2013

Develop a price escalation method for Minnesota Department of Transportation indefinite delivery/ indefinite quantity contracts: AxE bidding

Jorge Andres Rueda Benavides
Iowa State University

Develop a price escalation method for Minnesota Department of Transportation indefinite delivery/indefinite quantity contracts: AxE bidding

by

Jorge A. Rueda-Benavides

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Civil Engineering (Construction Engineering and Management)

Program of Study Committee:
Douglas D. Gransberg, Major Professor
Hyung Seok "David" Jeong
Shauna Hallmark

Iowa State University

Ames, Iowa

2013

TABLE OF CONTENTS

Page

Page

LIST OF FIGURES

Page

LIST OF TABLES

NOMENCLATURE

BCI	Building Cost Index
BHWY	Highway and Street Construction Index
BLS	Bureau of Labor Statistics
BONS	Other Non-Residential Construction Index
CALTRANS	California Department of Transportation
CCI	Construction Cost Index
CFLHD	Central Federal Lands Highway Division
ENR	Engineering News-Record
FAAR	Fixed-Annual Adjustment Rate
FASA	Federal Acquisition Streamlining Act
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
IDIQ	Indefinite Delivery/Indefinite Quantity
MnDOT	Minnesota Department of Transportation
MoDOT	Missouri Department of Transportation
NHCCI	National Highway Construction Cost Index
NYSDOT	New York State Department of Transportation
PPI	Producer Price Index
SDDOT	South Dakota Department of Transportation

ACKNOWLEDGEMENTS

First, I would like to express my sincere gratitude to my committee chair, Dr. Douglas Gransberg, for his continuous support and invaluable guidance throughout the course of this thesis. Working with him has greatly and positively impacted my academic, professional, and personal development.

Additionally, I would like to thank my committee members, Dr. David Jeong and Dr. Shauna Hallmark, for the time and support they have offered to me.

Finally, thanks to my family, colleagues and friends for their support, especially my wife, Silvia, for her continuous support, encouragement, and patience.

ABSTRACT

Although the use of single solicitations for the acquisition of multiple supplies or services through the issuance of individual work orders began in the 1970s, it was not until the mid-90s that the use of Indefinite Delivery/Indefinite Quantity (IDIQ) contracts was formally authorized by the U.S. Congress for use in federally funded projects. In view the federal success with this innovative contracting method, some state Departments of Transportation (DOTs) have incorporated IDIQ techniques into their contracting practices. However, some of the procedures established for federally funded IDIQ contracts are not implementable at the state level. In particular, DOTs need a simple, equitable approach to escalate contract unit prices on multi-year single award IDIQ contracts. Therefore the objective of this study is to develop a method for escalating IDIQ bid unit prices that is tailored for the Minnesota Department of Transportation (MnDOT).

The proposed escalation method is the result of a comprehensive literature review and detailed case study analysis that benchmarked the state-of-practice in IDIQ contracting in the transportation industry. DOT contractual information about current escalation clauses was also collected, and then the price adjustment methods described in these clauses were tested using actual MnDOT historical bid data. The result indicated that traditional price escalation techniques for construction projects were not compatible with IDIQ contracts, highlighting the need of an alternative price adjustment method.

The proposed method is termed "A times E" (AxE) bidding. AxE bidding is modeled after the "A plus B" (A+B) or "cost plus time" bidding method that has been in use throughout the country for the past two decades. In both cases, the "A" part is the sum of the products of the bid unit prices and the engineer's estimated quantities. In A+B bidding, the "B" part is the value of time in which the bidder proposes to complete the project. In A+B, a bidder with an aggressive schedule can win the contract without the need to be low on the "A" part of the bid. AxE bidding uses the same theory but the "E" part of the formula is the bidder's escalation rate. Again, a bidder can win without being the lowest price and can use the mathematical relationship between its bid unit prices and the amount they will escalate to achieve the lowest AxE amount.

CHAPTER 1
INTRODUCTION

The use of Indefinite Delivery/Indefinite Quantity (IDIQ) contracting to procure construction services in the transportation industry has grown over the last decade. The flexibility in quantity and delivery scheduling provided by IDIQ contracting, and the possibility of performing a number of projects under a single solicitation by preselecting one or more contractors, have proven to be a useful tool for both federal and state transportation agencies (1,2). Additionally, some agencies currently using this alternative contracting method have recognized a reduction in preconstruction cost and project delivery periods, as concluded from the case studies in Chapter 5 of this thesis.

The use of IDIQ contracting practices by federal agencies has been widely regulated since the enactment of the Federal Acquisition Streamlining Act (FASA) of 1994, which was aimed to simplify acquisition provisions through the regulation of different alternative methods including IDIQ contracting (3). On the other hand, as shown later in this thesis, the implementation of IDIQ contracting practices by state Departments of Transportation (DOTs) is still in an early stage of development and lacks standard procedures compatible with different DOTs. Given the specific requirements of this contracting method and the unique needs and regulations applicable to each agency, it is possible to find different approaches that address the same issue in different state DOTs across the country.

This thesis is focused on a major issue identified while developing the IDIQ implementation guide for the Minnesota Department of Transportation (MnDOT): construction cost escalation on multi-year single award IDIQ contracts. In order to find an appropriate method to adjust construction prices in MnDOT single award IDIQ contracts, it was first necessary to identify and analyze current escalation clauses used by different agencies to modify contracted prices when using either alternative or traditional contracting methods. Subsequently, the suitability of these escalation clauses was measured by applying them in four different types of projects built up from MnDOT historical bid data. A comprehensive assessment of these simulations led to the development of "A times E" (AxE) bidding, a price escalation method that meets MnDOT requirements and increases competition in IDIQ bidding processes.

Similarly to A+B contracting, in an IDIQ AxE contract contractors are required to bid in two different parts; A and E. In part A, contractors must submit unit prices for those pay items and bid quantities advertised by the agency; items that are expected to be repeatedly used in different work orders throughout the contract, and bid quantities that are intended to be in proportion with typical work orders. In part E, bidders are required to submit a fixed annual adjustment rate (FAAR) to be used to modify bid unit prices in the anniversary date of the letting of the contract. This FAAR is then transformed into an escalation multiplier (E) (in accordance with different options presented later in Chapter 6), which along with the price proposal (A), compose the selection formula (AxE) used to determine the low bid.

Content Organization

This thesis consists of a compilation of three different journal articles whose content and sequence was purposefully selected in accordance with the principal objective of the research mentioned above. Chapter 2 will furnish the reader the necessary background information to understand the remainder of the analysis and Chapter 3 will detail the methodology used to complete the research.

The logic used to select and organize the topics of these articles consisted of first determining the fundaments and appropriate application of IDIQ techniques (Chapter 4); then, narrowing the research to determine the current IDIQ practices implemented by different transportation agencies in an effort to identify patterns and different approaches adopted by each agency to address similar issues, including price escalation methods (Chapter 5); and finally, using all the knowledge and information collected to develop a price adjustment method that meets MnDOT needs and IDIQ contracting requirements (Chapter 6).

The first article (Chapter 4) was submitted to the Transportation Research Board (TRB) and was accepted for presentation at the 2014 annual meeting. This article discusses the fundamentals of IDIQ contracting and other major features of this contracting approach. Additionally, it describes the advantages that implementation of different IDIQ contracting models could represent for the transportation industry, as well as some disadvantages inherent to the use of IDIQ techniques.

The second article (Chapter 5) was also submitted to the TRB and was accepted for publication in *Transportation Research Record The Journal of the TRB*, and presentation at the

2014 annual meeting. This article presents a detailed case study analysis of four IDIQ contracts from different transportation agencies; the Central Federal Lands Highway Division (CFLHD), the New York State DOT (NYSDOT), the Florida DOT (FDOT), and the Missouri DOT (MoDOT). This case study analysis provides a better idea of current IDIQ procedures used in the transportation industry.

Finally, it is planned to have the third article (Chapter 6) submitted for publication in the American Society of Civil Engineers *Journal of Management in Engineering*. This final article analyzes the use of traditional escalation clauses in IDIQ contracting, and proposes an alternative price adjustment method: AxE bidding,

CHAPTER 2
BACKGROUND AND MOTIVATIONS

This chapter presents information that provides a better understanding of current IDIQ practices used to procure construction services, and some conclusions obtained from an exhaustive analysis of this information. The content of this chapter is used to complement and support the journal articles comprised in Chapters 4, 5, and 6. Furthermore, this chapter describes the main reasons that led to the objective of this thesis, and the principal issue that is expected to be addressed with its completion.

Background

In order to develop an applicable, effective, and reliable price escalation method for single award IDIQ contracts awarded by MnDOT, it was necessary to determine a complete state-of-practice of this contracting method in different federal and state agencies across the country. This section of the thesis provides the readers a proper background to better understand each of the articles. It also includes definitions, descriptions of different procedures, and the analysis of operational aspects related to the planning and execution of IDIQ contracts.

MnDOT Project Delivery Methods

Before 2000, most of the roadway construction projects in Minnesota were delivered through traditional low-bid, design-bid-build (DBB) contracting (4). In this method, the design must be fully accomplished, using either in-house or consultant designers, in order to begin with the bidding phase to select the low-bid responsive contractor. In other words, design and construction are contracted separately, so that, there is no contractual relationship between the designer and the contractor (5).

Known Issues with Traditional Project Delivery (DBB)

The increasing use of innovative contracting methods by different federal and state agencies across the country is driven by the need to enhance traditional contracting procedures (DBB). Most of these innovative methods are focused on tackling deficiencies or disadvantages observed for several years in the use of DBB contracting. A compilation of these observed issues is listed below:

- Minimal designer-constructor interaction: This lack of collaboration between designers and constructors is commonly identified as the cause of a series of issues such as increased number of change orders, and non-constructable designs. Hence, DBB contracts are more likely to present unexpected longer contract periods, higher projects costs, and lower quality (4, 5, 6).
- Lack of ability to overlap contract phases: Unlike some innovative contracting methods, DBB contract phases are performed in sequence. It means that design, procurement, and construction phases cannot be overlapped at any level. Therefore, DBB contracting implies longer contract periods in comparison with other alternative methods (4, 5, 6).
- High sensitivity to disputes over authority, quality and responsibility: As a consequence of this issue, DBB contracts are more likely to generate adversarial relationships among owners, designer, and contractors, negatively impacting the project (5).
- Increase owner's financial risk: Given that the owners are usually in charge of transferring final designs from designers to constructors, they basically own these designs, making them financially responsible for all omissions or inconsistencies found during construction (7).
- Lack of contractual incentives for constructors to minimize costs: Some innovative contracting methods include Value Engineering provisions aimed to incentivize constructors by offering compensation for ideas that result in lower costs for owners. These clauses typically operate during the entire contract, including the design phase, but do not apply for DBB contracts since contractors do not participate in the design. Although Value Engineering provisions may be used only during the construction phase of a DBB contract, builders who have submitted low bids to win the project, may see post-award changes as a better possibility to collect additional revenue (7).

MnDOT Innovative Contract Methods

Since 2000, MnDOT has been implementing innovative delivery methods and contracting approaches in order to improve its acquisition procedures by decreasing project delivery times, construction periods, and costs (8). The following alternative methods and approaches (other than IDIQ contracting) are listed on MnDOT Innovative Contracting Methods Website (9).

- A+B (cost plus time) Bidding
- Best-Value Contracting
- Construction Manager/General Contractor
- Design-Build
- Incentives – Early Completion
- Incentives – No Excuse Bonus
- Lane Rental
- Pay for Performance
- Warranties

IDIQ Contracting

Although a detailed description of IDIQ contracting is presented later in this thesis, at this point it is important to understand that IDIQ contracts provide for an indefinite quantity of supplies and/or services during a fixed period of time, and their delivery scheduling is determined by placing work orders with the contractors (5). During the research conducted for the elaboration of this thesis, it was possible to identify three different IDIQ contracting models (further explained in Chapter 4) which are determined in accordance with the number of firms involved in the contract and the number of work orders to be issue under the contract. Although definitions for these IDIQ contracting models are again provided in Chapter 4, it is necessary to present those in this section of the thesis in order to get a better understanding of the next few paragraphs. These contracting models are also illustrated in Figure 1.

- *Single work order:* A single contract is awarded to single contractor. Once the need to issue the work arises, the contractor then performs the desired services or furnishes the requisite supplies.

- *Single award:* A single contract is advertised and awarded to a single contractor who then is awarded work orders based on the pricing furnished in the initial bid package.
- *Multiple award:* A single contract is advertised and a pool of qualified contractors is selected. Only those selected are subsequently allowed to bid on work orders. In most cases the work orders are awarded to the lowest bidder among the contractors in the pool.

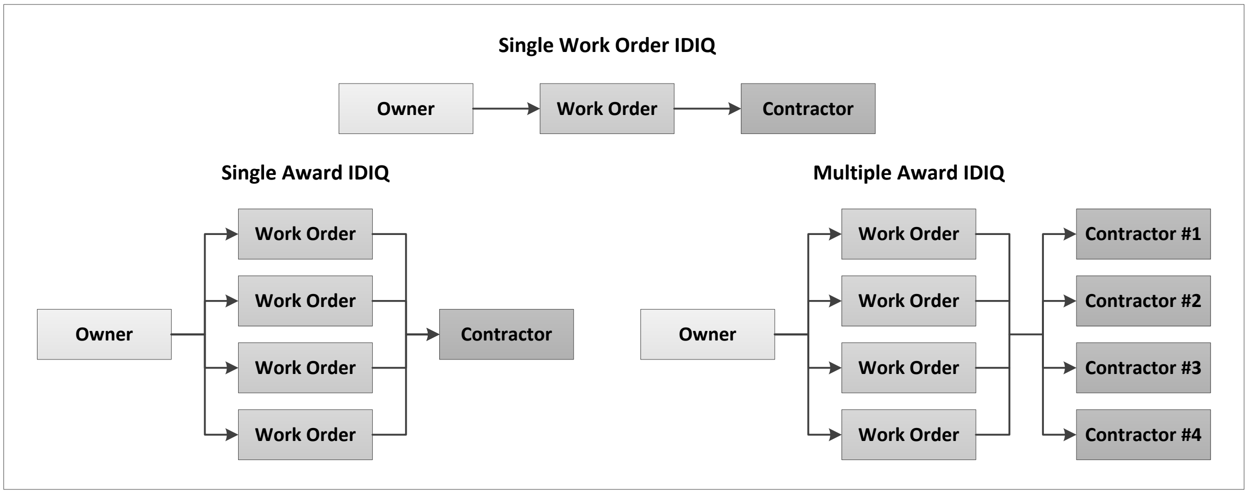


FIGURE 1 Generic IDIQ models.

The kind of projects suitable for IDIQ contracting are those that involve recurrent and repetitive tasks, mainly related to information technology and consulting services, repair and maintenance activities, and minor construction (2, 10), in which it is not possible to determine a reliable approximation of supplies and/or services to be required (11). However, some federal agencies have successfully used IDIQ techniques to execute larger and more complex construction projects.

Single Award vs. Multiple Award IDIQ Contracts

Multiple award IDIQ contracts should be executed only when the project engineer anticipates the issuance of enough work orders to allow the participation of more than one general contractor. Along with this decision, the project engineer must determine the optimum number of contractors to be awarded so as not to affect the benefits associated with a highly competitive environment. If too many firms are awarded, contractors may be tempted to bid higher prices given the lower probability of obtaining work orders beyond a stated minimum. On the other hand, when awarding too few contractors, there is a high risk of complaints arising from unsuccessful proposers and regulatory agencies claiming an inappropriate use of public funds. To make an appropriate decision, the project engineer may study historical bidders' behavior regarding similar kind of projects when using different delivery methods. For example; information analyzed could be the average number of bids received per contract and the number of different firms performing these projects during a similar period of time (e.g. one year).

Work Order Definition

Every project to be executed within an IDIQ contract is developed under the issuance of a work order. A work order becomes the contract document that determines location, contract time, and scope of work. Moreover, a work order outlines all required pay items, quantities, and unit prices (12).

Work Order Scoping

When determining the potential scope of work orders under IDIQ contracts, the project engineer must be careful to determine expected work order sizes. IDIQ minimum guaranteed amounts (minimum amount of work to be ordered to each contractor under a given IDIQ contract) are typically established so that the agency is committed to award at least one work order to each general contractor. In the case of single award contracts, the minimum guaranteed value usually corresponds to the first anticipated work order. Since this minimum value represents the worst-case scenario for interested contractors, they may be tempted to bid based on that assumption. Therefore, work orders should be neither so small that they encourage higher than normal bid pricing nor too large to prevent the agency from reasonably award future work.

In order to determine an optimal scope for work orders that would be issued under a given IDIQ contract, it is important to consider the average monetary size for that kind of project if the traditional delivery methods are used. By using this value to scope potential work orders, the agency will guarantee that even in the worst-case scenario bids will be similar or lower than those obtained if using a different delivery method. Additionally, it is important to keep a balance between the number of firms and the number of expected work orders in order to give contractors a good chance to perform work beyond the stated minimum.

In a balanced and well planned IDIQ contract, even if when submitting price proposals bidders do not consider the possibility of getting work orders beyond a minimum guaranteed amount to submit lower bids, the agency could still expect similar prices as those obtained by traditional contracting methods. The agency would still take advantage of others benefits provided by IDIQ contracting techniques such as the flexibility in quantity and delivery scheduling, shorter project delivery times, and lower preconstruction cost (see Chapter 5).

IDIQ Contracting Model Selection Process

Figure 2 presents a proposed decision making process followed to determine the appropriateness of a potential IDIQ project and the most appropriate contracting model to perform the work. This process comprises a series of questions that initially determine if the characteristics of the project(s) are consistent with IDIQ contracting requirements; subsequently, these questions are used to select the contracting model that better fits the project.

IDIQ Contracting for Emergency Situations

The capability of IDIQ contracts to issue work orders without conducting a full blown procurement process allows a quick response to contingency situations such as natural and environmental disasters, and industrial accidents (13). IDIQ techniques have been widely used by federal, state, and local agencies to obtain supplies, services, and/or equipment required to mitigate short-term impact after emergency situations.

In potential contingency situations, MnDOT would be able to issue a number of single award IDIQ contracts to cover different affected areas across the state in the same fashion that is used annually by the Florida DOT to cope with hurricane damage restoration (14), and the New York State DOT to expedite emergency bridge replacements (15). Furthermore, more than one general contractor may be assigned to the same area in accordance with the expected amount of work required after these events. It must be noted that instead of multiple award contracts, IDIQ emergency contracts must be assigned to single general contractors to avoid delays related to work orders awarding processes. Therefore, the use of multiple single award IDIQ contracts is more appropriate (see Figure 2).

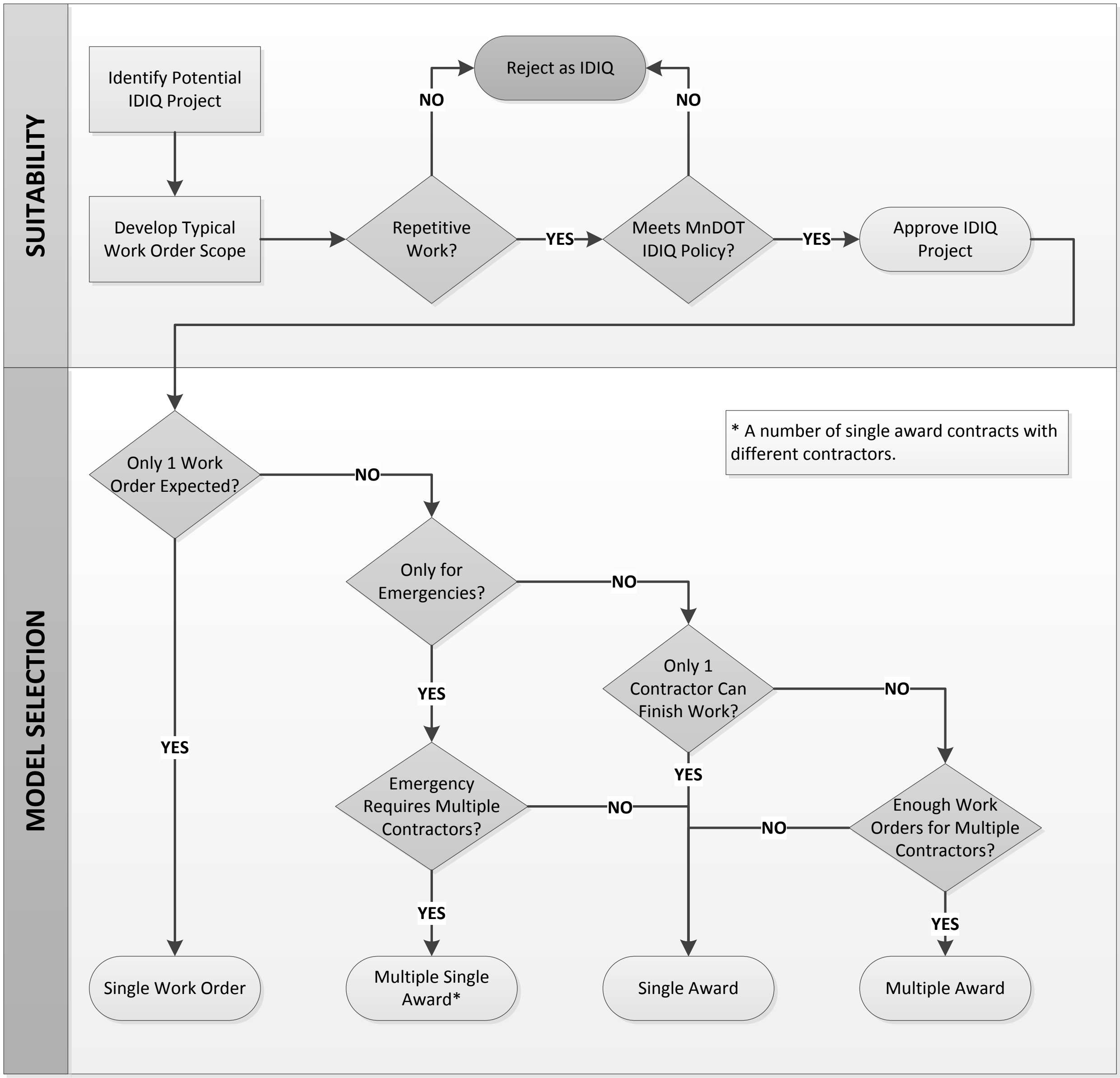


FIGURE 2 IDIQ suitability and model selection.

Price Escalation Methods Using Cost Indexes

The Bureau of Labor Statistics (BLS) in its *Escalation Guide for Contracting Parties* (16) proposes the methods presented below, but they can be applied to any of the indexes analyzed in Chapter 6. These are some of the alternatives mentioned in Chapter 6 that may be used to mitigate or redistribute the risk related to the use of cost indexes, or they may be also intended to obtain more accurate adjustments.

- *Simple Percentage Method:* This is the most common mechanism of escalation. Using this method the base or original price (at letting date) is modified by the same percentage as the change calculated for the index (16). The easiest way to escalate a price using this method is dividing the index at the adjustment date (last known) by the index at the time the base price was set; then this number is multiplied by the base price. An example of this method is shown in Table 1.

TABLE 1 Simple Percentage Adjustment - Example

Base Index (at letting date)	125
Current Index (at adjustment date)	135
Variation (Current Index/Base Index)	1.08
Base Unit Price Pay Item A (at letting date)	$100.00
Adjusted Unit Price (Base Unit Price x Variation)	$108.00

- *Escalation of a portion of the base price:* This method only adjusts a portion of the base price according to the percentage of change of the index. One way to do it is determining a certain dollar amount to be added or subtracted from the base price for each one-percent change in the selected index (16). Using the example above, and assuming only a 70% of the base price will be escalated, and the other 30% will remain unchanged, the dollar amount to be added or subtracted for each one-percent change in the index may be calculated by dividing the portion of the price to be escalated, $70.00 in this case, by 100. Therefore, the adjusted price can be calculated as following (see Table 2):

TABLE 2 Escalation of a Portion of the Base Price - Example

Base Index (at letting date)	125
Current Index (at adjustment date)	135
Variation ([Current Index/Base Index – 1] x 8%)	8%
Base Unit Price Pay Item A (at letting date)	$100.00
Adjustment for each 1-pecent ($70.00/100)	$0.70
Adjusted Unit Price (Base Unit Price + [$0.70 x 8])	$105.60

- *Index Points:* Unlike the two methods mentioned before, this method does not consider the percentage of change in the selected index. A dollar amount is added or subtracted from the base price for each point increased or decreased in the selected index (16). Thus, if in the example illustrated in Table 2, the owner agreed to increase or decrease the unit price of item A by $0.5 for each point change in the index, the adjusted unit price of item in this case would be $105.00 ($100.00 + $0.5 x [135 – 125]).

- *Limits for Price Adjustment:* Some contracts include escalation clauses that establish limits to the price adjustments during the period of the contract (16). For instance, an agency may establish maximum and minimum adjusted unit prices for specific pay items beyond which the unit price of those items would be renegotiated. Other kinds of limits incorporated into escalation clauses may be those referred to in Chapter 6, in which a minimum fluctuation in the index may occur (upward or downward) in order to adjust contract prices.

- *Multiple Indexes:* Sometimes, escalation clauses may consider the use of more than one index to adjust a single price. It could be considered a more accurate adjustment since it takes into consideration different factors involved in the production of particular goods or services (16). The following example illustrates the use of composite indexes (see Table 3).
  Suppose that a particular item in a contract is adjusted using three different indexes; one for labor costs which represents the 30% of the final price; another for materials, 60% of final price; and another for equipment, 10% of final price.

TABLE 3 Multiple Indexes Adjustment - Example

Base Unit Price Pay Item A (at letting date)	$100.00		
	Labor	**Materials**	**Equipment**
Current Index (at adjustment date)	115	145.7	260.1
Base Index (at adjustment date)	111.5	144.0	233.3
Variation (Current Index/Base Index)	1.031	1.012	1.115
Weighted Variation per Index (Labor 30%, Materials 60%, Equipment 10%)	0.31	0.61	0.11
Overall Variation (sum of weighed variations)	1.03*		
Adjusted Unit Price	$103.00		

***** The overall increase in the unit price of this item was 3%

The name used by the BLS for this method is “composite indexes”; however, this name is also used by some agencies to refer to a single index calculated by using multiple weighted elements. For the purposes of this thesis, this method is referred to as multiple indexes.

Motivation

While conducting the preliminary literature review for this thesis, it was found that IDIQ contracting practices at a federal level, and their pre-FASA versions, have been audited and studied several times by the U.S. Congress and other governmental organizations (2, 3, 17, 18), at least since the early ‘70s. In spite of the fact that most studies highlight major weaknesses of this IDIQ contracting, all of them agree that if used appropriately, this approach benefits federal agencies by improving their acquisition procedures (2, 17, 18). Moreover, most of their suggestions to overcome these weaknesses have been accepted and can be found in current federal IDIQ contracting regulations (2, 11, 17, 18). However, the situation of IDIQ contracting techniques at a state level is totally different. As mentioned before, this contracting approach is relatively new to state DOTs; so there is little research about its implementation in non-federal agencies.

Given the wide difference between federal and state contracting practices and requirements, state DOTs have realized that federal contracting procedures do not apply to their IDIQ contracts. Therefore, DOTs are unable to take advantage of all the years of experience contained in the Federal Acquisition Regulation (FAR). As such, each agency must develop its own procedures in accordance with their contracting practices, preferences, and applicable regulations. Since the use of this contracting approach has significantly increased among DOTs, and since it seems that these agencies have perceived a benefit in its implementation, there is an expected increase in research projects related to this approach, such as the one comprised in this paper.

Problem Statement

Unlike federal agencies, which are forced by the FAR to prefer multiple award contracts over single award IDIQ contracts, state DOTs commonly have a preference for single award contracts since those seem to fit better with their contracting procedures and needs (as explained in Chapter 5). MnDOT is not the exception. This is an example of how different IDIQ contracting models work better for federal or state agencies, and is one of the reasons why the FAR contracting guidelines are not adopted for state-funded IDIQ contracts. Each IDIQ model requires different procedures and implies different issues. By selecting single award over multiple award contracts, MnDOT had to deal with a number of factors including the adjustment of contract prices in multi-year contracts, which would not be an issue in a multiple award IDIQ contract (see Chapters 5 and 6). The development of a price escalation method for MnDOT multi-year single award IDIQ contracts became the principal issue to address in this study as shown in the flowchart presented in Figure 3. The highlighted lines in the logical path represent the research questions answered in this thesis and which conducted the development of the AxE bidding method proposed in Chapter 6.

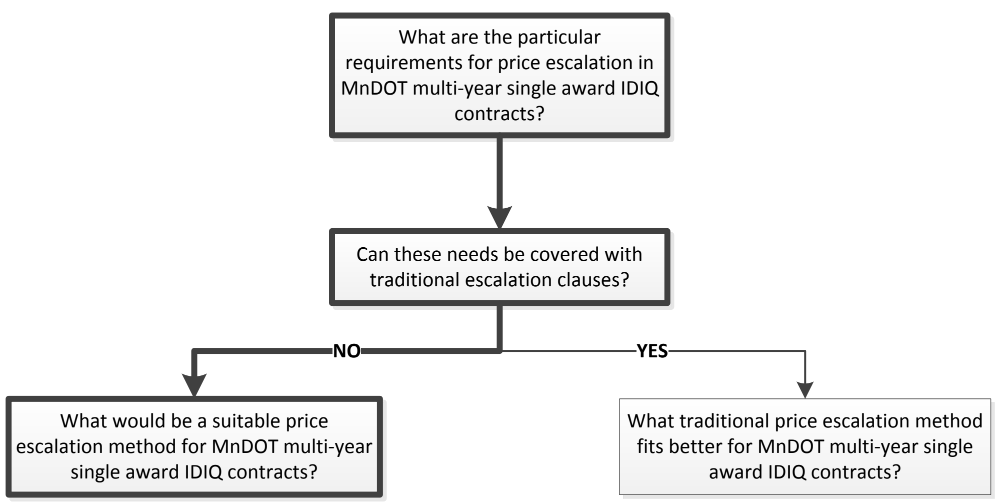


FIGURE 3 Problem Statement – Flow Chart.

CHAPTER 3
RESEARCH METHODOLOGY AND VALIDATION

Chapter 3 presents a compilation of the methodology followed in the articles presented in Chapters 4, 5, and 6, and the validation process designed to determine the suitability of the proposed price adjusted model. Overall methodology and validation is illustrated in Figure 4.

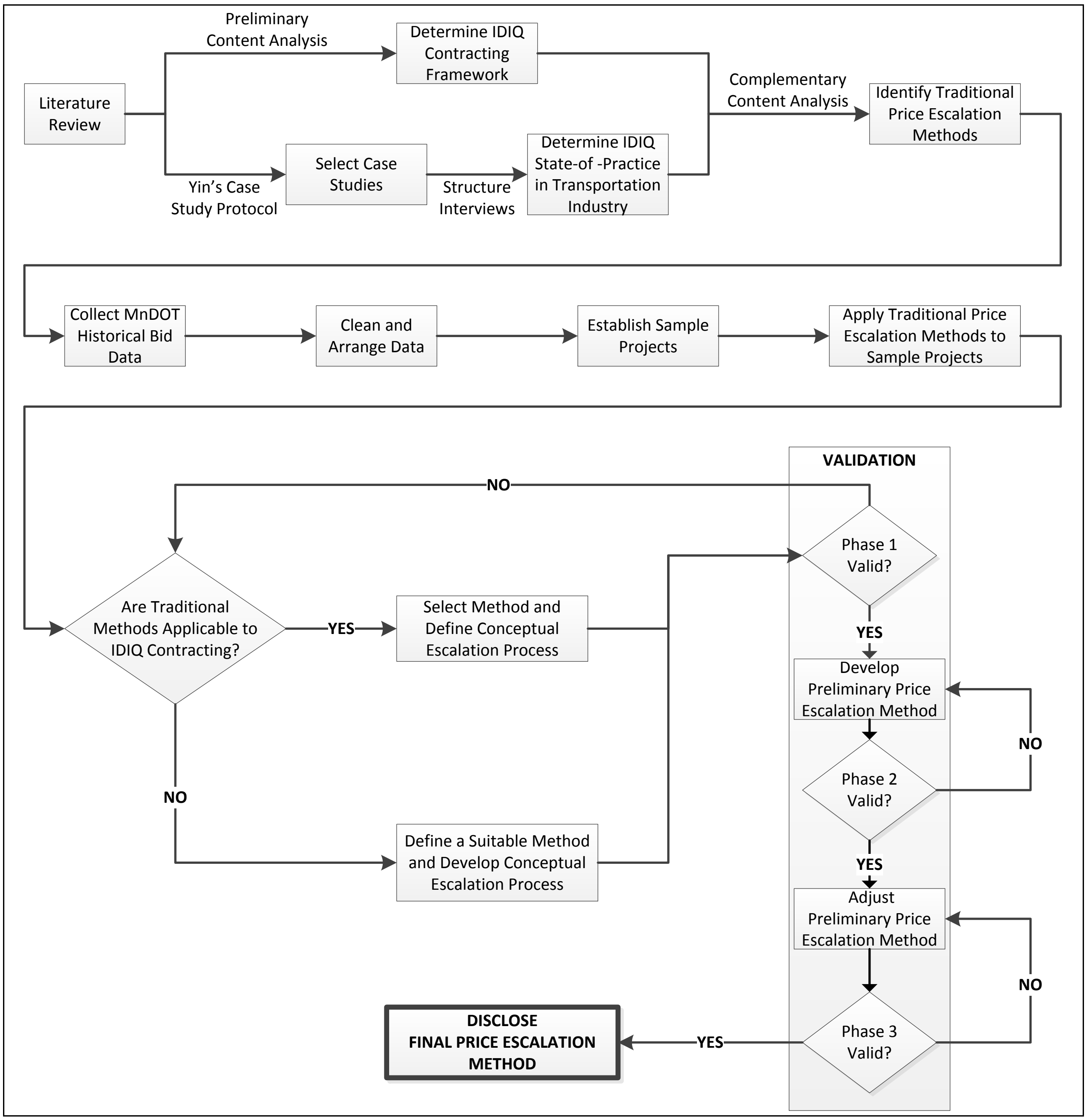


FIGURE 4 Price escalation method – methodology and validation.

Methodology

The steps and research instruments that compose the methodology illustrated in Figure 4 are explained in detail in the methodology sections of Chapters 4, 5, and 6. Additionally, this section of the thesis contains a further description of two elements that were not completely explained in the journal articles; the Yin's case study methodology applied to the four cases presented in Chapter 5, and the modified Z-score method used in Chapter 6 to remove unbalance bids from MnDOT historical bid data.

Yin's Case Study Methodology

The *Case Study Research: Design and Methods* manual published by Robert Yin (19) was used to select the cases and conduct the analysis contained in Chapter 5. For the selection of suitable cases, Yin recommends the following:

> "You need sufficient access to the data for your potential case study – whether to interview people, review documents or records or make field observations. Given such access to more than a single candidate case, you should choose the case(s) that will most likely illuminate your research questions" (19).

Thus, the case studies analyzed in Chapter 5 were strategically selected based on the research questions stated in Chapter 2 of this thesis. Likewise, following Yin's guidelines (19), before conducting the case studies, it was necessary to develop a theoretical framework for IDIQ contracting, which was obtained from the literature review and which is mostly explained in Chapter 4.

Modified Z-Score Method

The modified Z-score method was used in an effort to remove unit prices related to unbalanced bids that could compromise the integrity of the research. Since the use of the mean and sample standard deviation to detect and remove outliers in numerical data sets (commonly used to handle outliers) may not be appropriate for small samples, due to the fact that these tow indicators may be highly affected by one or few extreme values (20), and given that the way in which MnDOT historical data was arranged generated a number of small data sets that were individually analyzed (see Chapter 6), it was necessary to find a method more suitable for this research.

According to Iglewicz and Hoaglin, the modified Z-score method would be a more appropriate method for this study since it works better for small data sets (21). Instead of the mean and sample standard deviation, this method uses the median ($\tilde{x}$) and the absolute deviation of the median (MAD) to calculate the modified Z-score (M_i) for each number in the sample as shown below (20).

$$MAD = median\{|x_i - \tilde{x}|\} \quad \text{eq.1}$$

$$M_i = \frac{0.6745(x_i - \tilde{x})}{MAD} \quad \text{eq.2}$$

Where: MAD is the absolute deviation of the median;

x_i corresponds to each number in the data set;

$\tilde{x}$ is the sample median; and

M_i is the modified Z-score for each number in the data set.

Following Iglewicz and Hoaglin's suggestions, all unit prices whose absolute modified Z-score was less than 3.5 ($|M_i| < 3.5$) were removed from the data set (21). In this way, it was possible to obtain more realistic unit prices for the last five years (2008-2013).

Validation

The *AxE Bidding-Validation* section in Chapter 6 presents a complete description of the three phases of the validation process illustrated in Figure 4. It is important to understand that this thesis covers until the phase 2 of the validation since phase 3 is the result of the preliminary implementation of AxE bidding in future multi-year single award IDIQ contracts awarded by MnDOT.

CHAPTER 4

FUNDAMENTALS OF INDEFINITE DELIVERY/INDEFINITE QUANTITY CONTRACTING: A PRIMER FOR PUBLIC TRANSPORTATION AGENCIES

Rueda, J. A., and D.D. Gransberg. Fundamentals of Indefinite Delivery/Indefinite Quantity Contracting: A Primer for Public Transportation Agencies. *Transportation Research Board: 2014 Annual Meeting Compendium of Papers.* (Accepted for presentation in 2014).

This chapter presents a detailed description of IDIQ contracting and discusses the principal features, advantages, and disadvantages of three different IDIQ contracting models identified by the authors. The journal article contained in this chapter define an IDIQ contracting framework that was used as the basis for the next two articles presented in Chapter 5 and 6.

Abstract

Indefinite delivery/indefinite quantity (IDIQ) contracts are linked to the creation of the General Services Administration (GSA) in 1949, but have only become popular among nonfederal agencies during the last few years. Hence many state departments of transportation (DOT) still consider IDIQ as an alternative contracting method. The paper discusses the fundamentals of IDIQ contracting and proposes three generic models that were synthesized from both the literature and a content analysis of IDIQ procurement documents. The paper finds that IDIQ contracting has a number of distinct advantages for small, repetitive construction and/or maintenance projects by literally creating a capacity through an on-call contractor that can be mobilized and working in a much shorter period than traditional project delivery methods. It also finds that once the IDIQ contract is awarded the agency is able to utilize the contractor to furnish a number of preconstruction services in much the same manner as Construction Manager/General Contractor (CMGC) projects, which results in better pricing due to more constructable designs. Additionally the repetitive nature of the IDIQ work orders also offers the contractor the ability to leverage the learning curve on its means and methods to the benefit of the owner. Finally, IDIQ contracts provide a vehicle to rapidly obligate available year-end funding without the need to execute an expedited procurement process.

Introduction

Indefinite delivery/indefinite quantity (IDIQ) contracting was created for the newly organized General Services Administration (GSA) by the Federal Property and Administrative Service Act of 1949. Its purpose was to accelerate the acquisition of supplies and services by federal agencies (17, 22). This method has begun to be accepted only recently by state and municipal agencies, in states like Georgia, Florida, New York and Missouri. Since its implementation in the 1980s, multiple Congressional studies were conducted in response of repetitive protests claiming contracting agencies were using it to circumvent competitive bidding laws (1). As a result, Congress enacted the Federal Acquisition Streamlining Act (FASA) in 1994 which regulates the use of IDIQ, making it more transparent, efficient, and competitive (1, 3).

The primary advantage of IDIQ contracting is the flexibility permitted in ordered quantity and delivery scheduling (11). An agency can place orders with one or more contractors when the actual need appears. Authority to use either single award or multiple award contracts allows the agency to control both the amount of competition and the number of orders issued. IDIQ contracts also function as an on-call capacity to perform specific types of work in an expeditious fashion. For example the New York State Department of Transportation (DOT) used its emergency bridge repair/replacement job order contract (its term for IDIQ) to respond to massive damage caused by Hurricane Irene (15).

The purpose of this paper is to synthesize the state-of-the-practice in a manner that provides transportation agencies a fundamental understanding of possible approaches to implementing IDIQ contracting. The information comes from a comprehensive literature review supplemented by a content analysis of IDIQ procurement documents and a set of abbreviated case studies of actual DOT IDIQ contracts. The paper will propose three different models for employing IDIQ in typical transportation construction and maintenance programs and provide the reader with the advantages and disadvantages of each. Finally, the researcher’s conclusions and recommendations are offered to assist those agencies that are new to IDIQ contracting to evaluate its potential as another tool in the agency’s procurement toolbox.

Background

From 1949 to early 1980's, GSA was in charge of the Federal Supply Service (FSS) which procured common-used items for federal agencies. FSS consisted of "three basic buying programs" (17, 23).

- *Stores:* FSS purchased common-use items, stocked them in regional distribution facilities, and distributed them to federal agencies from Federal Supply Catalog and GSA self-service stores (17).
- *Non-Stores:* Definite quantity contracts to be delivered directly from suppliers to users. GSA was directed to provide items not available through the stores program (17).
- *Federal Supply Schedules:* Indefinite quantity contracts with commercial firms to provide supplies and services at stated prices for a given period of time. User agencies placed orders with contractors for direct shipment and are billed by the vendor (17).

As described above, Federal Supply Schedules are IDIQ contracts aimed to provide recurrent supplies and services to federal agencies. GSA was allowed to execute two kinds of these contracts; single and multiple award contracts (17). Federal supply schedule contracts became the main tool for the GSA to acquire supplies and services, For instance, 53% of GSA purchases in 1978 were via multiple award contracts, totaling $1.8 billion, while single award contracts only accounted for $200 million during the same year (17).

