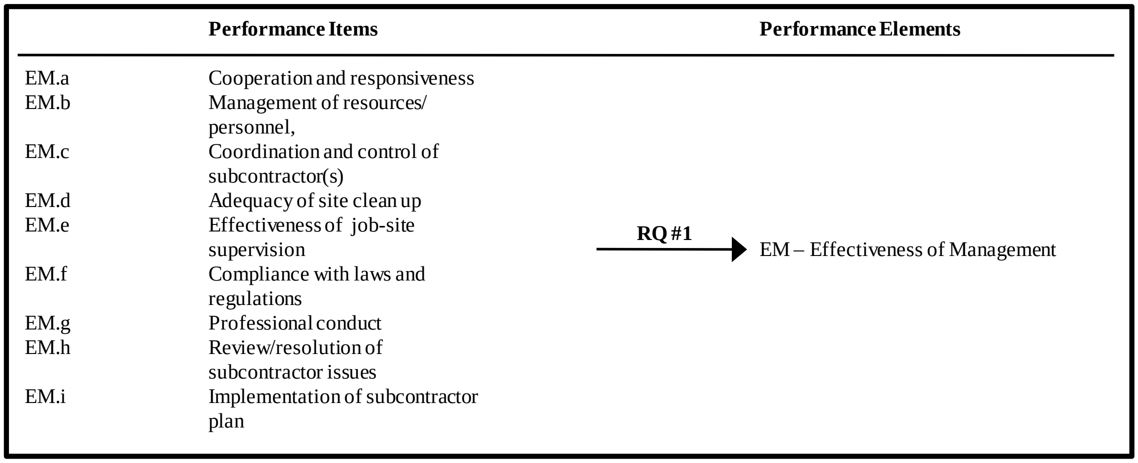

Figure 10. Conceptual Model of Research Question 1: Effectiveness of Management

The third performance element analyzed was Timely Performance. Figure 11 represents the analysis of the relationship between Timely Performance and its respective performance items. On DD Form 2626, Timely Performance is represented by seven performance items. The principle component analysis resulted in two components. The following performance items grouped into component 1 and were found to be representative of performance element Timely Performance: Adequacy of Initial Progress Schedule, Adherence to Approved Schedule, Resolution of Delays, Submission of Required Documentation, Completion of Punchlist Items, and Submission of Updated and Revised Progress Schedules. Component 2 only captures one performance item – Warranty Response. Not all construction projects were rated for Warranty Response. Of the 165 projects in the data set used in the analysis, only 67% were applicable for Warranty Response evaluation. This may account for Warranty Response factoring separately from the other six Timely Response performance items. To address research question two the performance items listed under Timely Response, excluding Warranty Response, were averaged together to represent performance element Timely Response.

Performance item Warranty Response was singled out as its own performance element. The initial and confirmatory results of the principle component analysis for timely performance are located in Appendix J.

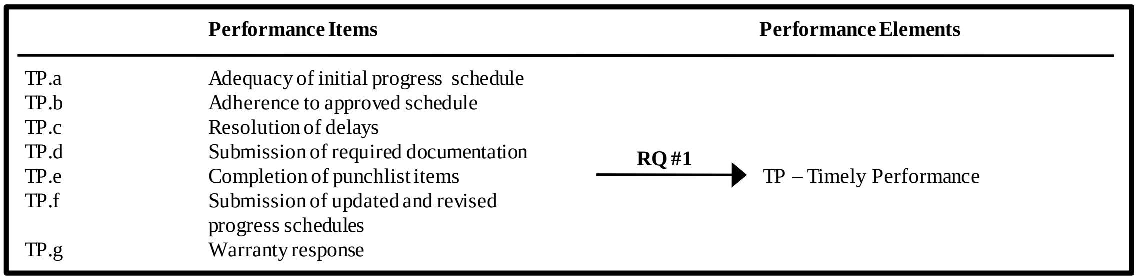

Figure 11. Conceptual Model of Research Question 1 - Timely Performance

The fourth performance element analyzed was Compliance with Labor Standards. Figure 12 represents the analysis of the relationship between Compliance with Labor Standards and its respective performance items. On DD Form 2626, Compliance with Labor Standards is represented by three performance items. The following performance items were found representative of the performance element Compliance with Labor Standards and were grouped into component 1: Payrolls Properly Completed and Submitted, and Compliance with Labor Laws and Regulations with Specific Attention to the Davis-Bacon Act and EEO Requirements. Component 2 only captures one performance item – Correction of Noted Deficiencies. For analysis of research question number two, all the performance items except Correction of Noted Deficiencies were averaged together to represent performance element Compliance with Labor Standards. The performance item Correction of Noted Deficiencies was singled out as its own performance element titled Correction of Compliance with Labor Standards (CLS) Noted Deficiencies. The initial and confirmatory results of the principle component analysis for compliance with labor standards are located in Appendix K.

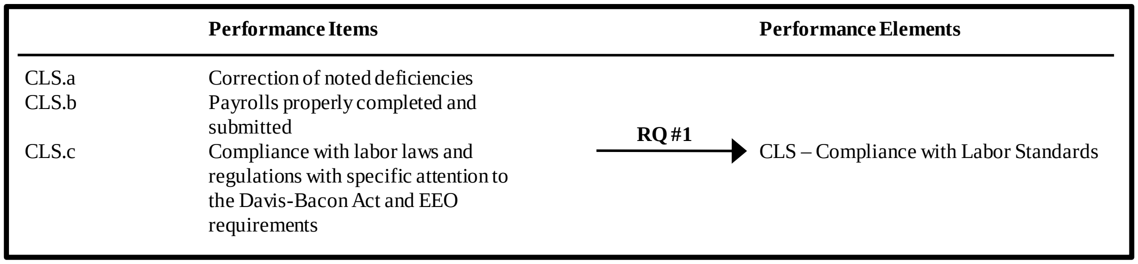

Figure 12. Conceptual Model of Research Question 1 - Compliance with Labor Standards

The fifth performance element analyzed was Compliance with Safety Standards. Figure 13 represents the analysis of the relationship between Compliance with Safety Standards and its respective performance items. On DD Form 2626, Compliance with Safety Standards is represented by three performance items. All the performance items listed under Compliance with Safety Standards were found to be representative and grouped into one component. These performance items are Adequacy of Safety Plan, Implementation of Safety Plan, and Correction of Noted Deficiencies. All the performance items listed under compliance with safety standards were averaged together to represent performance element Compliance with Safety Standards. This will be use din the analysis of research question two. The initial and confirmatory results of the principle component analysis for timely performance are located in Appendix L.

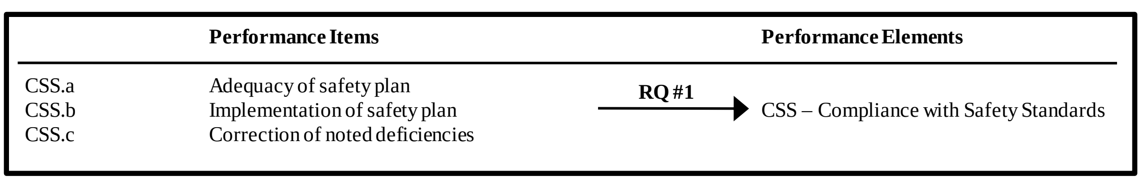

Figure 13. Conceptual Model of Research Question 1 - Compliance with Safety Standards

The overall result of the principle component analysis was a reduction of 33 independent variables to nine independent variables: Quality Control 1 (QC1), Quality Control 2 (QC2), Effectiveness of Management (EM), Management of Subcontractors

(MS), Timely Performance (TP), Warranty Response (WR), Compliance with Labor Standards (CLS), Correction of CLS Noted Deficiencies (CCLSND), and Compliance with Safety Standards (CSS). Table 8 summarizes the determinant and KMO values for each of the nine performance elements. Notice that all the factored performance elements exceed the determinant value for multicollinearity (R > 0.0001) and are considered to yield an "acceptable" distinct and reliable factor.

Table 8. Summary of Determinant and KMO Values for Finalized Performance Elements

	QC1	QC2	EM	MS	TP	WR	CLS	CCLSND	CSS
Determinant	0.023	0.688	0.017	0.378	0.071	NA*	0.336	NA	0.434
KMO Value	0.785	0.555	0.898	0.632	0.842	NA*	0.500	NA	0.650

* No determinant or KMO values because these represent single peformance items turned into individual performance elements

These nine acceptable factored performance elements were used as independent variables to analyze research question number two discussed in detail in the next section.

Research Question 2: Do the performance items as they are appropriately aggregated together into performance elements predict the contractor's overall performance rating?

Using SPSS version 16.0, a correlation analysis was conducted to determine if a relationship exists between the nine factored performance elements derived from the principle component analysis and the contractor's overall performance rating. Figure 14 is a conceptual model of the proposed relationship between the factored performance elements and the contractor's overall performance rating. A summary of the correlation results is provided in Table 9. Detailed results of each correlation analysis are provided in Appendix M. Eight of the nine performance elements analyzed have a significant relationship with the contractor's overall performance rating. Effectiveness of Management has the strongest correlation to the contractor's overall performance rating, whereas, Warranty Response has no relationship to the contractor's overall performance

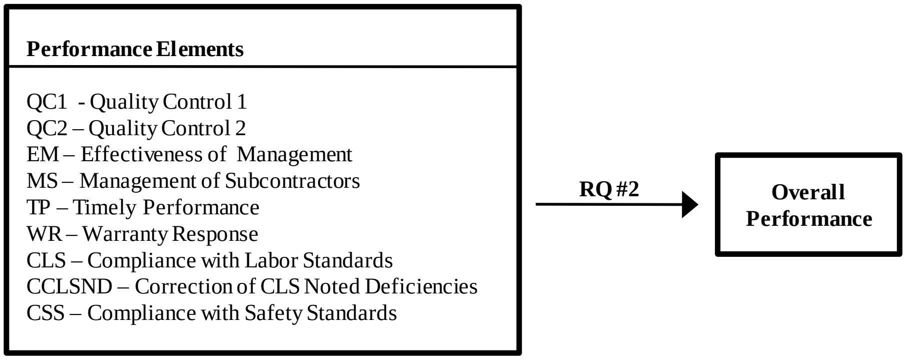

Figure 14. Conceptual Model of Research Question 2

rating. At first glance it would appear that Effectiveness of Management, as aggregated from the appropriate performance items, has the strongest influence on the contractor's overall performance rating. It also appears that the contractor's warrantee response and the contractor's correction of noted deficiencies in compliance with labor standards have little to no influence on the contractor's overall performance rating. Correlation analysis only considers the relationship between each individual performance element and the contractor's overall performance rating. The next step in this analysis was to conducted a step-wise linear regression in order to understand how the performance elements interact with each other to affect the contractor's overall performance rating.

Table 9. Correlation Analysis of Performance Elements and Contractor's Overall Performance Rating

	QC1	QC2	EM	MS	TP	WR	CLS	CCLSND	CSS
Contractor's Overall Performance Rating	0.628**	0.219**	0.869**	0.380**	0.448**	0.098	0.528**	0.156*	0.535**

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

Using SPSS version 16.0, a step-wise linear regression was conducted on those performance elements with a significant relationship to the contractor's overall performance rating to determine if in fact the contractor's overall performance rating is a composite score of the measured performance items as aggregated into performance

elements.   The step-wise linear regression resulted in two models. Detailed can be found in Appendix N.

Figure 15 is the first mathematical model that resulted from the linear regression. It has one predictor, EM = effectiveness of management, and a R^2 value of 0.755. This means that 75.5% of the variance in the contractor's overall performance rating is accounted for by effectiveness of management averaged ratings. Using the 50 project evaluations that were randomly removed from the original 215 project evaluations, mathematical Model #1 was tested for its accuracy its ability to predict the actual contractor's overall performance rating. Table 10 summarizes the prediction results for the 50 project evaluations set aside for model validation. Mathematical Model #1 accurately predicted 44 of 50 contractor's overall performance ratings. This gives the model a reliability of 88%. The model will accurately predict the contractor's overall performance rating only using the Effectiveness of Management score 88% of the time. This score is an average of the ratings given for the performance items: Cooperation and responsiveness, management of resources/personnel, adequacy of site clean-up, effectiveness of job-site supervision, compliance with laws and regulations, and professional conduct.

$$Y = 0.176 + 0.936X_1$$

where

Y = *Contractor's Overall Performance Rating (Predicted)*

X_1 = *Effectiveness of Management (EM)*

Figure 15: Mathematical Model #1

Table 10: Model Validation EM					
Project	**Overall Rating Actual**	**Overall Rating Predicted**	**Project**	**Overall Rating Actual**	**Overall Rating Predicted**
Project 1	3	3	Project 26	3	3
Project 2	3	3	Project 27	3	3
Project 3	3	3	Project 28	4	4
Project 4	4	4	Project 29	3	3
Project 5	3	4	Project 30	3	3
Project 6	3	3	Project 31	4	4
Project 7	4	4	Project 32	4	3
Project 8	4	4	Project 33	3	3
Project 9	3	3	Project 34	2	3
Project 10	4	4	Project 35	3	3
Project 11	3	3	Project 36	3	3
Project 12	4	4	Project 37	3	3
Project 13	3	3	Project 38	5	5
Project 14	4	4	Project 39	3	3
Project 15	4	4	Project 40	4	4
Project 16	4	3	Project 41	4	4
Project 17	4	4	Project 42	3	3
Project 18	3	3	Project 43	3	3
Project 19	3	3	Project 44	3	4
Project 20	3	3	Project 45	3	3
Project 21	3	4	Project 46	3	3
Project 22	4	4	Project 47	3	3
Project 23	3	3	Project 48	3	3
Project 24	4	4	Project 49	3	3
Project 25	4	4	Project 50	3	3

Figure 16 is the second mathematical model that resulted from the linear regression. It has two predictors, EM = effectiveness of management and TP = timely performance, and a R^2 value of 0.766. This means that 76.6% of the variance in the contractor's overall performance rating is accounted for by the combination of effectiveness of management averaged ratings and timely performance averaged ratings. Mathematical Model #2 was tested for its accuracy in predicting the actual contractor's overall performance rating using the 50 randomly sequestered project evaluations from the original 215 project evaluations. Table 11 summarizes the prediction results for the 50 project evaluations set aside for model validation. Mathematical Model #2 accurately predicted 45 of 50 contractor's overall performance ratings, giving the model a reliability of 90%. This means that 90% of the time, the model will accurately predict the contractor's overall performance rating using the Effectiveness of Management (EM) score and the Timely Performance (TP) score. Derivation of the EM score was discussed previously; TP is derived by averaging of the ratings for the following performance items: Adequacy of initial progress schedule, adherence to approved schedule, resolution of delays, submission of required documentation, completion of punchlist items, and submission of updated and revised progress schedules.

$$Y = 0.116 + 0.885X_1 + 0.083X_2$$

where

Y = *Contractor's Overall Performance Rating (Predicted)*
X_1 = *Effectiveness of Management (EM)*
X_2 = *Timely Performance (TM)*

Figure 16: Mathematical Model #2

Table 11: Model Validation EM & TP					
Project	**Overall Rating Actual**	**Overall Rating Predicted**	**Project**	**Overall Rating Actual**	**Overall Rating Predicted**
Project 1	3	3	Project 26	3	3
Project 2	3	3	Project 27	3	3
Project 3	3	3	Project 28	4	4
Project 4	4	4	Project 29	3	3
Project 5	3	4	Project 30	3	3
Project 6	3	3	Project 31	4	4
Project 7	4	4	Project 32	4	3
Project 8	4	4	Project 33	3	3
Project 9	3	3	Project 34	2	3
Project 10	4	4	Project 35	3	3
Project 11	3	3	Project 36	3	3
Project 12	4	4	Project 37	3	3
Project 13	3	3	Project 38	5	5
Project 14	4	4	Project 39	3	3
Project 15	4	4	Project 40	4	4
Project 16	4	3	Project 41	4	4
Project 17	4	4	Project 42	3	3
Project 18	3	3	Project 43	3	3
Project 19	3	3	Project 44	3	4
Project 20	3	3	Project 45	3	3
Project 21	3	4	Project 46	3	3
Project 22	4	4	Project 47	3	3
Project 23	3	3	Project 48	3	3
Project 24	4	4	Project 49	3	3
Project 25	4	4	Project 50	3	3

When comparing the R^2 values for Model #1 and Model #2, accounting for the variance in the contractor's overall performance rating does not seem to be significantly improved by combining the independent variables EM and TP. The same holds true when the two models are validated; mathematical Model #1 and Model #2 appear to have similar prediction power. Using the 50 project evaluations set aside for model validation, Model #1 accurately predicted 88% of the contractor's overall performance ratings; Model #2 accurately predicted 90%. Implications of these results will be discussed in Chapter 5 of this research.

Research Question 3: Is the contractor's overall performance rating and the overall project schedule performance related?

Figure 17 is a conceptual model of research question 3. Correlation analysis was conducted on the 165 project evaluations to determine if a relationship exists between the contractor's overall rating and the overall project schedule performance. The results of this correlation analysis were a Pearson's correlation value of -0.195 and a significance value of 0.006. This indicates a significant relationship between the contractor's overall performance rating and the overall project schedule performance, though the relationship is small. Implications of these results will be discussed in Chapter 5 of this research.

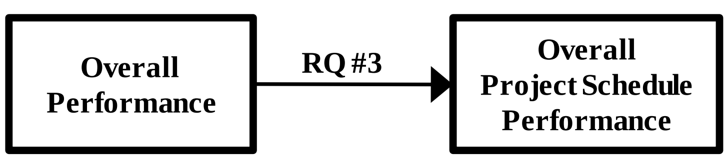

Figure 17. Conceptual Model of Research Question 3

Summary

This study gathered 215 DD Form 2626 construction project evaluations to determine if any of the performance items are correlated to a contractor's overall performance rating. This data were evaluated to determine if the 33 performance items reflected their respective performance elements. A principle component analysis on each performance element and their respective performance items revealed that most performance items represented their respective performance elements; however, not all performance items factored together as represented on DD Form 2626. Aggregation of the performance items resulted in nine performance elements; four greater than the original five performance elements as indicated on DD Form 2626. A correlation analysis was then conducted on these nine performance elements and the contractor's overall performance rating to determine if the performance items as aggregated into the "factored" performance elements are an indication of the contractor's overall performance. The correlation analysis revealed that eight of the nine performance elements had a significant relationship with the contractor's overall rating. The performance element that did not have a relationship with the contractor's overall performance rating was Warranty Response. These results are likely explained by the fact that Warranty Response was only rated for 66% of the evaluated construction projects. Using the eight performance elements that had a significant relationship with the contractor's overall performance rating, a linear regression analysis was conducted to identify if these performance elements were indicators of the contractor's overall performance. When the step-wise linear regression was complete, only two performance elements were predictive of the contractor's overall rating: Effectiveness of Management

and Timely Performance. Of the original 33 performance items used to rate a contractor's performance, only twelve have significant impact on how the contractor's overall performance is rated. Finally, one measure of traditional project success is schedule performance (Ling & Liu, 2004). This tradition is not reflected in the contractor's overall performance rating as indicated by the correlation analysis of the contractor's overall performance rating and the overall project schedule performance. Table 12 is a summary of the answers to each of the research questions. The implications of the results summarized here will be discussed in detail in Chapter 5 of this research.

Table 12. Summary of Answers to the Research Questions

RQ#	Research Question	Answer	Explanation
1	Do the DD Form 2626 performance elements reflect their respective performance items?	Yes, however	All the performance items factored into their respective performance elements with the exception of Adequacy of As-Builts, Coordination and Control of Subcontractors, Review/Resolution of Subcontractor's Issues, Implementation of Subcontracting Plan, Warranty Response, and Correction of Noted Deficiences (w.r.t. Compliance with Labor Standards). Based on the results of the PCA, the original five performance elements as shown on DD Form 2626 were factored into the following nine performance elements: Quality Control (QC), Adequacy of As-Builts (AAB), Effectiveness of Management (EM), Management of Subcontractors (MS), Timely Performance (TP), Warranty Response (WR), Compliance with Labor Standards (CLS), Correction of CLS Noted Deficiencies (CCLSND), and Compliance with Safety Standards (CSS).
2	Do the performance items as they are appropriately aggregated together into performance elements predict the contractor's overall performance rating?	Yes, however	A correlational analysis was used to determine the relationship between the contractor's overall performance rating and each factored performance element. Seven of the nine factored performance elements are significantly related to the contractor's overall performance rating. However, a linear regression analysis revealed that only two of the seven factored performance elements are predictive of a contractor's overall performance rating.
3	Is the contractor's overall performance rating and the overall project schedule performance related?	Yes, however	A significant relationship exists between the contractor's overall performance rating and the overall project schedule performance, though the relationship is small.

V. Conclusions and Recommendations

Chapter Overview

This chapter summarizes the results and answers the questions posed by each research question. Where Chapter 4 presented the results of each statistical analysis conducted on the data provided from DD Form 2626, this chapter will discuss the significance and limitations of these. Finally, this chapter will recommend actions that should be taken as a result of this research and recommend future areas of research.

Problem Statement

The objective of this research was to analyze DD Form 2626 – the USACE's method for evaluating construction contractors—in order to determine if their process is reliable, valid, and appropriate for implementation by the USAF civil engineers when evaluating and rating contractor performance. The research analyzed DD Form 2626 to determine if any of the performance items are correlated to a contractor's overall performance rating. The research determined if a relationship exists between the project schedule performance and the contractor's overall performance.

Research Questions

1. **Do the DD Form 2626 performance elements reflect their respective performance items?**

To test if the five performance elements provided on DD Form 2626 are represented by their respective performance items, a principle component analysis was

conducted. The results of the principle component analysis revealed that the performance elements are not completely reflective of the performance items as they are arranged on DD Form 2626. Though most performance items factored together with their respective performance element, a few performance items factored separately. Those performance items were Storage of Materials, Adequacy of As-Builts, Use of Specified Materials, Coordination and Control of Subcontractors, Review/Resolution of Subcontractor's Issues, Implementation of Subcontracting Plan, Warrantee Response, and Correction of Noted Deficiencies (under Compliance with Labor Standards). It is possible the reason why these particular performance items do not factor with their respective performance items because only 72% of the contractor evaluations were rated for Adequacy of As-Builts, 67% were rated for Warranty Response and only 82% were rated for Correction of Compliance with Labor Standard Noted Deficiencies. Without access to the individuals who completed these contractor evaluation forms, one can only speculate why these performance items were not applicable for rating. For instance, it is possible that only 72% of the projects evaluated required as-builts or that when the DD Form 2626 was completed for a particular contractor, they had not submitted the as-builts yet for review. As indicated by the local USACE resident engineer, this can sometimes be a problem with contractors. While the contractor is required by contract to submit as-builts three months prior to contract completion, typically the as-builts are not turned over to the USACE office until sometime after the construction has been completed.

The same holds true for Warranty Response which was only applicable for 67% of the contractor evaluations. However, one should question how appropriate it is to rate a contractor's warranty response immediately after the completion of construction. A

contractor’s response to warranty items would only begin once the construction project is complete and depending on the length of the warranty can be a period of months to two years after the construction is complete. If a contractor performance evaluation is completed on a contractor once the construction has been completed, there is not sufficient time or opportunity to fairly evaluate a contractor’s warranty response.

With 82% of the project evaluations including a rating for Correction of Compliance with Labor Standard Noted Deficiencies, one might question why this performance item did not factor with the other two performance items listed under Compliance with Labor Standards. The answer may correspond with how ‘Not Applicable’ ratings were scored for the statistical analysis and the reason why a contractor’s performance might be rated as not applicable for correction of noted deficiencies. Table 13 is a snapshot of all project evaluations where Correction of Compliance with Labor Standards Noted Deficiencies was rated as Not Applicable. Notice that for the other two related performance items, the contractor’s performance rating was either satisfactory, above average, or outstanding. It is possible that a contractor who properly completed and submitted payrolls and who complied with labor laws and regulation, likely did not have any noted deficiencies with compliance with labor standards. If the contractor did not have any noted deficiencies to correct, his ability to correct noted deficiencies could therefore not be rated. Recall from Chapter 3, for statistical analysis, the qualitative ratings were given numeric scores as follows: Not Applicable = 0, Outstanding = 5, Above Average = 4, Satisfactory = 3, Marginal = 2, and Unsatisfactory = 1. Quantitatively, a rating of zero is very different from a rating of three, four, or five. Therefore, during the principle component analysis, it appears that

the three performance item scores listed under Compliance with Labor Standards do not relate, where in fact, taken from an adjusted perspective, they are highly related. This statement becomes true when the scores are reversed coded such that 1) a score of zero means that there are not deficiencies to correct, therefore performance in this item is close to outstanding, and 2) if a contractor is rated high in correction of noted deficiencies, then his rating corresponds to his performance in completing payrolls and compliance with labor laws and regulations. When a principle component analysis was performed on the reverse coded data, all three performance items factored under one component, and therefore are reflective of the performance element Compliance with Labor Standards. Results of this principle component analysis are available in Appendix O.

Table 13. Compliance with Labor Standards

Project	18.a*	18.b**	18.c***	Project	18.a*	18.b**	18.c***
Project 1	0	4	4	Project 16	0	3	3
Project 2	0	4	4	Project 17	0	3	3
Project 3	0	3	3	Project 18	0	3	3
Project 4	0	4	3	Project 19	0	4	4
Project 5	0	4	3	Project 20	0	4	4
Project 6	0	3	3	Project 21	0	3	3
Project 7	0	3	3	Project 22	0	3	3
Project 8	0	4	4	Project 23	0	3	3
Project 9	0	3	3	Project 24	0	3	3
Project 10	0	3	3	Project 25	0	4	4
Project 11	0	3	3	Project 26	0	4	5
Project 12	0	3	3	Project 27	0	4	5
Project 13	0	3	3	Project 28	0	5	5
Project 14	0	4	4	Project 29	0	4	4
Project 15	0	4	4	Project 30	0	3	3

* Correction of Noted Deficiences
** Payrolls Properly Completed and Submitted
*** Compliance with Labor Laws and Regulations with Specific Attention to the Davis-Bacon Act and EEO Requirements

When a principle component analysis was conducted on the performance items listed under Effectiveness of Management, the result was three of the nine performance items to factor into a separate component. The three performance items that factored separately were Coordination and Control of Subcontractors, Review/Resolution of Subcontractor's Issues, and Implementation of Subcontracting Plan. Because only these three performance items relate to a contractor's ability to manage his subcontractor(s), it is appropriate that these performance items would factor together. Theoretically, it should also not surprising that these three performance items would not factor with the other six performance items listed under Effectiveness of Management since only 65% of the contractor evaluations included subcontractor work as indicated in Block 8 on DD Form 2626; however, closer examination of the data revealed an item of interests. While only 65% of the contractor evaluations were listed has having subcontractor work performed, 96% of the contractor evaluations rated the contractor's ability to coordinate and control subcontractor(s), 93% of the contractors were evaluated on their ability to review and resolve subcontractor(s) issues, and finally 83% of the contractors were evaluated on their ability to implement the subcontracting plan. Table 14 is a list of all the projects that were identified has having zero subcontracted work. The table also includes the contractor's performance rating on all performance items relating to the management of subcontractors. Theoretically, if a contractor has no subcontracted work, then his ratings for the following performance items should all be 'not applicable (N/A): Coordination and Control of Subcontractors, Review/Resolution of Subcontractor's Issues, and Implementation of Subcontracting Plan; however, for 58 projects listed as having no subcontracted work, only six meet this theoretical criterion (see the shaded

boxes in Table 14). Either only six projects of the total 165 projects used in this analysis did not have subcontracted work performed and therefore Block 9 on DD Form 2626 includes incorrect data for 52 projects; or, 52 of the projects were inappropriately evaluated for subcontractor performance, suggesting that the evaluator did not pay careful attention to the performance items when rating the contractor's performance. If the latter, then the question arises: how many other performance items were incorrectly rated when evaluating the contractor's performance and what effect does this have on the contractor's overall rating? These questions cannot be answered by this research and therefore impact the overall reliability of the DD Form 2626.

