5-11-2013

Construction Project Benchmarking in the U.S. Army Corps of Engineers

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By

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A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in Civil Engineering
in the Department of Civil and Environmental Engineering

Mississippi State, Mississippi

May 2013

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Pages in Study: 56

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The construction industry is unique with many challenges. Managing claims can be one of the greatest challenges. Construction projects are becoming more influenced by factors that lead to claims. The literature review highlighted a few of these factors which include: safety issues, design errors, delay, and changes. Moreover, the literature review presented studies in performance measurement and benchmarking as a way to mitigate these factors. The research presented the results from a benchmarking study used to improve contractors that performed work for the Army Corps of Engineers, Vicksburg District. The study selected and analyzed 40 random construction contractors. Five performance elements were identified to measure each contractor. A five-point scale evaluated each contractor based on these elements. The results of this research indicated that benchmarking is an effective tool for improving performance and mitigating the cause of claims.

DEDICATION

I dedicate this thesis to my family, especially…

to Grace for her love and support;

to Mom and Dad for teaching me about hard work;

to Brian and Robert for being the best brothers;

to Mawmaw and Pawpaw for wisdom and encouragement.

ACKNOWLEDGEMENTS

First and foremost I would like to thank God for giving me strength, wisdom, and perseverance during this research project. I would like to thank my wife for her love, patience, and support. I would also like to thank my parents for their love and support. Finally, I would like to express my appreciation to my Major Professor, Dr. Islam El-adaway. Without his guidance and persistent help, I would not have been able to complete my thesis.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

1.1 Research Topic

The construction industry contributes significantly to economic development in the United States. It contributes 1.3 trillion dollars to the U.S. Economy and provides 7.1 million jobs, making it the most productive sector (El-Adaway 2008; Bureau of Labor Statistics 2008). In addition, Cheeks (2004) states that the industry represents approximately 13% of the Gross Domestic Product. One of the industry's challenges is overcoming construction claims.

The construction industry is unique compared to other industries. Eck (1987) stated that the construction industry involves a broad range of tasks, skill mixes, climatic conditions and work environments making it uniquely different from other industries. Zhou et al. (2011) added that the construction industry incorporates many unique features and conditions such that risky and complex challenges become a regular occurrence. One of these major challenges affecting this industry is claims. Semple et al. (1994) defined a claim as a request for compensation for damages incurred by any party to the construction process. In another study, Diekmann and Nelson (1985) stated that claims are the seeking of consideration or change, or both, by one of the parties to a contract based on an implied or express contract provision. In short, it can be described as an administrative tool to remedy a failure in a construction process.

In that claims are a major challenge to the construction industry, researchers have put a lot of time and emphasis on determining the reasons for these claims. Kululanga (2001) highlighted that most of these claims were caused by direct and indirect sources and summarized these into four basic sources. These are: 1) contract documents due to errors, defects, and omissions, 2) failure to appreciate the real cost of a project in the beginning, changed conditions, 4) stakeholders involved in a project. Diekmann and Nelson (1985) studied the different causes of claims which include: design errors, changes, differing site conditions, weather, and strikes. In a separate study, Semple et al. (1994) identified the common causes of claims within in the construction process. In light of the above, the research conducted in support of this document detected a common theme among causes of claims in the construction industry. These are: lack of knowledge, errors, unforeseen changes, lack of resources, and financial/contractual issues. Subsequently, the research distributed these common causes into four areas that personified these issues. These are: safety issues, design errors, delay, and changes.

Diekmann and Nelson (1985) stated that the participants in construction have become increasingly concerned with construction claims. Realizing the challenges and threats, construction firms are constantly seeking ways to mitigate their effect. For this reason, performance measurement has become a commonly used tool to provide for customer needs. Performance measurement was defined by Yu et al. (2007) as a business tool for evaluating management performance, managing human resources, and formulating corporate strategy. Having the capability to evaluate and assess information allows for construction firms to effectively detect problems, disputes, and errors within their operations. Once detected, firms can make the necessary adjustments in their processes or operations for improvement.

One of the most important aspects of performance measurement is the ability to perform benchmarking. El-Mashaleh et al. (2007) states that benchmarking aims at comparing the performance of firms relative to each other, allowing these firms to recognize their weaknesses and strengths compared to the industry. By being able to promote changes based on knowing strengths and weaknesses, companies can significantly improve performance and minimize problems.

1.2 Goals and Objectives

Altogether, this study will provide background information of claims in the construction industry. The research will highlight the studies of performance measurement and benchmarking as they are applied to the construction industry. This study will identify a list of measures from data collected from 40 construction contractors who have performed work for the U.S. Army Corps of Engineers Vicksburg District. The measures will then be implemented to evaluate each contractor through benchmarking. The goal is to highlight the areas each contractor can improve to mitigate the aforementioned reasons for claims.

CHAPTER II

LITERATURE REVIEW

2.1 Reasons for Claims in the Construction Industry

This section provides background information in relation to reasons for claims in the construction industry: safety issues, design errors, delays, and changes.

2.1.1 Safety Issues

Research has highlighted the causes of safety issues. In a study of construction accidents, Adbelhamid et al. (2000) presented a model that summarized accidents into three root causes. These include: failing to identify an unsafe condition that existed before an activity was started or that developed after an activity was started; deciding to proceed with a work activity after the worker identifies an existing unsafe condition; and deciding to act unsafe regardless of initial conditions of the work environment. Construction Institute Committee on Construction Site Safety (2002) addressed safety problems to overcome. These include: lack of clear cut contractual responsibility for safety; lack of an industry-wide agreement on shop drawing responsibility; the need for general and site specific training; and the need for workers to accept responsibility for their own actions. In a study of construction safety, Huang and Hinze (2006) highlighted the impact that owners have with construction safety. Zhou et al. (2011) realized the effects of safety climate on construction safety. In a study in Hong Kong, Ahmed et al.

