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16. Abstract

Availability of historical unit cost data is an important factor in developing accurate project cost estimates. State highway agencies (SHAs) collect data on historical bids and/or production rates, crew sizes and mixes, material costs, and equipment costs, including contractor overhead and profit. The goal of this synthesis is to identify how state highway agencies develop unit prices for construction and maintenance projects. The synthesis approach consists of a comprehensive online survey, covering every aspect of unit cost development, to identify the state of practice in state highway agencies and interviews with several representative SHAs to gain a better understanding of the practices followed for unit cost development. This study finds that even though SHAs collect and store historical cost data, they do not have a formal and documented process for adjusting unit costs for project characteristics and market conditions.

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SYNTHESIS ON CONSTRUCTION UNIT COST DEVELOPMENT: TECHNICAL REPORT

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration (FHWA) or the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation. The United States Government and the State of Texas do not endorse products or manufacturers. Trades or manufactures' names appear herein solely because they are considered essential to the object of the report. The researcher in charge of the project was Stuart Anderson.

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1. INTRODUCTION

1.1 BACKGROUND

Project cost estimates play a crucial role in development of construction projects. The cost estimates are continuously updated in each phase of the project development as new information becomes available. The Engineer's Estimate is the final estimate prepared by the state agencies in the Plan, Specifications, and Estimate (PS&E) phase. This estimate is particularly important because the state agency uses it to compare the estimated cost with contractor bid prices and allocate funds for construction.

The two important inputs in developing accurate estimates are historical data and market conditions as identified by Anderson et al. 2007. Historical data are generally used in two different forms. The first form of historical data is unit costs from recent projects. These unit costs reflect bid pricing for items related to past projects that are relevant to project being estimated. The second form of historical data is related to production rates and crew sizes, material pricing, construction equipment pricing, which are marked up with contractor overhead and profit. Both forms of historical data need to be adjusted to market conditions specific to the project. Based on this information, the estimator selects unit costs for each line item in the Engineer's Estimate. This can be a challenge, as it requires the estimator to have sufficient knowledge of historical cost data, current project conditions and characteristics, and how to adjust these historical data for the current project estimate.

Estimators rely on two basic techniques to prepare the estimates: Historical Bid-Based Estimating and Cost-Based Estimating. Both techniques rely on historical data, although the type of historical data varies.

Historical Bid-Based Estimating creates cost estimates from historic bid prices. This is a relatively simple, straightforward, and quick technique to use. Once the quantities are determined from the project plans, the estimator matches those quantities to appropriate historical unit prices. The state agencies generate historical unit prices by systematically compiling bid data from past project lettings. An important decision to be made when using this approach is the number of bids from each project that should be included in the data. This number varies among state agencies with some using only the lowest bid from each project and others using the two or three lowest bids. Some agencies use all the bids from the project. The adjustment to historical unit prices rests upon the engineering judgment and experience of the estimator.

Cost-Based Estimating is a type of estimation based on knowledge about the construction methods, supply systems, labor markets, and productivity specific to the area where the work is being performed. This approach is more complex and time consuming than bid-based as the estimator must conceptualize the whole construction process in order to prepare the estimates.

State highway agencies utilize computer systems to assist them in developing estimates. This can range from a simple Excel spreadsheet to sophisticated computer systems like Trns*port® System. The estimator should be familiar with the available resources and have knowledge of construction process. All these elements are necessary for developing an accurate cost estimate.

1.2 PROBLEM DESCRIPTION

Cost estimating occurs repeatedly throughout the project stages involved in the project development process. The use of Historical Bid-Based or Cost-Based estimating technique depends on the project phase and the level of project scope information available. Historical cost data that support the preparation of estimation also vary based on the estimating techniques. Historical bid prices are often used when preparing cost estimates. At the PS&E phase, bid pricing is the most common approach, although some State Highway Agencies (SHAs) use production rates, crew sizes, labor wage rates, material costs, and equipment costs to build a unit price for their Engineers' Estimates. Historical bid prices are more frequently used for estimates prepared in the scoping and design phases. In the planning phase, estimators often use historical unit prices to develop average lane mile costs for planning estimates.

The effectiveness of both techniques is a function of the historical cost data available to support the two estimating techniques. This synthesis tries to address the problem of the lack of systematic methodology to analyze and develop unit costs for construction and maintenance projects. If such a systematic approach is not defined, estimators will spend considerable time searching databases for unit costs. Furthermore, having a standard approach that includes keeping the historical unit costs current will aid the estimator in making more consistent and accurate estimates.

1.3 OBJECTIVES

The objective of this synthesis is to explore the current practices in determining the unit costs based on historical bids and/or historical production rates, crew sizes, equipments and material costs. The processes and procedures SHAs utilize will be compared with TxDOT practices and procedures. The comparison will form a basis from which recommendations are provided to TxDOT.

2. LITERATURE REVIEW

Project cost estimation plays an integral part in the development of any construction project. The estimation process begins as early as the planning phase with a preparation of planning-level, or conceptual, estimates. As more details of the project become available, the estimates become more detailed. Conceptual estimates become design-level estimates and progress further to become the Engineer's Estimate. This estimate is used as a baseline estimate against which the bids submitted by the contractors are compared and awarded. Every estimate typically consists of the different types of work in the project, its associated quantity, and the cost. The purpose of the synthesis is to identify the process involved in developing the unit cost for each item of work.

The review of literature showed that there is no single approach to developing construction unit costs. Typically SHAs have developed their own process for preparing their project estimates, tailor made to suit their requirements. As a result, highway construction projects employ a number of estimating procedures.

A number of studies have investigated techniques used for cost estimation. The most common estimating technique reported is the historical bid-based estimation. According to AASHTO's Technical Committee on Cost Estimating (TCCE) publication (2007), historical bid-based estimation is a method of developing estimates using data from the unit cost database. The unit cost database is a repository of the costs associated with all standard items of work taken from the previously awarded contracts or bids. This database stores information in a suitable format to aid the estimator in preparing cost estimates for highway projects. The unit price from this database is adjusted to reflect the specific project/location (geographic) conditions.

Cost-Based Estimating is an estimation technique also used by SHAs but with less frequency. This method is used in developing project estimates using a production rate and the cost associated with labor, materials, and construction equipment. By estimating the cost of each component required to complete the work together with a contractor's profit and overhead, SHAs develop an estimated unit price for the work. This method also takes into account the unique character of the projects, geographical location, market factors, and volatility of material prices. Cost-based estimation is mainly used in preparing the Engineer's Estimate, as this method can provide a more accurate and defendable cost to support the decision for contract award/rejection.

In addition to bid-based estimation and cost-based estimation, SHAs use Parametric Estimation early in project development. Parametric estimation, as defined in Washington State Department of Transportation's (WSDOT) Cost Estimation Manual, is a method to estimate the cost of a project or a part of a project based on one or more project parameters. Historical bid data are used to define the cost of a typical transportation facility segment, such as cost per lane mile, cost per interchange, or cost per square foot. SHAs can also use historical percentages to estimate project segments based on major project parameters. These methods are often used in early estimating, such as planning and scoping.

2.1 ESTIMATING GUIDELINES

Agencies maintaining guidelines on cost estimating have outlined the factors that estimators need to consider when determining the unit prices for various line items. The common factors identified in the estimation manuals of Utah Department of Transportation (UDOT), Virginia Department of Transportation (VDOT) and Pennsylvania Department of Transportation (PennDOT) are:

- Project location,
- Project size,
- Quantity of materials,
- Time of year,
- Current market conditions,
- Constructability,
- Price-volatile materials,
- Sequence of construction,
- Contractor's familiarity of process,
- Risks to contractors, and
- Inflation.

Even though availability of guidelines and manuals on cost estimating ensure better estimates, in order to increase the accuracy of the estimates, as suggested by De la Garza (1991), the estimator must have a strong knowledge of costs as well as implicit design knowledge. The design knowledge insures that all components of work are included in the estimates. Without knowledge of the construction methodologies, the estimator may not realize that each component has its own associated cost that may have a significant impact on the final estimate.

Estimating guidelines available for WSDOT, UDOT, and PennDOT outline the steps involved in preparing estimates in each of the project development phases. The four main phases of project development are:

- **Planning** – concept definition to support a 20-year long range plan;
- **Scoping** – basic scope definition to place a project into a priority program (10 years or less from the project letting date);
- **Design** – development of plans and specifications to support a project in the State Transportation Improvement Program (4 years or less from the letting date); and
- **PS&E** – final plans and specifications to support an Engineer’s Estimate for letting a project for construction.

Planning

According to the Cost Estimating Manual (WSDOT), the planning level estimate is used during the Project Definition and Project Initiation and Alignment phase to determine funds for long range planning and to prioritize the need for highway system plan. The planning level estimates are prepared using either parametric estimating where the input from a per-mile cost for the roadway is combined with a per-square foot structure cost or by analogous project estimating (Cost Estimating Guidelines, PennDOT, 2007). Most agencies use simple Excel® spreadsheets for preparing the planning level estimates. Some agencies have developed their own conceptual cost estimating tools. Examples of conceptual cost estimating tools include the Planning Cost Estimate spreadsheet of VDOT, Comparative Bridge Costs of California Department of Transportation (Caltrans), and the Concept Cost Estimate Form of UDOT.

Scoping

A scoping level estimate is used during the post planning phase to set the baseline cost for the project and to program the project. This phase uses the bid-based estimation and parametric estimation methods of estimating. Here estimators determine approximate quantities for items such as asphalt, concrete pavements, structures, and roadway excavations. While most agencies update their planning level spreadsheets with more details for preparing the scoping level estimates, some agencies use sophisticated systems for preparing the same estimate. VDOT's Project Cost Estimating System (PCES) is an example of a sophisticated system used by an agency to prepare scoping level estimates.

Design

Design level estimates help in development of plans and specifications to support a project in the State Transportation Improvement Program (STIP). The project requirements typically become clearer at this stage. This solidifies many items in the scope such as Right of Way (ROW), permit conditions, quantities of major items, and outside stakeholders. Historical bid-based estimating and historical percentage estimation techniques are used in developing design level estimates. Some agencies also use cost-based estimating to estimate major items of work, that is, items having high cost impacts (80-20 Rule). At this stage many agencies use sophisticated computer software like the Proposal and Estimates System (PES), Cost Estimation System (CES) or the Estimator, all belonging to the Trns*port system developed by AASHTO [InfoTech].

Plans, Specifications and Estimate (PS&E)

At this phase the final Engineer's Estimate is prepared for advertising the project, committing construction funds, and evaluating contractors' bids. All the items of work required for the project, their quantities, and unit prices are available at this stage. Historical bid-based estimating and cost-based estimating are the two methods used in preparing the Engineer's Estimate.

Commercial software like Estimator and CES of Trns*port system are commonly used in preparing estimates at this level. Some agencies use their own in-house developed computer system, like the Project Development Business System (PDBS) of UDOT, and EBASE of WSDOT to prepare the final estimates.

2.2 INFORMATION SYSTEMS

The development of estimating software and its proliferation into the transportation industry has enabled estimators to make faster and more accurate estimates. Computer software allows the estimators to manage large volumes of project information. Estimator, a module of the Trns*port system, is the commonly used estimating software. According to Schexnayder et al. (2003), 22 state agencies use the Estimator module. CES is another module of Trns*port used by state agencies. Some agencies use Bid Tabs Pro® developed by Oman Systems to aid in estimate preparation.

Historical bid prices are necessary to prepare historical estimates. As such they are stored in a database. The database structure can be as simple or complex as the estimating needs dictate (Practical Guide to Estimating, AASHTO's Technical Committee on Estimating, 2007). Historic bid prices database can be created using the Bid Analysis Management System (BAMS), which is the Decision Support System (DSS) of Trns*port system. This historical database holds the construction contract information. When establishing a database, all aspects of a project that may become necessary during estimating should be saved. The following list, as identified in the TCCE report (2007), contains some of the important items for consideration when establishing a database.

- Bid Item Number,
- Item Description,
- Item Quantity,
- Unit of Work,
- Letting Date,
- Low Bidder Amount,
- Second Bidder Amount,
- Third Bidder Amount,
- Average Bid,
- Estimated Unit Price, and
- Project Number.

An important factor that is considered when historical unit prices are stored is the number of bids. Schexnayder et al. (2003) report the results for number of bids used in establishing the average prices.

- Low bid only – 20 DOTs
- Low and second bid – 1 DOT
- Three lowest bids – 15 DOTs
- All bids (but may exclude single bids that are very high or low) – 11 DOTs
- All bids except high and low – 2 DOTs
- Bid analysis to determine a reasonable bid amount for each line item – 1 DOT

Further, their study identified that using three low bids for each item produced the best results, while using all bids produced the worst.

State agencies make these historical averages available for their estimators to use. This can be in the form of a simple Excel spreadsheet containing all the historical bid details to a sophisticated computer system. Figure 1 shows sample historical bid data maintained by New York State Department of Transportation (NYSDOT) on its website as a simple PDF file.

New York State Department of Transportation 10:40 Wednesday, March 26, 2008 9
Contracts Let January 1, 2007 to December 31, 2007

WEIGHTED AVERAGE ITEM PRICE REPORT
BY ITEM, REGION AND QUARTER

ITEM	REGION	CALENDAR QUARTER	NUMBER OF OCCUR'S	TOTAL QUANTITY	TOTAL DOLLARS	AVERAGE AWARDED PRICE	AVERAGE OF LOW 3 BIDDERS
UNCLASSIFIED EXCAVATION AND DISPOSAL / CM							
203.02	03	2007Q3	3	1,911.00	$48,596	$25.43	$35.91
		2007Q4	1	1,610.00	$19,320	$12.00	$16.33
	04	2007Q1	5	31,546.00	$357,380	$11.33	$12.32
		2007Q2	7	85,380.00	$1,444,194	$16.91	$18.04
		2007Q3	4	100,540.00	$1,339,174	$13.32	$12.21
		2007Q4	2	625.00	$16,085	$25.74	$20.41
	05	2007Q1	1	50,389.00	$1,310,114	$26.00	$22.50
		2007Q2	5	109,674.00	$952,135	$8.68	$12.07
		2007Q3	4	7,095.00	$68,919	$9.71	$92.75
		2007Q4	3	207,946.00	$1,878,940	$9.04	$10.92
	06	2007Q1	3	1,109,163.00	$6,133,544	$5.53	$5.32
		2007Q2	7	7,335.00	$113,584	$15.49	$15.51
		2007Q3	1	27,795.00	$118,129	$4.25	$7.88
		2007Q4	1	722.00	$10,830	$15.00	$23.50
	07	2007Q1	1	200,159.00	$2,401,908	$12.00	$14.17
		2007Q2	2	119,693.00	$458,161	$3.83	$5.72
		2007Q3	1	1,650.00	$39,600	$24.00	$23.17
	08	2007Q1	5	12,968.00	$248,374	$19.15	$37.64
		2007Q2	7	15,483.00	$669,998	$43.27	$46.89
		2007Q3	3	3,654.00	$163,962	$44.87	$75.27
		2007Q4	3	12,320.00	$337,100	$27.36	$28.57
	09	2007Q1	2	34,552.00	$285,756	$8.27	$16.14
		2007Q2	5	19,450.00	$366,515	$18.84	$21.49
		2007Q3	2	5,048.00	$78,339	$15.52	$19.30
		2007Q4	5	4,821.00	$254,246	$52.74	$49.50
	10	2007Q1	8	51,384.00	$2,087,477	$40.63	$35.38
		2007Q2	5	8,056.00	$133,335	$16.55	$25.99
		2007Q3	1	1,733.00	$216,625	$125.00	$145.00
		2007Q4	2	353.00	$55,470	$157.14	$150.56

Figure 1.NYSDOT Average Price Report.

On the other hand, Caltrans and Ohio Department of Transportation (ODOT) use sophisticated computer systems that allow the estimators to search based on the districts, maximum and minimum quantity, and maximum and minimum amount. Figure 2 shows the Construction Management System (CMS) developed by ODOT for accessing historical bid information.

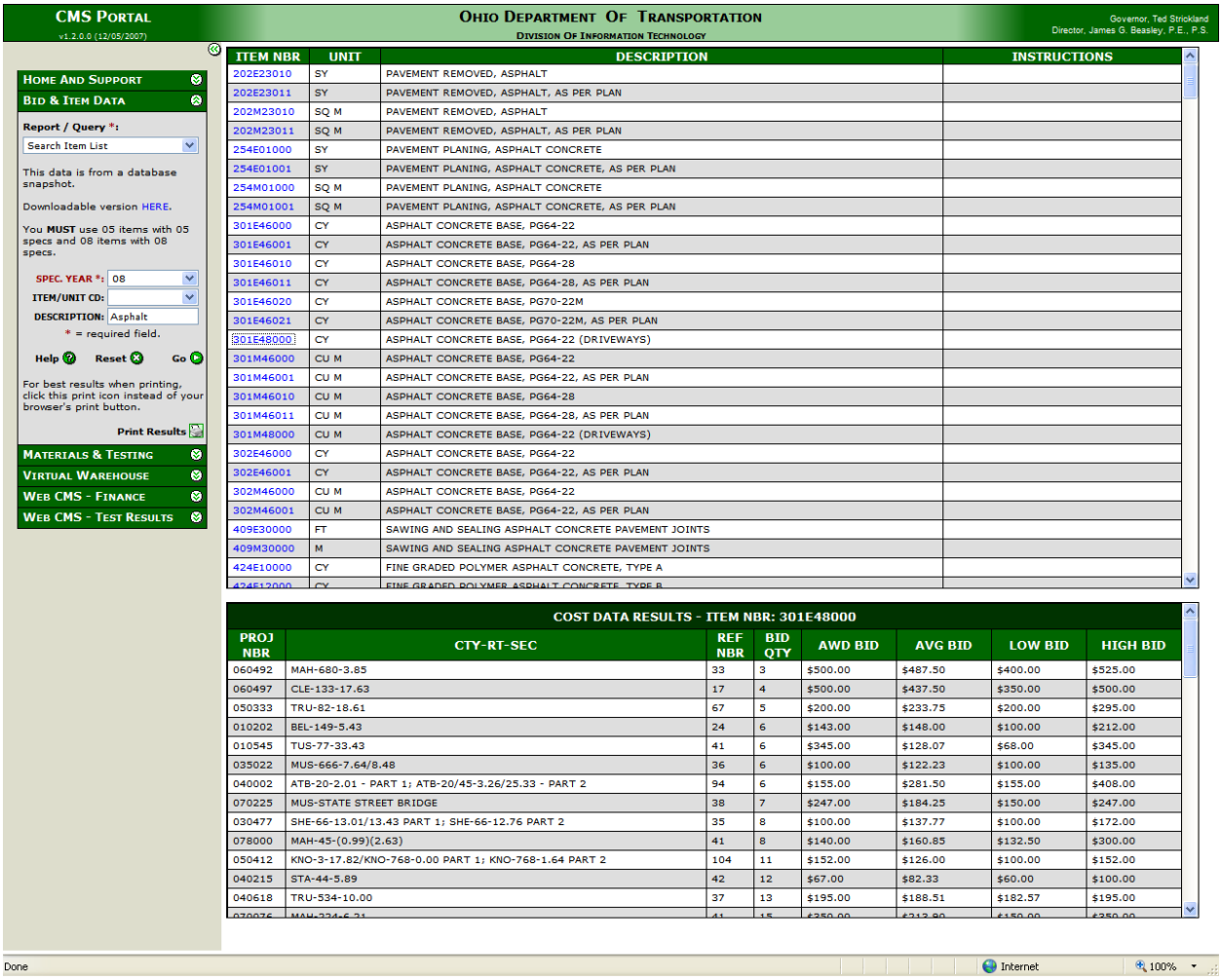


Figure 2. ODOT Construction Management System.

The main focus of this synthesis is to explore the various aspects of construction cost development. This includes details on estimating techniques used, use of historical data for arriving at a unit price, and the information systems used for developing construction unit cost information. Since estimating practices differs among the agencies, it necessary to investigate as many practices to be able to make sound recommendations.

3. RESEARCH APPROACH

3.1 INTRODUCTION

The most important task in the synthesis is to identify the state of practice within SHAs for developing unit costs for construction and maintenance projects. Information on the practices followed by other SHAs will be used as the basis for the recommendation to TxDOT on developing unit costs for construction project estimation. In order to identify the good practices, the researchers conducted two surveys. The first was a single questionnaire survey conducted by TxDOT, and the second was a comprehensive web-based survey conducted by the research team. In this chapter, the first section discusses the TxDOT survey and its results, followed by a discussion of the approach taken for the online survey and its results. The last section outlines the selection criteria used in identifying SHAs for further interviews.

3.2 TEXAS DEPARTMENT OF TRANSPORTATION SURVEY

3.2.1 Outline

TxDOT's Construction Division conducted this preliminary survey on unit price development. As part of the survey, the team sent emails to the transportation agencies of all fifty states to identify the process behind unit price development for estimating projects and possibly used for change order analysis. The survey question read as follows:

"Do you have a formal process that uses a systematic tool for developing unit prices that categorizes for issues such as complexity, total quantities, difficulty, and type of project? Please point us to your system on the web or transmit electronically or by mail."

3.2.2 Results

Thirty-seven state agencies replied. Though none of the agencies had any formal process for developing unit prices, 14 state agencies used systematic tools for developing unit prices for project estimation. Figure 3 shows the states which responded to the survey and the states which use a systematic tool for unit price development. The following list of states use a systematic tool or have a systematic approach to unit price development.

- California
- Colorado
- Florida
- Illinois
- New Jersey
- New York
- Minnesota

- Massachusetts
- Ohio
- Oregon
- Oklahoma
- Utah
- Virginia
- Washington

Refer to **Appendix A** for the complete list of state agencies and their replies.

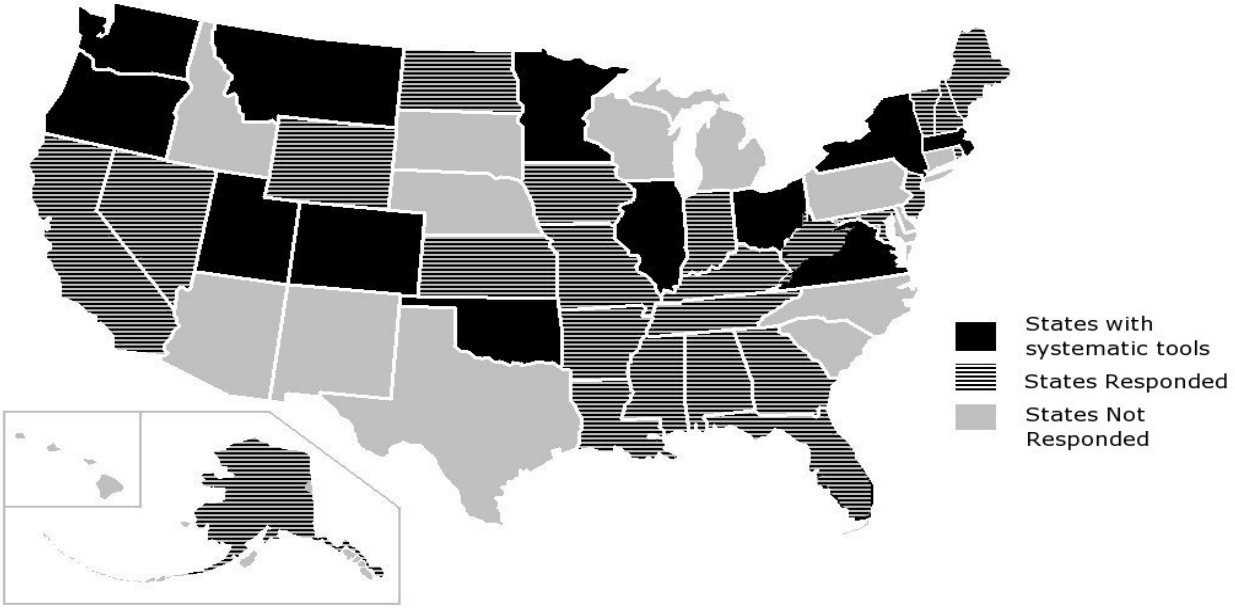


Figure 3. TxDOT Survey - Participating State Agencies.

The replies received for the TxDOT survey showed that the state agencies using a systematic tool to develop unit prices were referring to their estimating technique and the computer system used to prepare their final Engineer's Estimate. No state agencies that replied to the survey had a formal process to adjust unit prices for project type and complexity. The impact on unit prices due to project type and complexity was determined based on the knowledge and experience of the estimator.

3.3 ONLINE SURVEY

3.3.1 Survey Approach

The research team decided to carry out an online survey to determine the state of practice within SHAs regarding the development of unit prices for construction and maintenance. This survey

identified SHAs conducting considerable work in unit price development. The online survey was conducted using a web-based survey tool called Zoomerang® and request for participation was sent to the Offices of Construction and Design in all the state agencies. In total 104 survey requests were sent as part of the online survey.

3.3.2 Survey Structure

The research team formulated a questionnaire to identify good practices specifically on unit cost development. The survey questionnaire was broadly divided into two sections:

1. ***Section I - Construction Unit Cost,*** addressing the unit cost information for construction projects.
2. ***Section II - Maintenance Unit Cost,*** addressing the unit cost information for maintenance projects.

Section I was divided further into following five sub-sections in order to cover all aspects of developing construction unit cost development.

- ***General Section*** - Focuses on identifying whether the state agency has a structured construction unit cost database and unit cost development procedure in place.
- ***Acquiring Unit Cost Information*** - Identifies the use of any system that extracts unit cost information from the past contract details and stores them in an historical cost database.
- ***Storing Unit Cost Information*** - Focuses on how the unit cost details are stored in the database.
- ***Accessing Unit Cost Information*** - Identifies the presence of any mechanism to access historic unit cost information.
- ***Applying Unit Cost Information*** - Focuses on the use of the unit cost information in the estimation process.

Appendix B contains the complete questionnaire.

3.3.2.1 General Section

This section identifies the primary estimation technique used by a state agency when estimating a construction project and the tools used for estimation. Respondents chose between the traditional bid-based estimation and the cost-based estimation methods. One of requirements of this synthesis was to identify the development of unit prices in different phases of the project. For this purpose, the agencies were asked to identify the estimation technique along with the tools used in various project phases. The following are the four phases identified:

- **Planning** – concept definition to support a 20-year long range plan;
- **Scoping** – basic scope definition to place a project into a priority program (10 years or less from the project letting date);
- **Design** – development of plans and specifications to support a project in the State Transportation Improvement Program (4 years or less from the letting date); and
- **PS&E** – final plans and specifications to support an Engineers' Estimate for letting a project for construction.

Agencies listing cost-based estimation as their primary estimation technique were further required to identify different parameters, like the actual production rates and crew sizes, current material costs, and actual equipment rates that they tracked periodically. The survey also asked agencies to provide the names of the computer based system (Commercial or In-house) used for estimation in all four phases of project development. This section also included questions to identify the state agencies having a well-documented process or procedure for developing unit costs for construction cost estimating and using innovative techniques for developing unit costs for construction cost estimating. Figure 4 presents the flow of questions in the General section of the survey.