The overall result of the principle component analysis was a reduction of 33 independent variables (the performance items) into the following nine independent variables: Quality Control 1 (QC1), Quality Control 2 (QC2), Effectiveness of Management (EM), Management of Subcontractors (MS), Timely Performance (TP), Warranty Response (WR), Compliance with Labor Standards (CLS), Correction of CLS Noted Deficiencies (CCLSND), and Compliance with Safety Standards (CSS).

Table 14. Contractor Performance Rating with 0% Subcontracted Work

Project	16.c*	16.h**	16.i***	Project	16.c*	16.h**	16.i***	Project	16.c*	16.h**	16.i***
Project 1	4	0	0	Project 20	3	3	3	Project 39	3	3	3
Project 2	0	0	0	Project 21	3	3	3	Project 40	3	3	3
Project 3	0	0	0	Project 22	3	3	3	Project 41	3	3	3
Project 4	0	0	0	Project 23	3	3	3	Project 42	3	3	3
Project 5	0	0	0	Project 24	3	3	3	Project 43	3	3	3
Project 6	0	0	0	Project 25	3	3	3	Project 44	3	3	3
Project 7	0	0	0	Project 26	3	3	3	Project 45	3	3	3
Project 8	3	3	0	Project 27	3	3	3	Project 46	4	3	3
Project 9	3	3	0	Project 28	3	3	3	Project 47	2	3	3
Project 10	3	3	0	Project 29	3	3	3	Project 48	3	3	3
Project 11	3	3	0	Project 30	3	3	3	Project 49	3	3	3
Project 12	3	3	0	Project 31	3	3	3	Project 50	4	3	3
Project 13	3	4	0	Project 32	3	3	3	Project 51	4	3	3
Project 14	4	4	0	Project 33	3	3	3	Project 52	4	4	3
Project 15	4	5	0	Project 34	3	3	3	Project 53	4	4	3
Project 16	2	3	2	Project 35	3	3	3	Project 54	3	4	4
Project 17	2	3	3	Project 36	3	3	3	Project 55	4	4	4
Project 18	2	3	3	Project 37	3	3	3	Project 56	4	5	4
Project 19	2	3	3	Project 38	3	3	3	Project 57	4	5	4
								Project 58	5	5	4

* Coordination and Control of Subcontractor(s)
** Review/Resolution of Subcontractor's Issues
*** Implementation of Subcontracting Plan

2. **Do the performance items as they are appropriately aggregated into performance elements predict the contractor's overall performance rating?**

These nine acceptable factored performance elements were used as independent variables to analyze research question number two. Using SPSS version 16.0, a correlation analysis was conducted to determine if a relationship exists between the nine performance elements derived from the principle component analysis and the contractor's overall performance rating. Eight of the nine performance elements analyzed have a significant relationship with the contractor's overall performance rating. Effectiveness of Management has the strongest correlation to the contractor's overall performance rating, whereas, Warranty Response has no relationship to the contractor's overall performance rating. Correlation analysis only considers the relationship between each individual performance element and the contractor's overall performance rating. The next step in

this analysis was to conducted a step-wise linear regression in order to understand how the performance elements interact with each other to affect the contractor's overall performance rating. A step-wise linear regression was conducted on those performance elements with a significant relationship to the contractor's overall performance rating to determine if in fact the contractor's overall performance rating is a composite score of the measured performance items as aggregated into performance elements. The step-wise linear regression resulted in two mathematical models for predicting a contractor's overall performance rating. The first model only includes Effectiveness of Management (EM) as an independent variable with an R^2 value of 0.755. The second model includes both Effectiveness of Management and Timely Performance (TP) as independent variables with an R^2 value of 0.766 respectively. When comparing the R^2 values for each model, the contractor's overall performance rating does not seem to be significantly improved by combining the independent variables EM and TP. The same holds true when the two models are validated; mathematical Model #1 and Model #2 appear to have almost the same prediction power. Using the 50 project evaluations set aside for model validation, Model #1 accurately predicted 88% of the contractor's overall performance ratings; Model #2 accurately predicted 90%.

3. **Is the contractor's overall performance rating and the overall project schedule performance related?**

Correlation analysis was conducted on the 165 project evaluations to determine if a relationship exists between the contractor's overall rating and the overall project schedule performance. The results of this correlation analysis were a Pearson's

correlation value of -0.195 and a significance value of 0.006. There is a significant relationship between the contractor's overall performance rating and the overall project schedule performance, though the relationship is small. This result reveals the overall project schedule performance has little impact on the contractor's overall rating. This is contradictory to one of the traditional measures of a contractor's performance; quality, schedule, and cost (Ling & Liu, 2004).

Considering that the quality of the project is difficult to capture immediately after construction is completed, and the cost of the project is fixed, then all that remains for a project manager to evaluate is a contractor's schedule performance. However, as the results from the correlation analysis indicate, the project managers for the USACE seem to value other performance elements when rating the overall performance of the contractor. The results from the correlation analysis and linear regression from research question two support the conclusion that project managers seem to value the contractor's management effectiveness more than they value the contractor's timely performance. Further correlation analysis of each Effectiveness of Management's performance items revealed that Effectiveness of Job-Site Supervision has the strongest significant relationship with the contractor's overall performance rating. Table 15 summarizes the results of the correlation analysis. For the complete results of the correlation analysis see Appendix P.

Table 15. Correlation Analysis of EM Performance Items and Contractor's Overall Performance Rating	
	Contractor's Overall Performance Rating
Cooperation and Responsiveness	0.796**
Management of Resources/Personnel	0.758**
Adequacy of Site Clean-Up	0.556**
Effectiveness of Job-Site Supervision	0.801**
Compliance with Laws and Regulations	0.485**
Professional Conduct	0.787**

** Correlation is significant at the 0.01 level

Not surprisingly then a linear regression resulted in four mathematical prediction models, where Effectiveness of Job-Site Supervision as an individual independent variable was predictive of a contractor's overall performance rating with an R^2 value of 0.641. Recall from Chapter 4, Effectiveness of Management as an independent variable is an average score of the ratings given to each of the related performance elements. The mathematical model that includes only Effectiveness of Management as an independent variable has an R^2 value of 0.755. Therefore, if a project manager wanted to predict a contractor's overall performance rating, he could theoretically use only the rating of a contractor's job-site supervision effectiveness and attain approximately the same results as he would if he were to score the six performance items that are reflective of Effectiveness of Management, average those scores, and then apply mathematical model #1 described in Chapter 4. The R^2 value for the mathematical prediction model increased to 0.760 when ratings for performance items Professional Conduct, Compliance with Laws and Regulations, and Professional Conduct were added to the independent variable

Effectiveness of Job-Site Supervision. Results of the step-wise linear regression on the Effectiveness of Management's performance items are located in Appendix Q.

Significance of Research

In 2007, the AF Civil Engineer, Major General Del Eulberg, identified 35 initiatives in an effort to transform the civil engineering career field into a more efficient and effective enterprise (Eulberg, 2007). One such initiative is Transformation Project A-4. The purpose of this initiative is to strengthen the USAF rating system of contractor performance, to standardize performance criteria and eliminate inconsistencies between USAF MAJCOMs and bases, and to ensure best value is achieved for the government by establishing a system of rewards and penalties for good and bad contractor performance respectively. By studying the current USAF source selection practices, this research identified the limitations of the selection methods, supporting the requirement for a more rigorous USAF contractor performance rating system that can be used to predict future contractor performance as requested by the USAF Civil Engineer, General Del Eulberg. Rather than inventing a new method for evaluating and predicting contractor performance, this research examined the current contractor evaluation employed by the USACE. The motivation of this research was to determine if the construction performance evaluation process used by the USACE is reliable and valid, and if so, can it be adopted by the USAF civil engineers as a method for rating and predicting contractor performance.

The research determined that the DD Form 2626, USACE's method for evaluating contractor performance, is not an entirely reliable or valid process. First, not

all of the performance items listed on the DD Form 2626 are reflective of their respective performance elements. This means that project managers are rating performance items that don't actually measure the performance element that they represent. In cases such as these, either the performance items need to be listed into a separate performance element or they need to be removed from the evaluation form altogether.

Second, the contractor's overall performance rating is not a composite score of the 33 performance item ratings. As indicated by the correlation analysis and linear regression performed on the nine factored performance elements, eight of the factored performance elements had a significant relationship with the contractor's overall performance rating; and of those eight, only two factored performance elements, Effectiveness of Management and Timely Performance, are strongly indicative of a contractor's overall performance. This result was confirmed when determining the relationship between the contractor's overall performance rating and the overall project schedule performance. The contractor's inability to complete a construction project according to the revised contract completion date had little effect on a contractor's overall performance rating. Further analysis indicated that not only was a contractor's ability to manage effectively, but specifically, the contractor's effective job-site supervision was most indicative of the contractor's overall performance rating. Ultimately, this means that on average within the 165 sampled DD Form 2626s, the personnel that are completing the DD Form 2626 considered a contractor's job-site supervision effectiveness more over than traditional measures such as schedule.

Third, when decision makers use past contractor overall performance ratings in their source selection process, they are not selecting contractors on their ability to provide

quality control, nor timely performance; instead, they are selecting contractors that have demonstrated satisfactory or above average performance in their ability to manage effectively.

Fourth, if only Effectiveness of Management is indicative of a contractor's overall performance rating, is it necessary to rate the other 27 performance items, or can they be eliminated from DD Form 2626? This should be considered if revising DD Form 2626, especially since this research has demonstrated that DD Form 2626 is not always accurately completed. Take for instance the discussion of subcontractor management. Even though only 65% of the projects included subcontracted work, 93% of the contractor's were rated on their ability to coordinate and control their subcontractor(s). Either more projects included subcontracted work or the evaluator incorrectly rated the contractor on subcontractor performance items.

This leads to the fifth concern with DD Form 2626 – the raters and the rating system. Not only could a rater fail to pay close attention to the performance items they are rating, but their rating style could undermine the meaningfulness of a measurement. There is no USACE instruction that defines or standardizes the meaning of "satisfactory" performance, therefore, a more lenient rater may rate a contractor's overall performance as above average where a more strict rater could possible rate the same contractor's performance as satisfactory or even marginal. This has further implication to contractor selection. Technically, if disparities exist between raters' definition or understanding of satisfactory performance, then a decision maker on a source selection cannot use past performance scores as a reliable measure for distinguishing between contractors. In addition, the layout of DD Form 2626 encourages the rater to rate the contractor's overall

performance rating first and then rate each individual performance item. For this reason, raters may feel compelled to align their ratings of each individual performance item to the contractor's overall performance rating. And finally, because contractors have the opportunity to review the DD Form 2626 before it is finalized, raters may be compelled to evaluate the contractor favorably in order to avoid confrontation.

While DD Form 2626 represents a good starting point to meet General Eulberg's transformation request, the process and DD Form 2626 requires standardized instructions and a new format that aligns performance items and performance elements into a more rigorous and straightforward system for rating contractor performance. A revised DD Form 2626 that could be used on any size and/or type of construction project could strengthen the USAF system for rating contractor performance. If the revised DD Form 2626 was complimented with a standardized instruction, then this tool would standardize performance criteria and eliminate inconsistencies between USAF MAJCOMs and bases. Finally, if in addition to an instruction, the revised DD Form 2626 included a well defined rating system, then civil engineers across the Air Force could ensure best value is achieved for the government in future source selections. If civil engineers, and any other decision makers for that matter, have a clear and standardized understanding of 'satisfactory' performance, then a system of rewards and penalties for good and bad contractor performance could be fairly and appropriately implemented across USAF MAJCOMs and bases. This has important implications for deployed civil engineers. Turnover with replacement personnel requires imparting a large amount of information in a very limited time span. Distinguishing between good contractors and bad contractors is both subjective and can be overlooked during turnover. If the incumbent civil engineer

has access to past performance evaluations that are based on a standardized and well defined evaluation system, then he or she should not have to question the reliability or validity of the contractor's overall performance rating. If the incumbent civil engineer could immediately distinguish between the 'good' contractors and the 'bad' contractors, the civil engineer could save himself valuable time and energy, while at the same time preserving viable and limited government resources.

Limitations of Research

As identified in Chapter 1, one of the major limitations of this research is the amount of available data. While the sample size is large enough to make general conclusions about the results attained the various statistical analysis, there is limited opportunity to validate some of the results, specifically the linear regression. Using a sample size of 50 limits the ability to test the predictive power of mathematical models #1 and #2. In addition, the problem of limited sample data prevents the research from validly declaring difference between mathematical models #1 and #2.

The second limitation of the study is the unavailability of source selection data. This research would be very powerful if we could assess a contractor's performance as it compares to their past performance ratings. This type of analysis would empirically validate the statement that "past performance is predictive of future performance." It would support the use of past performance ratings and information for source selections. This research was only able to assess an existing contractor evaluation tool and make recommendations for strengthening its reliability and validity as both an evaluation tool and a means for source selection.

The third limitation of this research is the anonymity of the raters. As mentioned earlier, one rater's definition or understanding of 'satisfactory' performance may differ from another rater's. Therefore, it is not entirely appropriate to compare the ratings of each performance evaluation because we cannot establish a 'true' score for satisfactory performance. If the identify of each rater was known, then a rating style for each rater could be identified and the data could be adjusted to normalize the scores. This would then produce more reliable ratings which would in turn increase the validity of each statistical analysis.

The fourth limitation of the research is the generalizability of the results. All 215 data records were attained from a regional USACE district office and therefore, the results attained in this research may only be applicable to this region's USACE offices.

Recommendations for Action

The following actions are recommended if General Eulberg and the civil engineer community are to implement the use of DD Form 2626 as a means standardizing and strengthening the USAF contractor performance evaluation system. First, DD Form 2626 needs to be reformatted to align performance items such that they reflect their respective performance elements. For instance, all items relating to subcontractor issues should be consolidated under a new performance element titled Management of Subcontractors. In addition, some performance items may warrant total removal from the evaluation process. Specifically, Storage of Materials, Adequacy of As-Builts, Use of Specified Material, and Warranty Response could be removed from the evaluation form and not have an effect on the contractor's overall performance rating. Finally, Block 11 – Overall

Rating should be relocated directly after Block 19 – Compliance with Safety Standards. Placing the Overall Rating at the end of the performance element ratings encourages the rater to evaluate specific performance items before determining an overall performance rating for the contractor. A recommended revised DD Form 2626 is located in Appendix R. To further strengthen the overall rating and to ensure it reflects the contractor's performance in each of the performance elements, the Overall Rating could be a score that is computed from the ratings of each performance elements. As was done for research question two, a score for each performance element would be determined by averaging the ratings of each respective performance item. Then each performance element score could be multiplied by a predetermined weight factor, and then the sum of the weighted performance element scores would become the contractor's overall performance rating.

The second action for recommendation is a standardized and well defined rating system. An example of such a system is the one implemented by the National Security Personnel System (NSPS). Under the personnel management system, performance indicators are defined for the rater. Each subordinate's performance is rated on a scale from 1 to 5 where 1 = unsatisfactory performance, 3 = satisfactory performance, and 5 = outstanding performance. If a rater evaluates his subordinate performance as satisfactory, or a 3, then he must be able to justify that rating using a pre-established performance indicator check list. For instance, a non-supervisor technician in pay band 1 must meet the following performance indicators if his rater evaluates his performance as satisfactory: "with supervision, effectively completed assigned job objective and work assignments; ensured completed work adhered to given instructions and standards; in

achieving job objectives and work assignments adhered to work/project schedules and prioritization work tasks; adjusted scheduled activities as directed to achieve desired results (Department of Defense, 2009).” This type of standardized rating system aligns individual’s definition of performance terms and prevents raters from rater acquiescence or yeah-saying. This would also prevent a rater from “gaming” the evaluation if the contractor’s overall performance rating was calculated using weighted performance element scores.

The third recommended action is the development of an Air Force Instruction (AFI) that clearly explains how to correctly complete DD Form 2626. The only instruction USACE has for the application of DD Form 2626 is ER 415-1-17 Contractor Performance Evaluations. This document only directs the use of DD Form 2626 instead of SF 1420 as required by Federal Acquisition Regulations. The AFI would include detailed instructions of what information needs to be included in each block of DD Form 2626. The AFI would also include the standardized and defined evaluation system mentioned earlier. Finally, it would include instructions on the use of DD Form 2626 in future source selections. Specifically, it would identify how DD Form 2626 ratings would be use to reward or punish, good or bad (respectively) contractor performance.

The fourth recommended action is to reduce the total number of performance items that must be evaluated for each contractor. This recommended action concerns survey response as a social exchange. The Webster-Merriam dictionary’s definition of survey is “to query (someone) in order to collect data for the analysis of some aspect of a group or area; to view or consider comprehensively (survey, 2009).” Essentially, the DD Form 2626 Construction Contractor Performance Evaluation is a survey being conducted

by the USACE on each of its contractors. The survey respondent in this situation is the USACE project manager who has the responsibility of completing DD Form 2626. As Don Dillman, author of Mail and Internet Surveys points out, “longer questionnaires achieve slightly lower response rates,” whereas, “research has shown that respondent-friendly questionnaires, with carefully organized questions in easy-to-answer formats, can improve response rate (Dillman, 2007).” Eliminating performance items that have little to no reflection or impact on the contractor’s overall rating will increase the chance that the respondents, in this case the project engineers, will take more time to answer each survey question, therefore, providing a better overall evaluation of the contractors performance.

Finally, for each construction project, more than one rater should be required to complete a DD Form 2626 for contractor performance evaluation. Raters are inherently subjective and inconsistent, even with a standardized evaluation system. By including multiple raters into the overall evaluation process, an aggregated overall evaluation team score, will help to eliminate or at least reduce inconsistencies and subjectivity, thus achieving a more rigorous evaluation system (Expert Choice, Inc., 1998).

Recommendations for Future Research

Several topics have emerged from this research that would benefit the Air Force Civil Engineer community.

1. An Analysis of USACE Contractor Evaluation and Selection Methods. This analysis would replicate the study of this research; however, it would include data attained from all USACE district offices throughout the US.

2. Evaluating Performance Indicators for Rating Contractor Performance. This research would include a survey of subject matter experts (SMEs) for valued performance indicators to be incorporated into a new contractor evaluation form or revised DD Form 2626. This research would also include identification of an appropriate weighting system to be used in a multiple-attribute utility system for rating and predicting contractor performance.
3. A Case Study of Contractor Selection and Project Performance. This study would examine the execution of a construction project from bid evaluation, to source selection, and finally construction close out. The study would include a detailed investigation of contractor selection and contractor performance evaluation methods used for the duration of the construction project. To strengthen the statement "past performance is indicative of future performance", a follow-on study would examine the specific contractor's performance in a future project.
4. A Validation of Pre-Qualification Prediction Model for USAF Contractor Selection. This research would test the contractor selection prediction model developed by Wong. This would include a pre-survey of selected contractors, administered prior to the beginning of construction, that focuses on various qualifying criteria and a post survey, administered after construction is complete, that evaluates the contractor's performance. Using this data, the researcher would have the opportunity to validate Wong's contractor performance prediction model (Wong, 2004).

Summary

This chapter described the conclusions made from the results of this research as they related to each research question. The significance of this research was identified along with the limitations of this research. Recommended actions as a result of this research were outlined and a list of future research options that would expand on General Eulberg's desire for a strengthened and standardized contractor performance evaluation system was included in this chapter. This study provides support for the implementation of the USACE's contractor evaluation process as a means of standardizing contractor performance criteria and eliminating inconsistencies between USAF MAJCOMs and bases. If the recommendations for action are implemented, the Air Force Civil Engineer community could ensure best value is achieved for the government through the use of rewards and penalties for good and bad contractor performance.

Appendix A: DD Form 2626

FOR OFFICIAL USE ONLY *(WHEN COMPLETED)*

PERFORMANCE EVALUATION (CONSTRUCTION)	**1. CONTRACT NUMBER**
	2. CEC NUMBER

IMPORTANT: Be sure to complete Part III - Evaluation of Performance Elements on reverse.

PART I - GENERAL CONTRACT DATA

3. TYPE OF EVALUATION *(X one)* ☐ INTERIM *(List percentage ______%)* ☐ FINAL ☐ AMENDED	**4. TERMINATED FOR DEFAULT** ☐
5. CONTRACTOR *(Name, Address, and ZIP Code)*	**6.a.** PROCUREMENT METHOD *(X one)* ☐ SEALED BID ☐ NEGOTIATED
	b. TYPE OF CONTRACT *(X one)* ☐ FIRM FIXED PRICE ☐ COST REIMBURSEMENT ☐ OTHER *(Specify)*

7. DESCRIPTION AND LOCATION OF WORK

8. TYPE AND PERCENT OF SUBCONTRACTING

9. FISCAL DATA ▶	a. AMOUNT OF BASIC CONTRACT $	b. TOTAL AMOUNT OF MODIFICATIONS $	c. LIQUIDATED DAMAGES ASSESSED $	d. NET AMOUNT PAID CONTRACTOR $
10. SIGNIFICANT DATES ▶	a. DATE OF AWARD	b. ORIGINAL CONTRACT COMPLETION DATE	c. REVISED CONTRACT COMPLETION DATE	d. DATE WORK ACCEPTED

PART II - PERFORMANCE EVALUATION OF CONTRACTOR

11. OVERALL RATING *(X appropriate block)*

☐ OUTSTANDING ☐ ABOVE AVERAGE ☐ SATISFACTORY ☐ MARGINAL ☐ UNSATISFACTORY *(Explain in Item 20 on reverse)*

12. EVALUATED BY

a. ORGANIZATION *(Name and Address (Include ZIP Code))*		b. TELEPHONE NUMBER *(Include Area Code)*
c. NAME AND TITLE	d. SIGNATURE	e. DATE

13. EVALUATION REVIEWED BY

a. ORGANIZATION *(Name and Address (Include ZIP Code))*		b. TELEPHONE NUMBER *(Include Area Code)*
c. NAME AND TITLE	d. SIGNATURE	e. DATE

14. AGENCY USE *(Distribution, etc.)*

DD FORM 2626, JUN 94 (EG)

EXCEPTION TO SF 1420 APPROVED BY GSA/IRMS 6-94
Designed using Perform Pro, WHS/DIOR, Sep 96

PART III - EVALUATION OF PERFORMANCE ELEMENTS

N/A = NOT APPLICABLE   O = OUTSTANDING   A = ABOVE AVERAGE   S = SATISFACTORY   M = MARGINAL   U = UNSATISFACTORY

15. QUALITY CONTROL	N/A	O	A	S	M	U
a. QUALITY OF WORKMANSHIP						
b. ADEQUACY OF THE CQC PLAN						
c. IMPLEMENTATION OF THE CQC PLAN						
d. QUALITY OF QC DOCUMENTATION						
e. STORAGE OF MATERIALS						
f. ADEQUACY OF MATERIALS						
g. ADEQUACY OF SUBMITTALS						
h. ADEQUACY OF QC TESTING						
i. ADEQUACY OF AS-BUILTS						
j. USE OF SPECIFIED MATERIALS						
k. IDENTIFICATION/CORRECTION OF DEFICIENT WORK IN A TIMELY MANNER						
17. TIMELY PERFORMANCE						
a. ADEQUACY OF INITIAL PROGRESS SCHEDULE						
b. ADHERENCE TO APPROVED SCHEDULE						
c. RESOLUTION OF DELAYS						
d. SUBMISSION OF REQUIRED DOCUMENTATION						
e. COMPLETION OF PUNCHLIST ITEMS						
f. SUBMISSION OF UPDATED AND REVISED PROGRESS SCHEDULES						
g. WARRANTY RESPONSE						

16. EFFECTIVENESS OF MANAGEMENT	N/A	O	A	S	M	U
a. COOPERATION AND						
b. MANAGEMENT OF RESOURCES/ PERSONNEL						
c. COORDINATION AND CONTROL OF SUBCONTRACTOR(S)						
d. ADEQUACY OF SITE CLEAN-UP						
e. EFFECTIVENESS OF JOB-SITE SUPERVISION						
f. COMPLIANCE WITH LAWS AND REGULATIONS						
g. PROFESSIONAL CONDUCT						
h. REVIEW/RESOLUTION OF SUBCONTRACTOR'S ISSUES						
i. IMPLEMENTATION OF SUBCONTRACTING PLAN						
18. COMPLIANCE WITH LABOR STANDARDS						
a. CORRECTION OF NOTED						
b. PAYROLLS PROPERLY COMPLETED AND SUBMITTED						
c. COMPLIANCE WITH LABOR LAWS AND REGULATIONS WITH SPECIFIC ATTENTION TO THE DAVIS-BACON ACT AND EEO REQUIREMENTS						
19. COMPLIANCE WITH SAFETY STANDARDS						
a. ADEQUACY OF SAFETY PLAN						
b. IMPLEMENTATION OF SAFETY PLAN						
c. CORRECTION OF NOTED						

20. REMARKS *(Explanation of unsatisfactory evaluation is required. Other comments are optional. Provide facts concerning specific events or actions to justify the evaluation. These data must be in sufficient detail to assist contracting officers in determining the contractor's responsibility. Continue on separate sheet(s), if needed.)*

DD FORM 2626 (BACK), JUN 94

Appendix B: SF 1420

FOR OFFICIAL USE ONLY
(WHEN COMPLETED)

PERFORMANCE EVALUATION - CONSTRUCTION CONTRACTS

1. CONTRACT NUMBER

1. CONTRACTOR *(Name, address and ZIP code)*

3. TYPE OF CONTRACT *(Check)*
- A. ADVERTISED
- B. NEGOTIATED
- ☐ CPFF ☐ FIRM FIXED PRICE ☐ OTHER *(Specify)*

4. COMPLEXITY OF WORK
☐ DIFFICULT ☐ ROUTINE

5. DESCRIPTION AND LOCATION OF WORK

6. FISCAL DATA	a. AMOUNT OF BASIC CONTRACT $	b. TOTAL AMOUNT OF MODIFICATION $	c. LIQUIDATED DAMAGES ASSESSED $	d. NET AMOUNT PAID CONTRACTOR $
7. SIGNIFICANT DATES	a. DATE OF AWARD	b. ORIGINAL CONTRACT COMPLETION DATE	c. REVISED CONTRACT COMPLETION DATE	d. DATE WORK ACCEPTED

8. TYPE AND EXTENT OF SUBCONTRACTING

PART II - PERFORMANCE EVALUATION OF CONTRACT (*Check appropriate box*)

9. PERFORMANCE ELEMENTS	OUTSTANDING	SATISFACTORY	UNSATISFACTORY
a. QUALITY OF WORK			
b. TIMELY PERFORMANCE			
c. EFFECTIVENESS OF MANAGEMENT			
d. COMPLIANCE WITH LABOR STANDARDS			
e. COMPLIANCE WITH SAFETY STANDARDS			

