METHODS FOR IDENTIFYING BEST-VALUE BID FOR PERFORMANCE-BASED MAINTENANCE CONTRACTS

A Thesis

by

JUBAIR AHMED

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2010

Major Subject: Civil Engineering

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Approved by:

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ABSTRACT

Methods for Identifying Best-Value Bid for Performance-based Maintenance Contracts.

(December 2010)

Jubair Ahmed, B.S., Bangladesh University of Engineering & Technology, Dhaka

Chair of Advisory Committee: Dr. Nasir G. Gharaibeh

Performance-based contracting (PBC) for roadway maintenance is relatively new among various alternative contracting options available at present and is increasingly drawing more attention from state Departments of Transportation (DOTs) and the contracting community. Because performance-based maintenance contracts extend over multiple years (typically 5-7 years) and shift performance risk to contractors, it is critical that contractors be selected based on a form of best-value method rather than on the conventional low-bid method. Currently, highway agencies use various methods for determining the best-value bid based on cost and technical scores.

Five best-value bid identification methods that are already in practice by the state transportation agencies in Florida, Virginia, North Carolina, United Kingdom, and New Zealand were used as case studies for this research. These five methods were evaluated in terms of the agency's willingness to pay for quality and the neutrality of these methods with respect to lowest bid and highest quality. To understand and describe the bid evaluation method, the agency can develop a willingness to pay (WTP) curve. This curve should represent the agency's needs and budget, reflect their project characteristics, and accommodate associated performance risks. An Excel macro based software tool has

been developed that automates these five best-value bid identification methods and also helps customize anyone of these options for any agency.

ACKNOWLEDGEMENTS

All praises for the Almighty. I am grateful for His Mercy and Guidance and for His Blessings to give me the ability to join the Aggie network.

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CHAPTER I

INTRODUCTION

Performance-based maintenance contracting (PBMC) for roadway is relatively new among various alternative contracting options available at present and is increasingly drawing more attention from state Departments of Transportation (DOTs) and the contracting community. Under performance-based contracts, the agency (owner) does not specify any method or material requirements. Instead, it specifies measurable performance targets and standards (also called outcomes) that the maintenance contractor is required to meet or exceed within a certain timeframe. For example, the contractor is not paid for the linear feet of fence maintenance, but for the outcome of this work (such as, no damage that allows access through fence, less than 10% vegetation on fence, etc.).

National and International Practice

Various broader forms of performance based specifications and contracting have been used in many instances around the world. Thus, Performance Based Maintenance Contract (PBMC) is being exercised in many parts of the world including some states in the USA and in some other developing countries (Hyman 2009). This concept has been familiar with different names in different states, countries or provinces. In Virginia, the concept is termed as Turnkey Asset Maintenance Services (TAMS); in Georgia the concept is termed as Comprehensive Maintenance Contract (CMC); in Western Australia, it is called Term Network Contract (TNC) with an advancement of Integrated

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This thesis follows the style of the Journal of Construction Engineering and Management.

Service Arrangement (ISA); in Ontario, Canada, it is called Area Maintenance Contract (AMC); in the UK, the contracting is known as Managing Agent Contract (MAC); in the New Zealand and Australia, this is familiar as Performance-Specified Maintenance Contract (PSMC); in Argentina this is expressed as the Contract for Rehabilitation and Maintenance. The National Cooperative Highway Research Program (NCHRP) synthesis Report No. 389 (Hyman 2009) used the term Performance-Based Maintenance Contract (PBMC).

States in the USA that have experience in PBMC include Virginia, Florida, North Carolina, Texas, Maryland, Idaho, Oklahoma, New Mexico, District of Columbia, Utah, Alaska, and Georgia. Evolution of the PBMC contracts in the USA started in the year 1997 through Virginia Department of Transportation. Texas Department of Transportation signed for the first time two PBMC Contracts for IH-35 in Waco and IH-20 in Dallas. In the year 2007 a major contractor in the US possessed more than $2.5 billion worth PBMC contracts signed nationwide (VMS 2007).

Road assets that can be included in typical asset management contract include pavement surface, roadsides, tunnels, bridges, signs and traffic signals, guard rails, vegetation and aesthetics, rest areas, pavement markings etc (Stankevich, Qureshi and Queiroz 2005) . Types of road assets that will be favorable to consider for PBMC projects depend on number of factors; whether the owner agency or the contractor support the concept, whether the project is goal oriented and can be influenced by the contractor, the ability of the agency to use incentive/disincentive scheme, whether the contractor has flexibility in achieving the goals, the available resources of the owner agency to develop the contract and measure the performance, whether the owner agency can use best value or enhanced low bid award and finally whether the owner agency has sufficient time to train the work forces about the PBMC (SAIC 2006).

Advantages and Disadvantages of Performance Based Contract

Pakkala (2006) discussed some of the advantages and disadvantages of performance-based contracting (PBC) in general. The PBC concept is still new and much of the advantages are disputed. For example, some agencies do not agree that there is saving in terms of monetary value in this method. Another controversial aspect is the Level of Service (LOS). The expectation for improving the level of service is always there although the agency's current service standard might be low. The agency has to decide which LOS is to achieve through the contracting process and relates it to the cost structure. Besides cost saving and improved level of service, typical advantages also include shifting of risks to the contractor, scope for innovation, better asset management or integrated service arrangements, utilizing the benefits of partnering, economy of scale, improved or predicted budgeting and new service industry build up. However, disadvantages are also there as discussed or experienced by the community that include higher procurement cost, lengthy acquisition process, reduction in competition, uncertainty in long term relationships, loss of agency control and flexibility in fund management and challenges involving mobilization. Estimated potential saving that can be achieved by the owner agency typically ranges from 30-40% depending on location, culture and other factors affecting optimization (pakkala 2006).

Problem Statement

Because performance-based maintenance contracts extend over multiple years (typically 5-7 years) and shift performance risk to contractors (i.e. failure to meet performance standards and targets), it is critical that contractors be selected based on a form of best-value method rather than the conventional low-bid method. Much of the partnering success and fruitful project outcome depends on setting up the optimum contractor selection criteria and choosing the best-value contractor. Highway agencies use the best-value approach for awarding contracts to obtain the optimum combination of bid price and bid quality. Normally, a cost score is determined based on the bid price and the technical score is determined based on quality-related items (such as qualifications, quality management plan, past experience, etc.). The two scores are then combined to determine the best-value bid. It is to be noted that the term quality is used throughout this study to refer to the quality of the bid (not the maintenance project).

Currently, highway agencies use various methods for determining the best-value bid based on these cost and technical scores. Little efforts have been made to understand and compare the various methods that are being used for determining the best-value bid based on these cost and technical scores. Thus, there is a need to analyze current methods for evaluating the best-value bid and identifying the best bid with optimum combination of price and quality for performance-based contracts for roadway maintenance.

Research Objective

The primary objectives of the research are as follows:

1. Identify current practices in best-value bid identification methodologies for procuring performance-based highway maintenance contract.
2. Investigate the theoretical soundness and possible drawbacks of existing best-value bid identification methods.
3. Device a methodology for customizing the existing best-value identification methods for use in performance-based contracts for roadway maintenance.

Research Methodology

The following steps will be followed to accomplish the objectives of this research:

Step 1: Perform Literature Review

This step will lead to a better understanding of the core issues involved in identifying best-value bid with focus on performance maintenance contract.

Step 2: Identify and Computerize Existing Methods for Best-Bid Identification Methods

Alternative methods for best-value bid identification will be identified and summarized through decision-making flowcharts. These methods will then be coded in a software tool for further sensitivity analysis (see Step 3). Emphasis will be made on the state highway agencies that are experienced in performance-based contracting.

Step 3: Evaluate and Improve Existing Methods for Best-Bid Identification Methods

A comprehensive evaluation will be carried out on the best-value bid identification methods that were identified and computerized in Step 2. The analysis will reveal the strengths and possible drawbacks of these methods, as well as potential ways to improve them.

Step 4: Develop a Methodology for Customizing Existing Methods for Best-Bid Identification Methods

In this step, a computerized methodology will be developed for customizing the existing best-value identification methods for use in performance-based contracts for roadway maintenance.

Organization

The thesis work has been organized into six chapters. Chapter I provides an overview of PBMC and describes the research objectives and scope. Chapter II focuses on reviewing the existing literature, with emphasis on contractor selection and evaluation criteria that can be used in PBMC. Chapter III discusses five case studies of best-value bid identification methods for PBMC. Chapter IV analyzes the case studies. A sensitivity analysis was performed through software automation to investigate the neutrality of the methods. Chapter V discusses the customization process for the optimum method of selecting the best-value bid. Finally chapter VI concludes with summary discussion and future research needs.

CHAPTER II

LITERATURE REVIEW

Gransberg and Molenaar (2004) defined best-value procurement as "the process which allows government contracting agencies to evaluate offers based on total procurement cost, technical solution, completion dates, and other criteria." Modified or enhanced low bid and the best value selection require that certain weights are distributed for technical evaluation instead of assigning 100 percent values for the price. Pakkala (2002) suggested that Best-Value and innovative PBMC procurement success is contingent upon to the extent of quality criteria taken into consideration instead of only price. Table 1 shows different price and quality measures used by the different countries for best-value bid evaluation in performance-based contracting.

Table 1. Weights of Contractor Selection Criteria in Different Countries (Pekkala 2002)

Country	***Weights for Selection Criteria***
Sydney, Western Australia and Tasmania	50% price, 50% other, varies with territory
Alberta, Canada	78% price, 22% other
British Columbia, Canada	40% price; 60% other
Ontario, Canada	90% price; 10% other
England	30-40% price; 60-70% other
Finland	75% price; 25% other
New Zealand	50% price; 50% technical criteria
Sweden	90% price; 10% other

Best-value process is designed to maximize innovation and enhance performance through a cooperative and trust worthy partnering process that share risks and rewards. SAIC (2006) contracting framework suggests three dimensional valuations for contractor selection that include technical evaluation, quality management/staffing/past performance evaluation and finally price criteria. Contractors' proposals are given certain weights for each evaluation category. A minimum technical and management scoring is established for further consideration of whether the price is reasonable.

Other alternative methods for contractor evaluation and selection are discussed in the NCHRP Report 10-61 and two of them are cited in the SAIC (2006) report. One of them is Quantitative Cost Technical Trade off and the other is Qualitative Cost Technical Trade off. The Army Source Selection Manual (2007) uses a Qualitative Cost Technical Trade Off. The selection is subjective and depends on the judgment of the officials instead of scale and rating. If the lowest cost proposal is "superior" or is "essentially equal" to other proposal in terms of non cost factors then the award is made to the lowest priced offer. Two officers may not arrive at the same conclusion although they follow the same process.

Vassallo (2007) formulated an interesting idea that is based on microeconomic theory. He has introduced new terms like "Gross social benefits", "Net social benefits", "Marginal maintenance and operational cost", "Quality Level", "Quality Index" etc to explain the optimum bidding procedure to recruit the optimum bidder for infrastructure management services. Instead of using a fixed and pre-defined level of service (i.e., expected performance level), the contractors are allowed to submit their best-value bid price along with the best quality index or level of service they can achieve. The highway agency will then decide which combination of price and quality index will be the best for them to maximize the net social benefits. Each bidder will bid according to their best combination of the level of service quality and operational cost where the marginal cost of operation and maintenance will be equal to the offered marginal quality. Also there will be minimum bid quality level below which the contractors will not be allowed to bid. The contractor that gives the highest net social benefits will be selected. The highway agency has to fix high disincentive scheme in order to prohibit overoptimistic bidding.

Performance Based Studies Research Group (Kashiwagi 2005) has figured out the differences between performance based procurement and price based procurement in their research that was based on analysis of 350 survey results of performance based procurement. The author suggests that the industry should move forward to the performance based procurement which they claim have higher performance number (97%) than the price based procurement. The study reinforces that performance based procurement in the construction industry significantly shifts the risk to the contractor, diverts the system from subjectivity to objectivity and select the best contractor by taking price and performance rating of the contractor both into account. The group has proposed a Performance Information Procurement System (PIPS ®) model that describes in details how to select the best performance based contractor for best-value confirmation.

Minchin et al (2005) suggested a quality based contractor rating model named as Quality Based Performance Rating (QBPR) system for contractor selection. They have considered Project Performance Factor (PPF) based on both questionnaire and past test results. The questionnaire based performance factor (PPF_q) considers project personnel, project management /control, schedule adherence, contractor organization and plant and equipment aspects and provide some weights for each component. The weights have been evaluated based on the author's previous research that was based on the responses from focus group, survey and investigator's experience. The materials and workmanship factors (PPF_d) was evaluated based on the test results recorded with the DOTs from the contractor's previous projects. Finally the combined performance factor is calculated using both performance factors using 20:80 (Test Results: Questionnaire) ratio as shown in equation 2.2. The weight method has been referred to the building construction industry that uses similar weights ratio for quality and performance (CONQUAS 2003). The Contractor Factor (CF) is calculated by taking the averages of contractor's Project Performance Factors for all projects. A Project Value (PV) weight is accommodated to adjust for the project sizes that give the Weighted Contractor Factor (WCF).

$$\begin{aligned} PPF_q = \;& 0.3\,(\text{Project Personnel}) \\ & + 0.2(\text{Project Management/Control}) \\ & + 0.2(\text{Schedule Adherence}) \\ & + 0.2(\text{Contractor Organization}) \\ & + 0.1(\text{Plant and Equipment}) \end{aligned} \qquad (2.1)$$

$$PPF = 0.2(PPF_d) + 0.8(PPF_q) \qquad (2.2)$$

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

$$WCF = \frac{\sum \text{PPF x PV}}{\sum PV}$$

Table 2 shows the example calculation for bid evaluation for three contractors A, B and C. The Highway Agency official will be responsible for allotting the Quality points against unit CF which may differ from project to project. For this project this has been assigned as 10,000 quality points. The C factor in dollar amount is calculated by taking the product of CF and Quality points and then it is deducted from the Contractor's bid price. Contractor C has the lowest Total bid price (adjusted) and thus wins the bid although contractor C is the highest bidder considering price.

Table 2. Sample Bid Evaluation Calculation as per QBPR System (Minchin 2005)

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

Waara and Brochner (2005) examined 386 public bidding documents in the Swedish Municipalities in 2003 and concluded that typically 70% price weight combined with three non-price criteria were used for contractor selection. Prices were translated into scale value using lowest bid or bid spread or average bid prices. Lowest bid price formulas were further subdivided into four categories. Non-price criteria were evaluated based on either absolute or on relative merits. The paper also used regression analysis (Johnson and Wichern 1998) to figure out that the lowest weight for any non-price criterion depended on the inverse number of the criteria. After analyzing 164 cases that involved non-price criteria for contractor selection, they found that the average minimum weight for non-price criterion was 11.3% and the average maximum was around 17.6%. The regression equation fitted for minimum and maximum weights are shown in equations 2.3 and 2.4.

$$w_{min} = \frac{0.273}{m} + 0.0148 \quad (2.3)$$

$$w_{max} = \frac{0.140}{m} + 0.1256 \quad (2.4)$$

Use of multi-criteria contractor selection increases the contractor's incentive to align more with the Owner's needs and incorporates public policy objectives in the procurement process. The contractor incentive is high enough when the bid evaluation model is transparent, likelihood of future contract is more obvious and the weights for non-price criteria being decisive. The paper also explains the degree of information flow required about the bid evaluation criteria and corresponding weights to the bidders before their submission of bids. If the intention is to induce innovation from at least one of the bidders, then it would be recommended not to pre-specify the criteria and weights in details. This would lead to alternative investment of the owner agency's procurement resources in better defining the performance terms and preparing transparent bid documents that would later avoid transaction costs in terms of bid evaluation and litigation risks due to favoritism accuse. Bid evaluation cost can also be reduced by minimizing the number of criteria. Besides, minimizing the number of non-price selection criteria also increases the likelihood of choosing different bidder. Waara and Brochner (2005) found that no Swedish Municipalities used more than 11 criteria in selecting the best-value bid as found from the 386 bid analyses.