(2000) pointed to the lack of training and employee knowledge for their high accident rate. In a study of construction safety, Eck (1987) suggested a gap in knowledge and expertise regarding safety principles and practices by construction management and supervision. Hinze and Raboud (1988) highlighted the influence that policies and practices of companies have on worker safety. In a study, Lopez et al. (2010) contributed catastrophic accidents to design errors.

2.1.2 Design Errors

Several study haves highlighted the causes of design errors. In a study, Acharya et al. (2006) stated that design errors are due to lack of understanding of basic engineering methods, inadequate development of details, or last minute changes without proper assessment of the consequences of these changes. Lopez et al. (2010) grouped design errors into various classifications. These are: loss of biorhythm, adverse behavior, inadequate training/inexperience, ineffective utilization or automation, inadequate quality assurance, competitive professional fees, client/end user issues, time constraints, ineffective coordination and integration, and inadequate consideration toward constructability. El-Shahhat et al. (1995) studied the impact human error contributes in design and construction. In a study of structural design, Melchers (1989) noted the impact that human error has in design errors. Suther (1998) categorized major contributing factors to design errors into three groups: owner response, designer response, and contractor response.

2.1.3 Delay

Many studies have attempted to determine the causes of delay in the construction industry. In a study of road construction projects, Mahamid et al. (2012) determined 52 causes of delay. The top five severe delay causes were political situation, segmentation of the West Bank and limited movement between areas, award project to the lowest bid price, progress payment delay by owner, and shortage of equipment. In a study of large building construction projects, Assaf et al. (1995) identified 56 causes of delay. These causes were grouped into nine categories: materials, manpower, equipment, financing, environment, changes, government relations, contractual relationships, and scheduling and controlling techniques. In a study of building construction, El-Razek et al. (2008) indicated the most important delay causes were: financing by contractor during construction, delays in contractor payment by owner, design changes by owner or his agent during construction, partial payments during construction, and nonutilization of professional /contractual management. Kraiem and Diekmann (1987) summarized the cause of delays. These include: owner (compensable delay), contractor (nonexcusable delay), by acts of god, or a third party (excusable delay). Lee et al. (2005) reported that lost productivity or loss of productivity is one of the most important causes of delay among the various causes of construction delays. In a study in Nigeria, Aibinu and Odeyinka (2006) identified 44 factors which contribute to delay on a typical construction project. Lo et al. (2006) grouped 30 causes of delays into seven categories. These include: client related, engineer related, contract related, human behavior related, project related, external factor, and resource related. Nguyen et al. (2010) studied causes of delay by adverse weather.

2.1.4 Changes

Studies by researchers have pointed to causes of changes in construction. In a study of public school construction, Gunhan et al. (2007) suggested that changes are inevitable in construction projects because of the uniqueness of each project, unexpected conditions, and limited resources of time and money that are available for planning, executing, and delivering a project. Ibbs (1997) stated that construction change has many causes, including the uniqueness of each project and the difficulty in predicting the future. In a study of construction projects in Oman, Alnuaimi (2010) determined that client's additional works and modifications to design were the most important factors causing change orders, followed by non availability of construction manuals and procedures. Ibbs et al. (2001) defined common changes in projects. These are: lack of timely and effective communication, lack of integration, uncertainty, a changing environment, and increasing project complexity. Anastasopoulos et al. (2010) stated that changes are generally due to root causes which include: design errors, unexpected site conditions, and weather conditions. Hanna and Swanson (2007) stated that change is due to the uniqueness of each project and the limited resources of time available for planning. In a separate study, Serag (2010) highlighted that change occurs because of errors and omissions, variation in scope of work, and unforeseen conditions.

2.2 Performance Measurement

This section provides background information in relation to performance measurement namely: performance measurement defined, limitations in performance measurement, measures in performance measurement, procedure, studies in performance measurement, and results of performance measurement.

2.2.1 Performance Measurement Defined

Performance measurement has been defined in various studies. In a study of performance measurement systems in construction, Yu et al. (2007) states that performance measurement is a business tool used for evaluating management performance, managing human resources, and formulating corporate strategy. Isik et al (2010) described a performance measurement system as an information system used to deploy policy and strategy and to obtain feedback. Lin and Shen (2007) determined that performance measurement is used to represent performance evaluation and performance assessment.

2.2.2 Performance Measures

In order to effectively evaluate performance, a set of measures are to be established. In a study of safety performance in construction, Laufer and Ledbetter (1986) defined specific performance measures. These include: lost day cases, Doctor's cases, first aid cases, non injury cases, injury related absenteeism, total accident cost, unsafe acts, unsafe conditions, workers' perceptions. In a study of International Joint Ventures in construction, Ozorhon et al. (2011) summarized performance measures into four objectives. These are: project performance, partner performance, performance of IJV management, and perceived satisfaction. Isik et al. (2010) adopted the Balance Score Card model and five constructs were developed to measure variables. These include: project management competencies, strength of relationships, resources and capabilities, strategic decisions, and company performance. In a separate study, Abdel-Razek (1997) established measures for improving construction managers' performance. These include: achievement of planned, agreed objectives; efficient resource utilization; administrative and managerial efficiency; adherence to and achievement of quality; ability to innovate and develop; profitability (after analysis); personal integrity; technical efficiency; ability to communicate and establish contacts; discipline and adherence to company regulations and procedures; record-keeping and documentation of experience; and honesty. Yu et al. (2007) studied performance measurement for construction companies and summarized performance measures into four perspectives: financial, customer, internal business process, and learning and growth. In a study of highway maintenance operations, Otto and Ariaratnam (1999) classified performance measures as follows: snow removal and ice control, repairs to accident damage, emergency road or lane closures, crack-sealing, patching, vegetation control, and culvert repairs. In a study of web-based construction project management systems, Nitithamyong and Skibniewski (2006) indicated 36 measures that reflect performance summarized into six perspectives. These specific perspectives were: strategic, schedule/time, cost, quality, risk, and communication. Based on a study in New York, Abowitz and Violette (1985) categorized performance measures into three groups: efficiency, economic efficiency, and effectiveness. Measures defined for efficiency included: total operating ration and fixed route operating ratio. Measures defined for economic efficiency included: total operating cost/vehicle mile, total operating revenue/vehicle mile, and fixed route operating revenue/vehicle mile. Measures defined for effectiveness included: total passenger revenue/passenger and fixed route passenger/vehicle mile. Molden and Gates (1990) defined water-delivery-system-performance measures. These were: adequacy, efficiency, dependability, equity. Grau et al. (2012) summarized 29 project performance measures into four categories: cost, quality, schedule, and safety. Menches and Hanna (2006) identified eight success factors to measure performance which include: profit achievement, customer satisfaction, schedule performance, total team performance and communication, budget performance, accuracy of the cost estimate, management of labor and work hours, and planning effort.