Despite the fact that IDIQ contracts techniques were not clearly regulated until 1994, their use significantly increased in late 80's among federal agencies (1). Unlike GSA, other federal agencies showed a marked preference for single award contracts because they allow shorter work order processes, and the lack of clear statutory guidance on multiple award contracts made them less attractive to contracting agencies (2). Based on recommendations made by the Defense Acquisition Law Advisory Panel, whose report highlighted the benefits of using multiple award IDIQ contracts (2), Congress enacted the FASA, in which the government regulates the use of this delivery method, providing flexible contracting tools to encourage agencies to execute multiple award over single award IDIQ contracts (2).

After the enactment of the FASA, the act was incorporated into the Federal Acquisition Regulation (FAR), including all relevant provisions and definitions such as definite quantity, requirements and indefinite quantity contracts. Indefinite quantity contracts are just one of the three types of indefinite delivery contracts stated by the FAR as shown in Figure 5 (11). The difference between definite quantity and indefinite quantity contracts lies in whether or not it is possible to estimate a feasible quantity of supplies and/or services to be required during a fixed period of time. In the case of indefinite quantity and requirements contracts, their definitions are closer, mainly differing in the commitment acquired by the owner to order a minimum quantity of supplies and/or services from the contractor for the duration of an IDIQ contract. This type of commitment is not required in a requirements contract, in which the agency reserves the right to issue no work orders under the contract without any compensation for the contractor. On the other hand, when analyzing IDIQ practices at state level, one can find a number of different techniques and policies based on state regulations or agency preferences. For instance, some state DOTs have decided to take a contracting approach for their state funded IDIQ contracts similar to the one used by federal agencies for requirement contracts. An example is the Florida DOT IDIQ contracts for hurricane debris removal (14) where the contract is only activated if a hurricane makes shore in the IDIQ contractor's area of responsibility.

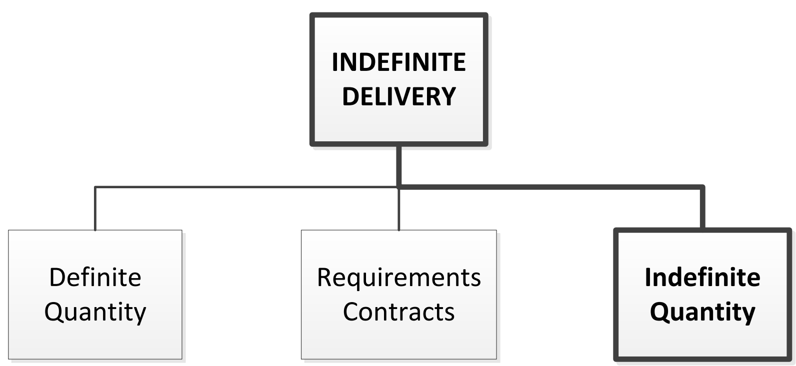


FIGURE 5 Indefinite delivery contract classification

It is important to first distinguish the different kinds of work orders that could be used in this procurement method before classifying the entire contract. Considering a work order as any requisition for supplies and/or services, taking into account the distinction as outlined by the FAR for supplies (delivery orders) and services (task orders) (11), and given the wide use of the term job orders for construction services (which may include supplies and services), it is possible to set the following classes of work orders (see Figure 6). Based on the classification shown in Figure 6, the FAR, some government entities, and academic researchers, the authors have assigned a different kind of contract type to each kind of work order. Thus, the overall IDIQ contract classification is based on the object of the contract.

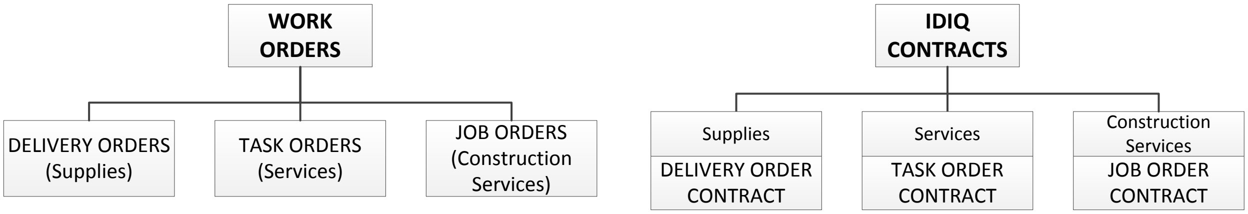


FIGURE 6 Work order and IDIQ contract classification scheme.

Although the FAR expresses a preference for multiple work order contracts with multiple contractors (11), it is common to find multiple work order contracts awarded to single general contractor, which are sometimes called Single Award Task Order Contracts (SATOCs) by federal and military agencies (24). Likewise, it is possible that an agency foresees a future necessity which may be fulfilled by issuing a single work order, but cannot accurately determine the total quantity of resources that will be ultimately required and/or the required delivery schedule. In this case, a single work order IDIQ contract with a single general contractor would be sufficient; saving time that could be used when the need materializes. An example is an IDIQ contract to remediate contaminated soil within a given area in the event of an accident. Figure 7 synthesizes a generic IDIQ contract classification based on the number of work orders and the number of contractors per contract.

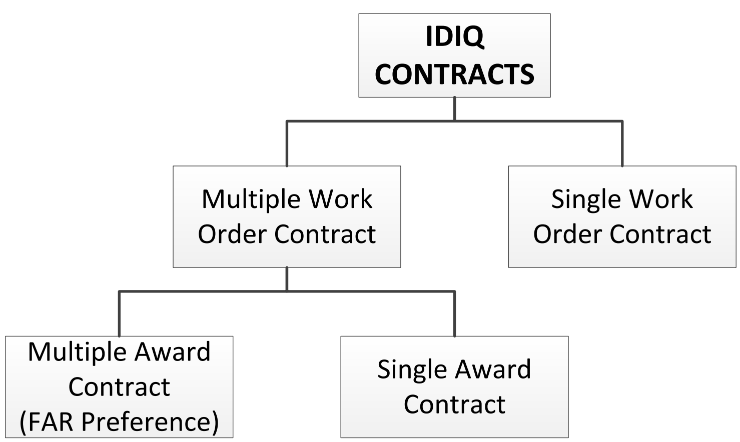


FIGURE 7 IDIQ classification according to the number of work orders and contractors

Federal agencies are the main users of IDIQ contracts in the U.S. and have become a great reference point for state and local agencies that want to apply this contracting technique. Their experience and larger budgets have allowed them to award longer and larger IDIQ contracts. An example of the evolution of IDIQ contracting at federal level are the Governmentwide Acquisition Contracts (GWACs), multiple award task or delivery order contracts for information technology support services, which are executed by one agency designated by the Office of Management and Budget, to be used by any government agency (25). For example, in 2012 the U.S. Department of Health and Human Services awarded a GWAC to 54 firms; a 10-year contract with a ceiling value of $20 billion (26). Likewise, in 2009 GSA awarded the Alliant GWAC to 58 prime contractors with 5-year base ordering period for a maximum expected value of $50 billion (27).

The Department of Defense has also uses this delivery method to support military forces worldwide with a set of three cost-plus-award-fee multiple award IDIQ contracts: the Logistics Civil Augmentation Program (28), the Global Contingency Construction Multiple Award Contract (29) and the Air Force Contract Augmentation Program (30) administrated by the Army, Navy and Air Force, respectively. The three contracts are aimed to provide support construction, facilities management, transportation, morale, welfare and recreation activities, and other logistics services to U.S. and allied forces worldwide. Likewise, these contracts may be used for a quick response to natural disasters or emergencies generated during military operations. This study found that most agencies use IDIQ contracts for small and repetitive projects or minor purchases; however, these three contracts are an example of the flexibility and usefulness of this delivery method in large, broad scope contracts. Finally, it is important to note that IDIQ contracts have been successfully used with a variety of project delivery methods. For example, both the Florida and Minnesota DOTs have awarded design-build IDIQ contracts as had many federal agencies.

IDIQ Terminology

Although the term IDIQ is new to government agencies at state and municipal levels, many of these entities have used similar approaches with different names. All of these concepts are work order contracts, which means that they are executed by placing work orders with the contractor(s). It is important to understand the differences between the different concepts since they may require different contracting procedures be governed by different sets of federal or state regulations. A listing of formal and informal concepts commonly used to refer to IDIQ contracts are listed below.

- ***Task Order Contracts*** are IDIQ for services whose performance and delivery scheduling is determined by placing task orders with the contractor or contractors during a fixed period of time (11).
- ***Delivery Order Contracts*** are IDIQ for supplies whose performance and delivery scheduling is determined by placing delivery orders with the contractor or contractors during a fixed period of time (11).
- ***Job Order Contracts*** are IDIQ contracts for construction services (31) whose performance and delivery scheduling is determined by placing work orders (task, delivery and job orders) with the contractor or contractors during a fixed period of time.
- ***Master Contracts***, also known as Master Agreements, are optional-use contracts whose purpose is to facilitate obtaining supplies and services from multiple contractors by placing competitive work orders (32).
- ***On-Call Contracts*** involve a group of undetermined or predetermined small projects usually related to professional/engineering services, which are requested by issuing task orders (33).
- ***Push-Button Contracts*** have a predetermined scope of work to be performed by the contractor pursuant to the agency's issuance of work orders, which specify location, project description and amount of work required (34).
- ***Standby Contracts*** are usually put in place foreseeing contingency situations. Once the emergency occurs, delivery orders are awarded to obtain critical equipment and supplies with in specified time frames and usually based on prices in effect the date before the emergency occurred (35)
- ***Framework Contract*** is a common term used in Europe to describe agreement between one or more contracting agencies and one or more contractors. The agreement is intended to govern a group of contracts awarded during a given period of time (36). This term is also widely used by the U.S. military for IDIQ Multi-Agency Contracts (37).

- ***Retainer Contracts***, also known as Retainer Agreements, are characterized by an advance payment (retainer fee) made by an agency to a firm for the total or partial cost of future services. This kind of contracts is commonly used to hire legal services (38).
- ***Bundled Contract*** is a term used when two or more small or medium-size tasks are combined into a single contract, allowing the participation of small companies in large projects (39).

Content Analysis Methodology

A formal content analysis of IDIQ solicitation and contract documents was conducted to create a basis for identifying effective practices and to quantify the state-of-the-practice regarding IDIQ programs. The primary approach is to develop a set of standard categories into which words that appear in the text of a written document can be placed and then the method utilizes the frequency of their appearance as a means to infer the content of the document (40). This allowed an inference to be made regarding the given owner's approach to IDIQ contracting. When the results are accumulated for the entire population, trends can be identified and reported. They are found by counting the number of times that specific terms of interest are required to be submitted by contractors to be considered for the project. This type of analysis can be used to develop "valid inferences from a message, written or visual, using a set of procedures" (41).

Table 4 contains the result of the IDIQ content analysis. It shows which agencies use each primary element in their IDIQ contracting program and the type of IDIQ contracts on which the element was used. The table is split in two major categories. The first category is work order pricing features. The features listed are those found for developing a price for a single work order. It is evident that using IDIQ does not change the range of pricing options already available with traditional project delivery. The second category is related to contract administration elements of the IDIQ contract. These elements impact how the contract is administered and furnish insight regarding the differences between IDIQ and other project delivery methods.

TABLE 4 IDIQ Document Content Analysis Results

IDIQ Type / Element	Job Order	Task Order	Delivery Order
Agency Use of Contract Elements			
Work Order Pricing Features			
Fixed price	1, 4, 5, 12, 13, 15, 16, 18, 23, 24, 25, 27, 28, 29	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 23, 24, 26, 27, 28, 29	1, 4, 5, 8, 10, 15, 27, 29
Unit price	19, 20, 21, 22	29	29, 31
Cost reimbursable	1, 4, 24, 27	1, 4, 5, 6, 8, 14, 16, 23, 24, 30	8
Guaranteed maximum price	9, 15		
Incentive/disincentive	4, 5, 13, 21, 24	4, 5, 7, 8, 15, 16, 23, 24	15
Two-step pricing (design-build work orders)	21, 27, 1, 24, 12, 4, 9, 5		
Contract Administration Features			
Single award	4, 5, 12, 13, 18, 19, 21, 22, 24, 25, 27, 28, 29	1, 4, 5, 6, 7, 8, 9, 11, 13, 16, 17, 23, 24, 27, 28, 29	1, 5, 8, 15, 29, 31
Multiple award	1, 4, 5, 9, 13, 15, 16, 23, 24, 27, 28, 29	1, 2, 4, 5, 6, 8, 9, 13, 15, 16, 23, 26, 27, 29, 30	5, 10, 15, 27
Guaranteed contract minimum value	1, 4, 5, 9, 12, 13, 15, 16, 21, 23, 24, 25, 27, 28, 29	1, 2, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 23, 24, 26, 27, 28, 29	1, 5, 10, 15, 29, 31
Maximum contract value	1, 4, 5, 9, 12, 13, 15, 16, 18, 19, 21, 22, 23, 24, 25, 27, 28, 29	1, 2, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 23, 24, 26, 27, 28, 29	1, 5, 10, 15, 29, 31
Multi-year contract	4, 9, 12, 13, 23, 27	1, 3, 4, 6, 8, 13, 14, 15, 16, 23, 27, 30	1, 15, 31
Follow-on options to extend	1, 4, 5, 9, 12, 13, 15, 16, 18, 21, 22, 23, 24, 25, 27, 28, 29	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 15, 16, 17, 23, 24, 26, 27, 28, 29, 30	5, 15, 27, 29
Liquidat1ed damages	1, 4, 12, 13, 15, 16, 21, 22, 23 24, 27	3, 24, 29	
Constructability reviews	1, 4, 9, 12, 15, 21, 22, 25, 27		
Value engineering	1, 4, 13, 15, 23, 24, 27, 28, 29	2, 4, 6, 24, 27, 29	1
Contractor quality control	1, 4, 5, 12, 13, 15, 16, 21, 23, 24, 25, 27, 29	2, 3, 4, 5, 6, 7, 8, 9, 13, 14, 15, 16, 24, 26, 27, 28, 29	5, 15,29, 31
Quality assurance plan	1, 4, 5, 12, 13, 21, 23, 24, 25, 27, 28	2, 3, 4, 5, 6, 11, 13, 14, 17, 23, 24, 26, 27, 29	1, 5, 10, 15, 27, 29, 31

1 = Army Contracting Command; 2 = Architect of the Capitol; 3 = California Department of Transportation; 4 = Department of the Air Force; 5 = Department of Homeland Security; 6 = Defense Information Systems Agency; 7 = Department of Commerce, 8 = Department of Energy; 9 = Department of the Interior; 10 = Department of State; 11 = Department of Education; 12 = Florida Department of Transportation; 13 = Federal Highway Administration; 14 = Georgia Department of Transportation; 15 = General Services Administration; 16 = Department of Health and Human Services; 17 = International Trade Commission; 18 = Metropolitan Atlanta Rapid Transit Authority; 19 = Massachusetts Department of Transportation; 20 = Montana Department of Transportation; 21 = Minnesota Department of Transportation; 22 = Missouri Department of Transportation; 23 = National Aeronautics and Space Administration; 24 = Naval Facilities Engineering Command; 25 = New York State Department of Transportation; 26 = Securities and Exchange Commission; 27 = Army Corps of Engineers; 28 = Department of Agriculture; 29 = Department of Veteran Affairs; 30 = Virginia Department of Transportation; 31 = Washington Metropolitan Area Transit Authority

Table 4 was developed by conducting a content analysis from IDIQ documents collected from twenty federal agencies, ten state and local transportation agencies, and one tri-jurisdictional government transit organization (WMATA). Agencies were placed in each column based on the scope of their contracts and the configuration proposed above in Figure 6 rather than the actual terminology used by them in their IDIQ contracts. In addition to the contracting approaches included in the content analysis, it is important to consider other nontraditional contracting approaches commonly used by federal and state agencies that could be used along with IDIQ contracts such as A+B, no excuse incentive or performance-based contractor prequalification. Base on the results of this analysis and literature review done by the authors, it is possible to conclude the following:

- It is evident that federal and military agencies tend to more often combine IDIQ contracts with other contracting approaches. It may be due to their great experience in this field, in contrast to state and municipal entities which began using this type of contracts recently. The ability to combine two or more constructive approaches allows agencies to handle larger and more complex IDIQ contracts by mitigating risk and transferring responsibilities to general contractors; an ability that state agencies do not yet have which limits their use to small and simple projects.
- Since job order contracts are usually more complex (because they include the purchase of supplies and services), they are more likely to be combined with different contracting methods. Sometimes task and delivery order contracts may be too simple and the inclusion of an additional approach cannot be justified. Furthermore, some methods fit better with construction projects or are limited to them, such as Guaranteed Maximum Price (GMP), and Constructability Review (CR). For purposes of this study, CR is considered a contracting approach only if prime contractor's responsibilities include the review of the scope and design of the projects prior to the issuance of job orders.
- Table 4 presents a clear trend to set fixed-price IDIQ contracts. It means that the contractor must submit its price list along with its proposal, upon which the agency will establish the price of each work order. It is a good practice to increase the agency control over the contract, more precisely over the budget. Additionally, fixed-price IDIQ contracts allow the agency to award larger contracts to a single source (Single Award

Contracts), at least at federal level, in accordance with the FAR (it is just one of two requirements) (11).

- Although not as common as fixed-price contracts, unit price and cost-reimbursable (also known as cost-award-fee) contracts also show a significant preference in Table 4. In the case of unit price IDIQ contracts, this approach was mostly observed in construction services contracts awarded by state agencies; decision that seems to be driven by the execution of simple, small and repetitive contracts, in which it is possible to get reliable amounts of work performed by measuring the product delivered by contractors. On the other hand, cost-reimbursable contracts are commonly used for projects with broad, complex and unclear scopes, in which agencies cannot accurately anticipate the cost of the projects in order to issue fixed-price work orders.

Base on this analysis, the authors elaborated a graph to illustrate the observed decision making process followed by federal and state agencies to determine the method to be used to compensate contractors for the work performed under each work order. In fact, some IDIQ solicitation documents anticipate the use of difference compensation methods in accordance with the scope of each work order. This decision making process is presented in Figure 8.

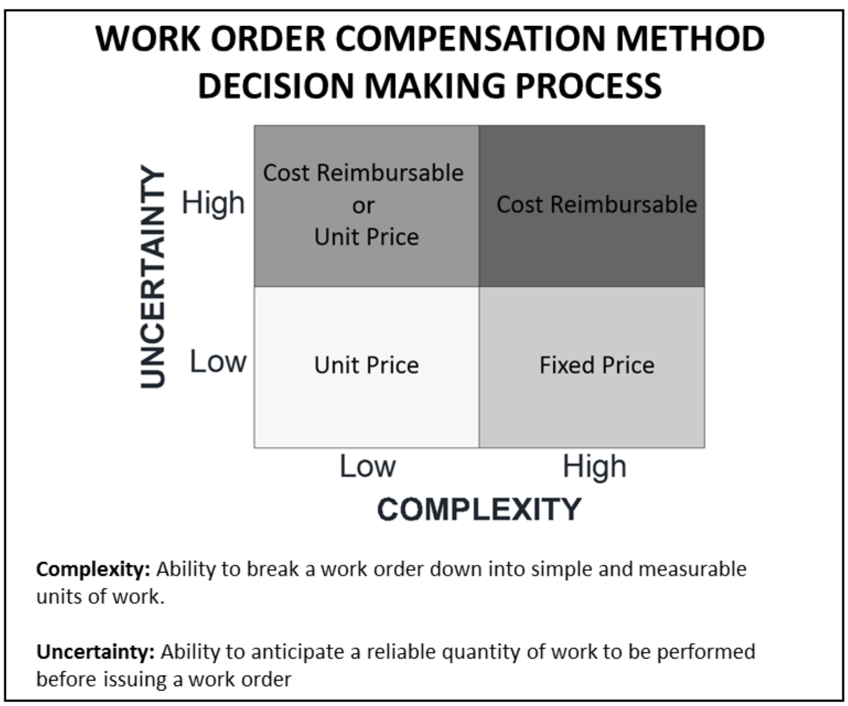


FIGURE 8 Work order compensation method – decision making process

- Besides certain provisions incorporated by some agencies in their IDIQ contracts to provide direct incentive to contractors, the authors identified some features inherent to this delivery method and others clauses that indirectly motivate contractors to provide high quality, precise schedules and lower prices in the execution of each work order. One of these indirect incentives is related with the fact that the decision of assigning future work orders to a contractor may be affected by its poor performance and high prices in previous orders. Likewise, it was identified a clear preference for awarding one-year base period IDIQ contracts with a number of one-year extension options. For example, the last Logistics Civil Augmentation Program was awarded for a base contract period of one year with nine one-year extension options (28). Thus, contractors are expected to offer outstanding executions motivated by the possibility of exercising these extension options while agencies can take advantage of knowledge acquired and skills improved by contractors during previous contract periods.

Generic IDIQ Models

Taking the above content analysis with the literature reviews yields three generic models shown in Figure 1 (Chapter 2) for implementing IDIQ contracts:

- *Single work order:* A single contract is awarded to single contractor. Once the need to issue the work arises, the contractor then performs the desired services or furnishes the requisite supplies.
- *Single award:* A single contract is advertised and awarded to a single contractor who then is awarded work orders based on the pricing furnished in the initial bid package.
- *Multiple award:* A single contract is advertised and a pool of qualified contractors is selected. Only those selected are subsequently allowed to bid on work orders. In most cases the work orders are awarded to the lowest bidder among the contractors in the pool.

When analyzing the three models showed in Figure 1 (Chapter 2), the authors identified three different levels of advantages when using IDIQ contracts to acquire supplies or services (see Table 5). It means that an agency would find the same and more advantages as it moves from a single work order to a multiple award IDIQ contracting model passing through a single award model. However, when comparing these three models with each other, it was recognized one advantage in level 1 and 2 that is not in level 3. This advantage is related with the number of firms involved in the contract. The use of multiple contractors requires higher efforts by agency staff to coordinate and supervise contractors' performance, so that, agencies in levels 1 and 2 would use less in-house personnel and resources to manage those contracts.

TABLE 5 Contracting Advantages per IDIQ Model

Model	Advantages	Level
Single Award, Single Work Order	- Owner only has to deal with one contractor	Level 1
Multiple Award, Single Award, Single Work Order	- Owner can keep lower inventory levels - Flexibility in quantity and delivery scheduling - Supplies and services are ordered when they are really needed - Agencies commit only for a minimum or no amount of work to be ordered - Owner can direct shipments directly to the users	Level 1
Multiple Award, Single Award	- Shorter project delivery period - Lower preconstruction costs - Allows contractor involvement in preconstruction activities - Fast use of year-end funding - Lower cost in future issuance of work orders - Useful contracting option during emergencies - Increase quality and timeliness of delivery	Level 2
Multiple Award	- Reduce potential for graft and corruption - Highly competitive - Lower bid prices - Larger participation of small-size and disadvantaged business - Preference over single award contracts expressed by the FAR	Level 3

As with any other delivery method, IDIQ contracting also have some disadvantages. There are two principal disadvantages related to this kind of contracts regardless of the model used. The first weakness of this delivery method is most evident at state level and is related to the lack of knowledge and experience of some agencies and contractors regarding IDIQ contracting (31). The second disadvantage is a result of the uncertainty associated with this kind of contracts which does not allow the agency to determine a reliable GMP for the entire contract; an ability that increases agency control over project budgets (42). This study identified only two agencies who have implemented GMP features in their IDIQ contracting system; the GSA (43) and the Department of the Interior (44). However, it was not done for the entire contract; a GMP was established on a work order basis and in the case of the GSA, it was done only for some work orders.

The inability of determining a feasible GMP puts IDIQ contracting at a disadvantaged position in comparison with other emerging delivery method that has been also widely recognized for accelerating the delivery of transportation projects; Construction Manager-General Contractor (CMGC) (45), in which GMP plays an important role. Despite this difference, and although state DOTs have been using IDIQ contracting methods for simple and repetitive tasks while CMGC contracts are reserved for larger and more complex projects, there are reasons to think that these two innovative approaches can be successfully combined. Given that in work order contracts IDIQ firms are engaged with the contract before developing work orders, at least after the first one, agencies can use them to furnish different preconstruction services, which is a distinctive feature of CMGC contracts and is recognized as the major advantage of this delivery method (42). By combining the benefits provided by these two methods, determining GMPs on a work order basis as done by the GSA and DOI, and involving contractors in preconstruction activities, agencies could feel more confident to take IDIQ contracting to the next level with larger and broader projects.

Table 6 presents a compilation of some implications, features and trends of each of the three IDIQ contracting models mentioned herein. All aspects included in this chart have been mentioned before in this paper and are shown here to illustrate their relation with each model.

TABLE 6 IDIQ Models Features

<table>
<tr><th>IDIQ Model / Feature</th><th>Single Work Order</th><th>Single Award</th><th>Multiple Award</th></tr>
<tr><td>Owner's Advantages</td><td>Level 1</td><td>Level 2</td><td>Level 3</td></tr>
<tr><td>Use of In-house Resources</td><td rowspan="3">Low</td><td rowspan="2">Medium</td><td rowspan="3">High</td></tr>
<tr><td>Project Complexity</td></tr>
<tr><td>Competitiveness</td><td>Low</td></tr>
</table>

Conclusions

By conducting a literature review of current IDIQ contracting practices used by different agencies in different industries, and after analyzing the information collected through a detailed content analysis, it was possible to identify some characteristics and trends that reflect the state-of-practice of this innovative delivery method in the U.S. This information was synthesized in three IDIQ contracting models: single work order, single award, and multiple award IDIQ contracts. In spite of the fact that multiple award contracts appear to offer more benefits to owners than the other two models, they also are more complicated and require more contract administration effort. Therefore, they should not be considered a better option for all requirements. To determine the most suitable IDIQ contracting approach agencies need to carefully evaluate different factors such as the expected cost of the entire contract, the complexity of the projects to be ordered, and the projected availability of in-house resources during the contract period. Nonetheless, the best model is useless if contractors do not understand the fundamentals of IDIQ contracting before bidding. Some agencies address this issue by conducting pre-bid meetings in which proposers are instructed about this delivery method rather than discuss the scope of the contract or technical aspects.

Although work order contracts are mainly use to execute small and repetitive projects, the GWACs and the worldwide military contracts mentioned in this paper, demonstrate that IDIQ contracts work well with very large, broad scopes, which have gotten as large as $150 billion over a 10-year period (28). It is unlikely that state DOTs may award a contract of this size given their limited resources in comparison with some federal organizations. However, although this contracting method is still in an early stage of development at state level, some important efforts for increasing its capabilities have arisen during the last few years. For instance, by combining IDIQ contracts with design-build methods, Florida DOT is able to execute twenty-million, three-year contracts; a practice that is taking hold in other agencies such as Minnesota DOT. In the final analysis, this study has found that IDIQ can be implemented in three different forms, providing the agency with a degree of flexibility and a mechanism to minimize procurement effort while furnishing an on-going capability to rapidly delivery a limited set of construction and maintenance projects and enhance its ability to efficiently use available year-end funding.

Acknowledgments

The authors acknowledge the members of Minnesota, Florida, New York State, and Missouri DOTs, as well as the Central Federal Lands Highway Division for their contribution to this study.

CHAPTER 5

INDEFINITE DELIVERY/INDEFINITE QUANTITY CONTRACTING: A CASE STUDY ANALYSIS

Rueda, J. A., and D.D. Gransberg. Indefinite Delivery/Indefinite Quantity Contracting: A Case Study Analysis. In *Transportation Research Board: Journal of Transportation Research Board*, National Academies. (Accepted for publication in 2014).

While the previous chapter was aimed to get a better understanding about the fundamentals of IDIQ contracting, this chapter is intended to determine the state-of-practice of IDIQ techniques in the transportation industry. Chapter 5 presents a complete case study analysis of four different IDIQ contracts execute by four different transportation agencies (one federal and three state agencies). Besides getting a better idea about current IDIQ contracting practices adopted by transportation agencies across the U.S. this chapter was also used to collect different escalation clauses implemented by these agencies; clauses that are analyzed later in Chapter 6.

Abstract

Indefinite delivery/indefinite quantity (IDIQ) contracts permit a transportation agency to literally award multiple job orders to a single contractor or a small group of competing contractors, doing away with the need to conduct a full procurement for every small construction or maintenance project. During the last few years, this procurement method has been increasingly accepted by state and municipal agencies; however, little research has been done to provide guidance on this powerful procurement tool. The paper discusses four different models for IDIQ contracting in use by three state departments of transportation (DOTs) and the Central Federal Lands Highway Division (CFLHD), based on detailed case study analysis. The paper finds that regardless of the model in use, agency IDIQ project managers believe the method accelerates the project delivery period, reduces preconstruction cost, and provides a flexible delivery scheduling. Furthermore, the research team identified that the use of multiple award IDIQ contracts also promotes price competition and reduces the risk of contractor default.

Introduction

Much has been written on the topic of procurement risk (15, 45, 46, 47, 48, 49), but very little research has been done to measure the impact of managing procurement risk by continuing to contract with a contractor whose past performance has been satisfactory via a continuing contract. NCHRP Synthesis 402 (50) found that "the most important incentive [to do high quality work] that an owner has is the promise of repeat work" (51) and NCHRP Synthesis 390 concluded that the ability to evaluate a contractor's performance and use that evaluation to impact its ability to bid "creates an incentive for achieving acceptable quality the first time" (52). To make that direct connection between past performance and the ability to compete for future work on a project-by-project basis, the agency must surmount statutory barriers as well as potential industry opposition (50, 51). Additionally, the agency must develop and field a contractor performance evaluation system that if not done well, merely adds to the administrative workload of agency field offices.

To satisfy the procurement risk requirements discussed above, a project delivery method is needed that permits a transportation agency to increase or decrease a particular contractor's work without the need to reprocure every new project. Indefinite delivery/indefinite quantity (IDIQ) contracting fills that bill (15). IDIQ permits the agency to award a contract for continuing construction services of a specific nature to a contractor on a basis of either lowest responsive bid or best value. The contract essentially creates a defined capacity to perform construction on an ongoing basis as long as the quality, cost, and timeliness of the work are satisfactory. It also provides a means to limit the risk of poor performance by only guaranteeing the contractor one "project" (called a delivery, job or task order) and permits the agency to effectively terminate the contract of a marginal contractor without the risk of protest or claim by merely not issuing any further job orders on the IDIQ contract. It also furnishes the ability to increase the amount of work a good performer gets up to the maximum total amount allowed in the IDIQ contract. Thus, IDIQ contracting inherently creates the incentive for satisfactory performance by directly connecting the contractor's past work orders to its ability to be offered another job order and satisfies Thomsen's (51) "promise of repeat work" incentive.

The purpose of this paper is to detail the practices of four transportation agencies' approaches to implementing IDIQ contracting. The information comes from a set of rigorous case studies of actual IDIQ contracts that successfully met the agencies' objectives for the contract. The paper will demonstrate four different models for employing IDIQ in typical transportation construction and maintenance programs and provide the reader with the advantages and disadvantages of each. Finally, the researcher's conclusions and recommendations are offered to assist those agencies that are new to IDIQ contracting to evaluate its potential as another tool in the agency's procurement toolbox.

Background

A large number of public transportation agencies are using IDIQ contracting methods; however, only a small portion of state DOTs use IDIQs to procure construction services. Most agencies use the IDIQ method to procure supplies or consulting services, mainly, information technology or design engineering services (2, 10). The literature review for this study identified the use of IDIQ construction practices in fourteen different transportation agencies including the Federal Highway Administration (FHWA), the New York City Department of Transportation (NYCDOT) and twelve state DOTs. The military departments of U.S. Department of Defense (DOD) have used IDIQs for construction since 1981 (31) and the U.S. Army Corps of Engineers (USACE), the Naval Facilities Engineering Command (NAVFAC) and the U.S. Air Forcnnne (USAF) are all quasi-transportation agencies in that many of their projects are indeed military and civil infrastructure projects such as USACE's locks and dams, NAVFAC's seaports, and the aviation infrastructure assets of the USAF. While there may indeed be more DOTs and municipal agencies, difficulty with the lack of standardization in contract terminology across the nation made it impossible for the research team to definitively classify any more than those fourteen.

In its simplest form, an IDIQ contract is merely a single contract for multiple small projects, typically termed delivery, job or task orders, of a similar technical scope where the actual scope, timing, and cost as well as the number of work orders is not quantified at the time of award (11). In other words, a construction contractor is literally "put on stand-by to perform construction services to be determined in the future" (15). An IDIQ contract can be awarded to a single contractor whom then performs all subsequent job orders, or a pool of prequalified contractors who then compete for each job order. The Florida DOT (FDOT) awards hurricane debris removal IDIQ contracts on an area of responsibility basis in advance of every hurricane season (53) and only activates those contractors whose area of responsibility is actually hit by a hurricane. Thus, the contracts are structured in a manner where no compensation is due if the IDIQ contract is not activated. NYSDOT has a similar arrangement for state-wide emergency bridge repair/replacement (53). Hence, it can be concluded that IDIQ project delivery is extremely flexible and can be tailored to match the requirements of a given situation.

The other unique feature of an IDIQ contract is the ability to expand the total contract volume without the need to reprocure or negotiate a contract modification. The typical IDIQ contract is awarded with a guaranteed minimum (usually the size the first anticipated work order) and a "not to exceed" value (53). Thus, it provides a mechanism to rapidly obligate/expend funding that comes available from other sources that were not contemplated during the original procurement. USACE routinely uses IDIQs as a means to utilize fiscal year-end funding and has found that IDIQs give it the ability "to maximize the efficient use of available capital" (53). When this is combined with IDIQ's ability to be terminated without protest once the guaranteed minimum is satisfied, it becomes a powerful tool to deliver a wide variety of design and/or construction services. Therefore, the remainder of this paper will provide the details on how four agencies are utilizing this tool to deliver construction in their jurisdictions.

Case Study Methodology

Case studies are empirical inquiries that investigate contemporary phenomenon in its real-life context and permit the researcher to drill down into the "how and why" aspects of a given project using structured interviews with project participants (15). The case studies were collected using a protocol based on Yin's methodology for case study research data collection (19). The structured interviews were developed using the protocol prescribed by Oppenheim (54) and conducted in accordance with the Government Accountability Office procedures (55). Once a case study interview was completed, the raw information collected was reduced and integrated with data from the literature review. Therefore, the information gleaned from the case studies is coupled with information collected in the literature review to validate any conclusion drawn from the case studies.

Case Study Background

All case studies were jointly selected by the research team and the Minnesota DOT (MnDOT), the research sponsor. All of them are related to construction activities such as repair and maintenance of roads and bridges, and the implementation of safety projects. The structured interview questionnaire was designed and approved by MnDOT. The primary purpose was to better understand the state-of-the-practice in transportation IDIQ contracting techniques. Additional project-specific information was obtained from contract documents provided by each agency.

TABLE 7 Case Studies

CASE STUDIES' FEATURES AND PROVISIONS				
Features/Provisions	**CFLHD**	**NYSDOT**	**FDOT**	**MoDOT**
Project Title	Roadway Surfacing, Resurfacing, and Repair Contracts: Northern California, Washington, Oregon, and Idaho.	Bridge Maintenance Work Various Routes, Various Towns Broome, Chenango and Tioga Counties.	Design-Build Push-Button Contract. Traffic Operations Projects to Improve Capacity and Safety.	Asphalt Pavement Repair.
IDIQ contract - terminology	Multiple Award Task Order Contract	Job Order Contract	Push Button Contract	Job Order Contract
Work order - terminology	Task Order	Job Order	Task Work Order	Job Order
Delivery method used for work orders	Design-Bid-Build	Design-Bid-Build	Design-Build	Design-Bid-Build
Base contract period	1 year	1 year	3 years	1 year
Actual contract duration	Ongoing	2.2 years	2.5 years	Ongoing
Extension options	Four 1 year periods	Three 1 year periods	Three 1 year periods	One 1 year period
Classification by location(s)	Single State	County-Wide	District-Wide	State-Wide
Minimum guaranteed value	50,000	50,000	12.5 Million (1st Task Work Order)	NA
Maximum value	35 Million	1.2 Million	20 Million	125,000
Minimum value per work order	50,000	NA	NA	NA
Maximum value per work order	7.5 Million	500,000	NA	NA
DBE, TGB, WBE or similar goals	DBE goal to the entire contract	DBE goal for the entire contract	DBE goal for the entire contract	NA
Performance Bond	One per Job Order (100%)	One for the entire contract (100%)	Required (no details provided)	One for the entire contract (100%)
Shortlist	NA	NA	3 or more proposers	NA
Pre-bid meeting	NA	1 or 2 meetings	1 meeting with shortlisted	Some Prebid Meetings are conducted
CFLHD = Central Federal Land Highway Division; DBE = Disadvantaged Business Enterprise; FDOT = Florida Department of Transportation; MoDOT = Missouri Department of Transportation; NA = Not Applicable; NYSDOT = New York State Department of Transportation; TGB = Targeted Group Business; WBE = Women Business Enterprise				

This paper analyzes the four IDIQ contracts shown in Table 7. These case studies were selected because they furnish a wide geographical dispersion and all involve the types of technical scope that MnDOT was contemplating for its own IDIQ program. They also represent a range of IDIQ contract types including single award, multiple award and stand-by contracts. As will be shown in subsequent sections of the paper, the case studies also demonstrate four unique approaches to IDIQ contracting that will furnish a range of options around which an agency that is new to IDIQ can tailor its own program.

Case Study Agency Context

Since IDIQ is a new project delivery method to many agencies, it is important to understand the organizational context in which each of the case study contracts were implemented. All four agencies have legislative authority to use alternative project delivery methods. Both CFLHD and FDOT have experience with construction manager/general contractor (CMGC) and design-build (DB) project delivery. MoDOT and NYSDOT are only authorized to use DB and NYSDOT received its legislative authority in 2012, after the case study IDIQ contract was awarded. Therefore, the four cases also portray a range of project delivery experience from New York with only design-bid-build (DBB) at the time of contract award to Florida with experience in all alternative project delivery methods. The structured interview asked each agency to describe its motivation and objectives for implementing the case study IDIQ contract. Their responses are shown in Table 8. It shows that all four agencies shared the desire to compress the delivery schedule, reduce preconstruction costs, and gain scheduling flexibility. Once again, the notion that compressing the schedule is the primary owner’s motivation for implementing alternative project delivery is validated (45). Only two agencies (CFLHD and NYSDOT) reported the potential to incentivize contractor performance as part of their IDIQ motivation by indicating quality-related objectives. It is also interesting to note that agencies cited more contract administration objectives than the classic cost, schedule and quality objectives. This testifies to the administrative flexibility that is inherent to IDIQ contracts, mainly due to the ability to deliver multiple small projects using a single procurement action that may extend across several years.

TABLE 8 Motivation and Objectives for Using IDIQ Contracting

Motivations	CFLHD	NYSDOT	FDOT	MoDOT
Cost-related objectives				
Reduce preconstruction cost	✓	✓	✓	✓
Reduce construction cost				✓
Encourage price competition	✓			
More value for agency' money			✓	
Schedule-related objectives				
Reduce/compress/accelerate project delivery period	✓	✓	✓	✓
Flexibility in delivery scheduling	✓	✓	✓	✓
Quality-related objectives				
Increase quality	✓	✓		
Reduce risk related to contractor poor performance	✓			
Reduce risk of contractor default	✓			
Contract administration-related objectives				
Funding flexibility	✓			
Cooperative relationship between agency and contractor(s)		✓		✓
Reduced agency staffing requirements		✓		
Usefulness in emergency situations	✓			
Limited owner's commitment (contractual minimal quantity)		✓		
Reduce change orders				✓
Minimize unbalanced bids				✓

As previously mentioned, reconciling terminology was a big issue for the research team when looking for potential case studies. Table 7 presents the terms used by the agencies that participated in the study. However, the following list includes alternative terms found in the literature review to refer to this kind of contracts:

- Delivery Order Contract
- Master Contract
- Framework Contract
- Bundled Contract
- On-Call Contract
- On-Demand Contract

The seemingly only discernible technical difference in the above terminology is whether or not the IDIQ contractor is guaranteed to actually perform compensable construction services. The on-call, on-demand, and push-button contracts all appear to contain a feature of services on an "only-if-needed basis." However, the jargon is so confusing that researchers are not willing to conclude that difference at this writing. For instance, after combining its conventional push-button contracting techniques with design-build methods, FDOT obtained a more traditional IDIQ contracting model which requires minimum and maximum quantities to be ordered under each contract, such as the contract included in this study. Similarly, other agencies have modified their methods to address their needs, making it difficult to determine standard procedures.

Figure 9 illustrates the IDIQ experience of each agency in terms of length of time, number of contracts, and average contract size. There are several aspects in information shown in the figure that must be mentioned before analyzing this section. Although FDOT has awarded a large number of DBB – IDIQ (Push-Button) contracts, the figure only refers to DB – IDIQ contracts that are similar to the case study contract. Likewise, even though the FHWA has extensive experience with IDIQ contracting, the case project study agency, CFLHD, only has 4 years of experience. However, CFLHD construction practices are based on the Federal Acquisition Regulation (FAR) and therefore, the CFLHD IDIQ program is based on a mature set of policies and procedures, making it an "experienced agency" when compared to the three state DOTs. This is given that the FAR is expected to reflect optimum practices resulted from years of experience of all U.S. Federal organizations, regulations that were introduced in 1984 by the Administrator of General Services, the Secretary of Defense; and the Administrator for the National Aeronautics and Space Administration (56).