Lo and Yan (2009) has postulated a simulation approach analyzing the pricing behavior of contractors and dynamic competition process to evaluate the Qualification-

Based Selection (QBS) of contractors. They concluded that the contractor's opportunistic bidding behavior can be avoided and quality be ensured only if the contractor's past performance is carefully and closely examined and reflected in the bid evaluation process.

Abdelrahman et al (2008) conducted research on the Best-Value Model based on the past projects data provided by the Minnesota Department of Transportation (MnDOT) and identified and analyzed the specific evaluation criteria and their weight impacts for best value score determination for each contractor for a specific project. Weighted average method and analytical hierarchy process were used as alternative options for selecting the best value bid. As cited in the paper, the MnDOT Engineers suggested a price weight in the range of 75-80% for the transition period; from the lowest bid to the Best-Value contractor selection.

CHAPTER III

CASE STUDIES

This chapter describes and analyzes five best-value bid identification methods used by five different highway agencies for performance-based maintenance contracts. In four of these case studies, the contract has already been awarded by the highway agency and is currently under execution by the maintenance contractors, whereas the fifth one (UK Highway Agency) is a model contract usually followed as a standard contract format by the agency.

Florida Department of Transportation Case Study

This case study consists of Florida Department of Transportation's (FDOT 2008) asset maintenance contract #E5N05 for maintenance of primary highways in Brevard, Osceola, and portions of Orange and Volusia Counties in Florida. The contract period is from July 1, 2009 up to June 30, 2016, for a total of 7 years with a provision of possible renewal once or twice with mutual agreements of both parties. The actual bid tabulation for this case study has been attached to appendix B.

The flowchart in Figure 1 shows the award process for the successful contractor. The minimum technical score required is 70. Price and Technical proposal are given 30 and 70 percent of weights as determined by formulae 3.1 and 3.2. The contractor with highest total proposal score (i.e., weighted sum of technical and price scores) is identified as the best-value bid and thus wins the bid. Thus, it is clear that meeting the minimum technical score requirement is not sufficient to win the bid. The agency by establishing price and technical proposal weights defines its incentive scheme for the quality which may be understood through the analysis of equivalent bid concept. Two bids can be said equivalent if, after evaluation, their total proposal score are same although they have different technical and price score combination.

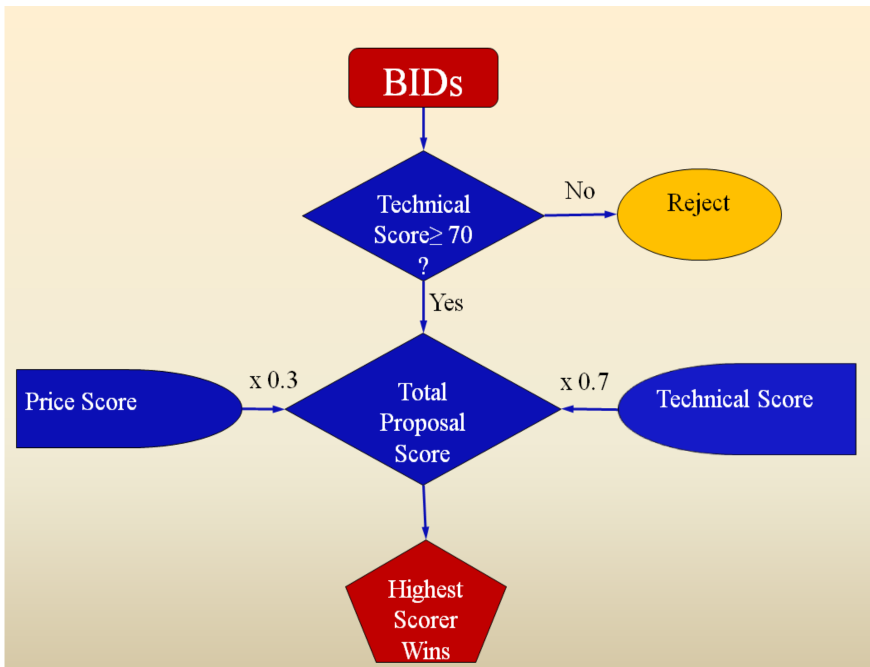

Fig. 1. Flowchart of FDOT's Maintenance Contract Bid Evaluation Method

Bid proposal is evaluated based on predefined project-specific technical criteria (see Table 3) to determine the total technical marks (TTM). A Technical Score (TS) is then computed as shown in Formula 3.1.

$$TS = TTM \times 0.7 \quad (3.1)$$

Price Score (PS) is computed relative to the lowest bid price according to Formula 3.2.

$$PS = \frac{P_L}{P} \times 30 \tag{3.2}$$

where P_L is the lowest bid price and P is the Proposer's bid price.

The Total Proposal Score (TPS) is calculated using Formula 3.3.

$$TPS = TS + PS \tag{3.3}$$

Table 3. FDOT's Technical Score Evaluation Criteria (FDOT 2008)

Item	*Mark*
1. Executive Summary	5
2. Administrative Plan	25
a. Identification of Key Personnel, Organization Structure, Coord., Comm.	10
b. Contractor Experience	10
c. DBE/Respect/Agency Participation	2
d. Proposed Facilities Capabilities	3
3. Management and Technical Plan	25
a. Plan to achieve and maintain MRP	15
b. Permit processing plan	NA
c. Bridge Inspection	NA
d. Customer service resolution plan	10
4. Operation Plan	35
a. Incident response operations	10
b. Routine/Periodic Maintenance Maintenance Operations	25
c. Bridge Maintenance Operations	NA
d. Rest area maintenance operations	NA
5. Plan for compliance with standards	10
a. Comliance with current department procedures, FL Statutes and FL Admistrative Code	5
b. Compliance with current department Manuals, Guides and Handbook	5
Max Technical Raw Score =	100

To be able to express the total proposal score as a function of technical marks and bid price, the concept of price ratio, R, is introduced, as follows:

$$R = \frac{P}{P_L}$$

A 3-D graph that represents the relationship between TPS, TTM, and R for FDOT's method is shown in Figure 2.

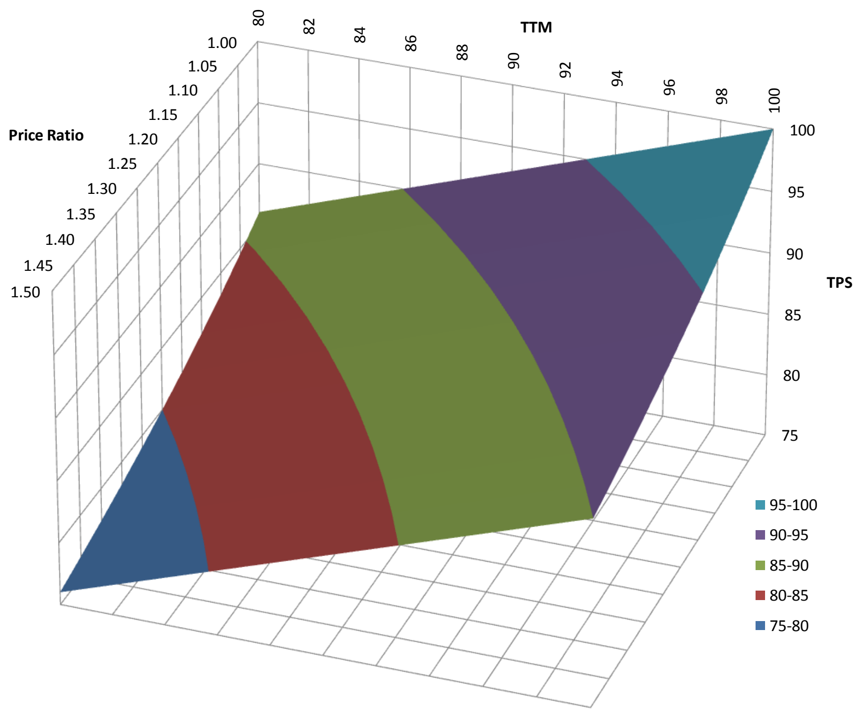

Fig. 2. 3-D Depiction of TPS as Function of Price Ratio and TTM for FDOT

Virginia Department of Transportation Case Study

This case study consists of the Virginia Department of Transportation's (VDOT) Turnkey Asset Maintenance Services (TAMS) contract on the Woodrow Wilson Bridge and associated highways. This project extends partly in the Commonwealth of Virginia and partly in the State of Maryland. The award is for five years (2010 to 2015), with a provision of two successive 2-year extension (a total of 4 years extension).

Figure 3 shows the flowchart for identifying the best-value bid for this maintenance contract.

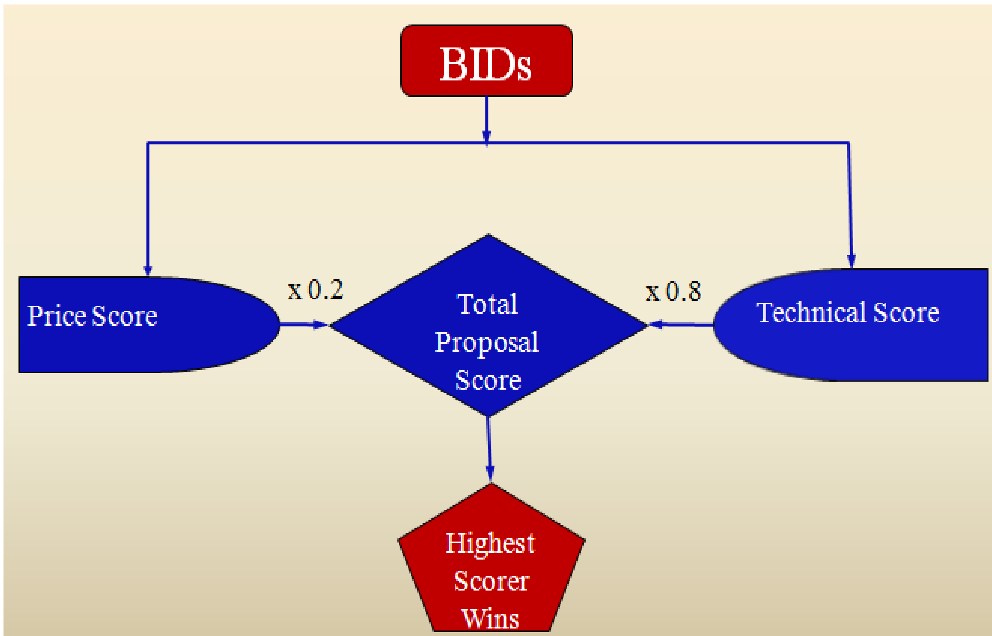

Fig. 3. Flowchart of VDOT's Maintenance Contract Bid Evaluation Method

The score evaluation criteria are shown in Table 4 where, out of a total of 100 points, VDOT allocates 20 points for price criterion and the remaining 80 points for quality. The TS for the proposal is determined as the summation of technical points obtained from Table 4. The PS is computed relative to the lowest bid price according to Formula 3.4.

$$PS = \frac{P_L}{P} \times 20 \qquad (3.4)$$

where P_L is the lowest bid price and P_1 is the Proposer's bid price.

Table 4. Maximum Point Values for Evaluation Criteria Used by VDOT (VDOT 2009)

Item	*Mark*
1.Experience and Qualifications	15
a. Reference	
b. Experience	
a. Qualifications	
2.Quality of Ordinary Maintenance Plan	30
a. Quality of ordinary maintenance plan	
b. Widrow Wilson Bridge inspection, maintenance and operations.	
c. Quality Management Plan	
d. Customer service, Timeliness Requirement and Tracking Plan	
e. Third party damages accounting receivable claims process and Reporting	
3.Quality of Emergency Response Plan	15
a. Quality of emergency response plan	
b. Quality of severe weather plan	
4.Small Business Subcontracting plan	20
5.Proposed Pricing Schedule	20

The Total Proposal Score (TPS) is calculated using Formula 3.5.

$$TPS = TS + PS \tag{3.5}$$

A 3-D graph that represents the relationship between TPS, TTM, and price ratio for VDOT is shown in Figure 4.

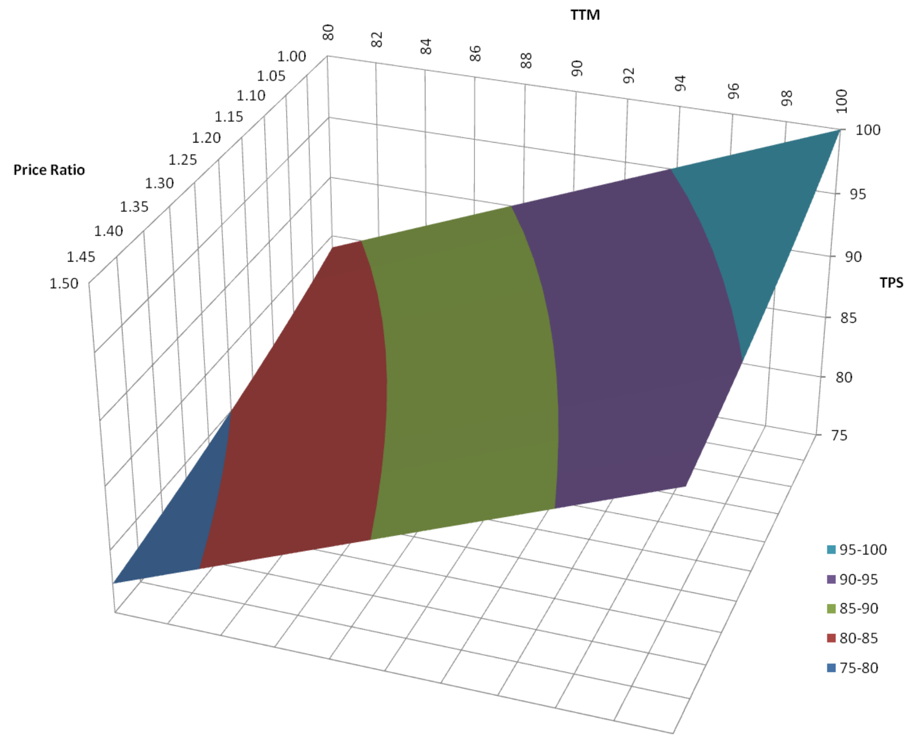

Fig. 4. 3-D Depiction of TPS as Function of Price Ratio and TTM for VDOT

North Carolina Department of Transportation Case Study

The North Carolina Department of Transportation (NCDOT 2007) case study consists of an interstate maintenance contract for 131 centerline miles on I-77, I-85, I-485, and I-277 in Mecklenburg, Gaston, Cabarrus and Cleveland counties. The contract extends from May 2007 to April 2012. The actual bid tabulation for this case study has been attached to appendix C. The final Request for Proposal required that the contractor submits technical and financial offers separately and the best-value bid was identified based on both price and technical evaluation.