10. OVERALL EVALUATION
☐ OUTSTANDING (*Explain in Item 13, on reverse*) ☐ SATISFACTORY ☐ UNSATISFACTORY *(Explain in Item 14, on reverse)*

11. EVALUATED BY

a. ORGANIZATION *(Type or print)*

b. NAME AND TITLE *(Type or print)*	c. SIGNATURE	d. DATE

12. EVALUATION REVIEWED BY

a. ORGANIZATION *(Type or print)*

b. NAME AND TITLE *(Type or print)*	c. SIGNATURE	d. DATE

AUTHORIZED FOR LOCAL REPRODUCTION
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STANDARD FORM 1420 (10-83)
Prescribed by GSA
FAR (48 CFR) 53.236-1(b)

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(When completed)

13. REMARKS ON OUTSTANDING PERFORMANCE - AS INDICATED BY THE CONTRACTOR'S PERFORMANCE ON THIS CONTRACT. IF YOU CONSIDER THE CONTRACTOR TO BE OUTSTANDING, SET FORTH FACTUAL DATA SUPPORTING THIS OBSERVATION. THESE DATA MUST BE IN SUFFICIENT DETAIL TO ASSIST CONTRACTING OFFICERS IN SELECTING CONTRACTORS THAT HAVE DEMONSTRATED OUTSTANDING QUALITY OF WORK AND RELIABILITY. (*Continue on separate sheet, if needed.)*

14. EXPLANATION OF UNSATISFACTORY EVALUATION. FOR EACH UNSATISFACTORY ELEMENT, PROVIDE FACTS CONCERNING SPECIFIC EVENTS OR ACTIONS TO JUSTIFY THE EVALUATION (*e.g., extent of Government inspection required, rework required, subcontracting, cooperation of contractor, quality of workmen and adequacy of equipment)*. THESE DATA MUST BE IN SUFFICIENT DETAIL TO ASSIST CONTRACTING OFFICERS IN DETERMINING THE CONTRACTOR'S RESPONSIBILITY. (*Continue on separate sheet, if needed.)*

Appendix C: Raw DD Form 2626 Data for Model Validation

Contract Number	% of Subcontracting	Amount of Basic Contract	Total Amount of Modifications	Liquidated Damages Assessed	Net Amount Paid Contractor	Project Cost Growth
DACA2700C0074	0%	$542,500	$299,905	$0	$5,742,905	5.82
DACA2700D00050190	90%	$349,907	$12,892	$0	$362,799	0.00
DACA2701D00030004	0%	$202,470	$107,103	$0	$304,873	-0.02
DACA2701D00030066	0%	$191,121	$1,534	$0	$181,351	-0.06
DACA2701D00030082	35%	$326,054	$94,941	$0	$328,846	-0.22
DACA2701D00030083	11%	$318,241	($741)	$0	$316,219	0.00
DACA2701D00030084	1%	$778,672	$16,451	$0	$789,616	-0.01
DACA2702C0015	35%	$10,263,000	$354,122	$0	$10,617,122	0.00
DACA2703D00080002	0%	$367,683	$0	$0	$367,683	0.00
DACA2703D00080008	0%	$746,520	$0	$0	$746,520	0.00
DACA2703D00080009	0%	$422,659	$0	$0	$422,659	0.00
DACA2703D00080032	74%	$189,255	$0	$0	$189,255	0.00
DACA2703D00080034	100%	$586,028	$0	$0	$586,028	0.00
DACA2703D00080037	100%	$296,876	$0	$0	$296,876	0.00
DACA2703D00080043	100%	$337,981	$0	$0	$337,981	0.00
DACA2703D00080049	74%	$418,500	$0	$0	$418,500	0.00
DACA2703D00080061	80%	$428,638	$0	$0	$428,638	0.00
DACA2703D00080063	80%	$477,433	$0	$0	$477,433	0.00
DACA2703D00080077	56%	$471,453	$0	$0	$471,453	0.00
DACA2703D00080078	59%	$389,671	$0	$0	$389,671	0.00
DACA2703D00080083	78%	$503,479	$0	$0	$503,479	0.00
DACW2701C0018	26%	$29,800,000	$20,362,359	$0	$50,142,359	0.00
DACW2701D00050019	0%	$243,086	$7,053	$0	$250,040	0.00
DACW2701D00050022	0%	$225,671	$15,356	$0	$225,671	-0.06
DACW2701D00050030	0%	$171,646	$0	$0	$171,646	0.00
DACW2701D00050062	22%	$519,998	$83,254	$0	$551,354	-0.09
DACW2701D00050063	0%	$83,929	$39,575	$0	$123,505	0.00
DACW2701D00050066	0%	$1,910,000	($17,841)	$0	$1,892,159	0.00
DACW2701D00050068	0%	$309,991	$9,400	$0	$319,391	0.00
DACW2701D00050071	100%	$217,526	$165,483	$0	$383,009	0.00
DACW2701D00050085	0%	$327,348	$9,700	$0	$337,048	0.00
DACW2797D00210163	72%	$110,570	$0	$0	$110,570	0.00
DACW2797D00210165	80%	$112,988	$0	$0	$112,988	0.00
W912QR04C0009	26%	$586,995,000	$33,605,000	$0	$597,826,812	-0.04
W912QR04C0013	80%	$9,305,000	$302,691	$0	$9,607,691	0.00
W912QR04C0029	22%	$2,030,872	($270)	$0	$1,970,489	-0.03
W912QR04C0033	78%	$587,510	$4,502	$0	$592,012	0.00
W912QR04D00150020	0%	$152,500	$0	$0	$152,500	0.00
W912QR04D00160005	19%	$191,982	$12,021	$0	$204,003	0.00
W912QR04D00160012	0%	$146,792	$24,444	$0	$171,236	0.00
W912QR05C0019	93%	$2,127,152	$934,415	$0	$3,061,567	0.00
W912QR05D00070014	0%	$145,410	($8,000)	$0	$137,310	0.00
W912QR06C0019	13%	$2,439,928	$134,316	$0	$2,424,468	-0.06
W912QR06C0031	74%	$25,300,000	$1,629,023	$0	$25,998,734	-0.03
W912QR06C0052	62%	$3,852,308	$384,665	$0	$4,236,973	0.00
W912QR06C0059	20%	$1,701,596	$0	$0	$1,677,842	-0.01
W912QR06D00080006	85%	$203,500	$0	$0	$203,000	0.00
W912QR06D00080015	82%	$597,989	$0	$0	$597,989	0.00
W912QR06D00080023	80%	$1,429,134	$1,881	$0	$1,431,015	0.00
W912QR06D00080038	72%	$388,255	$62,100	$0	$450,355	0.00

Contract Number	Date of Award	Original Contract Completion Date	Revised Contract Completion Date	Scheduled Days Work	Date Work Accepted	Actual Days Work
DACA2700C0074	9/21/2000	4/13/2002	12/15/2003	1180	6/11/2003	993
DACA2700D00050190	8/7/2002	12/5/2002	3/5/2003	210	6/3/2004	666
DACA2701D00030004	6/27/2001	10/19/2002	6/16/2003	719	8/7/2003	771
DACA2701D00030066	9/19/2003	1/17/2004	7/9/2004	294	8/20/2004	336
DACA2701D00030082	3/18/2005	6/16/2005	6/16/2005	90	11/2/2005	229
DACA2701D00030083	3/21/2005	1/15/2006	1/15/2006	300	7/1/2005	102
DACA2701D00030084	3/30/2005	9/26/2005	9/26/2005	180	9/6/2006	525
DACA2702C0015	6/28/2002	1/20/2004	12/6/2004	892	12/6/2004	892
DACA2703D00080002	9/27/2003	5/1/2004	5/1/2004	217	9/30/2004	369
DACA2703D00080008	9/29/2003	5/6/2004	5/6/2004	220	4/30/2004	214
DACA2703D00080009	9/29/2003	2/11/2004	5/11/2004	225	5/11/2004	225
DACA2703D00080032	8/18/2004	1/23/2005	4/30/2005	255	4/30/2005	255
DACA2703D00080034	8/25/2004	3/8/2005	3/8/2005	195	4/28/2005	246
DACA2703D00080037	9/3/2004	1/18/2005	1/18/2005	137	11/18/2004	76
DACA2703D00080043	9/16/2004	6/27/2005	6/27/2005	284	3/31/2005	196
DACA2703D00080049	9/22/2004	5/2/2005	5/2/2005	222	12/31/2005	465
DACA2703D00080061	4/28/2005	5/8/2006	5/8/2006	375	4/30/2006	367
DACA2703D00080063	5/12/2005	2/24/2006	2/24/2006	288	12/31/2005	233
DACA2703D00080077	9/29/2005	10/22/2006	10/22/2006	388	8/25/2006	330
DACA2703D00080078	9/30/2005	10/22/2006	10/22/2006	387	10/22/2006	387
DACA2703D00080083	12/27/2005	11/20/2006	11/20/2006	328	9/21/2006	268
DACW2701C0018	5/3/2001	5/18/2004	6/27/2005	1516	12/19/2005	1691
DACW2701D00050019	5/24/2002	10/25/2002	5/31/2003	372	4/3/2003	314
DACW2701D00050022	7/24/2002	10/13/2002	10/13/2002	81	10/13/2002	81
DACW2701D00050030	9/27/2002	2/18/2003	2/18/2003	144	2/18/2003	144
DACW2701D00050062	4/30/2003	10/1/2003	10/30/2006	1279	9/19/2006	1238
DACW2701D00050063	5/2/2003	8/18/2003	8/18/2003	108	8/18/2003	108
DACW2701D00050066	5/21/2003	9/21/2003	9/21/2003	123	7/7/2004	413
DACW2701D00050068	5/22/2003	1010/2003	9/15/2004	482	3/28/2005	676
DACW2701D00050071	6/19/2003	10/30/2003	4/15/2004	301	4/15/2004	301
DACW2701D00050085	7/22/2003	12/4/2003	12/4/2003	135	11/3/2004	470
DACW2797D00210163	6/26/2001	10/26/2001	10/26/2001	122	10/18/2001	114
DACW2797D00210165	6/28/2001	10/10/2001	10/10/2001	104	9/28/2001	92
W912QR04C0009	3/4/2004	11/15/2004	1/15/2006	682	1/15/2006	682
W912QR04C0013	6/17/2004	12/27/2005	6/12/2006	725	6/12/2006	725
W912QR04C0029	9/24/2004	10/16/2005	2/15/2006	509	2/15/2006	509
W912QR04C0033	9/30/2004	3/5/2005	3/5/2005	156	4/21/2005	203
W912QR04D00150020	3/29/2005	8/30/2005	10/13/2005	198	10/6/2005	191
W912QR04D00160005	9/23/2004	4/28/2005	4/28/2005	217	4/25/2005	214
W912QR04D00160012	2/1/2005	7/29/2005	7/29/2005	178	10/29/2005	270
W912QR05C0019	6/30/2005	4/8/2006	4/13/2006	287	4/13/2006	287
W912QR05D00070014	8/16/2006	9/15/2006	9/15/2006	30	2/14/2008	547
W912QR06C0019	3/29/2006	5/10/2007	6/29/2007	457	6/26/2007	454
W912QR06C0031	6/8/2006	2/7/2008	4/12/2008	674	4/4/2008	666
W912QR06C0052	9/28/2006	10/23/2007	2/20/2008	510	2/20/2008	510
W912QR06C0059	9/29/2006	10/2/2007	10/2/2007	368	10/2/2007	368
W912QR06D00080006	6/29/2006	11/9/2006	11/9/2006	133	1/17/2007	202
W912QR06D00080015	8/24/2006	5/4/2007	5/4/2007	253	5/1/2007	250
W912QR06D00080023	12/21/2006	10/2/2007	10/2/2007	285	4/26/2007	126
W912QR06D00080038	6/25/2007	10/14/2007	10/14/2007	111	9/5/2007	72

Contract Number	Project Schedule Growth	Overall Rating	15.a	15.b	15.c	15.d	15.e	15.f	15.g	15.h	15.i	15.j	15.k
DACA2700C0074	-16%	3	4	3	3	3	3	4	3	3	3	4	3
DACA2700D00050190	217%	3	4	3	3	3	3	3	3	3	4	3	3
DACA2701D00030004	7%	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030066	14%	3	4	3	3	3	3	3	3	3	3	3	4
DACA2701D00030082	154%	3	3	3	3	0	3	3	0	0	0	0	4
DACA2701D00030083	-66%	3	3	3	2	2	3	4	3	0	0	3	3
DACA2701D00030084	192%	3	3	3	3	3	3	3	3	3	3	3	3
DACA2702C0015	0%	3	3	3	2	2	3	3	4	3	3	3	3
DACA2703D00080002	70%	3	4	4	3	4	3	3	3	3	0	3	3
DACA2703D00080008	-3%	4	4	4	4	4	3	3	3	3	3	0	3
DACA2703D00080009	0%	4	4	4	4	4	3	3	3	3	3	0	0
DACA2703D00080032	0%	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080034	26%	3	4	3	3	3	3	3	3	3	0	3	3
DACA2703D00080037	-45%	3	4	3	3	3	3	3	3	3	0	3	3
DACA2703D00080043	-31%	4	4	4	4	4	4	4	4	4	4	4	4
DACA2703D00080049	109%	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080061	-2%	4	4	4	4	4	3	3	3	3	0	3	4
DACA2703D00080063	-19%	4	4	4	4	4	3	3	4	3	3	3	4
DACA2703D00080077	-15%	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080078	0%	3	3	3	3	3	3	3	3	3	0	3	3
DACA2703D00080083	-18%	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701C0018	12%	4	4	3	3	3	4	3	3	3	3	3	3
DACW2701D00050019	-16%	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050022	0%	3	3	3	3	3	0	3	3	0	4	3	3
DACW2701D00050030	0%	4	3	3	4	3	0	3	3	4	0	3	3
DACW2701D00050062	-3%	3	3	3	3	3	3	4	3	0	0	4	3
DACW2701D00050063	0%	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050066	236%	4	4	4	5	4	0	4	4	3	0	5	4
DACW2701D00050068	40%	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050071	0%	3	5	3	3	3	0	4	3	3	0	4	4
DACW2701D00050085	248%	4	4	3	3	3	4	4	3	3	3	4	4
DACW2797D00210163	-7%	3	3	3	3	3	3	3	3	0	0	3	3
DACW2797D00210165	-12%	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04C0009	0%	4	4	4	3	4	3	3	3	4	4	4	4
W912QR04C0013	0%	4	4	5	3	3	4	4	4	4	4	4	3
W912QR04C0029	0%	2	3	3	2	2	3	3	2	3	3	3	3
W912QR04C0033	30%	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150020	-4%	4	5	3	3	3	3	5	3	4	0	4	4
W912QR04D00160005	-1%	5	5	5	4	4	4	4	4	4	4	4	4
W912QR04D00160012	52%	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05C0019	0%	3	4	3	3	3	3	3	3	3	3	3	3
W912QR05D00070014	1723%	3	2	3	2	2	3	3	3	0	0	3	2
W912QR06C0019	-1%	4	4	3	4	4	3	3	3	3	0	3	3
W912QR06C0031	-1%	4	4	3	3	3	4	4	4	3	3	4	4
W912QR06C0052	0%	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06C0059	0%	4	4	3	4	3	3	3	3	3	3	3	4
W912QR06D00080006	52%	3	5	3	3	3	3	3	3	3	0	3	3
W912QR06D00080015	-1%	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06D00080023	-56%	4	4	3	3	3	3	0	3	3	0	0	0
W912QR06D00080038	-35%	4	5	3	3	3	0	4	3	0	0	4	3

Contract Number	16.a	16.b	16.c	16.d	16.e	16.f	16.g	16.h	16.i	17.a	17.b	17.c	17.d	17.e	17.f	17.g
DACA2700C0074	4	4	3	3	4	3	4	4	3	4	3	3	3	4	3	4
DACA2700D00050190	4	3	3	3	3	3	3	3	3	2	2	2	3	3	0	0
DACA2701D00030004	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
DACA2701D00030066	4	2	2	3	2	3	3	3	0	0	0	3	3	3	0	3
DACA2701D00030082	4	3	2	3	4	3	3	2	0	0	0	0	0	3	0	3
DACA2701D00030083	3	2	3	3	3	3	3	0	0	0	4	0	3	3	0	0
DACA2701D00030084	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
DACA2702C0015	2	2	2	3	3	4	4	2	4	2	2	2	2	1	3	3
DACA2703D00080002	4	4	3	3	4	4	3	3	3	3	3	3	3	3	3	3
DACA2703D00080008	4	4	4	4	4	3	4	4	4	3	3	3	3	3	3	3
DACA2703D00080009	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3
DACA2703D00080032	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080034	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3
DACA2703D00080037	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080043	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DACA2703D00080049	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080061	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DACA2703D00080063	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3
DACA2703D00080077	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080078	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080083	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701C0018	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	0
DACW2701D00050019	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3
DACW2701D00050022	2	2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
DACW2701D00050030	3	3	4	n	3	3	3	3	3	0	0	0	3	3	0	3
DACW2701D00050062	2	3	4	4	3	3	4	0	0	3	2	3	3	0	2	0
DACW2701D00050063	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050066	5	4	0	0	4	4	5	0	0	3	3	4	3	3	0	0
DACW2701D00050068	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	0
DACW2701D00050071	4	4	3	3	3	3	3	3	0	0	0	3	3	3	0	3
DACW2701D00050085	4	4	4	4	4	4	4	4	3	4	4	4	3	3	4	3
DACW2797D00210163	3	3	3	3	3	3	3	3	3	3	3	0	3	3	0	3
DACW2797D00210165	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3
W912QR04C0009	5	4	3	3	5	4	5	4	4	4	5	5	3	4	3	0
W912QR04C0013	4	3	3	4	3	4	5	3	3	5	3	3	3	3	3	5
W912QR04C0029	2	2	1	3	3	3	3	1	0	3	2	3	2	3	2	3
W912QR04C0033	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3	3
W912QR04D00150020	4	3	0	4	4	3	4	3	3	3	3	0	2	4	0	0
W912QR04D00160005	5	5	5	5	5	4	5	5	3	3	4	5	4	5	3	4
W912QR04D00160012	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3
W912QR05C0019	4	3	4	3	3	3	4	3	3	3	4	4	3	3	3	3
W912QR05D00070014	3	3	3	3	2	3	3	0	0	3	3	3	3	3	3	3
W912QR06C0019	4	3	3	3	4	3	4	3	3	3	3	3	3	3	3	0
W912QR06C0031	4	3	4	4	4	3	4	4	3	3	4	4	3	3	3	0
W912QR06C0052	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06C0059	5	3	3	4	4	3	4	3	3	3	3	4	3	4	3	3
W912QR06D00080006	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3
W912QR06D00080015	3	3	3	3	3	3	3	3	3	3	4	3	3	4	3	4
W912QR06D00080023	4	4	4	4	4	3	4	4	3	4	4	4	3	4	0	0
W912QR06D00080038	4	4	4	4	3	3	4	3	3	3	3	0	3	4	3	0

Contract Number	18.a	18.b	18.c	19.a	19.b	19.c
DACA2700C0074	0	3	4	4	3	0
DACA2700D00050190	0	3	3	3	3	3
DACA2701D00030004	3	3	3	3	3	3
DACA2701D00030066	3	3	3	3	3	3
DACA2701D00030082	3	3	3	3	3	3
DACA2701D00030083	0	3	3	3	3	3
DACA2701D00030084	3	3	3	3	3	3
DACA2702C0015	3	3	3	4	3	3
DACA2703D00080002	3	3	3	3	3	3
DACA2703D00080008	3	3	3	4	4	3
DACA2703D00080009	0	3	3	4	4	0
DACA2703D00080032	3	3	3	3	3	3
DACA2703D00080034	3	3	3	3	3	3
DACA2703D00080037	3	3	3	3	3	3
DACA2703D00080043	4	4	4	4	4	4
DACA2703D00080049	3	3	3	3	3	3
DACA2703D00080061	4	4	4	4	4	4
DACA2703D00080063	3	3	3	4	4	3
DACA2703D00080077	3	3	3	3	3	3
DACA2703D00080078	3	3	3	3	3	3
DACA2703D00080083	3	3	3	3	3	3
DACW2701C0018	3	3	2	3	4	4
DACW2701D00050019	3	3	3	3	3	0
DACW2701D00050022	3	3	3	3	3	3
DACW2701D00050030	3	3	3	3	3	3
DACW2701D00050062	0	3	4	3	3	0
DACW2701D00050063	3	3	3	3	3	3
DACW2701D00050066	4	3	5	4	4	5
DACW2701D00050068	0	3	3	3	3	3
DACW2701D00050071	3	3	3	3	3	3
DACW2701D00050085	0	3	3	4	4	0
DACW2797D00210163	0	3	3	3	3	0
DACW2797D00210165	3	3	3	3	3	0
W912QR04C0009	4	3	4	4	4	4
W912QR04C0013	4	4	4	5	5	5
W912QR04C0029	3	3	3	3	2	3
W912QR04C0033	3	3	3	3	3	3
W912QR04D00150020	4	3	3	3	3	3
W912QR04D00160005	3	3	3	5	5	5
W912QR04D00160012	3	3	3	3	3	3
W912QR05C0019	4	4	4	3	3	4
W912QR05D00070014	0	3	3	3	3	0
W912QR06C0019	0	3	3	3	3	3
W912QR06C0031	3	3	3	4	4	4
W912QR06C0052	3	3	3	3	3	3
W912QR06C0059	3	3	3	3	3	4
W912QR06D00080006	3	3	3	3	3	3
W912QR06D00080015	4	3	3	3	4	4
W912QR06D00080023	0	5	3	3	4	0
W912QR06D00080038	0	3	3	3	4	0

Appendix D: Raw DD Form 2626 Data for Statistical Analysis

Contract Number	% of Subcontracting	Amount of Basic Contract	Total Amount of Modifications	Liquidated Damages Assessed	Net Amount Paid Contractor	Project Cost Growth
DACA2700D00050019	0.00	$2,147,843	$4,199,190	$0	$6,147,117	-0.03
DACA2700D00050157	0.90	$599,998	$9,622	$0	$588,598	-0.03
DACA2701D00080003	0.90	$1,121,184	$45,301	$0	$1,166,485	0.00
DACA2701D00080040	0.84	$663,314	$17,126	$0	$680,440	0.00
DACA2702C0013	0.80	$11,202,000	$687,621	$0	$11,889,621	0.00
DACA2703D00080071	0.80	$267,854	$0	$0	$267,854	0.00
DACA2703D00080072	0.73	$401,408	$0	$0	$401,408	0.00
DACA2703D00080079	0.78	$392,488	$0	$0	$392,488	0.00
DACW2700C0016	0.23	$8,291,350	$195,455	$0	$5,754,437	-0.32
DACW2703C0025	0.00	$2,989,620	$83,017	$0	$3,047,637	-0.01
W912QR04D00160011	0.00	$218,435	$1,995	$0	$220,430	0.00
W912QR04D00160008	0.75	$2,047,000	$20,845	$0	$2,067,845	0.00
W912QR06C0010	0.00	$13,813,700	$0	$0	$13,502,154	-0.02
W912QR06C0044	0.47	$14,342,000	$602,275	$0	$14,635,030	-0.02
W912QR07C0040	0.40	$1,450,144	$49,438	$0	$1,485,032	-0.01
DACA2701D00090009	0.54	$4,120,759	$56,060	$0	$4,135,050	-0.01
DACW2701D00050029	0.00	$377,948	$0	$0	$377,948	0.00
W912QR04D00150014	0.50	$495,685	$98,909	$0	$551,640	-0.07
W912QR04D00150014	0.91	$1,415,000	$1,675	$0	$1,416,675	0.00
W912QR05C0013	0.62	$1,191,828	$95,390	$0	$1,287,217	0.00
W912QR06D00080040	0.25	$123,758	$0	$0	$123,758	0.00
W912QR06C0008	0.51	$8,449,300	$367,823	$0	$8,752,466	-0.01
DACW2701D00050052	0.00	$109,006	$1,317	$0	$110,324	0.00
DACW2701D00050078	0.86	$579,952	$0	$0	$579,952	0.00
W912QR04D00160027	0.31	$385,000	$19,540	$0	$404,540	0.00
W912QR06D00080007	1.00	$258,964	$359,075	$0	$618,039	0.00
W912QR06D00080032	0.00	$204,432	$32,485	$0	$236,917	0.00
W912QR07C0011	0.00	$213,500	$0	$0	$213,500	0.00
DACA2701D00100029	0.60	$258,250	$5,636	$0	$263,886	0.00
DACA2702C0021	0.66	$3,385,600	$468,955	$0	$3,854,555	0.00
DACA2703C0010	0.49	$1,342,942	$59,522	$0	$1,402,464	0.00
DACW2701D00050037	0.80	$126,266	$11,726	$0	$137,992	0.00
W912QR05C0016	0.71	$1,319,925	$73,346	$0	$1,393,271	0.00
W912QR05C0020	0.93	$1,102,200	$1,151,426	$0	$2,253,626	0.00
W912QR05C0030	0.65	$614,519	$18,556	$0	$633,075	0.00
W912QR04C0012	0.00	$2,650,000	$506,957	$0	$2,697,049	-0.15
W912QR05C0025	0.90	$212,069	$0	$0	$211,569	0.00
W912QR06C0035	0.70	$1,685,512	$25,000	$0	$1,694,412	-0.01
DACW2701D00050001	0.00	$184,088	$169,001	$0	$353,090	0.00
W912QR06C0014	0.72	$5,565,101	$137,613	$0	$5,625,541	-0.01
DACW2701D00050126	0.00	$121,649	$4,656	$0	$126,306	0.00
DACA270100030059	0.00	$180,864	$7,458	$0	$188,322	0.00
DACA2701D00030033	0.80	$280,497	$33,267	$0	$313,764	0.00
DACA2701D00030036	0.11	$187,000	$0	$0	$187,000	0.00
DACA2701D00030040	0.83	$118,735	$1,300	$0	$120,035	0.00
DACA2701D00030047	0.00	$288,963	$232,065	$0	$521,028	0.00
DACA2701D00030048	0.55	$918,821	$33,968	$0	$927,411	-0.03
DACA2701D00030051	0.00	$160,277	$22,507	$0	$182,784	0.00
DACA2701D00030054	0.00	$915,835	$109,406	$0	$1,002,100	-0.02
DACA2701D00030056	0.00	$358,572	$18,584	$0	$375,239	-0.01
DACA2701D00030057	0.00	$138,886	$15,039	$0	$153,925	0.00
DACA2701D00030058	0.35	$118,758	$9,724	$0	$128,483	0.00
DACA2701D00030063	0.00	$2,660,000	$119,692	$0	$2,779,692	0.00
DACA2701D00030063	0.00	$2,660,000	$119,692	$0	$2,779,692	0.00
DACA2701D00030065	0.00	$499,538	$0	$0	$499,171	0.00