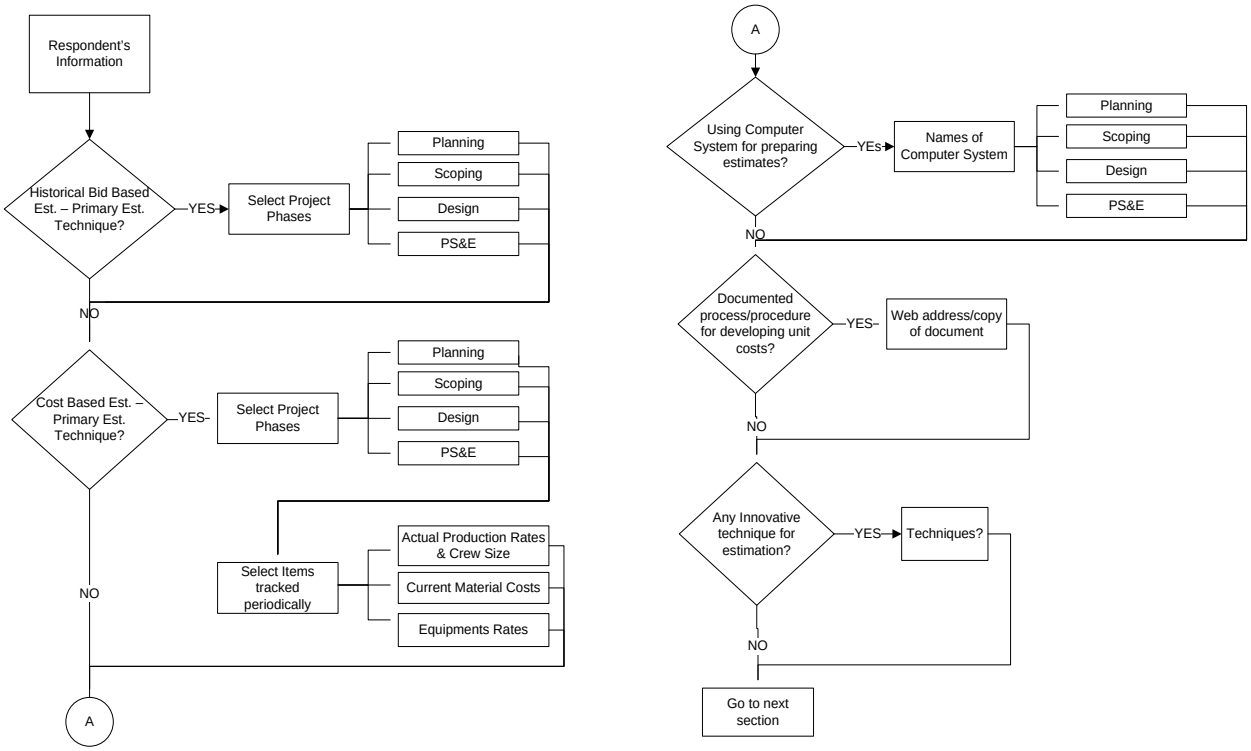


Figure 4. Flowchart - General Section.

3.3.2.2 Acquiring Unit Cost Information

The acquiring unit cost section of the survey captured the system (Commercial or In-house) used by the state agencies to extract unit cost information from the submitted bids and store them in a database. The section also captured the type of historical bid data acquired from the submitted bids to be stored in the database. Figure 5 shows the flow of questions for this section.

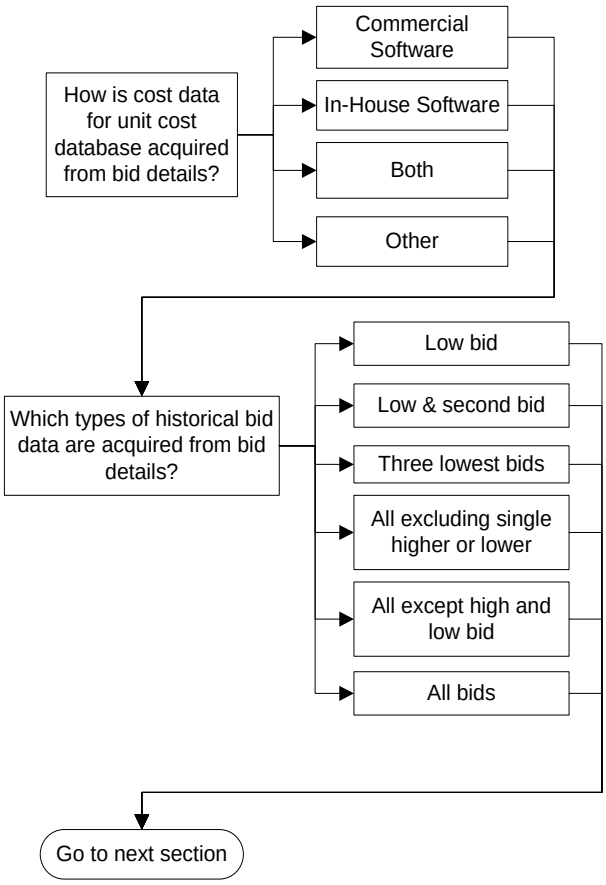


Figure 5. Flowchart - Acquiring Unit Cost Information.

3.3.2.3 Storing Unit Cost Information

The storing unit cost information section focused on how the unit cost details are stored in the database. This involves identifying the type of system (Commercial or In-house, internet or intranet, or Spreadsheet) used to store the historical unit costs and the duration for which these historical unit costs remain in the database. This section also identified whether the unit costs were available for the entire state, districts/regions, counties or market areas and the form in

which these unit cost details were stored, either as standard construction line items or based on different work categories or project types. Figure 6 shows the flow of questions for this section.

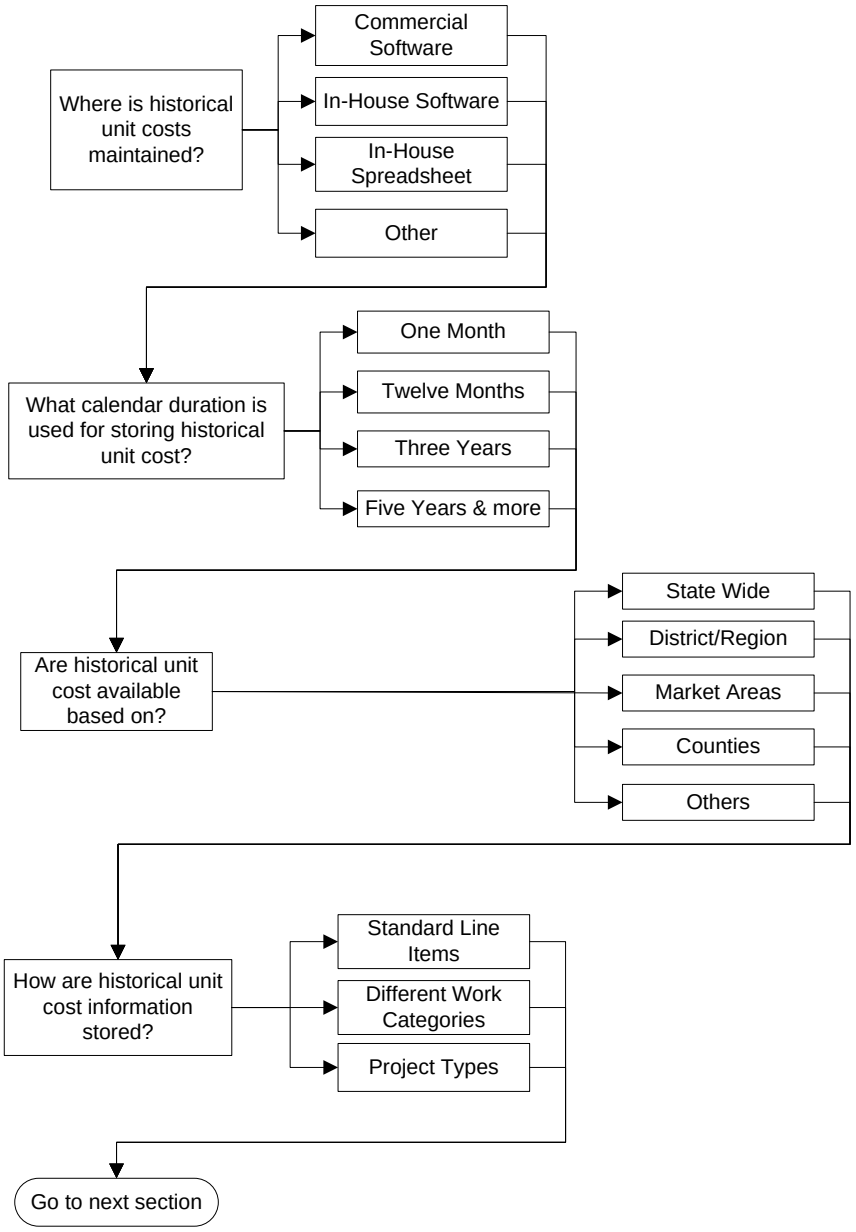


Figure 6. Flowchart - Storing Unit Cost Information.

3.3.2.4 Accessing Unit Cost Information

This section of the survey captured the ways in which historical unit costs can be accessed within the state agency. This includes any system (Commercial or In-House) used by the state agency to sort and summarize historical unit cost data based on the input parameters like standard line item number, quantities, and time period. Figure 7 presents the flow of questions for this section of the survey.

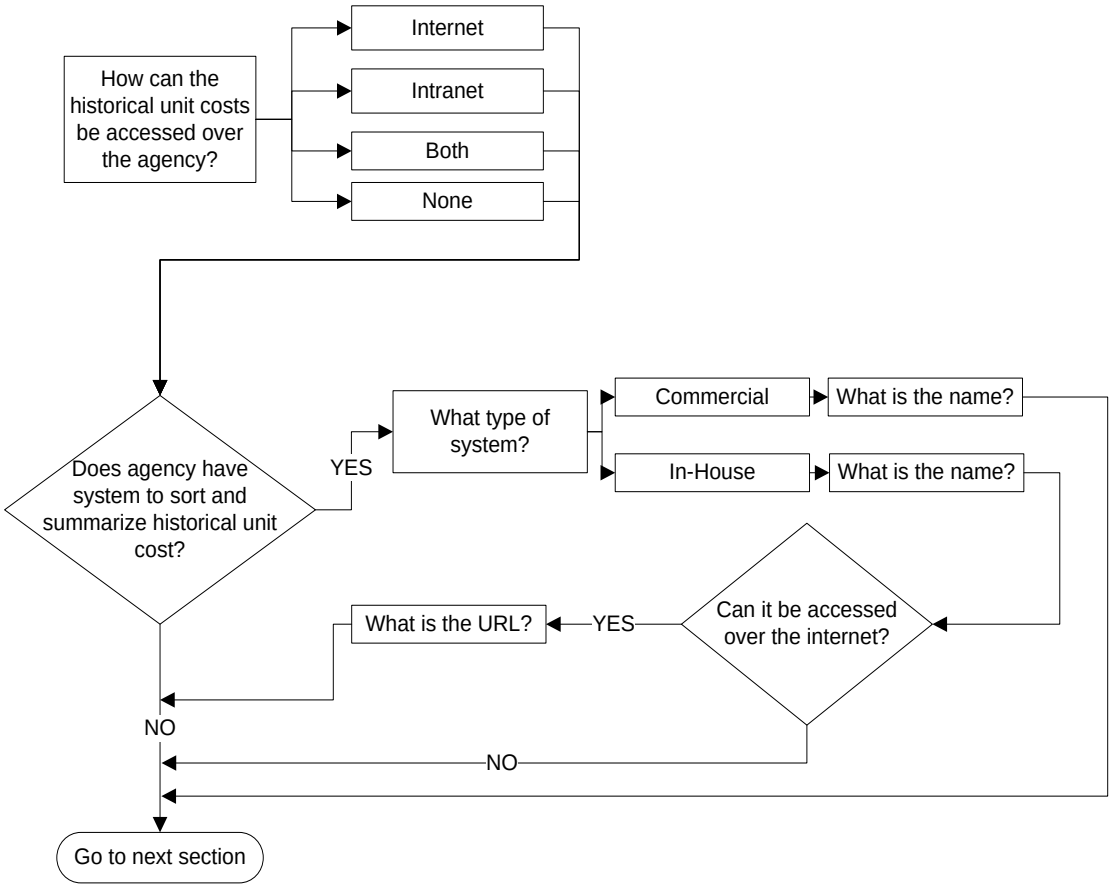


Figure 7. Flowchart - Accessing Unit Cost Information.

3.3.2.5 Applying Unit Cost Information

The final section of the Construction Unit Cost section focused on application of unit cost information in the estimation process. This section identified the calendar duration over which the historical unit costs are averaged, the type of statistical technique used to determine the unit prices, and the items of work (major or minor or both) to which these techniques are applied. Since TxDOT uses moving average when determining the unit price for an item, this section also identified the state agencies using moving averages as part of their estimation process, the type of moving average used (Simple or Weighted), and the duration considered. The final three

questions of this section captured the state agencies having a documented process or method for adjusting unit prices for project characteristics, current market conditions, and current day prices.

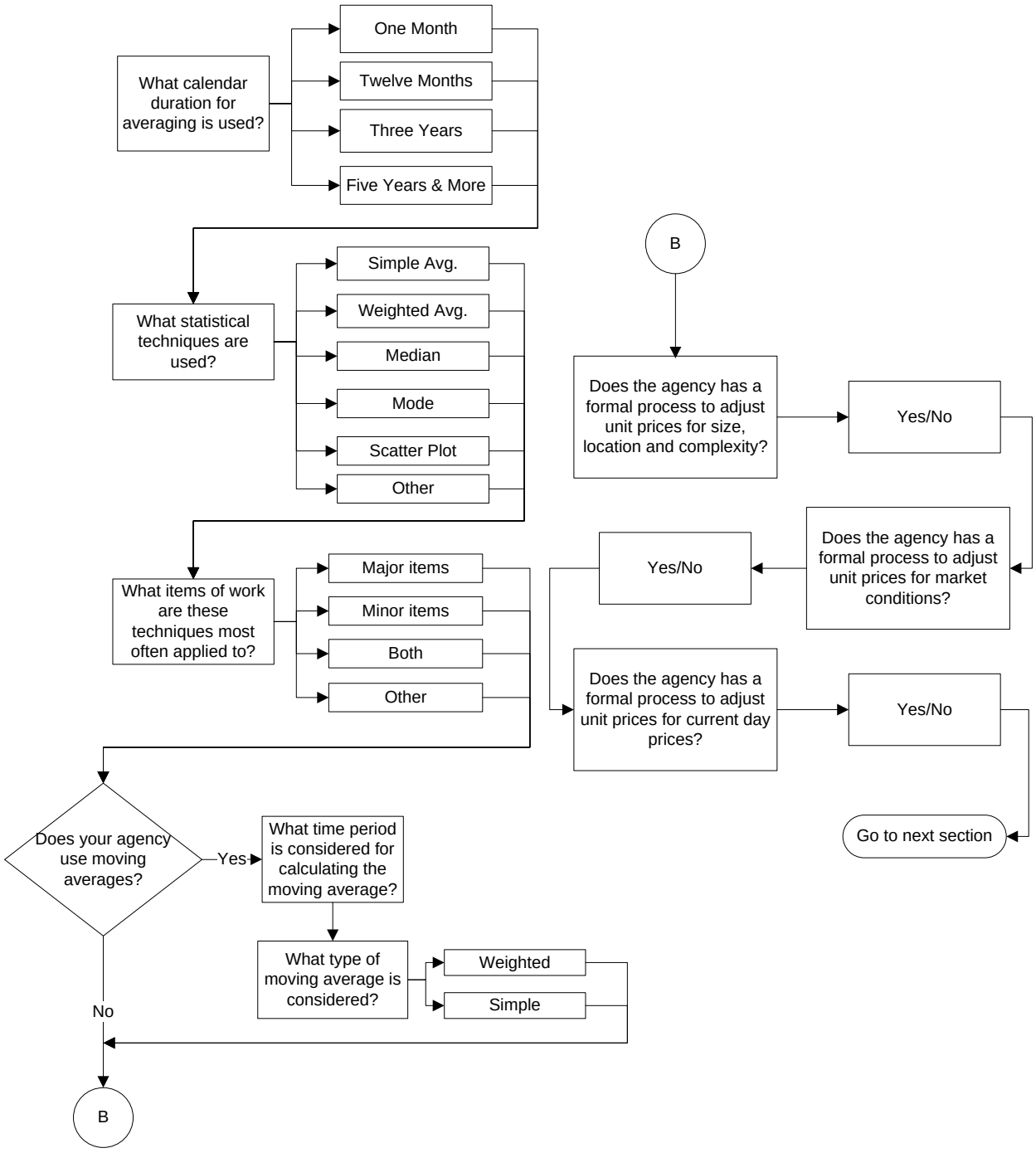


Figure 8. Flowchart - Applying Unit Cost Information.

3.3.2.6 Maintenance Unit Cost Information

The second section of the online survey, Maintenance Unit Cost Information, identified the presence of a maintenance database, the procedure to develop maintenance unit costs, and the difference between the maintenance and the construction unit cost estimation. In order to avoid going through the entire set of questions asked in the previous section, the survey asked the respondents to highlight the differences between maintenance and construction project estimation.

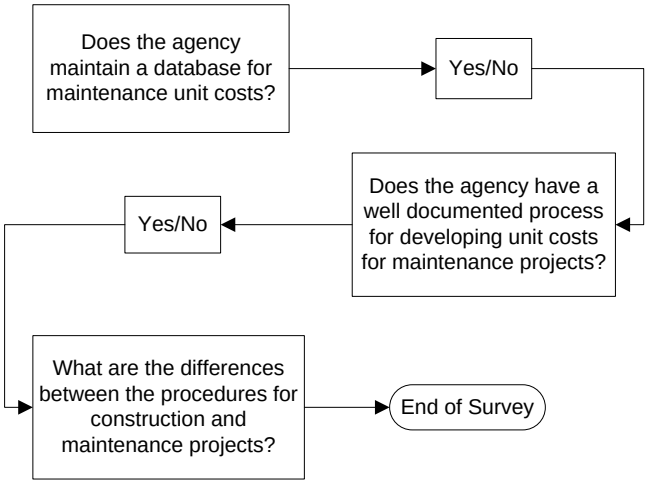


Figure 9. Flowchart - Maintenance Unit Cost Information.

3.3.3 Survey Results

The online survey conducted as part of identifying the state of practice within SHAs for the development of unit prices for construction and maintenance projects yielded thirty-eight (38) replies from thirty-six (36) different state agencies. Both the Office of Construction and Office of Design for Washington State Department of Transportation and Mississippi Department of Transportation replied. Figure 10 shows the states that responded to the online survey. Also shown are the state agencies with which follow up interviews were held.

The results were categorized based on each section identified in the questionnaire and also based on each state agency which replied to the survey.

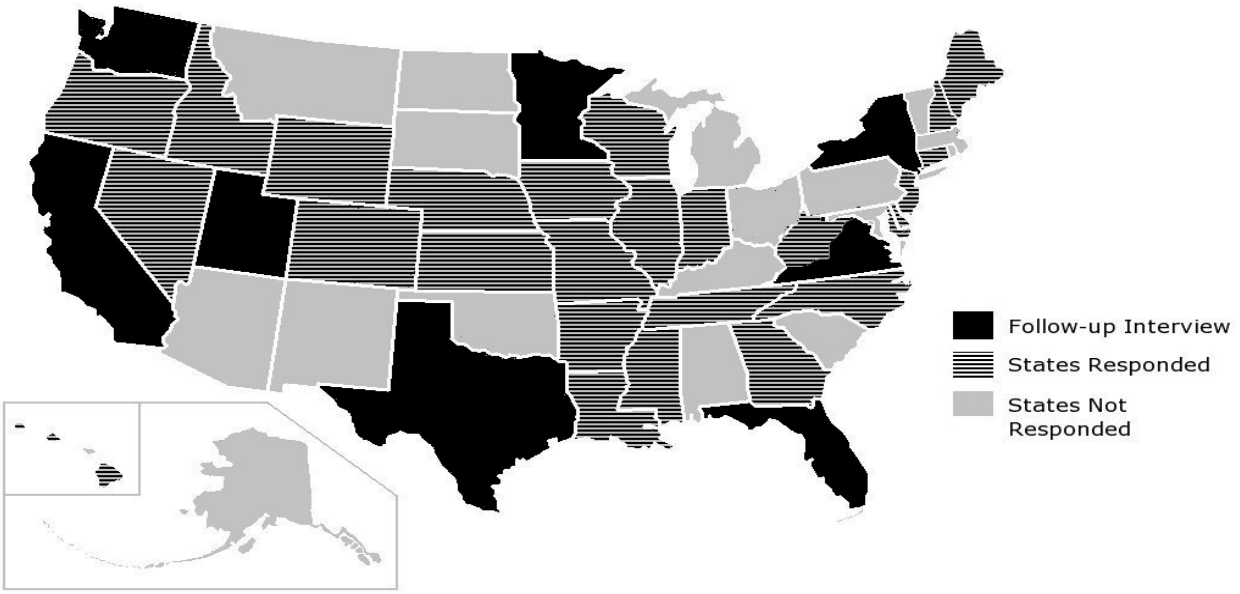


Figure 10. Online Survey - Participating State Agencies.

3.3.3.1 General Section

The responses received for the general section, which identifies the estimation techniques and tools used by the state agencies for developing unit costs for construction projects gave the following results.

- The majority of state agencies (32) that replied to the survey use the historical bid-based estimation as their primary estimation technique (Figure 11).

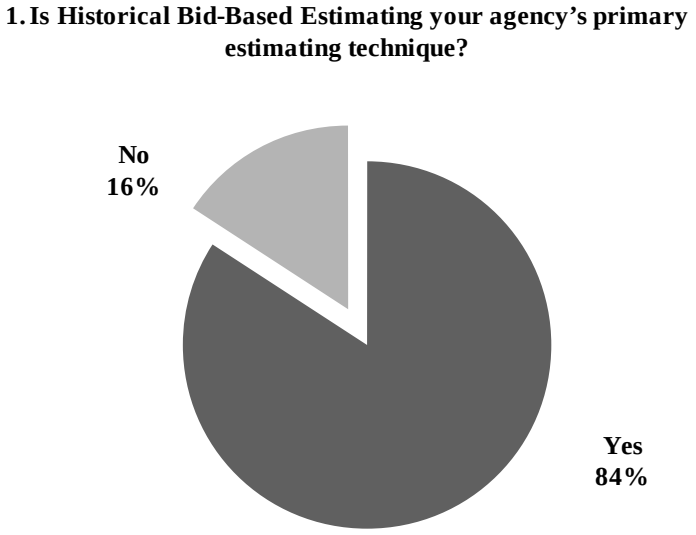


Figure 11. General Section - Estimating Technique (Bid-Based).

- The agencies using historical bid-based estimation as their primary estimation technique use it to estimate projects in their Design and PS&E phases. Some agencies use the bid-based estimation approach even in the Planning and Scoping phase of project development.

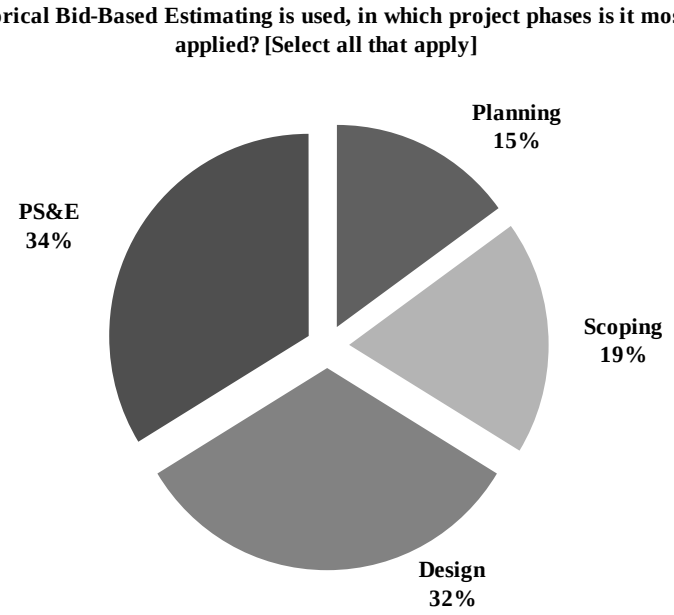


Figure 12. General Section - Application of Bid-Based Estimating Technique.

- When it comes to the use of cost-based estimation technique, only 10 state agencies listed cost-based estimation as their primary estimating technique, as shown in Figure 13. Some states apply this technique in the PS&E phase of project development, and some states use it in the Design as well as Scoping phases. No states reported using it in the Planning phase, as shown in Figure 14.

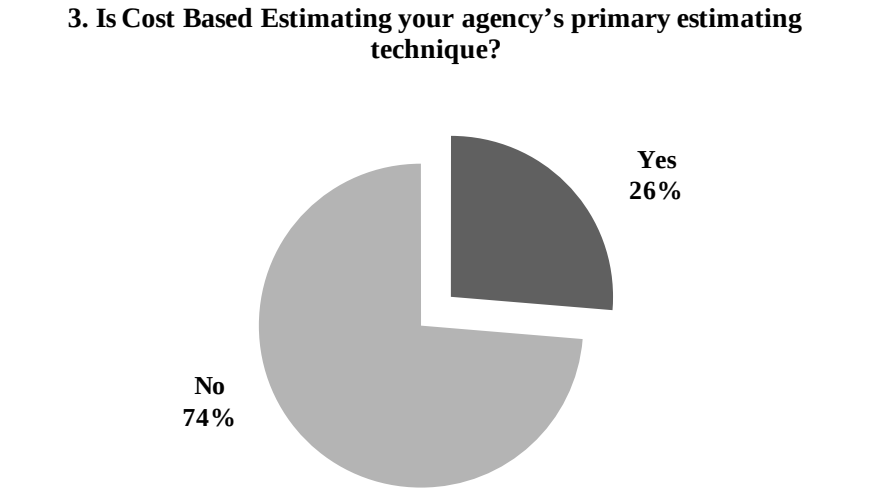


Figure 13 General Section - Estimating Technique (Cost-Based).