2.2.3 Limitations of Performance Measurement

Studies have indicated limitations with measuring performance. In a study of construction companies, Yu et al. (2007) highlighted the complexity of managerial work and a need to further develop current performance measurement systems. Otto and Ariaratnam (1999) revealed the difficulty in applying performance measurement systems to highway maintenance operations. Molden and Gates (1990) expressed the need for designs of performance measures that relate design and management decisions to achieve measurable objectives. Abkowitz and Violette (1985) stated that virtually no effort has been directed at assessing the performance of intercity bus services. Nitithamyong and Skibniewski (2006) identified gaps with performance measurement of project management systems. Bassioni et al. (2004) reported gaps in performance measurement in knowledge and practice both in general and the construction industry. A study of construction company performance, Isik et al. (2010) researched that performance measurement has been focused primarily in manufacturing and few studies have been conducted in the construction industry. Also, Isik et al. (2010) suggested studies have focused on project performance rather than company performance. In a separate study, Lin and Shen (2007) indicated little research has been done to measure the performance of Value Mangement studies, which has made users reluctant to use Value Management. Ozorhon et al. (2011) revealed that no consensus on measurement of performance of international joint ventures has emerged and the validity of underlying measures is still questionable. Menches and Hanna (2006) reported that there are few measures for project success and few studies have developed techniques for measuring successful performance. Grau et al. (2012) highlighted that on-site design on project performance is not yet understood.

2.2.4 Studies in Performance Measurement

Many studies have been conducted to measure performance. In a study to evaluate irrigation-water-delivery systems, Molden and Gates (1990) defined specific measures of system performance to make decisions about designing and rehabilitating a system. The study attempted to demonstrate approaches for evaluation rather than solving problems. The research would present the performance measures in several examples.

In a study in New York, Abkowtiz and Violette(1985) evaluated the performance of intercity buses. The study selected indicators to measure bus performance for policy decisions and evaluation of assistance programs. The research indicated a need to collect better information for future research.

Menches and Hanna (2006) proposed a study of project manager's performance. The research collected data and developed a model that measured a project's actual performance against the project manager's definition of successful performance. The study determined that the model would be useful for assessing project performance.

Laufer and Ledbetter (1986) studied safety performance on construction sites. The research collected data through a questionnaire sent to safety directors of 400 U.S. contractors. The collected data was analyzed to determine if measures were effective at various construction sites.

Lin and Shen (2007) emphasized the importance of value management as a tool for budge and schedule challenges. The study examines current performance measurement frameworks in the context of value management. The research concluded that current performance measurement studies of value management are insufficient.

Isik et al. (2010) investigated the impact company resources and strategies have on construction company performance. Data was collected through a questionnaire survey administered to 73 Turkish contractors and analyzed using a structural equation model. The study revealed that resources and strategies have an impact on company performance.

Bassioni et al. (2004) reviewed existing performance measurement frameworks including the Balanced Scorecard and the European Foundation Quality Management Excellence Model. The research highlighted the gaps in performance measurement which include: existing performance measurement models and how they interact with new systems, setting targets and measures, measures' aggregation, difficulty in implementing new performance measurement systems, and using performance information to take managerial action.

Nitithamyong and Skibniewski (2006) presented a study of Web-based project management systems. Data was collected from 39 professionals that had experience with these systems. The study assessed performance measures of these systems. The research suggested using the study to guide future research in Web-base project management systems.

Otto and Ariaratnam (1999) applied performance measurement systems to examples for highway maintenance in Alberta, Canada. The research developed input, process, output, and outcome measures specifically for highway maintenance operations. The study does not recommend using performance measurement systems for outsourced maintenance. Also, the study suggests a performance measurement system after several years of implementing under maintenance services.

Grau et al. (2012) implemented performance measurement of on-site design on project performance. Data was collected through a survey of 29 performance measures issued to 13 firms. The study finds that projects that implement on-site design strategies surpass those that do not.

Yu et al. (2007) studied performance measurement in the construction industry. Data was collected and analyzed from 34 Korean construction companies through a performance measurement system implementation model. The research suggests further studies to improve performance in the construction industry.

2.2.5 Results of Performance Measurement

Studies have determined that performance measurement produces good results. Menches and Hanna (2006) reported that a performance measurement index advanced the current research project and provided for academic and practical applications. Kang et al. (2008) concluded that performance measurement highlights the benefits of information technology across projects and companies. In a study of construction, Bassioni et al. (2004) described performance measurement as an integral part of management. Isik et al. (2010) summarized measurement as an essential ingredient in achieving objectives. In a study of irrigation –water- delivery systems, Molden and Gates (1990) noted that performance measures can be incorporated in an irrigation-system monitoring program and can prove a framework for assessing system improvement alternatives. Ozorhon et al. (2011) indicated that using performance indicators are valid for measuring performance of international joint ventures. Yu et al. (2007) highlighted the importance of performance measurement as it applies to the contemporary complex business environment. Grau et al. (2012) revealed that using performance measures to assess the influence of on-site design on project performance was effective in analyzing on-site design strategies.