Contract Number	% of Subcontracting	Amount of Basic Contract	Total Amount of Modifications	Liquidated Damages Assessed	Net Amount Paid Contractor	Project Cost Growth
DACA2701D00030069	0.00	$193,963	$0	$0	$193,963	0.00
DACA2701D00030071	0.28	$231,079	$0	$0	$231,079	0.00
DACA2701D00030074	0.00	$402,980	$87,141	$0	$490,021	0.00
DACA2701D00030075	0.00	$249,820	$0	$0	$249,820	0.00
DACA2701D00030076	0.26	$326,055	$0	$0	$326,055	0.00
DACA2701D00030077	0.00	$328,893	$0	$0	$328,893	0.00
DACA2701D00030078	0.33	$326,054	$0	$0	$326,054	0.00
DACA2701D00030081	0.75	$105,490	$2,198	$0	$107,689	0.00
DACA2701D00080001	0.80	$1,204,307	$0	$0	$1,204,307	0.00
DACA2799D00040004	0.00	$4,089,352	$297,257	$0	$4,386,609	0.00
DACW2701D00050132	0.67	$106,724	$11,981	$0	$118,704	0.00
DACW2701D00050002	0.00	$162,878	$22,606	$0	$185,485	0.00
DACW2701D00050074	0.80	$594,835	$0	$0	$594,835	0.00
DACW2701D00050102	0.75	$266,488	$0	$0	$266,488	0.00
DACW2702C0001	0.00	$1,589,303	$278,939	$0	$1,851,738	-0.01
DACW2702C0015	0.31	$12,748,027	$3,248,915	$0	$15,996,842	0.00
DACW2703C0008	0.38	$215,411,880	($16,509,562)	$0	$194,828,068	-0.02
DACW2703C0023	0.00	$1,526,984	$169,918	$0	$1,696,902	0.00
DACW2703C0026	0.77	$5,630,925	$107,684	$0	$5,736,610	0.00
W912QR04D00150005	0.40	$301,056	$62,770	$0	$363,726	0.00
W912QR04D00150006	0.00	$255,500	$16,708	$0	$272,208	0.00
W912QR04D00150026	0.95	$199,401	$28,998	$0	$228,399	0.00
W912QR04D00160004	0.94	$102,144	($1,875)	$0	$100,269	0.00
W912QR05D00040001	0.00	$179,718	$0	$0	$179,718	0.00
W912QR05D00070001	0.00	$326,052	$0	$0	$326,052	0.00
W912QR05D00070002	0.00	$31,446	$0	$0	$31,446	0.00
W912QR05D00070006	0.00	$325,958	$0	$0	$325,958	0.00
W912QR05D00070008	0.00	$325,959	$0	$0	$325,959	0.00
W912QR05D00070009	0.00	$325,959	$0	$0	$325,959	0.00
W912QR05D00070011	0.00	$430,794	$0	$0	$430,794	0.00
W912QR05D00070012	0.00	$104,809	$0	$0	$104,809	0.00
W912QR05D00070013	0.00	$243,913	$0	$0	$243,913	0.00
DACA2703C0020	0.80	$4,204,391	($39,076)	$0	$3,675,448	-0.12
DACA2703D00080001	0.00	$193,542	$0	$0	$193,542	0.00
DACA2703D00080003	1.00	$274,127	$0	$0	$274,127	0.00
DACA2703D00080007	1.00	$671,818	$0	$0	$671,818	0.00
DACA2703D00080018	0.00	$145,718	$0	$0	$145,718	0.00
DACA2703D00080019	1.00	$139,500	$0	$0	$139,500	0.00
DACA2703D00080025	1.00	$342,908	$0	$0	$342,908	0.00
DACA2703D00080026	0.00	$549,231	$13,718	$0	$472,949	-0.16
DACA2703D00080029	1.00	$133,934	$0	$0	$133,934	0.00
DACA2703D00080033	1.00	$251,083	$0	$0	$251,083	0.00
DACA2703D00080039	1.00	$223,200	$0	$0	$223,200	0.00
DACA2703D00080040	1.00	$135,791	$0	$0	$135,791	0.00
DACA2703D00080047	1.00	$133,312	$0	$0	$133,312	0.00
DACA6303C0020	0.81	$640,000	$69,292	$295	$319,567	-0.55
DACW2701C0022	0.00	$424,548	$155,277	$0	$579,825	0.00
DACW2701D00050015	0.00	$135,523	$0	$0	$135,523	0.00
DACW2701D00050017	0.00	$149,549	$25,801	$0	$175,351	0.00
DACW2701D00050024	0.98	$146,722	$0	$0	$146,722	0.00
DACW2701D00050110	0.77	$208,917	$6,945	$0	$215,862	0.00
DACW2702C0026	0.00	$1,183,345	$15,000	$0	$1,198,345	0.00
W912QR04C0003	0.26	$3,620,000	$170,836	$0	$3,776,296	0.00
W912QR04D00090001	0.77	$1,307,210	$121,874	$0	$1,429,075	0.00
W912QR04D00150013	0.00	$178,696	$0	$0	$176,696	-0.01

Contract Number	% of Subcontracting	Amount of Basic Contract	Total Amount of Modifications	Liquidated Damages Assessed	Net Amount Paid Contractor	Project Cost Growth
W912QR04D00080003	0.85	$1,927,040	($1,080)	$0	$1,925,960	0.00
DACA2701D00080058	0.09	$725,966	$27,037	$0	$753,003	0.00
W912QR04D00150007	0.25	$280,909	$34,527	$0	$314,436	0.00
W912QR04D00150022	0.00	$205,083	$0	$0	$205,083	0.00
W912QR04D00150028	0.25	$213,383	$29,070	$0	$242,453	0.00
W912QR04D00160009	0.00	$440,615	$0	$0	$440,615	0.00
W912QR05C0021	0.80	$8,207,218	$141,120	$0	$8,321,132	0.00
W912QR06C0017	0.20	$3,556,000	$58,458	$0	$3,573,980	-0.01
DACA2701D00080056	0.95	$139,829	$0	$0	$139,829	0.00
DACA2701D00080059	0.90	$154,208	$0	$0	$152,634	-0.01
DACA2701D00100008	0.95	$81,873	$242,015	$0	$323,888	0.00
DACA2703C0018	0.78	$8,524,000	$826,295	$0	$9,387,769	0.00
W912QR04D00160017	0.95	$38,863	$0	$0	$38,863	0.00
W912QR05C0006	0.09	$3,980,000	$19,095	$0	$3,880,467	-0.03
W912QR04D00160033	0.00	$124,000	$0	$0	$124,000	0.00
W912QR04D00250001	0.63	$1,075,150	$823,655	$0	$1,898,805	0.00
W912QR05C0034	0.01	$764,112	$5,875	$0	$769,987	0.00
W912QR05D00040002	0.00	$175,014	$0	$0	$175,014	0.00
W912QR05D00040003	0.00	$780,001	$0	$0	$769,253	-0.01
W912QR05D00070017	0.00	$255,000	$79	$0	$254,920	0.00
W912QR05D00070020	0.28	$1,451,043	$0	$0	$1,052,640	-0.27
W912QR05D00070022	0.45	$183,161	$0	$0	$183,161	0.00
W912QR05D00070024	0.62	$283,000	$0	$0	$267,813	-0.05
W912QR05D00070025	0.47	$1,048,000	$0	$0	$0	-1.00
W912QR06C0020	0.45	$5,027,500	$693,363	$0	$5,720,863	0.00
W912QR06C0057	0.30	$241,857	$4,618	$0	$235,640	-0.04
DACW2701C0030	0.04	$24,156,000	$470,785	$0	$24,626,785	0.00
DACW2701D00050016	0.30	$749,831	$215,000	$0	$964,831	0.00
DACW2701D00050087	0.00	$111,952	$0	$0	$111,952	0.00
DACW2701D00050092	1.00	$1,537,641	($173,850)	$0	$1,361,841	0.00
DACW2701D00050093	0.99	$919,849	$321,578	$0	$1,241,426	0.00
DACW2701D00050094	0.99	$113,825	$0	$0	$113,825	0.00
DACW2701D00050095	1.00	$629,465	$0	$0	$629,465	0.00
DACW2702C0005	0.30	$8,696,883	$3,153,117	$0	$11,786,029	-0.01
W912QR04D00150003	0.60	$156,710	$24,185	$0	$180,895	0.00
W912QR04D00160030	1.00	$308,900	$0	$0	$308,900	0.00
W912QR06D00080011	0.80	$1,265,000	($118,466)	$0	$1,146,434	0.00
W912QR06D00080036	0.10	$1,233,375	($10,001)	$0	$1,223,373	0.00
W912QR07C0041	1.00	$179,400	$0	$0	$174,477	-0.03
W912QR06C0011	0.98	$2,269,884	$23,654	$0	$2,222,741	-0.03
W912QR06C0016	0.95	$1,409,850	$2,504	$0	$1,330,452	-0.06
DACW2702C0018	0.00	$3,064,200	$452,365	$0	$3,497,850	-0.01
W912D06D0001CY01	0.04	$964,502	$184,311	$0	$1,148,813	0.00
W912QR04D00150030	0.05	$1,542,840	$28,352	$0	$1,571,192	0.00
W912QR04C0024	0.00	$10,109,000	$485,923	$0	$10,565,423	0.00
W912QR04D00140006	0.70	$1,520,000	$509,138	$0	$1,868,606	-0.08
W912QR04D00150031	0.67	$1,837,191	$6,546	$0	$1,843,737	0.00
W912QR04D00150033	0.80	$330,000	($22,343)	$0	$307,558	0.00
W912QR04D00160016	0.00	$952,800	$215,502	$0	$1,168,302	0.00
W912QR06C0029	0.37	$2,620,000	$21,221	$0	$2,641,221	0.00
DACA2703C0007	0.71	$83,329,000	$3,039,877	$0	$86,368,877	0.00
W912QR06C0039	0.47	$5,855,387	$582,721	$0	$6,218,816	-0.03
W912QR06C0040	0.87	$3,095,554	$105,329	$0	$3,200,883	0.00
W912QR06D00080017	0.00	$172,530	$48,764	$0	$221,294	0.00
W912QR06D00080018	0.00	$81,900	$36,349	$0	$118,249	0.00

Contract Number	Date of Award	Original Contract Completion Date	Revised Contract Completion Date	Scheduled Days Work	Date Work Accepted	Actual Days Work
DACA2700D00050019	3/15/2001	6/1/2002	5/31/2006	1903	6/27/2006	1930
DACA2700D00050157	4/4/2002	9/26/2002	11/10/2002	220	9/16/2003	530
DACA2701D00080003	9/7/2001	8/21/2002	10/11/2002	399	10/8/2002	396
DACA2701D00080040	6/20/2003	12/17/2003	4/15/2004	300	4/15/2004	300
DACA2702C0013	5/31/2002	6/24/2004	9/7/2004	830	9/7/2004	830
DACA2703D00080071	8/17/2005	6/25/2006	6/25/2006	312	12/31/2005	136
DACA2703D00080072	9/22/2005	7/27/2006	7/27/2006	308	7/27/2006	308
DACA2703D00080079	9/30/2005	10/17/2006	10/17/2006	382	5/31/2006	243
DACW2700C0016	4/13/2000	11/22/2001	11/22/2001	588	8/11/2004	1581
DACW2703C0025	9/30/2003	11/11/2004	5/25/2006	968	10/3/2006	1099
W912QR04D00160011	1/6/2005	4/30/2005	4/30/2005	114	4/29/2005	113
W912QR04D00160008	9/24/2004	12/10/2005	12/31/2005	463	1/11/2007	839
W912QR06C0010	2/15/2006	9/4/2007	9/4/2007	566	10/30/2007	622
W912QR06C0044	8/30/2006	2/5/2008	3/17/2008	565	3/18/2008	566
W912QR07C0040	6/26/2007	6/20/2008	6/20/2008	360	6/12/2008	352
DACA2701D00090009	12/22/2003	2/21/2006	4/30/2006	860	6/5/2006	896
DACW2701D00050029	9/23/2002	2/18/2003	6/30/2003	280	12/1/2003	434
W912QR04D00150014	2/17/2005	7/13/2005	7/15/2006	513	3/19/2007	760
W912QR04D00150014	2/18/2005	3/15/2006	3/8/2006	383	3/8/2006	383
W912QR05C0013	5/27/2005	5/16/2006	9/22/2006	483	10/3/2006	494
W912QR06D00080040	7/17/2007	9/2/2007	9/2/2007	47	8/30/2007	44
W912QR06C0008	2/16/2006	10/7/2007	11/28/2007	650	11/28/2007	650
DACW2701D00050052	1/31/2003	6/14/2003	6/14/2003	134	10/9/2003	251
DACW2701D00050078	6/20/2003	11/13/2003	11/13/2003	146	3/16/2005	635
W912QR04D00160027	9/29/2006	8/27/2007	8/27/2007	332	8/10/2007	315
W912QR06D00080007	7/21/2006	9/30/2006	6/30/2007	344	6/26/2007	340
W912QR06D00080032	3/20/2007	8/8/2007	8/29/2007	162	9/4/2007	168
W912QR07C0011	6/7/2007	8/31/2007	8/31/2007	85	10/4/2007	119
DACA2701D00100029	9/30/2005	2/21/2006	2/21/2006	144	1/25/2006	117
DACA2702C0021	8/28/2002	12/17/2003	6/30/2004	672	6/30/2004	672
DACA2703C0010	6/23/2003	5/12/2004	11/23/2004	519	11/23/2004	519
DACW2701D00050037	9/28/2002	12/17/2002	12/17/2002	80	12/11/2002	74
W912QR05C0016	6/17/2005	6/30/2006	7/22/2006	400	7/18/2006	396
W912QR05C0020	6/30/2005	4/8/2006	4/13/2006	287	4/13/2006	287
W912QR05C0030	9/14/2005	5/31/2006	9/1/2006	352	5/2/2006	230
W912QR04C0012	5/21/2004	5/2/2005	11/18/2005	546	11/30/2005	558
W912QR05C0025	8/16/2005	5/21/2006	5/21/2006	278	5/18/2006	275
W912QR06C0035	9/29/2006	9/25/2007	10/30/2007	396	10/29/2007	395
DACW2701D00050001	9/30/2001	11/26/2002	12/26/2002	452	12/26/2002	452
W912QR06C0014	2/27/2006	7/13/2007	9/17/2007	567	9/17/2007	567
DACW2701D00050126	5/4/2004	10/16/2004	10/16/2004	165	10/1/2004	150
DACA270100030059	6/18/2003	2/13/2004	7/12/2004	390	7/16/2004	394
DACA2701D00030033	6/21/2002	1/17/2003	7/25/2005	1130	7/13/2005	1118
DACA2701D00030036	8/23/2002	1/5/2003	1/4/2005	865	12/2/2004	832
DACA2701D00030040	8/30/2002	2/6/2003	3/8/2003	190	11/10/2003	437
DACA2701D00030047	11/1/2002	4/30/2003	5/31/2004	577	12/2/2004	762
DACA2701D00030048	12/30/2002	7/6/2004	2/1/2005	764	1/27/2005	759
DACA2701D00030051	2/11/2003	6/11/2003	3/31/2004	414	4/19/2006	1163
DACA2701D00030054	4/1/2003	6/30/2003	8/14/2003	135	12/1/2003	244
DACA2701D00030056	4/18/2003	9/15/2003	12/14/2003	240	3/1/2004	318
DACA2701D00030057	5/15/2003	8/13/2003	1/10/2004	240	8/23/2004	466
DACA2701D00030058	6/4/2003	11/13/2003	12/13/2003	192	6/22/2004	384
DACA2701D00030063	9/3/2003	12/28/2004	2/6/2006	887	6/22/2006	1023
DACA2701D00030063	9/3/2003	12/28/2004	2/6/2006	887	6/22/2006	1023
DACA2701D00030065	9/16/2003	1/14/2004	1/14/2004	120	7/16/2004	304

Contract Number	Date of Award	Original Contract Completion Date	Revised Contract Completion Date	Scheduled Days Work	Date Work Accepted	Actual Days Work
DACA2701D00030069	9/30/2003	3/28/2004	12/13/2004	440	2/13/2006	867
DACA2701D00030071	4/1/2004	9/28/2004	9/28/2004	180	5/16/2005	410
DACA2701D00030074	9/9/2004	3/8/2005	3/8/2005	180	5/9/2005	242
DACA2701D00030075	9/9/2004	3/8/2005	3/8/2005	180	2/7/2006	516
DACA2701D00030076	10/6/2004	1/4/2005	1/4/2005	90	12/10/2004	65
DACA2701D00030077	10/29/2004	7/26/2005	7/26/2005	270	2/13/2006	472
DACA2701D00030078	12/11/2004	3/11/2005	3/11/2005	90	3/11/2005	90
DACA2701D00030081	3/17/2005	11/12/2005	11/12/2005	240	9/30/2005	197
DACA2701D00080001	9/7/2001	8/15/2002	5/12/2003	612	7/28/2003	689
DACA2799D00040004	12/23/2002	8/22/2004	2/5/2005	775	5/16/2005	875
DACW2701D00050132	7/8/2004	10/17/2004	10/17/2004	101	6/30/2005	357
DACW2701D00050002	10/24/2001	12/8/2001	12/22/2001	59	11/29/2001	36
DACW2701D00050074	6/23/2003	11/6/2003	11/6/2003	136	8/1/2005	770
DACW2701D00050102	11/4/2003	5/22/2004	5/22/2004	200	6/30/2005	604
DACW2702C0001	11/2/2001	12/13/2002	1/17/2003	441	3/31/2004	880
DACW2702C0015	5/30/2002	6/27/2004	1/5/2006	1316	12/8/2005	1288
DACW2703C0008	2/26/2003	3/27/2004	3/4/2005	737	6/25/2004	485
DACW2703C0023	9/16/2003	10/2/2004	10/2/2004	382	12/10/2004	451
DACW2703C0026	9/29/2003	1/1/2005	3/5/2005	523	3/5/2005	523
W912QR04D00150005	7/2/2004	9/30/2004	9/30/2006	820	9/29/2006	819
W912QR04D00150006	7/6/2004	10/16/2004	10/16/2004	102	12/11/2006	888
W912QR04D00150026	6/10/2005	9/30/2005	9/30/2005	112	8/18/2006	434
W912QR04D00160004	7/29/2004	9/30/2005	6/30/2005	336	8/19/2005	386
W912QR05D00040001	3/31/2005	10/16/2005	10/16/2005	199	10/16/2005	199
W912QR05D00070001	6/17/2005	9/18/2005	9/18/2005	93	3/24/2006	280
W912QR05D00070002	7/18/2005	12/15/2005	12/15/2005	150	3/13/2006	238
W912QR05D00070006	9/15/2005	12/14/2005	12/14/2005	90	12/14/2005	90
W912QR05D00070008	12/8/2005	3/9/2006	3/9/2006	91	1/4/2007	392
W912QR05D00070009	3/6/2006	6/8/2006	6/8/2006	94	1/3/2007	303
W912QR05D00070011	6/2/2006	9/30/2006	9/30/2006	120	4/10/2007	312
W912QR05D00070012	6/14/2006	9/12/2006	1/30/2007	230	4/19/2007	309
W912QR05D00070013	8/2/2006	10/1/2006	10/1/2006	60	1/17/2007	168
DACA2703C0020	9/24/2003	10/13/2004	11/26/2004	429	12/14/2004	447
DACA2703D00080001	9/26/2003	12/28/2003	12/28/2003	93	12/26/2003	91
DACA2703D00080003	9/27/2003	3/2/2004	4/1/2004	187	3/31/2004	186
DACA2703D00080007	9/29/2003	4/12/2004	2/28/2005	518	3/17/2005	535
DACA2703D00080018	3/5/2004	8/6/2004	8/6/2004	154	7/31/2004	148
DACA2703D00080019	3/19/2004	8/6/2004	2/28/2005	346	3/10/2005	356
DACA2703D00080025	6/1/2004	2/19/2005	2/19/2005	263	10/27/2004	148
DACA2703D00080026	6/3/2004	12/18/2004	12/18/2004	198	11/30/2004	180
DACA2703D00080029	8/13/2004	12/21/2004	12/21/2004	130	10/31/2004	79
DACA2703D00080033	8/20/2004	12/28/2004	12/28/2004	130	11/29/2004	101
DACA2703D00080039	9/8/2004	3/14/2005	3/15/2005	188	3/14/2005	187
DACA2703D00080040	9/9/2004	1/18/2005	3/19/2005	191	6/1/2005	265
DACA2703D00080047	9/20/2004	1/28/2005	3/31/2005	192	3/31/2005	192
DACA6303C0020	9/20/2003	2/24/2004	7/21/2004	305	6/1/2005	620
DACW2701C0022	6/22/2001	1/16/2002	6/22/2002	365	11/1/2001	132
DACW2701D00050015	4/17/2002	8/15/2002	11/8/2002	205	12/3/2002	230
DACW2701D00050017	5/15/2002	9/12/2002	10/30/2002	168	10/30/2002	168
DACW2701D00050024	8/8/2002	9/30/2002	9/30/2002	53	9/30/2002	53
DACW2701D00050110	1/15/2004	8/1/2004	8/1/2004	199	8/1/2004	199
DACW2702C0026	9/30/2002	7/21/2003	10/13/2003	378	7/20/2006	1389
W912QR04C0003	12/18/2003	1/13/2006	1/13/2006	757	3/24/2005	462
W912QR04D00090001	8/12/2004	12/31/2004	8/1/2005	354	7/26/2005	348
W912QR04D00150013	2/1/2005	4/30/2005	4/30/2005	88	9/21/2005	232

Contract Number	Date of Award	Original Contract Completion Date	Revised Contract Completion Date	Scheduled Days Work	Date Work Accepted	Actual Days Work
W912QR04D00080003	9/26/2005	8/25/2006	9/19/2006	358	9/8/2006	347
DACA2701D00080058	9/28/2004	10/21/2005	10/21/2005	388	10/17/2005	384
W912QR04D00150007	7/9/2004	10/16/2004	10/16/2004	99	10/16/2004	99
W912QR04D00150022	3/31/2005	8/11/2005	8/11/2005	133	8/4/2005	126
W912QR04D00150028	6/13/2005	9/30/2005	9/30/2005	109	9/30/2005	109
W912QR04D00160009	12/10/2004	12/29/2004	12/29/2004	19	11/19/2004	-21
W912QR05C0021	6/30/2005	1/29/2007	1/29/2007	578	1/18/2007	567
W912QR06C0017	3/28/2006	10/18/2006	11/7/2006	224	11/7/2006	224
DACA2701D00080056	9/3/2004	12/31/2004	12/31/2004	119	12/2/2004	90
DACA2701D00080059	9/30/2004	1/19/2005	5/19/2005	231	5/20/2005	232
DACA2701D00100008	8/15/2003	7/18/2004	2/23/2005	558	9/22/2005	769
DACA2703C0018	9/17/2003	7/5/2005	7/5/2005	657	6/30/2005	652
W912QR04D00160017	6/2/2005	9/14/2005	9/14/2005	104	10/14/2005	134
W912QR05C0006	3/11/2005	9/13/2005	9/22/2005	195	9/22/2005	195
W912QR04D00160033	9/4/2007	12/5/2007	12/5/2007	92	4/15/2008	224
W912QR04D00250001	9/28/2005	9/30/2007	3/1/2008	885	2/28/2008	883
W912QR05C0034	9/16/2005	6/18/2006	6/18/2006	275	6/15/2006	272
W912QR05D00040002	11/4/2005	7/11/2006	7/11/2006	249	1/8/2008	795
W912QR05D00040003	2/28/2007	12/1/2007	12/1/2007	276	5/8/2008	435
W912QR05D00070017	11/9/2006	9/5/2007	9/5/2007	300	9/5/2007	300
W912QR05D00070020	9/13/2007	5/23/2008	5/23/2008	253	5/9/2008	239
W912QR05D00070022	9/19/2007	12/23/2007	12/23/2007	95	11/2/2007	44
W912QR05D00070024	9/28/2007	8/10/2008	8/10/2008	317	1/25/2008	119
W912QR05D00070025	9/28/2007	9/24/2008	9/24/2008	362	4/28/2008	213
W912QR06C0020	4/21/2006	11/3/2007	2/28/2008	678	2/22/2008	672
W912QR06C0057	9/30/2006	2/21/2007	5/2/2007	214	3/7/2007	158
DACW2701C0030	9/27/2001	7/7/2005	7/7/2005	1379	7/7/2005	1379
DACW2701D00050016	5/13/2002	7/5/2002	7/5/2002	53	7/5/2002	53
DACW2701D00050087	8/7/2003	10/14/2003	10/14/2003	68	4/9/2004	246
DACW2701D00050092	9/4/2003	9/24/2004	10/21/2004	413	8/31/2005	727
DACW2701D00050093	9/8/2003	1/24/2004	7/30/2004	326	12/10/2004	459
DACW2701D00050094	9/16/2003	11/10/2003	11/20/2003	65	10/22/2003	36
DACW2701D00050095	9/30/2003	4/11/2004	4/11/2004	194	1/31/2005	489
DACW2702C0005	3/8/2002	7/1/2004	10/28/2005	1330	10/28/2005	1330
W912QR04D00150003	6/18/2004	12/5/2004	1/4/2005	200	6/20/2007	1097
W912QR04D00160030	7/17/2007	11/12/2007	11/12/2007	118	10/18/2007	93
W912QR06D00080011	8/3/2006	11/12/2006	1/1/2007	151	12/31/2006	150
W912QR06D00080036	6/1/2007	11/19/2007	11/19/2007	171	8/27/2007	87
W912QR07C0041	6/28/2007	1/12/2008	1/12/2008	198	10/19/2007	113
W912QR06C0011	2/16/2006	2/13/2007	2/13/2007	362	2/9/2007	358
W912QR06C0016	3/2/2006	3/1/2007	3/1/2007	364	2/9/2007	344
DACW2702C0018	8/16/2002	10/16/2003	11/29/2004	836	10/29/2004	805
W912D06D0001CY01	6/30/2006	11/15/2006	11/15/2006	138	8/22/2007	418
W912QR04D00150030	6/27/2005	5/10/2006	6/2/2006	340	4/26/2006	303
W912QR04C0024	9/9/2004	3/17/2006	9/6/2006	727	10/27/2006	778
W912QR04D00140006	9/30/2005	9/20/2006	7/9/2007	647	6/21/2007	629
W912QR04D00150031	6/27/2005	5/10/2006	7/13/2006	381	7/11/2006	379
W912QR04D00150033	4/6/2006	8/30/2006	8/30/2006	146	8/9/2006	125
W912QR04D00160016	5/24/2005	12/10/2005	5/3/2006	344	5/23/2006	364
W912QR06C0029	5/26/2006	2/16/2007	6/5/2007	375	6/5/2007	375
DACA2703C0007	5/21/2003	11/27/2006	4/7/2007	1417	4/6/2007	1416
W912QR06C0039	8/24/2006	4/10/2008	6/30/2008	676	6/28/2008	674
W912QR06C0040	8/16/2006	8/14/2007	9/25/2007	405	9/24/2007	404
W912QR06D00080017	9/15/2006	10/31/2006	9/30/2007	380	8/27/2008	712
W912QR06D00080018	9/18/2006	10/31/2006	12/15/2006	88	12/15/2006	88