As shown in Figure 5, the bid evaluation criteria for this case study is based on the concept of quality credit. A quality value is determined based on technical score (see Table 5) and quality credit percentage (see Table 6). The quality value is computed as:

Quality Value = Quality Credit % x Bid Price (3.6)

Bid Prices are then adjusted based on the quality value, as follows:

Adjusted Bid Price = Bid Price – Quality Value (3.7)

The bid with the lowest adjusted bid price is identified as the best-value bid.

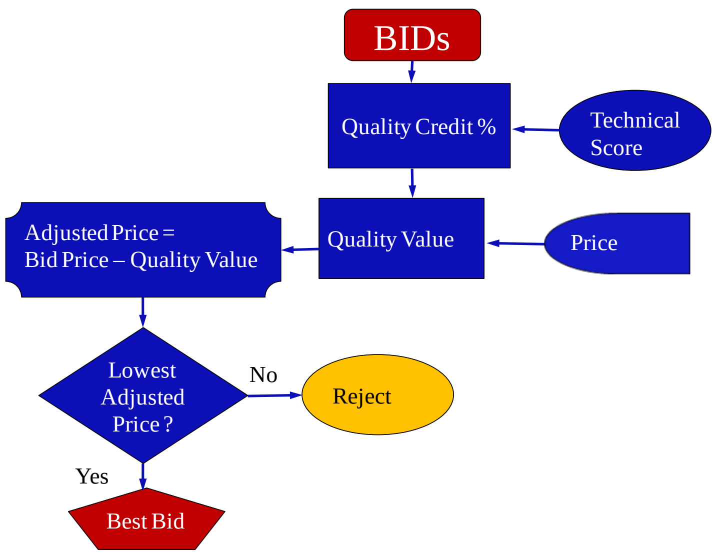

Fig. 5. Flowchart of NCDOT's Maintenance Contract Bid Evaluation Method

Table 5. Technical Score Criteria for North Carolina DOT Case Study

Technical Attribute	***Mark***
Management	20
Responsiveness to Request for Proposal	40
Maintenance of Traffic and Safety Plan	20
Timeliness Requirements and Tracking	15
Oral Interview	5
Total Technical Mark =	100

In Table 5, Responsiveness to RFP carried 40 points that included four subcategories: General 15 points; Quality Management 15 points; Minority and Women's Business Enterprise and Small Business 5 points; and finally Natural Environmental Responsibility 5 points. After assigning the quality marks, NCDOT distributed the quality credit for each proposal. The maximum quality credit for this specific project was 20; meaning that the proposal with 100 technical marks (i.e., full marks) would receive a quality credit of 20%. The quality credit distribution for technical scores ranging between 100 and 80 is shown in Table 6. A quality value is determined based on technical score (Table 5) and quality credit percentage (Table 6). The bid with the lowest adjusted bid price is identified as the best-value bid.

Table 6. Quality Credit Distribution for Technical Proposal (NCDOT 2007)

Technical Score	***Quality Credit (%)***	***Technical Score***	***Quality Credit (%)***
100	20	89	9
99	19	88	8
98	18	87	7
97	17	86	6
96	16	85	5
95	15	84	4
94	14	83	3
93	13	82	2
92	12	81	1
91	11	80	0
90	10		

Table 7 provides a hypothetical example to illustrate NCDOT's method. In this example, Contractor C has a technical score 90 and corresponding quality credit percentage of 10. This leads to an adjusted bid price of $2,520,000 (using Eq. 3.6 and 3.7). Since Contractor C has the lowest adjusted price, contractor C is selected as the best-value bid.

Table 7. Hypothetical Example for Calculating Adjusted Price (NCDOT 2007)

Proposal	***TS***	***Quality Credit (%)***	***Price Proposal ($)***	***Quality Value ($)***	***Adjusted Price ($)***
A	95	15	3,000,000	450,000	2,550,000
B	90	10	2,900,000	290,000	2,610,000
C*	90	10	2,800,000	280,000	2,520,000 (Best-Value Bid)
D	80	0	2,700,000	0	2,700,000
E	70	0	2,600,000	0	2,600,000

A 3-D graph that represents the relationship between Adjusted Price, TTM, and price ratio for NCDOT's method is shown in Figure 6.

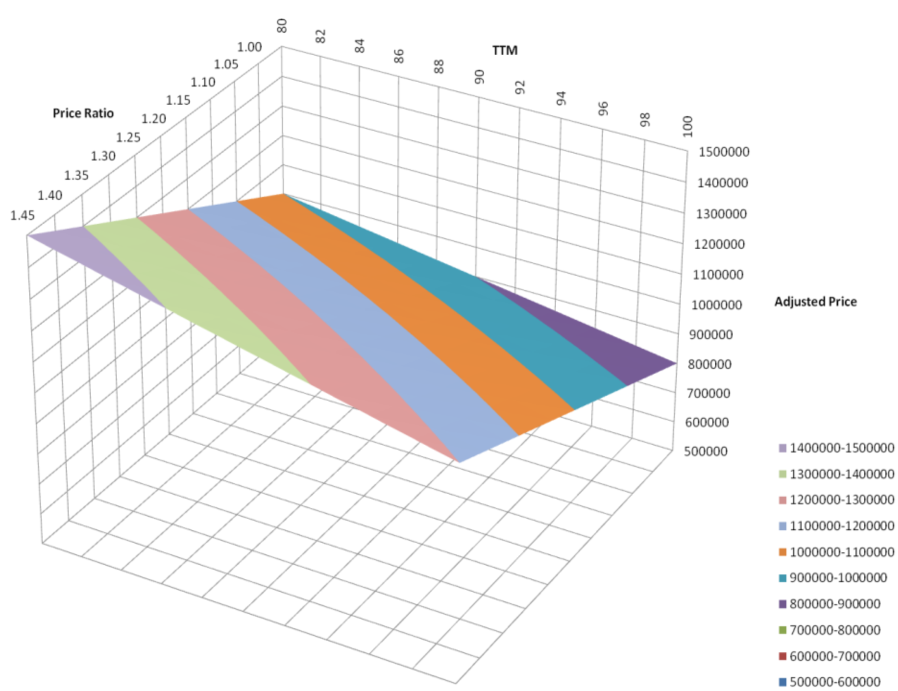

Fig. 6. 3-D Depiction of Adjusted Price as Function of Price Ratio and TTM (NCDOT)

New Zealand Transport Agency Case Study

The New Zealand Transport Agency (NZTA 2009) awarded its Westcoast and Canterbury region highway maintenance contract for a 5-year period (2009 to 2014). The bid evaluation procuedure followed the Price Quality Method (PQM) which is described in Figure 7. Bid prices are adjusted by subtracting the supplier quality premium (SQP) from the submitted bid price.

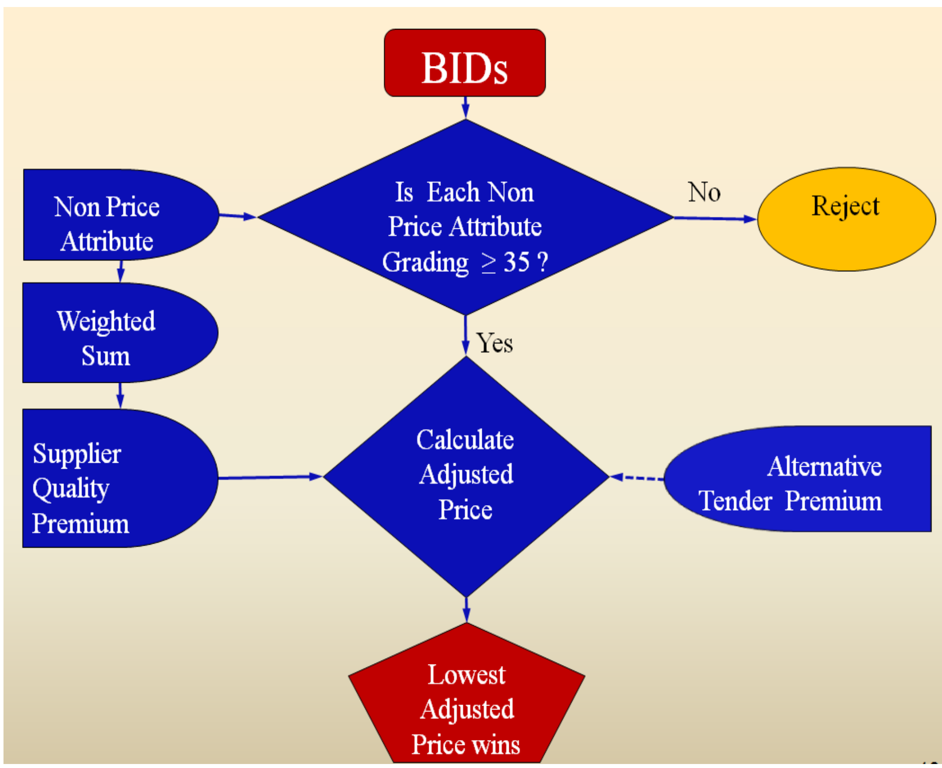

Fig. 7. Flowchart of NZTA's Maintenance Contract Bid Evaluation Method

This bid evaluation method is described through an example. This hypothetical example consists of four bidders with different quality attributes and prices.

As shown in Table 8, a weighted sum index is computed for each bidder based on several technical attributes (relevant experience, track recor, technical skills, resources, management skills, and methodology). Each individual index is computed as the the product of an assessed grade and an attribute weight. The weights are determined by NZTA and the grade is determined by agency's evaluators.

Table 8. Weighted Sum Calculation for NZTA (NZTA 2009)

Attribute	***Relevant Experience***		***Track Record***		***Technical Skills***		***Resources***		***Management Skills***		***Methodology***		***Weighted Sum (WS)***
Bidder	Grade	Index*	Grade	Index*	Grade	Index*	Grade	Index*	Grade	Index*	Grade	Index*	
1	69	2.07	83	2.49	83	3.32	78	5.46	82	3.28	55	4.95	21.57
2	75	2.25	87	2.61	87	3.48	87	6.09	84	3.36	80	7.20	24.99
3	68	2.04	84	2.52	80	3.20	76	5.32	79	3.16	57	5.13	21.37
4	75	2.25	85	2.55	87	3.48	85	5.95	82	3.28	60	5.40	22.91
									Lowest Weighted Sum				21.37

*Index = %Weight x Grade. (see Table 10 for weights)

Table 9 shows the attributes and their weights. Once the weighted sum (WS) is computed, then the weighted sum margin is calculated for each bidder by subtracting the weighted sum of the contractor from the lowest weighted sum of all bidders. A supplier quality premium (SQP) (Table 10) is computed as follows:

SQP = Agency's Estimate x (WS Margin / Price Weight) (3.8)

Table 9. Technical Score Criteria (New Zealand Transportation Agency Case Study)

Bid Attributes	***Weight***
Relevant Experience	3%
Track Record	3%
Technical Skills	4%
Resources	7%
Management Skills	4%
Methodology	9%
Price	70%
TOTAL	100%

In this hypothetical example, the agency's estimate for this project is $1,000,000 and the price weight is 70, as decided by the agency.

Table 10. Calculation of Supplier Quality Premium for NZTA

Bidder	*WS Margin (WS – Lowest WS)*	*Supplier Quality Premuim (SQP) (dollars)*
1	0.2	2,857.14
2	3.62	51,714.29
3	0	0
4	1.54	22,000.00

An adjusted price is then computed as follows:

Adjusted Price = Bid Price - SQP (3.9)

As shown in table 11, Bidder 2 received a quality premium of $51,714 and the bid price was $1,117,030, thus the adjusted price for this bidder is $1,065,315 (which is the best-value bid).

Table 11. Identification of Best-Value Bid for NZTA

Bidder	*SQP (dollars)*	*Original Bid Price (dollars)*	*Adjusted Bid Price (dollars)*
1	2,857.14	1,250,240	1,247,382
2*	51,714.29	1,117,030	1,065,315 (Best Value Bid)
3	0	1,109,470	1,109,470
4	22,000	1,182,970	1,160,970

A 3-D graph that represents the relationship between Adjusted Price, TTM, and price ratio for NZTA's method is shown in Figure 8.

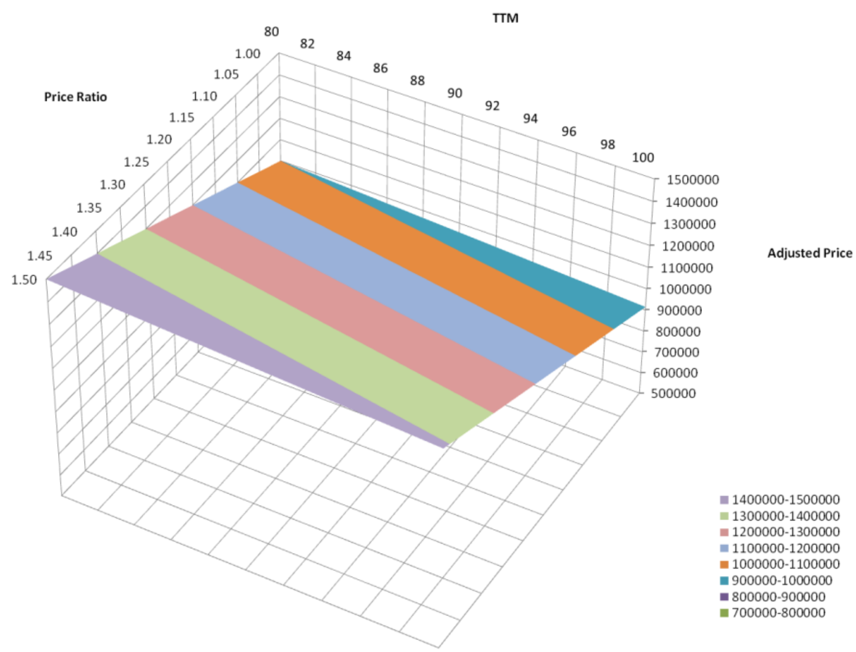

Fig. 8. 3-D Depiction of Adjusted Price as Function of Price Ratio and TTM for NZTA

United Kingdom Highway Agency Case Study

The United Kingdom Highway Agency (UKHA) outsources the maintenance contract through a Managing Agent Contract (MAC). The bid evaluation process is illustrated in Figure 9. Quality marks are assigned for project specific criteria (pre-defined by the agency) based on the contractor's approach to meet these criteria. The bidder's proposed approach is verified through supporting evidence from its past performance records.