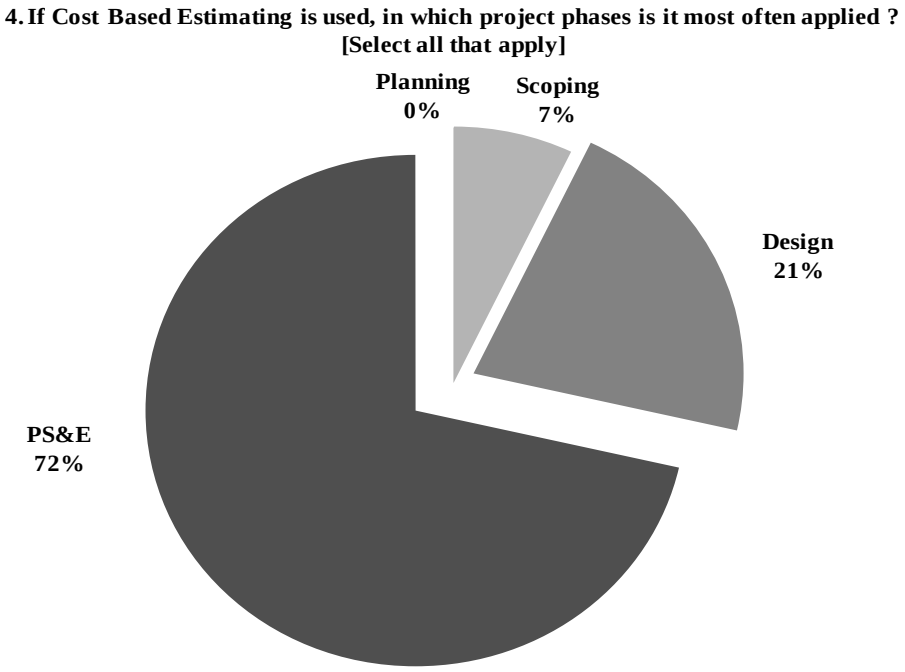


Figure 14. General Section - Application of Cost-Based Estimating Technique.

- On the question of having a well documented process or procedure for developing unit costs for construction cost estimating, more than half of the agencies replied negatively, as shown in Figure 15. Some agencies which had answered 'Yes' for this question, when interviewed, replied that they did not have any formal documentation on the development of unit costs.

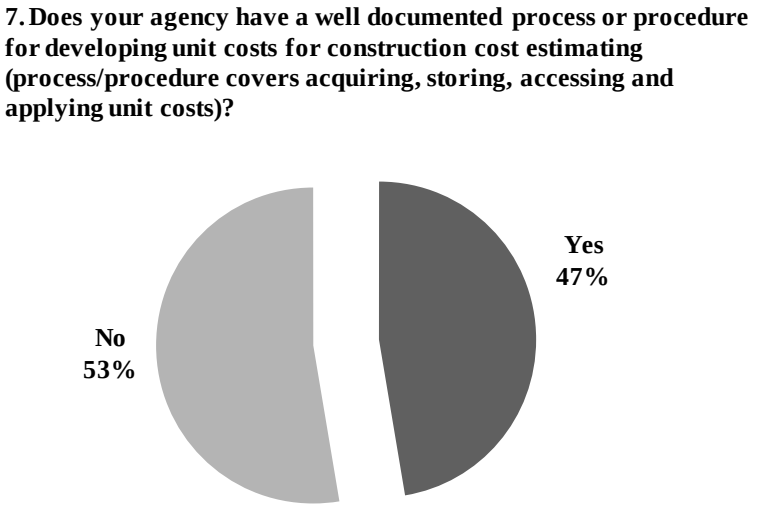


Figure 15. General Section - Documented Process/Procedure for Unit Cost Development.

3.3.3.2 Acquiring Unit Cost Information

The responses to the section on acquiring unit cost information showed that most of the state agencies use commercial software to acquire data from the bid tabulations, as shown in Figure 16. Some state agencies like California Department of Transportation (Caltrans), Utah Department of Transportation (UDOT) and Texas Department of Transportation (TxDOT) have their own systems to acquire and store bid information.

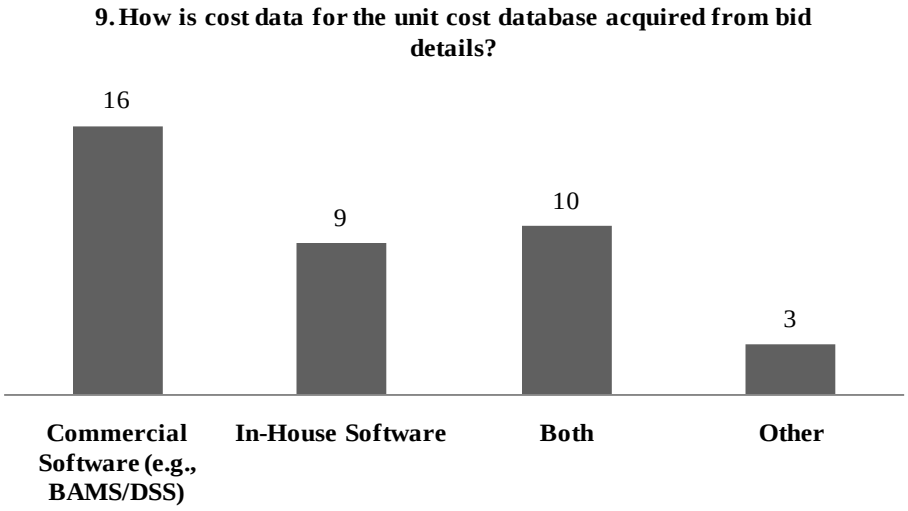


Figure 16. Acquiring Unit Cost - Extracting of Bid Details.

Twenty of the thirty-eight state agencies which responded to the survey considered using all the submitted bids for storing in the database. This enabled the agency to assess the price range for various items of work in the submitted bids.

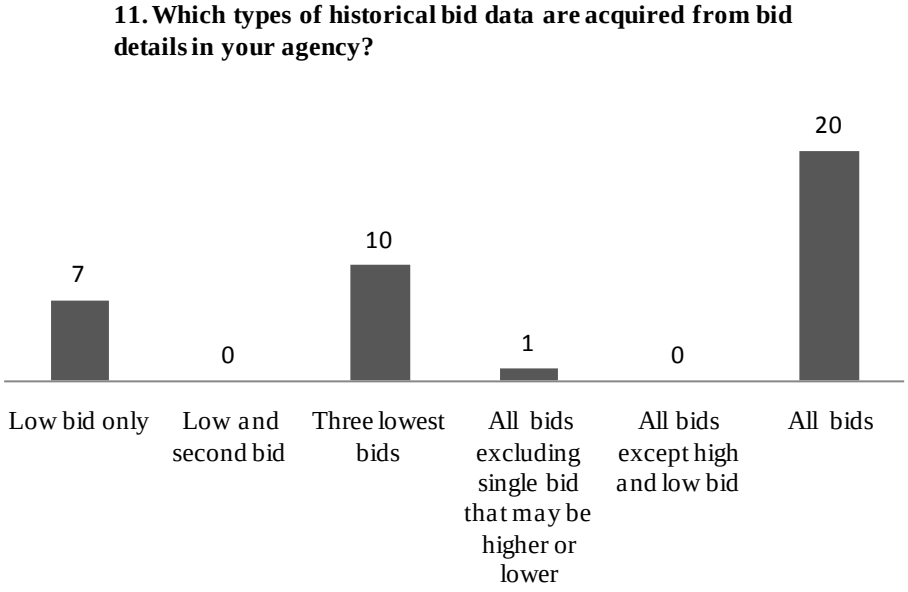


Figure 17. Acquiring Unit Cost - Types of Historical Bid Data.

3.3.3.3 Storing Unit Cost Information

The survey responses for the Storing Unit Cost section showed that 26 state agencies of the 38 that replied used commercial computer system like BAMS/DSS to store the unit cost information. The majority of the state agencies had more than five years of historical data stored in the database. These historical data were available mostly for the entire state and districts/regions, with a few state agencies like Caltrans, Florida Department of Transportation (FDOT), and Colorado Department of Transportation (CDOT) storing it based on market areas. Standard construction line item was the most popular form of storing these historical unit costs (Figure 18).

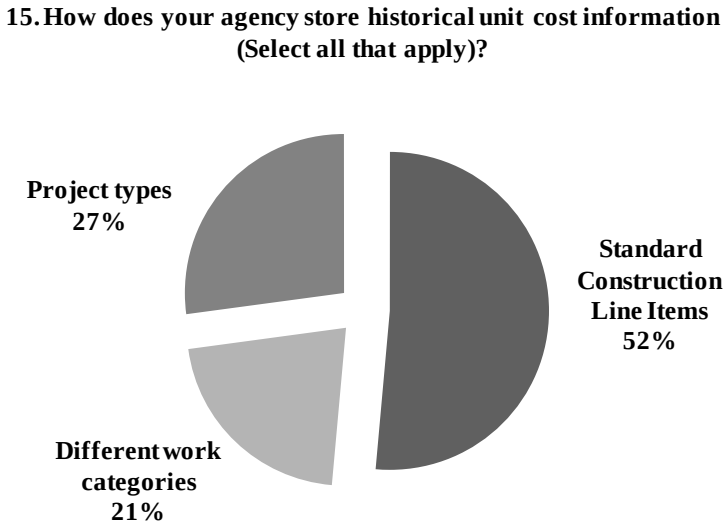


Figure 18. Storing Unit Cost - General Form of Storing Unit Costs.

3.3.3.4 Accessing Unit Cost Information

The responses to the Accessing Unit Cost section showed that state agencies maintain historical unit costs on the internet (SHAs' website) as well as on their intranet. In order to access the historical unit costs, 28 state agencies have systems capable of sorting and summarizing the historical unit costs based on line item number, quantity range, time period, source of funding, etc.

3.3.3.5 Applying Unit Cost Information

Based on the response received from the state agencies, the researchers observed the following results for the Applying Unit Cost section.

State agencies prefer to consider more than 12 months of historical data to establish the unit prices for cost estimating as shown in Figure 19 below.

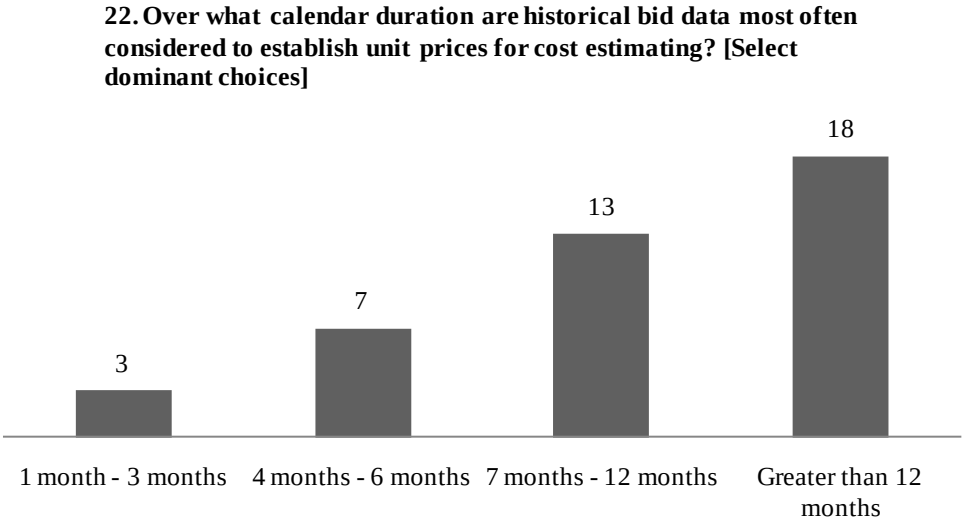


Figure 19. Applying Unit Cost - Calendar Duration for Unit Prices.

The statistical technique most commonly used in determining the unit prices for cost estimating is the weighted average followed by equal number of agencies using simple averages and regression analysis for determining the unit prices. Weighted average is the preferred statistical technique since it takes into consideration the effects of quantities on unit prices. Agencies applied these techniques to both major and minor items of work.

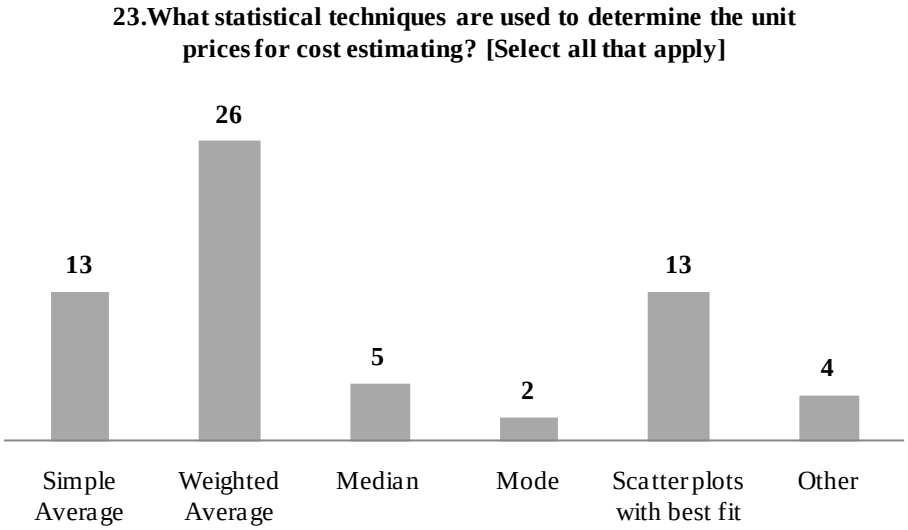


Figure 20. Applying Unit Cost - Statistical Technique for Cost Estimating.

A fewer number of agencies have any formal process or method to adjust unit prices for project characteristics (e.g., complexity, location, size), current market conditions (e.g., bidding environment) or current day prices (e.g., inflation) as shown in Figure 21, Figure 22, and Figure 23. Table 1 lists the agencies that have a formal process or method for adjusting unit prices.

Table 1. State Agencies with Formal Process for Adjusting Unit Prices.

State Agencies	Formal Process/Methods (Documented) for adusting unit prices based on		
	Project Characteristics (Complexity, Size)	Current Market Condition	Current Day Prices
California	X	X	X
Colorado	X	X	X
Hawaii			X
Minnesota	X		X
New Hampshire	X		
Oregon	X	X	X
Utah	X	X	X
Wisconsin	X		

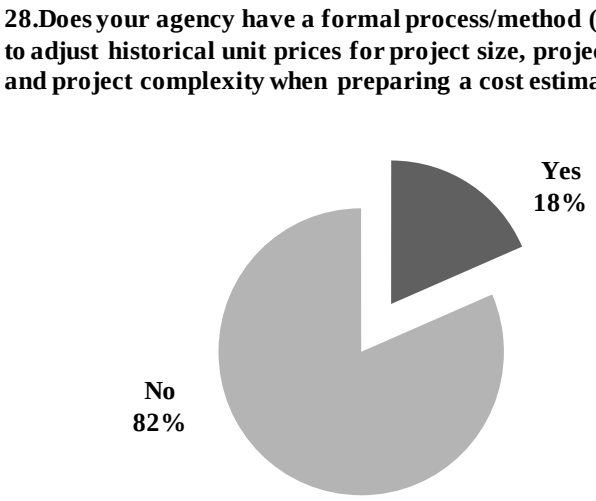


Figure 21. Applying Unit Cost - Unit Price Adjustment (Project Characteristics).

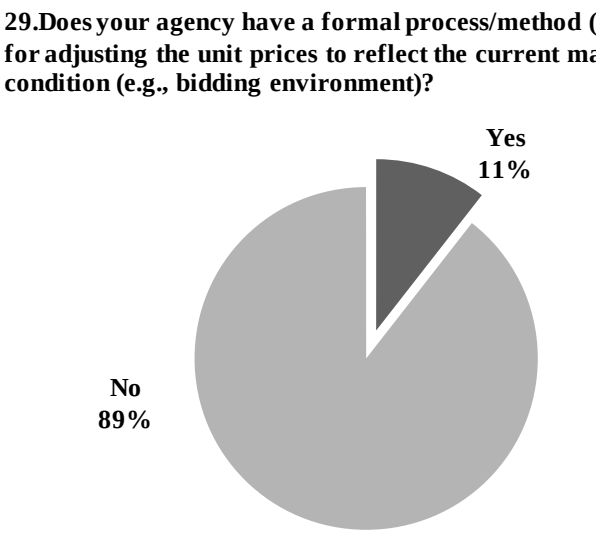


Figure 22. Applying Unit Cost - Unit Price Adjustment (Current Market Conditions).

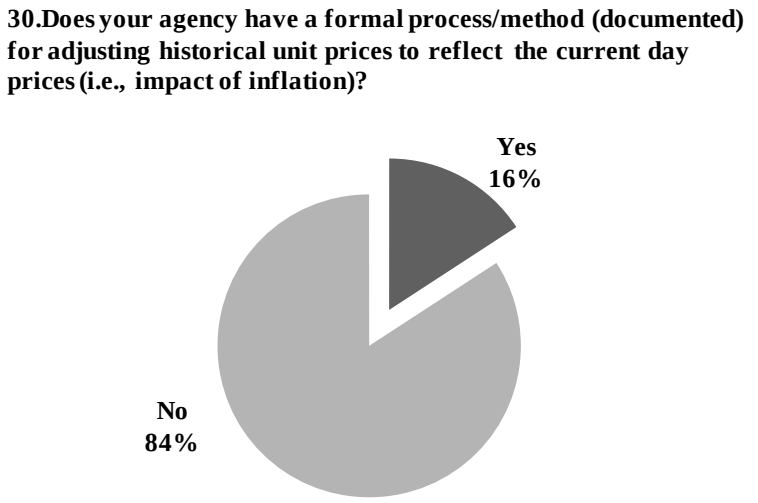


Figure 23. Applying Unit Cost - Unit Price Adjustment (Current Day Prices)

3.3.3.6 Maintenance Unit Cost Information

The results for the maintenance unit cost information section showed that 25 state agencies that replied to the survey had a database for maintenance unit costs (Figure 24). 21 agencies have no procedure or process for developing unit prices for maintenance projects, as shown in Figure 25.

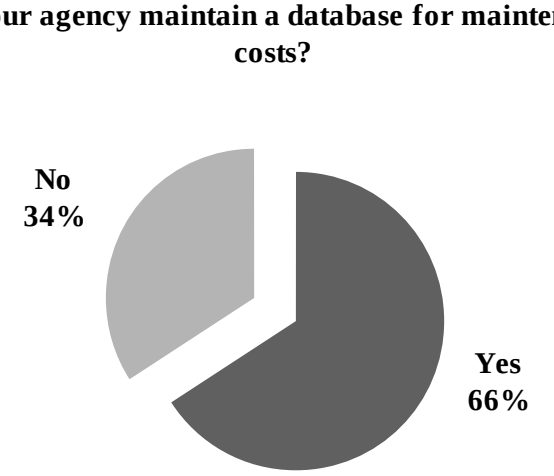


Figure 24. Maintenance Unit Cost - Maintenance Database.

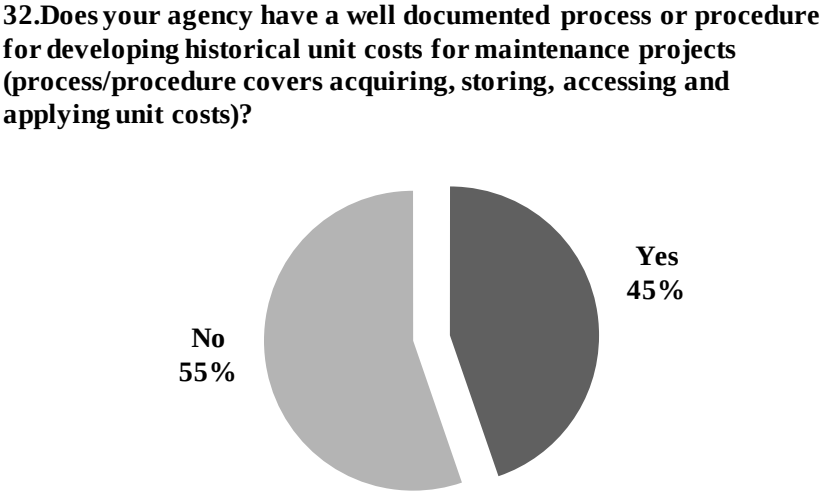


Figure 25. Maintenance Unit Cost – Documented Process/Procedure for Unit Cost Development.

3.4 ANALYSIS OF THE RESULTS

The research team analyzed the results from the online survey to identify the state agencies conducting considerable work in the development of unit costs for project estimation. The team selected seven state agencies for further interview. The analysis technique involved conducting interviews over the telephone and visiting the state agency's offices. For this purpose, a structured interview protocol was developed and used in all the interviews. The follow-up interview questionnaire for the respective states was developed based on the replies received for the online survey.

3.4.1 Interviews – Selection Criteria

The criteria applied to select state agencies for the follow-up interviews covered different aspects of unit cost development for construction projects. They included:

- **Estimating approach** – Type of estimating technique used by the agency in estimating construction projects. Either (1) Historical Bid-Based Estimating or (2) Cost-Based Estimating.
- **Trns*port Users** – Agencies using Trns*port suite of software like CES, PES, Estimator.
- **Non-Trns*port Users** – Agencies using in-house developed system for estimating construction projects.

- **Innovative approach to estimating** – Agencies using innovative ways to estimate construction projects.
- **Sophisticated databases** – Agencies having sophisticated databases for historical unit costs.
- Agencies having guidance on developing estimates for construction projects.

The team also considered different districts within TxDOT for interview to gain a better understanding of the unit cost development followed in the districts. The results of these interviews were compared with the replies from other state agencies and used as the basis for recommendations.

3.4.2 State Agencies Interviewed

The research team selected the following state agencies for a follow-up interview based on the selection criteria identified in the previous section.

- California
- Florida
- New York
- Minnesota
- Utah
- Virginia
- Washington
- Texas
    - Dallas District
    - Fort Worth District
    - Bryan District

Each agency was given a follow-up questionnaire developed based on their replies to the online survey. The interviews were conducted over the telephone for all state agencies except Minnesota Department of Transportation (MnDOT). Appendix D shows the sample questionnaire used for the telephone interview with the VDOT. The researchers also interviewed TxDOT personnel to understand the development of unit costs within TxDOT. Dallas, Fort Worth, and Bryan districts were selected for the interview. The Dallas and Fort Worth interviews were conducted over the telephone, while the Bryan District interview was conducted on site.

4. RESULTS FROM INTERVIEWS

This section consolidates the replies received from the SHAs interviewed over the telephone or by personal visit to their offices. Similar to the online survey, the replies from the interview are grouped under two sections, construction and maintenance unit cost information, for each SHA. Similar to the survey, construction unit cost information section is further divided into five sub-sections: 1) a general section; 2) acquiring; 3) storing; 4) accessing; and 5) applying unit cost information.

4.1 VIRGINIA DEPARTMENT OF TRANSPORTATION

4.1.1 Construction Unit Cost Information

4.1.1.1 General Section

VDOT's primary estimation technique is cost-based estimating carried out in the PS&E phase of project development. VDOT uses cost-based estimating to develop project estimates using a production rate and the cost associated with labor, materials, and construction equipment. By estimating the cost of each component required to complete the work together with a contractor's profit and overhead an estimated unit price for the work is developed. Estimation during the planning, scoping, and design phase is performed with the help of different software which includes the commercially available Trns*port system as well as software developed in-house by VDOT. Table 2 provides details of the software used by VDOT in different phases of project development. Figure 26 provides the cost estimation framework used by VDOT, set against its contract time estimation framework (Williams et al., 2007).

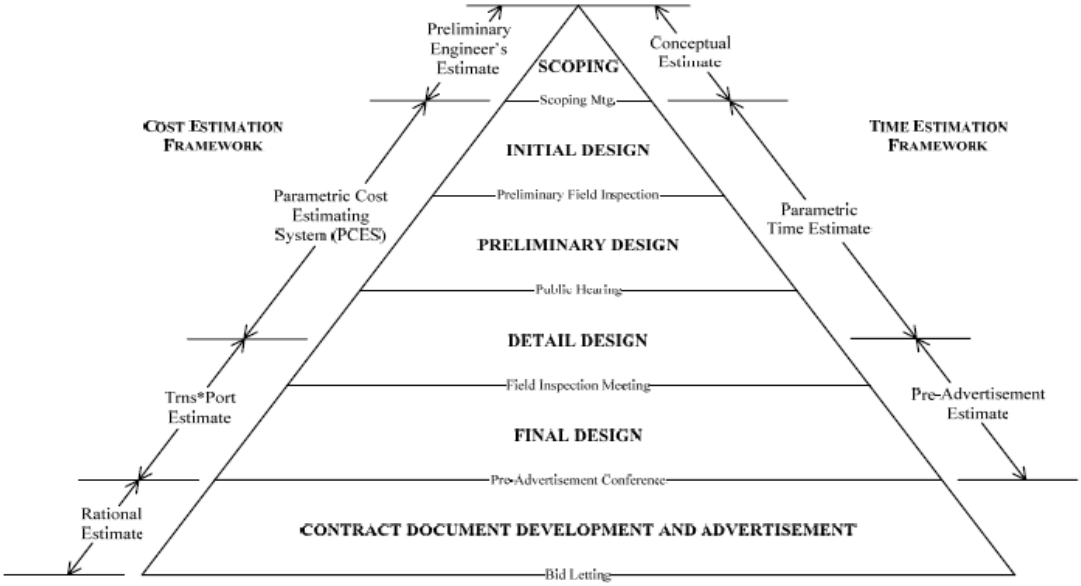


Figure 26. VDOT Estimation Framework.

Table 2. VDOT Estimation Software.

Project Development Phases	Computer Based System
Planning	Planning Cost Estimate Excel
Scoping	Project Cost Estimating System (PCES)
Design	Trns*port PES
PS&E	Estimator, InfoTech Pvt. Ltd

4.1.1.1.1 Planning Cost Estimate Excel

The planning division of VDOT uses Planning Cost Estimate Excel to arrive at the planning level cost estimate. This Excel spreadsheet was last updated on June 2006 and is used throughout the state in preparing planning level estimates. This includes cost of typical sections for urban and rural regions, bridge cost, other improvement costs, Right-of-Way (ROW), and Utilities cost (expressed as percentage of construction cost). The estimates are given for three different regions of Virginia. A contingency factor of 20 percent for Preliminary Engineering (PE) and Construction Engineering (CE) is included in the costs. At the planning level, statewide inflation is assumed to be 5.5 percent annually and an inflation rate of 6.5 percent is assumed for NOVA/Hampton roads.

The urban and rural typical section estimates, given in Table 3, do not include bridge, right-of-way (ROW), and other improvement costs. The estimates are represented in Cost Per Mile (CPM). The three regions include Bristol and Lynchburg for Region I, Richmond,

Fredericksburg, Culpeper, Salem and Staunton for Region II and NOVA/Hampton Roads for Region III.

Table 3. VDOT Urban/Rural Sections - Planning Cost Estimate Excel.