Contract Number	Project Schedule Growth	Overall Rating	15.a	15.b	15.c	15.d	15.e	15.f	15.g	15.h	15.i	15.j	15.k
DACA2700D00050019	0.01	4	3	3	3	3	0	3	3	0	0	3	3
DACA2700D00050157	1.41	3	3	2	2	2	3	3	2	3	3	2	2
DACA2701D00080003	-0.01	3	4	3	3	3	2	3	3	3	3	3	2
DACA2701D00080040	0.00	3	4	4	3	3	3	3	3	3	3	3	3
DACA2702C0013	0.00	3	3	3	3	3	3	3	3	3	4	3	3
DACA2703D00080071	-0.56	4	4	4	4	4	3	3	3	4	0	3	4
DACA2703D00080072	0.00	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080079	-0.36	4	4	4	4	4	4	4	4	4	0	4	4
DACW2700C0016	1.69	5	0	3	3	3	3	3	3	3	3	3	4
DACW2703C0025	0.14	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00160011	-0.01	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00160008	0.81	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06C0010	0.10	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06C0044	0.00	3	3	3	3	3	3	3	3	3	3	3	3
W912QR07C0040	-0.02	4	4	4	4	4	3	3	3	3	4	3	4
DACA2701D00090009	0.04	3	3	3	2	2	3	3	3	3	4	2	3
DACW2701D00050029	0.55	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150014	0.48	4	5	4	4	3	5	4	4	5	0	5	5
W912QR04D00150014	0.00	4	4	4	4	3	3	5	4	4	4	5	3
W912QR05C0013	0.02	3	3	3	2	3	3	3	2	3	2	3	3
W912QR06D00080040	-0.06	3	3	3	3	2	0	3	3	0	3	3	2
W912QR06C0008	0.00	3	3	3	3	4	3	3	3	3	3	3	3
DACW2701D00050052	0.87	4	5	5	5	5	5	5	4	5	0	5	5
DACW2701D00050078	3.35	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00160027	-0.05	3	5	3	3	3	3	3	3	3	2	3	3
W912QR06D00080007	-0.01	4	5	3	3	3	4	5	3	0	0	5	4
W912QR06D00080032	0.04	4	4	3	3	3	5	5	4	4	3	5	3
W912QR07C0011	0.40	4	4	0	0	3	0	0	0	3	0	0	0
DACA2701D00100029	-0.19	5	5	4	4	4	4	4	4	4	4	4	5
DACA2702C0021	0.00	2	3	3	1	2	3	3	1	1	1	2	2
DACA2703C0010	0.00	5	5	4	5	4	4	5	4	5	5	5	4
DACW2701D00050037	-0.08	4	3	3	3	3	0	3	3	0	0	3	0
W912QR05C0016	-0.01	5	5	4	5	4	4	4	4	4	4	4	5
W912QR05C0020	0.00	3	4	3	3	3	3	3	3	3	3	3	3
W912QR05C0030	-0.35	5	4	3	3	3	3	3	3	3	3	3	4
W912QR04C0012	0.02	4	5	4	4	4	3	3	4	4	4	4	4
W912QR05C0025	-0.01	3	3	3	3	3	3	3	3	0	0	0	3
W912QR06C0035	0.00	4	5	4	5	4	3	3	3	3	3	3	5
DACW2701D00050001	0.00	3	3	3	3	3	0	3	3	0	0	3	3
W912QR06C0014	0.00	4	4	4	3	4	3	3	3	4	3	4	4
DACW2701D00050126	-0.09	3	3	3	3	3	3	3	3	3	3	3	3
DACA270100030059	0.01	3	4	3	3	3	4	3	3	3	3	4	4
DACA2701D00030033	-0.01	3	3	3	2	2	3	3	3	0	0	3	3
DACA2701D00030036	-0.04	3	3	3	2	2	3	3	3	3	3	3	3
DACA2701D00030040	1.30	4	3	3	3	4	4	4	3	3	3	3	4
DACA2701D00030047	0.32	4	4	4	4	4	4	4	4	4	4	4	4
DACA2701D00030048	-0.01	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030051	1.81	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030054	0.81	4	4	4	4	4	4	4	4	4	4	4	4
DACA2701D00030056	0.33	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030057	0.94	3	3	3	3	2	3	3	3	3	3	3	3
DACA2701D00030058	1.00	3	3	3	2	2	3	3	3	3	3	3	3
DACA2701D00030063	0.15	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030063	0.15	4	4	3	4	3	3	3	4	3	3	3	4
DACA2701D00030065	1.53	3	3	3	3	3	3	3	3	3	3	3	4

Contract Number	Project Schedule Growth	Overall Rating	15.a	15.b	15.c	15.d	15.e	15.f	15.g	15.h	15.i	15.j	15.k
DACA2701D00030069	0.97	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030071	1.28	3	3	3	2	2	3	3	3	3	3	3	2
DACA2701D00030074	0.34	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030075	1.87	3	4	3	3	3	3	3	3	3	3	3	3
DACA2701D00030076	-0.28	4	4	3	3	3	0	3	0	0	0	0	3
DACA2701D00030077	0.75	3	3	4	4	4	3	3	3	2	0	3	3
DACA2701D00030078	0.00	3	3	3	3	0	3	3	0	0	0	0	3
DACA2701D00030081	-0.18	3	3	3	4	3	3	3	3	0	0	3	4
DACA2701D00080001	0.13	3	4	2	2	3	3	3	3	4	4	3	3
DACA2799D00040004	0.13	4	4	4	4	4	4	4	4	4	4	4	4
DACW2701D00050132	2.53	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050002	-0.39	3	4	3	3	3	3	3	3	3	3	3	3
DACW2701D00050074	4.66	4	5	3	3	3	3	4	4	3	3	3	3
DACW2701D00050102	2.02	3	3	3	3	3	3	3	3	3	3	3	3
DACW2702C0001	1.00	3	4	3	3	3	3	3	3	3	3	3	3
DACW2702C0015	-0.02	3	3	3	3	3	3	3	3	3	3	3	3
DACW2703C0008	-0.34	4	5	4	5	4	4	4	4	4	4	4	5
DACW2703C0023	0.18	3	4	4	4	4	4	4	4	4	4	4	4
DACW2703C0026	0.00	4	4	4	4	4	3	3	3	3	3	3	4
W912QR04D00150005	0.00	4	5	4	3	4	4	5	4	4	3	5	5
W912QR04D00150006	7.71	3	3	3	3	2	3	3	3	3	3	3	2
W912QR04D00150026	2.88	3	3	3	3	2	3	3	3	3	3	3	2
W912QR04D00160004	0.15	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00040001	0.00	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070001	2.01	3	3	0	0	0	3	3	3	3	0	0	3
W912QR05D00070002	0.59	4	3	4	4	3	3	3	3	3	0	3	4
W912QR05D00070006	0.00	3	3	3	3	3	3	3	0	0	0	0	3
W912QR05D00070008	3.31	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070009	2.22	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070011	1.60	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070012	0.34	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070013	1.80	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703C0020	0.04	4	4	3	3	4	4	4	3	5	0	4	4
DACA2703D00080001	-0.02	3	4	3	3	3	3	3	3	3	0	3	3
DACA2703D00080003	-0.01	4	4	4	4	4	3	3	3	4	3	0	4
DACA2703D00080007	0.03	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080018	-0.04	4	4	4	4	4	3	3	3	3	3	0	3
DACA2703D00080019	0.03	4	4	4	4	4	4	4	4	4	0	4	4
DACA2703D00080025	-0.44	3	3	3	3	3	3	3	3	3	0	3	3
DACA2703D00080026	-0.09	3	4	3	4	3	3	3	3	3	0	3	3
DACA2703D00080029	-0.39	3	4	3	4	4	0	3	3	3	0	3	3
DACA2703D00080033	-0.22	3	4	4	3	3	3	3	3	3	0	3	3
DACA2703D00080039	-0.01	4	4	4	4	4	4	4	4	4	4	4	4
DACA2703D00080040	0.39	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080047	0.00	4	4	4	4	4	4	4	4	4	0	4	4
DACA6303C0020	1.03	2	3	3	2	2	1	3	1	0	3	3	2
DACW2701C0022	-0.64	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050015	0.12	3	4	4	4	3	3	3	0	0	0	3	0
DACW2701D00050017	0.00	3	4	3	3	3	3	3	3	3	0	3	0
DACW2701D00050024	0.00	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050110	0.00	3	3	3	3	3	3	3	3	3	0	0	3
DACW2702C0026	2.67	3	3	3	3	3	3	3	3	3	3	3	2
W912QR04C0003	-0.39	4	3	4	4	4	3	3	4	4	4	4	3
W912QR04D00090001	-0.02	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150013	1.64	3	4	3	3	3	3	3	3	3	3	3	3

Contract Number	Project Schedule Growth	Overall Rating	15.a	15.b	15.c	15.d	15.e	15.f	15.g	15.h	15.i	15.j	15.k
W912QR04D00080003	-0.03	4	4	4	3	3	4	3	3	3	4	4	4
DACA2701D00080058	-0.01	4	4	3	3	3	3	4	3	3	3	3	4
W912QR04D00150007	0.00	4	4	4	4	4	0	4	4	4	0	5	5
W912QR04D00150022	-0.05	4	5	3	4	3	5	3	3	3	0	4	5
W912QR04D00150028	0.00	4	4	4	3	3	4	4	3	4	0	4	5
W912QR04D00160009	-2.11	4	4	3	3	3	0	0	0	0	0	0	4
W912QR05C0021	-0.02	5	5	4	5	4	5	4	4	4	4	5	5
W912QR06C0017	0.00	5	5	3	4	5	5	5	5	4	4	5	5
DACA2701D00080056	-0.24	4	4	4	4	3	3	3	3	3	0	4	4
DACA2701D00080059	0.00	4	5	4	4	4	4	3	3	3	3	4	4
DACA2701D00100008	0.38	5	5	4	4	5	5	4	4	4	0	4	5
DACA2703C0018	-0.01	5	5	5	4	4	4	4	4	4	4	4	4
W912QR04D00160017	0.29	5	5	3	3	3	5	3	3	3	0	4	5
W912QR05C0006	0.00	5	5	3	4	5	4	4	5	5	3	4	5
W912QR04D00160033	1.43	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00250001	0.00	4	4	3	4	3	0	0	0	3	0	0	4
W912QR05C0034	-0.01	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00040002	2.19	3	3	3	3	3	3	3	3	3	0	3	3
W912QR05D00040003	0.58	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070017	0.00	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070020	-0.06	3	3	4	3	3	3	4	3	3	3	3	3
W912QR05D00070022	-0.54	3	3	3	3	3	0	3	3	0	0	3	0
W912QR05D00070024	-0.62	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070025	-0.41	5	5	4	4	4	0	5	5	4	4	3	5
W912QR06C0020	-0.01	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06C0057	-0.26	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701C0030	0.00	4	4	5	3	4	4	4	5	3	4	4	3
DACW2701D00050016	0.00	4	4	3	3	3	0	3	3	3	0	3	4
DACW2701D00050087	2.62	3	3	3	3	3	0	3	3	3	4	0	3
DACW2701D00050092	0.76	3	3	3	2	3	3	3	0	3	3	3	3
DACW2701D00050093	0.41	5	4	0	0	4	0	4	4	0	0	4	0
DACW2701D00050094	-0.45	4	5	4	4	4	0	4	4	4	5	0	0
DACW2701D00050095	1.52	3	4	3	3	2	4	3	3	3	0	4	1
DACW2702C0005	0.00	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150003	4.49	3	4	4	3	3	4	4	3	3	2	4	4
W912QR04D00160030	-0.21	4	4	5	4	4	0	5	4	5	0	0	0
W912QR06D00080011	-0.01	4	5	4	3	3	4	4	3	3	0	4	0
W912QR06D00080036	-0.49	4	4	4	4	3	3	4	4	4	0	3	3
W912QR07C0041	-0.43	5	5	5	5	5	5	5	5	0	0	5	0
W912QR06C0011	-0.01	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06C0016	-0.05	3	3	3	3	3	3	3	3	3	3	3	3
DACW2702C0018	-0.04	3	3	3	3	3	3	3	3	3	2	3	3
W912D06D0001CY01	2.03	5	4	3	3	3	0	3	3	3	3	3	3
W912QR04D00150030	-0.11	4	3	4	4	4	3	3	3	3	3	3	3
W912QR04C0024	0.07	5	5	4	4	4	5	5	4	5	5	5	4
W912QR04D00140006	-0.03	4	5	5	4	5	4	4	4	4	5	5	5
W912QR04D00150031	-0.01	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150033	-0.14	3	4	3	3	3	3	3	3	3	3	0	3
W912QR04D00160016	0.06	3	3	3	3	3	3	1	3	1	4	2	5
W912QR06C0029	0.00	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703C0007	0.00	5	4	5	4	4	4	5	5	4	4	5	5
W912QR06C0039	0.00	3	3	3	3	3	3	3	3	3	3	3	0
W912QR06C0040	0.00	4	4	3	4	3	4	4	4	3	4	3	4
W912QR06D00080017	0.87	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06D00080018	0.00	3	0	3	3	3	0	0	3	0	0	3	0

Contract Number	16.a	16.b	16.c	16.d	16.e	16.f	16.g	16.h	16.i	17.a	17.b	17.c	17.d	17.e	17.f	17.g
DACA2700D00050019	4	4	4	3	4	3	4	4	3	4	4	4	4	4	0	4
DACA2700D00050157	2	2	2	3	2	3	3	2	2	1	1	1	2	3	1	3
DACA2701D00080003	3	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3
DACA2701D00080040	4	4	4	3	4	3	3	3	3	3	3	3	3	3	3	3
DACA2702C0013	3	3	3	3	2	4	3	3	3	3	3	3	3	3	3	3
DACA2703D00080071	4	4	4	4	4	3	4	4	4	3	3	3	3	3	3	3
DACA2703D00080072	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080079	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DACW2700C0016	5	4	3	4	4	3	5	3	3	3	3	3	3	3	3	0
DACW2703C0025	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00160011	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00160008	3	3	3	3	3	3	3	3	0	3	3	3	2	2	3	3
W912QR06C0010	4	3	3	4	3	3	3	3	3	3	4	3	3	3	4	3
W912QR06C0044	4	3	4	4	4	3	4	4	3	3	3	3	3	3	4	3
W912QR07C0040	4	4	3	4	4	3	4	3	3	3	4	4	3	4	3	0
DACA2701D00090009	3	2	2	3	2	3	3	3	3	3	2	4	3	3	3	0
DACW2701D00050029	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150014	5	4	5	5	5	3	5	5	3	3	3	4	3	5	0	5
W912QR04D00150014	5	4	4	4	4	4	5	3	4	5	4	5	4	4	5	0
W912QR05C0013	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	4
W912QR06D00080040	4	3	4	4	3	3	4	3	3	3	3	3	3	3	3	0
W912QR06C0008	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3
DACW2701D00050052	5	4	4	5	5	5	5	5	0	4	4	4	4	5	0	0
DACW2701D00050078	3	3	3	3	3	3	3	3	3	3	3	4	4	4	3	3
W912QR04D00160027	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
W912QR06D00080007	5	5	3	4	4	3	5	3	3	3	3	4	3	0	0	0
W912QR06D00080032	5	3	0	5	5	3	5	0	0	3	3	3	3	3	0	0
W912QR07C0011	5	4	0	3	5	3	5	0	0	0	0	5	0	0	0	0
DACA2701D00100029	5	4	5	5	5	4	5	4	4	5	5	4	3	5	4	4
DACA2702C0021	2	2	2	3	2	3	2	1	2	3	2	1	2	2	2	2
DACA2703C0010	5	5	4	5	5	4	5	5	4	4	4	5	5	5	4	0
DACW2701D00050037	4	3	3	3	3	3	3	3	3	4	4	n	3	3	3	0
W912QR05C0016	5	5	5	5	5	4	5	4	4	4	5	5	5	5	4	5
W912QR05C0020	4	3	3	3	3	3	4	3	3	3	4	4	3	3	3	3
W912QR05C0030	5	4	4	4	5	4	5	4	4	3	3	4	3	4	3	3
W912QR04C0012	5	4	4	3	4	4	5	4	3	3	3	3	4	4	3	5
W912QR05C0025	3	3	2	3	3	3	3	4	3	3	3	3	3	3	3	3
W912QR06C0035	5	4	3	3	4	3	4	3	3	3	3	4	3	3	3	4
DACW2701D00050001	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3	3
W912QR06C0014	5	4	3	4	4	4	4	3	3	3	4	4	3	3	3	0
DACW2701D00050126	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
DACA270100030059	4	2	2	4	3	4	3	3	3	0	0	3	3	3	0	4
DACA2701D00030033	3	3	3	3	3	3	3	3	3	0	3	3	3	3	0	0
DACA2701D00030036	3	3	3	3	3	3	3	3	3	0	3	3	0	3	0	0
DACA2701D00030040	4	3	3	4	3	4	4	3	3	3	3	3	3	4	3	4
DACA2701D00030047	5	5	4	4	4	4	4	5	4	5	5	5	4	4	4	5
DACA2701D00030048	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2701D00030051	3	2	2	3	3	3	3	3	3	0	0	2	3	3	0	3
DACA2701D00030054	5	5	4	4	4	4	4	5	4	5	5	5	4	4	4	5
DACA2701D00030056	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
DACA2701D00030057	3	3	2	3	3	3	3	3	3	0	1	2	0	3	0	3
DACA2701D00030058	3	3	3	3	3	3	3	3	3	3	3	3	0	3	0	0
DACA2701D00030063	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
DACA2701D00030063	5	4	4	3	4	3	4	3	3	3	3	3	3	4	3	3
DACA2701D00030065	4	3	3	3	3	3	4	3	0	3	3	3	3	4	3	4

Contract Number	16.a	16.b	16.c	16.d	16.e	16.f	16.g	16.h	16.i	17.a	17.b	17.c	17.d	17.e	17.f	17.g
DACA2701D00030069	4	3	3	4	3	3	3	3	0	0	0	3	3	2	0	3
DACA2701D00030071	3	3	3	3	3	3	3	3	3	3	2	3	3	2	0	0
DACA2701D00030074	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
DACA2701D00030075	4	3	3	4	3	3	3	3	3	0	0	n	3	4	0	3
DACA2701D00030076	4	4	4	4	3	4	4	4	0	0	0	0	0	0	0	4
DACA2701D00030077	3	3	0	3	3	3	4	0	0	0	0	0	0	3	0	0
DACA2701D00030078	4	3	2	3	4	3	3	2	0	0	0	0	0	3	0	3
DACA2701D00030081	4	3	4	4	4	3	3	3	3	0	0	0	3	3	0	0
DACA2701D00080001	3	2	2	3	2	3	3	3	3	3	3	3	3	4	0	4
DACA2799D00040004	5	4	4	4	5	5	4	4	4	4	4	4	4	4	3	4
DACW2701D00050132	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050002	4	4	0	3	4	3	4	0	0	3	3	3	3	4	0	0
DACW2701D00050074	4	4	3	4	4	3	5	3	3	4	4	4	3	3	3	5
DACW2701D00050102	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
DACW2702C0001	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3
DACW2702C0015	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACW2703C0008	5	5	5	5	5	3	5	5	4	4	4	0	4	4	0	4
DACW2703C0023	4	4	4	5	4	4	5	4	0	3	3	3	3	4	3	3
DACW2703C0026	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3
W912QR04D00150005	5	5	5	4	5	3	5	5	3	5	3	5	0	5	0	5
W912QR04D00150006	3	2	2	3	2	3	3	3	3	3	2	3	3	2	2	3
W912QR04D00150026	3	2	2	3	3	3	3	3	3	3	2	2	2	3	3	3
W912QR04D00160004	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
W912QR05D00040001	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
W912QR05D00070001	3	3	3	3	3	3	3	3	0	0	0	0	3	4	0	3
W912QR05D00070002	4	4	0	4	4	3	4	0	0	0	0	0	0	4	0	0
W912QR05D00070006	3	3	3	3	4	3	4	3	3	0	0	0	0	3	0	3
W912QR05D00070008	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070009	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070011	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070012	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070013	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703C0020	5	4	3	3	4	4	4	4	0	4	3	5	5	0	5	0
DACA2703D00080001	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080003	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0
DACA2703D00080007	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080018	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080019	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DACA2703D00080025	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080026	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080029	4	4	3	3	3	3	4	3	3	3	3	3	3	3	3	3
DACA2703D00080033	4	4	4	3	4	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080039	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DACA2703D00080040	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703D00080047	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
DACA6303C0020	2	2	1	1	1	3	3	2	0	3	3	1	1	2	3	2
DACW2701C0022	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACW2701D00050015	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	0
DACW2701D00050017	4	4	3	3	3	3	3	3	3	3	3	3	3	3	0	3
DACW2701D00050024	3	4	5	3	3	3	3	4	3	0	0	0	3	3	0	3
DACW2701D00050110	3	3	3	3	3	3	3	3	0	3	3	0	3	3	3	0
DACW2702C0026	2	3	3	3	3	3	3	3	3	3	2	2	2	2	2	3
W912QR04C0003	4	3	4	4	4	4	4	3	4	4	4	4	4	3	4	4
W912QR04D00090001	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00150013	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Contract Number	16.a	16.b	16.c	16.d	16.e	16.f	16.g	16.h	16.i	17.a	17.b	17.c	17.d	17.e	17.f	17.g
W912QR04D00080003	3	4	4	3	4	3	3	4	3	4	4	5	4	0	4	0
DACA2701D00080058	4	4	4	4	4	4	4	4	0	3	3	3	3	4	3	0
W912QR04D00150007	5	5	5	4	4	3	5	5	4	4	3	5	3	4	3	4
W912QR04D00150022	5	4	5	4	4	3	5	5	4	3	3	4	3	5	3	4
W912QR04D00150028	5	4	4	5	4	3	5	4	5	3	3	4	4	5	3	5
W912QR04D00160009	5	5	3	4	4	4	5	3	0	3	3	0	0	3	0	0
W912QR05C0021	5	5	5	4	5	4	5	5	4	4	5	5	4	4	3	5
W912QR06C0017	5	5	4	4	5	4	5	4	3	4	5	5	4	5	4	0
DACA2701D00080056	5	4	4	4	5	3	5	3	3	3	4	4	3	5	3	5
DACA2701D00080059	5	5	5	3	5	3	5	4	4	4	3	4	3	4	3	4
DACA2701D00100008	5	5	4	4	5	4	5	4	4	4	4	5	4	5	4	5
DACA2703C0018	5	5	5	4	5	4	5	5	3	4	4	5	3	4	4	0
W912QR04D00160017	5	5	4	4	4	3	5	5	3	3	3	5	4	5	3	5
W912QR05C0006	5	5	4	5	5	3	4	5	0	3	0	5	4	3	4	3
W912QR04D00160033	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR04D00250001	4	4	4	5	4	4	4	4	4	3	3	4	3	4	3	4
W912QR05C0034	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
W912QR05D00040002	4	4	0	4	4	0	4	0	0	3	0	0	3	3	0	3
W912QR05D00040003	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0
W912QR05D00070017	3	3	3	3	3	3	3	3	3	0	0	3	3	3	0	0
W912QR05D00070020	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR05D00070022	3	3	3	3	3	3	3	3	3	0	0	0	3	3	0	0
W912QR05D00070024	3	3	3	3	3	3	3	3	3	0	0	3	0	0	0	0
W912QR05D00070025	5	5	5	4	5	5	5	5	5	5	5	0	4	5	0	5
W912QR06C0020	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3
W912QR06C0057	3	3	3	3	3	3	4	3	3	3	3	3	2	3	2	3
DACW2701C0030	4	4	2	5	4	4	5	2	3	3	3	4	4	4	5	2
DACW2701D00050016	5	4	4	4	3	4	5	4	0	4	3	5	4	4	0	0
DACW2701D00050087	3	4	3	3	3	4	4	4	0	3	3	3	3	3	0	0
DACW2701D00050092	3	2	2	3	2	3	3	2	2	0	0	3	3	0	0	0
DACW2701D00050093	5	5	0	5	5	4	5	0	0	4	4	5	4	0	0	0
DACW2701D00050094	5	4	4	5	4	5	5	0	0	0	4	0	0	0	0	0
DACW2701D00050095	3	2	3	4	2	4	3	0	3	2	3	2	3	2	1	0
DACW2702C0005	2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	2
W912QR04D00150003	3	3	4	4	3	4	4	4	4	3	3	3	3	3	3	5
W912QR04D00160030	4	4	4	4	4	0	5	4	0	4	4	4	4	5	0	0
W912QR06D00080011	5	5	3	4	3	4	4	3	3	0	5	0	2	0	0	0
W912QR06D00080036	3	3	3	0	4	5	4	5	0	3	3	3	3	3	3	3
W912QR07C0041	5	5	5	5	5	5	5	0	5	5	5	0	5	5	0	0
W912QR06C0011	4	3	3	3	3	3	3	3	3	4	4	3	5	4	5	0
W912QR06C0016	4	3	3	3	3	3	4	3	3	3	5	3	5	4	5	0
DACW2702C0018	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912D06D0001CY01	5	3	4	3	4	3	4	3	3	3	3	5	3	3	3	0
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W912QR04C0024	5	4	3	3	4	5	5	4	4	4	3	3	4	5	4	4
W912QR04D00140006	4	4	5	4	4	5	5	4	4	3	3	3	4	5	4	0
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W912QR04D00150033	3	3	3	3	4	3	3	4	3	3	4	3	3	3	3	3
W912QR04D00160016	4	4	2	5	4	3	4	3	2	3	3	3	3	5	4	5
W912QR06C0029	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DACA2703C0007	5	5	5	4	5	4	5	5	4	5	5	5	4	4	5	5
W912QR06C0039	4	4	3	4	3	3	3	4	3	3	3	4	3	3	3	3
W912QR06C0040	5	3	4	4	4	3	4	4	3	3	3	4	3	4	4	5
W912QR06D00080017	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W912QR06D00080018	5	4	4	0	4	3	5	0	0	0	0	0	3	0	0	0