2.3 Benchmarking

This section provides background information in relation to benchmarking namely: benchmarking defined, limitations in benchmarking, measures in benchmarking, benchmarking models, steps in benchmarking process, studies in benchmarking, and results of benchmarking.

2.3.1 Benchmarking Defined

Benchmarking has been defined in various studies. In a study focusing on engineering productivity, Liao et al. (2011) defined benchmarking as a systematic approach of measuring one's performance against that of recognized leaders with the purpose of determining best practices for continuous improvement. Mohamed (2003) presented benchmarking as an external focus on internal activities, functions, or operations in order to achieve continuous improvement. Camp (1989) defined benchmarking as the continuous process of measuring products, services, and practices against the toughest competitors or those companies recognized as industry leaders. Hamilton and Gibson (1996) described benchmarking as a process that targets key improvement areas, and identifies and studies best practices for continuous improvement and increased competitive advantage. El-Mashaleh et al. (2007) stated that benchmarking identifies a construction firm's strengths and weaknesses compared to others in the industry. Moreover, it identifies the leaders in the construction industry and the best practices that result in superior performance. Lee el al. (2005) stated that benchmarking is a tool that will offer great promise for improving performance in the construction industry. Costa et al. (2006) defined benchmarking as comparing and measuring an organization's performance against that of other similar organizations in key business activities. In a study of rework mitigation, Love and Smith (2003) described benchmarking as a widespread application for identifying ways to improve organizational and project performance. In a study of pre-project planning, Hamiliton and Gibson (1996) defined benchmarking as a process for targeting key performance areas and identifying and studying best practices for continuous improvement and continued advantage. Ramı´rez et al. (2004) described benchmarking as an important continuous improvement tool that enables companies to enhance their performance by identifying, adapting, and implementing the best practice identified in participating group of companies. In a separate study, Jackson et al. (1994) illustrated benchmarking as a modern productivity improvement tool.

2.3.2 Limitations in Benchmarking

Benchmarking has been widely acknowledged as an effective tool for improving performance. However, studies have discovered that applying benchmarking can be difficult to translate into real world processes. As per Love and Smith (2003), organizations have been reluctant to make data available for benchmarking out of fear of identifying problems within their processes. By withholding this data, benchmark metrics have become nearly impossible for organizations to identify areas to target for improvement. In a study of benchmarking in the construction industry, Costa et al. (2006) discussed that performance data for benchmarking is not readily available primarily due to managers lacking training and their reluctant attitudes. Costa et al. (2006) highlighted companies that collect many variables but only a small number of these are collecting the performance data needed to support decision making processes. Also, the study found that companies are collecting many measures that are related to support functions and not the processes most companies need to control. El-Mashaleh et al. (2007) found that existing benchmarking models are limited in their ability to guide the industry toward more efficient and effective performance. El-Mashaleh et al. (2007) suggested that the industry needs new benchmarking models that will offer managers a better guide in improving future performance. In a study of web-based benchmarking, Lee et al. (2005) emphasized that benchmarking has been difficult to translate to the construction industry. Lee et al. (2005) highlighted that concepts and principles of benchmarking are difficult to apply to construction because project-based activities are being executed in different locations. Also, the study found that the construction industry lacks systematic framework to follow. A study of construction companies, Horta et al. (2010) suggested that there are no insights concerning organization overall performance and improvement targets available.

2.3.3 Measures in Benchmarking

Benchmarking requires defining measures and metrics to analyze performance. A study by El-Mashaleh et al. (2007) defined metrics in a benchmarking model. Seven specific metrics identified were schedule performance, cost performance, customer satisfaction, EMR, profit, safety expenses, and project management expenses. Based on a study of safety culture, Mohamed (2003) summarized measures into four categories: management, learning, operational, and customer. A separate study by Hamilton and Gibson (1996) examined project performance in preproject planning. They are: cost performance, schedule performance, design capacity attained, plant utilization, and scope changes. Kang et al. (2008) used metrics to measure project and company performance. These include: cost, schedule, and cost schedule. Based on a study in Hong Kong, Yeung et al. (2012) examined three case studies: Case 1 – A Civil Engineering Project; Case 2 – A Building Project; and Case 3 – A Building Project. Each case study covered project performance of safety, cost, time, quality, client's satisfaction, effectiveness of communication, end user's satisfaction, effectiveness of planning, functionality, and environmental performance. Costa et al. (2006) summarized a main set of performance measures adopted in four initiatives. The KPI (United Kingdom) measures included: Client satisfaction, defects, predictability cost, predictability time, profitability, safety, and productivity. The CDT (Chile) measures included: cost deviation by project, deviation of construction due date, change in amount contracted, rate of subcontracting, cost client, efficiency of direct labor, accident rate, risk rate, effectiveness of planning, urgent orders, and productivity performance. The CII Benchmarking and Metrics (USA) measures included: project cost growth, project budget factor, project schedule growth, project schedule factor, total project duration, change cost factor, recordable incident rate, lost workday case incident rate, total field rework factor phase cost, factor phase cost growth (owner data only), phase duration factor, and construction phase duration. Finally, the SISIND-NET (Brazil) measures included: cost deviation, time deviation, degree of client satisfaction (user), degree of client satisfaction (owner), average time for selling unit, contracting index, ratio between the number of accidents and total man-hour input, nonconformity index in the unit delivery, PPC (percentage of plan completed), construction site best practice, supplier performance (subcontractors, material suppliers, and designers, number of nonconformity in audits, degree of employee satisfaction, rate of training courses, and rate of employees trained. In a study of benchmarking productivity, Park et al. (2005) summarized performance measures into seven categories. These include: concrete, structural steel, electrical, piping, instrumentation, equipment, and insulation. In a study to evaluate project delivery, Brunso and Siddiqu (2003) established metrics to measure improvements made in the delivery of environmental construction projects. These include: project cost growth, design cost growth, construction cost growth, design phase factor, total schedule growth, design schedule growth, and construction schedule growth. Lee et al. (2005) researched focused on the Construction Industry Institute (CII) for broad application in the construction industry. The study focused on performance metric norms which include: cost, schedule, safety, changes, and rework. Ramirez et al. (2004) highlighted performance areas in a benchmarking study for evaluating management practices in the construction industry. These are: cost, due date, scope of project, safety, labor, construction, subcontracts, quality, procurement, and planning. A study of construction companies, Horta et al. (2010) established indicators for organizational performance and operations performance. Organizational performance indicators included: productivity, profitability, hanging invoice, accident frequency rate, and sales growth. Operations performance indicators included: contractor satisfaction with costumers cooperation, contractor satisfaction level with customer involvement, contractor satisfaction with cooperative work, and cost predictability.