Urban Typical Sections							
Bikeway		5' pavement		CPM	$ 490,000	$ 540,000	$ 630,000
2 lanes	U2	26'-30' pavement	Reconstruct or New	CPM	$ 2,700,000	$ 3,000,000	$ 3,500,000
3 lanes	U3	36'-40' pavement	Reconstruct or New	CPM	$ 5,200,000	$ 5,700,000	$ 6,600,000
4 lanes	U4	40'-48' pavement	Reconstruct or New	CPM	$ 6,200,000	$ 6,800,000	$ 7,900,000
4 lanes divided	U4D	48' pavement w/16' raised median	Reconstruct or New	CPM	$ 6,900,000	$ 7,600,000	$ 8,800,000
4 lanes divided	U4D	48' pavement w/28' raised median	Reconstruct or New	CPM	$ 7,400,000	$ 8,200,000	$ 9,400,000
6 lanes divided	U6D	72' pavement w/16' raised median	Reconstruct or New	CPM	$ 8,900,000	$ 9,800,000	$ 11,300,000
6 lanes divided	U6D	72' pavement w/28' raised median	Reconstruct or New	CPM	$ 9,700,000	$ 10,600,000	$ 12,300,000
8 lanes divided	U8D	96' pavement w/16' raised median	Reconstruct or New	CPM	$ 11,100,000	$ 12,200,000	$ 14,200,000
8 lanes divided	U8D	96' pavement w/ 28' raised median	Reconstruct or New	CPM	$ 11,800,000	$ 12,900,000	$ 14,900,000
Rural Typical Sections							
Bikeway		5' pavement		CPM	$ 220,000	$ 240,000	$ 280,000
1 lane		12' pavement		CPM	$ 300,000	$ 330,000	$ 380,000
2 lanes	R2	18' pavement	Reconstruct or New	CPM	$ 460,000	$ 500,000	$ 580,000
2 lanes	R2	20' pavement	Reconstruct or New	CPM	$ 750,000	$ 830,000	$ 960,000
2 lanes	R2	22' pavement	Reconstruct or New	CPM	$ 900,000	$ 990,000	$ 1,140,000
2 lanes	R2	24' pavement	Reconstruct or New	CPM	$ 1,300,000	$ 1,400,000	$ 1,700,000
3 lanes	R3	36' pavement	Reconstruct or New	CPM	$ 2,600,000	$ 2,900,000	$ 3,300,000
4 lanes divided	R4D	48'pavement	Reconstruct	CPM	$ 3,500,000	$ 3,900,000	$ 4,500,000
4 lanes divided	R4D	48' pavement	New	CPM	$ 5,300,000	$ 5,900,000	$ 6,800,000
4 lanes divided	R4D	48' pavement	Parallel	CPM	$ 2,700,000	$ 3,000,000	$ 3,500,000
4 lanes divided	R4D	48' pavement w/16' raised median	Reconstruct or New	CPM	$ 3,800,000	$ 4,100,000	$ 4,800,000
4 lanes divided	R4D	48' pavement w/28' raised median	Reconstruct or New	CPM	$ 4,400,000	$ 4,900,000	$ 5,600,000
6 lanes divided	R6D	72' pavement widen 4-6 lanes	Reconstruct	CPM	$ 4,900,000	$ 5,400,000	$ 6,300,000
6 lanes divided	R6D	72' pavement w/depress median	New	CPM	$ 6,500,000	$ 7,100,000	$ 8,300,000
8 lanes divided	R8D	96' pavement widen 6-8 lanes	Reconstruct	CPM	$ 4,900,000	$ 5,400,000	$ 6,300,000
8 lanes divided	R8D	96' pavement widen 4-8 lanes		CPM	$ 9,800,000	$ 10,700,000	$ 12,400,000

The tool excludes bridges from the typical section since they contribute significantly to construction cost. Estimates for bridge are computed using the available costs per square footage multiplied by the bridge dimensions. Table 4 gives the bridge cost used in the planning level cost estimate.

Table 4. VDOT Bridge Cost - Planning Cost Estimate Excel.

Bridge Cost				
Over 25' to 200' in length	Widen Reconst or New per sq ft	$ 110	$ 120	$ 140
Over 200' in length	Widen Reconst or New per sq ft	$ 140	$ 150	$ 170

Other improvement costs are added to construction cost based on the project condition. The urban/rural sections, bridges and other improvement costs make up the planning level construction estimate. The Planning Cost Estimate Excel derives the planning level cost estimate by adding the ROW cost and utilities cost to the construction estimate. The ROW and utilities cost, given in Table 5, are classified based on location of project.

Table 5. VDOT ROW Cost Percentages - Planning Cost Estimate Excel.

Right of Way & Utilities Cost % of Cost Estimate		
Rural	25%	30%
Residential/Suburban low density	50%	55%
Outlying business/Suburban high density	60%	75%
Central business district	100%	125%

4.1.1.1.2 Project Cost Estimating System (PCES)

PCES is an in-house system developed by VDOT for preparing estimates during the scoping phase of project development. The current version of the PCES is 2.5, though the discussion used version 2.1. The PCES consists of following sections:

- Summary Page

  The summary page gives the total project estimate, which is made up of the construction estimate, Preliminary Engineering (PE) estimate, and right-of-way and utilities estimate along with the project number, district, and year of estimation.

- Construction/Bridge/PE

  This section uses lane mile cost for different geometric standards taken from the bid details. The construction estimate includes details of the roadway like the total length of project, length of two/four lanes to be built, length of the curb (ft), length of the sidewalk, number of new traffic signals required or number of signals requiring adjustment, cost of large drainage structures, and in-plan utility cost.

  The PCES system provides an estimate based on project features rather than the quantities. For example, the cost of all the components required in constructing a new

signal is rolled up into one cost, which constitutes the unit price for the signal. By entering the number of new signals to be constructed, a total estimate for the signals is computed.

PCES estimates bridges separately, again for the same reason that they contribute significantly to project construction cost. The dimensions of the existing and new bridge along with the complexity/type of new bridge are entered for estimating the bridge construction cost. Bridge complexity can be selected as simple, moderate, or complex based upon the height, difficulty of construction and other factors. Estimates for a bridge of moderate complexity are taken as the base estimate, which is increased by 15 percent for complex bridges and decreased by 10 percent for bridges of simple complexity. Also, PCES provides the option to select whether the bridge work is only widening of existing structure or super structure repair. The demolition of bridges is estimated as a lump sum item.

- Right-of-way (ROW) Estimate

  The costs associated with the ROW estimate can be either “computed” or “user-defined” costs. ROW estimate comprises of the land value, building value, damages, other improvements, administrative settlements, condemnation increases, administrative costs and incidental expenses, demolition contracts, hazardous materials removal, property management, relocation assistance, year of ROW authorization and a manual inflation rate.

- Utilities Estimate

  The utilities estimate includes the cost associated with setting up electrical lines, telephone lines, water, sanitary sewer, natural gas/propane, petroleum, cellular, and any additional items.

4.1.1.1.3 Trns*port Proposal and Estimate System (PES)

VDOT uses the PES module of the Trns*port system for preparing the design level estimates. PES generates an item cost estimate using the historical bid data stored in the BAMS/DSS. The emphasis at this stage is on estimating the correct quantities. VDOT uses a detailed estimate generated by PES to compare the estimates generated by the estimators.

4.1.1.1.4 Trns*port Estimator

VDOT uses the Estimator to perform "rational estimation" or cost-based estimation to compare the estimates of designers. The definition of rational estimate given by VDOT is "*An estimate prepared by determining the required manpower, equipment, labor, and production rate, per day needed to complete a unit of work.*" Rational estimation is performed on bid items which constitute 65 percent of total project cost. All unit prices are reviewed and modified as necessary. VDOT checks the remaining 35 percent of project cost, which mostly includes minor items of work, against the prices estimated in PES and does not modify the amounts unless there is a large deviation in the prices contained in PES. VDOT uses various catalogs for its rational estimation. These catalogs are databases containing the equipment, labor, and material costs that are loaded into Estimator. The Site Manager module of the Trns*port suite of software is also used in the estimation to obtain production rates based on the similarity of work being estimated.

4.1.1.2 Acquiring Unit Cost Information

As part of its rational estimation, VDOT makes use of different catalogs. These 'catalogs' are databases of equipment, labor and material costs loaded into Estimator to help in preparing the cost estimate. These catalogs are updated every year from their respective sources specified in Table 6.

Table 6. VDOT Source of Equipment, Labor, Material, and Production Rates.

Equipment Costs	Blue Book of Construction Equipment Rental Rates
Material Costs	Material on Hand (VDOT form C-22) reports, individual suppliers, and internet
Labor rates	Virginia Employment Commission (VEC)
Production Rates	RS Means and Site Manager (Trns*port), Bid Item Duration Data System (BIDDS)

Equipments rates, labor rates, and material costs are updated periodically as and when their respective data sources are revised. The State Estimates Officer and Bid Engineer are responsible for verifying the updated catalogs of equipments, labor, and material costs.

4.1.1.3 Storing Unit Cost Information

VDOT maintains over five years of historical unit costs in its BAMS/DSS database. These historical unit costs are available for the entire state as well as for each district. Apart from storing historical unit costs as standard construction line items, VDOT also categorizes them based on different work categories (e.g., grading/excavation, asphalt, bridge, traffic control, etc.) and based on project types (e.g. bridge replacement, lane widening, intersection reconstruction,

etc.). PES project details are updated every night in a separate data. This is used to compare the estimates prepared using PCES software.

4.1.1.4 Accessing Unit Cost Information

The BAMS/DSS database is the primary source of historical data used in PES and Estimator. VDOT also maintains a comprehensive two-year historical bid price listing as well as the statewide and district averages on its website at http://www.virginiadot.org/business/const/ under the '***Other Resources***' section. Figure 27 provides a sample of a two-year historical bid price listing maintained by VDOT. Figure 28 and Figure 29 give a snapshot of the statewide and district averages maintained for different work items.

Virginia Department of Transportation 14:37 Thursday, May 22, 2008 1
Two Year Bid History
APRIL 2006 through MARCH 2008

HISTORICAL BID PRICE LISTING

PAY ITEM: 00100 DESCRIPTION: MOBILIZATION / LS

REGION	CALENDAR QUARTER	CONTRACT NUMBER	COUNTY LOCATION	PROJECT DESCRIPTION	BID QUANTITY	AWARD PRICE	SECOND BIDDER	THIRD BIDDER	ESTIMATE
1	2006Q2	C00008078C02	SMYTH	0610-086-157,C502	1	$50,000	$125,000	$50,000	
		C00018044N01	TAZEWELL	0606-092-571,B642	1	$20,000	$26,500	$48,000	
		C00070079C01	SCOTT	0058-084-113,C501	1	$151,825	$296,500	$425,000	
		C00070847C01	WASHINGTON	0611-095-294,C501	1	$9,500	$20,000	$35,000	
		C00078638N01	BRISTOL	(NFO)0VHD-961-101,N5	1	$19,485	$20,000	$42,100	
		C00078829N01	RUSSELL	0645-083-446,N501	1	$18,000	$11,635	$30,000	
		CM103BRA39543	SMYTH	0624-086-6034,SR00	1	$25,000	$35,490	$50,000	
		CM103BRA39623	BUCHANAN	0083-013-1026,SR00	1	$29,505	$50,000	$18,000	
		CM105BRA39575	WISE	0072-097-1093,SR00	1	$24,500	$15,000	$28,000	
		CM105BRA39659	DICKENSON	0072-025-1020,SR00	1	$12,750	$37,913	$27,500	
		CM106BRB39575	WISE	(NFO)PM06-097-144,M4	1	$150,000	$325,000	$151,475	
		CM106BRB39578	GRAYSON	BR-1A-06	1	$25,000	$33,000	$60,000	
	2006Q3	C00013897N01	SCOTT	0852-084-241,B632	1	$30,000	$25,250	$40,000	
		C00016906B40	RUSSELL	0657-083-346, B640	1	$35,000	$15,000	$40,000	
		C00065067N01	TAZEWELL	(NFO)0019-092-119,N5	1	$3,000			
		C00071603B25	BLAND	0622-010-181,B625	1	$15,250	$40,000	$35,000	
		C00080349N01	SCOTT	0370-084-313,N501	1	$17,225	$25,000	$25,000	
		C00080388M00	WISE	BR07-097-153, M400	1	$42,000	$69,000	$167,000	
		C00080698C01	BUCHANAN	BR07-013-184, C501	1	$49,000	$120,000	$112,100	
		CM106BRA39537	SCOTT	0645-084-6062, SR01	1	$12,000	$25,000	$30,000	
	2006Q4	C00000313C02	BUCHANAN	0680-013-122,C502	1	$94,600	$200,000	$900,000	
		C00018235N01	DICKENSON	0650-025-450,N501	1	$55,000	$20,000	$30,000	
		C00018612N01	SCOTT	0625-084-P63,N501	1	$12,250	$12,000	$25,000	
		C00018930B04	WASHINGTON	0058-095-114,B604	1	$46,500	$52,300	$129,000	
		C00062409N02	WISE	0610-097-481,N502	1	$33,300	$100,000	$45,000	
		C00080223M00	WISE	BR07-097-150,M400	1	$25,000	$20,000	$31,000	
	2007Q1	C00012500C01	WASHINGTON	0736-095-277,C501	1	$60,000	$83,000	$120,000	
		C00051556N01	RUSSELL	0635-083-P27,N501	1	$12,500	$15,120	$10,000	
		C00058265N04	BUCHANAN	0616-013-P92,N504	1	$26,000	$12,000	$30,000	
		C00058266N01	BUCHANAN	0628-013-P56,N501	1	$17,980	$7,500	$16,000	
		C00080215SR2	SMYTH	0730-086-630,SR02	1	$106,000	$105,000	$121,000	
		C00080217SR3	WISE	(NFO)0083-097-104,SR	1	$70,000	$37,800	$83,000	
		C00080785N09	BRISTOL	IS00-961-101,N509	1	$70,000	$110,750	$131,000	

Figure 27. VDOT Two-Year Historical Bid Price Listing.

STATEWIDE AVERAGES APRIL 2006 THROUGH MARCH 2008

ITEM	ITEM DESCRIPTION	UNIT	MINIMUM PRICE	MAXIMUM PRICE	AVERAGE LOW BIDS
00010	LABOR	TEC	$ 32.00	$ 42,000.00	$ 189.18
00100	MOBILIZATION	LS	$ 1.00	$ 11,500,000.00	$ 152,515.03
00101	CONSTRUCTION SURVEYING	LS	$ 248.50	$ 4,000,000.00	$ 91,596.16
00110	CLEARING AND GRUBBING	LS	$ 47.50	$ 1,700,000.00	$ 227,244.77
00120	REGULAR EXCAVATION	CY	$ 3.03	$ 140.00	$ 12.22
00124	ROCK EXCAVATION	CY	$ 1.00	$ 600.00	$ 373.79
00125	GRADING	LS	$ 1.00	$ 826,000.00	$ 98,509.16
00126	EARTHWORK	LS	$ 85,000.00	$ 170,000.00	$ 127,500.00
00128	EXTRA EXCAVATION	CY	$ 1.53	$ 30.00	$ 7.99
00140	BORROW EXCAVATION	CY	$ 0.01	$ 50.00	$ 10.56
00150	EMBANKMENT	CY	$ 0.01	$ 50.00	$ 3.78
00155	GEOTEXTILE (EMBANKMENT STABILIZATION)	SY	$ 1.65	$ 5.01	$ 1.90
00190	SURCHARGE PLACEMENT & REMOVAL	CY	$ 63.00	$ 63.00	$ 63.00
00200	SETTLEMENT PLATE	EA	$ 1,200.00	$ 1,700.00	$ 1,311.11
00211	MINOR STRUCTURE EXCAV. PIPE CULVERT	CY	$ 5.00	$ 75.00	$ 17.41
00212	MINOR STRUCTURE EXCAV. BOX CULVERT	CY	$ 11.00	$ 100.00	$ 41.75
00270	SELECT MATL. TY. I MIN. CBR-30	TON	$ 11.98	$ 40.00	$ 26.02
00272	SELECT MATL. TY. I MIN. CBR-30	CY	$ 23.17	$ 58.30	$ 29.00
00280	SELECT MATL. TY. II MIN. CBR-20	CY	$ 12.23	$ 400.00	$ 18.09
00355	GEOTEXTILE (SUBGRADE STABILIZATION)	SY	$ 0.55	$ 25.00	$ 2.19
00491	CLASS I BACKFILL MATERIAL	CY	$ 48.02	$ 48.02	$ 48.02
00502	BED.MAT.FINE AGR.OR AGGR.NO.10	TON	$ 20.00	$ 20.00	$ 20.00
00505	BEDDING MATL.AGGR.NO. 25 OR 26	TON	$ 13.00	$ 108.34	$ 27.58
00515	TEMPORARY SHEET PILING	SF	$ 9.20	$ 75.71	$ 26.79
00519	SHEET PILE, STEEL	SF	$ 31.83	$ 31.83	$ 31.83
00522	CONCRETE CLASS A4 BOX CULVERT	CY	$ 373.25	$ 1,900.00	$ 973.76
00525	CONCRETE CLASS A3 MISC.	CY	$ 129.50	$ 6,712.07	$ 757.83
00529	FLOWABLE BACKFILL	CY	$ 50.00	$ 1,200.00	$ 117.45
00530	CONCRETE CLASS B2	CY	$ 3,000.00	$ 3,000.00	$ 3,000.00
00540	REINF. STEEL	LB	$ 0.01	$ 3.75	$ 0.90
00542	EPOXY COATED REINF. STEEL	LB	$ 0.01	$ 2.70	$ 1.68
00560	STRUCTURAL STEEL JB-1	LB	$ 4.68	$ 25.00	$ 8.64
00571	ENDWALL PIPE GRATE EW-11 TY.I	LF	$ 550.00	$ 550.00	$ 550.00
00574	ENDWALL GRATE & FRAME EW-11A	EA	$ 950.00	$ 3,500.00	$ 2,543.75
00580	UNDERDRAIN UD-1	LF	$ 7.00	$ 15.00	$ 14.52
00585	UNDERDRAIN UD-2	LF	$ 15.00	$ 36.35	$ 26.55
00587	UNDERDRAIN UD-3	LF	$ 12.19	$ 34.00	$ 16.19
00588	UNDERDRAIN UD-4	LF	$ 5.40	$ 25.00	$ 7.71
00589	UNDERDRAIN UD-5, GEOCOMPOSITE	LF	$ 25.00	$ 25.00	$ 25.00
00590	COMB. UNDERDRAIN CD-1	LF	$ 0.61	$ 47.79	$ 14.75

Figure 28. VDOT Statewide Averages.

DISTRICT AVERAGES APRIL 2006 THROUGH MARCH 2008

ITEM	ITEM DESCRIPTION	UNIT	MINIMUM PRICE	MAXIMUM PRICE	AVERAGE LOW BIDS	DISTRICT
00100	MOBILIZATION	LS	$ 3,000.00	$ 180,000.00	$ 41,471.99	BRSTL
00101	CONSTRUCTION SURVEYING	LS	$ 3,245.00	$ 55,125.00	$ 8,136.47	BRSTL
00110	CLEARING AND GRUBBING	LS	$ 2,000.00	$ 170,000.00	$ 74,198.55	BRSTL
00120	REGULAR EXCAVATION	CY	$ 3.03	$ 25.00	$ 6.46	BRSTL
00124	ROCK EXCAVATION	CY	$ 463.42	$ 463.42	$ 463.42	BRSTL
00125	GRADING	LS	$ 6,510.00	$ 480,475.00	$ 76,685.65	BRSTL
00140	BORROW EXCAVATION	CY	$ 0.01	$ 26.00	$ 5.43	BRSTL
00150	EMBANKMENT	CY	$ 50.00	$ 50.00	$ 50.00	BRSTL
00211	MINOR STRUCTURE EXCAV. PIPE CULVERT	CY	$ 8.50	$ 20.00	$ 11.07	BRSTL
00212	MINOR STRUCTURE EXCAV. BOX CULVERT	CY	$ 11.00	$ 40.00	$ 20.33	BRSTL
00270	SELECT MATL. TY. I MIN. CBR-30	TON	$ 11.98	$ 18.50	$ 13.37	BRSTL
00505	BEDDING MATL.AGGR.NO. 25 OR 26	TON	$ 14.35	$ 26.94	$ 20.22	BRSTL
00522	CONCRETE CLASS A4 BOX CULVERT	CY	$ 425.41	$ 875.00	$ 468.82	BRSTL
00525	CONCRETE CLASS A3 MISC.	CY	$ 496.99	$ 1,500.00	$ 725.80	BRSTL
00529	FLOWABLE BACKFILL	CY	$ 199.97	$ 300.00	$ 205.53	BRSTL
00540	REINF. STEEL	LB	$ 0.76	$ 2.00	$ 0.78	BRSTL
00542	EPOXY COATED REINF. STEEL	LB	$ 2.00	$ 2.00	$ 2.00	BRSTL
00560	STRUCTURAL STEEL JB-1	LB	$ 25.00	$ 25.00	$ 25.00	BRSTL
00574	ENDWALL GRATE & FRAME EW-11A	EA	$ 3,500.00	$ 3,500.00	$ 3,500.00	BRSTL
00590	COMB. UNDERDRAIN CD-1	LF	$ 10.00	$ 15.00	$ 13.00	BRSTL
00591	COMB. UNDERDRAIN CD-2	LF	$ 43.35	$ 43.35	$ 43.35	BRSTL
00595	OUTLET PIPE	LF	$ 10.00	$ 20.50	$ 11.24	BRSTL
00596	ENDWALL EW-12	EA	$ 350.00	$ 461.24	$ 387.47	BRSTL
01062	6" CONC. PIPE	LF	$ 30.00	$ 30.00	$ 30.00	BRSTL
01080	8" PIPE	LF	$ 15.08	$ 15.08	$ 15.08	BRSTL
01120	12" PIPE	LF	$ 40.95	$ 40.95	$ 40.95	BRSTL
01122	12" CONC. PIPE	LF	$ 50.00	$ 50.00	$ 50.00	BRSTL
01150	15" PIPE	LF	$ 15.23	$ 30.00	$ 22.41	BRSTL
01180	18" PIPE	LF	$ 18.25	$ 45.00	$ 26.46	BRSTL
01182	18" CONC. PIPE	LF	$ 23.50	$ 60.56	$ 40.62	BRSTL
01240	24" PIPE	LF	$ 24.36	$ 83.35	$ 39.08	BRSTL
01242	24" CONC. PIPE	LF	$ 50.00	$ 72.22	$ 56.46	BRSTL
01300	30" PIPE	LF	$ 45.70	$ 109.95	$ 49.38	BRSTL
01302	30" CONC. PIPE	LF	$ 68.75	$ 75.77	$ 73.33	BRSTL
01360	36" PIPE	LF	$ 42.10	$ 42.10	$ 42.10	BRSTL
01362	36" CONC. PIPE	LF	$ 82.30	$ 106.95	$ 92.23	BRSTL
01422	42" CONC. PIPE	LF	$ 171.30	$ 171.30	$ 171.30	BRSTL
01480	48" PIPE	LF	$ 70.00	$ 147.83	$ 138.95	BRSTL
01600	60" PIPE	LF	$ 93.90	$ 93.90	$ 93.90	BRSTL
01602	60" CONC. PIPE	LF	$ 212.75	$ 280.15	$ 239.05	BRSTL

Figure 29. VDOT District Averages.

4.1.1.5 Applying Unit Cost Information

VDOT considers various factors for adjusting the unit prices generated from the PES when performing rational cost estimation. The following are common factors considered when adjusting unit prices, though these might vary based on work involved and specific contract provisions:

- Plan and proposal review
- Project site conditions
- Time limit
- Sequence of construction
- Seasonal limitations
- Regional conditions
- Current market conditions
- Quantities/price relationships
- Inflation and risks involved in the project

In performing the rational estimation, VDOT adjusts unit prices for the above factors based on recent bid history received for particular items of work. The labor rates available from the VEC are escalated at the average rate for the previous two years since these rates are a year old when they are published. This adjustment is applied twice to the published rate, first to bring this rate current and the second to project the cost on future work being performed. Furthermore, this rate is increased by 50 percent to 52 percent to reflect the labor burden. VDOT uses RS Means as guidance on the production rates but relies more on experience and on software like the Site Manager and BIDDS for finding the production rates for various items of work. Site Manager reflects the current production rates from various ongoing projects in VDOT and BIDDS maintains a historical database of production rates. BIDDS is generally used within VDOT for preparing an estimate on the contract time at the pre-advertisement level, but it is also used to report historical bid item level performance data, which can be used by the estimator to estimate the production rates for individual bid items. Figure 30 shows the role of BIDDS in determining the production rates.

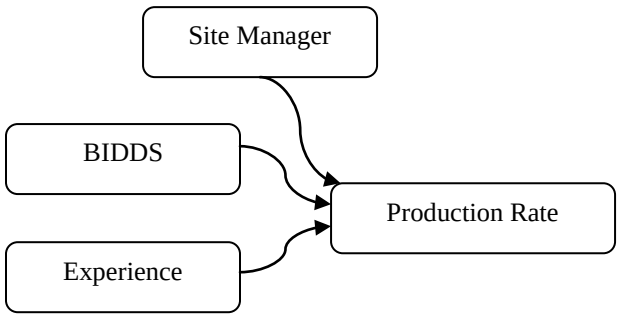


Figure 30. VDOT Production Rate Estimation.

VDOT uses 24 months of historical data when establishing the unit prices for its major items of work. A work item is considered a major work if it constitutes 60 percent of total estimated contract cost or 10 percent of total quantities, whichever is smaller. If sufficient historical data are available, VDOT conducts a regression analysis to establish the unit price. Otherwise, a weighted average is used for determining the unit price. VDOT performs a manual comparison of historical bid data generated by PES with recent bids and adjusts unit costs accordingly. The unit price prepared for non-standard work item by the design division is not modified in the final engineers estimate. Sometimes other states are referenced as a check if similar work item have been used.

4.1.2 Maintenance Unit Cost Information

The unit costs for maintenance projects are determined the same way as a construction project. The 30-day rates are used in estimation of maintenance projects along with a database on costs associated with moving, snow plowing, and so on. No separate software is used for estimating maintenance projects. Maintenance unit costs generated through PES are adjusted based on the recent bids received by VDOT.

4.2 UTAH DEPARTMENT OF TRANSPORTATION

4.2.1 Construction Unit Cost Information

4.2.1.1 General Section

UDOT follows the historical bid-based estimating technique right from the planning phase through the PS&E phase of project development. Planning level estimates are prepared using an in-house Excel spreadsheet called Concept Cost Estimate Form. UDOT prepares estimates for the remaining phases using its in-house application called Project Development Business System (PDBS). PDBS also generates bid documents for contractors to submit bids and tracks the progress of the projects and change orders. Figure 31 depicts the estimation framework of UDOT. UDOT maintains an estimation guideline on its website (*UDOT's Statewide Estimation Process: http://www.udot.gov/main/uconowner.gf?n=35214810363450832*), which provide estimators with general guidelines for developing project estimates at various phases of project development.