Contract Number	18.a	18.b	18.c	19.a	19.b	19.c
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DACA2701D00080003	3	3	3	3	3	3
DACA2701D00080040	3	3	3	3	3	3
DACA2702C0013	3	3	3	3	2	3
DACA2703D00080071	4	4	4	4	4	4
DACA2703D00080072	3	3	3	3	3	3
DACA2703D00080079	4	4	4	4	4	4
DACW2700C0016	4	3	3	3	3	3
DACW2703C0025	3	3	3	3	3	3
W912QR04D00160011	3	3	3	3	3	3
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W912QR07C0040	3	3	3	4	4	4
DACA2701D00090009	0	4	4	3	3	3
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W912QR05C0013	3	3	3	3	3	3
W912QR06D00080040	3	3	3	3	3	3
W912QR06C0008	3	3	3	3	4	4
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DACW2701D00050078	3	3	3	3	3	3
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DACA2702C0021	2	2	2	3	2	2
DACA2703C0010	4	4	4	4	5	5
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W912QR05C0020	4	4	4	3	3	4
W912QR05C0030	4	4	4	3	4	4
W912QR04C0012	5	4	4	3	3	4
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DACA2701D00030054	0	4	4	5	5	5
DACA2701D00030056	3	3	3	3	3	3
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DACA2701D00030063	3	3	3	3	3	3
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Contract Number	18.a	18.b	18.c	19.a	19.b	19.c
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DACA2701D00030075	4	4	4	4	4	4
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DACA2701D00030081	3	3	3	4	3	4
DACA2701D00080001	4	3	3	3	3	3
DACA2799D00040004	4	5	5	5	4	4
DACW2701D00050132	0	3	3	3	3	3
DACW2701D00050002	0	3	3	3	3	3
DACW2701D00050074	5	3	3	4	4	5
DACW2701D00050102	3	3	3	3	3	3
DACW2702C0001	3	3	3	3	3	3
DACW2702C0015	3	3	3	3	2	3
DACW2703C0008	4	3	3	3	5	4
DACW2703C0023	3	3	3	4	4	4
DACW2703C0026	3	3	3	4	4	4
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W912QR05D00040001	3	3	3	3	3	3
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DACA2703D00080029	3	3	3	3	4	3
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DACA2703D00080039	4	4	4	4	4	4
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DACA2703D00080047	4	4	4	4	4	4
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DACW2701D00050017	3	3	3	3	3	0
DACW2701D00050024	3	3	3	3	3	3
DACW2701D00050110	0	3	3	3	3	0
DACW2702C0026	3	2	3	3	3	3
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Contract Number	18.a	18.b	18.c	19.a	19.b	19.c
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W912QR05C0006	4	3	3	4	3	5
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W912QR06C0057	4	3	3	3	3	3
DACW2701C0030	4	4	4	4	4	4
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DACW2701D00050087	3	4	4	4	4	3
DACW2701D00050092	3	3	3	3	3	3
DACW2701D00050093	0	4	4	0	4	0
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DACW2701D00050095	3	3	4	4	4	4
DACW2702C0005	3	2	3	3	3	3
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W912QR07C0041	0	5	5	5	5	0
W912QR06C0011	2	2	2	3	4	4
W912QR06C0016	2	2	2	3	4	4
DACW2702C0018	3	2	3	3	3	3
W912D06D0001CY01	3	3	3	3	3	3
W912QR04D00150030	3	3	4	4	4	4
W912QR04C0024	4	5	5	5	5	5
W912QR04D00140006	4	3	5	5	4	4
W912QR04D00150031	3	3	3	3	3	3
W912QR04D00150033	3	3	3	3	3	3
W912QR04D00160016	4	4	4	4	5	4
W912QR06C0029	4	3	3	3	3	3
DACA2703C0007	4	4	4	5	5	5
W912QR06C0039	0	4	4	3	4	4
W912QR06C0040	4	3	4	4	5	5
W912QR06D00080017	3	3	3	3	3	3
W912QR06D00080018	0	3	3	3	3	0

Appendix E: Normality Analysis

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Overall_Rating	165	100.0%	0	.0%	165	100.0%

Descriptives

			Statistic	Std. Error
Overall_Rating	Mean		3.50	.054
	95% Confidence Interval for Mean	Lower Bound	3.39	
		Upper Bound	3.60	
	5% Trimmed Mean		3.45	
	Median		3.00	
	Variance		.483	
	Std. Deviation		.695	
	Minimum		2	
	Maximum		5	
	Range		3	
	Interquartile Range		1	
	Skewness		.838	.189
	Kurtosis		-.188	.376

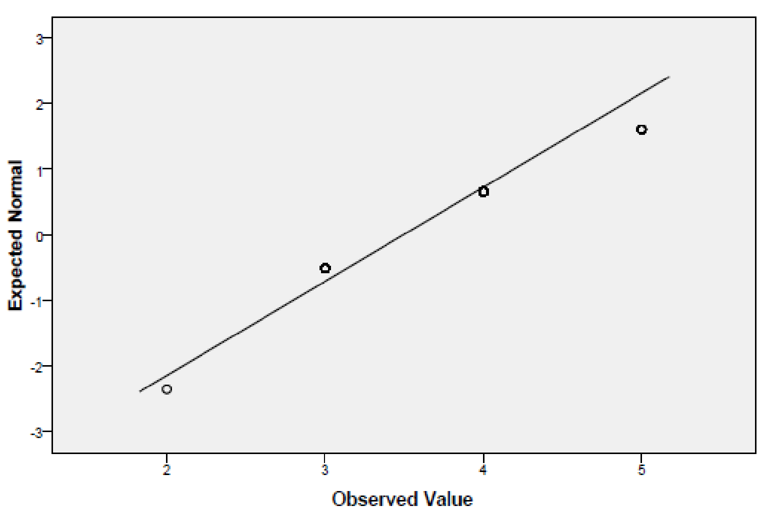
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Overall_Rating	.357	165	.000	.747	165	.000

a. Lilliefors Significance Correction

Overall_Rating

Normal Q-Q Plot of Overall_Rating



Descriptives

			Statistic	Std. Error
QC	Mean		3.1709	.05128
	95% Confidence Interval for Mean	Lower Bound	3.0697	
		Upper Bound	3.2722	
	5% Trimmed Mean		3.1742	
	Median		3.0000	
	Variance		.434	
	Std. Deviation		.65871	
	Minimum		1.00	
	Maximum		4.90	
	Range		3.90	
	Interquartile Range		.70	
	Skewness		.038	.189
	Kurtosis		.612	.376

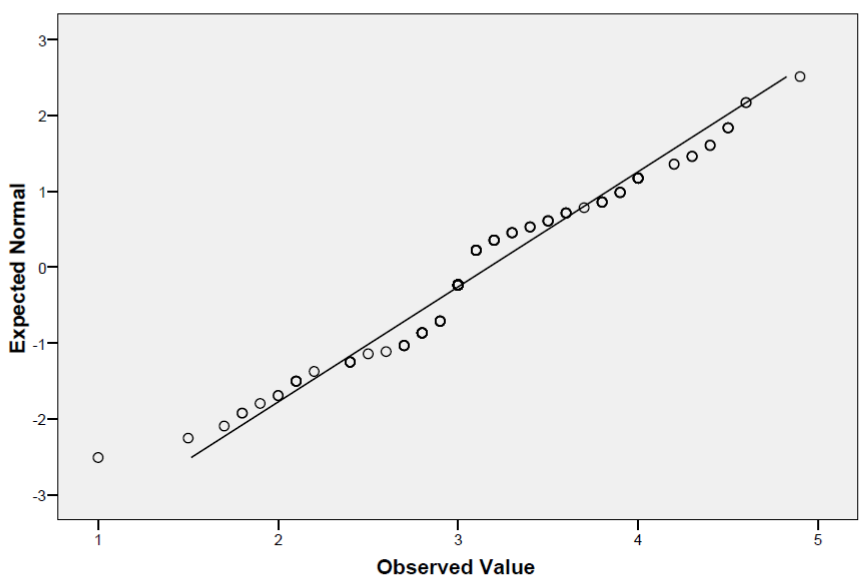
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
QC	.161	165	.000	.949	165	.000

a. Lilliefors Significance Correction

QC

Normal Q-Q Plot of QC



Descriptives

			Statistic	Std. Error
AAB	Mean		2.3030	.11987
	95% Confidence Interval for Mean	Lower Bound	2.0663	
		Upper Bound	2.5397	
	5% Trimmed Mean		2.3165	
	Median		3.0000	
	Variance		2.371	
	Std. Deviation		1.53981	
	Minimum		.00	
	Maximum		5.00	
	Range		5.00	
	Interquartile Range		3.00	
	Skewness		-.612	.189
	Kurtosis		-1.121	.376

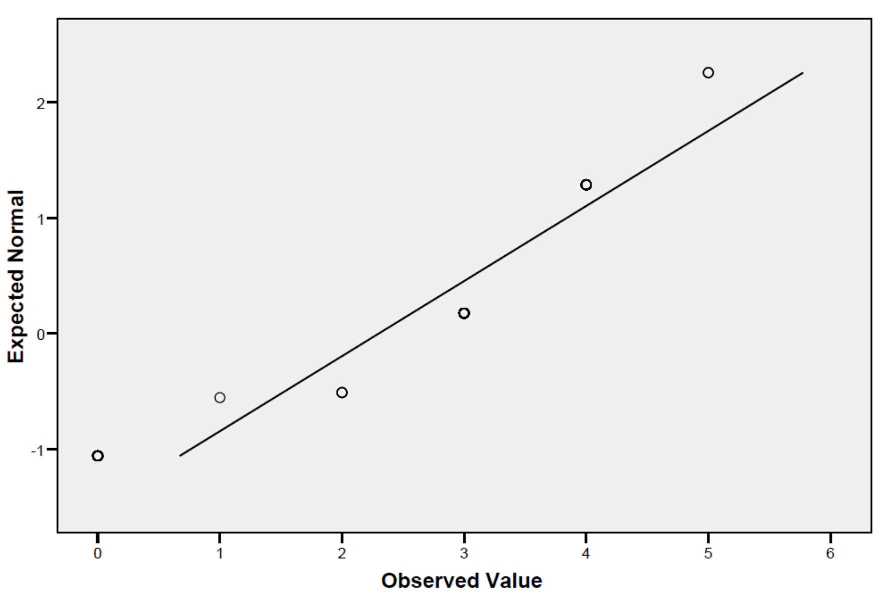
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
AAB	.359	165	.000	.763	165	.000

a. Lilliefors Significance Correction

AAB

Normal Q-Q Plot of AAB



Descriptives

			Statistic	Std. Error
EM	Mean		3.5495	.05026
	95% Confidence Interval for Mean	Lower Bound	3.4503	
		Upper Bound	3.6487	
	5% Trimmed Mean		3.5351	
	Median		3.3333	
	Variance		.417	
	Std. Deviation		.64556	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.17	
	Skewness		.446	.189
	Kurtosis		-.873	.376

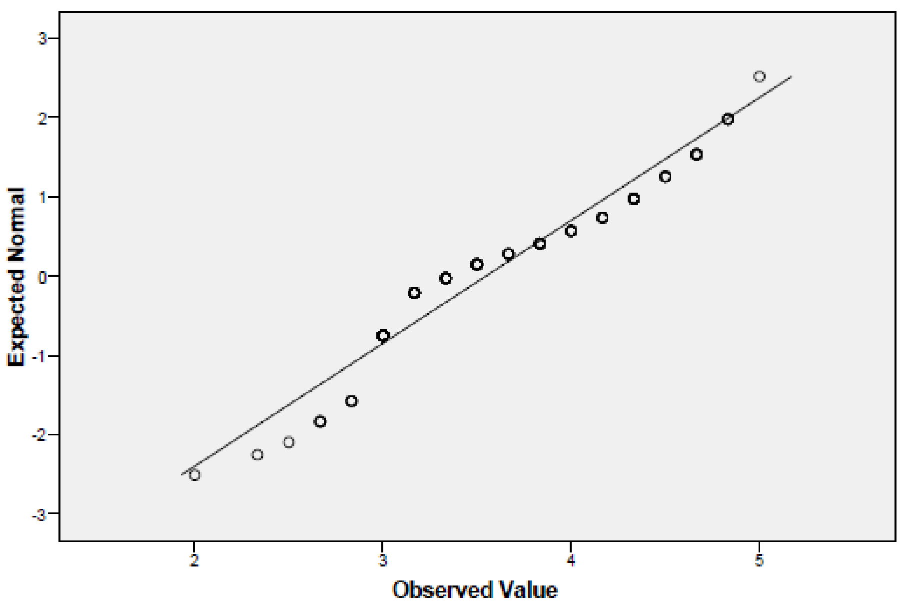
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
EM	.184	165	.000	.912	165	.000

a. Lilliefors Significance Correction

EM

Normal Q-Q Plot of EM



Descriptives

			Statistic	Std. Error
MS	Mean		3.0162	.07372
	95% Confidence Interval for Mean	Lower Bound	2.8706	
		Upper Bound	3.1617	
	5% Trimmed Mean		3.0859	
	Median		3.0000	
	Variance		.897	
	Std. Deviation		.94697	
	Minimum		.00	
	Maximum		5.00	
	Range		5.00	
	Interquartile Range		.33	
	Skewness		-1.146	.189
	Kurtosis		2.729	.376

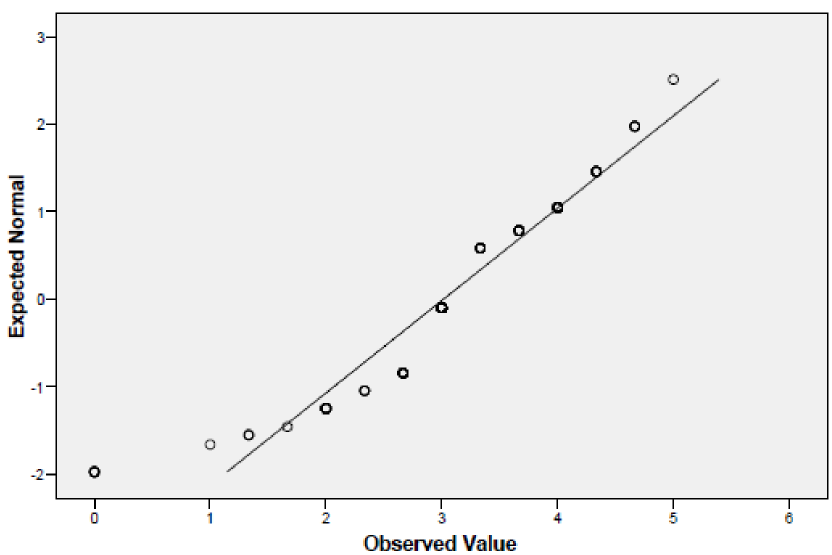
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
MS	.257	165	.000	.854	165	.000

a. Lilliefors Significance Correction

MS

Normal Q-Q Plot of MS



Descriptives

			Statistic	Std. Error
TP	Mean		2.8685	.07492
	95% Confidence Interval for Mean	Lower Bound	2.7205	
		Upper Bound	3.0164	
	5% Trimmed Mean		2.9091	
	Median		3.0000	
	Variance		.926	
	Std. Deviation		.96238	
	Minimum		.00	
	Maximum		4.67	
	Range		4.67	
	Interquartile Range		.78	
	Skewness		-.866	.189
	Kurtosis		.633	.376

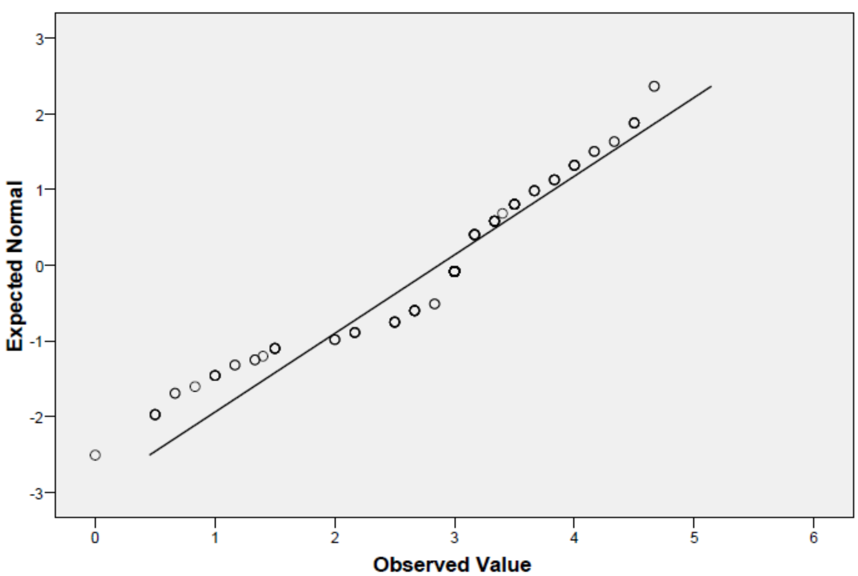
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TP	.245	165	.000	.908	165	.000

a. Lilliefors Significance Correction

TP

Normal Q-Q Plot of TP



Descriptives

			Statistic	Std. Error
WR	Mean		2.3091	.13718
	95% Confidence Interval for Mean	Lower Bound	2.0382	
		Upper Bound	2.5800	
	5% Trimmed Mean		2.2879	
	Median		3.0000	
	Variance		3.105	
	Std. Deviation		1.76213	
	Minimum		.00	
	Maximum		5.00	
	Range		5.00	
	Interquartile Range		3.00	
	Skewness		-.251	.189
	Kurtosis		-1.322	.376

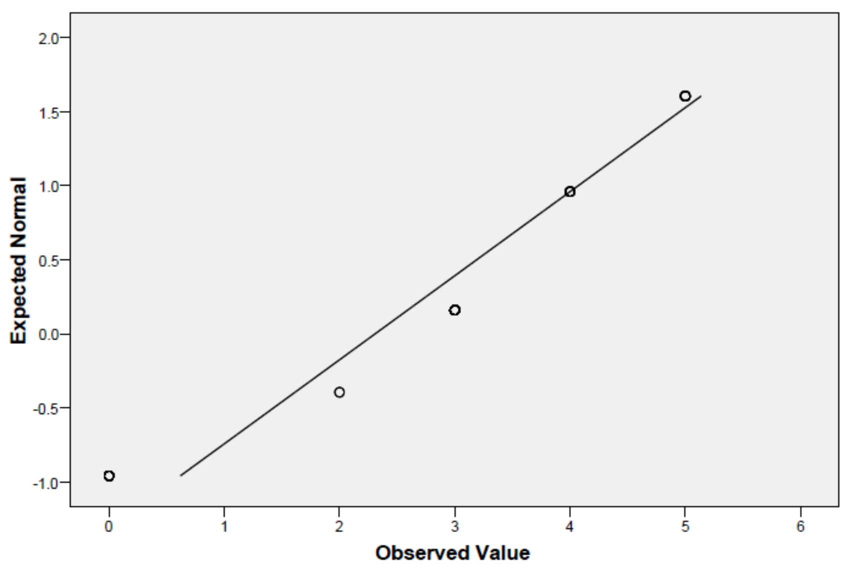
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
WR	.295	165	.000	.812	165	.000

a. Lilliefors Significance Correction

WR

Normal Q-Q Plot of WR



Descriptives

			Statistic	Std. Error
CLS	Mean		3.2606	.04158
	95% Confidence Interval for Mean	Lower Bound	3.1785	
		Upper Bound	3.3427	
	5% Trimmed Mean		3.2306	
	Median		3.0000	
	Variance		.285	
	Std. Deviation		.53416	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		.50	
	Skewness		1.083	.189
	Kurtosis		1.240	.376

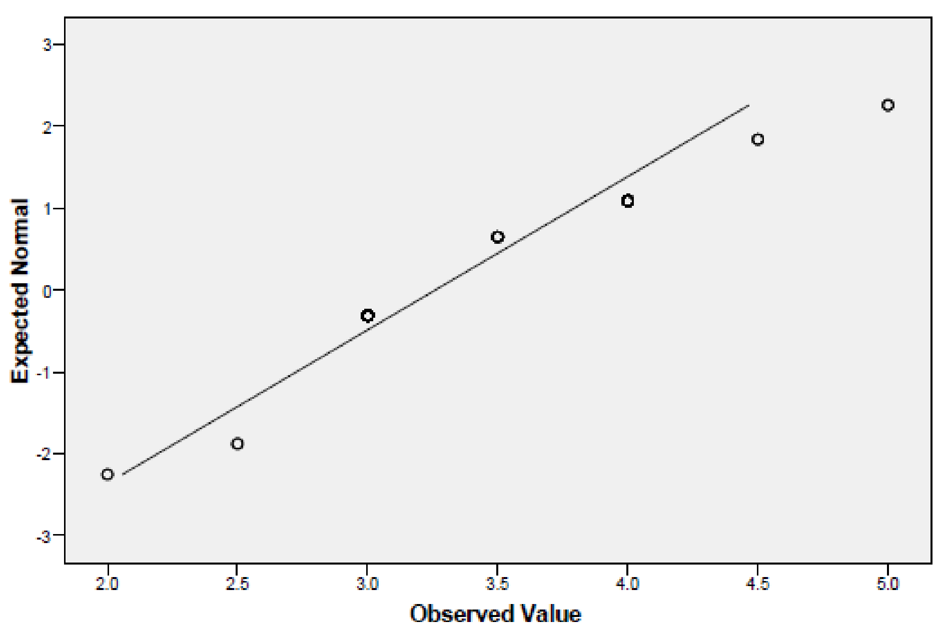
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CLS	.402	165	.000	.719	165	.000

a. Lilliefors Significance Correction

CLS

Normal Q-Q Plot of CLS



Descriptives

			Statistic	Std. Error
CCLSND	Mean		2.7515	.11123
	95% Confidence Interval for Mean	Lower Bound	2.5319	
		Upper Bound	2.9712	
	5% Trimmed Mean		2.7795	
	Median		3.0000	
	Variance		2.042	
	Std. Deviation		1.42882	
	Minimum		.00	
	Maximum		5.00	
	Range		5.00	
	Interquartile Range		1.00	
	Skewness		-.950	.189
	Kurtosis		.062	.376

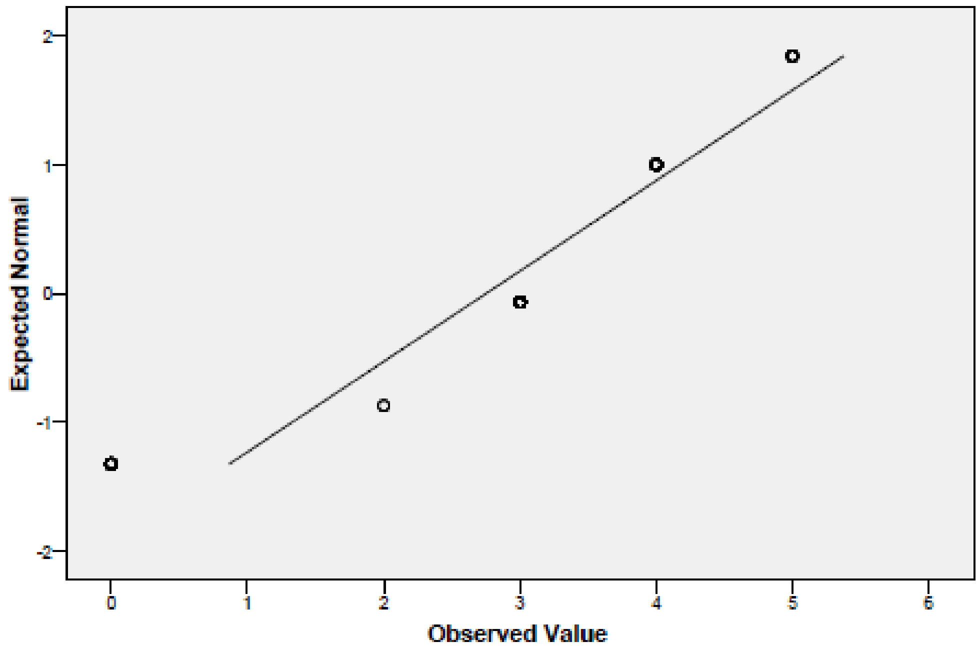
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CCLSND	.369	165	.000	.768	165	.000

a. Lilliefors Significance Correction

CCLSND

Normal Q-Q Plot of CCLSND



Descriptives

			Statistic	Std. Error
CSS	Mean		3.4364	.05598
	95% Confidence Interval for Mean	Lower Bound	3.3258	
		Upper Bound	3.5469	
	5% Trimmed Mean		3.4327	
	Median		3.0000	
	Variance		.517	
	Std. Deviation		.71910	
	Minimum		1.33	
	Maximum		5.00	
	Range		3.67	
	Interquartile Range		1.00	
	Skewness		.313	.189
	Kurtosis		.305	.376

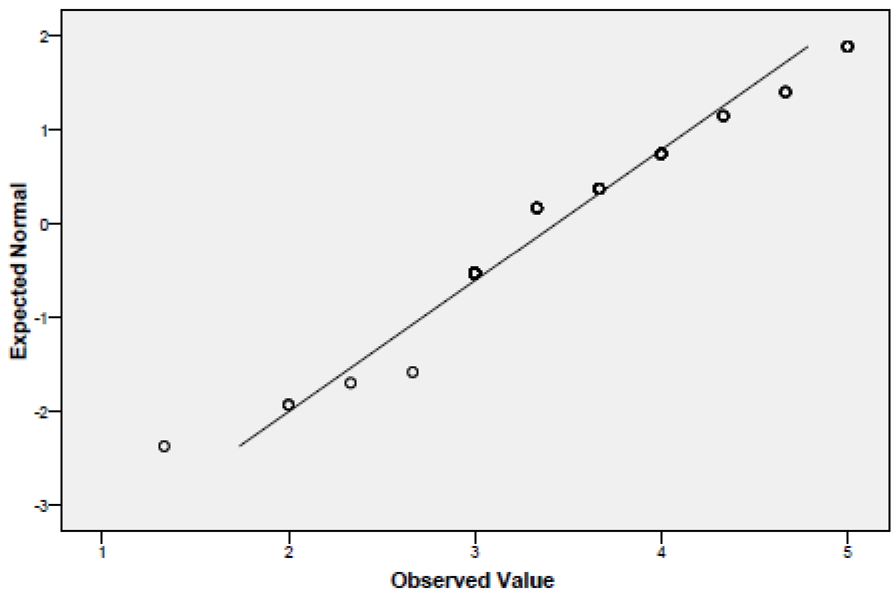
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CSS	.261	165	.000	.881	165	.000

a. Lilliefors Significance Correction

CSS

Normal Q-Q Plot of CSS



Appendix F: Reliability Analysis

Performance Element: Quality Control

Reliability Statistics

Cronbach's Alpha	N of Items
.846	11

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
QC.a	30.41	45.340	.497	.836
QC.b	30.73	45.285	.594	.831
QC.c	30.79	44.461	.609	.829
QC.d	30.82	45.451	.585	.832
QC.e	31.07	41.312	.560	.830

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
QC.f	30.76	44.108	.636	.827
QC.g	30.93	42.824	.669	.823
QC.h	31.10	40.893	.620	.825
QC.i	31.71	43.390	.291	.866
QC.j	30.96	41.419	.589	.827
QC.k	30.85	42.385	.513	.835

Performance Element: Effectiveness of Management

Reliability Statistics

Cronbach's Alpha	N of Items
.839	9

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
EM.a	26.56	24.029	.693	.808
EM.b	26.84	24.321	.731	.806
EM.c	27.13	22.929	.679	.807
EM.d	26.88	25.798	.536	.825
EM.e	26.82	24.406	.711	.808
EM.f	27.05	27.271	.430	.834
EM.g	26.62	24.760	.647	.813

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
EM.h	27.18	24.064	.499	.830
EM.i	27.68	25.414	.278	.867

Performance Element: Timely Performance

Reliability Statistics

Cronbach's Alpha	N of Items
.810	7

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TP.a	16.72	29.732	.782	.745
TP.b	16.69	31.377	.649	.768
TP.c	16.54	31.793	.564	.782
TP.d	16.60	33.747	.586	.782
TP.e	16.39	34.350	.487	.795
TP.f	17.20	29.360	.626	.769
TP.g	17.25	33.211	.286	.847

Performance Element: Compliance with Labor Standards

Reliability Statistics

Cronbach's Alpha	N of Items
.268	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CLS.a	6.52	1.147	.020	.896
CLS.b	6.06	2.426	.298	.062
CLS.c	6.00	2.282	.333	-.013[a]

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings.