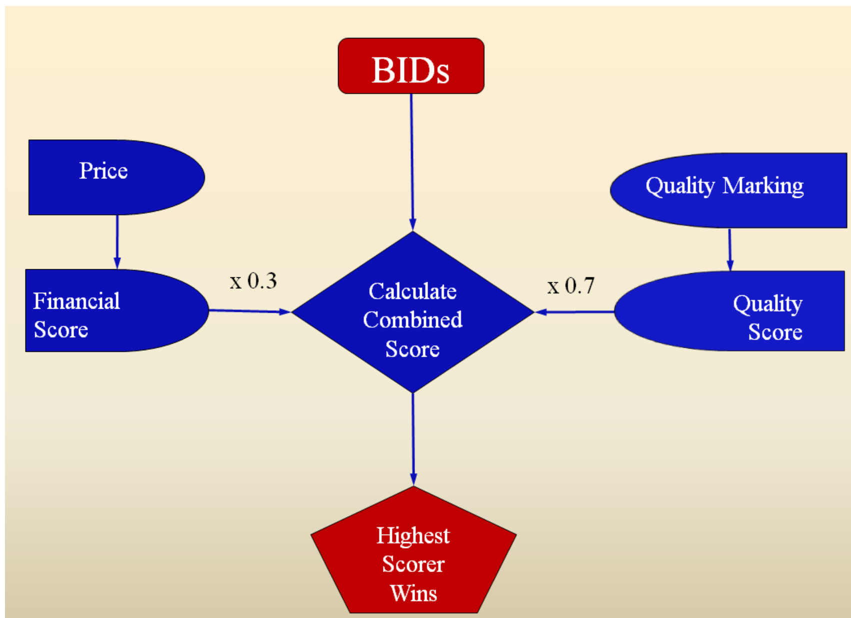

Fig. 9. Flowchart for UKHA Bid Evaluation Method

Table 12 shows the the assessment criteria along with example marks (for a hypothetical bidder). It can be seen that quality mark is assigned as the minimum of two marks: Part A mark on proposed approach and Part B mark on evidence provided by the bidder. For example, in the "Reducing Congestion" category, Part A mark is 9 and Part B mark is 8. Since Part B mark is the minimum of A and B, the quality mark assigned for this example bidder in this category is 8.

Table 12. Quality Marks for UKHA Bid Evaluation (UKHA 2009)

Assessment Criteria	*Part A Marks (0-10)* **Approach on this Contract**	*Part B Marks (0-10)* **Evidence from past projects**	*Lower of Mark A and B*
Maintaining Network Value	8	7	7
Enabling Network Use	8	8	8
Reducing Congestion	9	8	8
High Quality Customer Service	8	7	7
Improving Efficiency	9	8	8
Effective Management	9	7	7
Control of Quality	9	9	9
Reliability of Cost Estimates	9	8	8
Reliability of Time Estimates	9	8	8
Improvement of Safety	9	9	9
		Total	79

Part A marks and Part B marks are obtained from Tables 13 and 14, respectively.

Table 13. Categories for Part A Marks (UKHA 2009)

Proposed Approach	*How well does the proposed approach demonstrate an understanding of the project objectives and address the main management and technical risks relating to the project?*	*Marks*
Week	The approach fails to demonstrate an adequate understanding of the project objectives and fails to address adequately the main management and technical risks	1-4
Acceptable	The approach demonstrates an adequate understanding of the project objectives and covers the main management and technical risks to an acceptable standard	5-7
Good	The approach demonstrates a good understanding of the project objectives. It deals fully with the main management and technical risks and provides for delivering continual improvement over the life of the project	8-9
Excellent	The approach has been tailored specifically to suit the project objectives, uses innovative approaches to deal comprehensively with the main management and technical risks, and is likely to maximize performance against Key Performance Indicators and deliver continual improvement.	10

Table 14. Categories for Part B Marks (UKHA 2009)

Supporting Evidence	***How well does the evidence from previous projects provide confidence that the proposed approach is likely to be successfully delivered.***	***Mark***
Week	There is little evidence that the proposed approach has been influenced by experience on other projects	1-4
Acceptable	There is an adequate level of evidence that the proposed approach has been developed as a result of successful experience on other projects	5-7
Good	There is substantial evidence that the proposed approach has been developed from other projects using formal continual improvement processes	8-9
Excellent	There is substantial evidence that the approach has been developed using continual improvement processes, which are routinely used to develop approaches and deliver the objectives successfully on all projects.	10

After assigning the quality marks, the bidder with the highest quality mark is given a technical score of 100. The remaining bidders receive a deduction of one quality mark for each full percentage point below the highest quality mark. A price score is determined in a similar manner. The lowest bidder receives a price score of 100 and the remaining bidders receive a deduction of one price mark for each full percentage point above the lowest bid. The total proposal score is computed as follows:

$$TPS = 0.7 \times TS + 0.3 \times PS \qquad (3.10)$$

where TPS is total proposal score; TS is technical score; and PS is price score. The bidder with highest TPS is determined as the Leading Bidder (or best-value bid). This process is described through the hypothetical example shown in Tables 15, 16, and 17.

Table 15. Quality Score Distribution (UK-HA 2009)

Bidder	*Quality Mark*	*% below Highest Quality Mark*	*Reduction*	*TS*
A	68	13.9%	13	87
B	61	22.8%	22	78
C*	79	0.0%	0	100 (Highest Quality)
D	75	5.1%	5	95
E	65	17.7%	17	83

Table 16. Financial Score Distribution (UK-HA 2009)

Bidder	*Bid Price*	*% above lowest Price*	*Deduction*	*PS*
A	52,000,000	23.8%	23	77
B*	42,000,000	0%	0	100 (Lowest Bid)
C	55,000,000	30.9%	30	70
D	47,000,000	11.9%	11	89
E	44,000,000	4.8%	4	96

As shown in Table17, contractor D is the highest combined scorer and thus determined as the best-value bidder.

Table 17. Combined Score Calculation (UKHA 2009)

Bidder	*70% of TS*	*30% of PS*	*TPS*
A	60.9	23.1	84.0
B	54.6	30.0	84.6
C	70.0	21.0	91.0
D*	66.5	26.7	93.2 (Best-Value Bid)
E	58.1	28.8	86.9

A 3-D graph that represents the relationship between TPS, TTM, and price ratio for UKHA's method is shown in Figure 10.

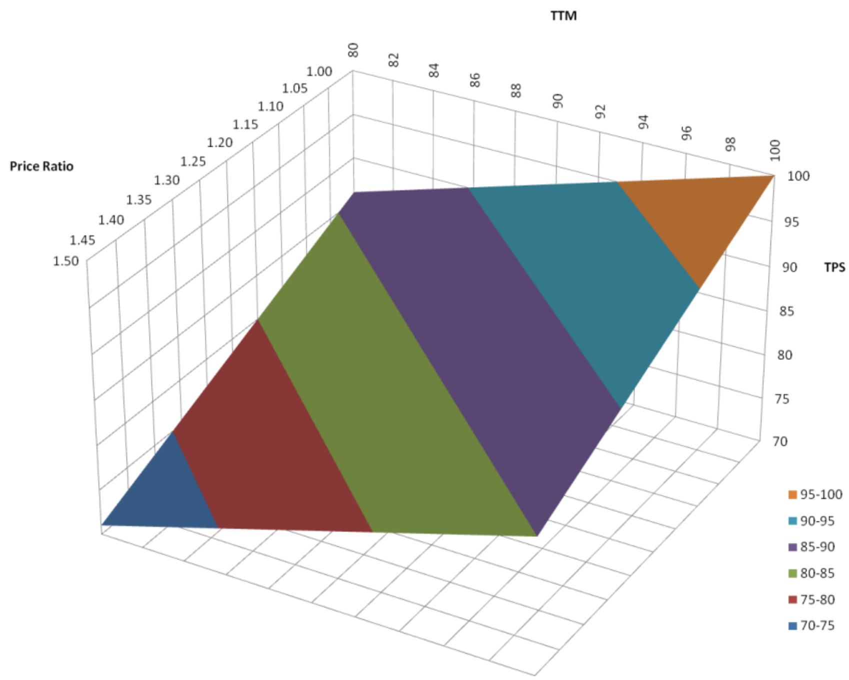

Fig. 10. 3-D Depiction of TPS as Function of Price Ratio and TTM for HAUK

CHAPTER IV

ANALYSIS OF CASE STUDIES

In this chapter, the best-value bid identification methods discussed earlier are evaluated in terms the agency's willingness to pay for quality and the neutrality of these methods with respect to lowest bid and highest quality.

Evaluation of Willingness to Pay for Quality

A best-value bidding system represents the agency's willingness to pay for bid quality (i.e. contractor performance track record). The agency's willingness to pay for any given increment in quality score over the quality score of the lowest bidder is evaluated using the the concept of equivalent bid. Suppose that the lowest bidder has a bid price P_L, total technical marks of TTM_L, and a technical score of $TS_{L.}$ For any other bidder (with a bid price of P and total technical marks of TTM) to be equivalent to the lowest bidder, their technical score (TS) must be greater than TS_L, so that their total proposal score (TPS) becomes equal to the total proposal score of the lowest bidder (TPS_L). The agency's willngness to pay for quality can then be measured using a curve that represents the relationship between technical score and bid price ratio *p*. This analysis was carried out on each of the case studies using a TTM_L of 80, as discussed in the following sections of this thesis report.

FDOT Bid Evaluation Method

Using Formulas 3.1 through 3.3, TPS_L and TPS can be expressed as follows:

$$TPS_L = \frac{P_L}{P_L} * 30 + TTM_L * 0.7$$

$$TPS = \frac{P_L}{P} * 30 + TTM * 0.7$$

where TPS_L is the total proposal score for the lowest bidder; TPS is the total proposal score for the equivalent proposer; TTM_L is the total technical marks for the lowest bidder; TTM is the total technical marks for the equivalent proposer; P_L is the lowest bid price; and P is the bid price for the equivalent proposer.

If the two proposals are equivalent then, TPS = TPS_L. Thus, the price ratio R is computed as follows:

$$R = \frac{30}{0.7*(TTM_L - TTM)+30} \quad (4.1)$$

The R vs. TTM curve represents FDOT's willingness to pay for quality (see Figure 11). For example, the agency in this case is willing to pay for the highest quality bidder (100 score) 1.9 times (90% more) of the price of the lowest bidder (who is assumed to have a TTM of 80).

VDOT Bid Evaluation Method

Since VDOT's technical marks range between zero and 80, it was necessary to convert this range to 0-100 to be consistent with the bid evaluation methods from the other case studies. Thus, TPS_L and TPS can be expressed as follows:

$$TPS_L = \frac{P_L}{P_L} * 20 + TTM_L * 0.8$$

$$TPS = \frac{P_L}{P} * 20 + TTM * 0.8$$

where TTM is on a 0-100 scale.

If the two proposals are equivalent then, $TPS_1 = TPS_L$. Thus, the price ratio *p* is computed as follows:

$$R = \frac{20}{0.8*(TTM_L - TTM)+20} \tag{4.2}$$

The R vs. TTM curve represents VDOT's willingness to pay for quality (see Figure 11). For example, the agency in this case is willing to pay for the highest quality bidder (a TTM of 100) five times of the price of the lowest bidder (who is assumed to have a TTM of 80).

NCDOT Bid Evaluation Method

Using formula 3.6 and 3.7, the adjusted prices are expressed as follows:

For $TTM \geq 100 - Q_{max}$

$$AP_L = P_L - P_L \times [Q_{max} - (100 - TTM_L)] \times 0.01$$

$$AP = P - P \times [Q_{max} - (100 - TTM)] \times 0.01$$

where AP_L is the adjusted price for the lowest bidder; AP is the adjusted price for the equivalent proposer; and Q_{max} is the maximum quality credit.

If the two proposals are equivalent then, $AP = AP_L$. Thus, the price ratio R is computed as follows:

$$R = \frac{200 - TTM_L - Q_{max}}{200 - TTM - Q_{max}} \tag{4.3}$$

For $TTM < 100 - Q_{max}$ the bidder does not receive any quality credit and thus R = 1.0

In this case study, the maximum quality credit was 20. The *R* vs. *TTM* curve represents NCDOT's willingness to pay for quality (see Figure 11). For example, NCDOT in this case is willing to pay for the highest quality bidder (a TTM of 100) 1.25 times (25% more) the price of the lowest bidder (who is assumed to have a TTM of 80).

NZTA Bid Evaluation Method

Using formula 3.8 and 3.9, the adjusted prices are expressed as follows:

$$AP_L = P_L$$

$$AP = P - \frac{WS - WS_L}{70} * NE$$

where AP_L is the adjusted price for the lowest quality bid; AP is the adjusted price for the equivalent proposer; WS_L is the weighted sum for the lowest quality bid; WS is the weighted sum for the equivalent proposer; and NE is the net estimate of the bid price by the agency.

If the two bids are equivalent, then AP = AP_L and the price ratio with respect to the lowest bid price is given by,

$$R = 1 + \frac{NE}{70 * P_L} * (WS - WS_L) \quad (4.4)$$

Since NZTA's WS (which represents the total technical marks) ranges between zero and 30, it was necessary to convert this range to 0-100 to be consistent with the bid evaluation methods from the other case studies. Thus, the price ratio equation becomes:

$$R = 1 + \frac{0.3 * NE}{70 * P_L} * (TTM - TTM_L) \quad (4.5)$$

For this case study the price and TTM of the lowest bidder were $6,500,000 and 80, and the agency's net estimate was $9,850,000. Using these values, equation 4.5 can be plotted as shown in Figure 11 which represents the NZTA's willingness to pay for quality. For example, the agency is willing to pay for the highest quality bidder (a TTM of 100) 1.12 times (12% more) of the price of the lowest bidder (who is assumed to have a TTM of 80).

HAUK Bid Evaluation Method

Using equation 3.10 and HAUK's definition of price and technical scores, TPS_L and TPS can be expressed as follows:

$$TPS_L = 0.7 * \left(100 - \frac{TTM^* - TTM_L}{TTM^*}\right) + 30$$

$$TPS = 0.7 * \left(100 - \frac{TTM^* - T}{TTM^*}\right) + 0.3 \left(100 - \frac{P - P_L}{P_L}\right)$$

If the two proposals are equivalent then, $TPS = TPS_L$. Thus, the price ratio R is computed as follows:

$$R = 1 + \frac{0.7}{0.3} * \frac{1}{TTM^*} * (TTM - TTM_L) \quad (4.6)$$

Equation 4.6 is plotted in Figure 11 assuming a TTM* of 100. For example, the agency is willing to pay for the highest quality bidder (a TTM of 100)1.47 times (47% more) of the price of the lowest bidder (who is assumed to have a quality score of 80).

Discussion of Evaluation Results

The purpose of this analysis is not to determine the optimal payment for quality, but rather to measure the agency's willingness to pay for quality. Willingness-to-pay-for-quality (WTP) curves are shown in Figures 11 and 12 for all case studies, assuming a TTM_L of 80 and TTM_L of 70. Since VDOT's method uses a technical weight of 80%, if TTM_L is less than 70, a bidder with TTM=100 would be able to have a very high price and still be equivalent to the lowest bidder. Thus, VDOT's method is not applicable when TTM_L=70. The optimum WTP curve is a matter of agency policy. Highway agencies can develop optimum WTP curves using direct survey, indirect survey (Discrete choice analysis), experiments or empirical methods (Breidert 2005).

The VDOT method for best-bid evaluation provides the highest pay for quality, followed by the FDOT method, and then by the HAUK method. The NZTA and the NCDOT method provide the least pay for bid quality.