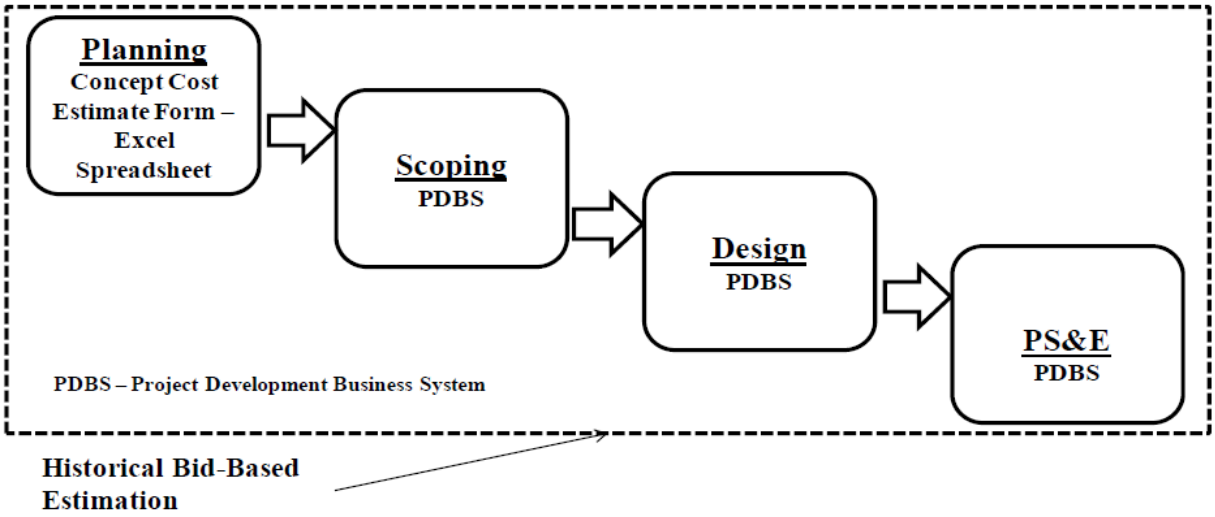


Figure 31. UDOT Estimation Framework.

4.2.1.1.1 Concept Cost Estimate Form

The Cost Estimate Form developed by UDOT enables the estimators to estimate the cost involved for major items of work such as roadway and drainage, traffic and safety, structures, environmental mitigation, and ITS at the planning or conceptual level (see Figure 32). Certain percentages are assumed to cover the contingency, yearly inflation, right-of-way cost, and utilities. The values for inflation, preliminary engineering, and construction engineering are not fixed and are adjusted based on engineering judgment.

Cost Estimate - Concept Level

Approximate Route Reference Post (BEGIN) =	101.48	(END) =	106.000	
Accumulated Mileage (BEGIN) =	95.202	(END) =	99.872	
Project Length =	4.670	miles	24,658 ft	
Current Year =	2007			
Assumed Construction Year =	2012			
Assumed Yearly Inflation for Construction and Utility Items (%/yr) =	7.0%	5 yrs for inflation		For projects 1 Year out use 10%, 2 Years 9%, 3
Assumed Yearly Inflation for Engineering Services (PE and CE) (%/yr) =	6.0%			
Assumed Yearly Inflation for Urban Residential Right of Way (%/yr) =	6.5%			
Assumed Yearly Inflation for Urban Commercial Right of Way (%/yr) =	4.0%			
Assumed Yearly Inflation for non-Urban Right of Way (%/yr) =	2.0%			
Construction Items Contingency (% of Construction) =	20.0%			10% Rural PB; 15% Urban PB; 20% Non PB
Preliminary Engineering (% of Construction + Incentives) =	8.0%			
Construction Engineering (% of Construction + Incentives) =	10.0%			

Item #					Cost	Remarks
Construction						
	Roadway and Drainage				$1,502,596	
	Traffic and Safety				$269,450	
	Structures				$65,300	
	Environmental Mitigation				$595,000	
	ITS				$50,000	
				Subtotal	$2,482,346	
			Construction Items Contingency (for minor items not listed)	(20%)	$496,469	
				Construction Subtotal	**$2,978,815**	
P.E. Cost				**P.E. Subtotal**	**$245,000**	8%
C.E. Cost				**C.E. Subtotal**	**$306,000**	10%
Right of Way Urban/Suburban Residential				**Right of Way Subtotal**	$5,000	
Right of Way Urban Suburban Commercial				**Right of Way Subtotal**	$15,000	
Right of Way non-Urban/Suburban				**Right of Way Subtotal**	$21,000	
Utilities				**Utilities Subtotal**	$70,500	
Incentives				**Incentives Subtotal**	$86,084	
Miscellaneous				**Miscellaneous Subtotal**	**$0**	

Cost Estimate (ePM screen 505)		2007		2012
Concept Report Cost				
P.E.		$245,000		$328,000
Right of Way		$41,000		$48,000
Utilities		$71,000		$100,000
Construction		$2,979,000		$4,178,000
C.E.		$306,000		$409,000
Incentives		$86,000		$121,000
Contingency	10%	$372,800		$523,000
Miscellaneous		$0		$0
	TOTAL	$4,100,800	TOTAL	$5,707,000

PROPOSED COMMISSION REQUEST	TOTAL	$4,100,800	TOTAL	$5,707,000

Figure 32. UDOT Concept Cost Estimate Form.

Estimators are advised to compare the project data from PDBS and abstracts from previous projects of similar locality, size, and scope while preparing an estimate for any project. Also, the price comparison report generated using PDBS provides a quick method to evaluate the project unit prices against region or statewide averages. The price comparison report compares the average of the historical data and gives averages for each item of work (including standard deviation).

4.2.1.2 Acquiring Unit Cost Information

UDOT utilizes its PDBS to extract all the bid details from the submitted bids.

4.2.1.3 Storing Unit Cost Information

The database within PDBS enables UDOT to store more than five years of historical bid data in its database. The historical unit cost information is available for the entire state, districts, and counties. Historical unit costs are also available for the date range specified in PDBS, quantity range, awarded bid only, source of funding, and based on units (English or Metric). All of the historical bid details are stored as standard construction line items.

4.2.1.4 Accessing Unit Cost Information

PDBS enables the estimator to access all the historical bid information. UDOT provides its estimators with a list of statewide average (weighted) low bid for each of the line items of work. Figure 33 shows a snapshot of the average low bid information. The low bid information is generated every year, and it is available on their website at *http://www.udot.utah.gov/main/f?p=100:pg:12302720542229821131:::1:T,V:446*. The statewide average low bid price contains the average unit price, total quantity, and unit of measure for each line item of work arranged by the item number.

Statewide Average Bid Price Calculation for 2007

Item Number	Units	Description	Unit of Measure	Average Price	Total Quantity
00830001U	CSI - INCH/PO	Equal Opportunity Training	Hour	$4.02	53851
012850010	CSI - INCH/PO	Mobilization	Lump	$221,887.12	115
013150010	CSI - INCH/PO	Public Information Services	Lump	$8,684.37	69
015540005	CSI - INCH/PO	Traffic Control	Lump	$116,168.75	106
015580005	CSI - INCH/PO	Temporary Pavement Markings	ft	$0.10	16632
015710020	CSI - INCH/PO	Check Dam (Stone)	cu yd	$81.82	55
015710022	CSI - INCH/PO	Check Dam (Stone)	Each	$230.43	295
015710025	CSI - INCH/PO	Check Dam (Fiber Roll)	ft	$7.16	5718
015710030	CSI - INCH/PO	Silt Fence	ft	$3.37	85531
015710060	CSI - INCH/PO	Drop-Inlet Barriers (Stone)	cu ft	$29.75	78
015710070	CSI - INCH/PO	Drop-Inlet Barriers (Silt Fence)	ft	$8.30	60
015710075	CSI - INCH/PO	Drop-Inlet Barrier (Fiber Roll)	ft	$13.00	3184
015710100	CSI - INCH/PO	Curb Inlet Barrier	Each	$121.46	275
015710110	CSI - INCH/PO	Pipe-Inlet Barrier (Stone)	cu yd	$158.43	35
015710120	CSI - INCH/PO	Sediment Trap	cu yd	$182.19	30
015710130	CSI - INCH/PO	Stabilized Construction Entrance	sq yd	$10.15	1238
015710140	CSI - INCH/PO	Straw Bale Barrier	ft	$5.23	1664
015710150	CSI - INCH/PO	Temporary Environmental Fence	ft	$2.31	14781
015710155	CSI - INCH/PO	Environmental Control Supervisor	Lump	$19,438.91	10
015720020	CSI - INCH/PO	Dust Control and Watering	1000 gal	$7.00	132355
017210010	CSI - INCH/PO	Survey	Lump	$43,872.00	51
018910010	CSI - INCH/PO	Move Street Sign	Each	$198.95	21
018910020	CSI - INCH/PO	Move Mailbox	Each	$300.60	82
018910030	CSI - INCH/PO	Mailbox Assembly	Each	$296.76	29

Figure 33. UDOT Statewide Average Unit Low Bid Prices.

4.2.1.5 Applying Unit Cost Information

UDOT maintains a set of guidelines for preparing estimates during different phases of project development. The project designer is responsible for compiling and updating the project estimates. Each design group within UDOT is required to complete the estimates for all work performed on their respective portion of a project. For example, the structural designer is required to prepare and update the estimates for structural items. PDBS tracks the history of bid items and determines the unit prices for cost estimates. The estimating chapter of UDOT's Roadway Design Manual of Instruction provides the steps that need to be followed while preparing the bid portion of Engineer's Estimate. The guidelines include the following steps:

1. Compiling quantities for each items of work and checking their accuracy against the current level of design.
2. Determining and documenting the unit prices for all items of work.
3. Assigning responsibility to each department to provide the quantities and costs for all items of work.
4. Adding necessary contingencies for unknown items, miscellaneous items, and inflation.
5. Conducting a Red Flag Analysis on the estimates.
6. Verifying the estimate is on target for project delivery and identifying areas of concerns.
7. Performing Quality Control/Quality Assurance (QC/QA).

Unit prices determined in Step 2 of the general guidelines take into consideration the following factors influencing the unit bid price:

- Location
- Time of year
- Constructability
- Quantity of item
- Limitations of operation
- Availability of materials
- Familiarity of process
- Specialty equipments
- Risk to contractors

- Construction schedule

UDOT considers seven to twelve months of historical data for establishing the unit prices using weighted moving average for duration of one year or one quarter. Using PDBS, the estimators can also obtain the weighted unit prices based on a specified time range.

4.2.1.5.1 Red Flag Analysis

PDBS has a built in feature, Red Flag Analysis, that aides the engineers in considering factors affecting the project cost while preparing an Engineer's estimate. The Red Flag Analysis lowers or raises the Engineer's Estimate by a certain percentage to address the specific characteristics of the project. To perform this analysis, the estimator is provided with a screen (see Figure 34) where specific questions about the project are answered.

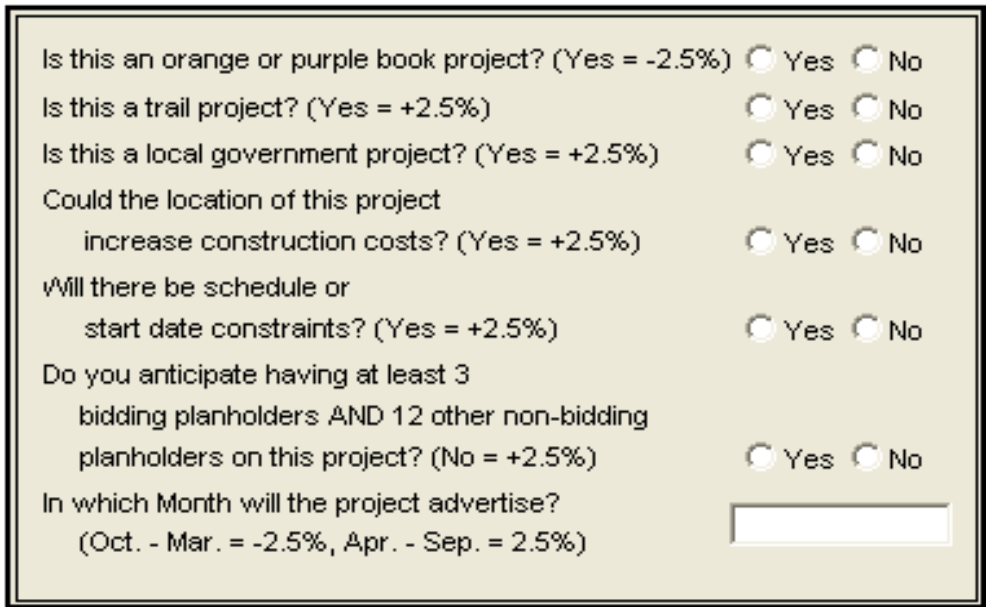


Figure 34. UDOT Red Flag Analysis – PDBS.

- **Orange/Purple Book Project**: Pavement preservation projects (Negative flag since they are simple and straightforward).
- **Trail Project**: Bike or pedestrian trail project (Positive flag since they are historically higher than estimated).
- **Local Government Project**: Historically higher than estimated due to size and increased number of project stakeholders (Positive flag if local Government project).

- **Location of Project**: Remote project locations can increase the cost of project (Positive flag if project is in a remote location).
- **Schedule/Start Date Constraints of Project**: Tight schedules without allowing any flexibility for contractor increases the project cost (Positive flag, if schedule is tight).
- **Plan holders (Contractor Interest)**: More plan holders provide more bidders leading to more number of bids received and lower bids. (Negative flag, if contractor interest is minimal).
- **Bidding Season**: Advertisement of project in winter leads to a negative red flag.

UDOT can also perform a Red Flag analysis on cost-sensitive materials, lump sum/specialty items, and non-bid items. Examples of cost-sensitive materials are hot mix asphalt (HMA), concrete, and steel. If the cost of these volatile materials is greater than 10 percent of the total estimate on a large project (30% for smaller project), the Red Flag Analysis suggests adding a positive flag (2.5%) to account for market volatility. Red flag analysis always suggests an increase or decrease of a constant 2.5 percent. Previous projects and experience established this value. However, the percentage can be overridden if the estimator finds it to be not appropriate for the project.

UDOT sets certain amount (percentages) for minor items of work not covered during the initial phases of project development. Table 7 includes the contingency used by UDOT to cover these minor items of work.

Table 7. UDOT Contingency Percentages.

Project Phase	Contingency (%)
Planning	25
Scoping	10
Design	10
PS&E	5

4.2.2 Maintenance Unit Cost Information

UDOT estimates maintenance projects similarly to construction projects. PDBS provides the necessary unit costs to be used in the estimation of maintenance projects.

4.3 CALIFORNIA DEPARTMENT OF TRANSPORTATION

4.3.1 Construction Unit Cost Information

4.3.1.1 General Section

Caltrans uses historical bid-based estimating from the Planning phase through the PS&E phase of project development. Caltrans performs cost estimation in all these phases using an in-house developed Excel spreadsheet (see Figure 35). The district offices, which are responsible for preparing the Engineer's Estimate, rely on these spreadsheets for estimation purposes. For preliminary estimates, Caltrans uses Planning Level Excel spreadsheets available on its website under the Division of Engineering Services (http://www.dot.ca.gov/hq/esc/estimates/forms). The Structures Division in Caltrans has identified cost per square unit for typical structural sections, and updates the value annually. The district offices used the value for their preliminary estimation until detailed design information is available. Figure 36 shows the comparative bridge costs developed for the year 2007 in metric units, and Figure 37 shows the Advance Planning Estimate Excel spreadsheet used by the Structures office for preparing the planning level estimates.

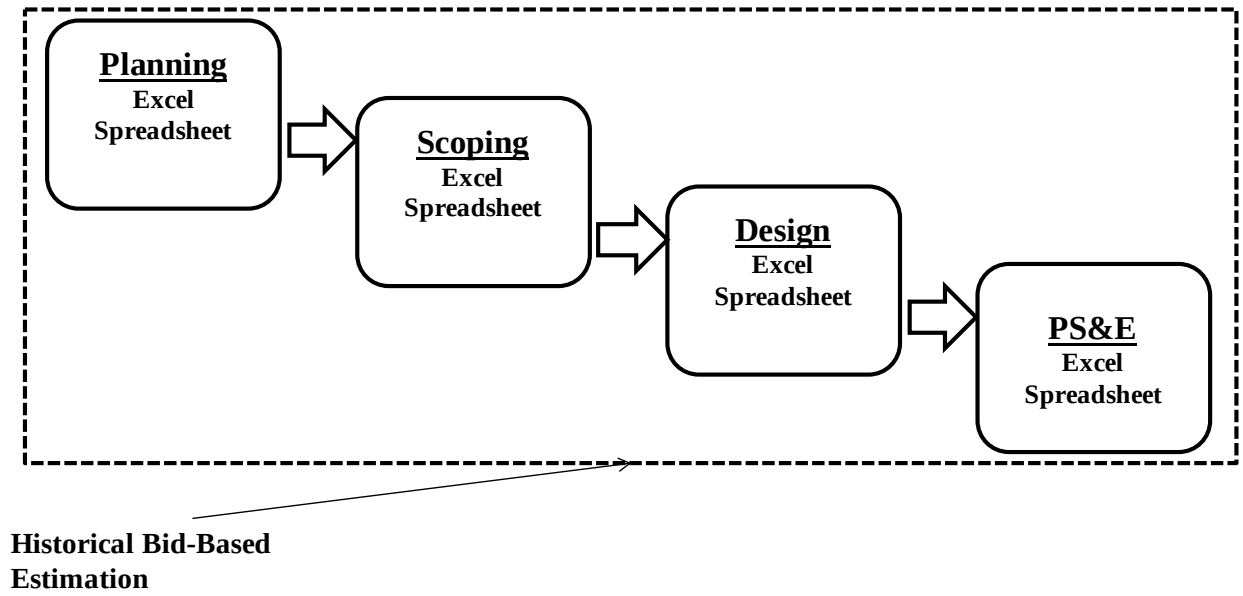


Figure 35. Caltrans Estimation Framework.

Factors that will increase the price over the high end of the Price Range 25%-150%

Structures with more than 2 construction stages
Unique substructure construction
Widenings less than 5 M

STRUCTURAL SECTION	(STR. DEPTH / MAX SPAN) SIMPLE	CONTINUOUS	COMMON SPAN RANGE meters	COST RANGE $ / Square meter	REMARKS
RC SLAB	0.06	0.045	5 - 13	1700-3000	THESE ARE THE MOST COMMON TYPES AND ACCOUNT FOR ABOUT 80% OF BRIDGES ON CALIFORNIA STATE HIGHWAYS.
RC T-BEAM	0.07	0.065	12 - 18	1950-3200	
RC BOX	0.06	0.055	15 - 37	1950-3000	
CIP/PS SLAB	0.03	0.03	12 - 20	1850-2700	
CIP/PS BOX	0.045	0.04	30 - 76	1950-3000	
PC/PS SLAB	0.03 (+3" AC)	0.03 (+3" AC)	6 - 15	2250-3100	NO FALSEWORK REQUIRED.
PC/PS T, TT, ⊥	0.06 (+3" AC)	0.055 (+3" AC)	9 - 37	2350-3100	
BULB T GIRDER	0.05	0.045	27 - 44	2350-3350	
PC/PS I	0.055	0.05	15 - 37	2250-3000	
PC/PS BOX	0.06	0.045	37 - 61	2700-4300	
STRUCT STEEL I GIRDER	0.045	0.04	18 - 91	2700-4100	NO FALSEWORK REQUIRED.

NOTE: Removal of a box girder structure costs from $160 - $215 per square meter.

COSTS INCLUDE 10% MOBILIZATION

Figure 36. Caltrans Comparative Bridge Costs (2007).

☐ GENERAL PLAN ESTIMATE ☐ ADVANCE PLANNING ESTIMATE

Revised - December 3, 2007

RCVD BY: JTY **IN EST:**

OUT EST:

BRIDGE: **BR. No.:** **DISTRICT:**

TYPE: **RTE:**

CU: **CO:**

EA: **KP:**

LENGTH: **WIDTH:** **AREA (SQ. M)=**

DESIGN SECTION:

 # OF STRUCTURES IN PROJECT : **EST. NO.**

PRICES BY : **COST INDEX:**

PRICES CHECKED BY : **DATE:**

QUANTITIES BY: **DATE:**

	CONTRACT ITEMS	TYPE	UNIT	QUANTITY	PRICE	AMOUNT
1	TEMPORARY RAILING		m			
2	REMOVE CONCRETE		m3			
3	STRUCTURE EXCAVATION (BRIDGE)		m3			
4	STRUCTURE EXCAVATION		m3			
5	STRUCTURE BACKFILL (BRIDGE)		m3			
6	PERVIOUS BACKFILL MATERIAL		m3			
7	CIDH CONCRETE PILING		m			
8	FURNISH PILING		m			
9	DRIVE PILES		EA			
10	FURNISH PC/PS CONCRETE GIRDERS		EA			
11	ERECT PC/PS CONCRETE GIRDERS		EA			
12	STRUCTURAL CONCRETE, BRIDGE		m3			
13	STRUCTURAL CONCRETE, BRIDGE FOOTING		m3			
14	STRUCTURAL CONCRETE, APPROACH SLAB		m3			
15	PRESTRESSING STEEL		kg			
16	BAR REINFORCING STEEL (BRIDGE)		kg			
17	FURNISH STRUCTURAL STEEL		kg			
18	ERECT STRUCTURAL STEEL (INCL PAINT)		kg			
19	JOINT SEAL ASSEMBLY (MR =) >50 mm		m			
20	JOINT SEAL (MR =) 50mm max		m			
21	SLOPE PAVING		m3			
22	CONCRETE BARRIER		m			
23						
24						
25						
26						
27						
28						
29						
30						

SUBTOTAL	
TIME RELATED OVERHEAD	
MOBILIZATION (@ 10 %)	
SUBTOTAL BRIDGE ITEMS	
CONTINGENCIES (@ 20%)	
BRIDGE TOTAL COST	
COST PER SQ. METER	
BRIDGE REMOVAL (CONTINGENCIES INCL.)	
WORK BY RAILROAD OR UTILITY FORCES	
GRAND TOTAL	
BUDGET ESTIMATE AS OF	

ROUTING

1. DES SECTION
2. OFFICE OF BRIDGE DESIGN - NORTH
3. OFFICE OF BRIDGE DESIGN - CENTRAL
4. OFFICE OF BRIDGE DESIGN - SOUTH
5. OFFICE OF BRIDGE DESIGN - WEST
6. OFFICE OF BRIDGE DESIGN SOUTHERN CALIFORNIA

COMMENTS:

Escalated Budget Estimate to Midpoint of Construction *

Escalation Rate per Year 5.5%

Years Beyond Midpoint	Escalated Budget Est.
1	
2	
3	

Years Beyond Midpoint	Escalated Budget Est.
4	
5	

* Escalated budget estimate is provided for information only, actual construction costs may vary. Escalated budget estimates provided do not replace Departmental policy to update cost estimates annually.

Figure 37. Caltrans Advance Planning Estimate Excel Spreadsheet.

For each item of work identified in the planning level Excel spreadsheet, the unit prices are obtained from the District 8 database containing the historical bid data and from the Highway Cost Index/Bridge Cost Index. Apart from the District 8 database, which represents statewide historical bid data, districts also rely on similar projects to compute the unit price for different items of work.

The items of work identified in the planning level spreadsheet are broken down into more detail as the project moves from planning phase through scoping and design, until the PS&E phase. The estimates are prepared for the current date and escalated to five years in the future. Caltrans has an annual update policy, which dictates an annual review of each project's estimates and an update with new escalation rates.

4.3.1.2 Acquiring Unit Cost Information

Caltrans uses their Basic Engineering Estimating System (BEES) for preparing the project design cost estimates. BEES is also used in bid opening, tracking the progress of the projects and producing segregated cost estimates based on the fund source. BEES consists of two components: (1) District (Highway) Cost Estimate and (2) the Structures (Bridge) Cost Estimate. These two components are combined to estimate the total construction cost for a project. BEES stores these two components separately and permits the recall of the combined or separate cost estimates. District Offices and the Office of Structures use the BEES coded item list for entering the District Cost Estimate and Structure Cost Estimate separately. All the associated quantities and unit prices are entered for each item of work. This forms the Preliminary Engineer's Cost Estimate (blue sheet estimate). Once the contract documents are finalized, the preliminary cost estimate becomes the Final Engineer's Cost Estimate. Once the project is let, the bid details from all the submitted bids are stored within the BEES database.

4.3.1.3 Storing Unit Cost Information

The BEES database and the District 8 database hold the historical bid data, which is made available to all the Districts. District 8 database is updated with the recent bid details available from the BEES database. Over five years of historical data are stored and made available through the District 8 webpage (internet) as well through an Excel spreadsheet (intranet). The database holds bid data for the entire state, districts, counties, and even market areas. The Contract Item Cost Database, located in the main office, is another source for storing historical bid data though only low bid details are stored within this database.

4.3.1.4 Accessing Unit Cost Information

Estimators in various districts of Caltrans use the Contract Item Cost Database and the District 8 database (http://sv08data.dot.ca.gov/contractcost/) for accessing the historical bid data. Figure 38 presents the District 8 webpage showing the online tool developed by Caltrans for accessing historical bid data. Figure 39 provides the typical search results. Estimators can search for historical data based on such area as districts of interest, year, maximum and minimum amount, maximum and minimum quantities, and relevant unit prices.