Performance Element: Compliance with Safety Standards

Reliability Statistics

Cronbach's Alpha	N of Items
.729	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CSS.a	6.90	2.495	.663	.543
CSS.b	6.76	2.660	.571	.637
CSS.c	6.96	1.889	.498	.781

Appendix G: Principle Component Analysis Results All Performance Items

Principle Component Analysis

Correlation Matrix[a]

a. Determinant = 1.17E-011

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.856
Bartlett's Test of Sphericity	Approx. Chi-Square	3755.350
	df	528
	Sig.	.000

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
QC.a	.690	-.244	.077	.048	-.127	.054	.056
QC.b	.679	-.017	.024	.350	.271	-.354	-.218
QC.c	.736	-.034	.117	.236	.182	-.351	-.194
QC.d	.743	-.161	-.145	.017	.021	-.040	-.262
QC.e	.432	.342	-.008	.542	-.305	.034	.035
QC.f	.619	.000	-.327	.390	-.109	-.011	.234
QC.g	.661	.117	-.426	.219	-.116	-.029	.156
QC.h	.551	.270	-.129	.219	-.132	.235	-.049
QC.i	.209	.421	-.240	.184	.174	.422	-.195
QC.j	.556	.224	-.264	.271	-.396	-.017	.057
QC.k	.598	.275	.451	.019	-.266	.082	-.012
EM.a	.690	-.480	.057	-.202	-.266	.028	-.024
EM.b	.708	-.446	.055	-.240	-.161	-.133	-.063
EM.c	.657	.123	.183	-.122	.234	-.354	.073
EM.d	.602	-.328	.029	.031	-.153	.124	.196

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
EM.e	.718	-.437	.062	-.133	-.247	-.051	.006
EM.f	.513	-.147	-.001	.083	.303	.341	-.111
EM.g	.684	-.522	.042	-.148	-.189	.043	-.009
EM.h	.604	.379	.324	-.186	.079	-.074	.108
EM.i	.441	.477	-.006	.002	.233	-.111	.183
TP.a	.652	.286	-.352	-.370	.059	-.119	.011
TP.b	.638	.184	-.374	-.302	.191	-.110	-.094
TP.c	.530	.289	-.214	-.402	-.249	.247	-.113
TP.d	.552	.332	-.356	-.216	-.067	-.137	.058
TP.e	.610	.192	.134	.028	-.003	-.164	.274
TP.f	.430	.604	-.127	-.274	.086	.080	-.296
TP.g	.331	.323	.422	-.115	.067	.044	.471
CLS.a	.329	.421	.467	-.058	.035	.095	.160
CLS.b	.531	-.412	-.155	-.059	.360	.370	.278
CLS.c	.595	-.370	-.150	.082	.506	.250	.219
CSS.a	.638	-.169	.331	.265	.219	-.035	-.259
CSS.b	.725	-.266	.152	-.025	.038	.019	-.154
CSS.c	.485	.249	.544	-.010	-.078	.367	-.275

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

Pattern Matrix[a]

	Component						
	1	2	3	4	5	6	7
QC.a	.492	-.022	.064	.220	.174	-.116	.105
QC.b	-.020	.023	-.049	.183	.050	-.840	-.052
QC.c	.134	.053	-.014	.128	-.012	-.772	.041
QC.d	.345	.286	.118	.136	.134	-.379	-.203
QC.e	-.091	-.169	.137	.800	-.153	-.141	.110
QC.f	.077	-.015	-.219	.701	.227	-.094	.000
QC.g	.075	.254	-.202	.626	.164	-.060	-.034
QC.h	-.014	.156	.240	.509	.119	-.011	.043
QC.i	-.455	.253	.365	.277	.306	.031	-.103
QC.j	.157	.152	-.018	.742	-.145	.008	-.019
QC.k	.289	-.001	.371	.224	-.191	-.086	.474

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 21 iterations.

Pattern Matrix[a]

	Component						
	1	2	3	4	5	6	7
EM.a	.839	.093	.065	.037	.091	-.014	-.029
EM.b	.783	.177	-.021	-.066	.035	-.183	-.023
EM.c	.121	.256	-.159	-.119	.010	-.486	.396
EM.d	.522	-.094	-.020	.241	.267	.060	.125
EM.e	.787	.065	.005	.095	.059	-.096	.008
EM.f	.040	.031	.271	-.007	.555	-.165	-.026
EM.g	.789	.039	.043	.034	.178	-.052	-.048
EM.h	.068	.272	.110	-.046	-.028	-.177	.597
EM.i	-.297	.301	-.110	.128	.101	-.191	.432
TP.a	.112	.788	-.145	.035	.062	-.047	.100
TP.b	.058	.740	-.113	-.034	.162	-.187	-.033
TP.c	.281	.681	.255	.113	-.016	.302	.048
TP.d	.061	.648	-.170	.223	-.044	-.005	.089
TP.e	.124	.094	-.147	.226	.029	-.166	.477
TP.f	-.202	.737	.306	-.029	-.082	-.104	.089
TP.g	-.016	-.055	-.039	.000	.112	.134	.834
CLS.a	-.073	.002	.236	-.005	-.022	-.015	.661
CLS.b	.204	.000	-.078	-.050	.857	.117	.089
CLS.c	.058	-.033	-.118	-.028	.870	-.144	.069
CSS.a	.171	-.185	.285	.009	.175	-.647	.054
CSS.b	.464	.066	.185	-.011	.185	-.333	.028
CSS.c	.158	-.017	.725	-.014	-.003	-.105	.333

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 21 iterations.

Structure Matrix

	Component						
	1	2	3	4	5	6	7
QC.a	.642	.230	.139	.419	.429	-.424	.281
QC.b	.295	.290	.053	.432	.348	-.890	.231
QC.c	.414	.320	.092	.409	.316	-.873	.324
QC.d	.548	.471	.182	.423	.452	-.596	.095
QC.e	.057	.151	.257	.772	.032	-.307	.291
QC.f	.315	.297	-.098	.762	.435	-.375	.173
QC.g	.300	.509	-.073	.753	.400	-.358	.180
QC.h	.162	.404	.346	.638	.290	-.271	.253

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Structure Matrix

	Component						
	1	2	3	4	5	6	7
QC.i	-.285	.363	.422	.371	.283	-.071	.037
QC.j	.273	.401	.097	.784	.113	-.251	.197
QC.k	.375	.265	.491	.423	.037	-.358	.646
EM.a	.890	.251	.094	.266	.398	-.342	.151
EM.b	.861	.312	.016	.208	.367	-.460	.177
EM.c	.350	.440	-.027	.214	.250	-.657	.566
EM.d	.642	.142	.043	.383	.463	-.272	.233
EM.e	.866	.253	.051	.320	.383	-.413	.198
EM.f	.275	.223	.314	.227	.636	-.374	.124
EM.g	.869	.210	.069	.258	.466	-.369	.124
EM.h	.236	.470	.258	.264	.148	-.428	.736
EM.i	-.072	.474	.039	.342	.187	-.357	.537
TP.a	.280	.852	-.023	.372	.297	-.327	.320
TP.b	.263	.798	-.012	.315	.387	-.413	.205
TP.c	.311	.724	.332	.367	.177	-.026	.248
TP.d	.197	.732	-.048	.455	.173	-.251	.284
TP.e	.314	.347	.001	.429	.224	-.430	.595
TP.f	-.078	.763	.404	.271	.064	-.246	.321
TP.g	.094	.145	.098	.149	.112	-.119	.780
CLS.a	.027	.186	.353	.166	.019	-.198	.695
CLS.b	.447	.187	-.033	.171	.877	-.218	.123
CLS.c	.384	.199	-.053	.222	.918	-.425	.147
CSS.a	.421	.091	.348	.266	.411	-.754	.285
CSS.b	.644	.282	.244	.282	.463	-.578	.256
CSS.c	.246	.196	.793	.223	.136	-.311	.510

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Confirmatory Factor Analysis – 5 Components

Correlation Matrix[a]

a. Determinant = 1.17E-011

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.856
Bartlett's Test of Sphericity	Approx. Chi-Square	3755.350
	df	528
	Sig.	.000

Component Matrix[a]

	Component				
	1	2	3	4	5
QC.a	.690	-.244	.077	.048	-.127
QC.b	.679	-.017	.024	.350	.271
QC.c	.736	-.034	.117	.236	.182
QC.d	.743	-.161	-.145	.017	.021
QC.e	.432	.342	-.008	.542	-.305
QC.f	.619	.000	-.327	.390	-.109
QC.g	.661	.117	-.426	.219	-.116
QC.h	.551	.270	-.129	.219	-.132
QC.i	.209	.421	-.240	.184	.174
QC.j	.556	.224	-.264	.271	-.396
QC.k	.598	.275	.451	.019	-.266
EM.a	.690	-.480	.057	-.202	-.266
EM.b	.708	-.446	.055	-.240	-.161
EM.c	.657	.123	.183	-.122	.234
EM.d	.602	-.328	.029	.031	-.153

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

Component Matrix[a]

	Component				
	1	2	3	4	5
EM.e	.718	-.437	.062	-.133	-.247
EM.f	.513	-.147	-.001	.083	.303
EM.g	.684	-.522	.042	-.148	-.189
EM.h	.604	.379	.324	-.186	.079
EM.i	.441	.477	-.006	.002	.233
TP.a	.652	.286	-.352	-.370	.059
TP.b	.638	.184	-.374	-.302	.191
TP.c	.530	.289	-.214	-.402	-.249
TP.d	.552	.332	-.356	-.216	-.067
TP.e	.610	.192	.134	.028	-.003
TP.f	.430	.604	-.127	-.274	.086
TP.g	.331	.323	.422	-.115	.067
CLS.a	.329	.421	.467	-.058	.035
CLS.b	.531	-.412	-.155	-.059	.360
CLS.c	.595	-.370	-.150	.082	.506
CSS.a	.638	-.169	.331	.265	.219
CSS.b	.725	-.266	.152	-.025	.038
CSS.c	.485	.249	.544	-.010	-.078

Extraction Method: Principal Component Analysis.

a. 5 components extracted.

Pattern Matrix[a]

	Component				
	1	2	3	4	5
QC.a	.513	.005	.135	.223	.185
QC.b	-.011	-.092	.164	.345	.603
QC.c	.133	-.054	.269	.274	.499
QC.d	.364	.219	-.007	.225	.329
QC.e	-.081	-.167	.181	.842	-.099
QC.f	.118	.065	-.191	.681	.235
QC.g	.106	.316	-.194	.609	.161
QC.h	.010	.168	.120	.526	.043
QC.i	-.421	.239	.013	.309	.186
QC.j	.167	.181	-.043	.744	-.180
QC.k	.267	-.018	.691	.249	-.173

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 15 iterations.

Pattern Matrix[a]

	Component				
	1	2	3	4	5
EM.a	.852	.110	.035	.028	.043
EM.b	.785	.163	.063	-.046	.132
EM.c	.102	.227	.432	-.070	.364
EM.d	.552	-.012	.028	.193	.153
EM.e	.797	.079	.058	.095	.079
EM.f	.089	.033	.073	.024	.541
EM.g	.809	.061	-.004	.028	.148
EM.h	.043	.275	.667	-.043	.087
EM.i	-.303	.329	.345	.123	.234
TP.a	.105	.802	.037	.020	.097
TP.b	.061	.723	-.037	-.014	.277
TP.c	.276	.698	.124	.074	-.268
TP.d	.053	.671	.001	.203	-.028
TP.e	.118	.146	.375	.204	.141
TP.f	-.223	.660	.320	.028	-.030
TP.g	-.030	.060	.648	-.098	.017
CLS.a	-.094	.027	.724	-.023	-.031
CLS.b	.275	.135	-.165	-.138	.649
CLS.c	.130	.064	-.136	-.066	.845
CSS.a	.187	-.288	.375	.149	.539
CSS.b	.479	.024	.220	.053	.340
CSS.c	.150	-.087	.747	.055	-.030

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 15 iterations.

Structure Matrix

	Component				
	1	2	3	4	5
QC.a	.647	.242	.321	.428	.474
QC.b	.293	.238	.376	.548	.717
QC.c	.405	.270	.468	.520	.677
QC.d	.560	.436	.248	.478	.591
QC.e	.058	.146	.365	.791	.126
QC.f	.325	.337	.108	.742	.466
QC.g	.304	.540	.132	.733	.432
QC.h	.174	.402	.341	.639	.282

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Structure Matrix

	Component				
	1	2	3	4	5
QC.i	-.255	.347	.153	.370	.194
QC.j	.271	.410	.223	.774	.152
QC.k	.353	.248	.765	.459	.149
EM.a	.893	.258	.207	.266	.404
EM.b	.855	.306	.236	.233	.465
EM.c	.316	.431	.566	.280	.535
EM.d	.650	.181	.199	.357	.419
EM.e	.865	.259	.243	.329	.437
EM.f	.308	.219	.220	.245	.606
EM.g	.877	.220	.171	.259	.471
EM.h	.201	.470	.753	.300	.309
EM.i	-.096	.489	.480	.360	.325
TP.a	.259	.860	.297	.370	.367
TP.b	.254	.792	.223	.333	.483
TP.c	.305	.723	.318	.336	.073
TP.d	.176	.744	.248	.446	.237
TP.e	.286	.375	.526	.441	.369
TP.f	-.091	.718	.468	.310	.145
TP.g	.059	.201	.633	.124	.133
CLS.a	.000	.194	.704	.184	.092
CLS.b	.481	.254	.010	.116	.709
CLS.c	.418	.250	.064	.203	.860
CSS.a	.432	.039	.489	.368	.658
CSS.b	.651	.259	.387	.333	.588
CSS.c	.248	.147	.756	.278	.182

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Appendix H: Principle Component Analysis Results for Quality Control

Initial PCA

Correlation Matrix[a]

		QC.d	QC.e	QC.f	QC.g	QC.h	QC.i	QC.j	QC.k
Correlation	QC.d	1.000	.213	.419	.522	.406	.130	.400	.322
	QC.e	.213	1.000	.448	.358	.442	.229	.520	.440
	QC.f	.419	.448	1.000	.652	.402	.173	.549	.255
	QC.g	.522	.358	.652	1.000	.510	.307	.583	.281
	QC.h	.406	.442	.402	.510	1.000	.400	.334	.425
	QC.i	.130	.229	.173	.307	.400	1.000	.174	.214
	QC.j	.400	.520	.549	.583	.334	.174	1.000	.325
	QC.k	.322	.440	.255	.281	.425	.214	.325	1.000
	QC.c	.640	.309	.397	.446	.346	.117	.355	.435
	QC.b	.558	.339	.485	.411	.332	.129	.381	.334
	QC.a	.496	.302	.501	.338	.366	.003	.326	.349

a. Determinant = .006

Correlation Matrix[a]

		QC.c	QC.b	QC.a
Correlation	QC.d	.640	.558	.496
	QC.e	.309	.339	.302
	QC.f	.397	.485	.501
	QC.g	.446	.411	.338
	QC.h	.346	.332	.366
	QC.i	.117	.129	.003
	QC.j	.355	.381	.326
	QC.k	.435	.334	.349
	QC.c	1.000	.791	.465
	QC.b	.791	1.000	.403
	QC.a	.465	.403	1.000

a. Determinant = .006

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.821
Bartlett's Test of Sphericity	Approx. Chi-Square	815.498
	df	55
	Sig.	.000

Component Matrix[a]

	Component	
	1	2
QC.d	.723	-.344
QC.e	.619	.365
QC.f	.743	.044
QC.g	.754	.173
QC.h	.666	.366
QC.i	.331	.650
QC.j	.688	.179
QC.k	.584	.131
QC.c	.751	-.430
QC.b	.732	-.385
QC.a	.639	-.303

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Confirmatory PCA

Quality Control 1 (QC1)

Correlation Matrix[a]

		QC.d	QC.f	QC.g	QC.h	QC.k	QC.c	QC.b	QC.a
Correlation	QC.d	1.000	.419	.522	.406	.322	.640	.558	.496
	QC.f	.419	1.000	.652	.402	.255	.397	.485	.501
	QC.g	.522	.652	1.000	.510	.281	.446	.411	.338
	QC.h	.406	.402	.510	1.000	.425	.346	.332	.366
	QC.k	.322	.255	.281	.425	1.000	.435	.334	.349
	QC.c	.640	.397	.446	.346	.435	1.000	.791	.465
	QC.b	.558	.485	.411	.332	.334	.791	1.000	.403
	QC.a	.496	.501	.338	.366	.349	.465	.403	1.000

a. Determinant = .023

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.785
Bartlett's Test of Sphericity	Approx. Chi-Square	602.051
	df	28
	Sig.	.000

Component Matrix[a]

	Component
	1
QC.d	.777
QC.f	.722
QC.g	.731
QC.h	.645
QC.k	.567
QC.c	.807
QC.b	.772
QC.a	.681

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Quality Control 2 (QC2)

Correlation Matrix[a]

a. Determinant = .688

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.555
Bartlett's Test of Sphericity	Approx. Chi-Square	60.553
	df	3
	Sig.	.000

Component Matrix[a]

	Component
	1
QC.i	.518
QC.j	.817
QC.e	.842

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Appendix I: Principle Component Analysis Results for Effectiveness of Management

Initial PCA

Correlation Matrix[a]

		EM.a	EM.b	EM.c	EM.d	EM.e	EM.f	EM.g
Correlation	EM.a	1.000	.781	.401	.573	.797	.365	.815
	EM.b	.781	1.000	.482	.522	.798	.335	.743
	EM.c	.401	.482	1.000	.293	.422	.346	.358
	EM.d	.573	.522	.293	1.000	.561	.274	.534
	EM.e	.797	.798	.422	.561	1.000	.333	.772
	EM.f	.365	.335	.346	.274	.333	1.000	.390
	EM.g	.815	.743	.358	.534	.772	.390	1.000
	EM.h	.237	.351	.710	.191	.277	.238	.210
	EM.i	.061	.105	.480	.162	.099	.175	-.002

a. Determinant = .004

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.869
Bartlett's Test of Sphericity	Approx. Chi-Square	874.682
	df	36
	Sig.	.000

Component Matrix[a]

	Component	
	1	2
EM.a	.872	-.291
EM.b	.875	-.162
EM.c	.661	.603
EM.d	.679	-.163
EM.e	.872	-.239
EM.f	.519	.119
EM.g	.842	-.337
EM.h	.505	.672
EM.i	.272	.732

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Confirmatory PCA

Effectiveness of Management

Correlation Matrix[a]

		EM.a	EM.b	EM.d	EM.e	EM.f	EM.g
Correlation	EM.a	1.000	.781	.573	.797	.365	.815
	EM.b	.781	1.000	.522	.798	.335	.743
	EM.d	.573	.522	1.000	.561	.274	.534
	EM.e	.797	.798	.561	1.000	.333	.772
	EM.f	.365	.335	.274	.333	1.000	.390
	EM.g	.815	.743	.534	.772	.390	1.000

a. Determinant = .017

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.898
Bartlett's Test of Sphericity	Approx. Chi-Square	655.767
	df	15.000
	Sig.	.000

Component Matrix[a]

	Component
	1
EM.a	.915
EM.b	.884
EM.d	.707
EM.e	.902
EM.f	.495
EM.g	.896

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Management of Subcontractors

Correlation Matrix[a]

		EM.c	EM.h	EM.i
Correlation	EM.c	1.000	.710	.480
	EM.h	.710	1.000	.397
	EM.i	.480	.397	1.000

a. Determinant = .378

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.632
Bartlett's Test of Sphericity	Approx. Chi-Square	157.562
	df	3.000
	Sig.	.000

Component Matrix[a]

	Component
	1
EM.c	.897
EM.h	.863

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Appendix J: Principle Component Analysis Results for Timely Performance

Initial PCA

Correlation Matrix[a]

		TP.a	TP.b	TP.c	TP.d	TP.e	TP.f	TP.g
Correlation	TP.a	1.000	.788	.572	.591	.465	.582	.255
	TP.b	.788	1.000	.483	.502	.372	.514	.137
	TP.c	.572	.483	1.000	.454	.248	.517	.164
	TP.d	.591	.502	.454	1.000	.382	.499	.121
	TP.e	.465	.372	.248	.382	1.000	.281	.353
	TP.f	.582	.514	.517	.499	.281	1.000	.263
	TP.g	.255	.137	.164	.121	.353	.263	1.000

a. Determinant = .058

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.824
Bartlett's Test of Sphericity	Approx. Chi-Square	451.758
	df	21
	Sig.	.000

Component Matrix[a]

	Component	
	1	2
TP.a	.893	-.084
TP.b	.810	-.204
TP.c	.715	-.230
TP.d	.742	-.174
TP.e	.592	.496
TP.f	.755	-.085
TP.g	.371	.819

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Confirmatory PCA

Correlation Matrix[a]

		TP.a	TP.b	TP.c	TP.d	TP.e	TP.f
Correlation	TP.a	1.000	.788	.572	.591	.465	.582
	TP.b	.788	1.000	.483	.502	.372	.514
	TP.c	.572	.483	1.000	.454	.248	.517
	TP.d	.591	.502	.454	1.000	.382	.499
	TP.e	.465	.372	.248	.382	1.000	.281
	TP.f	.582	.514	.517	.499	.281	1.000

a. Determinant = .071

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.842
Bartlett's Test of Sphericity	Approx. Chi-Square	421.046
	df	15.000
	Sig.	.000

Component Matrix[a]

	Component
	1
TP.a	.897
TP.b	.824
TP.c	.723
TP.d	.756
TP.e	.569
TP.f	.753

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Appendix K: Principle Component Analysis Results for Compliance with Labor Standards

Initial PCA

Correlation Matrix[a]

		CLS.a	CLS.b	CLS.c
Correlation	CLS.a	1.000	-.010	.045
	CLS.b	-.010	1.000	.815
	CLS.c	.045	.815	1.000

a. Determinant = .333

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.494
Bartlett's Test of Sphericity	Approx. Chi-Square	177.220
	df	3
	Sig.	.000

Component Matrix[a]

	Component	
	1	2
CLS.a	.042	.999
CLS.b	.952	-.055
CLS.c	.953	.012

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Confirmatory PCA

Correlation Matrix[a]

		CLS.b	CLS.c
Correlation	CLS.b	1.000	.815
	CLS.c	.815	1.000

a. Determinant = .336

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	176.211
	df	1.000
	Sig.	.000

Component Matrix[a]

	Component
	1
CLS.b	.953
CLS.c	.953

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Appendix L: Principle Component Analysis Results for Compliance with Safety Standards

Initial PCA

Correlation Matrix[a]

		CSS.a	CSS.b	CSS.c
Correlation	CSS.a	1.000	.641	.503
	CSS.b	.641	1.000	.400
	CSS.c	.503	.400	1.000

a. Determinant = .434

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.650
Bartlett's Test of Sphericity	Approx. Chi-Square	135.301
	df	3
	Sig.	.000

Component Matrix[a]

	Component
	1
CSS.a	.881
CSS.b	.835

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Confirmatory PCA– Not Required

Appendix M: Performance Element Correlation Analysis Results

Correlations

		Overall_ Rating	QC1	QC2	EM	MS	TP
Overall_Rating	Pearson Correlation	1.000	.628**	.219**	.869**	.380**	.448**
	Sig. (2-tailed)		.000	.005	.000	.000	.000
	N	165	165	165	165	165	165
QC1	Pearson Correlation	.628**	1.000	.605**	.666**	.573**	.625**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	165	165	165	165	165	165
QC2	Pearson Correlation	.219**	.605**	1.000	.222**	.390**	.471**
	Sig. (2-tailed)	.005	.000		.004	.000	.000
	N	165	165	165	165	165	165
EM	Pearson Correlation	.869**	.666**	.222**	1.000	.348**	.405**
	Sig. (2-tailed)	.000	.000	.004		.000	.000
	N	165	165	165	165	165	165
MS	Pearson Correlation	.380**	.573**	.390**	.348**	1.000	.588**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	165	165	165	165	165	165
TP	Pearson Correlation	.448**	.625**	.471**	.405**	.588**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	165	165	165	165	165	165
WR	Pearson Correlation	.098	.284**	.194*	.137	.414**	.274**
	Sig. (2-tailed)	.211	.000	.013	.078	.000	.000
	N	165	165	165	165	165	165
CCLSND	Pearson Correlation	.156*	.297**	.213**	.115	.406**	.288**
	Sig. (2-tailed)	.046	.000	.006	.142	.000	.000
	N	165	165	165	165	165	165
CLS	Pearson Correlation	.528**	.455**	.120	.578**	.259**	.284**
	Sig. (2-tailed)	.000	.000	.124	.000	.001	.000
	N	165	165	165	165	165	165
CSS	Pearson Correlation	.535**	.618**	.325**	.576**	.457**	.414**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	165	165	165	165	165	165

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		WR	CCLSND	CLS	CSS
Overall_Rating	Pearson Correlation	.098	.156*	.528**	.535**
	Sig. (2-tailed)	.211	.046	.000	.000
	N	165	165	165	165
QC1	Pearson Correlation	.284**	.297**	.455**	.618**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	165	165	165	165
QC2	Pearson Correlation	.194*	.213**	.120	.325**
	Sig. (2-tailed)	.013	.006	.124	.000
	N	165	165	165	165
EM	Pearson Correlation	.137	.115	.578**	.576**
	Sig. (2-tailed)	.078	.142	.000	.000
	N	165	165	165	165
MS	Pearson Correlation	.414**	.406**	.259**	.457**
	Sig. (2-tailed)	.000	.000	.001	.000
	N	165	165	165	165
TP	Pearson Correlation	.274**	.288**	.284**	.414**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	165	165	165	165
WR	Pearson Correlation	1.000	.471**	.134	.304**
	Sig. (2-tailed)		.000	.086	.000
	N	165	165	165	165
CCLSND	Pearson Correlation	.471**	1.000	.025	.387**
	Sig. (2-tailed)	.000		.746	.000
	N	165	165	165	165
CLS	Pearson Correlation	.134	.025	1.000	.393**
	Sig. (2-tailed)	.086	.746		.000
	N	165	165	165	165
CSS	Pearson Correlation	.304**	.387**	.393**	1.000
	Sig. (2-tailed)	.000	.000	.000	
	N	165	165	165	165

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix N: Step-Wise Linear Regression Results

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	EM	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	TP	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Overall_Rating

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.869[a]	.755	.753	.345	
2	.875[b]	.766	.763	.338	1.884

a. Predictors: (Constant), EM

b. Predictors: (Constant), EM, TP

c. Dependent Variable: Overall_Rating

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	59.821	1	59.821	501.904	.000[a]
	Residual	19.428	163	.119		
	Total	79.248	164			
2	Regression	60.698	2	30.349	265.042	.000[b]
	Residual	18.550	162	.115		
	Total	79.248	164			

a. Predictors: (Constant), EM

b. Predictors: (Constant), EM, TP

c. Dependent Variable: Overall_Rating

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	.176	.151		1.170	.244	-.121	.474
	EM	.936	.042	.869	22.403	.000	.853	1.018
2	(Constant)	.116	.149		.777	.438	-.179	.411
	EM	.885	.045	.822	19.774	.000	.797	.974
	TP	.083	.030	.115	2.768	.006	.024	.142

a. Dependent Variable: Overall_Rating

Coefficients[a]

Model		Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)		
	EM	1.000	1.000
2	(Constant)		
	EM	.836	1.197
	TP	.836	1.197

a. Dependent Variable: Overall_Rating

Excluded Variables[c]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance	Collinearity Statistics VIF	Collinearity Statistics Minimum Tolerance
1	QC	.068[a]	1.389	.167	.108	.624	1.602	.624
	MS	.088[a]	2.147	.033	.166	.879	1.138	.879
	TP	.115[a]	2.768	.006	.213	.836	1.197	.836
	CCLSND	.057[a]	1.460	.146	.114	.987	1.013	.987
	CLS	.038[a]	.795	.428	.062	.666	1.503	.666
	CSS	.053[a]	1.110	.269	.087	.669	1.496	.669
2	QC	.000[b]	-.014	.989	-.001	.459	2.179	.459
	MS	.040[b]	.848	.398	.067	.640	1.563	.609
	CCLSND	.031[b]	.775	.440	.061	.917	1.091	.777
	CLS	.029[b]	.629	.530	.049	.663	1.509	.602
	CSS	.023[b]	.476	.635	.037	.630	1.588	.630

a. Predictors in the Model: (Constant), EM

b. Predictors in the Model: (Constant), EM, TP

c. Dependent Variable: Overall_Rating

Coefficient Correlations[a]