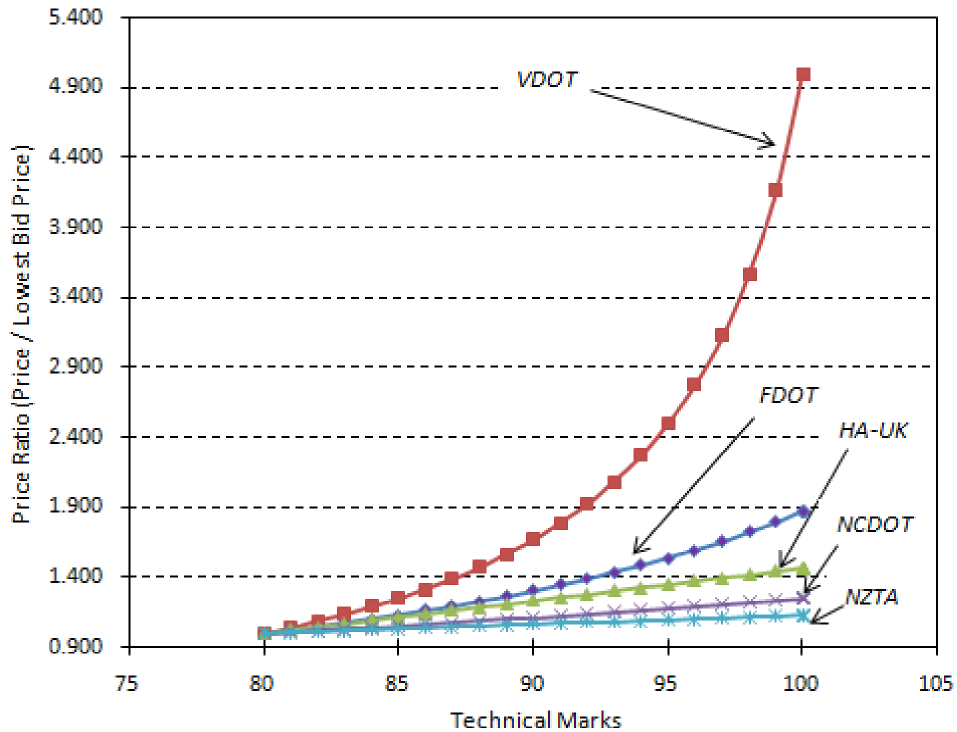

Fig. 11. Price Ratio Vs Technical Marks (TTM_L=80)

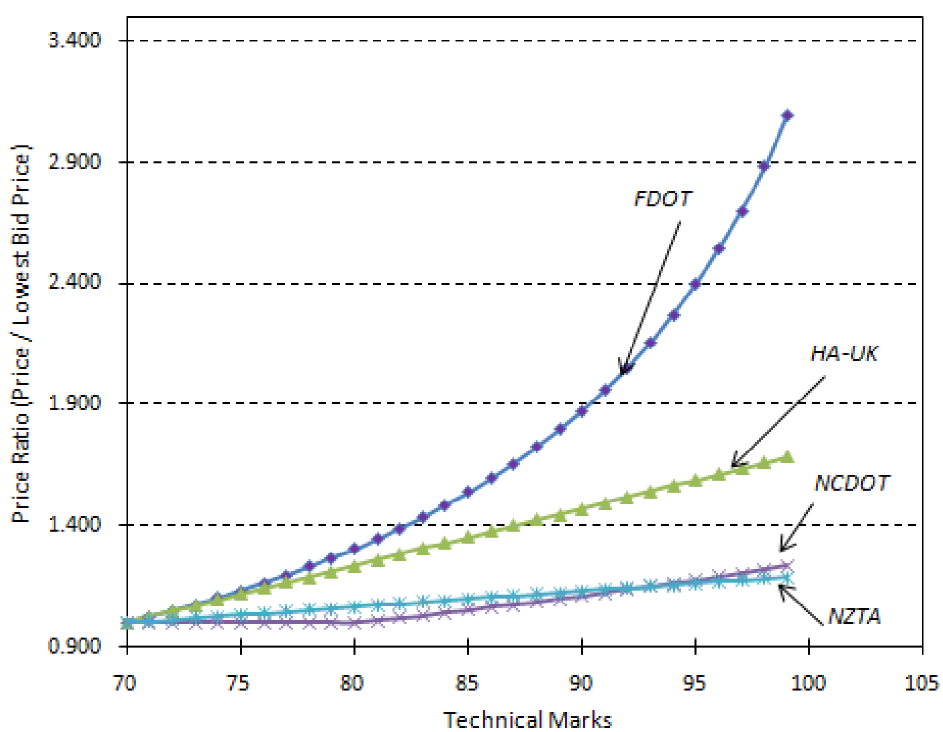

Fig. 12. Price Ratio Vs Technical Marks (TTM_L=70)

The FDOT and VDOT methods use the concept of technical and price weights that add to 100%. FDOT uses technical and price weights of 70% and 30%, respectively; whereas VDOT uses technical and price weights of 80% and 20%, respectively. As shown in Figure 11, these weights have a dramatic impact on the WTP curves. Highway agencies can set these weights to achieve a desired WTP curve (set by the agency's policy).

The NCDOT and NZTA methods both use the adjusted price concept to identify the best-value bid. The WTP curves depend on the quality credit used by these methods. However, for the specific parameters used in these case studies, agencies that use the price and technical weights concept appear to be more willing to pay for quality than those that use the adjusted price concept.

The UKHA method is the only method that considers the maximum quality offered by the bidders. Thus the bid mechanism is influenced by the quality of the highest bidder, instead of the price of the lowest bidder as in the case of the FDOT and VDOT method.

Neutrality in Best-Value Bid Evaluation Methods

To assess neutrality in the studied bid-evaluation methods with respect to quality and price, a Monte Carlo simulation of four hypothetical bids (A through D) with different bid prices and technical marks was carried. It should be noted that VDOT's and FDOT's methods use the same concept (i.e., technical and price weights). Only FDOT's method is simulated; however, FDOT's results can be extended to VDOT's method. In this analysis, it is assumed that the bidders will choose their prices based on the WTP curves (discussed earlier in this Chapter). Assuming that the lowest bidder has a total technical mark of 70 and a bid price of =$6.0 million (i.e., TTM_L=70 and P_L=$6.0 million), the ranges for the total technical mark and bid price of these hypothetical bids would be as illustrated in Table 18.

Table 18. Hypothetical Bid Price Range and Technical Marks

Bidder	***TTM Range***	**Bid Price Range $ million**			
		FDOT	NCDOT	UKHA	NZTA
A	86-90	9.2-10.8	7.1-7.4	8.1-8.7	6.6-6.8
B	81-85	7.8-8.9	6.7-7.0	7.4-8.0	6.4-6.6
C	76-80	6.8-7.6	6.3-6.6	6.7-7.26	6.2-6.4
D	70-75	6.0-6.6	6.0-6.3	6.0-6.56	6.0-6.2

For each best-value bid evaluation method, Monte Carlo simulation was used to generate 3000 bidding cases from the TTM and corresponding bid price ranges shown in Table 18. A best-value bid was then identified for each simulated bidding case. The probability of being identified as the best-value bid was then computed as follows:

$$P_r = \frac{N_D}{N_T} * 10 \qquad (4.7)$$

where P_r is the probability of being selected as best-value bid; N_D is the number of times (i.e., number of simulation iterations) for which the bid is selected as best-value bid; N_T is the total number of simulation iterations.

Since the bid prices were determined according the WTP curves, the behaviour of the analyzed methods can be classified as follows:

- Balanced: all bids have approximatly equal probability of being identified as best-value bid
- Favors Quality: bids with higher total technical mark have higher probability of being identified as best-value bid
- Favors Low Bid Price: bids with low bid price have higher probability of being identified as best-value bid

The results of the simulation are illustrated in Figure 13-16 and the detailed inputs and results are shown in Appendix A. Figure 13 shows that Bid D (lowest bidder and least TTM) has the highest probability of being identified as the best-value bid, whereas Bid A (highest bidder and highest TTM) has the lowest probability of being selected. Thus, FDOT’s method appears to favor low bid prices. Since bidders cannot predict the low bid with certainty, an underestimation of the low bid can mislead other bidders to raise their price and consequently lose the bid, as described in Figure 14.

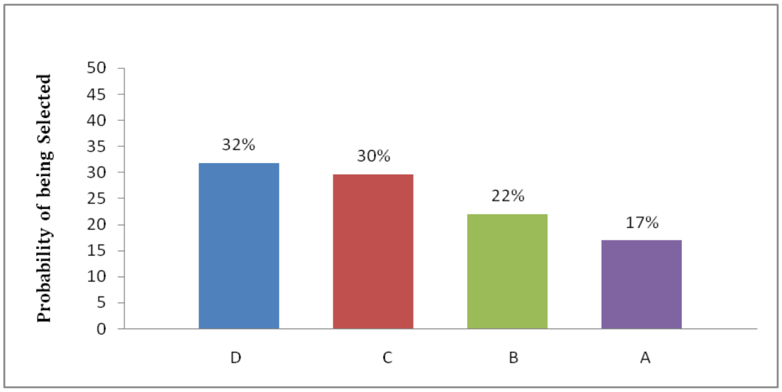

Fig. 13. FDOT's Best Bid Simulation Results

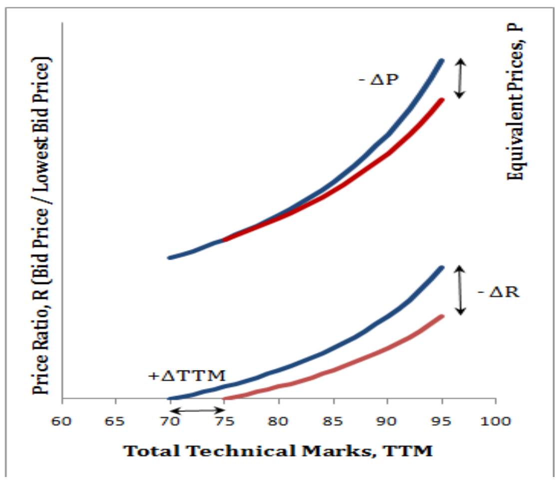

Fig. 14. Change in Price Ratio Vs change in TTM

Figure 15 shows that Bid A (highest bidder and highest TTM) has the highest probability of being identified as the best-value bid, whereas Bid D (lowest bidder and least TTM) has the lowest probability of being selected. Thus, UKHA's method appears to favor high-quality bids.

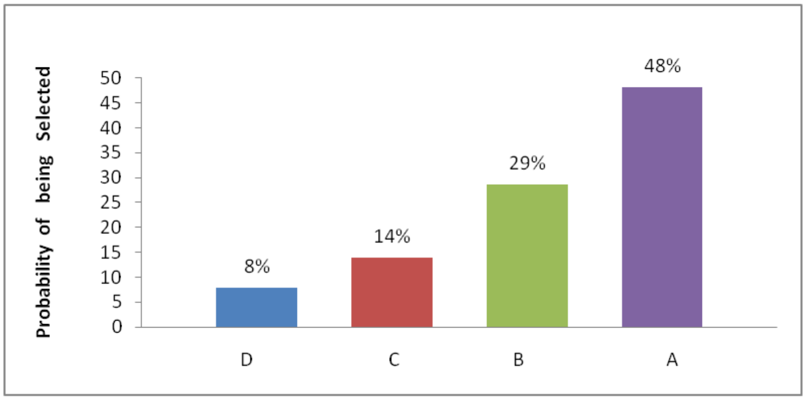

Fig. 15. UKHA's Best Bid Simulation Results

Figures 16 and 17 show that approximately all bids have equal chances of being identified as the best-value bid. Thus, NCDOT's and NZTA's methods appear to be balanced.

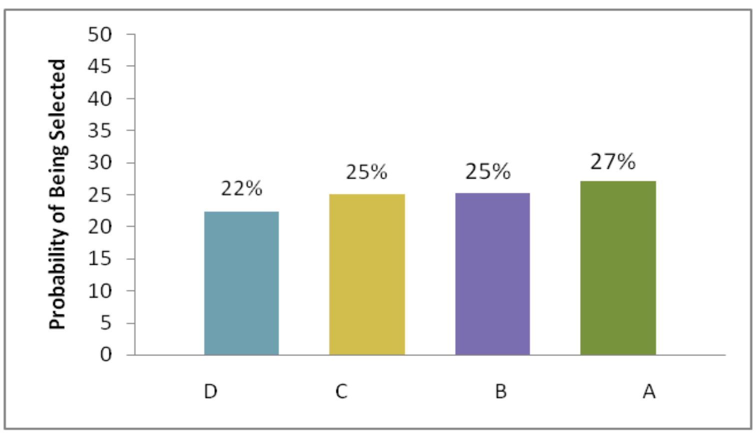

Fig. 16. NCDOT's Best Bid Simulation Results

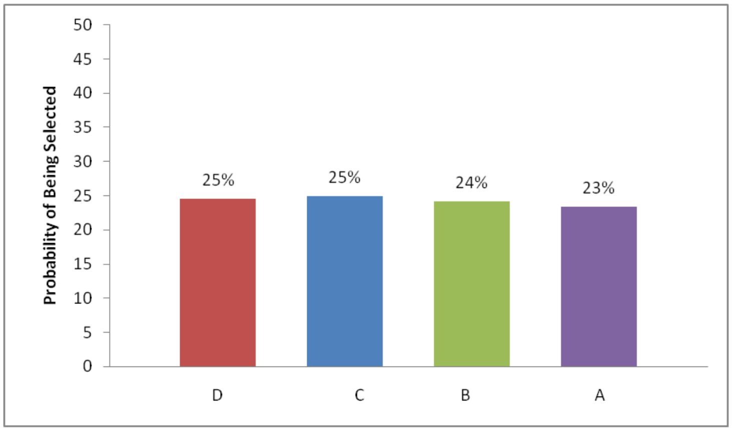

Fig. 17. NZTA's Best Bid Simulation Results

CHAPTER V

CUSTOMIZATION OF BEST-VALUE BID SELECTION METHODS

To help highway agencies customize the bid evaluation methods discussed earlier to specific projects, a software tool was developed and is discussed in this chapter.

Customization Process

This process involves determining the relative importance of bid price and bid quality to the agency based on project-specific parameters. The inputs, mathematical models, and outputs of this process are illustrated in Figure 18 for each category of the studied best-value bid selection methods (balanced, favors low bid, and favors high quality). Since NZTA's and NCDOT's methods are both "balanced", only NCDOT's method is considered in this analysis. As discussed earlier, NCDOT's method has an additional advantage of not requiring the agency to make and publish a bid net estimate.

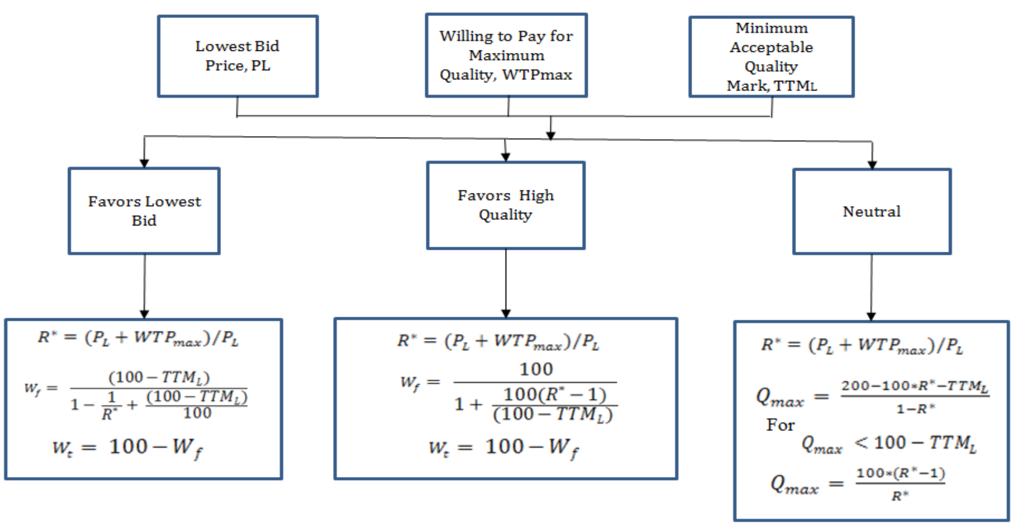

Fig. 18. Summary for Determining Technical and Financial Weights

Highway agencies can determine the willingness to pay for maximum quality (WTP_{max}) (in dollars) based on agency's budget limit, policy guideline, public willingness to pay for high quality maintenance, performance risks by the contractor and associated negative impacts on the agency and the public. However, there is a minimum acceptable quality limit (expressed in terms of minimum acceptable total technical mark, or TTM_L) below which the quality cannot be accepted by the public and thereby by the agency. Finally, this process assumes that the agency can anticipate the lowest bid price (based on past experience and historical data).