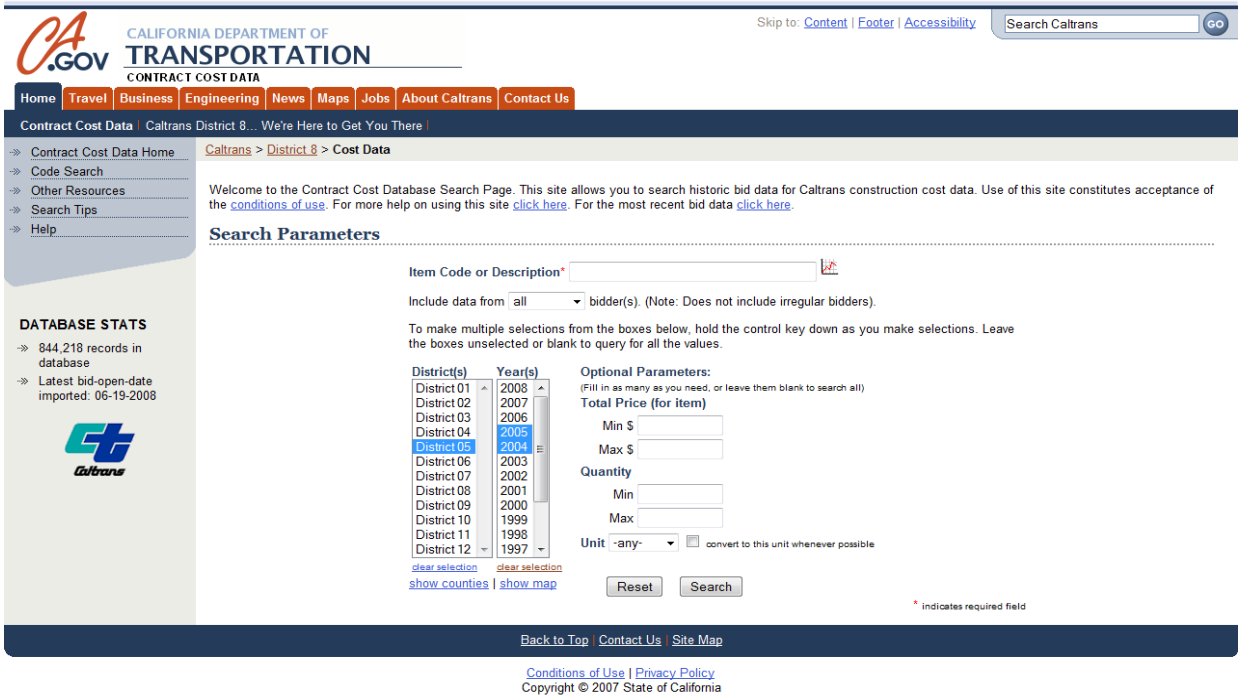
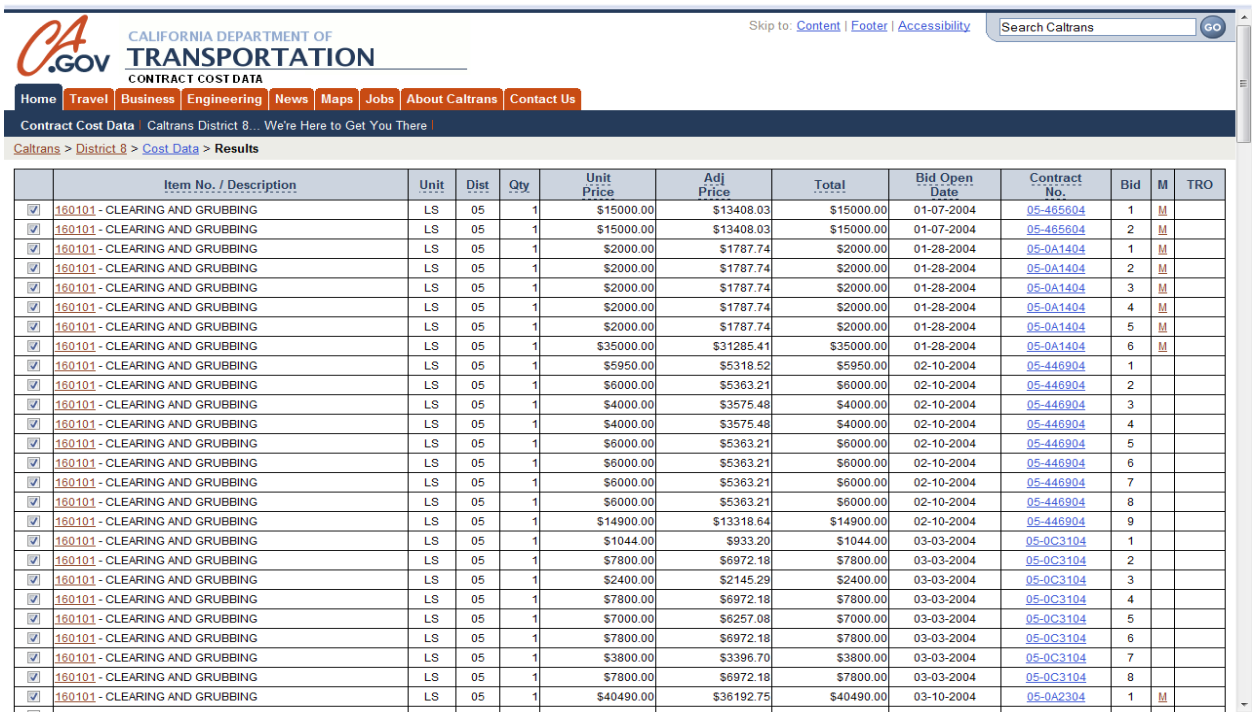


Figure 38. Caltrans District 8 Contract Cost Database.



CALIFORNIA DEPARTMENT OF TRANSPORTATION
CONTRACT COST DATA

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Contract Cost Data | Caltrans District 8... We're Here to Get You There |

Caltrans > District 8 > Cost Data > **Results**

	Item No. / Description	Unit	Dist	Qty	Unit Price	Adj Price	Total	Bid Open Date	Contract No.	Bid	M	TRO
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$15000.00	$13408.03	$15000.00	01-07-2004	05-465604	1	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$15000.00	$13408.03	$15000.00	01-07-2004	05-465604	2	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$2000.00	$1787.74	$2000.00	01-28-2004	05-0A1404	1	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$2000.00	$1787.74	$2000.00	01-28-2004	05-0A1404	2	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$2000.00	$1787.74	$2000.00	01-28-2004	05-0A1404	3	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$2000.00	$1787.74	$2000.00	01-28-2004	05-0A1404	4	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$2000.00	$1787.74	$2000.00	01-28-2004	05-0A1404	5	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$35000.00	$31285.41	$35000.00	01-28-2004	05-0A1404	6	M	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$5950.00	$5318.52	$5950.00	02-10-2004	05-446904	1		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$6000.00	$5363.21	$6000.00	02-10-2004	05-446904	2		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$4000.00	$3575.48	$4000.00	02-10-2004	05-446904	3		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$4000.00	$3575.48	$4000.00	02-10-2004	05-446904	4		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$6000.00	$5363.21	$6000.00	02-10-2004	05-446904	5		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$6000.00	$5363.21	$6000.00	02-10-2004	05-446904	6		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$6000.00	$5363.21	$6000.00	02-10-2004	05-446904	7		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$6000.00	$5363.21	$6000.00	02-10-2004	05-446904	8		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$14900.00	$13318.64	$14900.00	02-10-2004	05-446904	9		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$1044.00	$933.20	$1044.00	03-03-2004	05-0C3104	1		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$7800.00	$6972.18	$7800.00	03-03-2004	05-0C3104	2		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$2400.00	$2145.29	$2400.00	03-03-2004	05-0C3104	3		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$7800.00	$6972.18	$7800.00	03-03-2004	05-0C3104	4		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$7000.00	$6257.08	$7000.00	03-03-2004	05-0C3104	5		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$7800.00	$6972.18	$7800.00	03-03-2004	05-0C3104	6		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$3800.00	$3396.70	$3800.00	03-03-2004	05-0C3104	7		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$7800.00	$6972.18	$7800.00	03-03-2004	05-0C3104	8		
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$40490.00	$36192.75	$40490.00	03-10-2004	05-0A2304	1	M	

Figure 39. Caltrans Search Results for Contract Cost Database.

The Contract Item Cost Database (http://www.dot.ca.gov/hq/esc/oe/costinfo.html) is a tabulation of the BEES item list having weighted averages of the low bidder's prices for those items (see Figure 40).

State of California - Department of Transportation

CONTRACT ITEM COST DATA

ITEM CODE	ITEM DESCRIPTION		UNIT	DIST	NO. OF PROJ	QUANTITY	AVE PRICE PER UNIT	TOTAL AMOUNT
153103	COLD PLANE ASPHALT CONCRETE PAVEMENT		SQYD	7	3	548,490.00	$1.13	$618,235.00
			SQYD	8	1	2,380.00	$3.00	$7,140.00
			SQYD	11	4	20,930.00	$5.23	$109,409.60
			SQYD	12	1	950.00	$4.00	$3,800.00
		Unit Sub Total	**SQYD**		**32**	**1,558,264.00**	**$1.47**	**$2,289,777.40**
	Item Code 153103	**Total No. of Proj.**			**212**		**Total Amount**	**$17,132,500.57**
153110	COLD PLANE ASPHALT CONCRETE PAVEMENT (.10' MAXIMUM)		SQYD	3	1	1,460.00	$12.00	$17,520.00
		Unit Sub Total	**SQYD**		**1**	**1,460.00**	**$12.00**	**$17,520.00**
	Item Code 153110	**Total No. of Proj.**			**1**		**Total Amount**	**$17,520.00**
153152	COLD PLANE ASPHALT CONCRETE PAVEMENT (30 MM MAXIMUM)		M2	8	1	51,900.00	$0.69	$35,811.00
		Unit Sub Total	**M2**		**1**	**51,900.00**	**$0.69**	**$35,811.00**
	Item Code 153152	**Total No. of Proj.**			**1**		**Total Amount**	**$35,811.00**
153153	COLD PLANE ASPHALT CONCRETE PAVEMENT (45 MM MAXIMUM)		M2	8	1	29,800.00	$0.69	$20,562.00
		Unit Sub Total	**M2**		**1**	**29,800.00**	**$0.69**	**$20,562.00**
	Item Code 153153	**Total No. of Proj.**			**1**		**Total Amount**	**$20,562.00**

Figure 40. Caltrans Contract Item Cost Report.

4.3.1.5 Applying Unit Cost Information

Caltrans generally uses four to six months of historical data when establishing the unit price for a line item but also considers using older data than that. The District 8 database along with the Contract Item Cost database serve as a good source of historical bid data for the district estimators. Based on parameters like the district number, year, minimum and maximum quantity, and minimum and maximum total price, historical bid data can be obtained for various items of work. Apart from the list of historical bid data, the database provides estimators with the simple average, weighted average (unmodified and adjusted) and standard deviation for the items selected from the search results. Figure 41 provides the summary of average price/unit along with the standard deviation. Another feature available is the generation of a trend line for the line item being searched. Figure 42 shows the trend line for line item Clearing and Grubbing. The standard deviation allows the estimators to understand the variation with the unit pricing. Though the trend analysis, shown in Figure 42, helps the estimator in modifying the unit costs, unit prices are adjusted based on experience and engineering judgment.

☑	160101 - CLEARING AND GRUBBING	LS	05	1	$60000.00	$48549.17	$60000.00	10-12-2005	05-314304	4	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$21750.00	$17599.07	$21750.00	10-26-2005	05-0K1104	1	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$55000.00	$44503.41	$55000.00	10-26-2005	05-0K1104	2	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$55000.00	$44503.41	$55000.00	10-26-2005	05-0K1104	3	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$5000.00	$4045.76	$5000.00	11-01-2005	05-0K6204	1	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$5000.00	$4045.76	$5000.00	11-01-2005	05-0K6204	2	
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$45000.00	$36411.88	$45000.00	11-02-2005	05-448104	1	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$45000.00	$36411.88	$45000.00	11-02-2005	05-448104	2	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$84477.00	$68354.81	$84477.00	11-02-2005	05-448104	3	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$69000.00	$55831.55	$69000.00	11-02-2005	05-448104	4	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$15000.00	$12137.29	$15000.00	11-08-2005	05-0L5504	1	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$15000.00	$12137.29	$15000.00	11-08-2005	05-0L5504	2	M
☑	160101 - CLEARING AND GRUBBING	LS	05	1	$15000.00	$12137.29	$15000.00	11-08-2005	05-0L5504	3	M

uncheck all | check all

cost indexes |

SUMMARY

	Unmodified	Adjusted		
Average Price/Unit: $	26,571.78	**25,645.21**	Avg No. Units	1
Std Dev. (of Unit Price): ±$	36,099.56	**33,052.46**	Rows Selected	172
Weighted Avg.: $	26,571.78	**25,645.21**	Rows Returned	172
Minimum Price/Unit: $	1,044.00	933.20		
Maximum Price/Unit: $	275,000.00	222,517.04		

- Adjusted prices are adjusted to today's dollars based on the Caltrans Construction Cost Index
- To remove a row from the calculations, uncheck the checkbox next to that row.
- To see additional information for a contract, click on that contract number.
- To see a trend graph of prices for an item, click on the item number.

| Back | New Search |

PARAMETERS: Item = Clearing; District=05; Year=2005,2004; Convert=No; Bidders=All Bidders
TIMESTAMP: 07/16/2008 23:33:36
CURRENT 12-MO INDEX: 249.3

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Figure 41. Caltrans Summary of Average/Weighted Average Price.

Figure 42. Caltrans Trend Line Feature of Contract Cost Database.

Caltrans has standard sliding scale contingencies for different phases of project development to cover estimate uncertainties. Table 8 outlines the contingency included in Chapter 20, Project Development Cost Estimates, of Caltrans' Project Development Procedures Manual.

Table 8. Caltrans Contingency Percentages.

Project Phase	Contingency (%)
Project Feasibility Cost Estimate	30 – 50
Project Study Report (PSR) Cost Estimate	25
Draft Project Report (PR) Cost Estimate	20
Project Report Cost Estimate	15
Preliminary Engineer's Cost Estimate	10
Final Engineer's Cost Estimate	5

The Engineer's Estimate is checked against the low bid cost estimate received to draw a comparison between the two estimates based on the number of bidders for all projects. This would enable the estimators to analyze the effect of number of bidders on the total project cost. Figure 43 shows the comparison of the low bid with the Engineer's Estimate for all the projects let between 1993 and 2006.

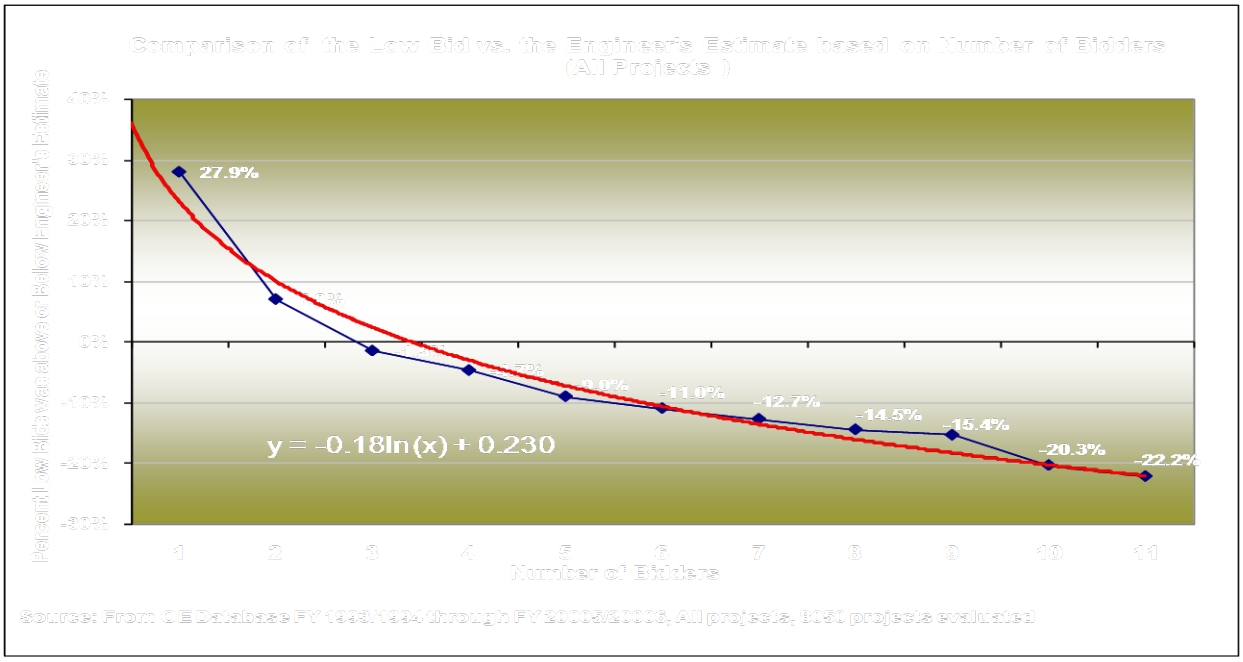


Figure 43. Caltrans Comparison of Low Bid versus Engineer's Estimate.

4.4 MINNESOTA DEPARTMENT OF TRANSPORTATION

4.4.1 Construction Unit Cost Information

4.4.1.1 General Section

MnDOT relies primarily on Cost-Based Estimating to prepare the Engineer's Estimate in the PS&E phase of project development. Historical bid-based estimating is used in the planning, scoping and design phase of project development. All the items of work identified in the design phase are re-estimated in PS&E phase. MnDOT uses the CES of Trns*port system for preparing the final Engineer's Estimate. Preliminary estimates and design level estimates are prepared using Excel spreadsheets, developed in-house, at the District Offices. The source of historical unit cost is an Excel spreadsheet generated by the Trns*port system. This Excel spreadsheet is available on their intranet as well as MnDOT's website. Bridge estimates are prepared separately and added to the final estimate. Estimators use the 80/20 rule, that is, 20 percent of work contributes to 80 percent of the total cost when preparing cost estimates. Major items of work are estimated using a cost-based estimating approach, while the minor items are estimated by taking the arithmetic average of historical bid data.

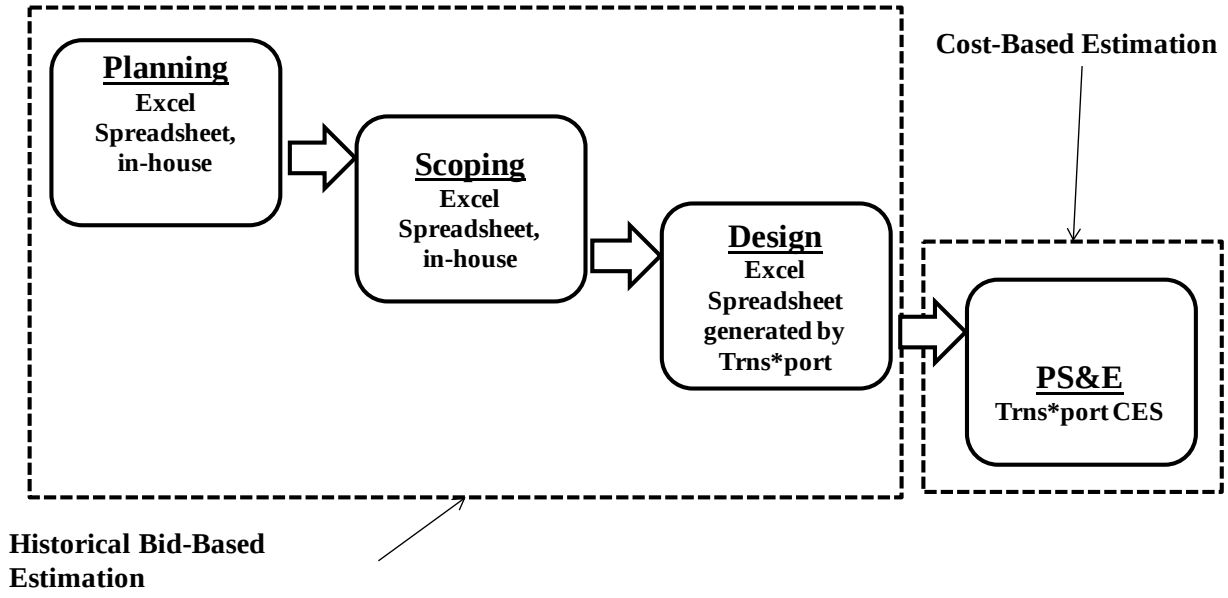


Figure 44. MnDOT Estimation Framework.

4.4.1.2 Acquiring Unit Cost Information

MnDOT uses different libraries or catalogs for storing the labor, materials, equipment, and production rate data in CES. A separate library containing historical data from June 2006 to June 2008 is used as source of historical bid data in CES. The estimators use historical bid data extracted from BAMS/DSS when preparing the historical cost library. Using BAMS/DSS, the threshold on the number of historical bid data used in the regression analysis and arithmetic average can be set. MnDOT uses a minimum of 15 occurrences of historical data when performing the regression analysis and a minimum of 10 occurrences when performing arithmetic average. The catalogs for labor, material, equipment, and production rates are updated every year from their respective sources given in Table 9.

Table 9. MnDOT Source of Equipment, Labor, Material, and Production Rates.

Equipment Costs	Commissioners Equipment Rental Rates, Department of Labor Truck Rental Rates, Rental Blue Book (Vol. 3)
Material Costs	Call suppliers and Materials Engineers
Labor rates	Minnesota department of labor and industry
Production Rates	Contract time (Construction Division of MnDOT)

4.4.1.3 Storing Unit Cost Information

The historical unit costs are stored in BAMS/DSS of Trns*port system. The BAMS/DSS stores over five years of historical bid data as standard construction line items. Historical unit costs are available for the entire state, districts, and counties. District offices have historical bid data stored in Excel spreadsheets.

4.4.1.4 Accessing Unit Cost Information

MnDOT uses an Excel spreadsheet containing all the bid information available on their intranet (iHub) and their internet website. This spreadsheet is generated from BAMS/DSS and made available to all the District offices for estimation purposes. Estimators can sort historical unit costs based on Item Id, Item Description, Quantities, Districts, Engineer's Estimate, and three low bidders. Figure 45 and Figure 46 show a snapshot of the Excel spreadsheet used by the estimators at MnDOT.

Item	Item Description	Dist.	Quarter	Contract	County	SP	Units	QTY
2011601/00001	CONSTRUCTION LAYOUT STAKING	3	2003Q2	030050	STEARNS	7380-206	LS	1
2011601/00001	CONSTRUCTION LAYOUT STAKING	4	2003Q3	030165	DOUGLAS	2101-20	LS	1
2011601/00001	CONSTRUCTION LAYOUT STAKING	7	2003Q2	030080	BLUE EARTH	0703-16	LS	1
2011601/00001	CONSTRUCTION LAYOUT STAKING	M	2003Q2	030073	HENNEPIN	2723-109	LS	1
2011601/00001	CONSTRUCTION LAYOUT STAKING	2	2003Q2	030067	BELTRAMI	0416-31	LS	1
2011601/00002	TUNNEL CONSTRUCTION LAYOUT STAKING	M	2005Q2	050073	HENNEPIN	2771-31	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2003Q1	030027	KOOCHICHING	3609-30	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2003Q1	030054	CARLTON	0906-42	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2003Q2	030082	CARLTON	0901-72	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2003Q2	030125	VARIOUS	8821-73	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2003Q3	030207	ST LOUIS	6920-37	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2003Q4	030227	ITASCA	3108-56	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2004Q2	040008	ITASCA	3108-63	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2004Q2	040083	LAKE	3805-90	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2004Q2	040128	KOOCHICHING	8821-74	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2004Q3	040161	ST LOUIS	6903-13	LS	1
2011601/00003	CONSTRUCTION SURVEYING	1	2004Q3	040162	ST LOUIS	6928-26	LS	1

Figure 45. MnDOT Historical Price Database.

Awarded Price	Second Bidder	Third Bidder	Estimate
$84,900.00	$84,900.00	$96,000.00	$44,800.00
$10,000.00	$13,900.00	$15,000.00	$20,000.00
$20,000.00	$10,000.00	$40,000.00	$22,000.00
$66,000.00	$60,000.00	$11,800.00	$48,200.00
$40,000.00	$42,000.00	$41,200.00	$70,800.00
$67,000.00	$15,000.00	$67,000.00	$8,000.00
$18,700.00	$14,000.00	$15,368.82	$17,600.00
$83,000.00	$118,000.00	$95,000.00	$40,000.00
$30,837.00	$30,857.00	$31,600.00	$40,000.00
$9,500.00	$15,000.00	$13,300.00	$26,400.00
$275,000.00	$201,840.00	$233,000.00	$125,000.00
$105,000.00	$140,000.00	$108,500.00	$85,000.00
$50,204.00	$76,000.00	$85,000.00	$85,000.00
$10,000.00	$15,000.00	$12,000.00	$15,000.00
$16,520.00	$15,863.10	$7,595.25	$4,769.60
$30,000.00	$50,000.00	$0.00	$17,520.00
$65,000.00	$68,000.00	$61,000.00	$10,700.00

Figure 46. MnDOT Historical Price Database.

Estimators at MnDOT also make use of project abstracts when preparing all types of estimates. Project abstracts can be found on their website at http://www.dot.state.mn.us/bidlet/abstract.html. These abstracts provide the bid tabulation details based on the year selected. The abstracts are available for every month in the year selected, and they enable the estimators to consider unit prices used by the contractors in past projects. Figure 47 shows the abstract for a project let in January 2007.

LETTING : 07012601 CALL : 013 COUNTIES : HENNEPIN

LETTING DATE : 01/26/07 9:30 A.M.
JOB NO. : 070013 DISTRICT : M
STATE PROJECT : 2789-126 ROUTE : TH 394=010 LENGTH :
CONTRACT NO. : S07013 START DATE: 07/30/07 COMPLETION DATE :

LINE NO / ITEM CODE / ALT ITEM DESCRIPTION	QUANTITY		(0) -EST- ENGINEER'S ESTIMATE UNIT PRICE	 AMOUNT	(1) E110 EGAN COMPANIES UNIT PRICE	 AMOUNT	(2) E0009 ELECTRICAL INSTALLATION & MAI UNIT PRICE	 AMOUNT
0030 2104509/00150 REMOVE FOUNDATION	2.000	EACH	200.00000	400.00	650.00000	1300.00	850.00000	1700.00
0040 2104509/00290 REMOVE SERVICE INSTALLATION	1.000	EACH	250.00000	250.00	475.00000	475.00	200.00000	200.00
0050 2104509/00300 REMOVE SERVICE EQUIPMENT	1.000	EACH	400.00000	400.00	335.00000	335.00	200.00000	200.00
0060 2104509/00399 REMOVE HANDHOLE	5.000	EACH	225.00000	1125.00	250.00000	1250.00	250.00000	1250.00
0070 2104601/00085 REMOVE MISCELLANEOUS STRUCTURES		LUMP	10000.00000	10000.00	2800.00000	2800.00	800.00000	800.00
0080 2211501/00050 AGGREGATE BASE CLASS 5	50.000	TON	21.32000	1066.00	36.00000	1800.00	100.00000	5000.00
0090 2550511/00010 PEDESTAL FOUNDATION	1.000	EACH	600.00000	600.00	500.00000	500.00	500.00000	500.00
0100 2550511/00020 CABINET FOUNDATION	1.000	EACH	2000.00000	2000.00	2050.00000	2050.00	500.00000	500.00
0110 2550511/00031 SERVICE FOUNDATION	2.000	EACH	1400.00000	2800.00	1150.00000	2300.00	500.00000	1000.00
0120 2550511/00048 SHELTER FOUNDATION	1.000	EACH	4500.00000	4500.00	12780.00000	12780.00	7200.00000	7200.00
0130 2550512/00041 HANDHOLE TYPE-PVC METAL COVER	4.000	EACH	775.00000	3100.00	885.00000	3540.00	600.00000	2400.00
0140 2550514/00010 FIBEROPTIC SPLICE VAULT	3.000	EACH	3814.59000	11443.77	4785.00000	14355.00	4650.00000	13950.00
0150 2550515/00010 OUTDOOR FIBER SPLICE ENCLOSURE	6.000	EACH	1500.00000	9000.00	1625.00000	9750.00	2200.00000	13200.00
0160 2550516/00010 BURIED CABLE SIGN	12.000	EACH	100.00000	1200.00	105.00000	1260.00	100.00000	1200.00

Figure 47. MnDOT Project Abstracts.