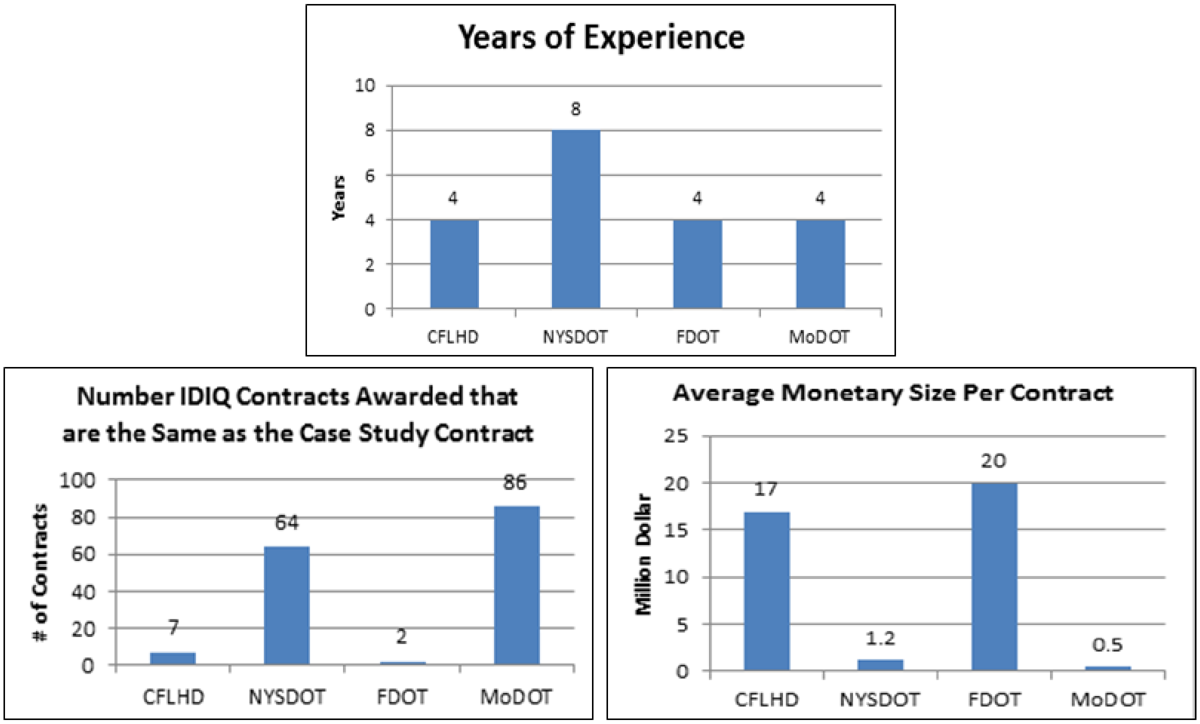


FIGURE 9 Agency IDIQ contract experience.

Combining Figure 9 with the information found in the literature review, it is also possible to identify three different risk tolerance-related approaches. First, agencies like MoDOT prefer to award a large number of small contracts. Since April 2010, MoDOT have awarded 86 IDIQ (job order) contracts for an average expected maximum amount of $500,000. Additionally, more than 50% of these contracts had an original expected maximum amount of $300,000 or less, while roughly 20% were estimated to go up to $1 million or above, with the largest contract estimated to be about $1.5 million. On the other hand, with twice as many years of experience as MoDOT, NYSDOT has awarded 64 IDIQ contracts, 22 less than MoDOT with an average monetary size of $1.2 million. Finally, agencies like FDOT award larger contracts on a less frequent basis. In a three years period FDOT has awarded only 2 DB-IDIQ contracts, each of them for an original estimated amount of about $20 million.

In a single year MoDOT, NYSDOT, and FDOT spend relatively the same amount of money in IDIQ contracts for minor construction, repair and maintenance projects (between $8 and $9 million), but with difference in the number of contracts awarded and the monetary size of each of them. This difference can be related to the risk each agency is willing to accept under each contract in spite of the fact that IDIQ contracts are typically considered by agencies as low risk acquisition alternatives regarding contractor poor performance and default (17). This is because typically agencies are only committed to the guaranteed minimum amount of work in the contract, contractors are motivated by the possibility of future work orders, and in the case of multiple award contracts, there are more firms willing to complete unfinished work orders left by other contractors. When awarding a single award IDIQ contract, the agency typically knows the types of the projects to be developed under the contract. The procurement process provides knowledge of costs and qualifications of the contractor to successfully complete all of them. Therefore, risk is directly related to how long the IDIQ contract will be in force and how much funding is allocated to the contract. Hence, it can be concluded that a large, long-term IDIQ contract would correlate to a higher risk profile than a small short-term contract. From the information in Figure 10, one can infer that MoDOT by using lots of small IDIQs would illustrate a low risk approach; whereas, CFLHD and FDOT with a small number of large IDIQ contracts represent high risk approaches. NYSDOT is in between and can therefore be classified as using a medium risk approach to its IDIQ program.

Agency Procurement Models

Analysis of the case studies identified the three different procurement models shown in Figure 10.The primary difference among the three models is the number of contractors involved in a single contract and the methods used to select these contractors. For instance, federal agencies such as CFLHD prefer multiple award task order contracts (MATOCs), while the state agencies have a preference for single award IDIQ Contracts. Federal agencies expect competition for work orders to increase product quality and timeliness of deliveries, as well as reduce project costs (1, 2). Likewise, by involving multiple firms in the contract, Federal agencies mitigate the risk of contractor default or poor performance. Additionally no price escalation procedures are required for typical multiple award IDIQ contracts since contractors bid current market prices for each work order. This preference for multiple award contracts is also reflected in the fact that the FAR clearly expresses a preference for this contracting approach by directing federal contracting officers to justify using a single award IDIQ and gain authorization before advertising (11).

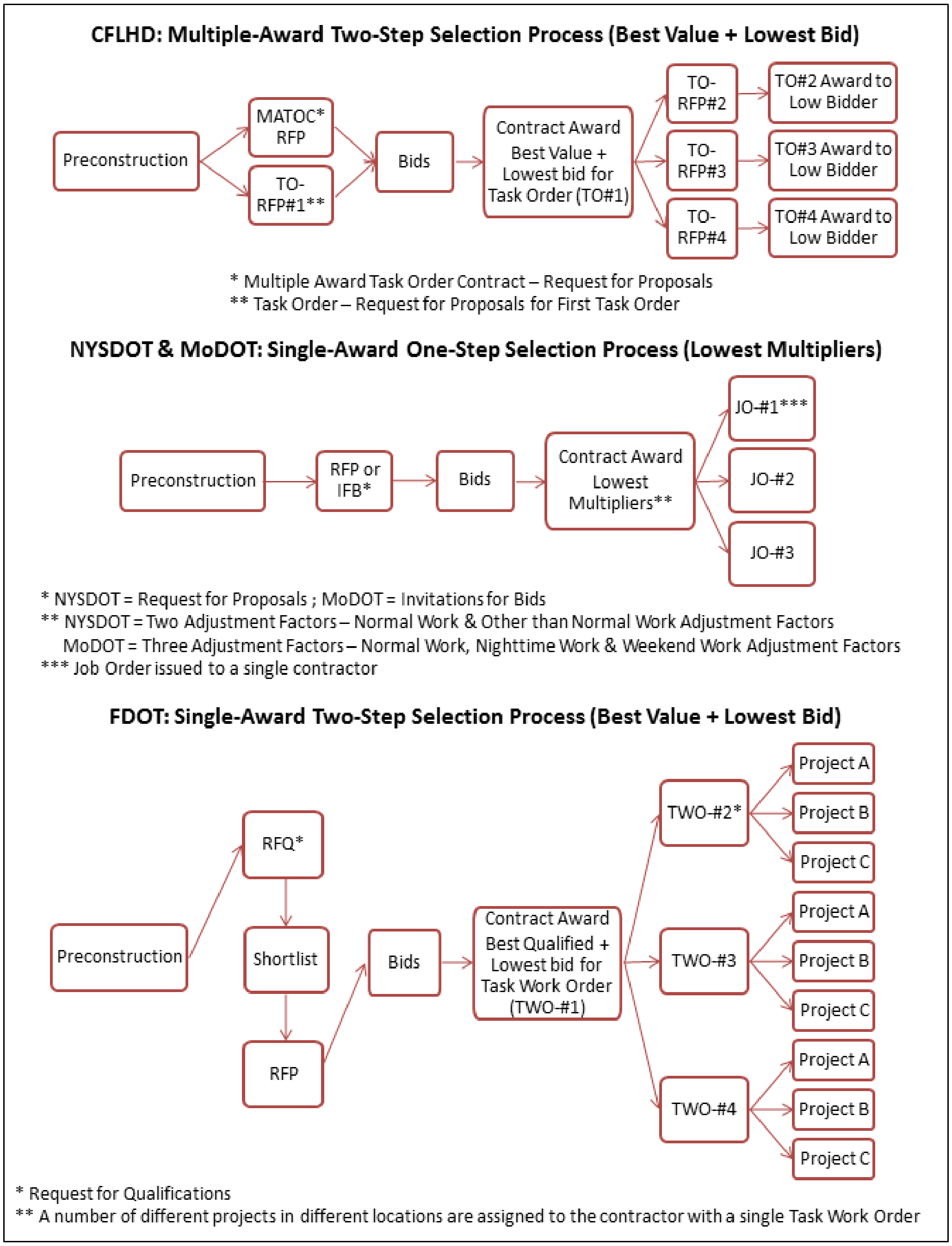


FIGURE 10 Case studies procurement methods.

On the other hand, the literature found that state transportation agencies prefer to use single award IDIQ contracts for minor construction, repair, and maintenance projects. One reason may be that single award IDIQ contracts allow agencies to develop more expeditious methods to issue work orders under a contract given that there is no competition involved in this process (2). With the exception of FDOT which awards $20 million IDIQ contracts to single contractors, the remaining three agencies seem to prefer awarding lower volume IDIQ contracts with small work orders, which may make it impractical to multiple award contracts.

Contractor Selection Process

The four case studies utilize two different contractor selection methods. CFLHD and FDOT use a two-step selection process, consisting of evaluating the qualifications and past performance of each proposer followed by receiving bids price for the first job order (task order in FAR jargon) from short-listed contractors. CFLHD advertises the RFP for the contract including the technical scope for the first task order. The first step is the evaluation of factors such as previous experience, logistic skills, qualifications and financial capability of each bidder. Step-2 involves evaluating the price proposal and selecting the three lowest bids. That group then is permitted to compete for subsequent task orders on a low bid basis. FDOT follows a similar selection process to select a single contractor. The main difference is that FDOT develops a Step-1 shortlist with three or more proposers and only these bidders are requested to submit a full price and technical proposal for the first job order ("task work order" in FDOT jargon).

Alternatively, NYSDOT and MoDOT decided to use a single-step selection approach, in which contractors are only asked to bid different adjustment factors (also called multipliers) based on a fixed unit price list included in the solicitation. The price list includes all pay items to be required for anticipated scope of the contract's job orders. The adjustment factors comprise the contractor's profit and overhead under different working conditions (see Table 9). The contract is awarded to the contractor who bid the overall lowest adjustment factors.

TABLE 9 Adjustment Factors (Multipliers)

<table>
<tr><th colspan="2">ADJUSTMENT FACTORS</th></tr>
<tr><th>NYSDOT</th><th>MoDOT</th></tr>
<tr><td rowspan="2">Normal Work Adjustment Factor:
7:00 am to 5:00 pm Monday-Friday</td><td>Normal Work Adjustment Factor:
6:00 am to 7:30 pm Monday-Friday</td></tr>
<tr><td rowspan="2">Nighttime Work Adjustment Factor:
7:30 pm to 6:00 am Monday-Thursday</td></tr>
<tr><td rowspan="2">Other than Normal Work Adjustment Factor:
5:00 pm to 7:00 am Monday-Friday
All day Saturday, Sunday and Holidays</td></tr>
<tr><td>Weekend Work Adjustment Factor:
7:30 pm Friday - 6:00 am Monday
Holidays</td></tr>
</table>

In addition to the case studies, the research team found that the Massachusetts Department of Transportation (MassDOT) and MnDOT award IDIQ contracts (termed task order contracts by both agencies) based on the lowest price list proposed by bidders. Basically, they advertise a solicitation with a list of pay items and bid quantities based on the first job order plus other items that may be used on subsequent job orders that must be priced and submitted by proposers; thus, the contract is awarded to the lowest bid for the bid quantities in the same manner as a DBB contract for a single project.

Considering each agency's IDIQ contract risk approach with the contractor selection method allows one to conclude that those agencies adopting higher risk approach utilize the more complex two-step selection processes in order to ensure the selection of competitive contractors with relevant experience and qualifications. By doing this, the agency intends to mitigate the risks of poor quality, late deliveries and contractor default by a rigorous prequalification process before considering price.

IDIQ Proposal Submittal Contents

The complexity of the procurement processes is also reflected in the amount of requirements to be submitted by proposer to compete for these contracts (see Table 10). In order to determine the technical and financial suitability of proposers, CFLHD and FDOT require the submission of a larger number of requirements whose evaluation implies a greater expenditure of time, and other resources in the procurement process. However, by awarding larger, longer contracts CFLHD and FDOT minimize the number of procurement actions on a single contract. Thus the two agencies need to procure IDIQ services once every one or two years, whereas, NYSDOT and MoDOT conduct shorter, smaller procurement processes 8 and 30 times per year respectively.

TABLE 10 Agency Submittal Requirements

Requirements	CFLHD	NYSDOT	FDOT	MoDOT
Organization structure/chart	✓		✓	
Previous relevant contracting experience	✓		✓	
Previous contracts contact information	✓			
Team Work qualifications	✓		✓	
QA/QC program	✓		✓	
Subcontracting plan	✓			
Logistics Plan	✓		✓	
Price list for entire contract			✓	
Price list for first Task Order	✓		✓	
Adjustment Factors (multipliers)		✓		✓
Proof of financial capability	✓		✓	
Proof of bonding capability	✓			
Bid bond	✓	✓		✓

Funding and Payment Provisions

Table 11 presents more information about the IDIQ contracting practices of these four transportation agencies, specifically about payment provisions. This table also indicates for each case study how funds were obtained and when they were secured. By checking Table 11, one can see how agencies adopt different methods to tackle each factor; decisions that are usually made base on Federal or local regulations, specific contract features or agency convenience.

TABLE 11 Funding and Payment Provisions

Provisions	CFLHD	NYSDOT	FDOT	MoDOT
Task Order compensation method	Fixed Price	Fixed Price	Fixed Price	Unit Price
Mobilization	Bided per Job Order	Construction Task Catalog includes some mobilization pay items	(MOT + MOB)* is a percentage of construction cost	Fixed Unit Price List includes pay items for mobilization
Cost Escalation	NA	Annually adjustments of Adjustment Factors by using CCI published by ENR	Adjustments made to monthly payments based on the PPI published by BLS	Adjustments made only to some items on a payment basis using indexes published by Poten & Partners
Funding	Federal	Federal (SEP-14)	State & Federal (Federal Safety Funds)	State
When are funds assigned?	When anticipating a Task Order	At the beginning 100% of maximum quantity	Funds for this kind of projects are assigned in July every year	When anticipating a Job Order

*Maintenance of Traffic (MOT) & Mobilization (MOB), paid as a percentage of the construction cost (<20%).

After conducting the literature review and analyzing all the case studies, the research team concluded that there is no common practice for dealing with cost escalation on multi-year IDIQ contracts. Each of the case study agencies used different indexes published by different sources. The four agencies included in this paper present four distinct alternatives; no cost escalation policy, adjustments by using the Engineering News Record's Construction Cost Index, the Bureau of Labor Statistics' Producer Price Index, and the use of a number of indexes issued by a private engineering consulting company which publishes asphalt market price analysis on a weekly basis. Additionally, the literature showed that some agencies, like the California and South Dakota DOTs use indexes developed specifically from their bid tabulations. Therefore, this gap in knowledge is a topic for future research. Since multiple award IDIQ contracts require the pool of IDIQ contractors to bid against each other for each work order, the need to adjust pricing over multiyear contracts is eliminated.

Contract Period and Capacity

To better understand each case study agency's method for establishing contract periods and maximum contact amounts, it is necessary to remember the different contracting approaches discussed in a previous section. Information contained in Table 7 reflects how NYSDOT and MoDOT award shorter, smaller contracts, while FDOT awards multi-year, multimillion dollar contract. The table does not show that NYSDOT and MoDOT execute a number of simultaneous IDIQ contracts in a single year, ordering a similar volume of work as FDOT over the same period of time. All of the case study contracts include the possibility of both extending the initial contract period and increasing total capacity of the contract. Both features function to create an incentive since the decision to extend the contract and/or increase the capacity depends on satisfactory contractor performance during the original contract period.

Another decision that an agency must make when developing an IDIQ system is whether to stipulate minimum and maximum contract amounts for single work orders. This decision is normally governed by applicable regulations or statutory constraints, and if it is not, becomes a matter of agency preference. In federal-aid projects, Part 16 of the FAR obliges agencies to state maximum and minimum amounts for the entire contract, which is seen in case studies that involve Federal aid (CFLHD, NYSDOT and FDOT). While CFLHD and NYSDOT determine a standard minimum total amount to be used in all IDIQ similar contracts, FDOT establishes this minimum amount based on the total cost of the first job order which is awarded along with the contract. In the FDOT DB – IDIQ case, the minimum amount for the first job order was $12.5 million. FDOT also permits the bundling of multiple projects in multiple locations on a single job order. The case study contract had 13 job orders. The first job order included 11 different projects which represent more than 60% of the maximum expected cost for the contract. This high amount of work in a single job order clearly demonstrates the level of risk FDOT is willing accept and shows its confidence in its IDIQ contracting approach.

Conclusions and Recommendations

The following conclusions can be drawn from the above analysis:

- There are benefits of IDIQ contracting practices that were clearly identified by all the interviewees in this study. All of them agree that the implementation of IDIQ techniques accelerates the project delivery period, reduces preconstruction cost, and provides a flexible delivery scheduling. Furthermore, the research team identified that the use of multiple award IDIQ contracts also promotes price competition and reduce risk of contractor default.
- Three different IDIQ contracting approaches are being successfully used by the case study agencies. Each approach is related to the risk an agency is willing to accept and the management of its resources.
- The option to extend the IDIQ contract has two direct functions. First, the agency can exercise these options to manage quality risk by retaining the incumbent contractor with a good performance record. It makes the options to extend function as an incentive to encourage satisfactory performance. Second, the agency can extend the contract to address unexpected factors, like environmental permitting, that delay the execution of specific job orders without the need to execute contract modifications for delay claims.

Two recommendations are made from the above analysis. First, an initiative by the AASHTO or FHWA is needed to gain and maintain control of the contracting jargon in use across the nation. The research team struggled to make clear connections between various agencies and finally was forced to take a very conservative approach to interpreting the terminology in its content analysis. The second recommendation is that research is needed to develop specific guidance for escalating multi-year IDIQ contracts. Past research (57, 58) has shown that depending on national-level commercial construction cost indices fails to adequately account for local construction price fluctuations and the volatility of construction material prices. The research should do a comparative analysis of the accuracy of national indices versus local indices already in use in states like California and South Dakota and develop a methodology for public agencies to develop their own local construction cost indices for use in not only IDIQ contracts but through their cost engineering program.

Acknowledgments

The authors acknowledge the members of Minnesota, Florida, New York State, and Missouri DOTs, as well as the Central Federal Lands Highway Division for their contribution to this study.

CHAPTER 6

DEVELOP A PRICE ESCALATION METHOD FOR INDEFINITE DELIVERY/INDEFINITE QUANTITY CONTRACTING FOR THE MINNESOTA DEPARTMENT OF TRANSPORTATION: AxE BIDDING

Rueda, J. A., D.D. Gransberg, and H.Y. Jeong. Price Escalation Method for Indefinite Delivery/Indefinite Quantity Contracting: A times E Bidding. (to be submitted for publication in the *Journal for Construction Engineering and Management*, ASCE, in 2014).

This chapter describes the process followed to develop AxE bidding. Using the information a conclusion drawn from Chapter 4 and 5, this chapter identifies the price escalation requirements and explains how they differ from those in traditional contracting methods. Likewise, this chapter presents an analysis of escalation clauses commonly used in the transportation industry. After recognizing the need for an alternative price adjusted method for multi-year single award IDIQ contract, the authors develop the AxE bidding method presented in this chapter, which is ready for a preliminary implementation in future IDIQ contracts awarded by MnDOT.

Abstract

As a result of comprehensive research conducted for the Minnesota Department of Transportation (MnDOT) on the current IDIQ practices adopted by different transportation agencies across the U.S., the authors have identified a major issue needs to be addressed before MnDOT can fully implement IDIQ contracting: cost escalation in multi-year single award IDIQ contracts. This paper introduces a new escalation methodology and terms it: Cost times Escalation (AxE) bidding. It seeks to eliminate the need to depend on external construction cost indices or to develop a MnDOT construction cost index by shifting the escalation risk to the contractor during bidding and allowing it to propose its own escalation adjustment factor. The proposed process requires competing contractors to submit a fixed annual adjustment rate, which will be used to modify bid unit prices over time throughout the IDIQ contract's life cycle. The adjustment rate is also factored into the selection of the low bid in a manner similar to A+B bidding. The paper presents different alternatives to incorporate this rate into the selection of the successful contractor (formulas for E) and quantifies the risk related to each alternative for

different case scenarios. Additionally, the paper discusses how AxE bidding may reduce construction costs and agency staffing requirements, as well as overcome the disadvantages associated with using traditional price escalation methods, such as the lack of flexibility to adapt to the nature of the contract and the inability to consider imminent future changes in the construction industry. This paper also presents an analysis of these traditional price escalation methods by applying twelve different cost escalation indexes, and one alternative method currently used by MnDOT on its IDIQ contracts, on four case study projects over a five-year period. Outcomes for each index were compared with observed bid prices along the same period of time, which was used by the authors as a reference to develop an escalation method that meets MnDOT needs.

Introduction

In 2011, the Minnesota Department of Transportation (MnDOT) chose to incorporate Indefinite Delivery/Indefinite Quantity (IDIQ) contracting into its list of innovative contracting methods. By September 2013, MnDOT had awarded more than twenty IDIQ contracts for different types of work such as bituminous surfacing, micro-surfacing, seal coating, milling, noise wall construction, and drainage projects (59). The objective of the research is to evaluate the issue of developing an equitable method to address unit price escalation in multi-year single award IDIQ contracts. Cost escalation has been studied by researchers around the world in relation to traditional contracting methods (60, 61), but the literature appears to be silent on how the risk of escalating construction prices can be mitigated in an IDIQ contract that includes several options for the owner to extend the base contract for a period of several years.

After recognizing a number of external factors that impact the original conditions of traditional fixed-price long-term construction contracts, regulatory agencies in several countries have developed procedures to standardize escalation clauses on public construction contracts (60). In the U.S. the Federal Acquisition Regulation (FAR) indicates three different types of price adjustments that can be used on federally funded projects; adjustments based on established prices, actual cost on labor and material, or cost indexes (62). These regulations were designed to mitigate the impact generated by changes in the construction industry on traditional long-term projects (60, 62, 63). However, as will be discussed in greater detail later in this paper, the need for a price escalation method on IDIQ contracts has a different basis due to the unique features of this contracting approach.

The purpose of this paper is to propose an alternative bidding method, termed Cost times Escalation (AxE) bidding for IDIQ contracts for MnDOT. In the AxE method, contractors are required to submit a fixed annual adjustment rate (FAAR) used to modify bid unit prices over time. AxE bidding has the added advantage of shifting the out-year escalation risk from the owner to the IDIQ contractor and making it a competitive factor in the low bid selection process. To develop this alternative method the authors analyzed traditional escalation clauses and policies obtained from an extensive literature review, a detailed content analysis of IDIQ procurement documents, and four case studies. Twelve cost escalation indexes, and one alternative method currently used by MnDOT on its IDIQ contracts, were applied to four different types of highway construction projects for a five-year period. Their outcomes were compared with the actual cost of these contracts in the same period of time. The analysis was focused on features that should be kept in the proposed method, and those characteristics that must be improved in order to meet the specific requirements of IDIQ contracting. Combining the two aspects made it possible to develop a price escalation method that meets MnDOT expectations while increasing competition in IDIQ procurement processes.

Background

IDIQ contracts are also known as Job Order, Task Order, Delivery Order, and On-Call contracts (64) and have been widely used by U.S. federal agencies since the 1980's. The Federal Acquisition Streamlining Act (FASA) of 1994 (1) was introduced to regulate the use of IDIQ contracting on federally funded projects (3). Despite their wide-spread use in the federal sector, IDIQ contracts were only introduced by state Departments of Transportation (DOTs) during the last decade (65). Case studies conducted with four different transportation agencies showed that these agencies perceived that IDIQ contracting "accelerates the project delivery period, reduces preconstruction cost, and provides a flexible delivery scheduling" (65).

IDIQ Contracting – Definition

At the federal level, an IDIQ contract "is one that provides for an indefinite quantity of supplies or services, within limits that are stated in the contract, to be provided during a time period that is fixed in the contract" (62). Supplies or services that are order to the contractor by placing work orders during the contract period (11). This definition has been slightly modified by state DOTs, for which the implementation of limits in number of units or dollars became more a complementary policy rather than part of the definition. Limits are mainly stated on IDIQ contracts based on agency preferences or state regulations.

Figure 1 (found in Chapter 2) presents three IDIQ contracting models used by different agencies. Agency selection of an IDIQ model depends on a number of factors such as:

- The scope of the contract,
- Maximum expected amount to be ordered,
- Location,
- Agency experience and preferences, and
- Applicable regulations.

The simplest model is the single work order contract, in which one contractor is selected to complete a single work order to be issued at an unspecified period of time (64). Secondly, the single award contract is awarded to a single contractor who will perform a number of work orders for similar projects during a stated contract period (64). Finally as with single award, multiple award contracts are also used to perform a number of projects, but in this case there is a pool of contractors who compete for each work order (64).

Cost Escalation and Price Escalation

Cost escalation, as used in the context of this paper, "refers to the difference between the actual cost […] and the contracted cost" (66) of the project. The difference tends to be positive (actual cost > contracted cost) in long-term contracts (63). The cost increase occurs as a result of changes in material cost, adverse weather, natural disasters, poor project planning, underestimation of costs, and scope changes during the contract period (61, 63, 67).

For the purpose of this paper, price escalation or price adjustment refers to changes in bid unit prices to compensate for future changes in the construction market. Therefore, a price escalation/adjustment method refers to clauses aimed to modify unit prices in a given contract as a consequence of observed cost escalation during a given period of time. It is not intended to cover all causes of cost escalation, only those resulting from generalized changes in the construction market mainly related to labor, materials and equipment cost, increases in taxes or interest rates, and other factors that may have a direct impact on contract unit prices. It is important to understand that there are other alternatives to contractually address cost escalation without modifying bid unit prices. Some of these alternatives are change orders, using cost reimbursable contracts, and quantity over/under-run clauses.

Price Adjustment Methods on IDIQ Contracts

As a result of the literature review and the case study analysis, it was concluded that price adjustment requirements vary in accordance with the IDIQ contracting method used (see Figure 1 in Chapter 2). It was determined that escalation clauses are mainly required when using single award IDIQ contracts (65).

Single work order contracts are better suited for construction services required in the short term, usually less than a year (14, 15). Thus, given that traditionally price escalation is performed on an annual basis (12, 62), the use of escalation clauses becomes unnecessary. Alternatively, multiple award contracts tend to be longer (26, 27, 28, 29, 30), but every work order is competitively bid using current market pricing making the need to escalate unit pricing needless.

In single award IDIQ contracts, agencies such as MnDOT and the Florida DOT require the contractor to bid unit prices for a specific list of pay items. Other state DOTs such as New York and Missouri, bidders must submit two or three multipliers (65), which are used to adjust unit prices stated by these agencies. These factors are aimed to represent contractors' overhead and profit under different working conditions (i.e. normal working hours, nighttime, weekends) (65). Regardless of the bid package requirements, the intention of all these agencies is to create an annually-adjusted master pay item list to be used throughout the duration of the contract (65). In order to retain the advantage of a competitive procurement process (68), price adjustment provisions must be clearly specified in the contract and must be completely understood by the contractor.

It is also important to understand the difference between the reasons for using escalation clauses on traditional construction contracts, and the reasons to use them on multi-year single award IDIQ contracts. When bidding on traditionally procured contracts, contractors prepare their price proposals usually based on detailed schedules and designs. Therefore, bidders have a good idea about when, where and how each task will be performed and are able to develop estimates of labor, material and equipment costs for each construction activity. The purpose of escalation clauses in use tend to be either share the pricing risk for highly volatile commodities like diesel fuel and liquid asphalt (60) or significant variation (as defined in the contract) the actual quantities of work. (60, 62). In other words, a minimum observed variation must occur on construction prices in order to trigger the escalation clause and adjust contract unit prices for the portion of work affected by this variation. For example, state DOTs in Florida, Alabama, North Carolina, and South Carolina require a minimum variation of 5% on selected pay items before authorizing an adjustment on covered pay items (69).

As previously mentioned, price adjustment practices appeared in the construction industry as a mechanism to modify the original contract conditions on long-term fixed-price contracts as a result of changes in the construction market or unavoidable delays due to availability of materials (60). Unlike traditional contracts, a long-term single award IDIQ contract is composed of multiple short-term projects (work orders) instead of a single multi-year construction project. The pricing for each work order is drawn from the bid prices provided at letting. This is further complicated by the fact that since only one work order is guaranteed to the successful bidder, a prudent contractor is discouraged from attempting to develop pricing for the entire contract period. Therefore, the uncertainty regarding the total scope of work for the life of the contract is high and grows proportionally with the length of the contract (61). There is extensive information in the risk management literature regarding the relationship between contract duration, uncertainty, and perceived risk. Most authors agree that the longer contractors are required to maintain construction prices, the higher the uncertainty. This higher uncertainty is then reflected in larger contingencies as a risk mitigation strategy (61, 63, 70, 71, 72).

Another way to understand the necessity of price adjustment methods in IDIQ contracting is by considering the difference between a traditional fixed-price three-year construction contract with an IDIQ contract with no escalation clause. Based on the above discussion and assuming that at the end these contracts will produce the same quantities of work, one would expect to find higher unit prices on the IDIQ contract given its higher uncertainty on the actual final scope of work at the time of the bid opening. The way to mitigate the risk generated by this uncertainty and make long-term IDIQ contracts more attractive for owners and contractors would be requesting bid unit prices for short periods of time, usually a year, and propose escalation mechanisms to fairly adjust unit prices in subsequent periods in proportion with actual changes in the construction market.

In typical IDIQ contracts, agencies commit to a minimum guaranteed amount of work to be ordered, after which the agency is no longer obligated to issue further work orders (64). It should be noted that some IDIQs do not contain a guaranteed minimum. In traditional contracts, agencies must pay either for contingencies generated by including no escalation clauses in the contract (72) or for observed changes in costs during the construction period by adjusting bid unit prices. In contrast, no escalation clauses in multi-year single award IDIQ contracts implies that the contractor establish its unit prices including estimated escalation, which if no work orders are issued after the guaranteed minimum would make the cost of the initial work order very dear.

Methodology

The methodology followed in this research to develop an effective price adjustment method used both qualitative and quantitative methods. The research instruments were used are described below.

Literature Review and Case Study Analysis

The literature review process covered several IDIQ solicitations and contract documents from different types of agencies in the U.S., academic papers from different publications and researchers worldwide, official reports, and other documents that could provide a better understanding of IDIQ contracting and current price escalation methods used on alternative and traditional delivery methods.

Content analysis methods proposed by Neuendorf were applied to all documents and data collected from the literature review to extract the information relevant for this research. Content analysis is a "systematic, objective, quantitative analysis of message characteristics" (41), commonly use in academic and industrial research as a method to make inferences from large amounts of textual information. This method is based on the frequency of occurrence of specific keywords, selected and categorized in accordance with the objective of the study (40). Although it is described by Neuendorf as a quantitative method, it is mainly used to generate qualitative assessments of documents.

Four IDIQ case studies were selected from the literature review for a deeper assessment of their escalation clauses and other specific characteristics related to these kinds of contracts. Case studies were conducted based on Yin's guidelines (19) and by using structured interviews designed and conducted in accordance with survey and interview methods suggested by Oppenheim (54) and the U.S. Government Accounting Office protocols (55).

Data Collection, Processing, and Analysis

The literature and content analysis found an agency preference for the use of cost indexes to measure cost escalation and adjust bid prices. This preference was observed in both IDIQ contracting and traditional contracting. However, there was not an observed preference for a specific cost index. Some agencies use national or local indexes published by governmental agencies such as the Bureau of Labor Statistics (BLS), or by private companies that maintain construction cost databases such as the Engineering News-Record (ENR) and the RSMeans. Likewise, other agencies have decided to create their own construction cost index such as the U.S. Federal Highway Administration (FHWA) and some state DOTs.

In order to determine the suitability of price adjustment procedures by using construction cost indexes in IDIQ contracting, twelve selected indexes, including one published and maintained by MnDOT (not used on IDIQ contracts), were applied to four different types of projects over a five-year period, from July 1st, 2008 to July 1st, 2013. Unit prices on these four sample projects were adjusted on an annual basis, and the results of these adjustments were compared with actual observed prices of the same construction activities during the same period of time. Similarly, this study tested the applicability of the current IDIQ price escalation method used by MnDOT.

The types of projects selected for this study are asphalt pavement, concrete pavement, traffic barriers and drainage projects. The selection, scoping, and pricing of sample projects for these four types of contracts, was conducted following the steps below:

- Identify types of projects previously awarded by MnDOT as IDIQ contracts, those that MnDOT is planning to develop into future IDIQ contracts, and those repetitive types of projects that traditionally are best suited to IDIQ contracts.

- From the MnDOT historical bid database (73), select a sample project for each type of contract identified in the previous step, in which the most representative items must be characteristic of its category.
- Discard those items whose units are not precisely defined (e.g. each, lump-sum), and keep those with consistent and specific characteristics that allow a price comparison over time.
- Determine the participation (%) of each pay item on the total cost of its respective sample projects and discard irrelevant pay items that do not have a significant impact in the final cost of the projects.
- After checking frequency of occurrence of each pay item in the projects, replace those pay items with low frequency by more repetitive similar items whose price change over time would be easier to track.
- Assign the same final total cost to all four sample projects, \$1.5 million, which will represent the total cost for all projects if performed during the first year. Then adjust the total cost of each pay item (quantity X unit price) in order to keep the same proportions of the original contract. Thus, if two different types of asphalt were replaced by a type of asphalt that is more commonly used by MnDOT, the participation in the project (%) of the latest must be equal to the sum of the participation of both discarded pay items.

Mobilization and Traffic Control pay items were not discarded given their high frequency of occurrence on MnDOT construction project and because their removal could unbalance the project affecting its integrity and the results of the study, as it is intended to measure the impact of the indexes on typical projects. However, these pay items were not annually adjusted, but its participation in the total cost of each project (%) was unchanged along the five years.

There is not a specific reason for the selection of \$1.5 million as the base total cost (from July 1st, 2008 to July 1st, 2009) for all projects, it is irrelevant to the goals of the study. Regardless of its value, it is important to have the same base total cost for all sample projects since it makes it easier to compare the impact of the same index on different types of contracts. Quantities and unit prices are also irrelevant for the sample projects, since price changes of each pay item will be applied to the total cost of pay item rather than to its unit price. Nonetheless, the actual variation in the price of each pay item will be measured from observed unit price fluctuations registered by MnDOT for the same item, for a similar work quantity, and in the same period of time.

All bids received by MnDOT between January 2008 and September 2013 for the pay items contained in the sample projects were considered in this study. Historical bid data obtained from MnDOT official website (73) was shaped into a three-dimensional arrangement based on the pay item identification number, letting date, and bid quantity.

Since a deeper analysis on each pay item on the sample projects indicates that units prices in all pay items is inversely proportional to the bid quantity, except in one case (2501603/00124 Lining Culvert Pipe 24”) in which no relation was found between unit price and quantity, and given that average bid quantities on a single pay item may vary from period to period, it was necessary to group all bids received by MnDOT in groups of bids for similar work quantities. Bid quantity ranges for each pay item were determined based on the distribution of the bids on a scatter plot and the average largest variation between the lowest and largest bids received for the same item for the same contract at the same moment. In other words, this average variation was recognized as the typical maximum difference between two bids for the same pay item and quantity. Figure 11 and Table 12 illustrate the process followed to define the bid quantity ranges for one pay item, and the estimation of average unit prices for that item in six-month intervals.

As will be presented later in this paper, the adjustment of the sample projects due to the cost indexes was performed annually since this is the typical time-frame used to adjust construction prices. Adjustment in the actual total cost of all pay items was performed in six-month intervals. This decision was made with the intention of observing the behavior of the prices between adjustments. Actual prices in sample projects were estimated for January 1st and July 1st on each year, from July 2008 to July 2013. Thus, bid unit prices collected by MnDOT between October and March were used to estimate the average unit price of each item in January 1st and those between April and September to determine the actual average unit price in July 1st (see Table 12).

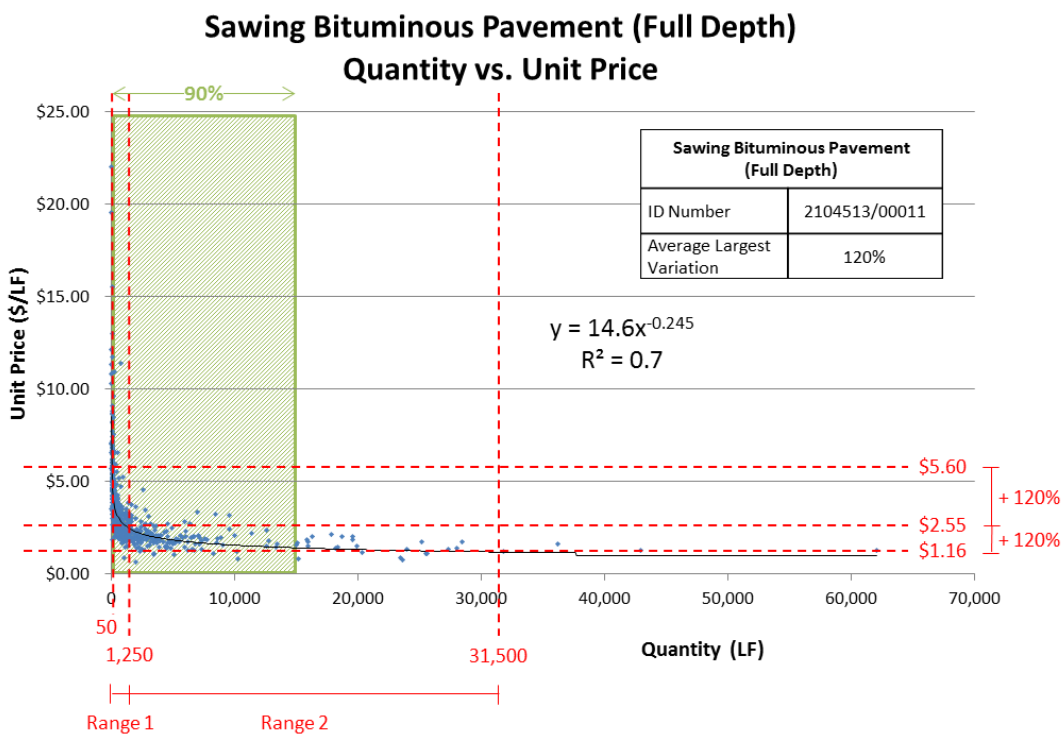


FIGURE 11 Sawing Bituminous Pavement – bid range determination.

TABLE 12 Sawing Bituminous Pavement – Average Unit Price

Sawing Bituminous Pavement (Full Depth) – Average Unit Price ($/LF)											
Time / Quantity (LF)	2008		2009		2010		2011		2012		2013
	Jul. 1st Apr-Sep	Jan. 1st Oct-Mar	Jul. 1st Apr-Sep	Jan. 1st Oct-Mar	Jul. 1st Apr-Sep	Jan. 1st Oct-Mar	Jul. 1st Apr-Sep	Jan. 1st Oct-Mar	Jul. 1st Apr-Sep	Jan. 1st Oct-Mar	Jul. 1st Apr-Sep
Range 1 (50 -1,250)	$3.24	$3.68	$3.51	$3.71	$3.34	$4.28	$3.83	$3.67	$3.84	$4.54	$4.05
Range 2 (1,250-31,500)	$1.96	$1.98	$1.76	$2.04	$2.00	$1.91	$2.21	$2.11	$2.05	$2.06	$2.10

Variation in the unit price of a single pay item was calculated by computing the arithmetic average of the variations of each quantity range between two periods of time, as shown in the equation 3 below. In order to calculate the unit price variation between two periods in a single quantity range, both periods must contain an average unit for the given item, otherwise, this quantity range is not considered to estimate the final variation for that item in that period. Equation 3 shows how the variation between July 1st 2008 and January 1st 2009 was calculated for the pay item presented in Table 12.

$$\frac{Average\ Range\ 1 + Average\ Range\ 2}{Number\ of\ Average\ Rates} = \frac{\frac{\$3.24+\$3.68}{2}+\frac{\$1.96+\$1.98}{2}}{2} = \$2.71 \qquad \text{eq.3}$$

In an effort to discard unbalance bids, those bids with units prices equal to $0.00 (zero) were excluded from the study. Likewise, outliers were removed from the data by applying the modified Z-score method on each quantity range on an annual basis. The modified Z-score method was selected given that it is more suitable for small samples (21), which was the case of some quantity ranges in this study. To use only commonly contracted quantities in the study, the five percent lowest quantities were discarded and quantity ranges were determined until at least 90% of the observations were covered (see Figure 11).

Traditional Construction Cost Index Analysis

Table 13 presents a description of the 12 indexes used in this study, whose use has been widely recognized in the building and highway construction industry. This table indicates the components used by each cost index, the scope of each index based on the area covered by their periodical publications, the frequency of publication, and the type of index (input or output index). Four building construction cost indexes were involved in this study; the national and local (Minnesota) indexes from the RSMeans Construction Cost Index (CCI) (74) and the national and local indexes from the Building Cost Index (BCI) published by the ENR (75).