2.3.4 Benchmarking Models

Studies have utilized existing models or created new models when benchmarking. Hamilton and Gibson (1996) developed a four process model with the guidance of the Construction Industry Institute (CII). In a study of environmental restoration programs, Brusno and Siddiqi (2003) followed the benchmarking processes of Camp's (1989) Xerox model, the Malcolm Balridge Award Criteria, and Emhjellan's model. Yepes et al. (2012) utilized a benchmark indicator to compare graduate programs related to management and administration in the construction sector. Lee et al. (2005) presented a benchmarking system developed by the Construction Industry Institute (CII) for application in the construction industry. In a separate study, Ahuja et al. (2010) developed a survey questionnaire which led to the development of a benchmarking framework for rating construction for ICT adoption for building project management. Costa et al. (2006) analyzed four benchmarking systems developed in different companies. These include: Key Performance Indicators (KPI) from the United Kingdom; the National Benchmarking System for the Chilean Construction Industry (NBS-Chile); the Construction Industry Institute Benchmarking and Metrics (CII BM&M) from the United States; and the Performance Measurement for Benchmarking in the Brazilian Construction Industry (SISIND-NET Project). Fang et al. (2004) developed a safety management benchmark framework to measure real-time safety management performance on construction sites. Ramirez et al. (2004) compared results from a questionnaire against the quantitative performance indices obtained from the Corporation for Technical Development (CDT) of the Chilean Chamber of Construction's national benchmarking study. Mohamed (2003) adopted the balanced scorecard framework in benchmarking the organizational safety culture in construction. In order to improve on shortcomings in existing benchmarking models, El-Mashaleh et al. (2007) developed a new model which consisted of five metrics of performance and incorporating data envelopment analysis (DEA). Love and Smith (2003) presented a generic benchmarking framework for determining rework costs and causes.

2.3.5 Steps in Benchmarking Process

The research determined that there are different steps when benchmarking. Camp (1989) indicated steps for the benchmarking process. Ten specific steps identified were: identify what is to be benchmarked; identify comparative companies; determine data collection method and collect data; determine current performance "gap"; project future performance levels; communicate benchmark findings and gain acceptance; establish functional goals; develop action plans; implement specific actions and monitor progress; and recalibrate benchmarks.

In a study, Hamilton and Gibson (1996) suggested many steps to benchmarking. However, the study summarized these into four main areas: planning; analysis; integration; and action. Planning identifies target processes to benchmark, selects benchmarking partners, and collects data. Analysis develops meaningful process measures. Integration consists of communication findings, indentifying needs, and establishing goals. Finally, action includes developing action plans, implementing plans, and monitoring progress.

2.3.6 Studies in Benchmarking

Benchmarking has been used as a tool to further improve an organization's performance. Many studies have been conducted to support further development of benchmarking systems.

Park et al. (2005) emphasized the competitive nature of the construction industry and the need for construction productivity performance to be improved. The research was driven by the construction industry's desire to improve construction productivity metrics. The research highlighted several studies that have emphasized the importance of productivity data such as the Construction Industry Institute. Park et al. (2005) collected data of 16 industrial projects and performed analysis using the developed construction productivity metrics.

Brunso and Siddigi (2003) researched metrics in the delivery of environmental construction projects. Specifically, the research defined metrics for Environmental Management Program construction projects within the Army Corps of Engineers and used this information to evaluate the program against industry standards established by the Construction Industry Institute.

Lee et al. (2005) reviewed a benchmarking system developed by the Construction Industry Institute (CII). The study presented the development of the CII Benchmarking and Metrics program for implementing into the construction industry. The research highlighted the effectiveness of this benchmarking system as a tool which offers feedback to participants.

Lema and Price (1995) desired to incorporate benchmarking from the manufacturing industry into the construction industry. The study suggests the development of a benchmarking framework into the construction industry. Lema and Price (1995) concluded that the manufacturing industry has a vast amount of knowledge and experience and should incorporate these experiences into the construction industry.

Liao et al. (2011) research was motivated by the shortage of information for comparing results of engineering productivity. The research identified factors, constructed a model, and analyzed the data using statistical methods to explore engineering productivity. Liao et al. (2011) illustrated two primary functions that were deemed effective in studying engineering productivity: utilizing a comparable method called metrics and identifying factors that affect productivity and the correlation with productivity metrics. Liao et al. (2011) suggested the need for more research to be conducted to clarify conflicting evidence.

Mohamed (2003) utilized the balanced scorecard tool for benchmarking the organizational safety culture within the construction industry. Mohamed (2003) stated that using the Balanced Scorecard approach would consider four important measures in benchmarking. These measures include: 1) understandable, 2) attainable, 3) valid, and 4) client-focused. Also, Mohamed (2003) highlighted several perspectives that the Balance Scorecard Approach utilizes: management, operational, customer, and learning

Love and Smith (2003) emphasized poor performance found in rework and a need for a measurement system to address rework causes and costs. The study established benchmark metrics for causes and costs of rework on 161 Australian construction projects.