This process is discussed for each method as follows:

FDOT Bid Evaluation Method

Using Equation 4.1 (derived in Chapter Four), the price ratio for maximum quality bid (with TTM = 100), R^*, can be computed as follows:

$$R^* = \frac{W_f}{W_f - 0.01 * W_t * (100 - TTM_L)}$$

where TTM_L is the technical marks for the lowest quality bid; W_t is a 0-100 technical weight, and W_f is a 0-100 financial weight.

By replacing W_t with $100 - W_f$ and simplifying the above equation, the financial and technical weights can be calculated as

$$W_f = \frac{(100 - TTM_L)}{1 - \frac{1}{R^*} + \frac{(100 - TTM_L)}{100}} \qquad (5.1)$$

where by definition, $R^* = (P_L + WTP_{max})/P_L$

$$W_t = 100 - W_f \qquad (5.2)$$

HAUK Bid Evaluation Method

Using Equation 4.6 (derived in Chapter Four), the price ratio for maximum quality bid (with TTM = 100), R^*, can be computed as follows:

$$R^* = 1 + \frac{W_f}{W_t} * \frac{1}{100} * (100 - TTM_L)$$

where TTM_L is the technical marks for the lowest quality bid; W_t is a 0-100 technical weight; and W_f is a 0-100 financial weight.

By replacing W_t with $100 - W_f$ and simplifying the above equation, the financial and technical weights can be calculated as

$$W_f = \frac{100}{1 + \frac{100(R^*-1)}{(100-TTM_L)}} \quad (5.3)$$

where by definition, $R^* = (P_L + WTP_{max})/P_L$

$$W_t = 100 - W_f$$

NCDOT Bid Evaluation Method

In this method, a maximum quality credit is determined in lieu of technical and financial weights. Using Equation 4.3 (derived in Chapter Four), the price ratio for maximum quality bid (with TTM = 100), R^*, can be computed as follows:

$$R^* = \frac{200 - TTM_L - Q_{max}}{100 - Q_{max}}$$

where TTM_L is the technical marks for the lowest quality bid and Q_{max} is the maximum quality credit. Thus,

Using the above formula, Q_{max} can be computed as follows:

$$Q_{max} = \frac{200-100*R^{*}-TTM_{L}}{1-R^{*}} \qquad (5.4)$$

However, to ensure that the adjusted price is not less than the lowest bid, $Q_{max} \geq$ 100-TTM_L. If Equation 5.4 results in $Q_{max} < 100 - TTM_L$, Q_{max} can be computed as follows:

$$Q_{max} = \frac{100*(R^{*}-1)}{R^{*}} \qquad (5.5)$$

Application of the Customization Process

A software tool was developed to facilitate the application of the above customization process (see Figure 18). The application of this process is further explained through the example shown in Table 19.

Table 19. Sample Input and Corresponding Output for Customization Process

Method	***Lowest Bid P_L ($ mil)***	***WTP ($ mil)***	***TTM_L***	***R****	***W_f, %***	***W_t %***	***Q_{max}***
Favors Low Bid	6,500,000	1,000,000	70	1.154	69	31	NA
Favors High Quality	6,500,000	1,000,000	70	1.154	66	34	NA
Neutral	6,500,000	1,000,000	70	1.154	NA	NA	13

For the same project-specific parameters (inputs), the customization process has resulted in a higher financial weight for the bid evaluation method that favors low bid (compared to that of the bid evaluation method that favors high quality). Again, for the same inputs, the customization process has resulted in a maximum quality credit value of 13.

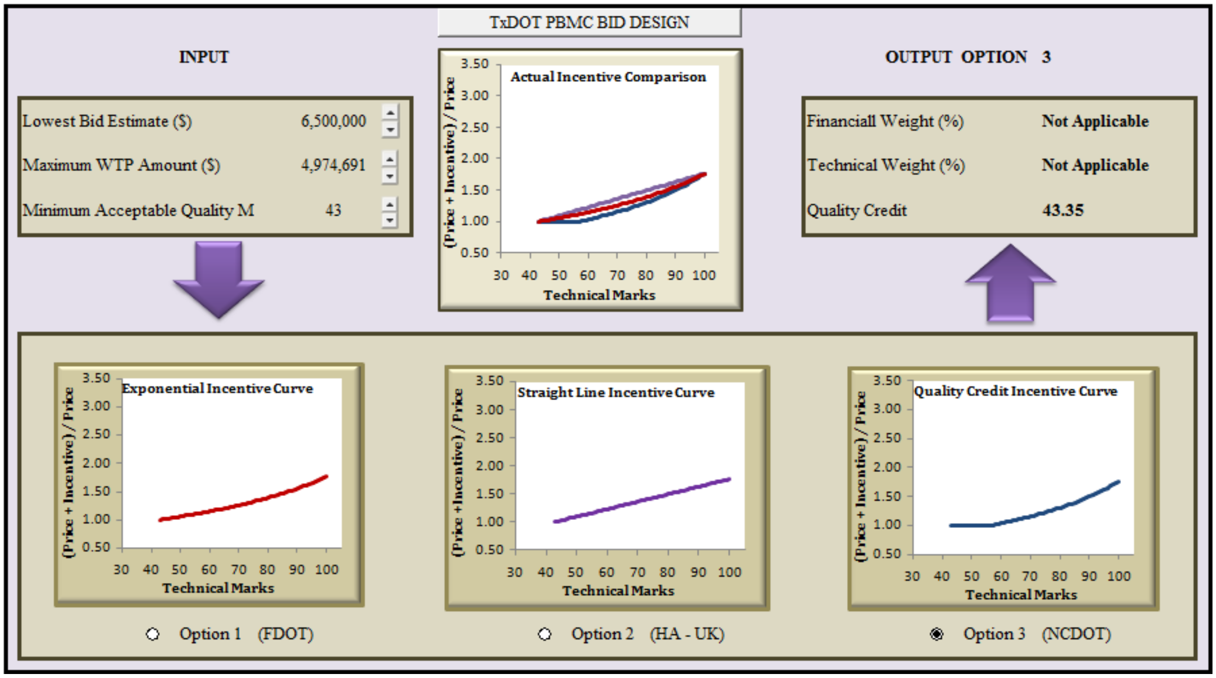

Fig. 19.TxBID Tool for TxDOT Bid Design.

Finally, it should be noted that the quality attributes or criteria must also be carefully chosen to align the contractor quality with the agency needs and project focus. Table 20 shows a comparison of the quality attributes used by the agencies in the case studies. These default technical marks are associated with the technical and financial weights and quality credit as shown in Table 21.

Table 20. Comparison of Quality Attributes Used by Different Agencies

Quality Attributes Vs TTM	***NZTA***	***FDOT***	***VDOT***	***NCDOT***	***HAUK***
Relevant Experience	7%	10%	18.75%		
Track Record	13%				
Technical Skills	13%				
Resources	17%				
Management Skill (Personnel)	17%	10%		15%	
Management Skill (Company Systems) / Quality Control / Health & Safety					10%
Methodology / Operation Plan / Routine / Periodic Maintenance Operations	33%	25%	37.5%	20%	10%
Executive Summary		5%			
DBE/Respect/Agency Participation/Minority/Women Business		2%	25%	5%	
Proposed Facilities Capabilities		3%			
Customer Service Resolution Plan / High Quality Customer Service		10%			10%
Incident Response Operations		10%			
Plan to Achieve and Maintain MRP		15%			
Plan for Compliance With standards		10%			
Emergency Response Plan			18.75%		
Oral Interview				5%	
Timeliness Requirements and Tracking				15%	
Maintenance of Traffic and Safety Plan				20%	10%
Natural Environment Responsibility				5%	
Understanding of Major components and Issues, Innovation, Initial Condition Assessment, Assessing and Collecting Funds as Third Party Claims etc.				15%	
Predictability of Cost					10%
Predictability of Time					10%
Improving efficiency and achieving continual improvement					10%
Reducing Congestion					10%
Maintaining Network Value					10%
Enabling Network Use					10%

Table 21. Default Weights and Quality Credit

Method	***W_f %***	***W_t %***	***Quality Credit %***
FDOT	30	70	NA
VDOT	20	80	NA
NCDOT	NA	NA	Q_{max}=20
UK	30	70	NA
NZTA	NA	NA	WS = 30

CHAPTER VI

SUMMARY, CONCLUSION AND FUTURE RESEARCH

This chapter is comprised of the summary of the research, conclusions that can be drawn based on the findings, and recommendations for future research in this context.

Summary

Based on a review of the literature of performance-based contracting and interviews of maintenance engineers at TxDOT, it was clear that lowest bid with minimum acceptable total technical marks is not suitable for the procurement of performance- based maintenance contracts. Rather, a contractor should be selected based on both quality and price. Five best-value bid identification methods that are already in practice by the state transportation agencies in Florida, Virginia, North Carolina, United Kingdom, and New Zealand were used as case studies for this research. These five methods were evaluated in terms of the agency's willingness to pay for quality and the neutrality of these methods with respect to lowest bid and highest quality. This analysis was conducted to investigate the inclination of these methods towards selecting lowest bid, higher quality bid or any bid with equal probability. To understand and describe the bid evaluation method, the agency can develop a willingness to pay (WTP) curve. This curve should represent the agency's needs and budget, reflect their project characteristics, and accommodate associated performance risks.

An Excel macro based software tool has been developed that automates these five best-value bid identification methods and also helps customize anyone of these options for any agency. Inputs to the customization algorithm include the maximum WTP amount, the minimum acceptable quality level, and an estimation of the lowest bid price. The outputs are appropriate price and quality weights, or a quality credit. Additionally, the transportation agency should determine appropriate attributes and marks for quality evaluation. The agency should carefully pick the quality evaluation criteria that will relate to the contractor's expected performance on site. The quality evaluation criteria used in the case studies are presented and compared. These criteria can be customized for any other agency and project.

Conclusion

Based on the analysis of the five case studies, the following conclusions can be made:

- Procedures that require minimum quality level and compare bidders against the lowest bid (i.e., FDOT's and VDOT's methods) tend to favor lowest bidder eventhough other bids follow the agency's willingness to pay curve.
- Procedures that require minimum quality level and compare bidders against both the lowest bid and highest quality (i.e., UKHA's method) tend to favor the highest quality bidder eventhough other bids follow the gancy's willingness to pay curve.

- Procedures that assign quality credit for each bidder in proportion to their quality level (i.e., NCDOT's and NZTA's methods) tend to be neutral (i.e., do not favor lowest bidder or highest quality) to bids that follow the agency's willingness to pay curve.
- Agency- and project-specific inputs (maximum WTP, minimum acceptable quality level, and estimated lowest bid price, and a shape for the WTP curve) can be used to customize any of the five-studied methods for best-value bid evaluation.

Future Research

Based on the results of this research and the literature review, future research areas have been identified as follows:

- Determine quality evaluation criteria (both attributes and marks) based on analysis of historical performance data and corresponding evaluation criteria that were used to select the best-value bidder.
- Determine the shape of the willingness to pay (WTP) curves based on an analysis of the risk of failing to meet the agency-specified performance targets.
- Although the five case studies are fairly representative of the existing state-of-the-practice in best-value bid evaluation methods, the customization process developed in this research needs to be extended beyond these five case studies.

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APPENDIX A

BEST-VALUE BID SIMULATION

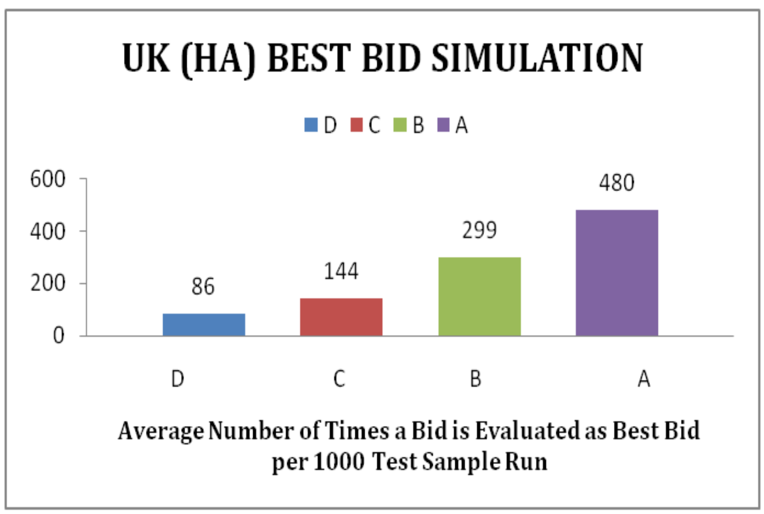
Technical Marks	UK Equivalent Bid Price @ 70% Technical Weight Ratio
71	6000000
72	6140000
73	**6280000**
74	6420000
75	6560000
76	6700000
77	6840000
78	**6980000**
79	7120000
80	7260000
81	7400000
82	7540000
83	**7680000**
84	7820000
85	7960000
86	8100000
87	8240000
88	**8380000**
89	8520000
90	8660000
91	8800000
92	8940000
93	9080000
94	9220000
95	9360000
96	9500000
97	9640000
98	9780000
99	9920000
100	10060000

Simulation – 1

UK

Sample Quality Range 71-75, Price Range 6.0 – 6.56 mil.

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6700000	7400000	8100000
	High	6560000	7260000	7960000	8660000
Cycle 1	1000	93	140	278	481
Cycle 2	1000	88	132	311	488
Cycle 3	1000	76	159	309	472
Average	**1000**	**86**	**144**	**299**	**480**



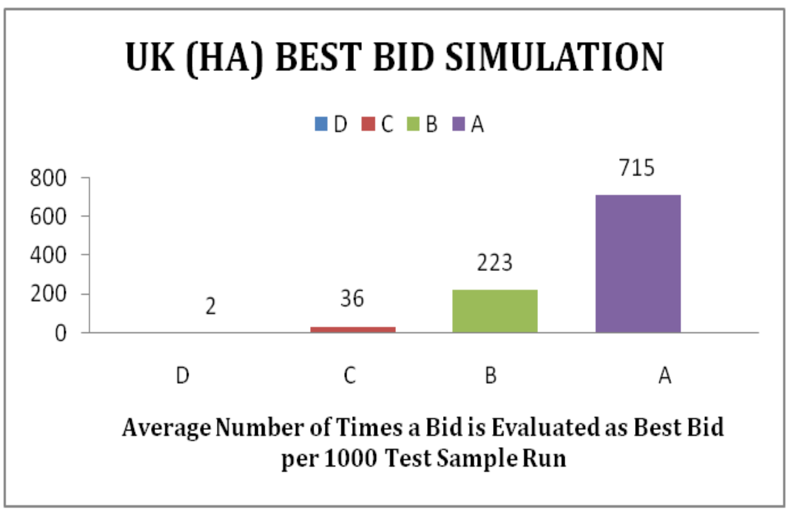
Technical Marks	UK Equivalent Bid Price @ 70% Technical Weight Ratio
71	6000000
72	6140000
73	**6280000**
74	6420000
75	6560000
76	6700000
77	6840000
78	**6980000**
79	7120000
80	7260000
81	7400000
82	7540000
83	**7680000**
84	7820000
85	7960000
86	8100000
87	8240000
88	**8380000**
89	8520000
90	8660000
91	8800000
92	8940000
93	9080000
94	9220000
95	9360000
96	9500000
97	9640000
98	9780000
99	9920000
100	10060000

Simulation – 2

UK

Sample Quality Range 71-75, Price Range 6.0 – 8.66 mil.