The remaining eight correspond to some cost indexes commonly used on highway construction contracts, and others developed by three different state DOT agencies. These indexes are; the national and local CCI from the ENR (75), the discontinued Highway and Street Construction (BHWY) (76) and current Other Non-Residential Construction (BONS) (77) Producer Price Indexes (PPIs) (used as a single index) from the BLS, the National Highway CCI (NHCCI) from the FHWA (78), the quarterly and 12-month construction indexes from California DOT (Caltrans) (79), and CCIs from South Dakota DOT (SDDOT) (80) and MnDOT (81).

This study involved input and output cost indexes as shown in Table 13. Input indexes measure the price change in one or more construction components or materials, while output indexes indicate observed changes in the construction prices including general costs, overhead, profit, risk, and other possible external factors (78, 82).

TABLE 13 Building and Highway Construction Cost Indexes

INDEX	COMPONENTS	SCOPE	FREQUENCY	TYPE
Building Construction				
RsMeans: Construction Cost Index (CCI) (National & Local)	• 9 types of buildings - 66 construction materials - Wage rates for 21 different trades - 6 types of construction equipment	• National: 30-city average • Local: 318 cities	• Quarterly	Input
Engineering News Record: Building Cost Index (BCI) (National & Local)	• Cement • Structural Steel • Lumber • Labor	• National: 20-city average • Local: 20 cities	• Monthly	Input
Highway Construction				
Engineering News Record: Construction Cost Index (CCI) (National & Local)	• Cement • Structural Steel • Lumber • Labor	• National: 20-city average • Local: 20 cities	• Monthly	Input
Bureau of Labor Statistics: Producer Price Index (PPI) – Highway and Street Construction (BHWY) & Other Non-Residential Construction (BONS)	• BHWY: Material and supply inputs for highway and street construction • BONS: Material and supply inputs for construction related to: - Water and sewer lines - Oil and gas pipelines - Power and communication lines - Highway, street and bridge construction - Flood control	• National	• Monthly	Input
U.S. Federal Highway Administration: National Highway Construction Cost Index (NHCCI)	• Pay items with constant price-determining characteristics from 45 U.S. states	• National	• Quarterly	Output
California Department of Transportation: Price Index for Selected Highway Construction Items (Quarterly & Annual)	• Roadway excavation • Aggregate base • Asphalt concrete pavement • Portland cement concrete (Pavement) • Portland cement concrete (Structure) • Bar reinforcing steel • Structural steel	• California	• Quarterly • Last 12 months	Output
South Dakota Department of Transportation: Construction Cost Index (CCI)	• Unclassified excavation • Liquid asphalt • Asphalt concrete • Gravel cushion (sub-base and base) • Portland cement concrete pavement • Class A concrete (structures) • Reinforcing steel • Structural Steel	• South Dakota	• Annual	Output
Minnesota Department of Transportation: Construction Composite Cost Index	• Excavation Index - Excavation • Structures Index - Reinforcing steel - Structural steel - Structural concrete • Surfacing Index - Bituminous pavement - Concrete Pavement	• Minnesota	• Quarterly • Annual	Output

Use of Construction Cost Indexes

Construction cost indexes are used in price escalation methods to measure changes in construction prices from period to period. Typically, the original bid price is defined as the base price, and the last index published by the letting date of the contract becomes the base index (16). Then, based on the price adjustment frequency stated in the contract, variation between the base index and the last index published at the moment of the adjustment is proportionally apply to the base price (16).

Adjustments are either applied to specific materials, construction activities, or to the entire remaining portion of the contract. Similarly, as suggested by the BLS, there are different escalation clauses or price adjustment methods that may be used in an effort to mitigate or redistribute risk, or to obtain more accurate adjustments (16).

In this research, the authors have identified the following common assumptions made when using construction cost indexes to adjust contract prices:

1. Changes in the construction market from period to period have equal or similar impact on all kind of construction projects.
2. Weighted price changes between construction periods in few significant materials or construction components represent an overall construction cost change during the same period of time. This assumption may appear after the one mentioned before only.
3. Steady quality and production rates over time in construction materials and activities.
4. Construction prices for the oncoming period follow a trend marked between the base period and the last period with known index.

Some of the previous assumptions may be avoided or altered by including specific clauses to restrict/ limit price adjustments, or by creating more dynamic adjustment methods that adapt in accordance with the scope of the projects. For instance, assumptions 1 and 2 above are mainly observed on contracts using escalation clauses based on a composite index. These two assumptions may be avoided when using specific indexes for specific materials to adjust only the unit price of those materials in a given contract. For example, a price escalation method that uses two price indexes; a concrete price index and a steel price index, to adjust the unit prices on these two items only.

Construction Cost Indexes - Analysis and Comparison

Before comparing the impact of different cost indexes on the four sample projects, the actual costs of these projects were calculated on six-month intervals and compared with each other. Figure 12 illustrates these costs for the five-year period comprised in this study.

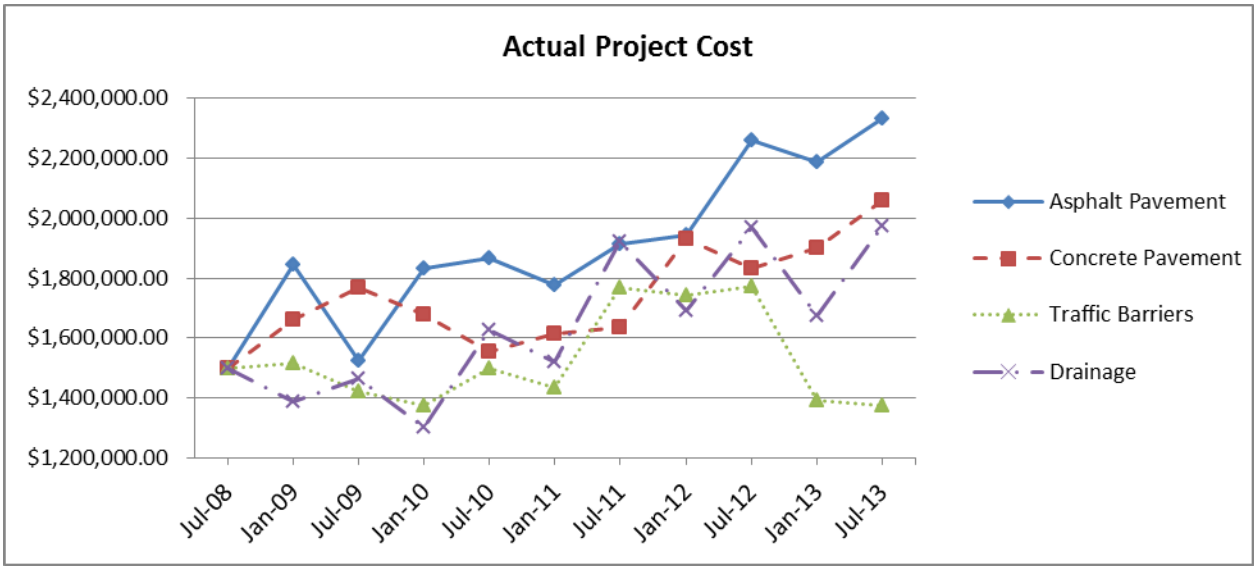


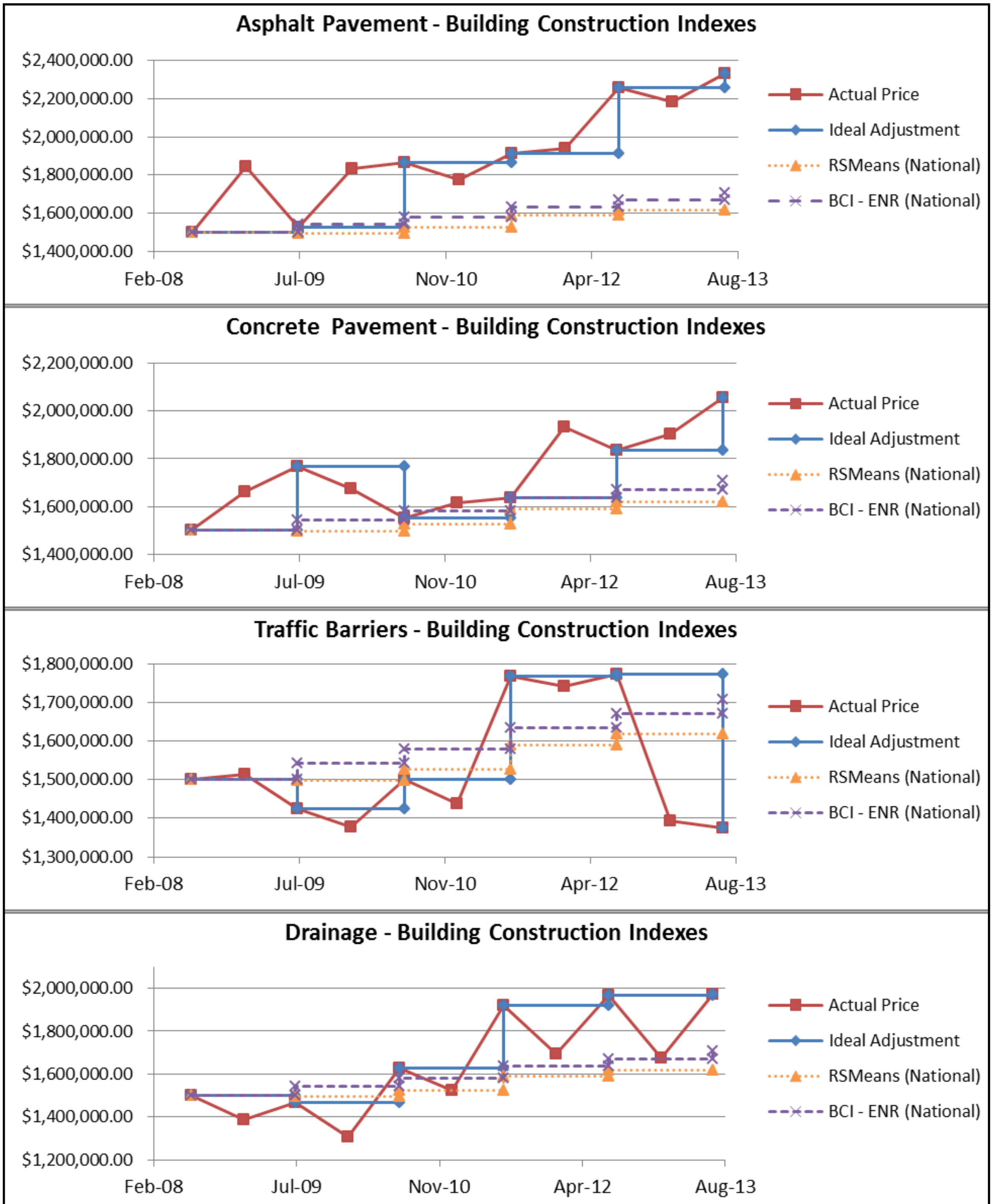
FIGURE 12 Actual project cost of sample projects.

Figure 12 challenges assumptions 1 and 2 stated before regarding the use of construction cost indexes to adjust contract prices. This figure shows how different types of projects are differently impacted by changes in the construction market during the same period of time. For instance, asphalt pavement projects present a higher volatility, while drainage projects show a seasonal behavior due to their cyclical variations. Moreover, only during one of the ten six-month periods did all the variations follow the same direction (project costs in all sample projects increased between January and July 2011).

Figure 13, 14, and 15 show the adjustments that would be applied if using each cost index on each sample project. Indexes were classified in three groups; Building Construction related (Figure 13), Highway Construction related (Figure 14), and those locally developed that apply only in Minneapolis or Minnesota (Figure 15). Additionally, to provide a benchmark for each sample project, a data series representing the ideal semiannual adjustment was included in each graph. This ideal adjustment is intended to modify last period project prices into actual observed bid unit prices in January and July each year.

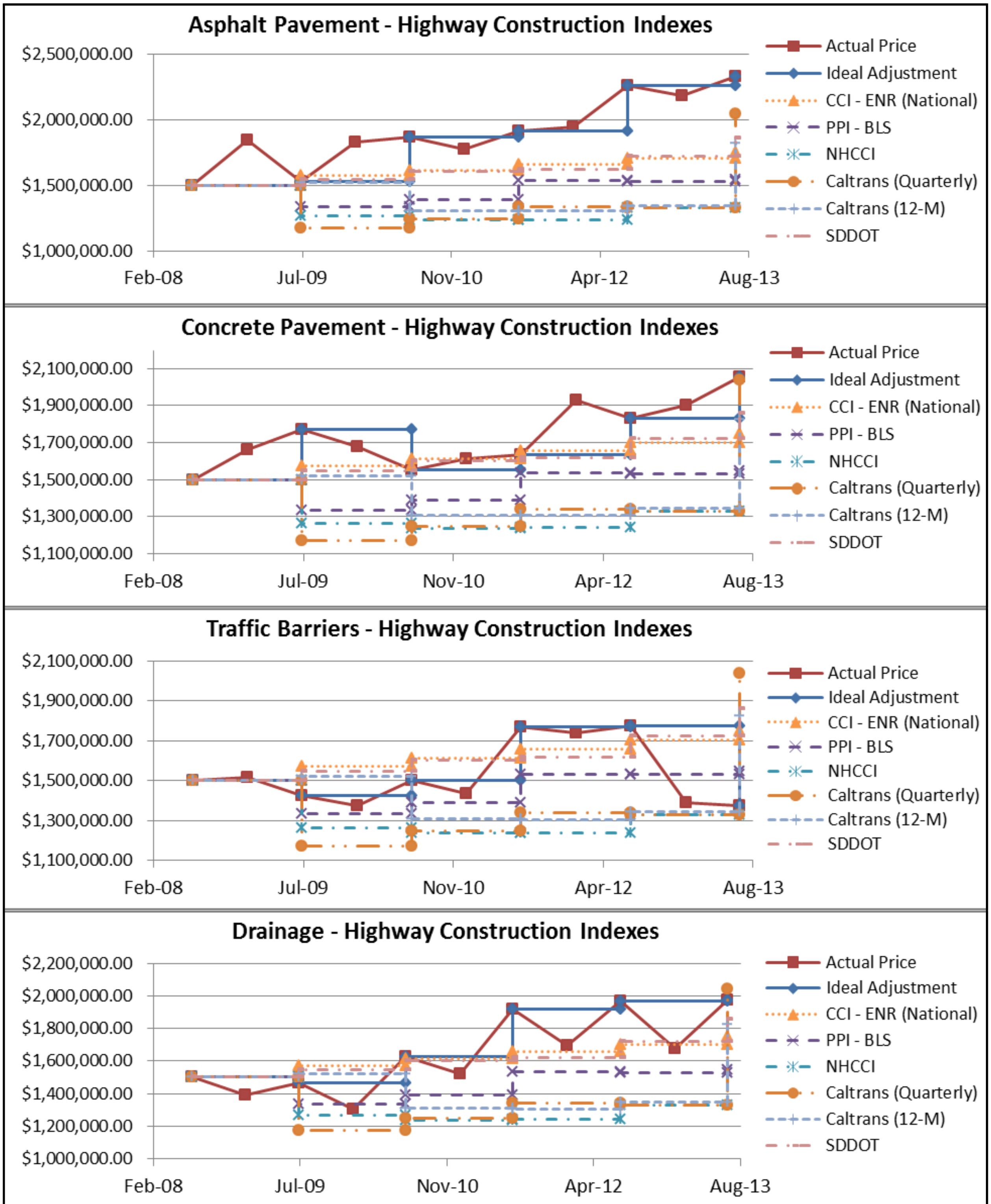
Figures 13 to 15 are intended to present the actual cost of the same projects at different times and the cost determined by using different construction indexes. This provides a clear idea of the results of using this kind of price adjustment methods on IDIQ contracts given that this contracting approach implies the execution of similar projects along the contract period, which usually cover more than one year. A five-year period was selected based in the fact that this is the largest possible contract period (base contract period + contract extensions) in those IDIQ contracts already awarded by MnDOT. Additionally, it corresponds to the last five years in order to use recent data that permits to infer current trends and relations between actual construction prices and construction cost indexes.

All cost indexes in this study are composite indexes and are typically used to adjust all the pay items encompassed by the contract, or its remaining portion. Therefore, agencies usually make all four assumptions mentioned before in this paper in regard to the use of these cost indexes in contract escalation clauses.



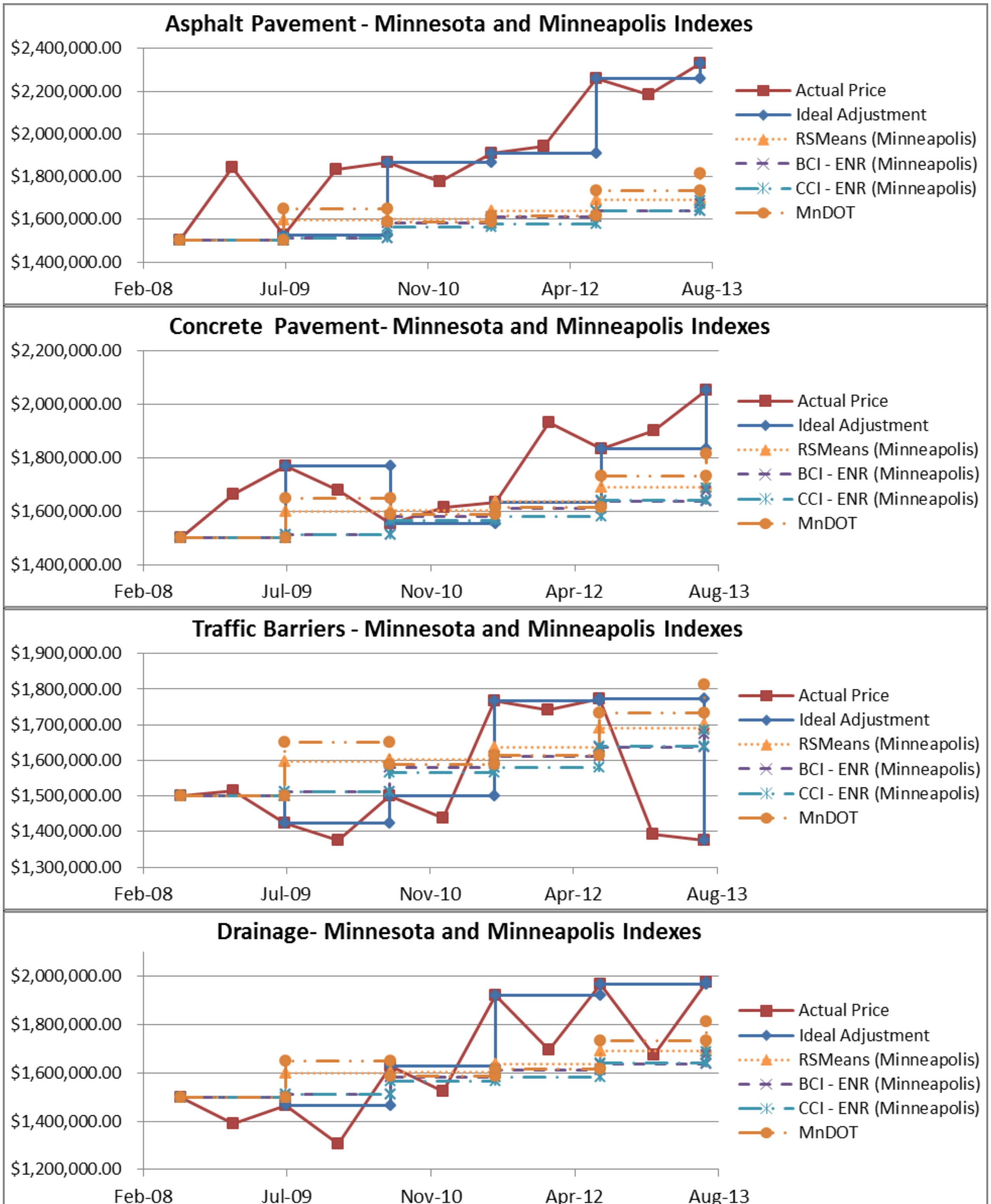
BCI = Building Cost Index; ENR = Engineering News-Record

FIGURE 13 Adjustment by using building construction indexes.



12-M = 12 months index; BLS = U.S. Bureau of Labor Statistics; Caltrans = California Department of Transportation; CCI = Construction Cost Index; ENR = Engineering News-Record; NHCCI = National Highway Construction Cost Index; PPI = Producer Price Index; SDDOT = South Dakota Department of Transportation

FIGURE 14 Adjustment by using highway construction indexes.



BCI = Building Cost Index; CCI = Construction Cost Index; ENR = Engineering News-Record; MnDOT = Minnesota Department of Transportation

FIGURE 15 Adjustment by using local indexes.

Table 14 presents a compilation of Figures 13 to 15. This table allows an easier comparison between cost indexes and works as a tool to measure their appropriateness on each type of project. Average variations shown in Table 14 correspond absolute difference between the actual cost and the adjusted cost of the projects (|1-(adjusted cost/actual cost)|).

TABLE 14 Average Variation pre Index and Type of Project

Cost Indexes	Average Variation (+/-)				
	Asphalt Pavement	Concrete Pavement	Traffic Barriers	Drainage	Average per Index
Building Construction Indexes (National)					
RSMeans - CCI (National)	16.3%	7.9%	6.4%	10.8%	**10.4%**
ENR - BCI (National)	16.7%	8.1%	10.2%	10.3%	**11.3%**
Average per Type of Project	**16.5%**	**8.0%**	**8.3%**	**10.6%**	-
Highway Construction Indexes					
ENR - CCI (National)	15.9%	7.7%	11.1%	9.3%	**11.0%**
BLS – PPI	24.7%	16.5%	10.6%	17.5%	**17.3%**
NHCCI	31.8%	25.2%	20.9%	26.4%	**26.1%**
Caltrans (Quarterly)	28.0%	20.0%	26.5%	21.9%	**24.1%**
Caltrans (12-M)	24.8%	17.6%	20.6%	18.9%	**20.5%**
SDDOT	14.9%	6.5%	12.4%	8.2%	**10.5%**
Average per Type of Project	**23.4%**	**15.6%**	**17.0%**	**17.0%**	-
Minnesota & Minneapolis Indexes					
RSMeans - CCI (Minneapolis)	17.0%	7.6%	11.0%	10.6%	**11.6%**
ENR - BCI (Minneapolis)	17.5%	9.4%	10.0%	10.8%	**11.9%**
ENR - CCI (Minneapolis)	17.9%	9.5%	10.3%	11.2%	**12.2%**
MnDOT - CCI	16.8%	5.5%	12.9%	10.2%	**11.4%**
Average per Type of Project	**17.3%**	**8.0%**	**11.1%**	**10.7%**	-

The following observations and conclusions were drawn from a deeper assessment of Figures 13 to 15 and Table 14. It is important to highlight that these observations apply to MnDOT and the five-year period comprised in this study only:

- Unexpectedly, those national construction indexes commonly used to adjust contract prices in building construction projects (RSMeans and BCI) presented an overall closer relation to actual price changes in the construction industry.

- Regardless of the kind of construction projects (building or highway) and the national or local coverage of the cost indexes, these construction cost indexes seem to work best in concrete pavement contracts. Nine out of the twelve indexes in this study showed a lower average variation in concrete pavement projects. The remaining three (RSMeans, PPI, and NHCCI) presented a lower variation in traffic barrier contracts.
- The national RSMeans CCI showed the lowest overall variation closely followed by SDDOT CCI; however, it seems to be a consequence of its significant low variation in traffic barrier projects. If removing the traffic barrier sample project from the study, the SDDOT CCI would become the one with the lowest average variation (9.9%) followed by the MnDOT CCI (10.8) and the national ENR CCI (11.0%). The RSMeans CCI would be moved to the fourth place with an average variation of 11.6%.
- All construction cost indexes presented the largest average variation in asphalt pavement projects, which is a significant observation given that, as determined in this research, those pay items related to these types of projects represent the largest portion of MnDOT average annual construction budget (25%) for the period comprised in this study.
- When considering the actual sign (positive or negative) of each variation obtained from Figures 13 to 15 (actual cost > adjusted cost, or, actual cost < adjusted cost), in 91% of the adjustments made to the asphalt pavement sample project (by all construction cost indexes), the difference benefited MnDOT with adjusted contract prices lower than observed unit prices. This percentage drops to 83% for concrete pavement and drainage projects, and 53% for traffic barrier contracts. Therefore, although lower for traffic barrier projects, the use of construction costs indexes as part of escalation clauses seems to represent a higher benefit for MnDOT while allocating more risk to the contractors.
- In spite of the fact that MnDOT CCI did not show the lowest overall variation, this index presented the lowest variation for a single type of project; concrete pavement. Additionally, this was the only index that in the case of the concrete pavement project, increased when observed prices increased and decreased when they decreased.
- NHCCI seems to be the least suitable index for escalation clauses in MnDOT construction contracts. NHCCI presented the largest variation in all types of projects, except in the one for traffic barriers, in which was the second largest variation after the one obtained from the quarterly Caltrans index.

- The fact that actual contract unit prices may increase in one period and decrease in next one, as shown in all sample contracts, challenges assumption number 4 mentioned previously regarding the use of cost indexes. These project cost fluctuations imply that unit prices for the upcoming period do not follow the trend stated by the base period and the last period with known index.

MnDOT Composite Cost Index Analysis

As mentioned before, the MnDOT CCI is not being used in current MnDOT IDIQ contracts. However, a deeper analysis of this index was conducted in order to determine why it did not show the lower overall variation in spite of having been calculated by using MnDOT historical bid data. This section explains why this index does not meet MnDOT expectations, even though it uses actual contract bids.

The composite cost index published on a quarter and annual basis by MnDOT, is the result of the weighted average of three different indexes for three different types of work; excavation, structures, and surfacing (81). Likewise, these three indexes are determined by using six different materials or construction activities (indicator items): excavation for the excavation index; reinforcing steel, structural steel, and structural concrete for the structures index; and bituminous and concrete pavement for the surfacing index (81).

This research found three main issues in MnDOT CCI. The first observed issue is that the six indicator items have not been appropriately selected. Only 12 out of the 28 quarterly composite indexes between 2006 and 2012 have been successfully published. The remaining 16 were not computed "due to the absence of data for one of the six indicator items" (81). The method to calculate this index requires that all indicators are contracted during its corresponding period. Thus, indicator items must be commonly required in MnDOT construction contracts regularly throughout the year. However, some of these materials and construction activities such as structural steel and concrete pavement have appeared only in 50% and 70% of the quarters, respectively, between 2006 and 2012 (81).

This issue seems to be the result of a change in the method for calculating the index. Before 2006, quarterly indexes have been calculated even without the occurrence of some indicator items during the corresponding period. To overcome this issue MnDOT could either select different items, change time-frequency of the index publication, or modify the index calculation method in a way to provide for missing data. Such adjustments have been done with other construction cost indexes (78).

Despite the missing data in the quarterly MnDOT CCI, MnDOT could still use the annual index in its escalation clauses, which requires that all indicator items are contracted at least once during the year, and what seems to be happening every year since 1988 (81). However, the other two observed issues mentioned below also affect this annual index.

The second issue corresponds to the fact that the three indexes used to calculate the final composite index have not been appropriately weighted. Elements in a composite index are usually weighted in accordance with their influence or participation in the total amount of data collected, or in the case or internal indexes developed by some agencies, it depends on the portion of the annual construction budget associate to each component. In order to calculate the composite cost index, MnDOT calculate the weighted average of the excavation, structures and surfacing indexes based on the fixed weights shown in Table 15. These weights remain unchanged, assuming that these elements are equally used year after year.

The authors determined the average relative annual participation of each indicator item (assuming that these items represent 100% of annual construction budget) in the annual construction budget for the five-year period comprised in this study, and concluded that MnDOT fixed weights are not consistent with its actual construction practices (see Table 15).

TABLE 15 MnDOT Composite Cost Index – Fixed and Observed Weights

	Fixed Weight	Average Observed Weight
Excavation Index	14%	20%
Structures Index	31%	19%
Surfacing Index	55%	61%
Composite Index	100%	-

With the intention of creating more dynamic indexes, some agencies and institutions have designed index calculation methods that allow them to adjust weights for each component in accordance with its use during a given period of time. For example, the Fisher ideal index equation is commonly used to calculate cost indexes due to its flexibility to adjust weights, and the possibility of determining periodical indexes without the occurrence of some components (78). This, or a similar equation, could be used to improve MnDOT CCI, making it more sensitive to changes in MnDOT construction practices and less susceptible to missing data.

The third issue is related to the process to calculate and publish the index. An efficient and effective price escalation method, based on a specific construction cost index, relies on the timeliness of the index publication. When reviewing the reports issued by MnDOT, it was found that some time indexes are released two or more periods later. For instance, the report for the second quarter of 2011, which goes from April 1st to June 30th, was published on November 16, 2011. Likewise, the report for the fourth quarter of the same year, which also includes the annual cost index for 2011, was published on April 11, 2012 (81).

The three main identified issues regarding MnDOT CCI discussed above could be the reason for not using this index to adjust contract unit prices in MnDOT IDIQ contracts. In fact, it was found that there were no contracts that include the MnDOT CCI in its escalation clauses. Alternatively, traditionally procured MnDOT contracts have a fuel escalation clause that "provides for compensation adjustments in the costs of motor fuels (diesel and gasoline) consumed in prosecuting the contract work" (83). These adjustments are performed based on a fuel index published by MnDOT, but built from fuel prices published by the OPIS Energy Group (83).

In the case of IDIQ contracts, MnDOT decided to use a fixed adjustment rate to be applied to all bid unit prices on an annual basis.

MnDOT Current IDIQ Escalation Clause

After recognizing the need for a different price escalation method for IDIQ contracting, and given the absence of an alternative price adjustment technique for this kind of contract, MnDOT decided to include the following clause in its IDIQ contracts. The clause is aimed to adjust all items in the Task Order Item List (TOIL) on an annual basis, and in accordance with a fixed adjustment rate stated by MnDOT.

> "To compensate for the potential of this Contract to extend over several construction seasons the Department will adjust the Unit Prices of all items on the TOIL by 2% once per year on the anniversary date of the letting of this Contract. Items not listed on the TOIL will not be adjusted. Fuel escalation will not be paid for items where the Inflation Index for cost increase is utilized" (12).

The TOIL is defined by MnDOT as the list of pay items and that will be used repetitively in the performance of all projects under a given IDIQ contract (12). Unit prices in the TOIL are used to price all work orders issued under the contract.

It seems that the used of this FAAR has been accepted by contractors since MnDOT has successfully awarded more than twenty IDIQ contracts in less than two months. Additionally, its simplicity increases MnDOT budget control and reduces administrative burden related to the maintenance of conventional escalation systems.

Figure 16 shows how the project cost would change in the four sample projects if using a 2% fixed adjustment rate in comparison with the observed actual cost during the period comprised in this study.

Adjusted prices obtained by using a 2% FAAR are closer to those obtained with the local ENR CCI for Minneapolis. Despite the administrative convenience of using a constant rate to adjust unit prices over time, it seems that the fixed rate currently used is not consistent with historical bid data from recent years. Table 16 presents the average variation obtained by using this rate on each sample project. This table shows a large overall average variation in comparison with the one obtained by the other indexes. In fact, based on current bid data, the MnDOT CCI seems to be more suitable for IDIQ contracting than the system currently being used in this kind of contracts.

TABLE 16 Average Variation – Fixed Annual Adjustment Rate (2%)

Cost Indexes	Average Variation (+/-)				
	Asphalt Pavement	Concrete Pavement	Traffic Barriers	Drainage	Overall Average Variation
Fixed annual Adjustment (2%)	18.1%	9.5%	10.1%	11.8%	**12.4%**

On the other hand, the use of the same FAAR for all kinds of projects implies the acceptance of some assumptions mentioned before in relation to the use of construction cost indexes, and whose validity has already been questioned in this paper.

These assumptions may be avoided, or their impact could be mitigated, by developing a system intended to determine a FAAR on a per-contract basis and in accordance with current construction market conditions, unit price forecasts, tentative contract scope, locations, weather conditions, applicable regulations, and other specific characteristics of the contract. Currently, this rate is the result of a consensus decision making process internally conducted by MnDOT, rather than the result of a systematic process aimed to determine current construction price trends.

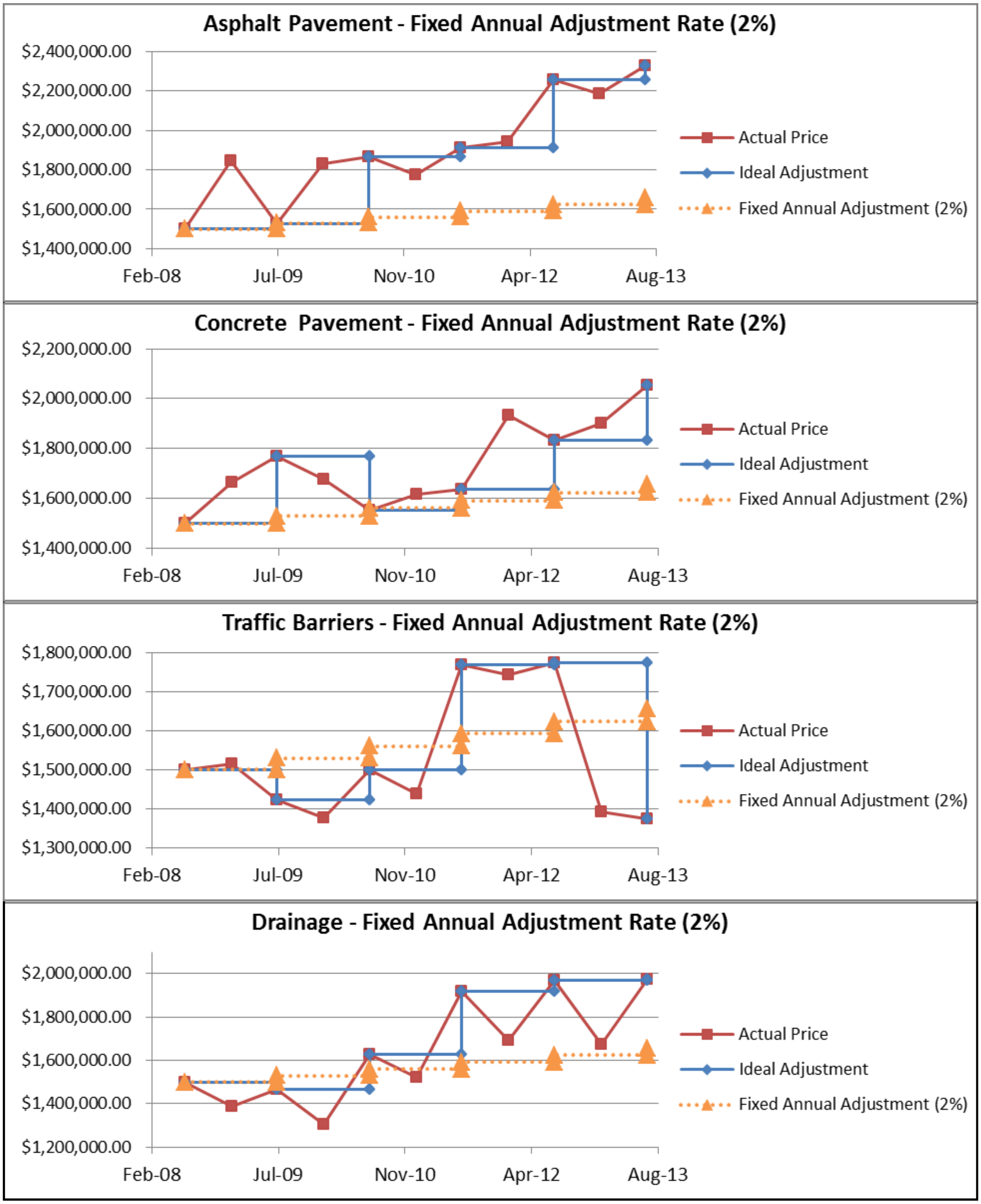


FIGURE 16 Adjustment by using a fixed annual adjustment rate (2%)

Development of an Alternative Price Escalation Method

Using the information discussed in this paper, and after determining MnDOT opinion and expectancies in regard to the implementation of alternative IDIQ contracting escalation clauses, the authors were able to identify some key factor to be considered for the development of an optimal IDIQ price escalation method:

- The method should be intended to predict contract price changes between the period immediately preceding the adjustment date and the oncoming period, rather than using observed construction price changes between two previous contract periods.
- The method should be flexible enough to adapt to the project scope, location, expected weather conditions, applicable regulation, typical changes in productivity, changes in MnDOT contracting practices, and other specific characteristics of the project.
- The method should rely on timelines easy to obtain data. Additionally, it should provide for missing data.
- The method should be as simple as possible in a way that is easy to understand and replicate by contractors in order to make them feel that contract prices will be fairly adjusted over time. The higher the contractors' confidence in the method, the lower the uncertainty, risk allocated for contractors, and bid unit prices. Its simplicity should also maintain MnDOT administrative requirements as low as possible.
- The method should provide for adjustments in accordance with actual changes in construction prices, rather than for extraordinary and unexpected changes in original contract conditions.

AxE Bidding – Method Development

The MnDOT current FAAR price escalation method was chosen as the starting point for the development of the innovative AxE bidding system given its convenience for MnDOT and its acceptance by contractors.

The process followed to develop a suitable price escalation method for multi-year single award IDIQ contracts, which resulted in the AxE bidding alternative proposed in this paper, consisted of answering a series of strategic questions intended to improve the current IDIQ contracting escalation clause in a way that it fits better with the requirements of this contracting approach.

How can this method better fit actual project price changes for different kind of projects?

In order to make this method more suitable for different types of projects, a flexible approach is required that allows users to determine a FAAR based on the characteristics and requirements inherent to each contract. Likewise, this rate should be the result of a project cost forecast, based on a detailed analysis of the current construction market and typical price behavior of construction materials, labor, and equipment. This analysis should also include all other internal and external factors that may impact contract unit prices.

What would be a reliable source of data to determine an adequate FAAR?

Since this rate is to be applied to all bid unit prices, which include material, labor, and equipment costs, as well as general costs, overhead, profits and contingencies, an adequate source of data would be the contractors who are the ones that really combine all this factors into a final bid unit price. Even if there is another source claiming more accurate price estimations for given commodities or construction tasks, it would be irrelevant if contractors are not willing to charge MnDOT for that amount. Therefore, contractors are the ones that finally determine actual unit prices for MnDOT construction projects.

How should this data be collected?

There are two possible ways to collect this data from contractors; either indirectly through bid unit prices submitted for previous MnDOT construction contracts, or directly from them with the only purpose of determining the FAAR for a given IDIQ contract. However, contractors are not usually willing to disclose their price lists and projections, so that it would be difficult to obtain this data directly from them. According to this, there are two possible answers for this question. Historical bid data could be used by MnDOT to calculate a FAAR for a given contract, or given that contractors are no usually willing to share their pricing methods, they may be require to bid a FAAR based on their unit price lists, projections, and experience, without disclosing this data. These two answers led the authors to the following question.

Who should collect and process the data, MnDOT or contractors?

Agencies and contractors are inured to forecast construction costs in order to obtain more accurate estimates and construction budgets for future and long-term contracts (84, 85, 86). Therefore, the calculation of an applicable FAAR for a given contract should not represent a significant challenge for any of both. However, if the contractor is the one who determines the FAAR to be used on a single award IDIQ contract, it may increase its reliance on a fair annual adjustment, decreasing the uncertainty generated by long contract periods, and resulting in lower bids due to a lower perceived risk.

How to prevent high FAARs from contractors?

The answer proposed by the authors for this question is competition. By asking contractors to bid FAARs on a per-contract basis, and letting them to know that these rates will be factored into the selection of the low bid, it would be expected of them to try to keep these rates as low as possible.

There is extensive information on construction management literature about the procurement of lower price proposals by increasing the level of competition during the bidding phase of the construction projects (68). Likewise, lessons learned from the implementation of A+B bidding (cost + time) indicate that competition not only decrease contract cost but also other type of factors such as construction time (87). Therefore, it would be reasonable to think that under an AxE contract construction firms will be motivated to bid fair low FAARs.

How should the FAAR be factored into the selection of the low bid?

In order to answer this question, the authors proposed different alternatives, and quantified the risk related to each alternative for different case scenarios.

Given that in a single-award IDIQ contract, the distribution of work along the contract period is normally hard to determine beyond a rough approximation, it is difficult to estimate during the bidding process which AxE bid will represent the lowest total cost at the end of the contract. Thus, another possibility is to use the total bid (first period) and future adjusted TOILs (for each contract period) to compare AxE bids.

The alternatives proposed in this paper for the selection of the low bid consist of different options for the escalation factor (E) to be applied to the total bid TOIL (A) (or original TOIL used during the first contract period) in the selection formula (AxE). These options are shown in Table 17.