Model			EM	TP
1	Correlations	EM	1.000	
	Covariances	EM	.002	
2	Correlations	EM	1.000	-.405
		TP	-.405	1.000
	Covariances	EM	.002	.000
		TP	.000	.001

a. Dependent Variable: Overall_Rating

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	EM	TP
1	1	1.984	1.000	.01	.01	
	2	.016	11.120	.99	.99	
2	1	2.926	1.000	.00	.00	.01
	2	.059	7.056	.12	.05	.95
	3	.016	13.707	.88	.95	.04

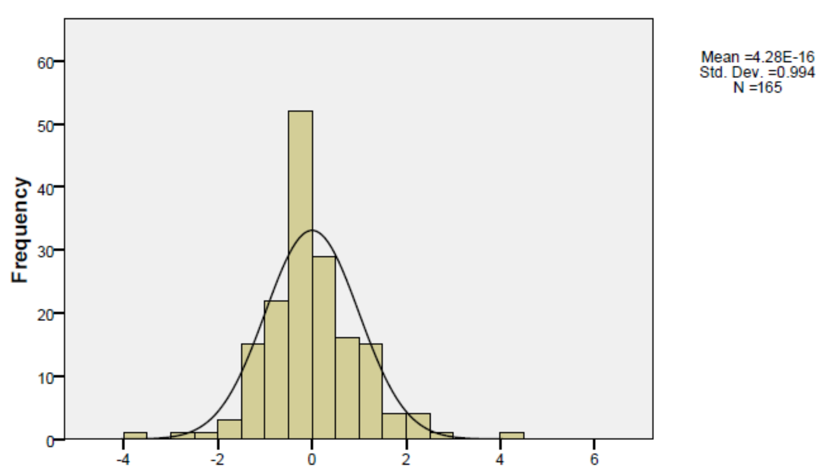
a. Dependent Variable: Overall_Rating

Residuals Statistics[a]

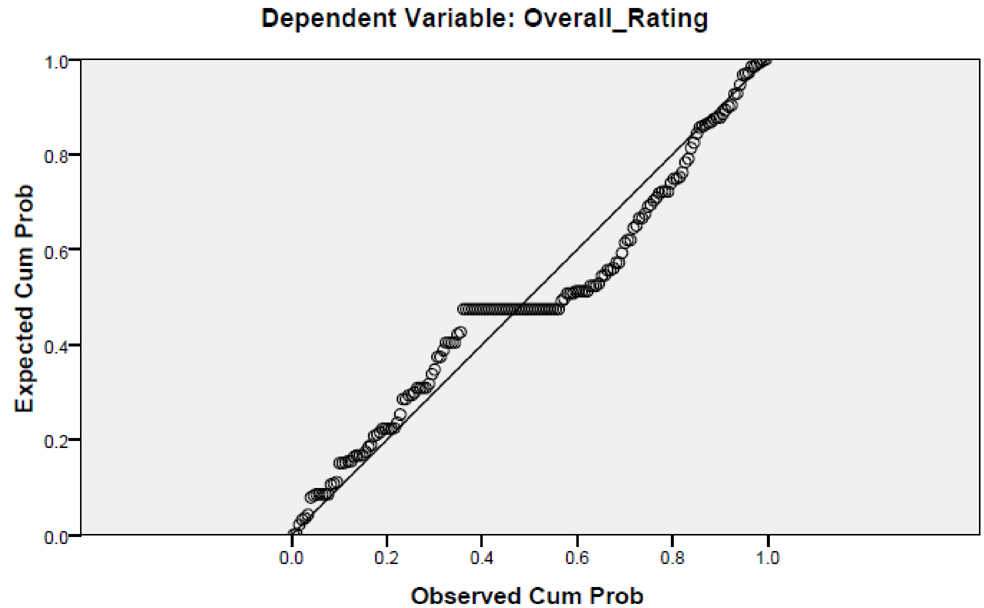
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.07	4.82	3.50	.608	165
Residual	-1.216	1.361	.000	.336	165
Std. Predicted Value	-2.351	2.174	.000	1.000	165
Std. Residual	-3.593	4.021	.000	.994	165

a. Dependent Variable: Overall_Rating

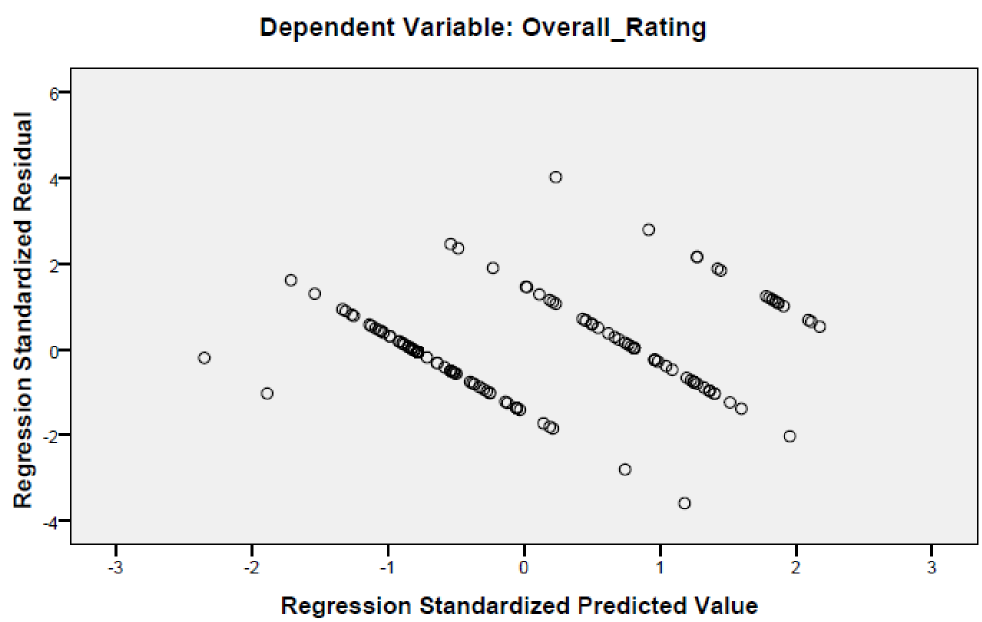
Dependent Variable: Overall_Rating



Normal P-P Plot of Regression Standardized Residual



Scatterplot



Appendix O: Principle Component Analysis Results of Reversed Scored CLS

Component Matrix[a]

	Component
	1
CLS.a	.669
CLS.b	.925

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Component Matrix[a]

	Component
	1
CLS.c	.901

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Appendix P: EM Performance Items Correlation Analysis Results

Correlations

		Overall_Rating	EM.a	EM.b	EM.d	EM.e
Overall_Rating	Pearson Correlation	1.000	.796**	.758**	.556**	.801**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	165.000	165	165	165	165
EM.a	Pearson Correlation	.796**	1.000	.781**	.573**	.797**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	165	165.000	165	165	165
EM.b	Pearson Correlation	.758**	.781**	1.000	.522**	.798**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	165	165	165.000	165	165
EM.d	Pearson Correlation	.556**	.573**	.522**	1.000	.561**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	165	165	165	165.000	165
EM.e	Pearson Correlation	.801**	.797**	.798**	.561**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	165	165	165	165	165.000
EM.f	Pearson Correlation	.485**	.365**	.335**	.274**	.333**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	165	165	165	165	165
EM.g	Pearson Correlation	.787**	.815**	.743**	.534**	.772**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	165	165	165	165	165

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		EM.f	EM.g
Overall_Rating	Pearson Correlation	.485**	.787**
	Sig. (2-tailed)	.000	.000
	N	165	165
EM.a	Pearson Correlation	.365**	.815**
	Sig. (2-tailed)	.000	.000
	N	165	165
EM.b	Pearson Correlation	.335**	.743**
	Sig. (2-tailed)	.000	.000
	N	165	165
EM.d	Pearson Correlation	.274**	.534**
	Sig. (2-tailed)	.000	.000
	N	165	165
EM.e	Pearson Correlation	.333**	.772**
	Sig. (2-tailed)	.000	.000
	N	165	165
EM.f	Pearson Correlation	1.000	.390**
	Sig. (2-tailed)		.000
	N	165.000	165
EM.g	Pearson Correlation	.390**	1.000
	Sig. (2-tailed)	.000	
	N	165	165.000

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix Q: EM Performance Items Linear Regression Results

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	EM.e	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	EM.g	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	EM.f	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	EM.a	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Overall_Rating

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.801[a]	.641	.639	.418

a. Predictors: (Constant), EM.e

b. Predictors: (Constant), EM.e, EM.g

c. Predictors: (Constant), EM.e, EM.g, EM.f

d. Predictors: (Constant), EM.e, EM.g, EM.f, EM.a

e. Dependent Variable: Overall_Rating

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	.843[b]	.711	.708	.376
3	.862[c]	.743	.738	.356
4	.872[d]	.760	.754	.345

a. Predictors: (Constant), EM.e

b. Predictors: (Constant), EM.e, EM.g

c. Predictors: (Constant), EM.e, EM.g, EM.f

d. Predictors: (Constant), EM.e, EM.g, EM.f, EM.a

e. Dependent Variable: Overall_Rating

ANOVA[e]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.791	1	50.791	290.919	.000[a]
	Residual	28.458	163	.175		
	Total	79.248	164			
2	Regression	56.382	2	28.191	199.721	.000[b]
	Residual	22.867	162	.141		
	Total	79.248	164			
3	Regression	58.861	3	19.620	154.945	.000[c]
	Residual	20.387	161	.127		
	Total	79.248	164			
4	Regression	60.244	4	15.061	126.797	.000[d]
	Residual	19.005	160	.119		
	Total	79.248	164			

a. Predictors: (Constant), EM.e

b. Predictors: (Constant), EM.e, EM.g

c. Predictors: (Constant), EM.e, EM.g, EM.f

d. Predictors: (Constant), EM.e, EM.g, EM.f, EM.a

e. Dependent Variable: Overall_Rating

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.068	.146		7.313	.000	.780	1.357
	EM.e	.689	.040	.801	17.056	.000	.609	.768
2	(Constant)	.734	.142		5.182	.000	.454	1.014

a. Dependent Variable: Overall_Rating

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	Upper Bound
2	EM.e	.411	.057	.478	7.197	.000	.298	.524
	EM.g	.353	.056	.418	6.294	.000	.242	.464
3	(Constant)	.324	.163		1.988	.049	.002	.646
	EM.e	.398	.054	.463	7.343	.000	.291	.505
	EM.g	.300	.054	.355	5.501	.000	.192	.407
	EM.f	.199	.045	.192	4.425	.000	.110	.288
4	(Constant)	.296	.158		1.869	.064	-.017	.608
	EM.e	.307	.059	.356	5.207	.000	.190	.423
	EM.g	.196	.061	.232	3.212	.002	.075	.316
	EM.f	.188	.044	.182	4.315	.000	.102	.275
	EM.a	.204	.060	.257	3.412	.001	.086	.322

a. Dependent Variable: Overall_Rating

Excluded Variables[e]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	EM.a	.433[a]	6.164	.000	.436	.365
	EM.b	.329[a]	4.467	.000	.331	.364
	EM.d	.156[a]	2.808	.006	.215	.685
	EM.f	.245[a]	5.325	.000	.386	.889
	EM.g	.418[a]	6.294	.000	.443	.404
2	EM.a	.280[b]	3.539	.001	.269	.266
	EM.b	.205[b]	2.824	.005	.217	.323
	EM.d	.098[b]	1.897	.060	.148	.660
	EM.f	.192[b]	4.425	.000	.329	.845
3	EM.a	.257[c]	3.412	.001	.260	.265
	EM.b	.190[c]	2.748	.007	.212	.322
	EM.d	.083[c]	1.685	.094	.132	.657
4	EM.b	.135[d]	1.923	.056	.151	.297
	EM.d	.056[d]	1.149	.252	.091	.636

a. Predictors in the Model: (Constant), EM.e

b. Predictors in the Model: (Constant), EM.e, EM.g

c. Predictors in the Model: (Constant), EM.e, EM.g, EM.f

d. Predictors in the Model: (Constant), EM.e, EM.g, EM.f, EM.a

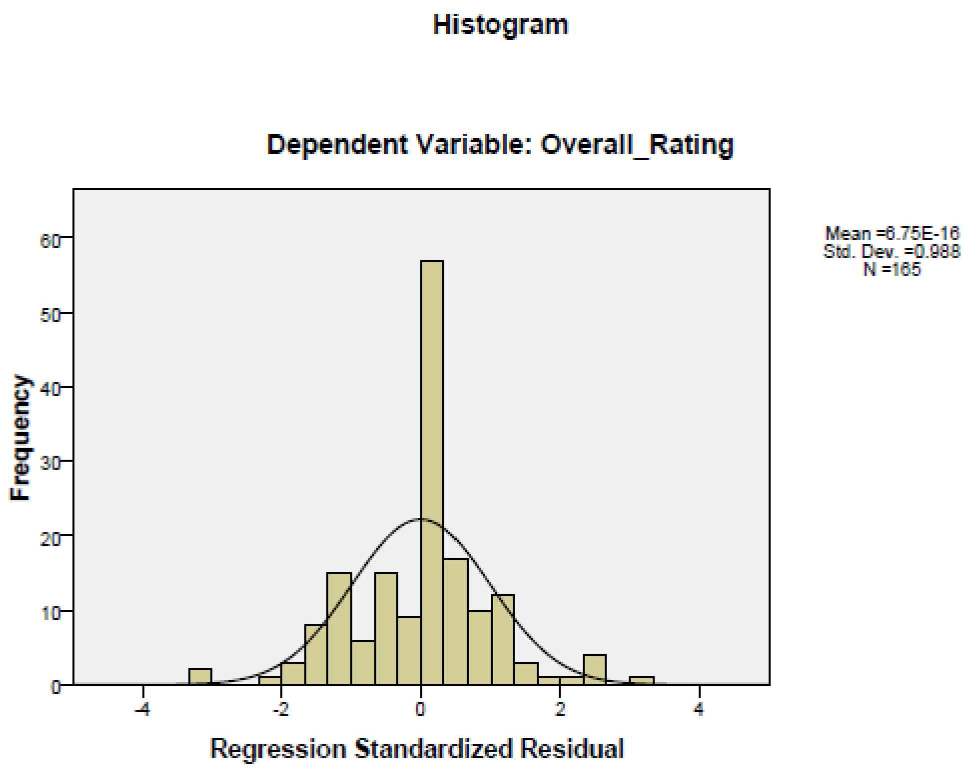
e. Dependent Variable: Overall_Rating

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.16	4.77	3.50	.606	165
Residual	-1.084	1.111	.000	.340	165
Std. Predicted Value	-2.203	2.097	.000	1.000	165
Std. Residual	-3.146	3.225	.000	.988	165

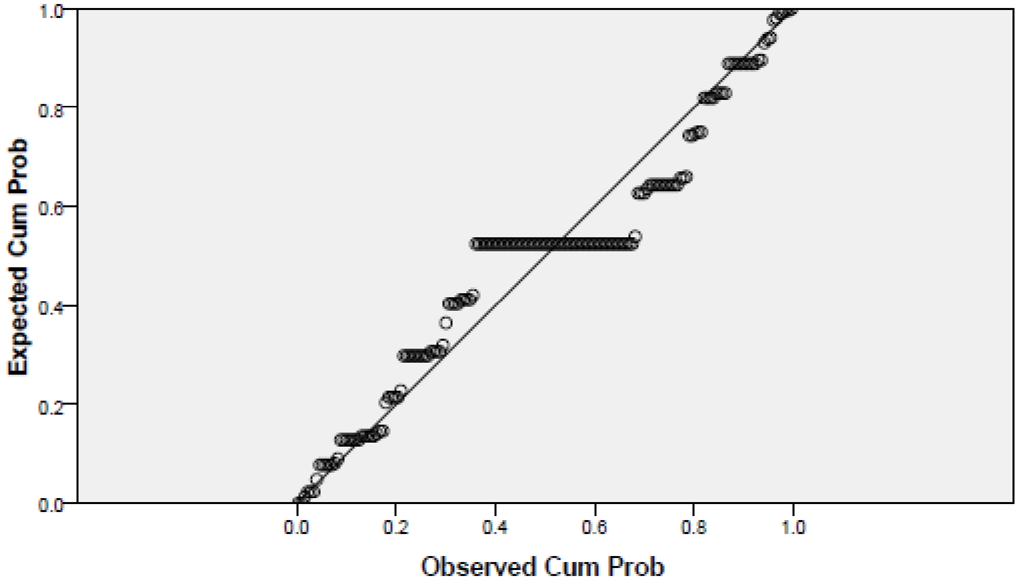
a. Dependent Variable: Overall_Rating

Charts



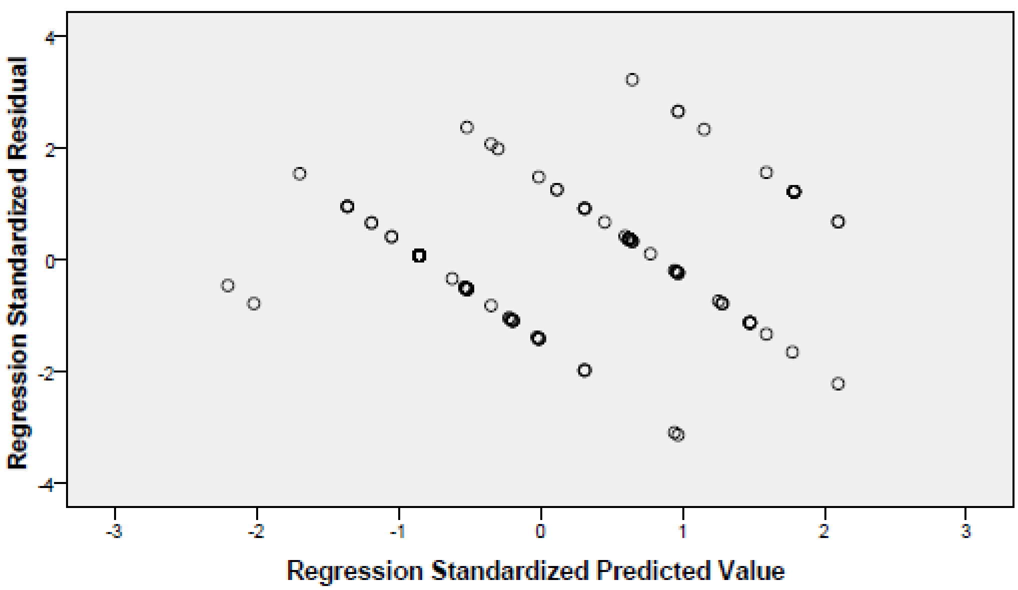
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Overall_Rating



Scatterplot

Dependent Variable: Overall_Rating



Appendix R: Recommended Revised DD Form 2626

PERFORMANCE EVALUATION (CONSTRUCTION)	1. CONTRACT NUMBER
	2. PROJECT NUMBER

IMPORTANT - Be sure to complete Part III - Performance Evaluation of Contractor on reverse

PART I - GENERAL CONTRACT DATA

3. TYPE OF EVALUATION (*X one*) ☐ INTERIM (*List percentage______%*) ☐ FINAL ☐ AMENDED	4. TERMINATED FOR DEFAULT ☐
5. CONTRACTOR (*Name, Address, and ZIP Code*)	6.a. PROCUREMENT METHOD *(X one)* ☐ SEALED BID ☐ NEGOTIATED 6.b. TYPE OF CONTRACT *(X one)* ☐ FIRM FIXED PRICE ☐ COST REIMBURSEMENT ☐ OTHER *(Specify)*
7. DESCRIPTION AND LOCATION OF WORK	
8. TYPE AND PERCENT OF SUBCONTRACTING	

9. FISCAL DATA	a. AMOUNT OF BASIC CONTRACT $	b. TOTAL AMOUNT OF MODIFICATIONS $	c. LIQUIDATED DAMAGES $	d. NET AMOUNT PAID CONTRACTOR $

10. SIGNIFICANT DATES	a. DATE OF AWARD	b. ORIGINAL CONTRACT COMPLETION DATE	c. REVISED CONTRACT COMPLETION DATE
	d. DATE WORK ACCEPTED	e. CONSTRUCTION START DATE	f. BENEFICIAL OCCUPANCY DATE

PART II - EVALUATOR INFORMATION

11. EVALUATED BY		
a. ORGANIZATION *(Name and Address - Include ZIP Code)*		b. TELEPHONE NUMBER *(Include Area Code)*
c. NAME AND TITLE	d. SIGNATURE	e. DATE
12. EVALUATION REVIEWED BY		
a. ORGANIZATION *(Name and Address - Include ZIP Code)*		b. TELEPHONE NUMBER *(Include Area Code)*
c. NAME AND TITLE	d. SIGNATURE	e. DATE
13. AGENCY USE *(Distribution, etc.)*		

PART III - PERFORMANCE EVALUATION OF CONTRACTOR

N/A = NOT APPLICABLE 5 = OUTSTANDING 4 = ABOVE AVERAGE 3 - SATISFACTORY 2 - MARGINAL U - UNSATISFACTORY

PERFORMANCE ELEMENTS & ITEMS	N/A	5	4	3	2	1	REMARKS
14. QUALITY OF CONTROL							
a. QUALITY OF WORKMANSHIP							
b. ADEQUACY OF THE CQC PLAN							
c. IMPLENENTATION OF THE CQC PLAN							
d. QUALITY OF THE CQC DOCUMENTATION							
e. STORAGE OF MATERIALS							
f. ADEQUACY OF MATERIALS							
g. ADEQUACY OF SUBMITTALS							
h. ADEQUACY OF TESTING							
i. USE OF SPECIFIED MATERIALS							
15. EFFECTIVENESS OF MANAGEMENT							
a. COOPERATION AND RESPONSIVENESS							
b. MANAGEMENT OF RESOURCES/PERSONNEL							
c. ADEQUACY OF SITE CLEAN-UP							
d. EFFECTIVENESS OF JOB-SITE SUPERVISION							
e. COMPLIANCE WITH LAWS AND REGULATIONS							
f. PROFESSIONAL CONDUCT							
16. MANAGEMENT OF SUBCONTRACTORS							
a. COORDINATION AND CONTROL OF SUBCONTRACTOR(S)							
b. REVIEW/RESOLUTION OF SUBCONTRACTOR'S ISSUES							
c. IMPLENENTATION OF SUBCONTRACTING PLAN							
17. TIMELY PERFORMANCE							
a. ADEQUACY OF INITIAL PROGRESS SCHEDULE							
b. ADHERENCE TO APPROVED SCHEDULE							
c. RESOLUTION OF DELAYS							
d. SUBMISSION OF REQUIRED DOCUMENTS							
e. IDENTIFICAITON/CORRECTION OF DEFICIENT WORK IN A TIMELY MANNER							
f. COMPLETION OF PUNCHLIST ITEMS							
g. SUBMISSION OF UPDATED AND REVISED PROGRESS SCHEDULES							
18. COMPLIANCE WITH LABOR STANDARDS							
a. CORRECTION OF NOTED DEFICIENCIES							
b. PAYROLLS PROPERLY COMPLETED AND SUBMITTED							
c. COMPLIANCE WITH LABOR LAWS AND REGULATIONS WITH SPECIFIC ATTENTION TO THE DAVIS-BACON ACT AND EEO REQUIREMENTS							
19. COMPLIANCE WITH SAFETY STANDARDS							
a. ADEQUACY OF SAFETY PLAN							
b. IMPLEMENTATION OF SAFETY PLAN							
c. CORRETCION OF NOTED DEFICIENCIES							

20. OVERALL RATING *(X appropriate block)*

	OUTSTANDING		ABOVE AVERAGE		SATISFACTORY		MARGINAL		UNSATISFACTORY

21. REMARKS

Appendix S: IRB Exemption Email from Lt Col Barelka

Rebecca,

File this email and put in an appendix when you get the final draft together later this year.

cjw

-----Original Message-----
From: Barelka Alexander J LtCol AFIT/ENV
Sent: Thursday, November 06, 2008 8:38 AM
To: West Christopher J LtCol AFIT/ENV
Subject: RE: IRB exemption

If it's existing data you just satisfied the IRB requirement and not further action is required on your part.

-----Original Message-----
From: West Christopher J LtCol AFIT/ENV
Sent: Wednesday, November 05, 2008 3:04 PM
To: Barelka Alexander J LtCol AFIT/ENV
Subject: IRB exemption

Alex,

It’s been awhile so I don’t know the quick answer – have student with existing regulatory required performance data on construction contractor performance for local Army Corps of Engineers detachment – all performance data is/will be kept anonymous and will not be presented in the thesis or made available to anyone else.   This requires as a formality an IRB exemption letter, correct? If so can you point me toward a copy and we’ll do the paperwork.

Chris

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Vita

Captain Rebecca S. Brown graduated from Del Norte High School in Albuquerque, New Mexico. She entered undergraduate studies at the University of Southern California in Los Angeles, California where she graduated with a Bachelor of Science degree in Environmental Engineering in May 2002. She was commissioned through Detachment 060 AFROTC at the University of Southern California where she was recognized as a Distinguished Graduate.

Her first assignment was at Seymour Johnson AFB as a Civil Engineer in June 2002. While stationed at Seymour Johnson AFB, she deployed to Al Udeid Air Base in July 2003 for five months serving as a construction project manager. In July 2004, she was assigned to the 8th Civil Engineer Squadron, Kunsan AB, ROK, where she served as the Chief Maintenance Engineer. Following her assignment in South Korea, Captain Brown was assigned to the 48th Civil Engineer Squadron, RAF Lakenheath, United Kingdom. During her time there she served as the Chief of Base Development and the Environmental Flight Commander. While stationed at RAF Lakenheath, she was deployed to Sather Air Base, Baghdad, Iraq in September 2006 for four months serving as the Environmental Flight Commander. In August 2007, she entered the Graduate School of Engineering and Management, Air Force Institute of Technology.

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

A rigorous system for rating construction contractor performance does not exist for the USAF as identified by the Air Force Civil Engineer (USAF CE), Major General Del Eulberg (Eulberg, 2007). The United States Army Corp of Engineers (USACE) uses DD Form 2626 for contractor performance evaluation and contractor selection. The objective of this research is to strengthen the USAF contractor rating system by exploring USACE's use of DD Form 2626.

Using data from DD Form 2626, statistical analysis was conducted to determine if the measured performance sub-items reflect their respective performance elements, if the resulting performance elements relate to the overall contractor performance rating, and finally, if a relationship exists between the overall contractor performance rating and the overall project schedule performance. 215 finalized DD Form 2626 were evaluated using various statistical analyses. A relationship between the performance elements and the contractor's overall performance rating was identified. Two of nine identified performance elements are predictive of the contractor's overall rating. The DD Form 2626 represents a good starting point to meet the USAF CE intent. However, it needs standardized instructions and formatting to align performance items and elements into a more rigorous system for rating contractor performance.

15. SUBJECT TERMS
Contractor Performance Evaluation, DD Form 2626, Past Performance, USACE, Source Selection

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