Ahuja et al. (2010) utilized a benchmarking framework to evaluate information communications technology. Ahuja et al. (2010) collected data through a questionnaire survey within the Indian construction industry. The benchmarking process was divided into four stages which include: benchmarking and bench measurement, bench learning, bench action, and bench monitoring. Ahuja et al. (2010) concluded that while the benchmarking process was incorporated into the Indian construction industry, it could be applied for other countries as well.

Horta et al. (2010) addressed the gaps found currently in web benchmarking systems that utilize performance indicators. The study proposed using data envelopment analysis (DEA) to fill these gaps. Horta et al. (2010) established two DEA models to attempt to better assess construction industry companies.

Hamilton et al. (1996) focused on measurement and benchmarking of preproject planning process for capital construction. Data was collected on 62 projects and totaled more than 3.4 billion dollars. The study concluded that the construction industry should integrate the benchmarking effort by recognizing best practices.

Kang et al. (2008) emphasized the importance of information technologies on performance. Two data sets were analyzed from 139 projects and 74 companies. The data sets were developed by the Construction Industry Institute Benchmarking and Metrics Program. The study added to existing research that information technology has a positive effect on performance.

2.3.7 Results of Benchmarking

Studies have indicated that benchmarking produces beneficial results. In a study, Park et al (2005) discovered that benchmarking provides a method for improving construction productivity. Brunso and Siddigi (2003) reported that the Army Corps of Engineers should establish metrics and benchmarks for improvement. Lee et al. (2005)

researched that implementing the CII Benchmarking System produces results that create vast improvement in performance improvement. Love and Smith (2003) found that benchmarking is an effective step in improving activities within projects. Horta et al. (2010) concluded that benchmarking is a useful tool to measure performance for construction industry companies and provide management targets for improvement. Hamilton et al. (1996) reported that implementing benchmarking can reduce risk, cost performance can be increased up to 20%, and schedule performance can be increased up to 40%. A study of organization safety culture in construction, Mohamed (2003) noted that the scorecard approach to benchmarking becomes a valid tool to analyze the safety culture. Camp (1989) highlighted five important benefits to benchmarking which include: more adequately meeting end user customer requirements; establishing goals based on a concerted view of conditions; determining true measures of productivity; attaining a competitive position; and becoming aware of and searching for industry best practices. Costa et al. (2006) highlighted that the greatest benefits of benchmarking is that it allows more efficient work and it involves managers proactively in the process. Benchmarking can also generate innovation in receptive environments. Fang et al. (2004) emphasized the importance of benchmarking and described it as an important ingredient for improving safety management.

CHAPTER III

METHODOLOGY

3.1 General Overview of Model Development

Based on the literature review, four main areas were identified for reasons for claims. These areas included: safety issues, design errors, delay, and changes. In order to mitigate these reasons for claims, this study focused on improving performance through benchmarking. This study presents performance evaluations of 40 contractors that performed work for the U.S. Army Corps of Engineers, Vicksburg District. The data was compiled by conducting an internal file review.

3.2 Defining Measures

This study identified and utilized five elements which measured the performance of the contractors which were included in the sample. Those elements include: (1) quality control, (2) timely performance, (3) effectiveness of management, (4) compliance with labor standards, and (5) compliance with safety standards. Each element was defined by criteria as indicated in Table 3.1.

Table 3.1 Evaluation Criteria

Measures	Evaluation Criteria
Quality Control	1. Quality of Workmanship 2. Adequacy of the Quality Control Plan 3. Implementation of the CQC Plan 4. Quality of QC Documentation 5. Storage of Materials 6. Adequacy of Materials 7. Adequacy of Submittals 8. Adequacy of QC Testing
Timely Performance	1. Adequacy of Initial Progress Schedule 2. Adherence to Approved Schedule 3. Resolution of Delays 4. Submission of Delays 5.Submission of Required Documentation 6. Completion of Punch List Items 7. Submission of Updated and Revised Progress Schedules 8. Warranty Response
Effectiveness of Management	1. Cooperation and Responsiveness 2. Management of Resources/Personnel 3. Coordination and Control of Subcontractors 4. Adequacy of Site Clean-up 5. Effectiveness of Job-site Supervision 6. Compliance with Laws and Regulations 7. Professional Conduct 8. Review/Resolution of Subcontractor's Issues 9. Implementation of Subcontracting Plan
Compliance with Labor Standards	1. Correction of Noted Deficiencies 2. Payrolls Properly Completed and Submitted 3. Compliance with Labor Laws and Regulations with Specific Attention to the Davis Bacon Act and EEO Requirements
Compliance with Safety Standards	1. Adequacy of Safety Plan 2. Implementation of Safety Plan 3. Correction of Noted Deficiencies

3.4 Evaluation of Measures

An evaluation was conducted to rate the measures of each contractor. This evaluation consisted of a 5-point performance rating scale. The contractors were rated as follows: outstanding, above average, satisfactory, marginal, and unsatisfactory. These ratings were derived by performing an internal file review and assigning a rating based on the criteria in Table 3.2.

Table 3.2 5-Point Rating Scale

Ratings	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Range of Negative Remarks	40 or More	30-39	20-29	10-19	0-9

Once the evaluations were conducted, results were categorized into three project groups based on known characteristics which include: subcontractor, modification, and net amount paid. From these categorizations, the research evaluated and identified areas of improvement in order to increase efficiency.

CHAPTER IV

ANALYSIS AND RESULTS

4.1 Collected Data

The benchmarking model was developed from construction contractors who performed work for the Army Corps of Engineers, Vicksburg District. The data was collected through an internal file review of performance evaluations of 40 construction contractors. Table 4.3 shows the total number of contracts in each rating category based on measures as defined in Table 3.1. This format will be used in each table included in chapter 4. As mentioned earlier, the data was categorized into groups based on known characteristics of each project. These groups are indicated in the sections that follow.