TABLE 17 AxE – Selection Formulas

Selection Formulas	AxE		E
	Expanded	Factored	
TOIL 2	$A(1 + r)$		$1 + r$
TOIL 3	$A(1 + r)^2$		$(1 + r)^2$
Sum TOIL 1-3	$A + A(1 + r) + A(1 + r)^2$	$A(r^2 + 3r + 3)$	$r^2 + 3r + 3$
Weighted Sum TOIL 1-3**	$0.7A + 0.2A(1 + r) + 0.1A(1 + r)^2$	$A(0.1r^2 + 0.4r + 1)$	$0.1r^2 + 0.4r + 1$
A = Task Order Item List for Period 1; E = Escalation Factor; r = Fixed Annual Adjustment Rate (FAAR); TOIL 1 = Task Order Item List for Period 1			

** First period = 70%; second period = 20%; third period = 10%

To determine the maximum number of contract periods to be considered in the alternatives listed presented in Table 17, the authors used the maximum number of periods covered by the IDIQ contracts already awarded by MnDOT before September 2013. It was found that the maximum number of times these contracts will be adjusted during the base contract period (construction time without extensions) is two, and it will happen in approximately 60% of these contracts. It means that 60% of MnDOT current IDIQ contracts will be effective for at least three contract periods. No periods beyond the base construction duration, or contract extensions, were considered since at that time MnDOT will have the possibility of deciding whether or not to extend the contract in accordance with adjusted unit prices at that moment, actual unit prices that would be obtained if reprocuring the contract, and the cost of executing a new contract.

Before conducting the risk analysis of this innovated bidding method, and quantifying this risk for all proposed case scenarios, it is important to understand where this risk is allocated. The principal risk identified by the author is the possibility of awarding the contract to a firm that does not offer the lower TOIL along the entire base contract period. Figure 17 illustrates this risk in a three-year contract, which would require two adjustments.

In the case illustrated in Figure 17, the cost of all work performed during the third period will be higher if selecting Bid 1 than the cost that would be paid for the same work under Bid 2 during the same period. Given the difficulty of determining a feasible work distribution along these three periods, it is not possible to quantify the impact that this situation will have in the total final cost of the project when awarding the contract. However, a closer look at the case studies and some features of this contracting approach, allowed the authors to conclude that lower unit prices during earlier contracts periods would represent a higher benefit for MnDOT than those during final stages of the contract.

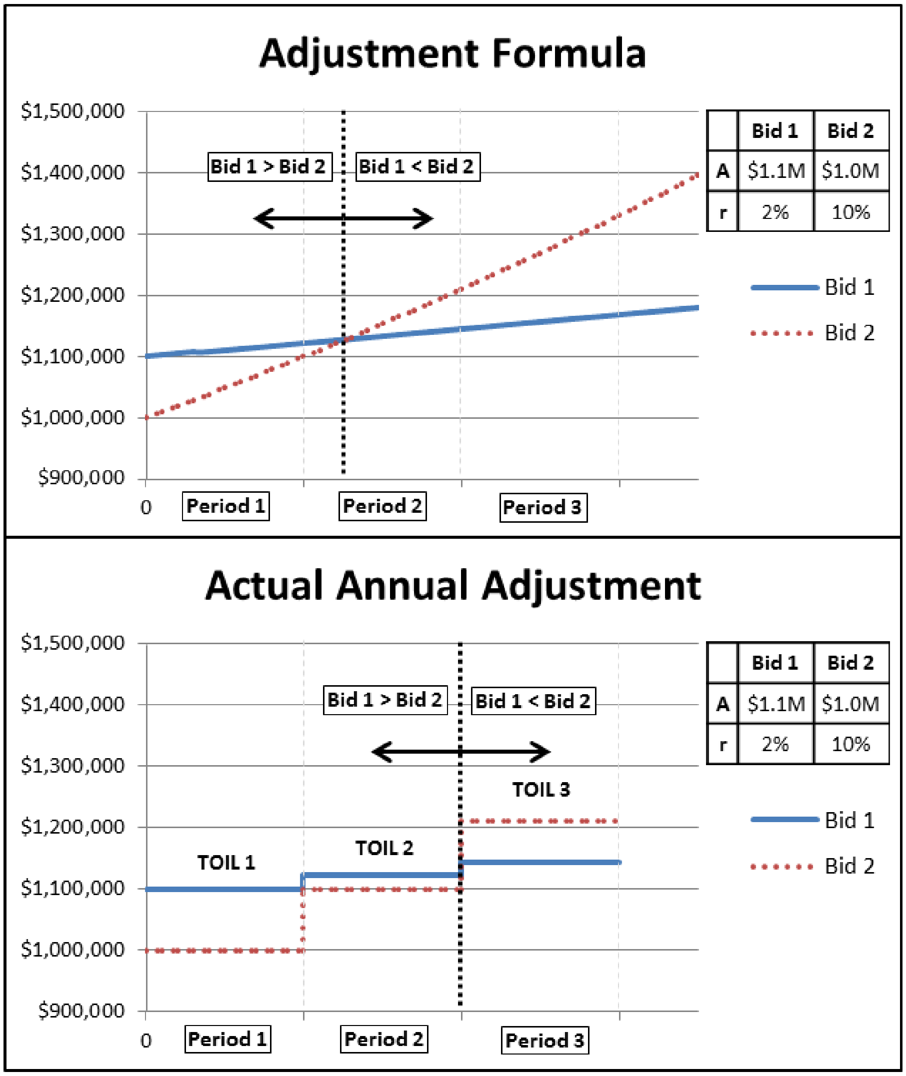


FIGURE 17 Bid comparison – critical situation

IDIQ contracting commonly provides for a minimum guaranteed amount to be ordered to the successful bidder(s) throughout the duration of the contract (64). This amount normally corresponds to the expected cost of the first work order, or a quantity of work that could be easily covered by the first few work orders. Therefore, this minimum guaranteed amount is usually covered during the first contract period, allowing the agency to discontinue the issuance of work orders for subsequent periods if deemed necessary. Thus, it would be more important to assure a lower TOIL for the first year since MnDOT could stop issuing work orders to the contractor during the second or third period in the case that adjusted unit prices are unfavorable for the agency.

Based on the identified higher relevance of first year unit prices, the risk quantified in this paper corresponds to the probability of awarding the contract to a firm that does not offer the lowest TOIL for the first period. The risk situation illustrated in Figure 17 may occur between two contractors when the firm with the lowest price proposal bid a higher FAAR. Therefore, larger differences in the FAAR and lower in the price proposals would represent a higher risk. For this reason, it is recommended to set limits for the FAAR bid by contractors in an effort to mitigate this risk.

TABLE 18 AxE Risk Analysis – Different Case Scenarios

	AxE - Risk Analysis Different Case Scenarios Probability of Awarding to Firm 1					
	A1 > A2 r1<r2		TOIL 2 A(1 + r)	TOIL 3 A(1 + r)^2	Sum TOIL 1-3 A(r^2 + 3r + 3)	Weighted Sum TOIL 1-3 A(0.1r^2 + 0.4r + 1)
	r1	r2				
Fixed Annual Adjustment Rates	-4%	10%	53%	81%	54%	23%
	-2%	10%	47%	76%	47%	20%
	0%	10%	39%	68%	40%	16%
	-4%	8%	47%	76%	48%	20%
	-2%	8%	40%	69%	41%	16%
	0%	8%	31%	59%	31%	12%
	-4%	6%	41%	70%	41%	16%
	-2%	6%	31%	59%	33%	12%
	0%	6%	24%	47%	24%	9%
	-4%	4%	33%	60%	33%	12%
	-2%	4%	24%	48%	25%	9%
	0%	4%	16%	31%	16%	5%
	Risk Ranges in which Firm 1 Wins the Contract v = (A1/A2 – 1) x 100%					
Fixed Annual Adjustment Rates	-4%	10%	0% > v ≤ 14.4%	0% > v ≤ 31.2%	0% > v ≤ 14.7%	0% > v ≤ 5.7%
	-2%	10%	0% > v ≤ 12.1%	0% > v ≤ 25.9%	0% > v ≤ 12.4%	0% > v ≤ 4.8%
	0%	10%	0% > v ≤ 9.9%	0% > v ≤ 20.8%	0% > v ≤ 10.1%	0% > v ≤ 4.0%
	-4%	8%	0% > v ≤ 12.4%	0% > v ≤ 26.3%	0% > v ≤ 12.6%	0% > v ≤ 4.8%
	-2%	8%	0% > v ≤ 10.1%	0% > v ≤ 21.4%	0% > v ≤ 10.4%	0% > v ≤ 4.0%
	0%	8%	0% > v ≤ 8.0%	0% > v ≤ 16.6%	0% > v ≤ 8.0%	0% > v ≤ 3.1%
	-4%	6%	0% > v ≤ 10.4%	0% > v ≤ 21.7%	0% > v ≤ 10.4%	0% > v ≤ 4.0%
	-2%	6%	0% > v ≤ 8.0%	0% > v ≤ 16.8%	0% > v ≤ 8.2%	0% > v ≤ 3.1%
	0%	6%	0% > v ≤ 5.9%	0% > v ≤ 12.4%	0% > v ≤ 5.9%	0% > v ≤ 2.2%
	-4%	4%	0% > v ≤ 8.2%	0% > v ≤ 17.1%	0% > v ≤ 8.2%	0% > v ≤ 3.1%
	-2%	4%	0% > v ≤ 5.9%	0% > v ≤ 12.6%	0% > v ≤ 6.2%	0% > v ≤ 2.2%
	0%	4%	0% > v ≤ 4.0%	0% > v ≤ 8.0%	0% > v ≤ 4.0%	0% > v ≤ 1.4%

A1 = Task Order Item List for period 1 bid by firm 1; E = Escalation Factor; r1 = Fixed Annual Adjustment Rate (FAAR) bid by firm 1; TOIL 1 = Task Order Item List for Period 1

Table 18 presents the probability of selecting a higher price proposal (bid TOIL) for the first contract period for each selection formula in different case scenarios. Each pair of FAARs (r_1 and r_2) in Table 18 may be seen as an option to limit the size of the FAARs. Likewise, the risk quantified for each option for each selection formula, would correspond to the worst-case scenario if using that option and that selection formula. For example, the first pair of rates in Table 18 represents a possible option used by MnDOT to limit the size of the rates bid by contractors; then, the worst-case scenario when using those limits would be a higher bid TOIL (A_1) with a -4% FAAR competing against a lower bid TOIL (A_2) with a 10% FAAR (see Table 18). In that case, the probability of awarding the contract to the firm with the higher bid TOIL would be between 23% and 81%, depending on the selection formula used.

To quantify this risk, it was also necessary to estimate the frequency of occurrence of different variations between the low bids and other bids received for the same contracts in all the contracts comprised in this study. The following example explains how this information was used to quantify the risk, and also provides a better idea about how Table 18 should be interpreted. This example corresponds to the worst-case scenario for the first FAAR limits proposed in Table 18 (-4% and 10%) when using the weighted TOIL sum (last column Table 18) as the selection formula.

Example:

- In a given multi-year single award IDIQ contract, MnDOT receives two AxE bids from two different contractors; Firm 1 and Firm 2. The bid TOIL submitted by Firm 1 (A_1), which is to be used during the first contract period, is higher than the bid TOIL from Firm 2 ($A_1 > A_2$). Firm 1 is fairly certain construction prices will decrease during the next few years, so that, Firm 1 decided to offered a negative FAAR of -4% (r_1). On the other hand, Firm 2 is expecting a significant increase in construction prices within the contract period and submits a FAAR of 10% (r_2). According to Table 18, the contract would be awarded to Firm 1, despite having bid a higher TOIL, if the variation between bid TOILs ($v = [A_1/A_2 – 1] \times 100\%$) is between 0% and 5.7% ($0\% < v \leq 5.7\%$), which in accordance with MnDOT historical bid data occurs 23% of the times. Therefore, if MnDOT decides to establish -4% and 10% as limits for adjustment rates submitted by contractors, in the worst-case scenario MnDOT would pay up to 5.7% more for the work performed during the first contract period (assuming that bid quantities in the TOIL are proportional to those in the work orders to be issued under the contract).

Negative rates were also included in Table 18 since it is possible that contractors predict a decrease in contract unit prices for the next few years, situation that could benefit MnDOT but also increases the risk of paying more for the same work during the first period, as shown in Table 18. For instance, a contractor could bid a large price proposal or TOIL for the first year, and win the contract due to a low FAAR. Thus, the lower the contractor can bid in the FAAR, the higher the TOIL the contractor can submit for the first year.

The idea of using the weighted sum of the TOILs for all three periods (last column in Table 18), is because, as mentioned before, lower unit prices are more significant during the first contract period. Likewise, obtaining lower unit prices for the second period is more important than getting those for the third period given the higher probability of performing work during earlier contract periods. In fact, in some of the contracts awarded by MnDOT, the third period (after the second adjustment) does not cover a complete year, increasing the probability of performing less or no work during that period.

The equations for the selection of the low bid proposed in Table 18 should be analyzed and modified if needed, in accordance with data that will be collected from the ongoing IDIQ contracts. For instance, after finishing a significant number of this contracts, they could be assessed in order to determine possible patterns in the work distribution for different contract periods; patterns that may help to determine more appropriate formulas and/or weights.

Weights proposed in Table 18 may vary in order to increase or decrease the risk accepted by MnDOT under single award IDIQ contracts. However, those proposed by the authors in this paper seem to be adequate for a preliminary implementation due to the apparent amount of work that could be expected for each period and the observed number of contracts that require one, two or no adjustments during their base contract periods.

In spite of the fact that the first contract period has a higher relevance on IDIQ contracts, later periods should not be underestimated. When awarding a single award IDIQ contract, the agency typically has an overall idea of the projects to be developed under the contract and their cost, and relies on the skills and willingness of the contractor to successfully complete all of them. Therefore, if MnDOT decides to discontinue the work with a given contractor, probably other contracts would have to be procured for the remaining projects, expending more money, time and other resources that might be limited or unavailable at that moment. Consequently, MnDOT should try (to the maximum extent practicable and in accordance with contract requirements) to continue issuing work orders with the same contractor until finishing the contract.

Although MnDOT is the one who must make a final decision on the most appropriate selection formula for IDIQ AxE contracts in accordance with their preferences and risk perception, the authors highly recommend the use of a weighted sum of TOILs to select the low bid. Besides being a significantly less risky method for MnDOT, this alternative recognizes the higher value of obtaining lower unit prices for work to be performed during earlier contract periods. Although weights proposed in this paper may be changed before a preliminary implementation of this method to reduce the risk allocated for MnDOT as low as desired, it is important to understand that MnDOT should be willing to accept a convenient amount of risk. A very low risk, as defined in this paper, would diminish the impact of the FAAR in the selection formula, which may result in higher adjustment rates.

AxE Bidding – Validation

The validation method followed by the researchers to determine the applicability and suitability of AxE bidding for multi-year single award IDIQ contracts consists of three phases. In the first phase an initial concept of the method was presented to MnDOT in a meeting held with some key personnel directly and indirectly involved in the planning, bidding, construction, and closure of IDIQ contracts. During this meeting, the researchers could perceive the interest of some participants, and also took notes about their concerns and expectations regarding the implementation of this alternative method.

Once determined the interest of MnDOT in this innovative bidding process, the authors proceeded to analyze all the inputs and information collected from MnDOT, from the extensive literature review, and from a set of rigorous case studies, to design reliable and appropriate AxE bidding procedures.

After having a preliminary AxE bidding model, the authors advanced to the second validation phase. During this phase, the preliminary model was evaluated by conducting multiple simulations based on MnDOT actual historical bid data. As a result of this evaluation, the preliminary model was slightly modified in order to make it more consistent with MnDOT contracting practices and observed contractor bidding behavior.

Although the AxE bidding model proposed in this paper is ready for implementation in future multi-year single award IDIQ contracts, it still must be subject to a final validation phase, in which its performance and effectiveness should be assessed during its implementation in actual IDIQ contracts. Given that AxE bidding has not yet been used to procure construction services, there is not information that permits to predict the response of the contractors to this method. Thus, AxE practices are expected to be constantly improved during the first years of implementation, until reaching a more applicable price escalation model with an optimal risk distribution.

Conclusions

The development of the AxE bidding procedures stated in this paper were the result of a comprehensive study intended to design a price escalation method that fulfill the specific needs of multi-year single award IDIQ contracts for MnDOT. Having demonstrated the incompatibility of traditional price adjustment methods with IDIQ contracting due to their lack of flexibility to adapt to the dynamic construction industry, and after recognizing the importance of increasing contractors' confidence in understandable, fair, and transparent escalation clauses, the authors proceeded to modify the current MnDOT IDIQ price adjustment system into a more suitable method, which allows greater contractors' participation while maintains low agency administrative requirements.

Similarly to A+B contracting practices, which take advantage of a competitive environment to procure shorter construction schedules, AxE bidding is designed to obtain fair low annual adjustment rates. Additionally, AxE bidding implementation is expected to reduce bid unit prices by lowering the need for contingencies related to the use of inadequate price escalation methods and the uncertainty inherent to long-term construction contracts.
Although this paper analyzed different selection formulas for awarding the contract, the used of a weighted sum of TOILs for the first three contract periods is shown as the most convenient method given its significant lower risk and its ability to recognize a different relevance in different contract periods. However, it is important to understand that this bidding method, as presented in this paper, is ready for a preliminary implementation on future multi-award single

award IDIQ contracts. It means that its performance and contractors' bidding behavior must be constantly monitored and analyzed during the first years of implementation in order to continually improve the method until finding an optimal standard selection formula.

Acknowledgments

The authors acknowledge the members of Minnesota, Florida, New York State, and Missouri DOTs, as well as the Central Federal Lands Highway Division for their contribution to this study.

CHAPTER 7
CONSOLIDATED CONCLUSIONS AND LIMITATIONS

Before finding an appropriate way to handle cost escalation in MnDOT IDIQ contracts, it was necessary to conduct a comprehensive research to get a better understanding of this innovative contracting method and determine current practices adopted by different agencies across the U.S., particularly in the transportation industry. Three different contracting approaches or models were identified and analyzed in this research; single work order, single award, and multiple award IDIQ contracts. It was concluded that in spite of the fact that multiple award IDIQ contracts seem to represent more benefits for owners, it is not always the most appropriate approach. That is the reason why, unlike federal agencies, state DOTs (including MnDOT) show a clear preference for single award IDIQ contracts. This approach seems to better fit their procurement methods and limited resources, and even with less apparent benefits, DOTs have perceived an opportunity to improve their contracting practices using this method.

After MnDOT made the selection of a single award contracting approach, it was found that this type of contract has particular price escalation requirements in comparison with single work order and multiple award IDIQ contracts. Given the absence of competence in the adjudication of work orders (in single award IDIQ contracts), contractors are either required to maintain unit prices throughout the contract period or expect a fair adjustment in contract prices in accordance with actual changes in the construction market. However, given the dynamic of the construction industry, the volatility of the prices of some materials and construction activities, and the difficulty in determining a feasible distribution of work along the duration of an IDIQ contract, it is hard for contractors to accurately estimate unit prices for multi-year contracts, making it difficult for them to bid on long-term contracts with no escalation clauses.

Once the need for price adjustment methods in multi-year single award IDIQ contracts was identified, and the wide use of construction indexes to measure construction price changes over time was recognized, the applicability of twelve different indexes, and the current price escalation method used by MnDOT in IDIQ contracts, was tested using MnDOT historical bid data. This study found that neither traditional price escalation methods nor the alternative FAAR used by MnDOT met the specific requirements of single award IDIQ contracts. Consequently, it is not expected that the incorporation of any of these methods into MnDOT IDIQ escalation clauses would generate a reduction in the uncertainty related to long construction periods.

AxE bidding was developed in an attempt to use unit price forecasts from a reliable source to adjust contract prices over time. Likewise, this alternative method was intended to increase contractors' confidence in fair future adjustments, which would be reflected in lower bids since contractors would perceive a lower need for contingencies; which are typically included in price proposals to compensate the uncertainty in obtaining reasonable prices in future contract periods. Thus, AxE bidding was designed to allow the contractors to determine a FAAR that they consider appropriate in accordance with the specific features and requirements of each project. At the same time, they are motivated to bid low FAARs by using this in the selection of the low bid. Additionally, this method conserves one of the characteristics observed in the current IDIQ escalation clause used by MnDOT in its IDIQ contracts, one in which MnDOT has expressed a particular interest; low administrative requirements to conduct the annual adjustments.

It is important to remember that AxE bidding, as presented in this thesis, is ready for a preliminary implementation on MnDOT single award IDIQ contracts only. This method should be modified for its use by other agencies based on their contracting practices and a complete analysis of their historical bid data. The use of AxE bidding in entering MnDOT IDIQ contracts should be considered preliminary since a final improved AxE version is expected from the analysis of its performance in real IDIQ contracts.

CHAPTER 8
CONTRIBUTIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Chapter 8 discusses and highlights the importance of some findings and contributions drawn during the elaboration of this thesis. Furthermore, this chapter presents some recommendations for future research, which are intended to improve the AxE procedures proposed in this thesis as well other aspects of IDIQ contracting. Likewise, these recommendations are aimed to take AxE bidding to the next level, making it applicable to different delivery methods, locations, and industries.

Contributions

The main contribution of this thesis is the development of a flexible IDIQ bidding method that is both equitable and easily understandable by both MnDOT and its contractors. The method does away with the need for MnDOT to develop its own cost index or rely on other indexes used elsewhere. Additionally, other important contributions are mentioned below.

- *IDIQ generic models:* The analysis of the three different IDIQ contracting models provided in Chapter 4 may help different agencies, or owners, to select the approach that better fits their needs, expectancies, and contracting practices.
- *IDIQ risk management:* Information provided in different sections of Chapter 2 regarding best practices for planning and executing IDIQ contracts, and the case study analysis contained in Chapter 5, offer to agencies, or owners, some useful tools and procedures that may be used to mitigate and redistribute risk in IDIQ contracts.
- *Cost Index Analysis:* The analysis of the existing cost indexes presented in Chapter 5 may be used both to improve these indexes and the way they are used to adjust contract prices or to develop more flexible and accurate cost indexes.

Recommendations for Future Research

Given the significant increase in the use of IDIQ techniques by state DOTs during the last few years, and the little existing research on the use of IDIQ contracts at a state level, it is expected, and even required, that there be an increase in the number of research projects as the one comprised in this thesis. Likewise, as mentioned before, more research on AxE bidding will be required once implemented in real IDIQ contracts. This additional research is necessary to obtain a final improved method that can be adapted to work with different delivery methods, locations, and industries. In the list below are some proposed research projects that may derive from this thesis:

- AxE bidding preliminary implementation: A case study analysis.
- Applicability of AxE bidding in traditional long-term fixed-price construction contracts.
- Applicability of AxE bidding in other state DOTs, federal agencies, and other industries.
- Applicability of AxE bidding in the global construction industry.
- Use of AxE bidding to adjust long-term Architect/Engineer and consulting services contracts.
- Alternative approaches to handle mobilization and traffic control unit prices in long-term IDIQ contracts.

REFERENCES

1. Sandner, C. L., and M. I. Snyder. Multiple Award Task and Delivery Order Contracting: A Contracting Primer. *Public Contract Law Journal*, Vol. 30, 2001, p. 461.

2. Office of Federal Procurement Policy (OFPP). *Best Practices for Multiple Award Task and Delivery Order Contracting.* Office of Management and Budget (OMB), Executive Office of the President, Interim Edition, Feb. 1997.

3. United States Congress. *Federal Acquisition Streamlining Act (FASA) of 1994*. Public Law 103-355, 1994.

4. Minnesota Department of Transportation (MnDOT) Office of Construction and Innovative Contracting (OCIC). *Design-Build Manual*. MnDOT, Aug 2011.

5. Walewski, J., E. Gibson, and J. Jasper. Project Delivery Methods and Contracting Approaches Available for Implementation by the Texas Department of Transportation. *Center for Transportation Research, The University of Texas at Austin*. FHWA/TX-0-2129-1, Oct. 2001.

6. Shrestha, P., J. O'Connor, and G. Gibson, Jr. Performance Comparison of Large Design-Build and Design-Bid-Build Highway Projects. *Journal of Construction Engineering and Management*, ASCE, Vol. 138, No.1, 2013, pp. 1-13.

7. Gransberg, D., S. Jennifer, S. Anderson, C. Lopez, K. Strong, and J. MacMinimee. *A Guide for Construction Manager/General Contractor (CMGC) Contracting for Highway Projects*. NCHRP Project 10-85, Transportation Research Board National Academies, Washington, D.C., 2012.

8. Minnesota Department of Transportation (MnDOT) Office of Construction and Innovative Contracting (OCIC). *Innovative Contracting in Minnesota 2000 to 2005*. MnDOT, 2006.

9. Minnesota Department of Transportation (MnDOT) Office of Construction and Innovative Contracting (OCIC). Innovative Contracting Methods. 2013. http://www.dot.state.mn.us/const/tools/innovativecontract.html. Accessed September 1, 2013.

10. U.S. General Service Administration (GSA). *How to Sell to the Government – Indefinite Delivery, Indefinite Quantity Contracts*. Dec. 2012. http://www.gsa.gov. Accessed July 6, 2013.

11. General Services Administration (GSA), Department of Defense (DOD), and National Aeronautics and Space Administration (NASA). *Federal Acquisition Regulation (FAR),* Volume I, Subpart 16.5, 2005.

12. Minnesota Department of Transportation (MnDOT). *Grading, Bituminous Mill & Overlay, Ada Improvements, and Signal Revision (IDIQ)*. MnDOT, Contract ID. 130601, State Project No. 5804-56. May 28, 2013.

13. Jeffrey, J., and C. Menches. Emergency Contracting Strategies for Federal Projects. *Journal of Professional Issues in Engineering Education and Practice*. ASCE, Vol. 134, No.4, 2008, pp. 371-379.

14. Florida Department of Transportation (FDOT). Disaster Debris Removal Monitoring Services Agreement, Exhibit A, Scope of Services. 2010.

15. Gransberg, D.D. Case Studies of Early Contractor Design Involvement to Expedite the Delivery of Emergency Highway Projects. In *Transportation Research Record: Journal of the Transportation Research Board*, National Academies, Washington, D.C. (Accepted for publication in 2013).

16. Bureau of Labor Statistics (BLS). *Producer Price Indexes: Escalation Guide for Contracting Parties.* U.S. Department of Labor (DOL), May 14, 2012. http://www.bls.gov/ppi/ppiescalation.htm. Accessed July 1, 2013.

17. Controller General of the United States. *Ineffective Management of GSA's Multiple Award Schedule Program – A Costly, Serious, and Longstanding Problem.* General Accounting Office (GAO), May 1979.

18. Office of the Inspector General Department of Defense. *DOD Use of Multiple Award Task Order Contracts.* U.S. Department of Defense, Apr. 2, 1999.

19. Yin, R. K., *Case Study Research: Design and Methods,* Sage Publications Beverly Hills, California, 1994.

20. Seo, S. *A review and comparison of methods for detecting outliers in univariate data sets*. Dissertation. University of Pittsburgh, 2006.

21. Iglewicz, B., and D. Hoaglin. *How to detect and handle outliers*. ASQC Quality Press, Wisconsin, 1993.

22. Unite States Congress. *The Budget of the United States Government for the Fiscal Year Ending June 30, 1952*. Unite States Government Printing Office, House Document No. 17, Washington, D.C., 1951.

23. Matchette, R. B., and J. S. Danis. Guide to Federal Records in the National Archives of the United States. *United States National Archives and Records Administration*, Washington, D.C., 1995.

24. Davis, D. MATOC/SATOC Overview. *U.S. Army Corps of Engineers.* 2011.

25. U.S. General Services Administration (GSA), U.S. Department of Defense (DOD), and National Aeronautics and Space Administration (NASA). *Federal Acquisition Regulation (FAR)*, Volume I, Subpart 2.1, 2005.

26. NIH Information Technology Acquisition and Assessment Center (NITAAC). *Chief Information Officer – Solutions and Partners 3 (CIO-SP3)*. U.S. Department of Health and Human Services (HHS), National Institute of Health (NIH). http://nitaac.nih.gov/nitaac/contracts/cio-sp3. Accessed June 24, 2013.

27. Federal Acquisition Service (FAS). *Alliant Governmentwide Acquisition Contract*. Solicitation Number: TQ2006MCB0001. General Service Administration (GSA), 2006.

28. U.S. Army Sustainment Command. *ASC Selects LOGCAP IV Contractors.* June 2007. U.S. Army. http://www.army.mil/article/3836. Accessed June 24, 2013.

29. Federal Business Opportunities (FBO). *Solicitation Number: N6247012R5010.* Apr. 2012. Naval Facilities Engineering Command. https://www.fbo.gov. Accessed June 24, 2013.

30. Office of the Assistance Secretary of Defense. *Contracts for November 8, 2005*. Nov. 2005. U.S. Department of Defense. http://www.defense.gov/contracts. Accessed June 24, 2013.

31. Farris, D. Checking Your Indefinite Delivery/Indefinite Quantity (IDIQ) IQ. *The Construction Lawyer*, Vol. 22, No. 4, 2002, p. 24.

32. Materials Management Division. *Professional/Technical Services Contract Manual, Section 17. Master Contracts*. Minnesota Department of Administration, St. Paul, MN, 2000.

33. Utah Department of Transportation. *Multiple Project Contracting for On-Call Professional/Engineering Services Process*, Dec. 2010.

34. Florida Department of Transportation (FDOT). *Design-Build Guidelines*, Aug. 2012.

35. Federal Emergency Management Agency (FEMA). *IS-230.c – Fundamentals of Emergency Management, Lesson 1: Emergency Management Overview, Course Summary*. U.S. Department of Homeland Security (DHS).

36. Europeaid. *Practical Guide 2013.1 (PRAG)*. European Commission, 2013.

37. Menches, C. L., N. Khwaja, and J. Chen. Synthesis Study on Innovative Contract Techniques for Routine and Preventive Maintenance Contracts. *Center for Transportation Research at The University of Texas at Austin*, Austin, TX, 2010.

38. Richmond, D. R. Understanding Retainers and Flat Fees. *Journal of the Legal Profession*, Vol. 34, 2009, pp. 113-144.

39. United States Congress. *Small Business Reauthorization Act 1997*. Public Law 105-135, 1997.

40. Weber, R.P. *Basic Content Analysis*. Sage Publications, California, 1985.

41. Neuendorf, K.A. *The Content Analysis Guidebook*. Sage Publications, California, 2002.

42. Shane, J. and D.D. Gransberg. Coordination of the Design Contract with the Construction Manager-at-Risk Preconstruction Service Contract. In *Transportation Research Board: Journal of the Transportation Research Board, No. 2151*, Transportation Research Board of the National Academies, Washington, D.C., 2010, pp. 55-59.

43. Federal Acquisition Service (FAS). Region 6 (R6) Indefinite Delivery Indefinite Quantity (IDIQ) Multiple Award Task Order Construction Contract (MATOC) with Construction Manager as Constructor (CMc) Capabilities, for the states of Iowa, Kansas, Missouri, and Nebraska. Solicitation Number: GS-06P-11-GZ-D-0009. General Service Administration (GSA), 2009.

44. Federal Acquisition Service (FAS). Indefinite Delivery Indefinite Quantity (IDIQ), Design/Build (D/B) Construction. Solicitation Number: F13PS00238. Department of the Interior, 2013.

45. West, N. J. N., D. D. Gransberg, and J. C. McMinimee. Effective Tools for Projects Delivered Using the Construction Manager/General Contractor. In *Transportation Research Board: Journal of the Transportation Research Board, No. 2268,*Transportation Research Board of the National Academies, Washington, D.C., 2012, pp.33-42.

46. Anderson, S.D. and I. Damnjanovic, *NCHRP Synthesis 379*: *Selection and Evaluation of Alternative Contracting Methods to Accelerate Project Completion*, Transportation Research Board of the National Academies, Washington, D.C., 2008, 77 pp.

47. Touran, A., D.D. Gransberg, and K. R. Molenaar, “A System for Selecting Project Delivery Methods in U.S. Airports,” *Journal of Airport Management*, Airports Council International, Vol.4 (4), July 2010, pp. 305-314.

48. Ernzen, J. and Feeney, T. “Contractor-Led Quality Control and Quality Assurance Plus Design-Build: Who Is Watching The Quality?” Transportation Research Record 1813, Transportation Research Board, National Research Council, Washington, D.C., 2002, pp. 253-259.

49. Ernzen, J., Murdough, G. and Drecksel, D. “Partnering on a Design-Build Project: Making the Three-Way Love Affair Work,” Transportation Research Record 1712, Transportation Research Board, National Research Council, Washington, D.C., 2000, pp. 202-212.

50. Gransberg, D.D., and J.S. Shane, Construction Manager-at-Risk Project Delivery for Highway Programs, NCHRP Synthesis 402, 2010, 127pp.

51. Thomsen, C., "Project Delivery Processes," Parsons Corporation, April 2, 2006, http://www.3di.com/rnd/Files/Essays/Project%20Delivery%20Strategy.pdf [November 22, 2012].

52. Gransberg, D.D. and C. Riemer, *Performance-Based Construction Contractor Prequalification*, NCHRP Synthesis 390, Transportation Research Board National Academies, Washington, D.C., 2009, 101pp.

53. Gransberg D.D. and M.C. Loulakis, *Expedited Procurement Procedures for Emergency Construction Services*, Synthesis 438, Transportation Research Board, National Academies, Washington, D.C. 2012, 118pp.

54. Oppenheim, A. N. *Questionnaire Design, Interviewing and Attitude Measurement*. Continuum, London. 2000.

55. Government Accounting Office (GAO), *Using Structured Interviewing Techniques*, GAO/PEMD-10.1.5, Government Accounting Office, Washington, D.C., June 1991, 191pp.

56. Johnson T. R., P. Feng, W. Sitzabee, and M. Jernigan. "Federal Acquisition Regulation Applied to Alliancing Contract Practices," *Journal of Construction Engineering and Management*, ASCE, Vol. 139, May 2013, pp. 480-487.

57. Gransberg, D.D. and J. Diekmann, "Quantifying Pavement Life-cycle Cost Inflation Uncertainty," 2004 Transactions, AACE, Int'l, Washington, DC, June, 2004, pp. R.08.01-R.08.11.

58. Gransberg, D.D. and C. Riemer. Impact of Inaccurate Engineer's Estimated Quantities on Unit Price Contracts. *Journal of Construction Engineering and Management,* ASCE, Vol. 135 (11), November 2009, pp. 1138-1145.

59. Minnesota Department of Transportation (MnDOT). *Bid Letting – Abstracts*. Aug. 2013. http://www.dot.state.mn.us/const/tools/idiq.html. Accessed September 1, 2013.

60. Choi, M., J. Kim, and M. Kim. A study on the price escalation system in a construction contract. *KSCE Journal of Civil Engineering*, Vol. 10, No. 4, 2006, pp. 227-232.

61. Morris, P., W. F. Willson. Measuring and Managing Cost Escalation. *AACE International Transactions*, 2006, pp. 06.1-06.7.

62. General Services Administration (GSA), Department of Defense (DOD), and National Aeronautics and Space Administration (NASA). *Federal Acquisition Regulation (FAR)*, Volume I, Subpart 16.2, 2005.

63. Touran, A., and R. Lopez. Modeling Cost Escalation in Large Infrastructure Projects. *Journal of Construction Engineering and Management*, ASCE, Vol. 132, No.2, 2006, pp. 853–860.

64. Rueda, J. A., D.D. Gransberg. Fundamentals of Indefinite Delivery/Indefinite Quantity Contracting: A Primer for Public Transportation Agencies. *Transportation Research Board: 2013 Annual Meeting Compendium of Papers.* (Accepted for presentation in 2014).

65. Rueda, J. A., D.D. Gransberg. Indefinite Delivery/Indefinite Quantity Contracting: A Case Study Analysis. In *Transportation Research Board: Journal of Transportation Research Board*, National Academies. (Accepted for publication in 2014).

66. Bouchaib, B., and S. Rivard. Cost Escalation in Information Technology Outsourcing: A moderated mediation study. *Decision Support Systems [serial online]*. Apr. 2013. http://dx.doi.org/10.1016/j.dss.2013.04.007. Accessed August 31, 2013.

67. Shane, J., K. R. Molenaar, S. Anderson, and C. Schexnayder. Construction Project Cost Escalation Factors. *Journal of Construction Engineering and Management*, ASCE, Vol. 25, No.4, 2009, pp. 221–229.

68. Carr, R. I. (1983). Impact of Number of Bidders on Competition. *Journal of Construction Engineering and Management,* ASCE, Vol. 109, No.1, pp. 61–73.

69. Clifford, E., and R. J. Eger, III. Study of liquid asphalt price indices applications to Georgia contracting. *Georgia Institute of Technology: Georgia Tech Research Institute.* Project No. A-7319, 2005.

70. Keller, A. Z., Y. P. Gupta, V. Supriyasilp. Optimal Policies for Claiming Payment under Price Escalation Clause Types of Contracts. *Management* Decision, Vol. 20, No.3, pp. 30-45

71. Federal Highway Administration (FHWA). *Development and Use of Price Adjustment Contract Provisions*. U.S. Department of Transportation (USDOT), Dec. 10, 1980.

72. Quilling, T. F. Escalation Claims and Clauses. *The Real State Finance Journal*, Winter 2006, pp. 65-67.

73. Minnesota Department of Transportation (MnDOT). *Bid Letting – Abstracts*. Aug. 2013. http://www.dot.state.mn.us/bidlet/abstract.html. Accessed September 1, 2013.

74. RSMeans. *Construction Cost Index*. Reed Construction Data, Vol. 37, No.1, Jan. 2013.

75. Engineering News Record (ENR). *Historical Indexes*. McGraw Hill Construction. http://enr.construction.com/economics/historical_indices/. Accessed October 1, 2013.

76. Bureau of Labor Statistics (BLS). *Producer Price Index Industry Data: Material and Supply Inputs to Highway and Street Construction (NDUBHWY--BHWY--)*. U.S. Department of Labor (DOL), Sep. 30, 2013.

77. Bureau of Labor Statistics (BLS). *Producer Price Index Industry Data: Other Nonresidential Construction (PCUBONS--BONS--)*. U.S. Department of Labor (DOL), Sep. 30, 2013.

78. Federal Highway Administration (FHWA). *National Highway Construction Cost Index (NHCCI).* U.S. Department of Transportation (USDOT). http://www.fhwa.dot.gov/policyinformation/nhcci.cfm. Accessed August 30, 2013.

79. California Department of Transportation (CALTRANS) Division of Engineering Services. *Price Index for Selected Highway Construction Items: Third Quarter Ending September 30, 2013*. CALTRANS. Oct. 22, 2013.

80. South Dakota Department of Transportation (SDDOT) Division of Finance and Management. *South Dakota Construction Cost Index for Calendar Year 2012*. SDDOT. Feb. 2, 2013.

81. Minnesota Department of Transportation (MnDOT). *Cost Index – 2012 Fourth Quarter/Year End.* MnDOT. Mar. 6, 2013

82. Couchman, J. Issues Regarding the Construction of a Price Index for the Electricity Lines Companies of New Zealand. *Statistics New Zealand: Inflation Measures Division.* Wellington, New Zealand, 2004.

83. Minnesota Department of Transportation (MnDOT). *(1910) Fuel Escalation Clause.* MnDOT, Jan. 28, 2009.

84. Forest Service Northern Region Engineering. *Cost Estimating Guide for Road Construction*. U.S. Department of Agriculture, Feb. 2011.

85. Federal Emergency Management Agency (FEMA) Technical Advisory Group (TAG). *Benefit-Cost Analysis Re-engineering (BCAR)*. U.S. Department of Homeland Security, Version 4.5, May 2009.

86. California Department of Transportation (CALTRANS) District 4. *Cost Escalation Rate Study for Caltrans District 4 Projects*. CALTRANS. May 2009.

87. Herbsman, Z. A+B Bidding Method—Hidden Success Story for Highway Construction. *Journal of Construction Engineering and Management*, ASCE, Vol. 121, No.4, pp. 430–437.

APPENDIX A
STRUCTURED INTERVIEW FOR INDEFINITE DELIVERY/INDEFINITE QUANTITY CASE STUDIES

This appendix contains a model of the structured interview used to collect information from the four case studies conducted in this research. This interview was used to collect the information analyzed in Chapter 5. The structured interview is divided into nine parts ad shown below:

I. Agency Interviewee General Information
II. Agency IDIQ Contracting – Experience
III. Agency IDIQ Contracting – General Information
IV. Case Study – General Information
V. Case Study – Delivery Method Selection
VI. Case Study – Procurement Process
VII. Case Study – Payment Provisions
VIII. Case Study – Quality Assurance
IX. Case Study – Complementary Information

Structured Interview Questionnaire - Agency

CONDITIONS: This interview can either be conducted in person or via telephone. The following protocol shall be followed during its administration:

1. The questionnaire shall be sent to the respondent at least 2 weeks prior to the interview via email.
2. Two days prior to the interview, a follow-up message with the questionnaire attached will be sent to confirm the date and time of the interview.
3. To maximize the quality and quantity of information collected, the primary respondent should be encouraged to invite other members of his/her organization to be present during the interview. Thus, a single transportation agency response can be formulated and recorded.
4. The interviewer will set the stage with a brief introduction that emphasizes the purpose of the research, the type of information expected to be collected, and the ground rules for the interview.
5. Once the interviewees indicate that they understand the process at hand, the interview will commence.
6. The interviewer will read each question verbatim and then ask if the interviewee understood the question before asking the interviewee to respond.
7. Each question contains a specific response that must be obtained before moving to the next question. Once that response is obtained, the interviewer can record as text additional cogent information that may have been discussed by the interviewees in working their way to the specific response.
8. Upon conclusion of the interview, the interviewer will ask the interviewees if they have additional information that they would like to contribute and record those answers as text.
9. The interviewer will assemble a clean copy of the final interview results and return them to the interviewee for verification.

I. Agency and Interviewee General Information

1. Interviewee name:

2. Interviewee job position in the agency:

3. Interviewee telephone number:

4. City and state in which the respondent agency is headquartered:

   A. Name of Agency:

5. What type of organization do you work for?

   ☐ State DOT ☐ Other public transportation agency

   ☐ Other: {explain}

6. Annual construction budget:

7. Average annual number of new construction projects:

8. Average annual number of repair projects:

9. Average annual number of maintenance projects:

10. Average annual number of other recurring projects (other than repair and maintenance):

11. Project monetary size range: $ to $

12. Average monetary size of a new construction project $

13. Average monetary size of a repair project $

14. Average monetary size of a maintenance project $

15. Average monetary size of a different recurring project (other than repair and maintenance) $

16. Which of the following delivery methods and contracting approaches are or have been commonly used by your agency? Please check all that apply.