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6000000	6000000	6000000
	High	8660000	8660000	8660000	8660000
Cycle 1	1000	4	24	216	728
Cycle 2	1000	1	40	216	709
Cycle 3	1000	1	43	236	709
Average	**1000**	**2**	**36**	**223**	**715**



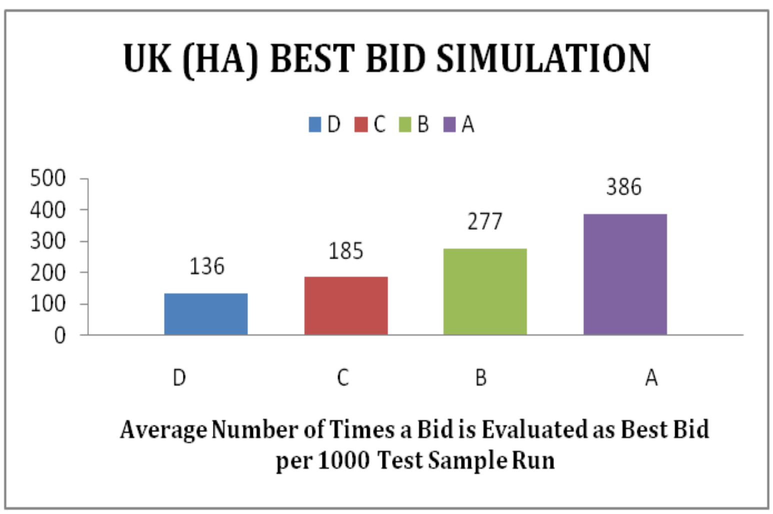
Technical Marks	UK Equivalent Bid Price @ 70% Technical Weight Ratio
71	6000000
72	6140000
73	6280000
74	6420000
75	6560000
76	6700000
77	6840000
78	6980000
79	7120000
80	7260000
81	7400000
82	7540000
83	7680000
84	7820000
85	7960000
86	8100000
87	8240000
88	8380000
89	8520000
90	8660000
91	8800000
92	8940000
93	9080000
94	9220000
95	9360000
96	9500000
97	9640000
98	9780000
99	9920000
100	10060000

<u>Simulation - 3</u>

UK

Sample Quality Range 71-77, Price Range 6.0 – 6.84 mil.

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	71	78	86	93
	High	77	85	92	100
Price Range	Low	6000000	6980000	8100000	9080000
	High	6840000	7960000	8940000	10060000
Cycle 1	1000	137	200	294	377
Cycle 2	1000	142	180	278	389
Cycle 3	1000	129	175	259	391
Average	**1000**	**136**	**185**	**277**	**386**



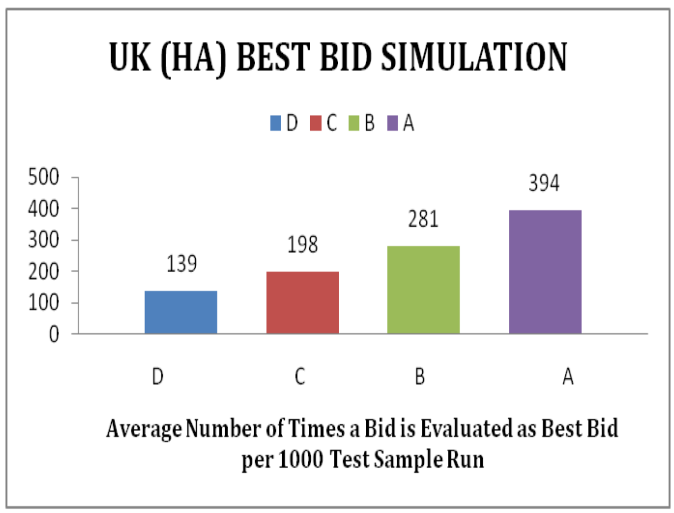
Technical Marks	UK Equivalent Bid Price @ 70% Technical Weight Ratio
61	6000000
62	6155556
63	6311111
64	6466667
65	6622222
66	6777778
67	6933333
68	7088889
69	7244444
70	7400000
71	7555556
72	7711111
73	7866667
74	8022222
75	8177778
76	8333333
77	8488889
78	8644444
79	8800000
80	8955556
81	9111111
82	9266667
83	9422222
84	9577778
85	9733333
86	9888889
87	10044444
88	10200000
89	10355556
90	10511111

Simulation - 4

UK

Sample Quality Range 61-67, Price Range 6.0 – 6.93 mil.

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	61	68	76	83
	High	67	75	82	90
Price Range	Low	6000000	7088889	8333333	9422222
	High	6933333	8177778	9266667	10511111
Cycle 1	1000	137	189	265	391
Cycle 2	1000	137	194	272	394
Cycle 3	1000	144	212	305	397
Average	**1000**	**139**	**198**	**281**	**394**



Technical Marks	UK Equivalent Bid Price @ 50% Technical Weight Ratio
61	6000000
62	6066667
63	6133333
64	6200000
65	6266667
66	6333333
67	6400000
68	6466667
69	6533333
70	6600000
71	6666667
72	6733333
73	6800000
74	6866667
75	6933333
76	7000000
77	7066667
78	7133333
79	7200000
80	7266667
81	7333333
82	7400000
83	7466667
84	7533333
85	7600000
86	7666667
87	7733333
88	7800000
89	7866667
90	7933333

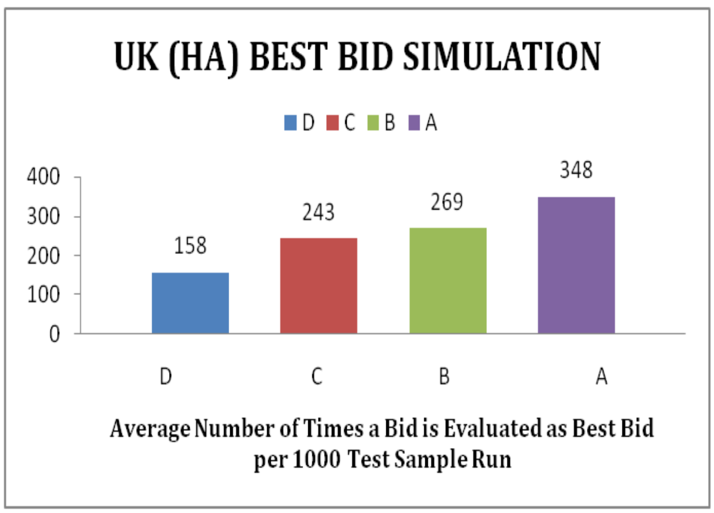
<u>Simulation - 5</u>

UK

Sample Quality Range 61-67, Price Range 6.0 – 6.40 mil.

Technical : Financial Weight ratio = 50:50

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	61	68	76	83
	High	67	75	82	90
Price Range	Low	6000000	6466667	7000000	7466667
	High	6400000	6933333	7400000	7933333
Cycle 1	1000	157	260	271	354
Cycle 2	1000	158	235	261	364
Cycle 3	1000	158	233	274	326
Average	**1000**	**158**	**243**	**269**	**348**



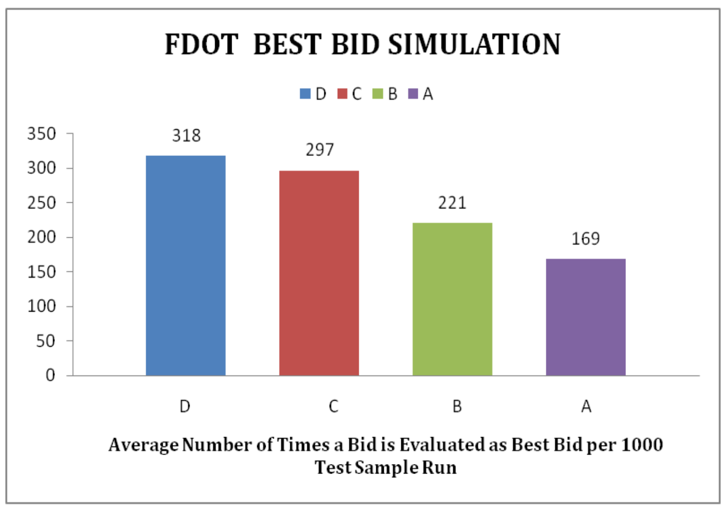
Technical Marks	FDOT Equivalent Bid Price @ 70% Technical Weight Ratio
71	6000000
72	6143345
73	**6293706**
74	6451613
75	6617647
76	6792453
77	6976744
78	**7171315**
79	7377049
80	7594937
81	7826087
82	8071749
83	**8333333**
84	8612440
85	8910891
86	9230769
87	9574468
88	**9944751**
89	10344828
90	10778443

Simulation – 1

FDOT

Sample Quality Range 71-75, Price Range 6.0 – 6.61 mil.

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6792453	7826087	9230769
	High	6617647	7594937	8910891	10778443
Cycle 1	1000	308	283	217	168
Cycle 2	1000	327	316	235	171
Cycle 3	1000	318	291	210	169
Average	**1000**	**318**	**297**	**221**	**169**



Technical Marks	FDOT Equivalent Bid Price @ 62% Technical Weight Ratio
71	6000000
72	6099518
73	**6202394**
74	6308799
75	6418919
76	6532951
77	6651109
78	**6773619**
79	6900726
80	7032696
81	7169811
82	7312380
83	**7460733**
84	7615230
85	7776262
86	7944251
87	8119658
88	**8302986**
89	8494784
90	8695652

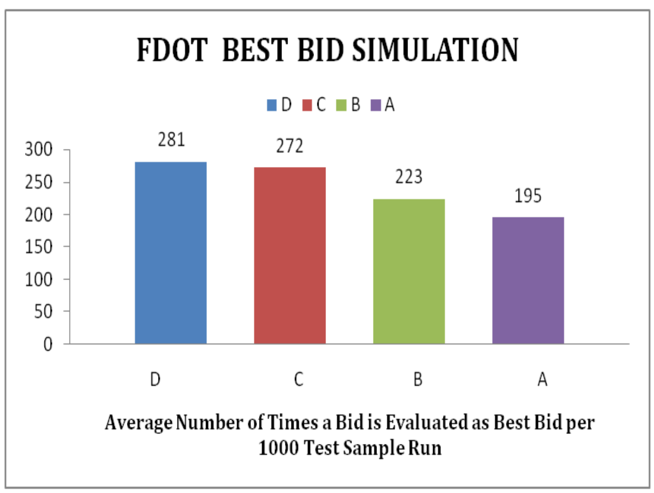
<u>Simulation – 2</u>

<u>FDOT</u>

Sample Quality Range 71-75, Price Range 6.0 – 6.41 mil.

Technical Weight 62%

Bidders		D	C	B	A
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6532951	7169811	7944251
	High	6418919	7032696	7776262	8695652
Cycle 1	1000	277	276	224	197
Cycle 2	1000	288	264	222	194
Cycle 3	1000	277	276	224	195
Average	**1000**	**281**	**272**	**223**	**195**



Technical Marks	FDOT Equivalent Bid Price @ 50% Technical Weight Ratio
61	6000000
62	6060606
63	6122449
64	6185567
65	6250000
66	6315789
67	6382979
68	6451613
69	6521739
70	6593407
71	6666667
72	6741573
73	6818182
74	6896552
75	6976744
76	7058824
77	7142857
78	7228916
79	7317073
80	7407407
81	7500000
82	7594937
83	7692308
84	7792208
85	7894737
86	8000000
87	8108108
88	8219178
89	8333333
90	8450704

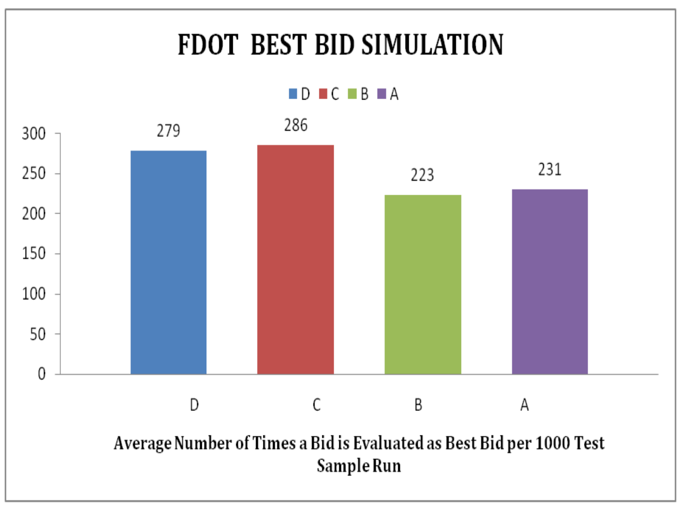
<u>Simulation - 3</u>

<u>FDOT</u>

Sample Quality Range 61-67, Price Range 6.0 – 6.38 mil.

Technical Weight 50%

Bidders		D	C	B	A
Technical Range	Low	61	68	76	83
	High	67	75	82	90
Price Range	Low	6000000	6451613	7058824	7692308
	High	6382979	6976744	7594937	8450704
Cycle 1	1000	273	280	234	219
Cycle 2	1000	281	309	218	247
Cycle 3	1000	283	268	217	227
Average	**1000**	**279**	**286**	**223**	**231**



Technical Marks	NCDOT Equivalent Bid Price @ 67 Quality Credit
71	6000000
72	6098361
73	6200000
74	6305085
75	6413793
76	6526316
77	6642857
78	6763636
79	6888889
80	7018868
81	7153846
82	7294118
83	7440000
84	7591837
85	7750000
86	7914894
87	8086957
88	8266667
89	8454545
90	8651163

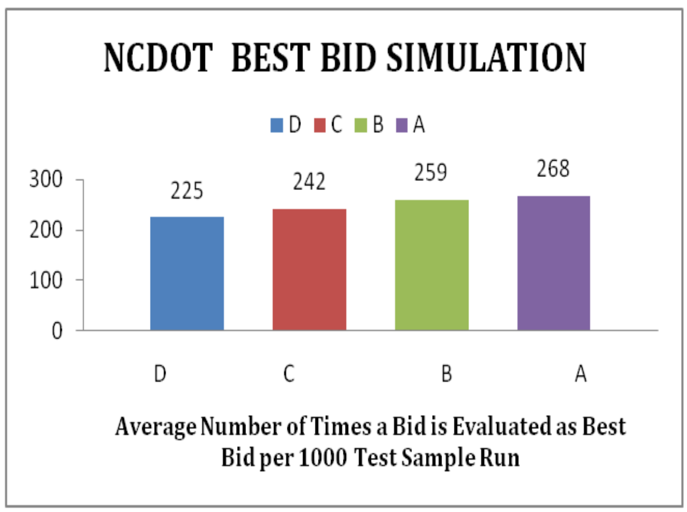
<u>Simulation – 1</u>

<u>NCDOT</u>

Sample Quality Range 71-75, Price Range 6.0 – 6.41 mil.