4.4.1.5 Applying Unit Cost Information

MnDOT generally considers using seven to twelve months of historical data for establishing the unit prices. Labor rates, material rates, and equipment rates are periodically tracked and updated annually. Only the labor and the material rates are adjusted based on project location. According to MnDOT Standard Specification 1904 (http://www.dot.state.mn.us/tecsup/spec/2005/1100-1911.pdf), overhead, and profit are assumed as follows for all the estimates:

- Labor – 62% of taxable wages + fringes
- Equipment – 0%
- Material – 15%
- Subcontractor – 10%

Major items of work are estimated using the cost-based estimation technique while the minor items of work are estimated by taking the arithmetic average or by regression analysis of historical bid data when preparing the Engineer's Estimate. Production rates for each task are calculated based on labor and equipment rates, material costs, and quantity. Adjustments to unit prices are primarily based on experience and engineering judgment, although haul distance factors are used for equipment pricing adjustments.

4.5 NEW YORK STATE DEPARTMENT OF TRANSPORTATION

4.5.1 Construction Unit Cost Information

4.5.1.1 General Section

NYSDOT's main estimating technique is historical bid-based estimating, which they use to prepare estimates in the Design and PS&E phase of project development (see Figure 48). NYSDOT uses the Trns*port suite of software extensively for project development and construction management. Trns*port Estimator is used to prepare the design level estimate as well as the Engineer's Estimate at the end of the PS&E phase. NYSDOT also uses the Tracer software for preliminary cost estimation since it offers the flexibility to add many special requirements, typical of NYSDOT. Estimators also use the Preliminary Cost Estimation spreadsheet (see Figure 49) available for bridges to prepare early bridge estimates. This spreadsheet is available on NYSDOT's Office of Structures webpage and is used to estimate the bridge cost for new and replacement bridge projects. The Preliminary Cost Estimation spreadsheet is based on Bridge Shoulder Break Area methodology (see Figure 50) developed by NYSDOT and used early in the project when bridge particulars like the site location and abutment heights are not known. The costs are taken from Weighted Average Item Price Report (WAIPR) or their 2005/2006 Bridge Features Cost Estimate Summary report available under the Engineering Section of their Office of Structures webpage (https://www.nysdot.gov/portal/page/portal/divisions/engineering/structures/manuals/preliminary-cost). Estimates are then validated against the current or recently completed projects of similar scope.

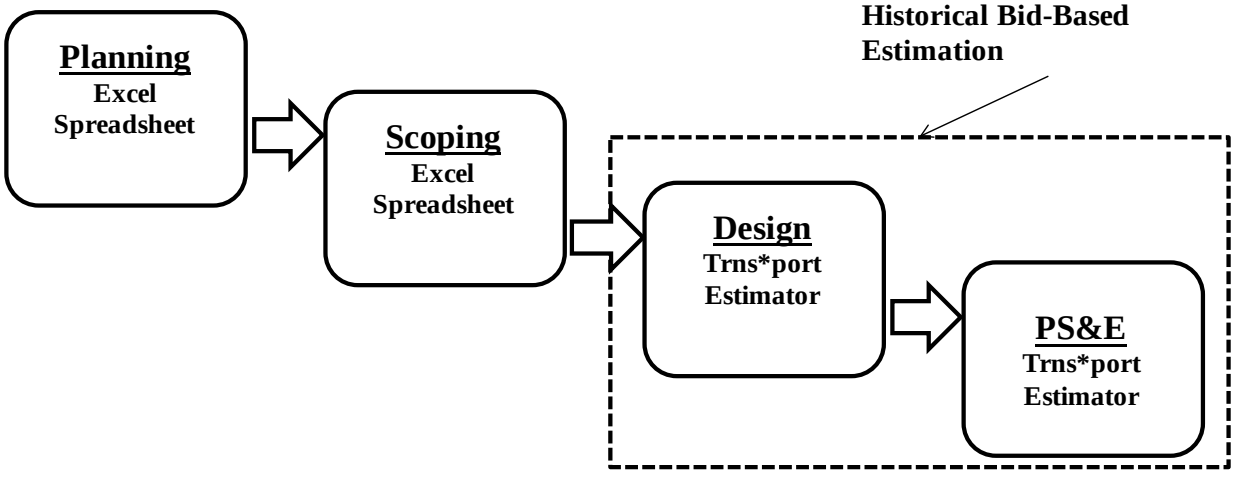


Figure 48. NYSDOT Estimation Framework.

PRELIMINARY COST ESTIMATE WORKSHEET (NEW AND REPLACEMENT BRIDGES)

P.I.N. _____ B.I.N. _____ PS&E _____

BRIDGE _____ OVER _____

NUMBER of SPANS _____ SPAN ARRANGEMENT _____ WIDTH _____ m

ABUTMENT TYPE _____ SKEW _____ DEG _____ CURVED GIRDERS ☐ RADIUS _____ m

SUPERSTRUCTURE: Steel ☐ Steel Curved ☐ Prestress Conc Box Beam ☐ SLAB ☐ OTHER: _____

Alternate Design Timber ☐ Inverset ☐ Box Culvert ☐ Con-Span ☐ Hy-Span ☐

M&PT By: Detour Structure ☐ Local Roads ☐ Exist. Bridge ☐ Stage Const. ☐ NA. ☐

PREPARED BY: _____ DATE: _____

SEE SHOULDER BREAK DIAGRAMS ON LAST PAGE FOR EXPLANATION OF SHOULDER BREAK AREA

SHOULDER BREAK DIAGRAM	(Shoulder Break Length)		(Bridge Width)		(Shoulder Break Area)
	_____ m	X	_____ m	=	_____ m^2

1.) Basic Bridge: ☐ DOT Regions 1 - 7 & 9 =$1250 to $1560 Region 8 = $1550 to $1720, Region 10 = $1740 to $1930
Basic RR. Bridge =$3200/$m^2$ (Subtract $80 - $140 for bridges with 4 + spans)
Note: In general, steel bridge costs are higher in the range than concrete bridge costs

2.) Culverts & three sided structures with horizontal openings from 6.1m to 14.65m ☐ Precast structures: Subtract 10 % of the basic bridge cost if the culvert or three sided structure is founded on a cast in place invert slab or piles.Subtract 20% to 30% if the three sided structure is founded on spread footings or precast culverts are not founded on piles. **This reduction can only be realized if there is no stage construction and/or if there are no cast in place pedestal walls supporting the structure.**

3.) Foundations: ☐ Footings on rock = Subtract $115. Add $100 for piles of integral abutments.
Piles average $200 - $350 per bridge based on average soil conditions & pile lengths of 6m to 12m. Poor soil can increase the number and length of piles resulting in cost inputs of $380 - $550.

4.) Abutments: ☐ Integral abutments = Subtract $100 MSE Walls supporting CIP stub abutments are included below the subtotal amount.
Abutments 6.1 m. - 9.1 m. high = $90 - $170. (Reg.1-7 & 9) & $130 to $240 (Reg. 8 & 10)

5.) Cofferdams: ☐ Significant cost usually found in deep water construction only. Costs based on bridges up to 15 m. wide
Water depths based on bottom of footing to OHW elev. Minor Water Diversion (Sand Bags) = $6800 - $12600 per bridge.
Divide cost on right by shoulder break m^2 & input Abutments in 1.2 m. to 1.8 m. of water = $17000 - $21,000 per unit.
Piers in 1.5 m. to 2.4 m. water = $60,000 - $80,000, 3.6 m. to 4.3 m. of water = $110,000 - $150,000,
Canal Pier Protection Cofferdam System (Sheeting 12.2 m High)= $160,000 - $200,000. (all are per unit)
(Tremie Seals cost $21,000 - $43,000 per unit)

6.) Long Spans: ☐ Average multi span continuous. For input choice for spans: 48m to 65m = $200 to $250
Spans 65m - 75m. = $320 to $400. Add $100.00 for each 4.6 m. of additional length over 75 m.
Truss:add $1200 plus the factor for long spans (ex:92.3m truss, input $1976)

7.) Curved Girders: ☐ 488 m. radius or less = $184, 488 m to 762 m. = $138, 762 m to 914 m. = $92

8.) Long Wingwalls: ☐ See chart on 2nd sheet for input. This factor necessary when total wingwall length exceeds 20m.

9.) Stage Construct.: ☐ Superstructure/Substructure staging = $120 to $160, Minor staging of substructure = $60 to
Region 8 & 10 staging = $185 to $355 $120, Integral Abut. Bridges = $90 to $130, Anchor tie back systems & H-Pile wall lagging can add $145 to $204 more.

10.) Miscellaneous: ☐ Final Adjustment Area. Examples: Bridge less than 9.1 m. wide = $65, Bridge over 23 m. wide = subtract $65, Paint steel = $20 to $45 based on m^2 deck area (Girder bridge). Painting Truss = $200 /SB m^2. Protection walls other than for staging.

SUBTOTAL: _____ (2008 Base Year)

TOTAL:

Shoulder Break Area (m^2) ☐ X Cost / m^2 ☐ = BRIDGE ONLY COST _____

Cost to remove existing bridge = _____

Cost of Maintenance & Protection of Traffic = _____

Cost of detour structure = _____

Cost of channel work = _____

Cost of slope protection, other than for channel work = _____

Cost of utilities = _____

Aesthetics (e.g. Formliners, decorative railing, lights & stone facades) = _____

MSE walls as part of the bridge foundation(s) ($425 to $750 per m^2 of suface area) = _____

Overhead (e.g.Construction office, computer software & hardware, office supplies) = _____

rev.3/27/08 **TOTAL BRIDGE SHARE** (Includes additional 4 % for mobilization) = $ _____

Figure 49. NYSDOT Preliminary Cost Estimate Worksheet for New and Replacement Bridges.

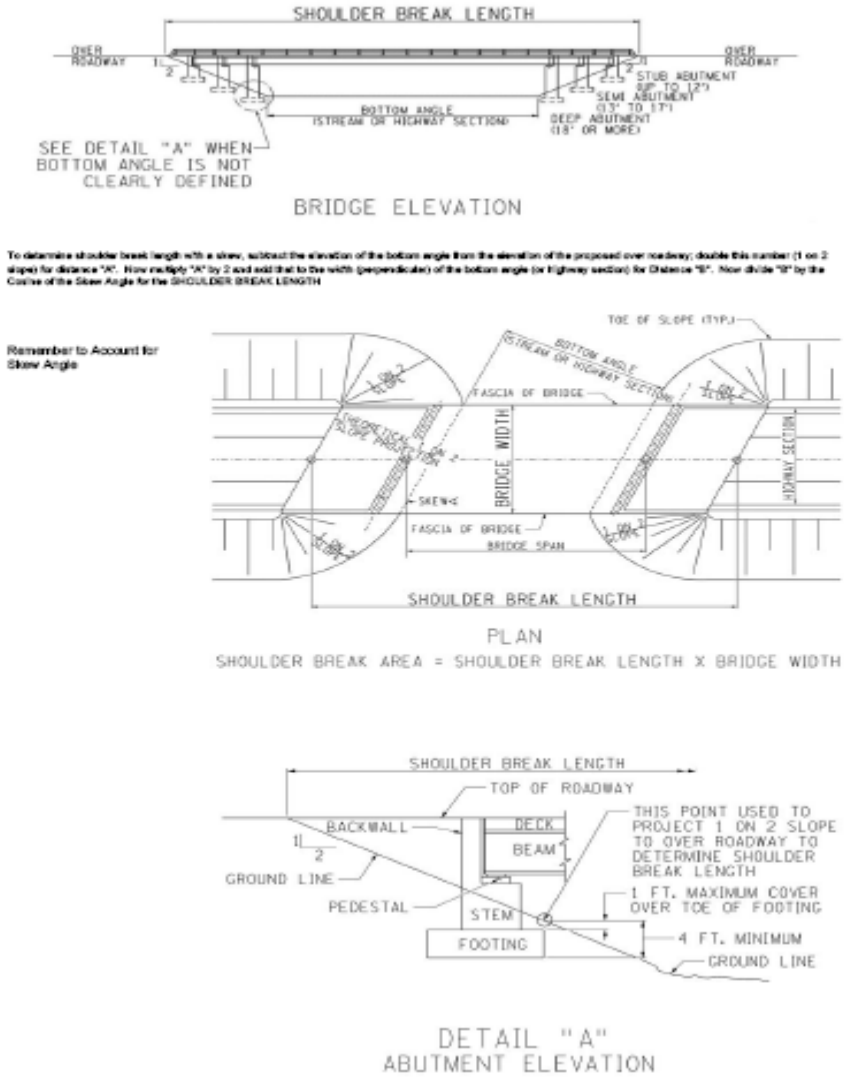


Figure 50. Shoulder Break Area Diagram – NYSDOT Preliminary Cost Estimate Worksheet.

4.5.1.2 Acquiring Unit Cost Information

Historical unit costs are acquired from the submitted bids by the contractors through the Letting and Approval System (LAS) and Site Manager of Trns*port suite of software. The BAMS/DSS stores the historical unit prices from the three lowest bids. Figure 51 explains the flow of historical bid data within the Trns*port system.

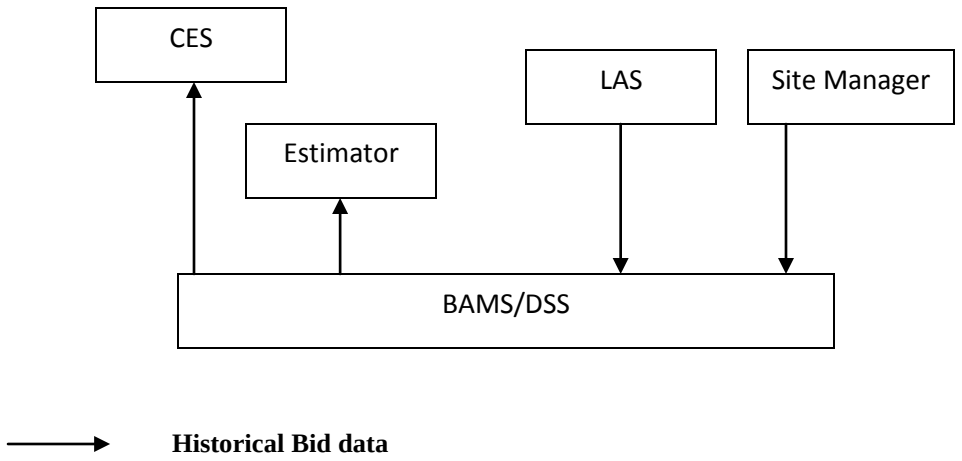


Figure 51. NYSDOT Historical Unit Costs within Trns*port System.

4.5.1.3 Storing Unit Cost Information

The historical bid prices stored in the BAMS/DSS database of the Trns*port system consist of the three lowest historical bid made available from the LAS and Site Manager. The BAMS/DSS database for NYSDOT consists of historical bid data available over a period of five years.

4.5.1.4 Accessing Unit Cost Information

NYSDOT unit cost information can be accessed through the Weighted Average Item Price Report (WAIPR) and the Regional and Statewide Average Awarded Price Report (RSWAAPR) available on their website (http://www.nysdot.gov). WAIPR (see Figure 52) is generated using the Trns*port system and RSWAAPR (see Figure 53) is generated using the Crystal Reports® software. Both of the reports contain all the items let during the period indicated in the report. WAIPR and RSWAAPR are generated twice a year containing the total dollars and weighted average price of the three low bidders. NYSDOT updates their historical bid prices every quarter.

New York State Department of Transportation 10:40 Wednesday, March 26, 2008
Contracts Let January 1, 2007 to December 31, 2007

WEIGHTED AVERAGE ITEM PRICE REPORT
BY ITEM, REGION AND QUARTER

ITEM	REGION	CALENDAR QUARTER	NUMBER OF OCCUR'S	TOTAL QUANTITY	TOTAL DOLLARS	AVERAGE AWARDED PRICE	AVERAGE OF LOW 3 BIDDERS
REMOVAL OF SUBSTRUCTURES / CM							
202.19	04	2007Q1	3	398.00	$21,500	$54.02	$73.07
		2007Q2	2	211.00	$20,375	$96.56	$87.36
		2007Q3	2	1,725.00	$85,925	$49.81	$63.13
	05	2007Q2	2	2,645.00	$100,050	$37.83	$39.23
		2007Q3	1	206.00	$14,420	$70.00	$80.00
		2007Q4	1	4,650.00	$116,250	$25.00	$35.00
	06	2007Q1	1	598.00	$53,820	$90.00	$103.33
		2007Q2	5	978.00	$88,790	$90.79	$89.19
	07	2007Q1	1	406.00	$38,570	$95.00	$105.45
		2007Q2	1	354.00	$30,090	$85.00	$85.00
		2007Q3	1	62.00	$3,720	$60.00	$85.47
	08	2007Q1	2	2,936.00	$293,600	$100.00	$131.63
		2007Q3	1	366.00	$36,600	$100.00	$225.00
	09	2007Q2	1	374.00	$22,440	$60.00	$92.00
	10	2007Q1	1	453.00	$113,250	$250.00	$340.00
		2007Q3	1	2,021.00	$3,536,750	$1,750.00	$1,333.33
	11	2007Q1	2	1,099.00	$276,280	$251.39	$420.46
			39	23,749.00	$5,255,833	$221.31	$203.87
REMOVING OLD BITUMINOUS CONCRETE OVERLAY / SQM							
202.20	04	2007Q3	1	3,147.00	$9,441	$3.00	$5.37
	08	2007Q2	1	6,500.00	$287,625	$44.25	$58.23
	10	2007Q1	6	6,396.00	$363,646	$56.86	$60.77
		2007Q2	2	180.00	$17,900	$99.44	$131.41
	11	2007Q1	1	200.00	$15,000	$75.00	$57.67
			11	16,423.00	$693,612	$42.23	$49.88

Figure 52. NYSDOT Weighted Average Item Price Report (WAIPR) - January 2007 to December 2007.

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
REGIONAL AND STATEWIDE WEIGHTED AVERAGE AWARDED PRICES
CONTRACTS LET JANUARY 1, 2007 TO DECEMBER 31, 2007

ITEM	DESCRIPTION	REGION	UNITS	# OF OCCUR'S	TOTAL QUANTITY	AVG. AWARDED PRICE
201.07	CLEARING AND GRUBBING		HA			
		03		1	2.0	$74,500.00
		06		1	40.9	$4,500.00
		09		1	1.0	$1.00
		11		1	2.0	$15,000.00
		STATEWIDE		4	45.9	$7,907.38
201.0701 63	CLEAR GRUBBING, EM/STBY, R 1 (0 -0.2)		HA			
		01		2	2.0	$1,750.00
		STATEWIDE		2	2.0	$1,750.00
201.0702 63	CLEAR GRUBBING, EM/STBY, R 2 (0.2 - 0.4)		HA			
		01		2	2.0	$750.00
		STATEWIDE		2	2.0	$750.00
201.0703 63	CLEAR GRUBBING, EM/STBY, R 3 (0.4 - 0.2)		HA			
		01		2	2.0	$750.00
		STATEWIDE		2	2.0	$750.00
202.0501	REM/DISP OF PETRO STOR TANK(0-1050)LITER		EACH			
		05		1	8.0	$1.00
		10		1	4.0	$1,000.00
		STATEWIDE		2	12.0	$334.00
202.0502	DISP PETRO STOR TANKS (1051-1900)LITERS		EACH			
		04		1	1.0	$1.00
		STATEWIDE		1	1.0	$1.00
202.0503	DISP OF PETRO STOR TANK(1901-3800)LITERS		EACH			
		03		1	2.0	$1,600.00
		06		1	1.0	$2,500.00
		STATEWIDE		2	3.0	$1,900.00
202.0504	DISP -PETRO STOR TANK(3801-9500)LITERS		EACH			
		03		1	3.0	$4,800.00
		10		1	2.0	$2,450.00
		STATEWIDE		2	5.0	$3,860.00
202.17 04	CHEM OXYGENAT MAT IN-SITU REMEDIATION		KG			
		04		1	3,468.0	$7.95
		STATEWIDE		1	3,468.0	$7.95
202.19	REMOVAL OF SUBSTRUCTURES		CM			
		01		4	460.0	$129.46
		02		5	2,527.0	$101.96
		03		2	1,280.0	$67.34
		04		7	2,334.0	$54.76
		05		4	7,501.0	$30.76
		06		6	1,576.0	$90.49
		07		3	822.0	$88.05
		08		3	3,302.0	$100.00
		09		1	374.0	$60.00
		10		2	2,474.0	$1,475.34
		11		2	1,099.0	$251.39
		STATEWIDE		39	23,749.0	$221.31

Figure 53. NYSDOT Regional and Statewide Average Award Prices (RSWAAPR) - January 2007 to December 2007.

BAMS/DSS data are used in generating the RSWAAPR report through the Crystal Reports Software. This reporting tool is much faster and works directly with the historical bid data in the BAMS database to generate customized reports. The data obtained through this tool can be saved to an Excel spreadsheet for further statistical analysis in Excel. NYSDOT also uses Crystal Reports software to prepare graphical reports on the accuracy of Engineer's Estimate. This software also allows grouping of historical bid data based on the different work types such as grading/excavation, pavements and traffic control.

4.5.1.5 Applying Unit Cost Information

NYSDOT considers seven to twelve months of historical data for establishing unit prices through bid-based estimation and the use of WAIPR and RSWAAPR for the necessary weighted average of historical prices. Scatter plots are also used in determining the unit prices. The unit prices are then adjusted based on the quantities used in the project—the higher the quantity, the lower the unit price and vice versa. Adjustment of unit prices for project type and complexity is based on engineering judgment and experience. NYSDOT, as per Federal Highway Administration (FHWA) guidance on estimating, performs either historical bid-based estimating or cost-based estimating or a combination of both. Major items of work, which contribute significantly to the total project cost, are once again estimated using cost-based estimating approach. NYSDOT applies certain percentages for contingency during different phases of project development. Table 10 provides contingency ranges recommended by NYSDOT for its projects.

Table 10. NYSDOT Contingency Percentage Ranges.

Project Phase	Contingency (%)
Planning	25 – 40
Scoping	20 – 25
Design	15 – 20
PS&E	5 -10

4.5.2 Maintenance Cost Information

Maintenance unit costs are stored as regular DOT specification items in the Trns*port system or available as contract work items. A separate group within NYSDOT maintains these unit costs. Maintenance work is either treated like the construction project involving bidding for this work or it is given as a job order to the contractor. A suitable overhead and contractor markup is added to the total amount. The maintenance database includes historical prices for such work as mowing and snow plowing.

4.6 FLORIDA DEPARTMENT OF TRANSPORTATION

4.6.1 Construction Unit Cost Information

4.6.1.1 General Section

Historical bid-based estimating is FDOT's primary estimating technique used in the PS&E phase of the project development. Estimators use the Lane Mile Cost information developed from the Long Range Estimation (LRE) system for preparing the Planning level estimates. The LRE is extensively used in the scoping and early design phases (see Figure 54). The District offices prepare the Engineer's Estimate using the CES of Trns*port system.

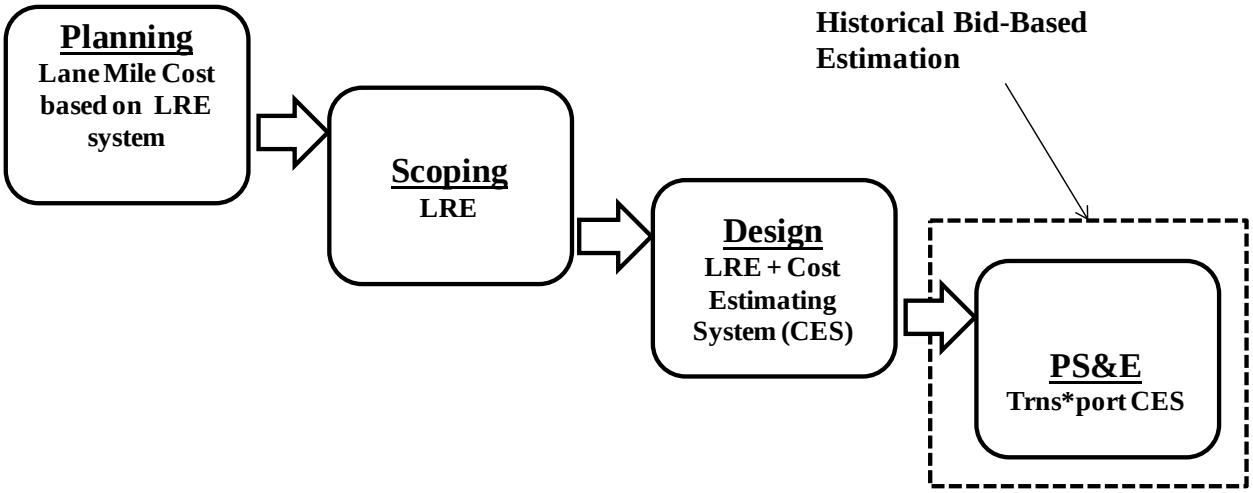
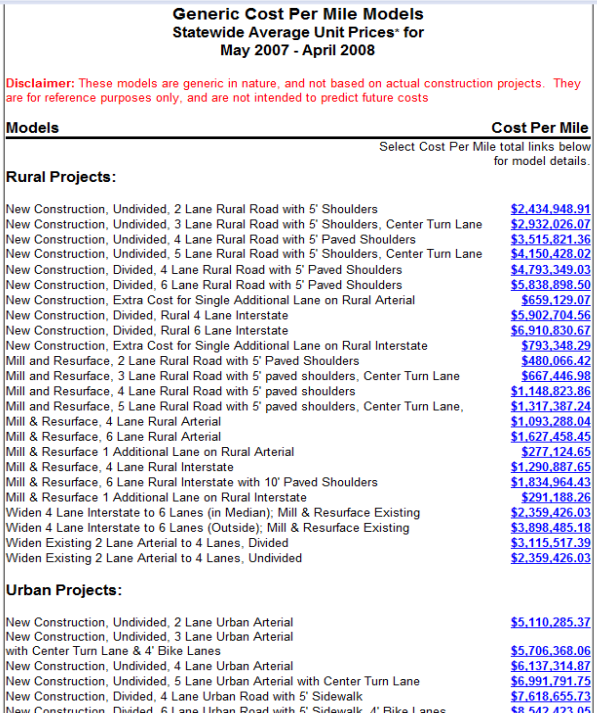


Figure 54. FDOT Estimation Framework.

The lane mile cost information is available for different types of rural and urban projects. The unit price used to develop lane mile costs as reflected in the estimate represents statewide averages. This information is available as a reference and not to be used to predict future costs. Generic Cost per Mile (Figure 55 and Figure 56) models developed is available on FDOT's website at http://www.dot.state.fl.us/estimates/LaneMileCosts/LaneMilecosts.htm.