- ☐ Indefinite Delivery/Indefinite Quantity
- ☐ Design-Bid-Build
- ☐ Design-Build
- ☐ Design-Build-Warrant
- ☐ Design-Build-Maintain (Operate)
- ☐ Construction Manager as Agent
- ☐ Construction Manager-at-Risk
- ☐ Construction Manager as Advisor
- ☐ Multi-Prime
- ☐ Fast-Track
- ☐ Quality Assurance/Control
- ☐ Quality-Base Contractor Prequalification
- ☐ Partnering
- ☐ A+B
- ☐ Value Engineering
- ☐ Lane Rental
- ☐ Construction Warranties
- ☐ Incentive/Disincentive Provisions
- ☐ Transfer of Quality Control
- ☐ No Excuse Incentives
- ☐ Lump Sum
- ☐ Guaranteed Maximum Price
- ☐ Cost Reimbursable

☐ Other(s): {explain}

II. Agency IDIQ Contracting - Experience

Questions below are associated to construction services contracts, the purchase of either supplies or services related to construction projects. For purposes of this interview terms "Job Order Contract" and "Job order" will be used to refer to IDIQ construction services contracts and orders issued under this contracts respectively.

1. Is your agency restricted on the use of Job Order Contracts?

   ☐ Yes ☐ No

   If yes:

   A. What is the restriction?

      ☐ Legislative ☐ Regulation ☐ Policy

      ☐ Other: {explain}

   B. Is your agency able to obtain a waiver for Job Order Contracts?

      ☐ Yes ☐ No

      If yes, explain how: {explain}

2. Has your agency awarded any Job Order Contract?

   ☐ Yes ☐ No If not, stop with the interview.

3. How many Job Order Contracts has your agency awarded?

☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ >20

4. On average, how many Job Order Contracts does your agency award annually?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ >4

5. How long have your agency used Job Order Contracts?

☐ 1 year ☐ 2 years ☐ 3 years ☐ 4 years ☐ >4 years

6. On average, how many Job Orders are issued under a single Job Order Contract?

☐ 1-3 ☐ 4-6 ☐ 7-9 ☐ >9

7. Average monetary size of a Job Order Contracts:

III. Agency IDIQ Contracting – General Information

1. What term is used by your agency to refer to Job Order contracts? Please check all that apply.

- ☐ Job Order Contracts
- ☐ Delivery Order Contracts
- ☐ Task Order Contracts
- ☐ Master Contracts
- ☐ Framework Contracts
- ☐ Other(s): {explain}
- ☐ Bundled Contracts
- ☐ On-Call Contracts
- ☐ Retainer Contracts
- ☐ On-Demand Contracts

If more than one term is used explain the reason below.

2. What term is used by your agency to refer to each order issued under an IDIQ contract? Please check all that apply.

- ☐ Task Order
- ☐ Delivery Order
- ☐ Job Order
- ☐ Other(s): {explain}
- ☐ Work Order
- ☐ Work Order Contract

If more than one term is used explain the reason below.

IV. Case Study – General Information

1. Case Study Project Title:

2. Short Description of Scope : (*list major features of work… 3-4 sentences, or get a copy of the RFP/RFQ. Include location of project)*

3. Expected contract duration for this contract:

   A. Average contract duration for Job Order Contracts:

4. Actual contract duration for this contract:

5. What was the minimum guaranteed amount?

6. . What was the maximum amount?

7. Was there a limit of the size of a job order and if so what was it?

8. Was there an option to extend the IDIQ and if so what were the conditions?

9. How was the DBE (or similar) goal, if any, applied to the contract?

   - ☐ To each Job Order on an individual basis (the same %)
   - ☐ Individually stated when issuing each Job Order
   - ☐ To the entire contract

10. How was this Job Order Contract funded?

☐ State funds ☐ Federal funds ☐ State and Federal funds

☐ Other(s): {explain}

11. In which part of the contracting period were funds assigned?

☐ At the beginning (100% maximum quantity)
☐ When anticipating the issuance of a Job Order (one at a time)

☐ Other: {explain}

12. Does the contract allow the removal of Contractor's personnel throughout the contract?

☐ Yes ☐ No

13. Does the contract allow the change of Contractor's personnel throughout the contract?

☐ Yes ☐ No

14. What Contractor's personnel must be devoted, if any, for the life of the contract?

☐ Project Manager ☐ Estimator
☐ Superintendent ☐ None

☐ Other(s): {explain}

15. General Composition:

☐ Road Construction ☐ Bridge Construction

☐ Road Repair ☐ Bridge Repair
☐ Road Routine Maintenance ☐ Bridge Routine Maintenance

☐ Other: {explain}

A. Are all Job Order Contracts in your agency limited to this composition?

☐ Yes ☐ No

16. According to the principal location or locations, how would you classify this contract?

☐ City-Wide ☐ State-Wide
☐ County-Wide
☐ District-Wide

☐ Other: {explain}

17. Were performance bonds required for this contract and if so how were these bonds required?

☐ Yes ☐ No

If yes:

A. How were bonds required?

☐ One for the entire contract (100% maximum quantity)
☐ One per Job Order (100% of each job order)
☐ One for the first Job Order only (100% first Job Order)

☐ Other: {explain}

V. Case Study – Delivery Method Selection

1. Which of the following were reasons that your agency uses to select IDIQ contracting method? Check all that apply. Which of the below is the **single** most significant reason for selecting IDIQ contracting method? (*Interviewer circle the check box*)

	IDIQ Contracting
Reduce/compress/accelerate project delivery period	☐
Agency experience in this contracting method	☐
Increase agency control over budget	☐
Increase Quality	☐
Encourage innovation	☐
Facilitate Value Engineering	☐
Project monetary size	☐
Encourage price competition	☐
Increase DBEs and small business participation	☐
Reduce preconstruction costs	☐
Reduce risk related to contractors pour performance	☐
Optimize use of agency resources	☐
Funding flexibility	☐
Third party issues (permits, utilities, etc.)	☐
Recurring nature of the project	☐
Flexibility in delivery scheduling	☐
Usefulness in emergency situations	☐
Reduced agency staffing requirements	☐
Limited owner's commitment (contractual minimum quantity)	☐
Other (explain below)	☐

VI. Case Study – Procurement Process

1. Do you award to a single contractor in your typical IDIQ process?

   ☐ Yes ☐ No

   A. If the answer is No, how many contractors are selected to compete for subsequent job orders?

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ >4

2. What type of procurement process was used by your agency to advertise this Job Order Contract?

   ☐ Request for Qualifications (RFQ) only ☐ Request for Proposals (RFP) only
   ☐ RFQ + RFP ☐ Request for letters of Interest
   ☐ Invitation for Bids (IFB)

   ☐ Other: {explain}

   A. Was this decision made as usual compared with other construction services contracts?

   ☐ Yes ☐ No

   If not, explain why it is different:

3. Did you develop a shortlist for this Job Order Contract?

   ☐ Yes ☐ No

If yes to question 3:

A. How many potential contractors were in the short list?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ >4

B. Was this decision made as usual compared with other construction services contracts?

☐ Yes ☐ No

If not, explain why it was different:

4. Did you interview Proposers as part of the selection process?

☐ Yes, in person ☐ Yes, remotely (video teleconference or other means)
☐ No

A. Was this decision made as usual compared with other construction services contracts?

☐ Yes ☐ No

If not, explain why it was different:

5. How was the contractor(s) selected for this project?

☐ Lowest price list ☐ Lowest bid for first Job Order
☐ Lowest multiplier ☐ Best qualified
☐ Best qualified + lowest price list ☐ Best qualified + lowest multiplier
☐ Best qualified + lowest bid for first job order

☐ Other: {explain}

A. Was this decision made as usual compared with other construction services contracts?

☐ Yes ☐ No

If not, explain why it is different:

6. Explain briefly how Job Orders under this contract were developed, priced and executed?

7. Which of the following pieces of information are required to be submitted in response to a typical RFQ/RFP/advertisement?

Do either the RFQ or the RFP require the following to be submitted as part of the Proposer's statement of qualifications or proposal?	**Required to this Job Order Contract?**		**Usually required to Job Order Contracts?**		**Usually required to construction services contracts?**	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**
Organizational structure/chart	☐	☐	☐	☐	☐	☐
Past IDIQ project experience	☐	☐	☐	☐	☐	☐
Past related project experience (non-IDIQ)	☐	☐	☐	☐	☐	☐
References from past projects	☐	☐	☐	☐	☐	☐
Qualifications of the Proposer's Project Manager	☐	☐	☐	☐	☐	☐
Qualifications of the Proposer's general superintendent	☐	☐	☐	☐	☐	☐
Qualifications of the Proposer's estimator/scheduler	☐	☐	☐	☐	☐	☐
Qualifications of other key personnel (list below)	☐	☐	☐	☐	☐	☐
Construction quality management plan	☐	☐	☐	☐	☐	☐
Construction traffic control plan	☐	☐	☐	☐	☐	☐
Other key project plans (list below)	☐	☐	☐	☐	☐	☐
Subcontracting plan	☐	☐	☐	☐	☐	☐
DBE/TGB (or similar) plan (if similar explain below)	☐	☐	☐	☐	☐	☐
Price List	☐	☐	☐	☐	☐	☐

8. If list of prices were required from potential contractors, how were items in this list stated?

   - ☐ Standard state price book (i.e bid tabs)
   - ☐ Standard national price book (Means manual)
   - ☐ Items related to the first Job Order stated in the RFO/RFQ/IFB
   - ☐ Items expected to be required for all Job Order Contracts stated in the RFP/RFQ/IFB
   - ☐ Items identified by the contractor stated in the proposal
   - ☐ Price list is not required

   - ☐ Other: {explain}

9. Have you ever had a protest of your IDIQ selection process? On this project?

   ☐ Yes ☐ No

   If yes:

   A. What was the basis of the protest?

   B. How was the protest settled?

   - ☐ Protest was sustained (in favor of the protestor)
   - ☐ Protest was denied (in favor of the agency)

VII. Case Study - Payment Provisions

1. What type of compensation method did your agency use for this Job Order Contract?

   ☐ Lump sum ☐ Unit price ☐ Other: {explain}

   A. Was this decision made as usual compared with other construction services contracts?

   ☐ Yes ☐ No

   If not, explain why it is different:

2. Were mobilization and demobilization expenses reimbursed to the contractor(s)?

   ☐ Yes ☐ No

   A. Was this decision made as usual compared with other construction services contracts?

   ☐ Yes ☐ No

   If not, explain why it is different:

   If yes to question 2:

   B. How were those expenses calculated? (explain briefly)

3. Was cost escalation considered for this project?

   ☐ Yes ☐ No

   A. Was this decision made as usual compared with other construction services contracts?

   ☐ Yes ☐ No

   If not, explain why it is different:

   If yes to question 3:

   A. How was this issue addressed? (explain briefly)

VIII. Case Study - Quality Assurance

1. Is the QA system that you use for IDIQ contracts different than the one used on regular construction projects? If yes, describe the differences

2. Please rate the following factors for their impact on the quality of the IDIQ project.

Factor	Very High Impact	High Impact	Some Impact	Slight Impact	No Impact
Qualifications of the Contractor's staff	☐	☐	☐	☐	☐
Contractor's past project experience	☐	☐	☐	☐	☐
Quality management plans	☐	☐	☐	☐	☐
Use of agency specifications	☐	☐	☐	☐	☐
Number of Contractors involved	☐	☐	☐	☐	☐
Use of incentive/disincentive provisions	☐	☐	☐	☐	☐
Warranty provisions	☐	☐	☐	☐	☐

IX. Case Study – Complementary Information

1. In your opinion, has IDIQ contracting methods impacted positively contracting procedures in your agency?

   ☐ Yes ☐ No

   If yes, explain how:

2. Is there anything else about IDIQ contracting that you consider relevant for this research?

3. Is there any other IDIQ contract awarded by your agency that in your opinion could provide value knowledge for this research?

APPENDIX B
INDEFINITE DELIVERY/INDEFINITE QUANTITY CASE STUDIES

This appendix shows the information collected for each case study with the structured interview in Appendix A. This information is presented following the nine sections of the structured interview (see Appendix A). Chapter 5 contains a complete analysis of this information. The information collected through the structured interviews was complemented with contract documents and other official documents issued by each agency. The case studies are presented as shown below (IDIQ contracts from these agencies):

B.1 Central Federal Lands Highway Division (CFLHD)
B.2 New York State Department of Transportation (NYSDOT)
B.3 Florida Department of Transportation (FDOT)
B.4 Missouri Department of Transportation (MoDOT)

B.1 Central Federal Lands Highway Division (CFLHD)

I. Agency and Interviewee General Information

Date:	January 31st, 2013
Agency:	Federal Highway Administration (FHWA) Central Federal Lands Highway Division (CFLHD)
Location:	FHWA Resource Center, Lakewood, CO.
Interviewee:	Mark Meng, PE, PMP - Contract Developer Engineer
Interviewers:	Jorge Andres Rueda - Graduate Research Assistance Kate Hunter - Graduate Research Assistance

Annual construction budget	$175 - $225 Million
Average number of new construction projects	30 -40 (in 14 states)
Average number of repair or maintenance projects	75%-80% of the contracts
Contract monetary size range	$100,000 - $40 Million
Delivery methods and construction approaches used by the agency	Indefinite Delivery/Indefinite Quantity Design-Bid-Build Design-Build Construction Manager/General Contractor A+B Value Engineering (within all contracts) Lane Rental Incentive/Disincentive Provisions No Excuse Incentives Lump sum (on items but NOT on contracts)

II. Agency IDIQ Contracting – Experience

IDIQ contracts awarded	6-10 Contracts
Annual average of IDIQ contracts awarded	1 Contract
Years of experience using IDIQ contracting	4 years
Single award IDIQ contracts awarded	1 Contract
Average monetary size of IDIQ contracts	17 Million

III. Agency IDIQ Contracting – General Information

Name used to refer to IDIQ contracts	Multiple Award Task Order Contracts (MATOC) Single Award Task Order Contracts (SATOC)
Name used to the other issued under an IDIQ contract	Task Order (TO)

IV. Case Study – General Information

Project title	IDIQ MATOC: Roadway Surfacing, Resurfacing, and Repair Contracts: Northern California, Washington, Oregon, and Idaho
Scope	Roadway surfacing, resurfacing, and repair contracting tool for work in Oregon, Idaho, Washington, and Northern California. The scope of work for task orders may include, but are not limited to, the following construction services: traffic control (permanent and temporary), contractor sampling and testing, asphalt milling, profile grinding, asphalt paving, thin asphalt overlays, patching, crack & joint sealing for flexible and rigid pavements, chip seals, micro surfacing, slurry seals, ultra-thin bonded wearing course, subexcavation, minor drainage improvements, placement of aggregate, roadway pulverization, grading, and slope stabilization.
Contract duration	1 Year and options to extend the contract for four additional one-year periods.
Average TO duration	3 – 4 months.
Minimum guaranteed amount	$50,000 for the contract
Maximum amount	35 Million
TO limits	From $50,000 to 7.5 Million
DBE goals	The contractor must submit a Subcontracting Plan for the entire contract which includes the participation of DBEs.
Contract funding	The contract is funded with federal funds and funds are assigned when anticipating the issuance of a TO.
Contractor's key personnel	The Contractor is allowed to remove, change or add personnel at any moment during the contract.
Bonding	Potential contractors will be required to demonstrate bonding capacity of up to $7,500,000.00 per TO with a yearly capacity of up to $15,000,000. Performance bonds are required to cover 100% of each TO.

V. Case Study – Delivery Method Selection

Reasons to use IDIQ contracting	Reduce/compress/accelerate project delivery period Encourage price competition Reduce preconstruction costs Reduce risk related to contractors poor performance Funding flexibility Recurring nature of the project Usefulness in emergency situations

VI. Case Study – Procurement Process

Number of awards	The contract was awarded to 3 contractors (as usual).
Procurement process	MATOC RFP + TO-RFP (First Task Order Request for Proposals). MATOC RFP involves technical qualifications and TO-RFP involves bid price for the first TO.
Shortlist	No shortlist developed.
Pre-bid meeting	Proposers were not interviewed.
Contractors selection method	Best qualified + lowest bid for first job order. CFLHD calls this method "Best-value negotiated type procurement." However, although they have the possibility to negotiate price or scope, they have never negotiated with contractors in IDIQ contracts.
TO development, pricing and execution	(see Figure B.1.1 below).
Information required to be submitted in response to RFP	Organizational structure/chart Past IDIQ project experience Past related project experience (non-IDIQ) References from past projects Subcontracting plan (includes DBE plan – required at award) Price list (per task order)
Protest	CFLHD has never had protest related to their selection process.

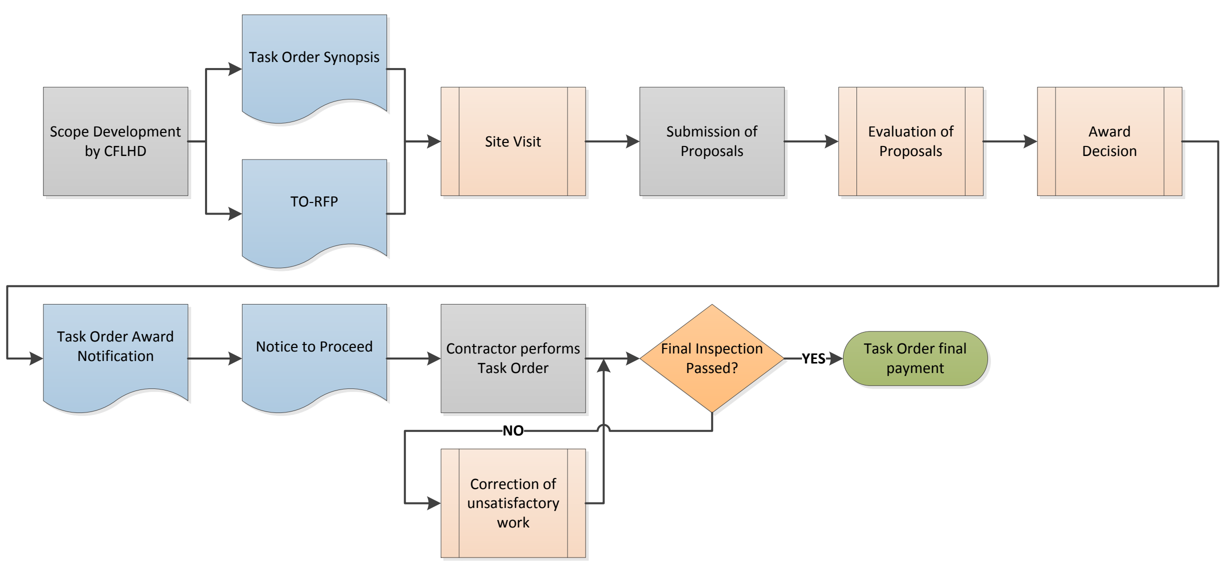


FIGURE B.1.1 CFLHD – Work order development flow chart.

VII. Case Study – Payment Provisions

Compensation method	Unit price
Mobilization	Mobilization is bided per TO. Demobilization is no included.
Price escalation	Escalation is not required since contractors submit proposal on a TO basis.

VIII. Case Study – Quality Assurance

QA system	It is the same as the one used in regular construction projects.
Factors with high impact on quality	Qualifications of the Contractor's staff Contractor's past project experience Use of agency specifications
Factor with some impact on quality	Number of contractors involved
Factors with slight impact on quality	Quality management plans Use of incentive/disincentive provisions
Factors with no impact on quality	Warranty provisions (CFLHD has never used warranty provisions on IDIQ contracts)

IX. Case Study – Complementary Information

Interviewee personal opinion about IDIQ contracting	• IDIQ has impacted positively CFLHD's contracting procedures. • It is not worthy to use single award IDIQ contracts. • Saves a lot on procurement costs on larger contracts but very expensive procurement costs for small jobs.
Additional information	• Due to the fact that IDIQ contracting allows the rapid use of funds, sometimes TOs are issued to use funds than otherwise will be lost due to the lack of time to initiate an entire procurement process. • CFLHD does not allow to other agencies the use of its IDIQ contracts. • Difficult to use in emergency contracts due to the recent change in Federal funding laws for emergency situations.

B.2 New York State Department of Transportation (NYSDOT)

I. Agency and Interviewee General Information

Date:	February 12th, 2013
Agency:	New York State Department of Transportation
Location:	Albany, NY
Interviewee:	Peter Weykamp- JOC Program Engineer
Interviewers :	Jorge Andres Rueda - Graduate Research Assistance Kate Hunter - Graduate Research Assistance

Delivery methods and construction approaches used by the agency	Indefinite Delivery/Indefinite Quantity Design-Bid-Build Design-Build Fast-Track A+B Value Engineering Lane Rental Incentive/Disincentive Provisions Quality-Based Contractor Pre-qualification Lump Sum Cost Reimbursable

II. Agency IDIQ Contracting – Experience

IDIQ contracts awarded	56 State Funded Contracts 8 Federal Funded Contracts
Annual average of IDIQ contracts awarded	8 Contracts
Years of experience using IDIQ contracting	8 years
Average Job Orders issued under a Task Order (TO)	29 – State Funded Contracts 15 – Federal Funded Contracts
Average monetary size of IDIQ contracts	1.14 M – State Funded Contracts 1.3 M – Federal Funded Contracts

III. Agency IDIQ Contracting – General Information

Name used to refer to IDIQ contracts	Job Order Contracts (JOC)
Name used to orders issued under an IDIQ contract	Job Order Work Order – Not commonly used

IV. Case Study – General Information

Project title	Job Order Contract for Bridge Maintenance Work Various Routes, Various Towns Broome, Chenango and Tioga Counties. D261160
Scope	This is 1 of the 8 contracts that constitute the three year pilot program to contract element-level bridge maintenance activities using the Job Order Contracting (JOC) which was approved on December, 2007, through the Federal "Alternative Contracting" SEP-14 program. Work has included red flag culvert repairs, steel repairs, gusset plate repairs, and scour repair in the Region 9. (not all NYSDOT's JOC are limited to this composition)
Expected duration	1 Year and options to extend the contract for 3 additional one-year periods. (Same expected contract duration for all federal funded JOCs. 1 additional one-year period for state funded JOCs)
Actual duration	1 year and 2 months (reach maximum amount)
Minimum guaranteed amount	$50,000 for the contract
Maximum amount	1.2 M, renewable up to three times
TO limits	$500,000
DBE & M/WBE goals	DBE (federal funded) or Minority and Women's Business Enterprises (M/WBE) (state funded) goals are stated to the entire contract, but they are hard to reach. NYSDOT monitors Equal Employment Opportunity EEO and Nondiscrimination Department policies in all its contracts
Contract funding	The contract is funded with federal funds and 1 M dollars were secured since the beginning of the contract. Additional $200,000 were required and assigned later
Contractor's key personnel	The Contractor is allowed to remove, change or add personnel at any moment during the contract.
Bonding	Bid Security = 25% of the total bid. Performance Bond = 100% of the contract Labor Bond = 100% of the contract Material Bond = 100% of the contract

V. Case Study – Delivery Method Selection

Reasons to use IDIQ contracting	Reduce/compress/accelerate project delivery period Flexibility in delivery scheduling Reduced agency staffing requirements

VI. Case Study – Procurement Process

Number of awards	The contract was awarded to 1 contractor (as usual).
Procurement process	Request for Proposals (RFP) only.
Shortlist	No shortlist developed.
Pre-bid meeting	1 o 2 meetings are held during a 5 week advertisement period.
Contractors selection method	Lowest multiplier. The contractor bids two different adjustment factors, one for normal hours (7 am – 5 pm) and one for other than normal hours. Lowest adjustment factors from an acceptable, responsive, responsible bidder wins. This factors are to be applied to a Construction Task Catalog developed by an external consultant.
TO development, pricing and execution	(see Figure B.2.1 below)
Information required to be submitted in response to RFP	The proposal basically consists of the two adjustment factors. No prequalification proof is required.
Protest	CFLHD has never had protest related to their selection process.

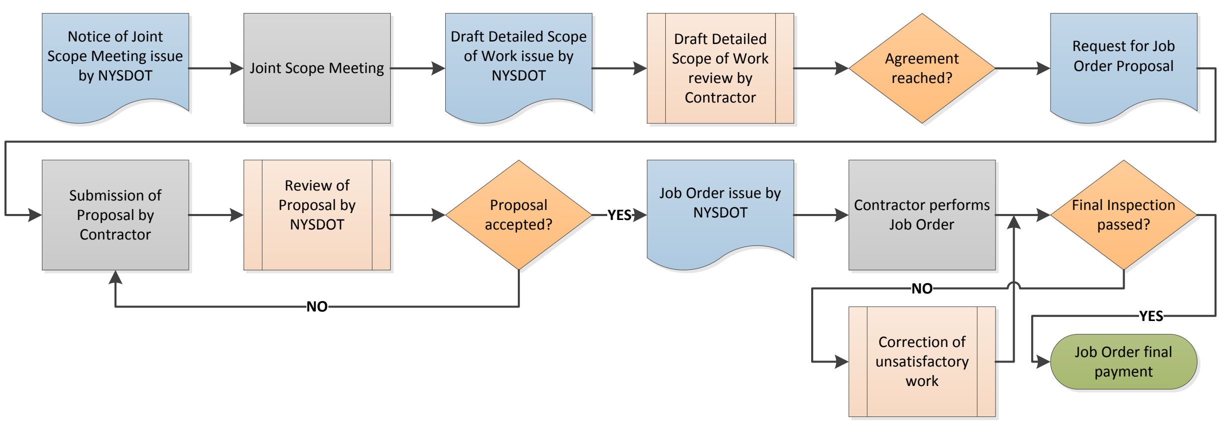


FIGURE B.2.1 NYSDOT – Job order development flowchart.

VII. Case Study – Payment Provisions

Compensation method	Lump Sum
Mobilization	A ratio is calculated based on the location of the contractor in order to reimburse mobilization and demobilization expenses.
Price escalation	Allowable adjustments made to the Contractor's bid adjustment factors will be made. These adjustments will be made at the written request of the Contractor, not more frequently than annually, on the contracts anniversary date. Adjustment Factors Updated Every 12 Months Based on Cost Construction Index Published by ENR.

VIII. Case Study – Quality Assurance

QA system	It is the same as the one used in regular construction projects.
Factors with some impact on quality	Qualifications of the Contractor's staff Contractor's past project experience Use of agency specifications Use of incentive/disincentive provisions
Factor with no impact on quality	Number of contractors involved Quality management plans Warranty provisions

IX. Case Study – Complementary Information

Interviewee personal opinion about IDIQ contracting	• IDIQ has impacted positively NYSDOT's contracting procedures for maintenance work. • Traditional contracting is not fast enough for typical and repetitive work.
Additional information	• IDIQ contracting is also use for facility work and environmental conservation. • Although the interviewee stated that contractors are not required to respond to emergency situations. There is a special note in the contract that indicates otherwise.

B.3 Florida Department of Transportation (FDOT)

I. Agency and Interviewee General Information

Date:	February 22nd, 2013
Agency:	Florida Department of Transportation – District 7
Location:	Tampa, Florida
Interviewee:	Steffanie L. Workman – DB-PB Project Administrator
Interviewers :	Jorge Andres Rueda - Graduate Research Assistance Kate Hunter - Graduate Research Assistance

Delivery methods and construction approaches used by the agency	Indefinite Delivery/Indefinite Quantity Design-Build

II. Agency IDIQ Contracting – Experience

IDIQ contracts awarded	2 using state and federal funds
Years of experience using IDIQ contracting	3.5 years
Task Orders (TO) issued under this contract	14 Task Orders. Each task order consists of multiple projects for a total of 47 projects.
Monetary size of this contract	$20.1 M

III. Agency IDIQ Contracting – General Information

Name used to refer to IDIQ contracts	Push Button Contracts (PB)
Name used to the orders issued under an IDIQ contract	Task Work Order

IV. Case Study – General Information

Project title	District 7 Design Build – Push Button
Scope	"The type of projects that may be assigned under this Contract shall include, but not be limited to modifications and improvements to median openings, intersections, signing and pavement markings, traffic signals, highway lighting, and intelligent transportation systems (ITS). Elements of work may include roadways, structures, intersections, interchanges, geotechnical activities, surveys, drainage, signing and pavement markings, signalization, lighting, utility relocation, maintenance of traffic, cost estimates, environmental permits, quantity computation books, coordination, public involvement efforts, and all necessary incidental items for a complete project. No right-of-way acquisition will be required under this project. This is a district 7 wide contract.
Expected duration	3 years
Actual duration	30 months
Contract Possible Extension	3 one-year extensions. $8,450,000 allocated for each year.
Minimum guaranteed amount	$12,500,000 which corresponds to Task 1 which was issued along with the RFP.
Maximum amount	According to contract documents it is $15M; first year = $5M, second year = $2.75M, and third year = $7.45 (this totals more the 15M, but interviewee could not clarify this inconsistency). If required additional funds may be added, which explains how this contract was over $20M.
TO limits	No monetary limits are stated, but Task Work Orders goes from $33,000 to 2.65 M. There is a duration limit of 270 calendar days.
Key personnel	Contract allows the contractor to change its key personnel at any moment, but with previous notification to FDOT.
DBE goals	DBE goals are stated to the entire contract, and for this case it was 8.1 %.
Contract funding	The contract is funded with federal and state funds, only those projects that meet Federal aid conditions were federal funded. District 7 received funds on an annual basis.
Contractor's key personnel	The Contractor is allowed to remove, change or add personnel at any moment during the contract.
Bonding	Performance bond is required, but interview has not information about it.

V. Case Study – Delivery Method Selection

Reasons to use IDIQ contracting	Flexibility in delivery scheduling

VI. Case Study – Procurement Process

Number of awards	The contract was awarded to 1 contractor (as usual).
Procurement process	Request for Qualifications (RFQ) + Request for Proposals (RFP)
Shortlist	A shortlist developed with 3 or 4 potential contractors.
Pre-proposal meeting	1 pre-proposal meeting with the contractors in the shortlist.
Contractors selection method	Best qualified + lowest bid for first Task Order. $\frac{(0.6)BPP+(0.4)ML}{TS} = Adjusted\ score$ BPP = Bid Price Proposal for initial Task Order ML = Master Item Lists Pricing TS = Technical Score Note: Department will provide the pay items and bid quantities in the Master Pay Item List, ML. Pay items and quantities for the initially assigned project locations will not be included in the ML calculation. However, when pay items included in the Master Pay Item List are also needed for the initially assigned project locations, the unit prices shall be identical. If submitted unit prices for identical pay items are different, the lower of the prices shall be used for the current and all future Task Work Orders.
TO development, pricing and execution	(see Figure B.3.1)
Information and documents required to be submitted in response to RFP	Past related project experience (IDIQ or non-IDIQ) Specific Qualifications from Prime Contractor, its staff and/or subcontractors. Organizational structure Price proposal guarantee Technical Proposal Price Proposal
Protest	There was one protest regarding the selection process for this contract, but the interviewee does not have information about it. The protest was sustained (in favor of the protestor.

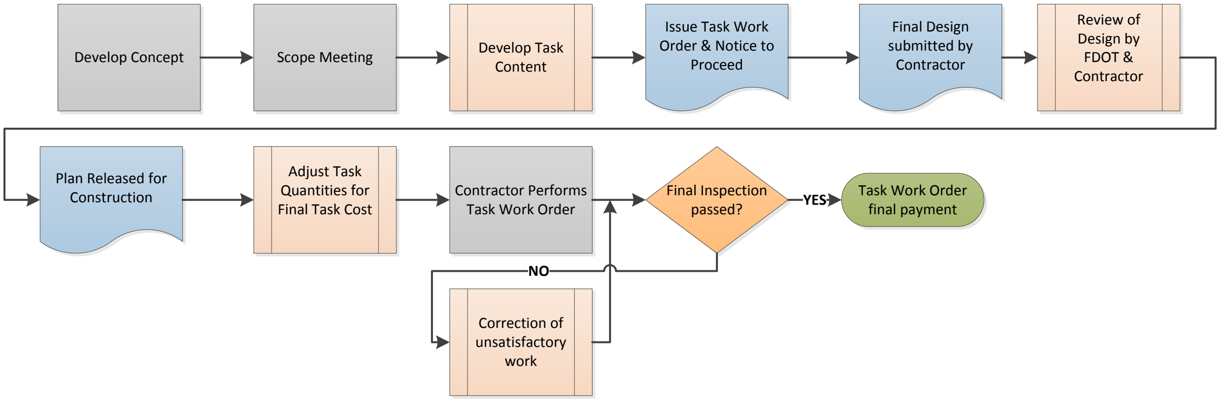


FIGURE B.3.1 FDOT – Task work order development flowchart.

VII. Case Study – Payment Provisions

Compensation method	Lump Sum Lump Sum proposals are required under each Task Work Order. Each proposal must be submitted with unit prices for all items involved in the project and these unit prices must be same for all Task Work Orders. (Design as a % of construction) Any new pay item for subsequent work orders will be pay by a Supplementary Agreement. The price must not exceed 10% of the price published at FDOT website.
Mobilization	Maintenance of Traffic (MOT) + Mobilization (MOB) must a percentage of the proposed construction cost. This percentage must not be greater than 20% and is the same for all Task Work Orders.
Price escalation	Use Producer Price Index (PPI) published by the Bureau of Labor Statistics for Highway and Street Construction (This index was discontinued). Adjustment is done to contractor's monthly payments.

VIII. Case Study – Quality Assurance

QA system	It is the same as the one used in regular construction projects.

IX. Case Study – Complementary Information

Interviewee personal opinion about IDIQ contracting	• IDIQ has impacted positively FDOT's contracting procedures.

B.4 Missouri Department of Transportation (MoDOT)

I. Agency and Interviewee General Information

Date:	May 29th, 2013
Agency:	Missouri Department of Transportation – District 7
Location:	Jefferson City, Missouri
Interviewee:	Natalie Roark – Bidding and Contract Service Engineer
Interviewers:	Jorge Andres Rueda - Graduate Research Assistance Edward O'Connor's - Graduate Research Assistance

Delivery methods and construction approaches used by the agency	Indefinite Delivery/Indefinite Quantity Design-Bid-Build Design-Build A + B Value Engineering Incentive/Disincentive Provisions

II. Agency IDIQ Contracting – Experience

IDIQ contracts awarded	More than 20 (18 contracts so far this year)
IDIQ contracts awarded annually	More than 4 (18 contracts so far this year)
Years of experience using IDIQ contracting	4 years
Average Task Order issue under a single contract	7-9 Task Orders
Monetary size of this contract	$550,000

III. Agency IDIQ Contracting – General Information

Name used to refer to IDIQ contracts	Job Order Contracts (On-Call contracts used before)
Name used to the orders issued under an IDIQ contract	Job Order

IV. Case Study – General Information

Project title	Job Order Contracting – Asphalt Pavement Repair. Job No. J2I2165T. Route I-55/I-57
Scope	"The scope of work for this project is to provide asphalt pavement repair on an as needed basis in response to sudden occurrences, such as physical damage by the elements, or as a result of wear and tear. The work will be prescribed through individual Job Orders issued to the contractor by the engineer for each work location." "A work location for this contract shall be limited to a 2-mile section of roadway. A 2-mile section shall be defined as 2 miles in one direction on a divided highway or 2 miles in both directions on an undivided highway." "The project limits for the work will be along the following Interstate Routes and Counties: l-55 in Ste. Genevieve, Perry, Cape Girardeau and Scott Counties l-57 in Mississippi County
Expected duration	13 months (April 28, 2013 – June 5, 2014)
Average duration	1 year
Actual duration	It is still ongoing
Contract Possible Extension	1 year extension
Minimum guaranteed amount	No minimum guaranteed amount
Maximum amount	Maximum expected amount is $125,000
Task Order limits	No Limits
DBE goals	No DBE or similar goals
Contract funding	This project was state funded. Before March 2013 all IDIQ contracts were federal funded by the SEP-14 program. Funds were secured before awarding the contract.
Contractor's key personnel	The Contractor is allowed to remove, change or add personnel at any moment during the contract.
Contract Composition	Road repair and maintenance
Bonding	One performance bond is required for the entire contract for a 100% of the expected amount.

V. Case Study – Delivery Method Selection

Reasons to use IDIQ contracting	Avoid unbalanced budgets.

VI. Case Study – Procurement Process

Number of awards	The contract was awarded to 1 contractor (as usual).
Procurement process	Invitation for Bids
Shortlist	No short list is developed
Pre-proposal meeting	They conduct some Prebid meetings to explain proposer how JOC works
Contractors selection method	The contractor must bid three different Adjustment factors; Norman Work, Nighttime work and Weekend Work. The lowest bid will be determined by multiplying each individual Adjustment Factor by the anticipated budget for each individual adjustment factor. For purposes of determining award of this contract, the estimated percentage of work performed during Normal Working Hours is 85%, the estimated percentage of Nighttime work is 10%, and the estimated percentage of Weekend work is 5%. The extended amount for each item will then be totaled, and the total sum will be used for bid comparison purposes. The initial contract value will be equal to the total sum. (Percentages vary for each contract)
Task Order development, pricing and execution	(see Figure B.4.1)
Information and documents required to be submitted in response to RFP	Only the three adjustment factors.
Protest	There have been no protests related to their selection method

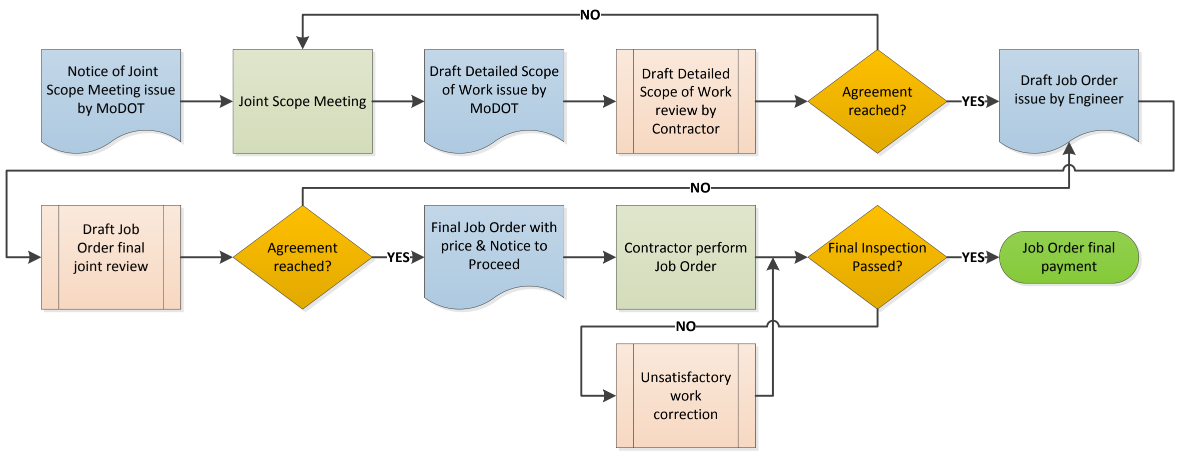


FIGURE B.4.1 MoDOT – Job order development flowchart.

VII. Case Study – Payment Provisions

Compensation method	Usually Unit Price. However, it can also be Lump Sum in accordance with the Job Order
Mobilization	The Fix Unit Price List includes a number of items for Mobilization to be pay in accordance with each Job Order. This prices are estimated using industry information.
Price escalation	The contract allows the adjustment of some prices, using specific equations and a number of different indexes such as: - Asphalt Cement Price Index - Seal Coat Price Index - Polymer Modified Emulsion Membrane Price Index When signing the contract, contractor decides if this adjustment will be applied or not. Indexes are published by Poten & Partners on a weekly basis

VIII. Case Study – Quality Assurance

QA system	It is the same as the one used in regular construction projects.
Factors that affect project quality	High Impact - Qualifications of the Contractor's staff - Contractor's past project experience - Use of agency specifications Some Impact - Quality management plans - Use of incentives/disincentives provisions No Impact or N/A - Number of Contractors Involved - Warranty Provisions

IX. Case Study – Complementary Information

Interviewee personal opinion about IDIQ contracting	• IDIQ has impacted positively MoDOT's contracting procedures.

APPENDIX C

MINNESOTA DEPARTMENT OF TRANSPORTATION HISTORICAL BID DATA

The historical bid data collected from MnDOT website and used in this thesis corresponds to all contracts awarded between January 25th, 2008 (first contract award in 2008), to August 23th, 2013 (last contract published on September 30th, 2013). There was a total of 1,361 contracts awarded throughout that period of time, and were distributed as presented below in Table C.1 and Table C.2.