Quality Credit 67

Bidders		**D**	**C**	**B**	**A**
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6526316	7153846	7914894
	High	6413793	7018868	7750000	8651163
Cycle 1	1000	201	252	253	266
Cycle 2	1000	237	232	266	263
Cycle 3	1000	236	242	258	276
Average	**1000**	**225**	**242**	**259**	**268**



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Technical Marks	NCDOT Equivalent Bid Price @ 30 Quality Credit
71	6000000
72	6061224
73	6123711
74	6187500
75	6252632
76	6319149
77	6387097
78	6456522
79	6527473
80	6600000
81	6674157
82	6750000
83	6827586
84	6906977
85	6988235
86	7071429
87	7156627
88	7243902
89	7333333
90	7425000

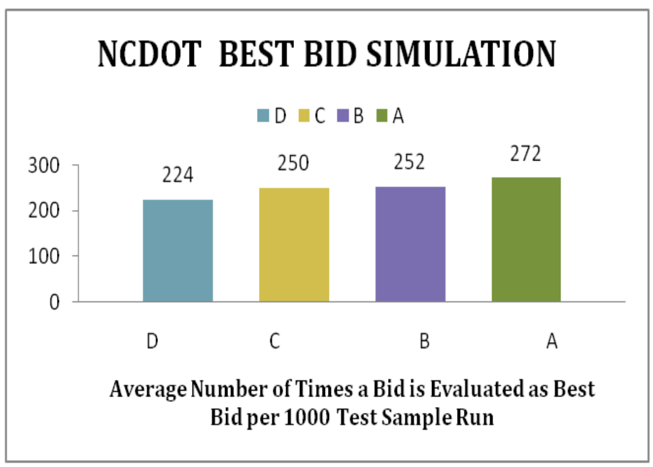
Simulation - 2

NCDOT

Sample Quality Range 71-75, Price Range 6.0 – 6.25 mil.

Quality Credit 30

Bidders		D	C	B	A
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6319149	6674157	7071429
	High	6252632	6600000	6988235	7425000
Cycle 1	1000	215	241	233	276
Cycle 2	1000	233	264	256	290
Cycle 3	1000	224	246	268	249
Average	**1000**	**224**	**250**	**252**	**272**



Technical Marks	NCDOT Equivalent Bid Price @ 30 Quality Credit
61	6000000
62	6000000
63	6000000
64	6000000
65	6000000
66	6000000
67	6000000
68	6000000
69	6000000
70	6000000
71	6060606
72	6122449
73	6185567
74	6250000
75	6315789
76	6382979
77	6451613
78	6521739
79	6593407
80	6666667
81	6741573
82	6818182
83	6896552
84	6976744
85	7058824
86	7142857
87	7228916
88	7317073
89	7407407
90	7500000

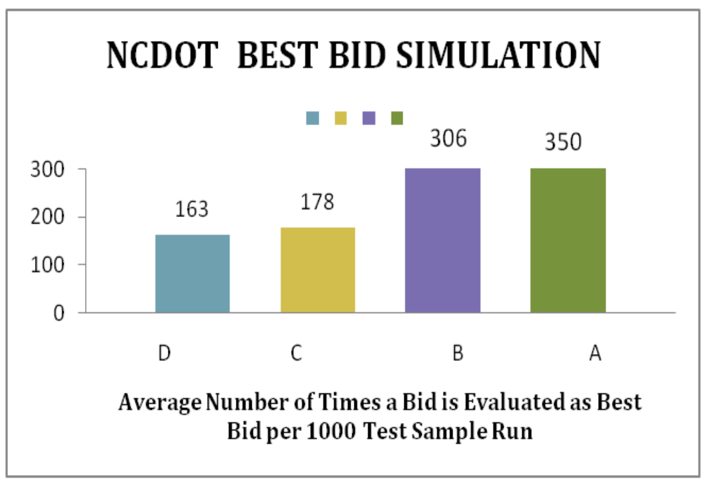
Simulation - 3

NCDOT

Sample Quality Range 68-75, Price Range 6-6.32 mil

Quality Credit 30

Bidders		D	C	B	A
Technical Range	Low	61	68	76	83
	High	67	75	82	90
Price Range	Low	6000000	6000000	6382979	6896552
	High	6000000	6315789	6818182	7500000
Cycle 1	1000	155	175	304	335
Cycle 2	1000	171	187	305	359
Cycle 3	1000	164	173	308	356
Average	**1000**	**163**	**178**	**306**	**350**



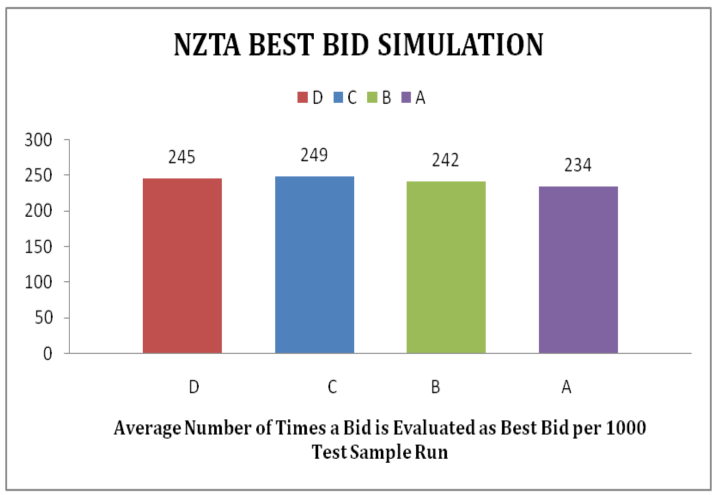
Technical Marks	NZTA Equivalent Bid Price @ 30% Weighted Sum
71	6000000
72	6042214
73	6084429
74	6126643
75	6168857
76	6211071
77	6253286
78	6295500
79	6337714
80	6379929
81	6422143
82	6464357
83	6506571
84	6548786
85	6591000
86	6633214
87	6675429
88	6717643
89	6759857
90	6802071

Simulation -1

NZTA

Sample Quality Range 71-75, Price Range 6-6.17 mil

Bidders		D	C	B	A
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6211071	6422143	6633214
	High	6168857	6379929	6591000	6802071
Cycle 1	1000	237	254	246	234
Cycle 2	1000	258	254	221	240
Cycle 3	1000	241	239	258	229
Average	**1000**	**245**	**249**	**242**	**234**



Technical Marks	NZTA Equivalent Bid Price @ 59% Weighted Sum
71	6000000
72	6141744
73	6283488
74	6425232
75	6566976
76	6708720
77	6850463
78	6992207
79	7133951
80	7275695
81	7417439
82	7559183
83	7700927
84	7842671
85	7984415
86	8126159
87	8267902
88	8409646
89	8551390
90	8693134

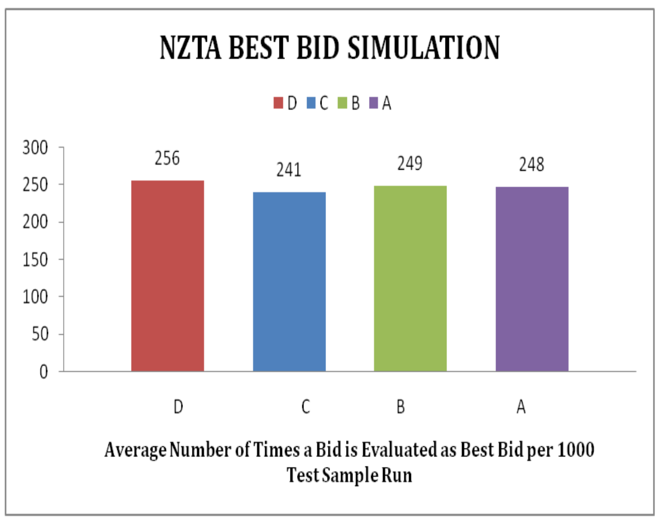
Simulation - 2

NZTA

Sample Quality Range 71-75, Price Range 6-6.57

Technical Weight 59%

Bidders		D	C	B	A
Technical Range	Low	71	76	81	86
	High	75	80	85	90
Price Range	Low	6000000	6708720	7417439	8126159
	High	6566976	7275695	7984415	8693134
Cycle 1	1000	245	238	260	248
Cycle 2	1000	249	251	233	240
Cycle 3	1000	274	233	253	256
Average	**1000**	**256**	**241**	**249**	**248**



APPENDIX B

FDOT BID TABULATION

E5N05 ~ Asset Maintenance in Brevard, Osceola, Orange & Volusia Counties ~ 42383617201

Public Announcement of Technical Evaluations and Bid Opening

2:15pm on Friday, March 6, 2009 in the Osceola County Conference Room, District Office

	VMS, INC.			
	D.Kyle	M.Heffinger	T.Hammerle	AVG SCORE
1. Executive Summary (5)	5	4	4.5	4.50
2. Administrative Plan (25)	25	22	23.5	23.50
a. Identification of Key Personnel, etc. (10)	10	9	9.5	
b. Contractor Experience (10)	10	10	9.5	
c. DBE/Respect/Agency Participation (2)	2	1	1.5	
d. Proposed Facilities Capabilities (3)	3	2	3	
3. Management and Technical Plan (25)	24	21	21.5	22.17
a. Plan to Achieve and Maintain MRP (15)	14	13	13	
d. Customer Service Resolution Plan (10)	10	8	8.5	
4. Operation Plan (35)	34	32	30	32.00
a. Incident Response Operations (10)	10	9	9	
b. Routine/Periodic Maintenance Operations (25)	24	23	21	
5. Plan for Compliance with Standards (10)	10	10	8	9.33
a. Compliance with Procedures, etc (5)	5	5	4	
b. Compliance with Manuals, etc (5)	5	5	4	
TECHNICAL AVERAGE (0-100)	98	89	87.5	91.50

TECHNICAL SCORE (this technical avg x 70%)	**64.0500**
THIS BID	**$22,108,909.00**
LOWEST BID	**$17,568,439.00**
PRICE SCORE (lowest bid/this bid x30%x100)	**23.8389**
TOTAL PROPOSAL SCORE (tech + price score)	**87.8889**

USA Services				Infrastructure Corp of America			
D.Kyle	M.Heffinger	T.Hammerle	AVG SCORE	D.Kyle	M.Heffinger	T.Hammerle	AVG SCORE
4	4	4.5	4.17	5	5	4.5	4.83
19	21	20.5	20.17	25	21	23.5	23.17
8	9	7.5		10	8	9	
6	7	8		10	10	10	
2	2	2		2	2	2	
3	3	3		3	1	2.5	
19	22	20.5	20.50	24	21	22.5	22.50
12	13	12.5		14	12	13.5	
7	9	8		10	9	9	
27	33	29	29.67	34	30	32	32.00
7	9	8.5		10	8	9	
20	24	20.5		24	22	23	
10	10	7	9.00	10	7	7.5	8.17
5	5	3.5		5	4	3.5	
5	5	3.5		5	3	4	
79	**90**	**81.5**	83.50	**98**	**84**	**90**	90.67

USA Services	Infrastructure Corp of America
58.4500	**63.4667**
$17,842,800.00	**$21,032,800.00**
$17,568,439.00	**$17,568,439.00**
29.5387	**25.0586**
87.9887	**88.5253**

Jorgensen Contract Services			
D.Kyle	M.Heffinger	T.Hammerle	AVG SCORE
5	4	4	4.33
25	21	20.5	22.17
10	9	8	
10	10	8.5	
2	1	1.5	
3	1	2.5	
22	19	21	20.67
13	12	13	
9	7	8	
33	30	31	31.33
10	8	8.5	
23	22	22.5	
10	5	7	7.33
5	2	3.5	
5	3	3.5	
95	**79**	**83.5**	85.83

Erosion Stoppers			
D.Kyle	M.Heffinger	T.Hammerle	AVG SCORE
4	4	4	4.00
16	19	20.5	18.50
7	9	8.5	
5	7	7.5	
2	1	2	
2	2	2.5	
23	19	20.5	20.83
14	12	13	
9	7	7.5	
26	30	28	28.00
8	8	9	
18	22	19	
10	8	7.5	8.50
5	3	3.5	
5	5	4	
79	**80**	**80.5**	79.83

Jorgensen Contract Services	Erosion Stoppers
60.0833	**55.8833**
$23,738,800.00	**$19,993,853.10**
$17,568,439.00	**$17,568,439.00**
22.2022	**26.3608**
82.2855	**82.2441**

DBI Services			
D.Kyle	M.Heffinger	T.Hammerle	AVG SCORE
5	4	4.5	4.50
25	21	23	23.00
10	8	8.5	
10	10	10	
2	1	1.5	
3	2	3	
21	16	21.5	19.50
13	11	13	
8	5	8.5	
32	29	31	30.67
9	8	9	
23	21	22	
10	8	8.5	8.83
5	4	4.5	
5	4	4	
93	**78**	**88.5**	86.50

60.5500

$17,568,439.00

$17,568,439.00

30.0000

90.5500

APPENDIX C

NCDOT BID TABULATION

HIGHWAY LETTING
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH N.C.
JANUARY 25, 2007

PAGE : 1 OF 1
ITEM C-2
HANDOUT

40682
STATE FUNDED
MECKLENBURG GASTON CABARRUS CLEVELAND

PROPOSAL LENGTH 131.000 MILES

TYPE OF WORK INTERSTATE MAINTENANCE.

LOCATION I-77, I-85, I-485, AND I-277 IN MECKLENBURG, GASTON, CABARRUS, AND CLEVELAND COUNTIES.

EST CONST PROGRESS... FY-2007.. 5% OF BID
FY-2008..20% OF BID
FY-2009..20% OF BID
FY-2010..20% OF BID
FY-2011..20% OF BID
FY-2012..15% OF BID

MBE GOAL 5% WBE GOAL 3%

ESTIMATE 25,648,533.00

DATE AVAILABLE MAY 01 2007
FINAL COMPLETION APR 30 2012

QUALITY ADJUSTED PRICE RANKING

PROPOSAL	TECH SCORE	QUALITY CREDIT %	ACTUAL CONT AMT (PRICE PROP)	ACT % DIFF	QUALITY VALUE	CONT AWARD BASIS (ADJ PRICE)	ADJ % DIFF
DBI SERVICES CORP	89	9.0	28,182,660.00	+9.9	2,536,439.40	25,646,220.60	0.0
INFASTRUCTURE CORP OF AMERICA	85	5.0	28,080,000.00	+9.5	1,404,000.00	26,676,000.00	+4.0
BALFOUR BEATTY CONST CO	89	9.0	36,870,000.00	+43.8	3,318,300.00	33,551,700.00	+30.8

ESTIMATE TOTAL	25,648,533.00	
LETTING TOTAL	28,182,660.00	+9.9

VITA

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Email Address: jbramd@yahoo.com

Education: M.S., Texas A&M University, College Station, 2010
B.S., Bangladesh University of Engineering & Technology, 2000

Experience: Graduate Research Assistant, Texas Transportation Institute
2009- 2010

Project Engineer, Emirates Building Systems LLC, Dubai, UAE
2001-2008

Structural Engineer, Automan Building Systems and Space Frame, Dhaka, Bangladesh
2000 - 2001