Table 4.3 Total Number of Contracts in Each Rating Category

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	22	13	5
Timely Performance	0	0	21	13	6
Management	0	0	18	14	8
Labor	0	0	14	15	11
Safety	0	1	17	14	8

4.2 Subcontractor Group

Table 4.4 Number of Contracts With No Subcontractor

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	10	3	3
Timely Performance	0	0	9	4	3
Management	0	0	8	5	3
Labor	0	0	8	5	3
Safety	0	0	9	3	4

Table 4.4 presents the number of contract categories when no subcontractors were utilized. From the table, it was noted that quality control, timely performance, management, labor, and safety had (3) three to (4) four contracts with outstanding performance. Also, it was observed that there were a high number of contracts that performed satisfactory compared to those that were above average or outstanding in each measure.

Table 4.5 Number of Contracts Who Utilized Subcontractors to Perform up to 10% of the Work

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	3	6	1
Timely Performance	0	0	5	4	1
Management	0	0	1	7	2
Labor	0	0	0	5	5
Safety	0	0	2	5	3

Table 4.5 shows the number of contracts in each category that utilized subcontractors to perform up to 10% of the work. It was noted that all (10) ten contract scored either above average or outstanding in the labor compliance category. In addition,

it was observed that (8) eight of the (10) ten contract scored either above average or outstanding in the safety compliance category.

Table 4.6 Number of Contracts Who Utilized Subcontractors to Perform over 10% of the Work

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	9	4	1
Timely Performance	0	0	7	5	2
Management	0	0	9	2	3
Labor	0	0	6	5	3
Safety	0	1	6	6	1

Table 4.6 demonstrates the number of contracts in each category that utilized subcontractors to perform over 10% of the work. It was noted that (1) one contract scored marginal in the safety compliance category. In addition, it was observed that (9) nine contracts scored satisfactory in quality control and management.

4.3 Modification Group

Table 4.7 Number of Contracts with Modifications less than $25,000

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	8	6	2
Timely Performance	0	0	9	4	3
Management	0	0	6	6	4
Labor	0	0	4	7	5
Safety	0	0	6	6	4

Table 4.7 shows the number of contracts in each category with modifications less than $25,000. It was noted that (5) five contracts scored outstanding in the labor compliance category. In addition, it was observed that (6) six contracts scored above

average in quality control, management, and safety. It was also recognized that a high number of contracts scored satisfactory in quality control and timely performance.

Table 4.8 Number of Contracts with Modifications between $25,001 and $500,000

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	9	4	2
Timely Performance	0	0	7	6	2
Management	0	0	8	4	3
Labor	0	0	7	4	4
Safety	0	1	6	5	3

Table 4.8 shows the number of contracts in each category with modifications between $25,001 and $500,000. It was noted that (1) one contract scored marginal in the safety compliance category. In addition, it was observed that (9) nine contracts scored satisfactory in quality control and (8) scored satisfactory in management.

Table 4.9 Number of Contracts with Modifications over $500,000

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	5	3	1
Timely Performance	0	0	5	3	1
Management	0	0	4	4	1
Labor	0	0	3	4	2
Safety	0	0	5	3	1

Table 4.9 shows the number of contracts in each category with modifications over $500,000. It was noted that (1) one contract scored outstanding in quality control, timely performance, management, and safety. In addition, it was observed that (5) five contracts scored satisfactory in quality control, timely performance, and safety.

4.4 Net Amount Paid Group

Table 4.10 Number of Contracts Paid a Net Amount up to $1,000,000

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	7	4	2
Timely Performance	0	0	6	5	2
Management	0	0	5	5	3
Labor	0	0	4	5	4
Safety	0	0	5	5	3

Table 4.10 shows the number of contracts in each category that were paid a net amount up to $1,000,000. It was noted that (5) five contracts scored above average timely performance, management, labor, and safety. In addition, it was observed that (7) seven contracts scored satisfactory in quality control.

Table 4.11 Number of Contracts Paid a Net Amount between $1,000,001 and $5,000,000

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	11	7	2
Timely Performance	0	0	11	6	3
Management	0	0	10	6	4
Labor	0	0	7	7	6
Safety	0	1	8	7	4

Table 4.11 shows the number of contracts in each category that were paid a net amount between $1,000,001 and $5,000,000. It was noted that (1) one contract scored marginal in the safety category. In addition, it was observed that (11) eleven contracts scored satisfactory in quality control and timely performance. It was also recognized that

a high number of contracts scored above average in quality control, timely performance, management, labor, and safety.

Table 4.12 Number of Contracts Paid a Net Amount Above $5,000,000.

Measures	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control	0	0	4	2	1
Timely Performance	0	0	4	2	1
Management	0	0	3	3	1
Labor	0	0	4	3	0
Safety	0	0	4	2	1

Table 4.12 shows the number of contracts in each category that were paid a net amount above $5,000,000. It was noted that (4) contracts scored satisfactory quality control, timely performance, labor, and safety. In addition, it was observed that no contract scored outstanding in labor.

From these results, the model indicated the strengths and weaknesses of each contract in key areas. If this model is used in conjunction with each project, it will provide valuable information about each contract through continuous comparisons. For the U.S. Army Corp of Engineers, these findings are beneficial in determining suitable contractors during the selection process. For managers, these results can highlight areas of weakness so adjustments can be made.

CHAPTER V

CONCLUSION

Claims are a major challenge facing today's construction industry. The research identified four reasons for claims which include: safety issues, design errors, delay, and changes. A comprehensive literature review discussed these issues while highlighting studies in performance measurement and benchmarking. The methodology demonstrated the approach of constructing a benchmarking model which includes: collecting data among similar construction contractors, identifying areas to be benchmarked, and performing an analysis of the data.