TABLE C.1 Contract Distribution by Year

NUMBER OF CONTRACTS = 1361							
	Annual	1st Half	2nd Half	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2008	163	126	37	45	81	24	13
2009	287	208	79	88	120	45	34
2010	224	167	57	66	101	34	23
2011	219	167	52	71	96	29	23
2012	238	185	53	74	111	26	27
2013	230	220	10	75	145	10	-

TABLE C.2 Contract Distribution by District

District	No. of Contracts
1	145
2	99
3	165
4	111
6	179
7	117
8	94
Metro	451
Total	**1361**

APPENDIX D
INDEFINITE DELIVERY/INDEFINITE QUANTITY SAMPLE PROJECTS

This appendix presents the sample projects used in Chapter 6 and the original MnDOT contracts used to form these sample projects. A further explanation about how these sample projects were selected and form is presented in Chapter 6. This appendix also contains the actual unit price for each sample project calculated from MnDOT historical bid data. The four sample projects are presented as shown below:

D.1 Asphalt Pavement Project
D.2 Concrete Pavement Project
D.3 Traffic Barriers Project
D.4 Drainage Project

D.1 Asphalt Pavement Project

TABLE D.1.1 Asphalt Pavement - Original Contract

Original Contract	
Description	Bituminous Surfacing, Aggregate Shouldering, Guardrail
Contract ID	80117
S.P. Number	1213-10
Letting Date	06/06/2008
District	8

TABLE D.1.2 Asphalt Pavement - Original Contract Pay Items

Item Number	Item ID	Description	Units	% of Total Cost
1	2021501/00010	MOBILIZATION	LS	2.08%
2	2051501/00010	MAINT AND RESTORATION OF HAUL ROADS	LS	Removed
3	2104509/00055	REMOVE TWISTED END TREATMENT	EACH	0.09%
4	2104521/00220	SALVAGE GUARD RAIL-PLATE BEAM	L F	0.08%
5	2104601/01011	HAUL SALVAGED MATERIAL	LS	0.05%
6	2105501/00010	COMMON EXCAVATION	C Y	0.07%
7	2221501/00010	AGGREGATE SHOULDERING CLASS 1	TON	3.20%
8	2221604/00010	AGGREGATE SHOULDERING	S Y	0.17%
9	2232501/00040	MILL BITUMINOUS SURFACE (1.5")	S Y	0.38%
10	2232602/00010	MILLED RUMBLE STRIPS	EACH	0.44%
11	2357606/00010	BITUMINOUS MATERIAL FOR SHOULDER TACK	GAL	0.07%
12	2360501/22200	TYPE SP 12.5 WEARING COURSE MIXTURE (2,B)	TON	87.15%
13	2411507/00060	CONCRETE END POST	EACH	Removed
14	2540602/00150	MAIL BOX SUPPORT	EACH	Removed
15	2554501/00001	TRAFFIC BARRIER DESIGN SPECIAL	L F	0.69%
16	2554501/02007	TRAFFIC BARRIER DESIGN B8307	L F	0.33%
17	2554501/02038	TRAFFIC BARRIER DESIGN B8338	L F	0.58%
18	2554521/00020	ANCHORAGE ASSEMBLY-PLATE BEAM	EACH	0.12%
19	2554523/00028	END TREATMENT-TANGENT TERMINAL	EACH	0.25%
20	2563601/00010	TRAFFIC CONTROL	LS	1.01%
21	2580603/00010	INTERIM PAVEMENT MARKING	L F	0.39%
22	2582501/03008	PAVEMENT MESSAGE (STOP AHEAD) EPOXY	EACH	0.15%
23	2582502/41104	4" SOLID LINE WHITE-EPOXY	L F	2.17%
24	2582502/41524	24" STOP LINE WHITE-EPOXY	L F	0.03%
25	2582502/42104	4" SOLID LINE YELLOW-EPOXY	L F	0.25%
26	2582502/42204	4" BROKEN LINE YELLOW-EPOXY	L F	0.23%

TABLE D.1.3 Asphalt Pavement – Sample Project

Item ID	Description	Units	% of Total Cost	Items Represented
2021501/00010	MOBILIZATION	LS	2.08%	1
2104501/00042	REMOVE GUARD RAIL-PLATE BEAM	L F	0.09%	3
2104521/00220	SALVAGE GUARD RAIL-PLATE BEAM	L F	0.13%	4-5
2105501/00010	COMMON EXCAVATION	C Y	0.07%	6
2211503/00050	AGGREGATE BASE (CV) CLASS 5	C Y	3.37%	7-8
2232501/00040	MILL BITUMINOUS SURFACE (1.5")	S Y	0.38%	9
2232603/00025	MILLED RUMBLE STRIPS	L F	0.44%	10
2356505/00010	BITUMINOUS MATERIAL FOR SEAL COAT	GAL	0.00%	0
2360501/23200	TYPE SP 12.5 WEARING COURSE MIXTURE (3,B)	TON	87.23%	11-12
2554501/02038	TRAFFIC BARRIER DESIGN B8338	L F	1.97%	15-19
2563601/00010	TRAFFIC CONTROL	LS	1.01%	20
2582502/11104	4" SOLID LINE WHITE-PAINT	L F	0.39%	21
2582502/41104	4" SOLID LINE WHITE-EPOXY	L F	2.34%	22-24
2582502/42104	4" SOLID LINE YELLOW-EPOXY	L F	0.25%	25
2582502/42204	4" BROKEN LINE YELLOW-EPOXY	L F	0.23%	26

TABLE D.1.4 Asphalt Pavement – Actual Unit Prices

Item Number			2021501/00010	2104501/00042	2104521/00220	2105501/00010	2211503/00050	2232501/00040	2232603/00025	2360501/23200	2554501/02038	2563601/00010	2582502/11104	2582502/41104	2582502/42104	2582502/42204	TOTAL
Units			LS	L F	L F	C Y	C Y	S Y	L F	TON	L F	LS	L F	L F	L F	L F	
Year	Period	Quantity	1	385	364	63	2533	1518	74905	31410	1467	1	101038	177221	14059	16914	
2008	Q2-Q3	Unit price	$ 31,231.25	$ 3.65	$ 5.37	$ 17.47	$ 19.97	$ 3.76	$ 0.09	$ 41.66	$ 20.19	$ 15,104.01	$ 0.06	$ 0.20	$ 0.27	$ 0.21	
		Extension	$ 31,231.25	$ 1,402.90	$ 1,954.57	$ 1,102.91	$ 50,599.18	$ 5,704.64	$ 6,554.20	$1,308,392.26	$ 29,614.42	$ 15,104.01	$ 5,917.92	$ 35,127.76	$ 3,802.86	$ 3,491.12	**$1,500,000.00**
	Q4-Q1	Unit price	$ 38,408.07	$ 3.47	$ 5.77	$ 17.68	$ 18.34	$ 4.14	$ 0.09	$ 52.46	$ 18.20	$ 18,574.85	$ 0.09	$ 0.19	$ 0.19	$ 0.23	
		Extension	$ 38,408.07	$ 1,333.93	$ 2,101.36	$ 1,115.89	$ 46,469.39	$ 6,280.66	$ 6,939.09	$1,647,868.63	$ 26,695.56	$ 18,574.85	$ 9,001.51	$ 33,254.66	$ 2,688.38	$ 3,962.04	**$1,844,694.02**
2009	Q2-Q3	Unit price	$ 31,765.85	$ 3.50	$ 6.94	$ 16.90	$ 21.31	$ 3.49	$ 0.12	$ 43.59	$ 18.41	$ 15,362.55	$ 0.08	$ 0.23	$ 0.25	$ 0.23	
		Extension	$ 31,765.85	$ 1,347.62	$ 2,526.91	$ 1,066.73	$ 53,974.78	$ 5,295.46	$ 8,911.31	$1,369,002.33	$ 27,004.79	$ 15,362.55	$ 8,224.76	$ 40,924.84	$ 3,448.61	$ 3,947.80	**$1,525,675.93**
	Q4-Q1	Unit price	$ 38,149.35	$ 3.23	$ 6.44	$ 21.71	$ 20.84	$ 4.40	$ 0.10	$ 53.49	$ 17.50	$ 18,449.73	$ 0.07	$ 0.22	$ 0.26	$ 0.27	
		Extension	$ 38,149.35	$ 1,241.01	$ 2,343.75	$ 1,370.45	$ 52,805.59	$ 6,677.05	$ 7,441.59	$1,679,966.14	$ 25,672.84	$ 18,449.73	$ 7,033.92	$ 39,565.49	$ 3,590.38	$ 4,559.87	**$1,832,268.10**
2010	Q2-Q3	Unit price	$ 38,869.51	$ 3.25	$ 11.58	$ 20.93	$ 20.26	$ 4.83	$ 0.07	$ 54.56	$ 17.65	$ 18,798.01	$ 0.09	$ 0.22	$ 0.30	$ 0.24	
		Extension	$ 38,869.51	$ 1,250.36	$ 4,215.27	$ 1,321.28	$ 51,323.63	$ 7,323.10	$ 5,561.61	$1,713,804.36	$ 25,889.18	$ 18,798.01	$ 8,790.54	$ 39,181.53	$ 4,214.11	$ 3,981.63	**$1,866,856.58**
	Q4-Q1	Unit price	$ 36,959.62	$ 3.49	$ 10.28	$ 16.40	$ 21.83	$ 5.19	$ 0.09	$ 51.06	$ 18.24	$ 17,874.35	$ 0.10	$ 0.27	$ 0.31	$ 0.31	
		Extension	$ 36,959.62	$ 1,343.87	$ 3,742.66	$ 1,035.26	$ 55,299.24	$ 7,883.71	$ 7,069.07	$1,603,704.77	$ 26,748.44	$ 17,874.35	$ 10,486.81	$ 48,084.47	$ 4,428.34	$ 5,300.21	**$1,775,126.85**
2011	Q2-Q3	Unit price	$ 39,789.12	$ 3.78	$ 11.88	$ 23.04	$ 23.10	$ 5.78	$ 0.09	$ 55.16	$ 19.94	$ 19,242.75	$ 0.13	$ 0.26	$ 0.33	$ 0.28	
		Extension	$ 39,789.12	$ 1,452.92	$ 4,322.63	$ 1,454.45	$ 58,532.11	$ 8,775.40	$ 6,628.95	$1,732,710.35	$ 29,253.63	$ 19,242.75	$ 12,874.89	$ 45,604.86	$ 4,607.48	$ 4,806.66	**$1,911,024.34**
	Q4-Q1	Unit price	$ 40,418.65	$ 3.02	$ 12.41	$ 33.41	$ 22.27	$ 7.39	$ 0.09	$ 55.58	$ 18.05	$ 19,547.20	$ 0.17	$ 0.32	$ 0.48	$ 0.38	
		Extension	$ 40,418.65	$ 1,160.83	$ 4,518.24	$ 2,109.24	$ 56,423.92	$ 11,215.88	$ 6,948.50	$1,745,841.34	$ 26,471.68	$ 19,547.20	$ 17,480.08	$ 55,891.73	$ 6,792.08	$ 6,406.34	**$1,941,259.87**
2012	Q2-Q3	Unit price	$ 46,993.15	$ 3.82	$ 15.78	$ 28.15	$ 23.22	$ 6.67	$ 0.15	$ 64.72	$ 19.09	$ 22,726.75	$ 0.26	$ 0.38	$ 0.52	$ 0.35	
		Extension	$ 46,993.15	$ 1,470.58	$ 5,742.04	$ 1,776.95	$ 58,818.52	$ 10,127.43	$ 11,566.59	$2,032,823.84	$ 28,008.87	$ 22,726.75	$ 26,042.63	$ 67,446.91	$ 7,309.29	$ 5,891.78	**$2,257,025.43**
	Q4-Q1	Unit price	$ 45,508.79	$ 3.25	$ 12.37	$ 25.42	$ 25.84	$ 7.21	$ 0.18	$ 62.35	$ 18.18	$ 22,008.89	$ 0.23	$ 0.37	$ 0.45	$ 0.41	
		Extension	$ 45,508.79	$ 1,249.16	$ 4,501.98	$ 1,604.60	$ 65,472.99	$ 10,947.40	$ 13,527.24	$1,958,341.18	$ 26,668.63	$ 22,008.89	$ 23,724.74	$ 66,444.47	$ 6,374.59	$ 6,876.39	**$2,185,733.38**
2013	Q2-Q3	Unit price	$ 48,501.11	$ 3.11	$ 13.59	$ 26.18	$ 28.05	$ 7.63	$ 0.14	$ 65.66	$ 18.83	$ 23,456.03	$ 0.40	$ 0.43	$ 0.91	$ 0.57	
		Extension	$ 48,501.11	$ 1,198.09	$ 4,946.95	$ 1,652.93	$ 71,050.11	$ 11,578.05	$ 10,637.09	$2,062,343.74	$ 27,616.95	$ 23,456.03	$ 40,277.84	$ 75,607.61	$ 12,832.91	$ 9,708.27	**$2,329,450.54**

D.2 Concrete Pavement Project

TABLE D.2.1 Concrete Pavement - Original Contract

Original Contract	
Description	Concrete Pavement
Contract ID	120038
S.P. Number	2770-01
Letting Date	03/23/2012
District	Metro

TABLE D.2.2 Concrete Pavement – Original Contract Unit Prices

Item Number	Item ID	Description	Units	% of Total Cost
1	2021501/00010	MOBILIZATION	LS	10.79%
2	2104501/00022	REMOVE CURB AND GUTTER	L F	6.23%
3	2104505/00120	REMOVE BITUMINOUS PAVEMENT	S Y	3.74%
4	2104513/00011	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	L F	1.91%
5	2104523/00004	SALVAGE CASTING	EACH	0.76%
6	2105501/00010	COMMON EXCAVATION	C Y	3.09%
7	2105525/00030	TOPSOIL BORROW (CV)	C Y	1.36%
8	2301511/00010	STRUCTURAL CONCRETE	C Y	30.83%
9	2301538/00010	DOWEL BAR	EACH	5.53%
10	2301541/00404	INTEGRANT CURB DESIGN D4	L F	5.66%
11	2301604/03080	PLACE CONCRETE PAVEMENT 8.0"	S Y	24.87%
12	2506503/00010	RECONSTRUCT DRAINAGE STRUCTURE	L F	Removed
13	2506516/00010	CASTING ASSEMBLY	EACH	Removed
14	2506521/00010	INSTALL CASTING	EACH	Removed
15	2531501/02000	CONCRETE CURB & GUTTER DESIGN SPECIAL	L F	Removed
16	2563601/00010	TRAFFIC CONTROL	LS	2.61%
17	2563602/00002	RAISED PAVEMENT MARKER TEMPORARY	EACH	0.05%
18	2573530/00010	STORM DRAIN INLET PROTECTION	EACH	Removed
19	2575555/00010	TURF ESTABLISHMENT	LS	Removed
20	2581501/00010	REMOVABLE PREFORMED PLASTIC MARKING	L F	1.15%
21	2581603/00020	REMOVABLE PREFORMED PLASTIC MASK (BLACK)	L F	0.54%
22	2582502/41104	4" SOLID LINE WHITE-EPOXY	L F	0.88%

TABLE D.2.3 Concrete Pavement – Sample Contract

Item ID	Description	Units	% of Total Cost	Items Represented
2021501/00010	MOBILIZATION	LS	10.79%	1
2104501/00022	REMOVE CURB AND GUTTER	L F	6.23%	2
2104505/00120	REMOVE BITUMINOUS PAVEMENT	S Y	3.74%	3
2104513/00011	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	L F	1.91%	4
2104521/00220	SALVAGE GUARD RAIL-PLATE BEAM	L F	0.76%	5
2105501/00010	COMMON EXCAVATION	C Y	3.09%	6
2105522/00030	SELECT GRANULAR BORROW (CV)	C Y	1.36%	7
2301511/00010	STRUCTURAL CONCRETE	C Y	61.36%	8,10-11
2401541/00011	REINFORCEMENT BARS (EPOXY COATED)	LB	5.53%	9
2563601/00010	TRAFFIC CONTROL	LS	2.66%	16-17
2582502/31104	4" SOLID LINE WHITE-POLY PREFORM (GROUND IN)	L F	1.69%	20-21
2582502/41104	4" SOLID LINE WHITE-EPOXY	L F	0.88%	22

TABLE D.2.4 Concrete Pavement – Actual Unit Prices

Item Number			2021501/00010	2104501/00022	2104505/00120	2104513/00011	2104521/00220	2105501/00010	2105522/00030	2301511/00010	2401541/00011	2563601/00010	2582502/31104	2582502/41104	TOTAL
Units			LS	L F	S Y	L F	L F	C Y	C Y	C Y	LB	LS	L F	L F	
Year	Period	Quantity	1	31543	23950	14634	1923	4399	1187	10582	44512	1	7401	46297	
2008	Q2-Q3	Unit price	$ 161,833.97	$ 2.96	$ 2.34	$ 1.96	$ 5.91	$ 10.54	$ 17.19	$ 86.98	$ 1.86	$ 39,895.16	$ 3.43	$ 0.28	
		Extension	$ 161,833.97	$ 93,510.90	$ 56,079.25	$ 28,677.90	$ 11,363.27	$ 46,359.63	$ 20,405.60	$ 920,470.54	$ 82,897.13	$ 39,895.16	$ 25,369.96	$ 13,136.69	**$ 1,500,000.00**
	Q4-Q1	Unit price	$ 179,400.08	$ 2.19	$ 2.18	$ 2.10	$ 6.35	$ 10.66	$ 16.98	$ 103.98	$ 1.57	$ 44,225.54	$ 3.41	$ 0.27	
2009		Extension	$ 179,400.08	$ 69,082.11	$ 52,239.87	$ 30,736.31	$ 12,216.66	$ 46,905.07	$ 20,157.78	$ 1,100,375.04	$ 69,827.79	$ 44,225.54	$ 25,213.57	$ 12,436.21	**$ 1,662,816.01**
	Q2-Q3	Unit price	$ 190,950.55	$ 2.41	$ 2.24	$ 1.94	$ 7.64	$ 10.19	$ 18.94	$ 111.60	$ 1.46	$ 47,072.95	$ 4.14	$ 0.33	
		Extension	$ 190,950.55	$ 75,932.58	$ 53,687.70	$ 28,340.57	$ 14,690.70	$ 44,838.74	$ 22,479.54	$ 1,180,945.22	$ 64,952.82	$ 47,072.95	$ 30,678.54	$ 15,304.62	**$ 1,769,874.54**
	Q4-Q1	Unit price	$ 180,934.32	$ 2.98	$ 2.65	$ 2.15	$ 7.09	$ 13.10	$ 19.00	$ 100.78	$ 1.35	$ 44,603.76	$ 3.71	$ 0.32	
2010		Extension	$ 180,934.32	$ 93,975.22	$ 63,420.11	$ 31,391.87	$ 13,625.86	$ 57,605.38	$ 22,550.55	$ 1,066,416.88	$ 60,222.20	$ 44,603.76	$ 27,494.10	$ 14,796.26	**$ 1,677,036.50**
	Q2-Q3	Unit price	$ 167,611.26	$ 2.78	$ 3.03	$ 2.02	$ 12.75	$ 12.63	$ 21.43	$ 88.84	$ 1.49	$ 41,319.37	$ 3.82	$ 0.32	
		Extension	$ 167,611.26	$ 87,584.36	$ 72,613.64	$ 29,562.29	$ 24,506.32	$ 55,538.42	$ 25,443.26	$ 940,162.14	$ 66,270.29	$ 41,319.37	$ 28,284.30	$ 14,652.68	**$ 1,553,548.33**
	Q4-Q1	Unit price	$ 174,275.12	$ 3.04	$ 2.89	$ 2.26	$ 11.32	$ 9.89	$ 19.76	$ 94.25	$ 1.53	$ 42,962.14	$ 3.76	$ 0.39	
2011		Extension	$ 174,275.12	$ 95,820.26	$ 69,100.44	$ 33,003.22	$ 21,758.72	$ 43,515.91	$ 23,458.41	$ 997,398.24	$ 68,231.14	$ 42,962.14	$ 27,808.27	$ 17,982.10	**$ 1,615,313.96**
	Q2-Q3	Unit price	$ 176,394.32	$ 3.79	$ 3.28	$ 2.32	$ 13.07	$ 13.90	$ 20.70	$ 90.48	$ 1.57	$ 43,484.56	$ 3.77	$ 0.37	
		Extension	$ 176,394.32	$ 119,413.72	$ 78,645.90	$ 33,879.91	$ 25,130.48	$ 61,136.26	$ 24,574.91	$ 957,499.18	$ 69,853.48	$ 43,484.56	$ 27,888.79	$ 17,054.80	**$ 1,634,956.31**
	Q4-Q1	Unit price	$ 208,408.73	$ 3.68	$ 4.07	$ 2.22	$ 13.66	$ 20.16	$ 18.24	$ 110.14	$ 1.75	$ 51,376.72	$ 3.39	$ 0.45	
2012		Extension	$ 208,408.73	$ 116,120.75	$ 97,570.59	$ 32,441.77	$ 26,267.71	$ 88,659.37	$ 21,651.70	$ 1,165,475.83	$ 77,741.77	$ 51,376.72	$ 25,073.51	$ 20,901.77	**$ 1,931,690.23**
	Q2-Q3	Unit price	$ 197,870.35	$ 3.51	$ 4.08	$ 2.23	$ 17.36	$ 16.98	$ 21.88	$ 102.65	$ 1.68	$ 48,778.81	$ 3.48	$ 0.54	
		Extension	$ 197,870.35	$ 110,835.69	$ 97,623.18	$ 32,699.78	$ 33,382.47	$ 74,692.10	$ 25,977.93	$ 1,086,218.30	$ 74,987.07	$ 48,778.81	$ 25,723.77	$ 25,223.05	**$ 1,834,012.49**
	Q4-Q1	Unit price	$ 205,170.61	$ 3.44	$ 4.14	$ 2.45	$ 13.61	$ 15.33	$ 20.11	$ 109.57	$ 1.69	$ 50,578.46	$ 3.43	$ 0.54	
2013		Extension	$ 205,170.61	$ 108,446.98	$ 99,196.53	$ 35,799.95	$ 26,173.17	$ 67,447.68	$ 23,873.47	$ 1,159,441.25	$ 75,297.80	$ 50,578.46	$ 25,402.77	$ 24,848.17	**$ 1,901,676.84**
	Q2-Q3	Unit price	$ 221,792.98	$ 3.93	$ 4.11	$ 2.34	$ 14.96	$ 15.80	$ 25.09	$ 120.06	$ 1.55	$ 54,676.19	$ 3.63	$ 0.61	
		Extension	$ 221,792.98	$ 124,039.43	$ 98,442.86	$ 34,233.47	$ 28,760.08	$ 69,479.19	$ 29,788.05	$ 1,270,482.92	$ 68,912.10	$ 54,676.19	$ 26,863.39	$ 28,274.90	**$ 2,055,745.57**

D.3 Traffic Barriers Project

TABLE D.3.1 Traffic Barriers - Original Contract

Original Contract	
Description	Tension Cable Guardrail
Contract ID	80115
S.P. Number	0282-28
Letting Date	06/06/2008
District	Metro

TABLE D.3.2 Traffic Barriers – Original Contract Unit Prices

Item Number	Item ID	Description	Units	% of Total Cost
1	2021501/00010	MOBILIZATION	LS	2.96%
2	2104501/00018	REMOVE PIPE SEWERS	L F	0.03%
3	2104501/00042	REMOVE GUARD RAIL-PLATE BEAM	L F	0.77%
4	2104509/00106	REMOVE CATCH BASIN GRATE CASTING	EACH	0.02%
5	2105523/00010	COMMON BORROW (LV)	C Y	0.08%
6	2105603/00010	MINOR GRADING	L F	0.29%
7	2211501/00050	AGGREGATE BASE CLASS 5	TON	0.13%
8	2501569/02912	12" RC SAFETY APRON	EACH	0.05%
9	2503541/90122	12" RC PIPE SEWER DESIGN 3006	L F	0.11%
10	2506522/00011	ADJUST FRAME & RING CASTING	EACH	0.03%
11	2506602/00024	CONNECT INTO EXISTING CATCH BASIN	EACH	0.03%
12	2506602/00034	GRATE CASTING NO 716	EACH	0.07%
13	2533507/00010	PORTABLE PRECAST CONCRETE BARRIER DESIGN 8337	L F	0.58%
14	2554501/00001	TRAFFIC BARRIER DESIGN SPECIAL	L F	0.54%
15	2554501/00040	TRAFFIC BARRIER DESIGN BULLNOSE	L F	3.52%
16	2554501/02038	TRAFFIC BARRIER DESIGN B8338	L F	13.72%
17	2554521/00020	ANCHORAGE ASSEMBLY-PLATE BEAM	EACH	0.37%
18	2554523/00028	END TREATMENT-TANGENT TERMINAL	EACH	2.92%
19	2554602/00005	IMPACT ATTENUATOR BARRELS	EACH	0.39%
20	2554602/00040	T-BARRIER BRIDGE CONN DES 8318	EACH	0.05%
21	2554603/00080	TENSION CABLE GUARDRAIL	L F	69.87%
22	2563601/00010	TRAFFIC CONTROL	LS	3.47%

TABLE D.3.3 Traffic Barriers – Sample Contract

Item ID	Description	Units	% of Total Cost	Items Represented
2021501/00010	MOBILIZATION	LS	2.96%	1
2104501/00016	REMOVE SEWER PIPE (STORM)	L F	0.03%	2
2104501/00042	REMOVE GUARD RAIL-PLATE BEAM	L F	0.77%	3-4
2105522/00030	SELECT GRANULAR BORROW (CV)	C Y	0.08%	5-6
2211503/00050	AGGREGATE BASE (CV) CLASS 5	C Y	0.13%	7
2501511/20180	18" CS PIPE CULVERT	L F	0.05%	8
2503541/90122	12" RC PIPE SEWER DESIGN 3006	L F	0.11%	9-12
2554501/02038	TRAFFIC BARRIER DESIGN B8338	L F	22.09%	13-20
2554603/00080	TENSION CABLE GUARDRAIL	L F	69.87%	21
2563601/00010	TRAFFIC CONTROL	LS	3.47%	22

TABLE D.3.4 Traffic Barriers – Actual Unit Prices

Item Number			2021501/00010	2104501/00016	2104501/00042	2105522/00030	2211503/00050	2501511/20180	2503541/90122	2554501/02038	2554603/00080	2563601/00010	TOTAL
Units			LS	L F	L F	C Y	C Y	L F	L F	L F	L F	LS	
Year	Period	Quantity	1	42	3998	318	75	12	86	16410	49374	1	
2008	Q2-Q3	Unit price	$ 44,426.36	$ 10.69	$ 2.98	$ 17.19	$ 26.39	$ 63.43	$ 42.18	$ 20.19	$ 21.23	$ 52,055.02	
		Extension	$ 44,426.36	$ 444.91	$ 11,913.53	$ 5,471.15	$ 1,990.18	$ 773.17	$ 3,642.78	$ 331,300.44	$1,047,982.45	$ 52,055.02	**$ 1,500,000.00**
	Q4-Q1	Unit price	$ 44,863.43	$ 12.03	$ 2.83	$ 16.98	$ 24.23	$ 49.95	$ 36.96	$ 18.20	$ 22.19	$ 52,567.14	
		Extension	$ 44,863.43	$ 501.06	$ 11,327.88	$ 5,404.70	$ 1,827.75	$ 608.87	$ 3,191.90	$ 298,646.87	$1,095,817.39	$ 52,567.14	**$ 1,514,756.98**
2009	Q2-Q3	Unit price	$ 42,168.70	$ 10.98	$ 2.86	$ 18.94	$ 28.15	$ 65.58	$ 32.46	$ 18.41	$ 20.38	$ 49,409.68	
		Extension	$ 42,168.70	$ 456.97	$ 11,444.07	$ 6,027.21	$ 2,122.95	$ 799.43	$ 2,803.09	$ 302,106.18	$1,006,434.45	$ 49,409.68	**$ 1,423,772.73**
	Q4-Q1	Unit price	$ 40,776.77	$ 10.06	$ 2.64	$ 19.00	$ 27.54	$ 47.80	$ 42.17	$ 17.50	$ 19.80	$ 47,778.74	
		Extension	$ 40,776.77	$ 418.79	$ 10,538.78	$ 6,046.25	$ 2,076.96	$ 582.74	$ 3,641.97	$ 287,205.49	$ 977,709.57	$ 47,778.74	**$ 1,376,776.07**
2010	Q2-Q3	Unit price	$ 44,443.19	$ 10.77	$ 2.66	$ 21.43	$ 26.77	$ 55.08	$ 43.37	$ 17.65	$ 22.08	$ 52,074.74	
		Extension	$ 44,443.19	$ 448.31	$ 10,618.17	$ 6,821.85	$ 2,018.67	$ 671.44	$ 3,745.17	$ 289,625.68	$1,090,100.93	$ 52,074.74	**$ 1,500,568.15**
	Q4-Q1	Unit price	$ 42,582.64	$ 11.84	$ 2.85	$ 19.76	$ 28.84	$ 50.95	$ 43.01	$ 18.24	$ 20.69	$ 49,894.71	
		Extension	$ 42,582.64	$ 492.93	$ 11,412.22	$ 6,289.67	$ 2,175.04	$ 621.14	$ 3,714.51	$ 299,238.42	$1,021,327.74	$ 49,894.71	**$ 1,437,749.02**
2011	Q2-Q3	Unit price	$ 52,371.28	$ 10.88	$ 3.09	$ 20.70	$ 30.53	$ 49.80	$ 36.70	$ 19.94	$ 26.37	$ 61,364.20	
		Extension	$ 52,371.28	$ 453.21	$ 12,338.29	$ 6,589.02	$ 2,302.20	$ 607.13	$ 3,169.69	$ 327,264.26	$1,301,790.82	$ 61,364.20	**$ 1,768,250.10**
	Q4-Q1	Unit price	$ 51,587.47	$ 12.46	$ 2.47	$ 18.24	$ 29.43	$ 63.81	$ 45.56	$ 18.05	$ 26.54	$ 60,445.79	
		Extension	$ 51,587.47	$ 518.73	$ 9,857.90	$ 5,805.25	$ 2,219.28	$ 777.82	$ 3,934.22	$ 296,142.28	$1,310,496.85	$ 60,445.79	**$ 1,741,785.58**
2012	Q2-Q3	Unit price	$ 52,548.93	$ 13.44	$ 3.12	$ 21.88	$ 30.67	$ 67.31	$ 51.40	$ 19.09	$ 26.72	$ 61,572.36	
		Extension	$ 52,548.93	$ 559.40	$ 12,488.32	$ 6,965.20	$ 2,313.46	$ 820.50	$ 4,438.31	$ 313,338.94	$1,319,202.88	$ 61,572.36	**$ 1,774,248.32**
	Q4-Q1	Unit price	$ 41,228.35	$ 13.54	$ 2.65	$ 20.11	$ 34.15	$ 64.46	$ 39.33	$ 18.18	$ 19.84	$ 48,307.87	
		Extension	$ 41,228.35	$ 563.62	$ 10,607.97	$ 6,400.95	$ 2,575.20	$ 785.74	$ 3,395.98	$ 298,345.60	$ 979,811.89	$ 48,307.87	**$ 1,392,023.17**
2013	Q2-Q3	Unit price	$ 40,723.06	$ 15.54	$ 2.54	$ 25.09	$ 37.05	$ 85.02	$ 45.68	$ 18.83	$ 19.26	$ 47,715.81	
		Extension	$ 40,723.06	$ 647.08	$ 10,174.26	$ 7,986.77	$ 2,794.56	$ 1,036.46	$ 3,944.87	$ 308,954.55	$ 950,985.28	$ 47,715.81	**$ 1,374,962.70**

D.4 Drainage Project

TABLE D.4.1 Drainage - Original Contract

Original Contract	
Description	Drainage Structures and Pipe Culverts
Contract ID	100129
S.P. Number	0303-62
Letting Date	06/04/2010
District	4

TABLE D.4.2 Drainage – Original Contract Unit Prices

Item Number	Item ID	Description	Units	% of Total Cost
1	2021501/00010	MOBILIZATION	LS	5.65%
2	2051501/00010	MAINT AND RESTORATION OF HAUL ROADS	LS	Removed
3	2104501/00022	REMOVE CURB AND GUTTER	L F	0.05%
4	2104505/00120	REMOVE BITUMINOUS PAVEMENT	S Y	0.06%
5	2104509/00013	REMOVE PIPE APRON	EACH	0.86%
6	2104509/00102	REMOVE CATCH BASIN	EACH	0.10%
7	2104509/00105	REMOVE CASTING	EACH	0.04%
8	2104513/00011	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	L F	0.09%
9	2105522/00010	SELECT GRANULAR BORROW (LV)	C Y	0.14%
10	2105601/00010	DEWATERING	LS	12.01%
11	2360501/23200	TYPE SP 12.5 WEARING COURSE MIXTURE (3,B)	TON	0.41%
12	2501511/90249	24" RC PIPE CULVERT CLASS V-JACKED	L F	41.64%
13	2501511/90309	30" RC PIPE CULVERT CLASS V-JACKED	L F	22.43%
14	2501515/90240	24" RC PIPE APRON	EACH	0.88%
15	2501515/90300	30" RC PIPE APRON	EACH	0.58%
16	2501569/01024	24" CS SAFETY APRON	EACH	1.26%
17	2501569/02924	24" RC SAFETY APRON	EACH	0.44%
18	2501602/00011	PLUG & ABANDON PIPE CULVERT	EACH	3.76%
19	2501603/00124	LINING CULVERT PIPE (24")	L F	6.82%
20	2506501/00070	CONSTRUCT DRAINAGE STRUCTURE DESIGN G	L F	0.44%
21	2506516/00010	CASTING ASSEMBLY	EACH	0.19%
22	2519607/00010	CLSM LOW DENSITY	C Y	Removed
23	2531501/02320	CONCRETE CURB & GUTTER DESIGN B624	L F	Removed
24	2563601/00010	TRAFFIC CONTROL	LS	2.15%
25	2573502/00040	SILT FENCE, TYPE MACHINE SLICED	L F	Removed
26	2575555/00010	TURF ESTABLISHMENT	LS	Removed

TABLE D.4.3 Drainage – Sample Contract

Item ID	Description	Unit s	% of Total Cost	Items Represented
2021501/00010	MOBILIZATION	LS	5.65%	1
2104501/00022	REMOVE CURB AND GUTTER	L F	2.46%	3, (1/5 of 10)
2104505/00120	REMOVE BITUMINOUS PAVEMENT	S Y	2.47%	4, (1/5 of 10)
2104501/00042	REMOVE GUARD RAIL-PLATE BEAM	L F	3.40%	5-7, (1/5 of 10)
2104513/00011	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	L F	2.49%	8, (1/5 of 10)
2105522/00030	SELECT GRANULAR BORROW (CV)	C Y	2.54%	9, (1/5 of 10)
2360501/23200	TYPE SP 12.5 WEARING COURSE MIXTURE (3,B)	TON	0.41%	11
2501511/90242	24" RC PIPE CULVERT	L F	42.96%	12,14,17
2501511/90302	30" RC PIPE CULVERT	L F	23.01%	13,15
2501511/20180	18" CS PIPE CULVERT	L F	1.26%	16
2501603/00124	LINING CULVERT PIPE (24")	L F	11.21%	18-21
2563601/00010	TRAFFIC CONTROL	LS	2.15%	24

TABLE D.4.4 Drainage – Actual Unit Prices

Item Number			2021501/00010	2104501/00022	2104505/00120	2104501/00042	2104513/00011	2105522/00030	2360501/23200	2501511/90242	2501511/90302	2501511/20180	2501603/00124	2563601/00010	TOTAL
Units			LS	L F	S Y	L F	L F	C Y	TON	L F	L F	L F	L F	LS	
Year	Period	Quantity	1	12422	15793	20468	19049	2215	73	10496	3404	299	2479	1	
2008	Q2-Q3	Unit price	$ 84,778.44	$ 2.96	$ 2.34	$ 2.49	$ 1.96	$ 17.19	$ 84.00	$ 61.40	$ 101.38	$ 63.43	$ 67.85	$ 32,184.32	
		Extension	$ 84,778.44	$ 36,825.24	$ 36,980.46	$ 51,016.54	$ 37,329.18	$ 38,072.97	$ 6,158.13	$ 644,407.94	$ 345,114.47	$ 18,968.00	$ 168,164.32	$ 32,184.32	$ 1,500,000.00
	Q4-Q1	Unit price	$ 78,458.32	$ 2.19	$ 2.18	$ 2.37	$ 2.10	$ 16.98	$ 105.79	$ 60.32	$ 63.84	$ 49.95	$ 88.35	$ 29,785.02	
		Extension	$ 78,458.32	$ 27,205.01	$ 34,448.65	$ 48,508.65	$ 40,008.55	$ 37,610.57	$ 7,755.92	$ 633,132.06	$ 217,332.75	$ 14,937.23	$ 218,994.29	$ 29,785.02	$ 1,388,177.02
2009	Q2-Q3	Unit price	$ 82,868.23	$ 2.41	$ 2.24	$ 2.39	$ 1.94	$ 18.94	$ 87.89	$ 64.86	$ 58.20	$ 65.58	$ 102.40	$ 31,459.15	
		Extension	$ 82,868.23	$ 29,902.77	$ 35,403.39	$ 49,006.22	$ 36,890.08	$ 41,942.55	$ 6,443.40	$ 680,748.59	$ 198,128.49	$ 19,612.12	$ 253,797.29	$ 31,459.15	$ 1,466,202.28
	Q4-Q1	Unit price	$ 73,797.42	$ 2.98	$ 2.65	$ 2.20	$ 2.15	$ 19.00	$ 107.86	$ 54.23	$ 49.55	$ 47.80	$ 95.59	$ 28,015.61	
		Extension	$ 73,797.42	$ 37,008.09	$ 41,821.26	$ 45,129.56	$ 40,861.87	$ 42,075.03	$ 7,906.99	$ 569,205.58	$ 168,673.41	$ 14,296.22	$ 236,919.83	$ 28,015.61	$ 1,305,710.87
2010	Q2-Q3	Unit price	$ 91,939.85	$ 2.78	$ 3.03	$ 2.22	$ 2.02	$ 21.43	$ 110.03	$ 71.90	$ 73.15	$ 55.08	$ 104.02	$ 34,903.00	
		Extension	$ 91,939.85	$ 34,491.32	$ 47,883.77	$ 45,469.51	$ 38,480.37	$ 47,472.29	$ 8,066.26	$ 754,692.01	$ 249,023.61	$ 16,472.24	$ 257,813.86	$ 34,903.00	$ 1,626,708.07
	Q4-Q1	Unit price	$ 86,016.61	$ 3.04	$ 2.89	$ 2.39	$ 2.26	$ 19.76	$ 102.96	$ 59.21	$ 66.03	$ 50.95	$ 127.23	$ 32,654.37	
		Extension	$ 86,016.61	$ 37,734.68	$ 45,567.05	$ 48,869.82	$ 42,959.32	$ 43,768.93	$ 7,548.06	$ 621,412.85	$ 224,775.27	$ 15,238.07	$ 315,362.10	$ 32,654.37	$ 1,521,907.11
2011	Q2-Q3	Unit price	$ 108,542.86	$ 3.79	$ 3.28	$ 2.58	$ 2.32	$ 20.70	$ 111.24	$ 95.45	$ 57.70	$ 49.80	$ 124.16	$ 41,205.98	
		Extension	$ 108,542.86	$ 47,025.94	$ 51,861.64	$ 52,835.45	$ 44,100.49	$ 45,852.10	$ 8,155.24	$ 1,001,803.67	$ 196,441.90	$ 14,894.59	$ 307,748.30	$ 41,205.98	$ 1,920,468.15
	Q4-Q1	Unit price	$ 95,675.84	$ 3.68	$ 4.07	$ 2.06	$ 2.22	$ 18.24	$ 112.08	$ 68.75	$ 67.98	$ 63.81	$ 139.42	$ 36,321.29	
		Extension	$ 95,675.84	$ 45,729.15	$ 64,341.19	$ 42,213.84	$ 42,228.50	$ 40,397.95	$ 8,217.04	$ 721,599.23	$ 231,433.32	$ 19,081.85	$ 345,570.43	$ 36,321.29	$ 1,692,809.63
2012	Q2-Q3	Unit price	$ 111,218.25	$ 3.51	$ 4.08	$ 2.61	$ 2.23	$ 21.88	$ 130.51	$ 83.63	$ 76.54	$ 67.31	$ 158.89	$ 42,221.63	
		Extension	$ 111,218.25	$ 43,647.86	$ 64,375.86	$ 53,477.94	$ 42,564.34	$ 48,469.87	$ 9,567.77	$ 877,719.48	$ 260,577.77	$ 20,129.02	$ 393,834.38	$ 42,221.63	$ 1,967,804.16
	Q4-Q1	Unit price	$ 94,634.00	$ 3.44	$ 4.14	$ 2.22	$ 2.45	$ 20.11	$ 125.73	$ 68.36	$ 63.49	$ 64.46	$ 135.95	$ 35,925.77	
		Extension	$ 94,634.00	$ 42,707.16	$ 65,413.38	$ 45,425.84	$ 46,599.74	$ 44,543.35	$ 9,217.20	$ 717,523.23	$ 216,131.19	$ 19,276.36	$ 336,978.92	$ 35,925.77	$ 1,674,376.15
2013	Q2-Q3	Unit price	$ 111,574.23	$ 3.93	$ 4.11	$ 2.13	$ 2.34	$ 25.09	$ 132.40	$ 84.79	$ 72.91	$ 85.02	$ 157.12	$ 42,356.77	
		Extension	$ 111,574.23	$ 48,847.58	$ 64,916.38	$ 43,568.58	$ 44,560.71	$ 55,578.84	$ 9,706.70	$ 889,917.11	$ 248,215.31	$ 25,427.09	$ 389,433.38	$ 42,356.77	$ 1,974,102.70

APPENDIX E

COST INDEXES AND ADJUSTED PRICES FOR SAMPLE PROJECTS

This appendix contains the twelve cost indexes analyzed in Chapter 6. Indexes presented below correspond to the last known index on July 1st each year from 2008 to 2013. The Producer Price Indexes (PPIs) Highway and Street Construction (BHWY) and Other Non-residential Construction (BONS) are used as a single index in Chapter 6 since the BHWY was discontinued in 2010 and combined with other indexes into the BONS. The RSMeans 20-city average index and National Highway Construction Cost Index (NHCCI) were not published or available at the moment of this study. More information about these indexes may be found in Table 13, Chapter 6.

TABLE E.1 Cost Indexes

Adjustment Dates		Jul-08	Jul-09	Jul-10	Jul-11	Jul-12	Jul-13
RSMeans	20-City Average	180.4	180.1	183.5	191.2	194.6	-
	Minneapolis	190.6	203.1	203.8	208.1	214.7	216.3
PPI	BHWY	234.4	208.7	217.1	-	-	-
	BONS	-	-	100.0	110.4	110.1	111.3
NHCCI		1.2938	1.0901	1.0671	1.0691	1.1468	-
CCI	20-City Average	8185	8578	8805	9053	9291	9542
	Minneapolis	9662.41	9745.02	10081.54	10177	10561.49	10852.11
BCI	20-City Average	4640	4771	4888	5059	5170	5286
	Minneapolis	4850.69	4885.99	5113.2	5213.9	5296.68	5415.65
Caltrans Quarterly		95.4	74.5	79.3	85.2	84.6	129.8
Caltrans 12-month		90.7	92	79.1	78.9	81.3	110.3
SDDOT		268.045	276.101	286.363	289.484	307.761	332.369
MnDOT Annual		212.88	234.22	225.32	229.17	245.95	257.36

BCI = Building Cost Index – Engineering News-Record; BHWY = Highway and Street Construction Index – Bureau of Labor Statistics; BONS = Other Non-residential Construction Index – Bureau of Labor Statistics; Caltrans = California Department of Transportation; CCI = Construction Cost Index – Engineering News-Record; MnDOT = Minnesota Department of Transportation; NHCCI = National Highway Construction Cost Index – Federal Highway Administration; PPI = Producer Price Index – Bureau of Labor Statistics; SDDOT = South Dakota Department of Transportation

This appendix also contains the adjusted cost of the sample projects in July 1st each year, since 2008 until 2013. Given the base price for all sample project was the same ($1,500,000.00) and since these indexes are equally applied to all contracts, adjusted prices for each period are the same for all sample projects.

TABLE E.2 Adjusted Contract Prices

Cost Indexes	Adjustment Dates					
	Jul-08	Jul-09	Jul-10	Jul-11	Jul-12	Jul-13
RsMeans National	$1,500,000.00	$1,497,505.54	$1,525,776.05	$1,589,800.44	$1,618,070.95	-
RsMeans Minneapolis	$1,500,000.00	$1,598,373.56	$1,603,882.48	$1,637,722.98	$1,689,664.22	$1,702,256.03
PPI	$1,500,000.00	$1,335,537.54	$1,389,291.81	$1,533,778.16	$1,529,610.28	$1,546,281.78
NHCCI	$1,500,000.00	$1,263,835.21	$1,237,169.58	$1,239,488.33	$1,329,571.80	-
CC National	$1,500,000.00	$1,572,021.99	$1,613,622.48	$1,659,071.47	$1,702,687.84	$1,748,686.62
CCI Minneapolis	$1,500,000.00	$1,512,824.44	$1,565,066.07	$1,579,885.35	$1,639,573.87	$1,684,689.95
BCI National	$1,500,000.00	$1,542,349.14	$1,580,172.41	$1,635,452.59	$1,671,336.21	$1,708,836.21
BCI Minneapolis	$1,500,000.00	$1,510,915.97	$1,581,177.11	$1,612,317.01	$1,637,915.43	$1,674,705.04
Caltrans Quarterly	$1,500,000.00	$1,171,383.65	$1,246,855.35	$1,339,622.64	$1,330,188.68	$2,040,880.50
Caltrans Last 12 months	$1,500,000.00	$1,521,499.45	$1,308,158.77	$1,304,851.16	$1,344,542.45	$1,824,145.53
SDDOT	$1,500,000.00	$1,545,081.98	$1,602,508.91	$1,619,974.26	$1,722,253.73	$1,859,961.95
MnDOT Annual	$1,500,000.00	$1,650,366.40	$1,587,655.02	$1,614,782.98	$1,733,018.60	$1,813,416.01

APPENDIX F
QUANTITY RANGES PER PAY ITEM

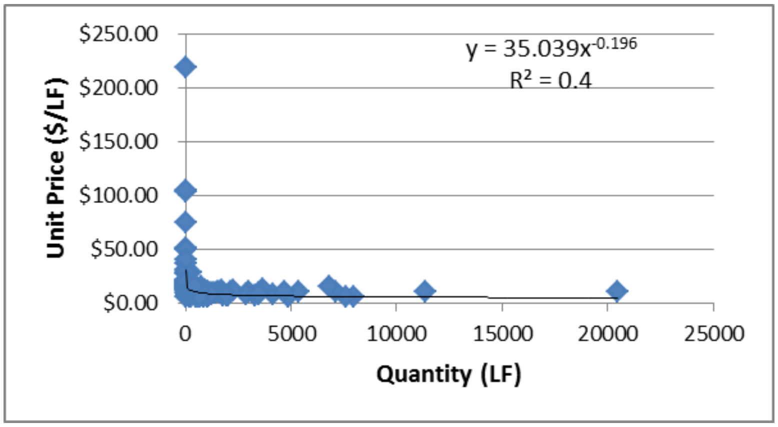
This appendix contains the quantity ranges used for each pay item in the sample projects to arrange and analyze MnDOT historical bid data. Besides the quantity ranges, this appendix presents the scatter plot with all bids received by MnDOT for each pay item (Quantity vs. Unit Price) and the regression used in the determination of the ranges. The pay item list shown in Table F.1 does include neither Mobilization nor Traffic Control since those items were handles in a different way. See Chapter 6 for more information about these quantity ranges. Pay items in this appendix are presented as shown below:

TABLE F.1 Sample Projects Pay Item List

PAY ITEMS		
No.	**Item ID**	**Description**
1	2104501/00016	REMOVE SEWER PIPE (STORM)
2	2104501/00022	REMOVE CURB AND GUTTER
3	2104501/00042	REMOVE GUARD RAIL-PLATE BEAM
4	2104505/00120	REMOVE BITUMINOUS PAVEMENT
5	2104513/00011	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)
6	2104521/00220	SALVAGE GUARD RAIL-PLATE BEAM
7	2105501/00010	COMMON EXCAVATION
8	2105522/00030	SELECT GRANULAR BORROW (CV)
9	2211503/00050	AGGREGATE BASE (CV) CLASS 5
10	2232501/00040	MILL BITUMINOUS SURFACE (1.5")
11	2232603/00025	MILLED RUMBLE STRIPS
12	2301511/00010	STRUCTURAL CONCRETE
13	2356505/00010	BITUMINOUS MATERIAL FOR SEAL COAT
14	2360501/23200	TYPE SP 12.5 WEARING COURSE MIXTURE (3,B)
15	2401541/00011	REINFORCEMENT BARS (EPOXY COATED)
16	2501511/20180	18" CS PIPE CULVERT
17	2501511/90242	24" RC PIPE CULVERT
18	2501511/90302	30" RC PIPE CULVERT
19	2501603/00124	LINING CULVERT PIPE (24")
20	2503541/90122	12" RC PIPE SEWER DESIGN 3006
21	2554501/02038	TRAFFIC BARRIER DESIGN B8338
22	2554603/00080	TENSION CABLE GUARDRAIL
23	2582502/11104	4" SOLID LINE WHITE-PAINT
24	2582502/31104	4" SOLID LINE WHITE-POLY PREFORM (GROUND IN)
25	2582502/41104	4" SOLID LINE WHITE-EPOXY
26	2582502/42104	4" SOLID LINE YELLOW-EPOXY
27	2582502/42204	4" BROKEN LINE YELLOW-EPOXY

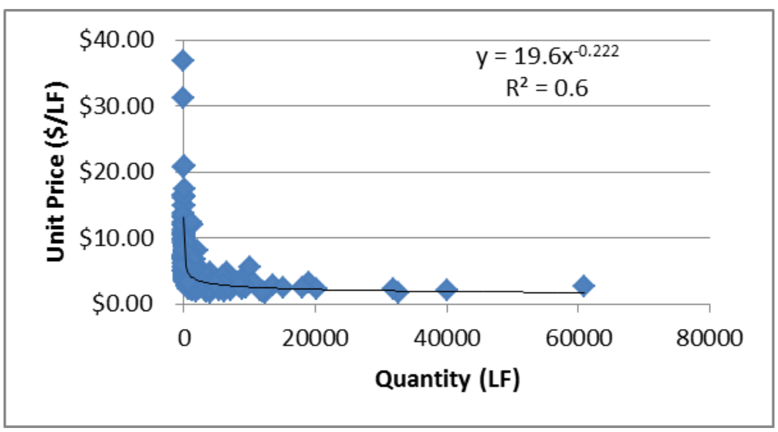
1. **2104501/00016 Remove Sewer Pipe (Storm)**

2104501/00016	
Average Variance	101%
Range 1 (LF)	10-350
Range 2 (LF)	350-12200



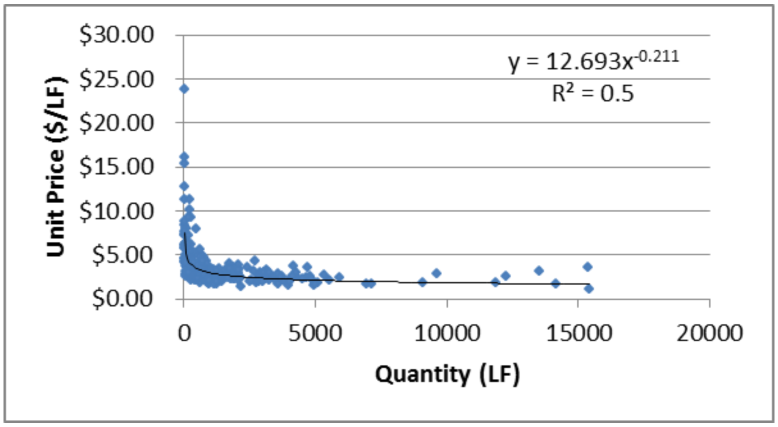
2. **2104501/00022 Remove Curb And Gutter**

2104501/00022	
Average Variance	115%
Range 1 (LF)	20-600
Range 2 (LF)	600-18000



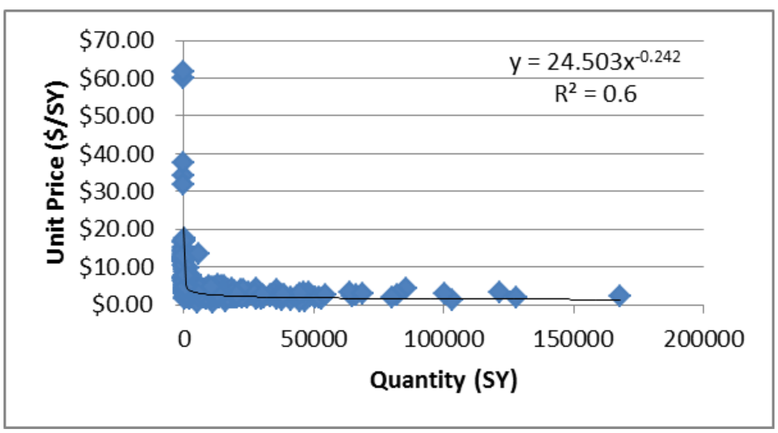
3. 2104501/00042 Remove Guard Rail-Plate Beam

2104501/00042	
Average Variance	37%
Range 1 (LF)	50-220
Range 2 (LF)	220-990
Range 3 (LF)	990-4400
Range 4 (LF)	4400-19500



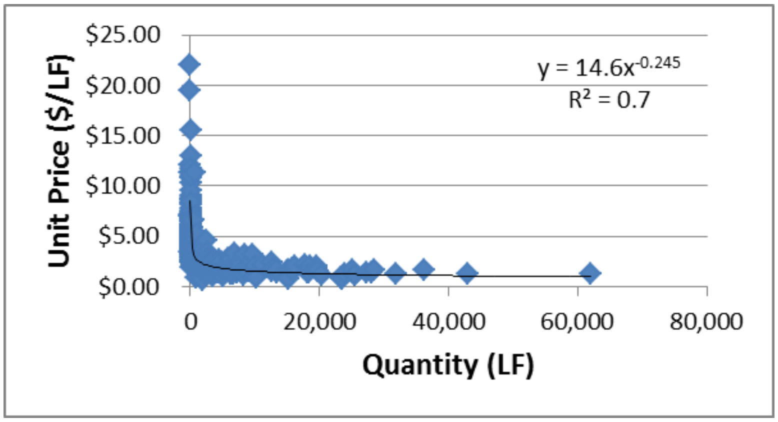
4. 2104505/00120 Remove Bituminous Pavement

2104505/00120	
Average Variance	121%
Range 1 (SY)	60-1500
Range 2 (SY)	1500-37500
Range 3 (SY)	37500-937500



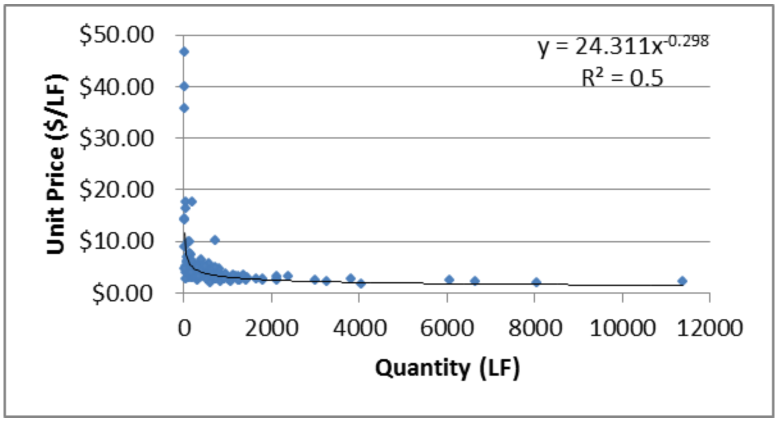
5. 2104513/00011 Sawing Bituminous Pavement (Full Depth)

2104513/00011	
Average Variance	120%
Range 1 (LF)	50-1250
Range 2 (LF)	1250-31500



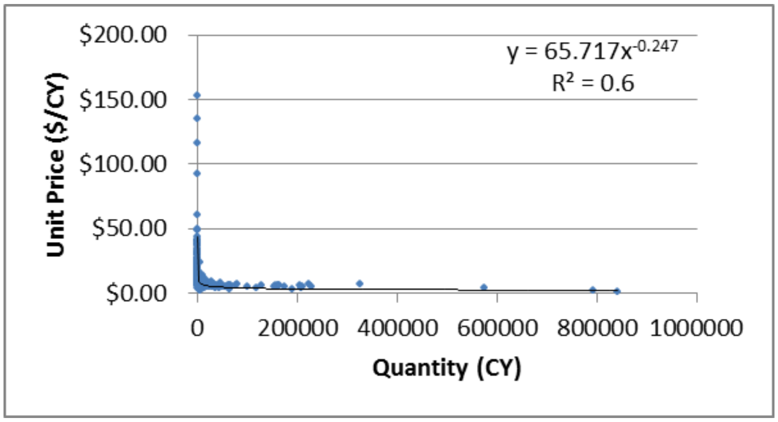
6. 2104521/00220 Salvage Guard Rail-Plate Beam

2104521/00220	
Average Variance	26%
Range 1 (LF)	25-55
Range 2 (LF)	55-120
Range 3 (LF)	120-260
Range 4 (LF)	260-570
Range 5 (LF)	570-1250
Range 6 (LF)	1250-2750
Range 7 (LF)	2750-6000



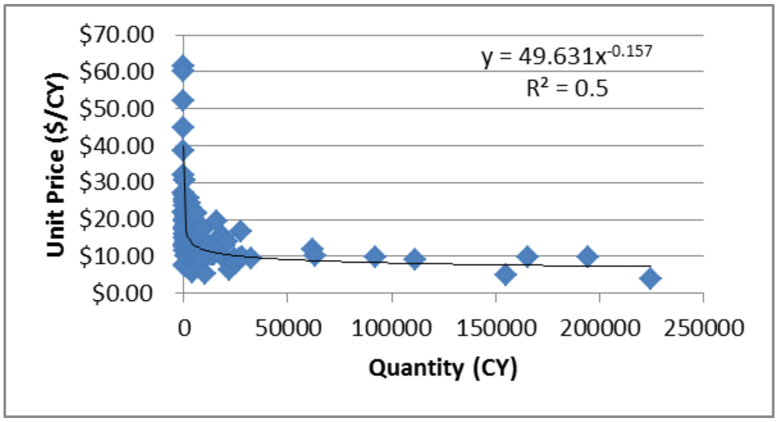
7. 2105501/00010 Common Excavation

2105501/00010	
Average Variance	93%
Range 1 (CY)	40-570
Range 2 (CY)	570-8200
Range 3 (CY)	8200-118000
Range 4 (CY)	118000-1700000



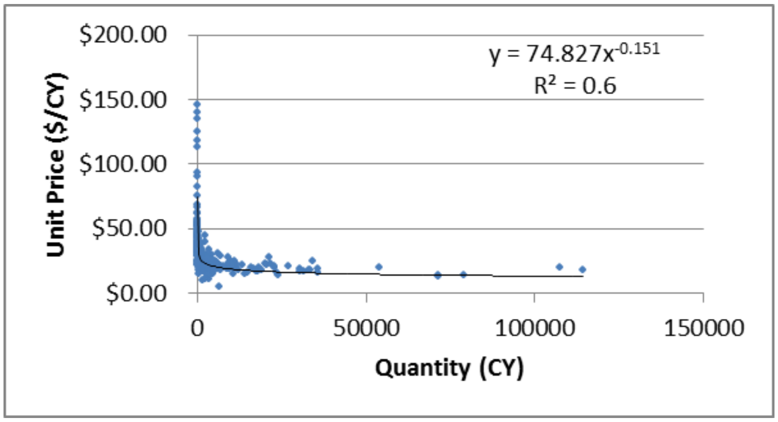
8. 2105522/00030 Select Granular Borrow (cv)

2105522/00030	
Average Variance	65%
Range 1 (CY)	70-1700
Range 2 (CY)	1700-41000
Range 3 (CY)	41000-1000000



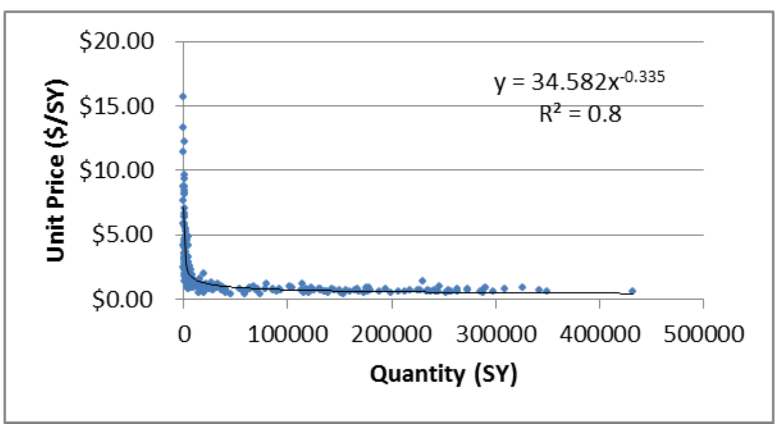
9. 2211503/00050 Aggregate Base (cv) Class 5

2211503/00050	
Average Variance	51%
Range 1 (CY)	75-1150
Range 2 (CY)	1150-18000
Range 3 (CY)	18000-280000



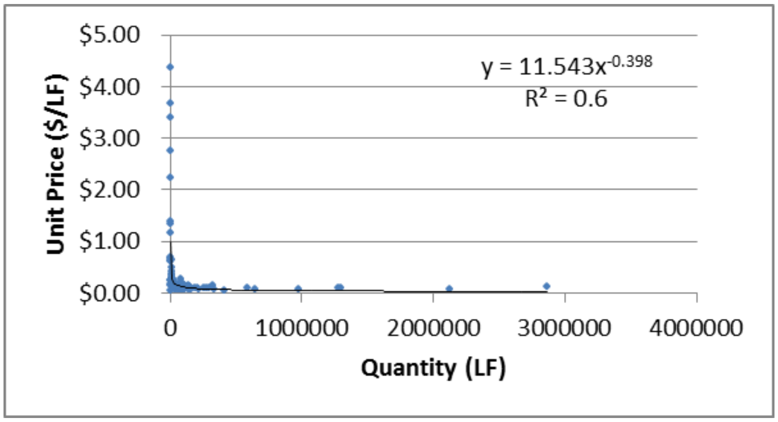
10. 2232501/00040 Mill Bituminous Surface (1.5")

2232501/00040	
Average Variance	113%
Range 1 (SY)	300-2850
Range 2 (SY)	2850-27200
Range 3 (SY)	27200-261000
Range 4 (SY)	261000-2500000



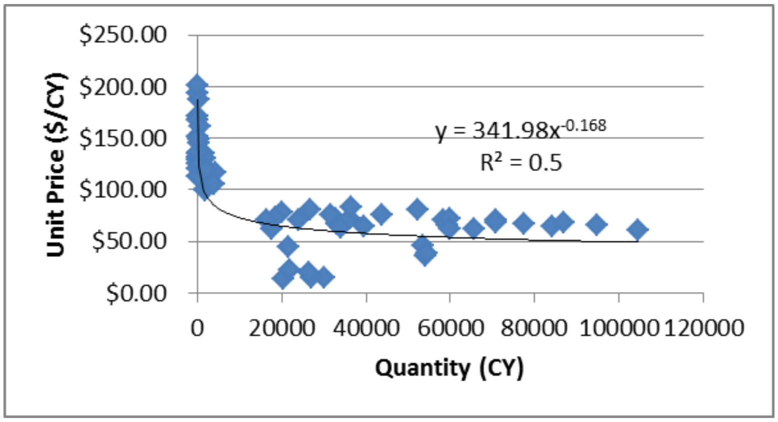
11. 2232603/00025 Milled Rumble Strips

2232603/00025	
Average Variance	99%
Range 1 (LF)	2600-14700
Range 2 (LF)	14700-83000
Range 3 (LF)	83000-470000
Range 4 (LF)	470000-2650000



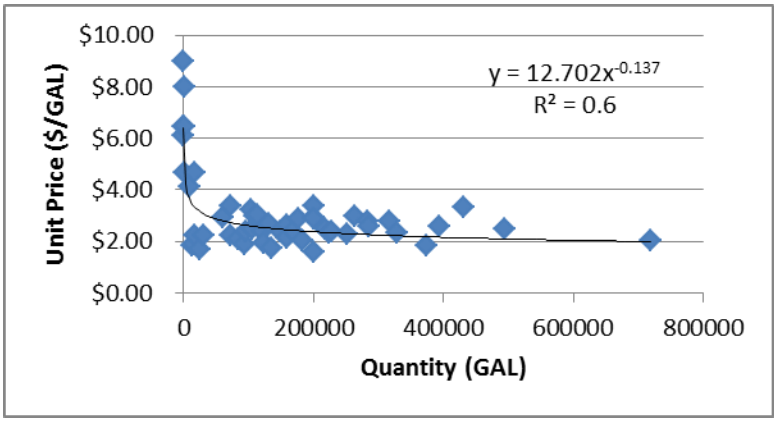
12. 2301511/00010 Structural Concrete

2301511/00010	
Average Variance	17%
Range 1 (CY)	75-190
Range 2 (CY)	190-490
Range 3 (CY)	490-1250
Range 4 (CY)	1250-3200
Range 5 (CY)	3200-8300
Range 6 (CY)	8300-21500
Range 7 (CY)	21500-55500
Range 8 (CY)	55500-144000



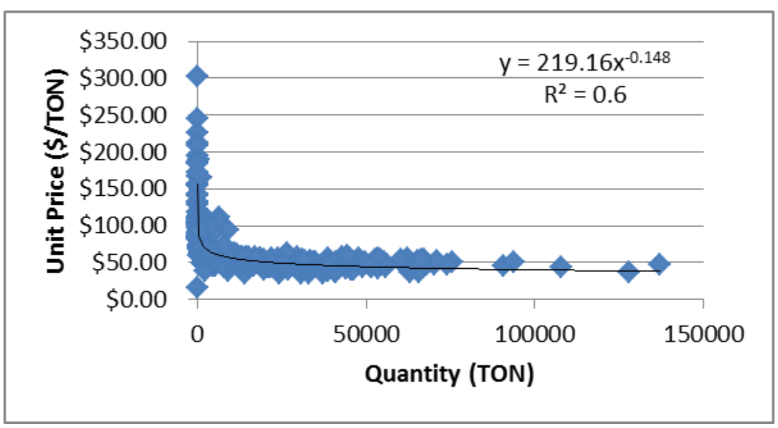
13. 2356505/00010 Bituminous Material For Seal Coat

2356505/00010	
Average Variance	48%
Range 1 (GAL)	500-8900
Range 2 (GAL)	8900-155000
Range 3 (GAL)	155000-2700000



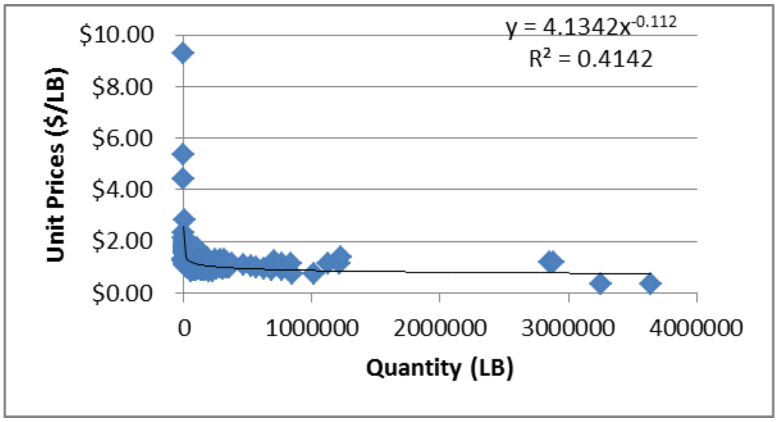
14. 2360501/23200 Type SP 12.5 Wearing Course Mixture (3,b)

2360501/23200	
Average Variance	18%
Range 1 (TON)	70-220
Range 2 (TON)	220-690
Range 3 (TON)	690-2100
Range 4 (TON)	2100-6600
Range 5 (TON)	6600-20700
Range 6 (TON)	20700-65000



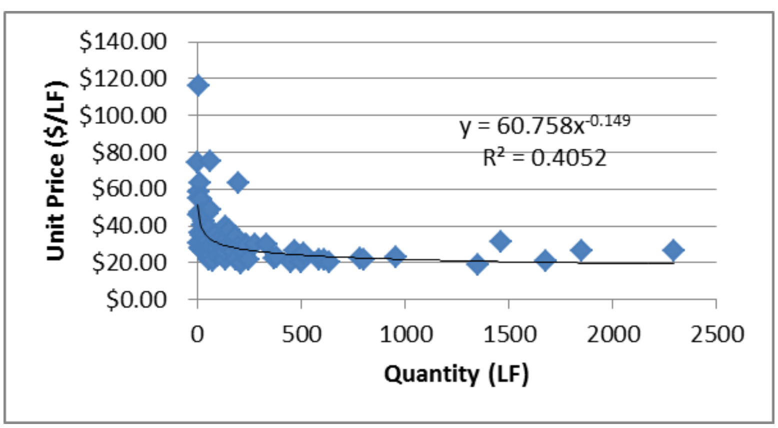
15. 2401541/00011 Reinforcement Bars (Epoxy Coated)

2401541/00011	
Average Variance	22%
Range 1 (LB)	3400-20800
Range 2 (LB)	20800-127000
Range 3 (LB)	127000-777000
Range 4 (LB)	777000-4662000



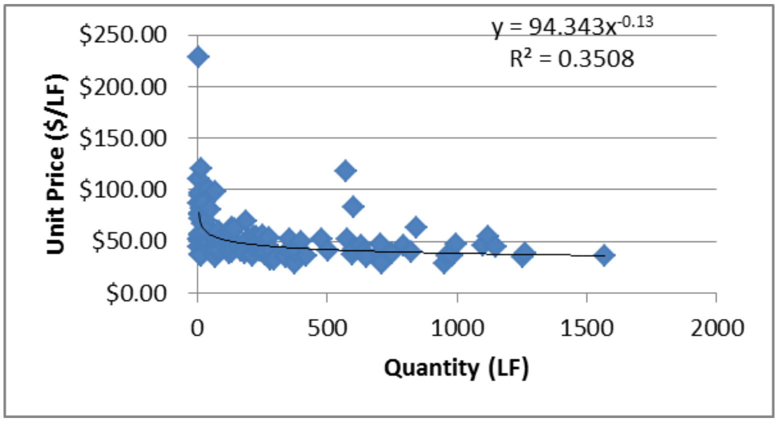
16. 2501511/20180 18" CS Pipe Culvert

2501511/20180	
Average Variance	52%
Range 1 (LF)	8-130
Range 2 (LF)	130-2200



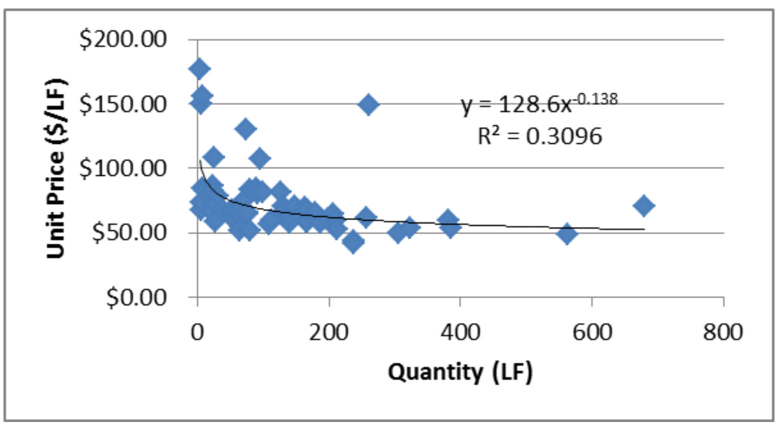
17. 2501511/90242 24" RC Pipe Culvert

2501511/90242	
Average Variance	54%
Range 1 (LF)	8-220
Range 2 (LF)	220-6200



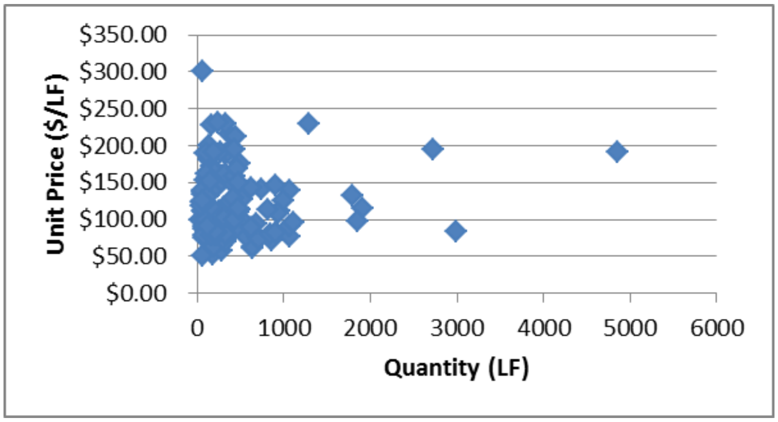
18. 2501511/90302 30" RC Pipe Culvert

2501511/90302	
Average Variance	46%
Range 1 (LF)	6-95
Range 2 (LF)	95-1500



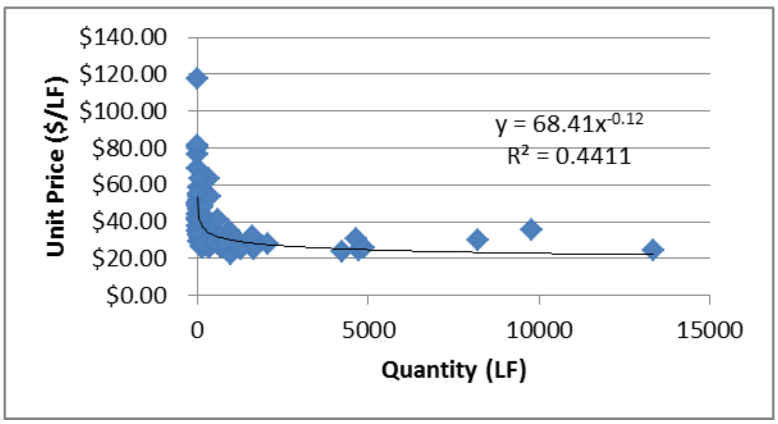
19. 2501603/00124 Lining Culvert Pipe (24")

No relation was found between unit price and quantity for this item. Therefore, all bids are considered in a single quantity range



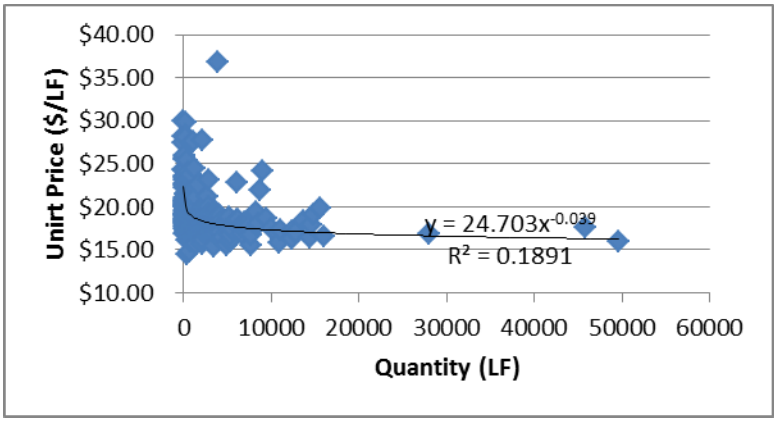
20. 2503541/90122 12" RC Pipe Sewer Design 3006

2503541/90122	
Average Variance	64%
Range 1 (LF)	12-750
Range 2 (LF)	750-47400



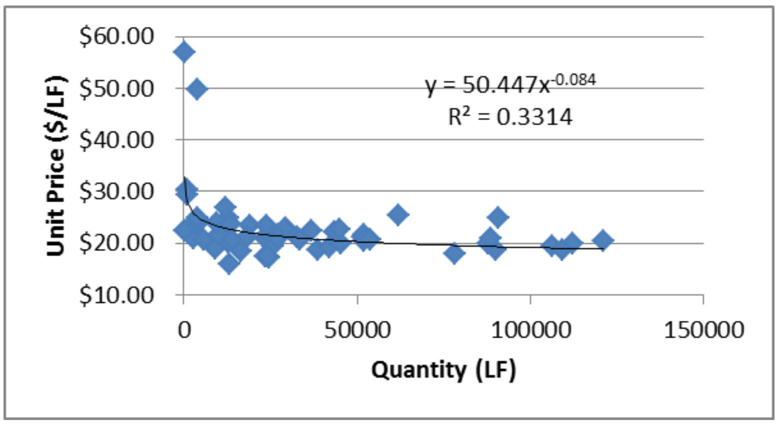
21. 2554501/02038 Traffic Barrier Design b8338

2554501/02038	
Average Variance	10%
Range 1 (LF)	100-1250
Range 2 (LF)	1250-15900



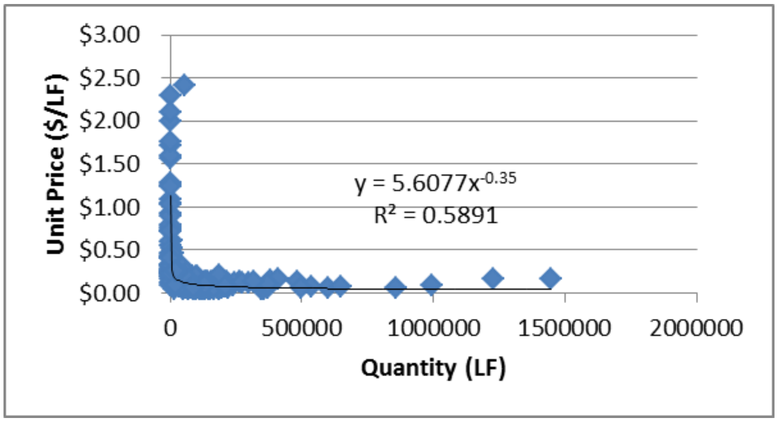
22. 2554603/00080 Tension Cable Guardrail

2554603/00080	
Average Variance	19%
Range 1 (LF)	1000-8300
Range 2 (LF)	8300-69000
Range 3 (LF)	69000-575000



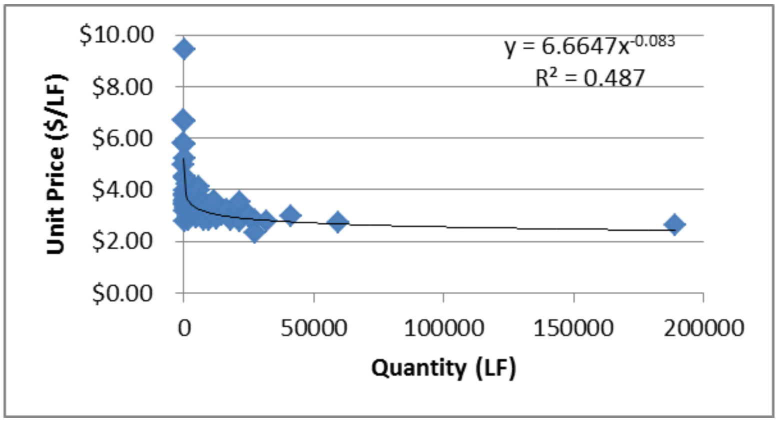
23. 2582502/11104 4" Solid Line White-Paint

2582502/11104	
Average Variance	35%
Range 1 (LF)	700-1650
Range 2 (LF)	1650-3930
Range 3 (LF)	3930-9300
Range 4 (LF)	9300-22100
Range 5 (LF)	22100-52600
Range 6 (LF)	52600-125300
Range 7 (LF)	125300-295000
Range 8 (LF)	295000-700000



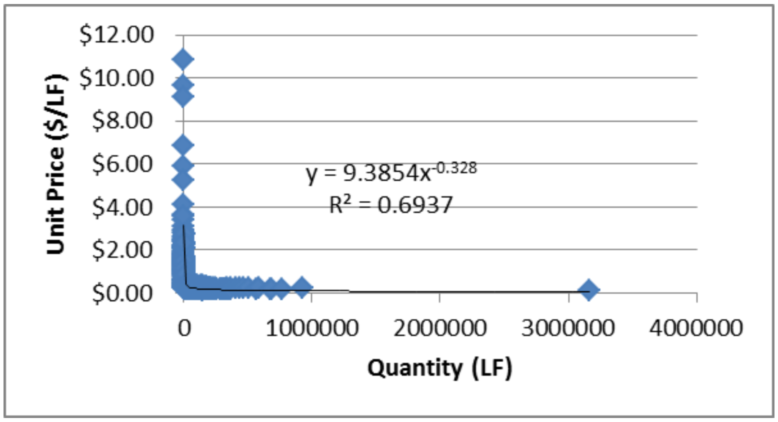
24. 2582502/31104 4" Solid Line White-Poly Preform (Ground In)

2582502/31104	
Average Variance	15%
Range 1 (LF)	110-620
Range 2 (LF)	620-3500
Range 3 (LF)	3500-19800
Range 4 (LF)	19800-110000



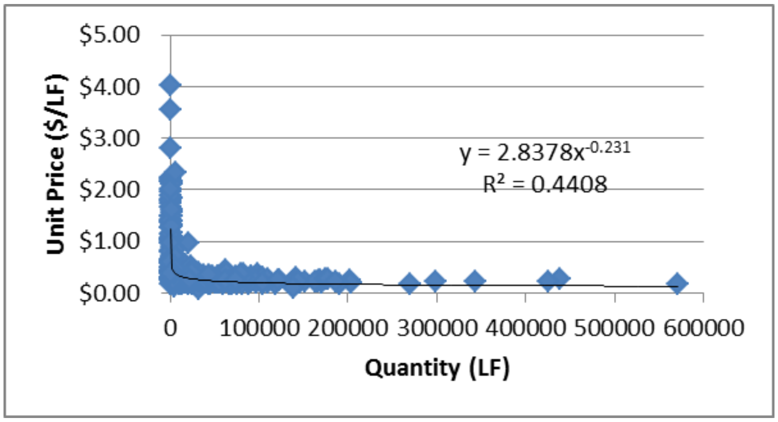
25. 2582502/41104 4" Solid Line White-Epoxy

2582502/41104	
Average Variance	17%
Range 1 (LF)	750-1200
Range 2 (LF)	1200-1900
Range 3 (LF)	1900-3100
Range 4 (LF)	3100-5000
Range 5 (LF)	5000-8000
Range 6 (LF)	8000-13000
Range 7 (LF)	13000-21000
Range 8 (LF)	21000-34000
Range 9 (LF)	34000-55000
Range 10 (LF)	55000-89000
Range 11 (LF)	89000-145000
Range 12 (LF)	145000-235000
Range 13 (LF)	235000-380000



26. 2582502/42104 4" Solid Line Yellow-Epoxy

2582502/42104	
Average Variance	15%
Range 1 (LF)	600-1100
Range 2 (LF)	1100-2000
Range 3 (LF)	2000-3700
Range 4 (LF)	3700-6900
Range 5 (LF)	6900-12000
Range 6 (LF)	12000-22000
Range 7 (LF)	22000-41000
Range 8 (LF)	41000-76000
Range 9 (LF)	76000-140000



27. 2582502/42204 4" Broken Line Yellow-Epoxy

2582502/42204	
Average Variance	14%
Range 1 (LF)	75-120
Range 2 (LF)	120-200
Range 3 (LF)	200-330
Range 4 (LF)	330-560
Range 5 (LF)	560-950
Range 6 (LF)	950-1600
Range 7 (LF)	1600-2700
Range 8 (LF)	2700-4500
Range 9 (LF)	4500-7600
Range 10 (LF)	7600-12800
Range 11 (LF)	12800-21700
Range 12 (LF)	21700-36800