The benchmarking model was developed by using data collected from performance evaluations of 40 contractors who worked on projects for the U.S. Army Corps of Engineers, Vicksburg District. This study identified elements used to measure the performance of these contractors. As demonstrated in the study, the use of benchmarking helps identify areas contractors need to improve in order to become more efficient compared to others in that field. The study concluded that such an evaluation has the potential to produce results that can be used to overcome deficits in these key areas. Though this study did not include a large volume of statistical data, the sample collected was sufficient to demonstrate the method of benchmarking. Additionally, the research showed or accomplished the following:

- Applying similar benchmarking models can improve performance in construction companies.
- The process of benchmarking is a viable tool if an adequate amount of data is included in the sample.
- Demonstrated that lessons can be learned from others for improved performance.

This research supports the effectiveness of benchmarking as a tool to identify ways to improve performance and mitigate reasons for claims in the construction industry. By identifying strengths and weaknesses in key areas, benchmarking should be used as a proactive process utilized continually throughout each project to make necessary adjustments. For the U.S. Army Corps of Engineers, this study is beneficial in determining suitable contractors during the selection process. For managers, similar models can highlight areas of weakness so adjustments can be made. This allows for projects to be completed on time, more safely, with fewer errors, and less change.

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APPENDIX A

EVALUATIONS OF EACH CONTRACTOR

Table A.1 Contractor Evaluation 1

Contractor 1	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.2 Contractor Evaluation 2

Contractor 2	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards					X
Compliance with Safety Standards				X	

Table A.3 Contractor Evaluation 3

Contractor 3	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance			X		
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.4 Contractor Evaluation 4

Contractor 4	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management			X		
Compliance with Labor Standards					X
Compliance with Safety Standards				X	

Table A.5 Contractor Evaluation 5

Contractor 5	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards			X		
Compliance with Safety Standards				X	

Table A.6 Contractor Evaluation 6

Contractor 6	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.7 Contractor Evaluation 7

Contractor 7	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance			X		
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.8 Contractor Evaluation 8

Contractor 8	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.9 Contractor Evaluation 9

Contractor 9	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control					X
Timely Performance					X
Effectiveness of Management					X
Compliance with Labor Standards				X	
Compliance with Safety Standards					X

Table A.10 Contractor Evaluation 10

Contractor 10	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance			X		
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.11 Contractor Evaluation 11

Contractor 11	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management					X
Compliance with Labor Standards					X
Compliance with Safety Standards				X	

Table A.12 Contractor Evaluation 12

Contractor 12	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.13 Contractor Evaluation 13

Contractor 13	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance					X
Effectiveness of Management					X
Compliance with Labor Standards					X
Compliance with Safety Standards					X

Table A.14 Contractor Evaluation 14

Contractor 14	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance			X		
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.15 Contractor Evaluation 15

Contractor 15	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.16 Contractor Evaluation 16

Contractor 16	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards					X
Compliance with Safety Standards					X

Table A.17 Contractor Evaluation 17

Contractor 17	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards					X
Compliance with Safety Standards				X	

Table A.18 Contractor Evaluation 18

Contractor 18	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control					X
Timely Performance					X
Effectiveness of Management					X
Compliance with Labor Standards					X
Compliance with Safety Standards					X

Table A.19 Contractor Evaluation 19

Contractor 19	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards			X		

Table A.20 Contractor Evaluation 20

Contractor 20	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards			X		

Table A.21 Contractor Evaluation 21

Contractor 21	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management					X
Compliance with Labor Standards					X
Compliance with Safety Standards					X

Table A.22 Contractor Evaluation 22

Contractor 22	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards		X			

Table A.23 Contractor Evaluation 23

Contractor 23	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control					X
Timely Performance					X
Effectiveness of Management					X
Compliance with Labor Standards					X
Compliance with Safety Standards					X

Table A.24 Contractor Evaluation 24

Contractor 24	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards			X		

Table A.25 Contractor Evaluation 25

Contractor 25	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.26 Contractor Evaluation 26

Contractor 26	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control					X
Timely Performance					X
Effectiveness of Management					X
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.27 Contractor Evaluation 27

Contractor 27	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.28 Contractor Evaluation 28

Contractor 28	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance				X	
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.29 Contractor Evaluation 29

Contractor 29	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management				X	
Compliance with Labor Standards					X
Compliance with Safety Standards			X		

Table A.30 Contractor Evaluation 30

Contractor 30	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.31 Contractor Evaluation 31

Contractor 31	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control					X
Timely Performance					X
Effectiveness of Management					X
Compliance with Labor Standards					X
Compliance with Safety Standards					X

Table A.32 Contractor Evaluation 32

Contractor 32	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.33 Contractor Evaluation 33

Contractor 33	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance				X	
Effectiveness of Management			X		
Compliance with Labor Standards				X	
Compliance with Safety Standards				X	

Table A.34 Contractor Evaluation 34

Contractor 34	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.35 Contractor Evaluation 35

Contractor 35	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards				X	
Compliance with Safety Standards			X		

Table A.36 Contractor Evaluation 36

Contractor 36	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control				X	
Timely Performance				X	
Effectiveness of Management				X	
Compliance with Labor Standards				X	
Compliance with Safety Standards					X

Table A.37 Contractor Evaluation 37

Contractor 37	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.38 Contractor Evaluation 38

Contractor 38	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.39 Contractor Evaluation 39

Contractor 39	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		

Table A.40 Contractor Evaluation 40

Contractor 40	Unsatisfactory	Marginal	Satisfactory	Above Average	Outstanding
Quality Control			X		
Timely Performance			X		
Effectiveness of Management			X		
Compliance with Labor Standards			X		
Compliance with Safety Standards			X		