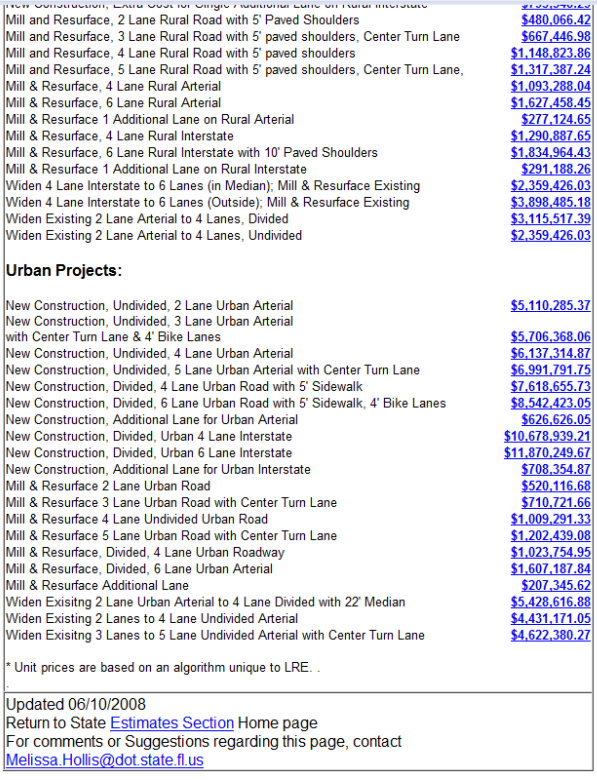


Generic Cost Per Mile Models
Statewide Average Unit Prices* for
May 2007 - April 2008

Disclaimer: These models are generic in nature, and not based on actual construction projects. They are for reference purposes only, and are not intended to predict future costs

Models	Cost Per Mile
	Select Cost Per Mile total links below for model details.
Rural Projects:	
New Construction, Undivided, 2 Lane Rural Road with 5' Shoulders	$2,434,948.91
New Construction, Undivided, 3 Lane Rural Road with 5' Shoulders, Center Turn Lane	$2,932,026.07
New Construction, Undivided, 4 Lane Rural Road with 5' Paved Shoulders	$3,515,821.36
New Construction, Undivided, 5 Lane Rural Road with 5' Shoulders, Center Turn Lane	$4,150,428.02
New Construction, Divided, 4 Lane Rural Road with 5' Paved Shoulders	$4,793,349.03
New Construction, Divided, 6 Lane Rural Road with 5' Paved Shoulders	$5,838,898.50
New Construction, Extra Cost for Single Additional Lane on Rural Arterial	$659,129.07
New Construction, Divided, Rural 4 Lane Interstate	$5,902,704.56
New Construction, Divided, Rural 6 Lane Interstate	$6,910,830.67
New Construction, Extra Cost for Single Additional Lane on Rural Interstate	$793,348.29
Mill and Resurface, 2 Lane Rural Road with 5' Paved Shoulders	$480,066.42
Mill and Resurface, 3 Lane Rural Road with 5' paved shoulders, Center Turn Lane	$667,446.98
Mill and Resurface, 4 Lane Rural Road with 5' paved shoulders	$1,148,823.86
Mill and Resurface, 5 Lane Rural Road with 5' paved shoulders, Center Turn Lane,	$1,317,387.24
Mill & Resurface, 4 Lane Rural Arterial	$1,093,288.04
Mill & Resurface, 6 Lane Rural Arterial	$1,627,458.45
Mill & Resurface 1 Additional Lane on Rural Arterial	$277,124.65
Mill & Resurface, 4 Lane Rural Interstate	$1,290,887.65
Mill & Resurface, 6 Lane Rural Interstate with 10' Paved Shoulders	$1,834,964.43
Mill & Resurface 1 Additional Lane on Rural Interstate	$291,188.26
Widen 4 Lane Interstate to 6 Lanes (in Median); Mill & Resurface Existing	$2,359,426.03
Widen 4 Lane Interstate to 6 Lanes (Outside); Mill & Resurface Existing	$3,898,485.18
Widen Existing 2 Lane Arterial to 4 Lanes, Divided	$3,115,517.39
Widen Existing 2 Lane Arterial to 4 Lanes, Undivided	$2,359,426.03
Urban Projects:	
New Construction, Undivided, 2 Lane Urban Arterial	$5,110,285.37
New Construction, Undivided, 3 Lane Urban Arterial with Center Turn Lane & 4' Bike Lanes	$5,706,368.06
New Construction, Undivided, 4 Lane Urban Arterial	$6,137,314.87
New Construction, Undivided, 5 Lane Urban Arterial with Center Turn Lane	$6,991,791.75
New Construction, Divided, 4 Lane Urban Road with 5' Sidewalk	$7,618,655.73
New Construction, Divided, 6 Lane Urban Road with 5' Sidewalk, 4' Bike Lanes	$8,542,423.05

Figure 55. FDOT Generic Cost Per Mile Model - Rural Projects.



Mill and Resurface, 2 Lane Rural Road with 5' Paved Shoulders	$480,066.42
Mill and Resurface, 3 Lane Rural Road with 5' paved shoulders, Center Turn Lane	$667,446.98
Mill and Resurface, 4 Lane Rural Road with 5' paved shoulders	$1,148,823.86
Mill and Resurface, 5 Lane Rural Road with 5' paved shoulders, Center Turn Lane,	$1,317,387.24
Mill & Resurface, 4 Lane Rural Arterial	$1,093,288.04
Mill & Resurface, 6 Lane Rural Arterial	$1,627,458.45
Mill & Resurface 1 Additional Lane on Rural Arterial	$277,124.65
Mill & Resurface, 4 Lane Rural Interstate	$1,290,887.65
Mill & Resurface, 6 Lane Rural Interstate with 10' Paved Shoulders	$1,834,964.43
Mill & Resurface 1 Additional Lane on Rural Interstate	$291,188.26
Widen 4 Lane Interstate to 6 Lanes (in Median); Mill & Resurface Existing	$2,359,426.03
Widen 4 Lane Interstate to 6 Lanes (Outside); Mill & Resurface Existing	$3,898,485.18
Widen Existing 2 Lane Arterial to 4 Lanes, Divided	$3,115,517.39
Widen Existing 2 Lane Arterial to 4 Lanes, Undivided	$2,359,426.03
Urban Projects:	
New Construction, Undivided, 2 Lane Urban Arterial	$5,110,285.37
New Construction, Undivided, 3 Lane Urban Arterial with Center Turn Lane & 4' Bike Lanes	$5,706,368.06
New Construction, Undivided, 4 Lane Urban Arterial	$6,137,314.87
New Construction, Undivided, 5 Lane Urban Arterial with Center Turn Lane	$6,991,791.75
New Construction, Divided, 4 Lane Urban Road with 5' Sidewalk	$7,618,655.73
New Construction, Divided, 6 Lane Urban Road with 5' Sidewalk, 4' Bike Lanes	$8,542,423.05
New Construction, Additional Lane for Urban Arterial	$626,626.05
New Construction, Divided, Urban 4 Lane Interstate	$10,678,939.21
New Construction, Divided, Urban 6 Lane Interstate	$11,870,249.67
New Construction, Additional Lane for Urban Interstate	$708,354.87
Mill & Resurface 2 Lane Urban Road	$520,116.68
Mill & Resurface 3 Lane Urban Road with Center Turn Lane	$710,721.66
Mill & Resurface 4 Lane Undivided Urban Road	$1,009,291.33
Mill & Resurface 5 Lane Urban Road with Center Turn Lane	$1,202,439.08
Mill & Resurface, Divided, 4 Lane Urban Roadway	$1,023,754.95
Mill & Resurface, Divided, 6 Lane Urban Arterial	$1,607,187.84
Mill & Resurface Additional Lane	$207,345.62
Widen Exisitng 2 Lane Urban Arterial to 4 Lane Divided with 22' Median	$5,428,616.88
Widen Existing 2 Lanes to 4 Lane Undivided Arterial	$4,431,171.05
Widen Exisitng 3 Lanes to 5 Lane Undivided Arterial with Center Turn Lane	$4,622,380.27

* Unit prices are based on an algorithm unique to LRE. .

Updated 06/10/2008
Return to State Estimates Section Home page
For comments or Suggestions regarding this page, contact Melissa.Hollis@dot.state.fl.us

Figure 56. FDOT Generic Cost per Mile Model - Urban Projects.

4.6.1.1.1 Long Range Estimation System

FDOT uses its LRE system, developed in-house, to prepare project estimates in the scoping and design phase. The Generic Cost per Mile models shown in Figure 55 and Figure 56 are generated using LRE system. LRE uses the same historical database as CES and generates a twelve-month rolling average for each pay item. It also provides the estimators with the statewide, county, and market area averages for a particular pay item. A market area is a grouping of counties based on similar bidding practices within districts. The rolling average is updated annually with new bid information.

FDOT utilizes the LRE system for preparing the estimates in the Design phase until the 60 percent of design completion point. When more than 60 percent of the design details are available, FDOT uses CES to build the estimate. FDOT does not have any guidance on the development of unit costs. FDOT is looking at using a cost-based estimating approach to estimate major pay items when preparing the Engineer's Estimate.

4.6.1.2 Acquiring Unit Cost Information

FDOT uses BAMS/DSS to acquire bid information from all the submitted bids.

4.6.1.3 Storing Unit Cost Information

FDOT stores all its historical unit costs in their BAMS/DSS system. Over five years of historical unit costs are stored in their database. Historical unit costs are available based on statewide, district, and market areas. All the historical unit costs are stored based on standard construction line items.

4.6.1.4 Accessing Unit Cost Information

FDOT maintains nine different cost history libraries used in the Trns*port CES. The libraries consist of recent six months, eighteen months, and thirty six months historical bid details for low bidders only, all bidders, contracts less than two years, and contracts greater than two years. FDOT offers annual statewide averages (see Figure 57) for all pay items using historical data stored in BAMS/DSS and also averages for various market areas (see Figure 58) on its website.

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Florida Department of Transportation
Item Average Unit Cost
From 2007/01/01 to 2007/12/31

Contract Type: ('CC') STATEWIDE
Displaying: VALID ITEMS WITH HITS
From: 0100 To: 1999999999

Item	No. of Conts	Weighted Average	Total Amount	Total Quantity	Unit Meas	Obs?	Description
0101 1	255	$421,924.77	$135,859,775.35	322.000	LS	N	MOBILIZATION
0102 1	255	$863.19	$66,784,873.67	77,370.000	DA	N	MAINTENANCE OF TRAFFIC
0102 2 1	9	$342,030.12	$3,420,301.21	10.000	LS	N	SPECIAL DETOUR 1
0102 2 2	5	$592,987.85	$2,964,939.23	5.000	LS	N	SPECIAL DETOUR 2
0102 2 3	4	$915,067.38	$3,660,269.51	4.000	LS	N	SPECIAL DETOUR 3
0102 2 4	4	$223,163.93	$892,655.72	4.000	LS	N	SPECIAL DETOUR 4
0102 2 5	2	$112,500.00	$225,000.00	2.000	LS	N	SPECIAL DETOUR 5
0102 2 6	1	$50,000.00	$50,000.00	1.000	LS	N	SPECIAL DETOUR 6
0102 2 7	1	$50,000.00	$50,000.00	1.000	LS	N	SPECIAL DETOUR 7
0102 3	65	$26.94	$1,446,579.53	53,699.900	CY	N	COMMERCIAL MATL FOR DRIVEWAY MAINT
0102 14	113	$51.76	$1,426,815.42	27,564.000	MH	N	TRAFFIC CONTROL OFFICER
0102 60	241	$.29	$1,301,225.68	4,490,720.000	ED	N	WORK ZONE SIGN
0102 61	49	$37.42	$89,387.81	2,389.000	EA	N	BUSINESS SIGN
0102 71 11	55	$21.66	$6,545,609.63	302,161.750	LF	N	BARRIER WALL,TEMP,F&I,CONCRETE
0102 71 12	4	$40.37	$109,039.09	2,701.000	LF	N	BARRIER WALL,TEMP,F&I,WATERFILLED
0102 71 13	14	$48.62	$2,794,112.32	57,468.000	LF	N	BARRIER WALL,TEMP,F&I,LOW PROFILE,CONC
0102 71 14	29	$51.89	$4,757,077.42	91,673.500	LF	N	BARRIER WALL,TEMP,F&I,TYPE K
0102 71 21	43	$6.12	$1,534,825.53	250,613.000	LF	N	BARRIER WALL,TEMP,REL,CONCRETE
0102 71 22	4	$9.72	$52,094.64	5,361.000	LF	N	BARRIER WALL,TEMP,REL,WATERFILLED
0102 71 23	11	$5.81	$479,496.93	82,560.000	LF	N	BARRIER WALL,TEMP,REL,LOW PROFILE,CONC
0102 71 24	18	$13.75	$978,933.41	71,199.000	LF	N	BARRIER WALL,TEMP,REL,TYPE K
0102 73	3	$24.64	$87,480.00	3,550.000	LF	N	TEMPORARY GUARDRAIL
0102 74 1	229	$.18	$2,602,937.68	14,847,968.000	ED	N	BARRICADE,TEMP,TYPS I,II,DI,VP & DRUM
0102 74 2	112	$.37	$395,572.16	1,073,803.000	ED	N	BARRICADE,TEMP,TYPE III, 6'
0102 76	173	$9.20	$673,355.62	82,148.000	ED	N	ADVANCE WARNING ARROW PANEL
0102 77	233	$.45	$692,907.42	1,504,921.000	ED	N	HIGH INTENSITY FLASH LI,TEMP,TYP B

Figure 57. FDOT Annual Statewide Averages.

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Florida Department of Transportation
Item Average Unit Cost
From 2007/01/01 to 2007/12/31

Contract Type: ('CC') AREAS :01
Displaying: VALID ITEMS WITH HITS
From: 0100 To: 1999999999

Item	No. of Conts	Weighted Average	Total Amount	Total Quantity	Unit Meas	Obs?	Description
0101 1	16	$274,616.61	$4,943,099.00	18.000	LS	N	MOBILIZATION
0102 1	16	$497.78	$2,074,031.10	4,252.000	DA	N	MAINTENANCE OF TRAFFIC
0102 2 1	1	$325,000.00	$650,000.00	2.000	LS	N	SPECIAL DETOUR 1
0102 3	6	$27.72	$135,920.19	4,904.000	CY	N	COMMERCIAL MATL FOR DRIVEWAY MAINT
0102 14	3	$47.55	$6,847.04	144.000	MH	N	TRAFFIC CONTROL OFFICER
0102 60	16	$.48	$63,052.01	132,712.000	ED	N	WORK ZONE SIGN
0102 61	2	$330.34	$3,633.75	11.000	EA	N	BUSINESS SIGN
0102 71 11	5	$12.23	$334,329.00	27,335.000	LF	N	BARRIER WALL,TEMP,F&I,CONCRETE
0102 71 14	1	$49.00	$245,490.00	5,010.000	LF	N	BARRIER WALL,TEMP,F&I,TYPE K
0102 71 21	4	$5.81	$176,612.10	30,411.000	LF	N	BARRIER WALL,TEMP,REL,CONCRETE
0102 73	1	$18.00	$18,900.00	1,050.000	LF	N	TEMPORARY GUARDRAIL
0102 74 1	11	$.22	$75,655.32	347,632.000	ED	N	BARRICADE,TEMP,TYPS I,II,DI,VP & DRUM
0102 74 2	7	$.91	$4,179.02	4,594.000	ED	N	BARRICADE,TEMP,TYPE III, 6'
0102 76	7	$10.70	$35,327.00	3,303.000	ED	N	ADVANCE WARNING ARROW PANEL
0102 77	16	$.62	$38,199.60	61,381.000	ED	N	HIGH INTENSITY FLASH LI,TEMP,TYP B
0102 78	7	$4.60	$174,295.33	37,924.000	EA	N	REFLECTIVE PAVT MARKER,TEMPORARY
0102 79	6	$.22	$14,238.58	63,871.000	ED	N	LIGHTS,BARR WALL MNT,TEMP,TYP C,STDY BRN
0102 89 7	5	$1,614.30	$95,243.79	59.000	LO	N	CRASH CUSHION/IMP ATTE,TEMP,REDIRECT OPT
0102 99	10	$23.44	$70,236.19	2,996.000	ED	N	CHANGEABLE-VARIABLE MESSAGE SIGN,TEMP
0102107	1	$1,689.51	$3,379.02	2.000	DA	N	TEMP TRAFFIC DETECTION, INTERSECT
0102150 1	4	$28.08	$35,918.40	1,279.000	ED	N	PORTABLE REGULATORY,SIGN
0102150 2	3	$35.54	$32,836.65	924.000	ED	N	RADAR SPEED DISPLAY UNIT
0102911 2	3	$2.27	$52,676.55	23,167.000	LF	N	PAVT MARKING REMOVABLE,WH-BLK,SOLID
0102912 2	3	$2.27	$26,663.55	11,741.000	LF	N	PAVT MARKING REMOVABLE, YELLOW,SOLID
0104 1	1	$6.00	$2,988.00	498.000	SY	N	ARTIFICIAL COVERINGS EROSION CNTL

Figure 58. FDOT Annual Market Areas Averages.

4.6.1.5 Applying Unit Cost Information

FDOT uses four to six months of historical bid data for establishing the unit prices. LRE and CES enable the estimator to select a weighted average or use a scatter plot when determining the unit prices for both major and minor items of work. LRE also provides estimators with statewide, county, and market area averages from which to choose unit costs for each pay item. Though this approach is just guidance on the prices based on historical data, the estimators have the option to override the unit price if it is not consistent with current market conditions. The libraries with contracts greater than two years duration have inflation built into the unit costs.

FDOT does not have any guidance on adjusting unit prices based on project complexity, size, current market conditions, and inflation but relies on experience and engineering judgment to adjust unit prices. Estimators handle uncertainties within the project by using contingencies varying from 25 percent at the planning phase to 0–5 percent in the final PS&E phase of project development.

4.6.2 Maintenance Unit Cost Information

Maintenance unit cost information is stored in the BAMS/DSS and pulled into the LRE system for estimating. Maintenance activities have different activity codes, which the LRE uses to group maintenance unit costs. The Maintenance Office in FDOT uses LRE to access maintenance unit costs.

4.7 WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

4.7.1 Construction Unit Cost Information

4.7.1.1 General Section

WSDOT relies on historical bid-based estimating to prepare the estimates in the planning, scoping, and design phases of project development (see Figure 59). The Final Engineer's Estimate is developed using a combination of cost based and historical bid-based estimating. The use of cost based approach is limited to those items of work that comprise the largest dollar value of the project, typically that 20 percent of items of work containing 80 percent of project cost. Along with the above two estimating techniques, WSDOT also uses the parametric estimating approach for planning level estimates. The planning level estimates are prepared using two tools that employ parametric methods: 1) Mobility Project Prioritization Process (MP3) and 2) Planning Level Project Cost Estimating (PLCE). Estimates in the scoping, design, and PS&E phases are prepared using WSDOT's in-house estimating system called Estimate and Bid Analysis System (EBASE). Along with EBASE, WSDOT uses the Bid Tabs Pro® software of Oman Systems to help in preparing the design level and Engineers Estimates. Figure 59 shows the estimating tools used by WSDOT in various project development phases.

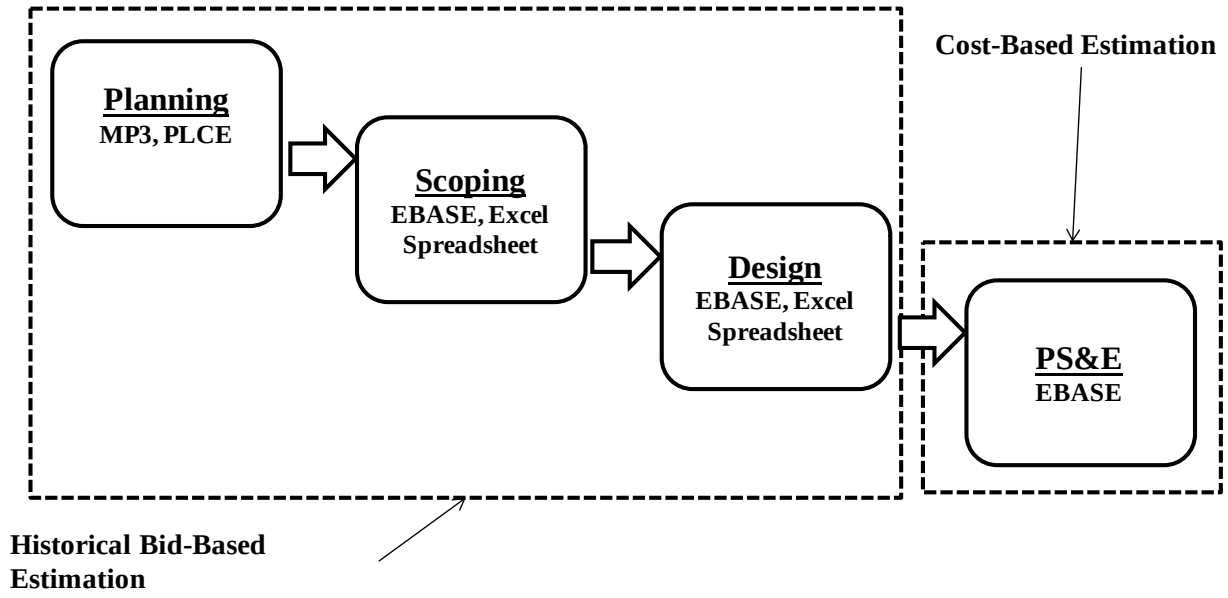


Figure 59. WSDOT Estimation Framework.

WSDOT maintains a manual providing cost estimating guidelines on its website at http://www.WSDOT.wa.gov/Projects/ProjectMgmt/RiskAssessment/Process/ under the Estimating section. The guideline provides an overview of the estimating techniques used by

WSDOT during different project development phases and explains the factors affecting the unit prices.

4.7.1.2 Acquiring Unit Cost Information

Historical bid data from bid tabulations are directly imported into the EBASE system. The bid information from all the submitted bids is stored in the database.

4.7.1.3 Storing Unit Cost Information

WSDOT maintains over five years of historical data within their EBASE system. Historical bid details are also transferred to Oman systems for building their Bid Tabs Pro database. EBASE holds data for the entire state, districts/regions, and counties. Apart from storing historical unit costs as standard construction line items, WSDOT also has them categorized based on different work categories (e.g., grading/excavation, asphalt, bridge, traffic control, etc.) and based on project types (e.g., bridge replacement, lane widening, intersection reconstruction, etc.).

4.7.1.4 Accessing Unit Cost Information

WSDOT's Unit Bid Analysis system allows access to historical unit costs. This in-house developed system contains the bid history for standard bid items used in their projects. This history consists of listing of projects in which bid items were used, the three low bidders' information, quantities, and units of measurement. Unit Bid Analysis can be accessed on their webpage at http://www.WSDOT.wa.gov/Design/ProjectDev/EngineeringApplications/UnitBidHistory.htm. The 'Search' hyperlink on the webpage lets the user specify standard item name or number, the region, the measurement system (English or Metric) and the date range for the inquiry. The results can be viewed online or can be downloaded as an Excel spreadsheet. Figure 60 shows the Unit Bid Analysis system for searching WSDOT's historical database, and Figure 61 shows the result of the inquiry.

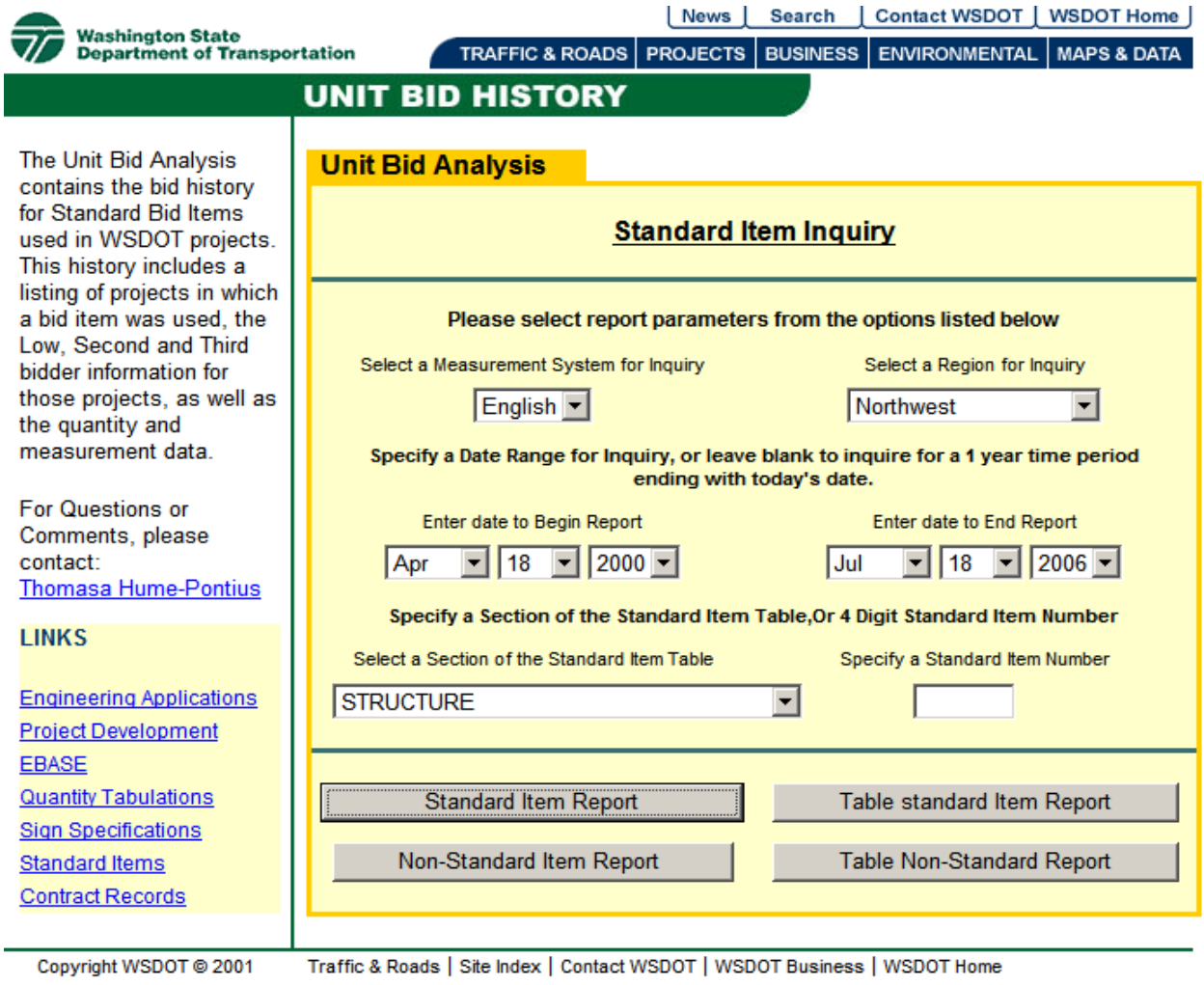
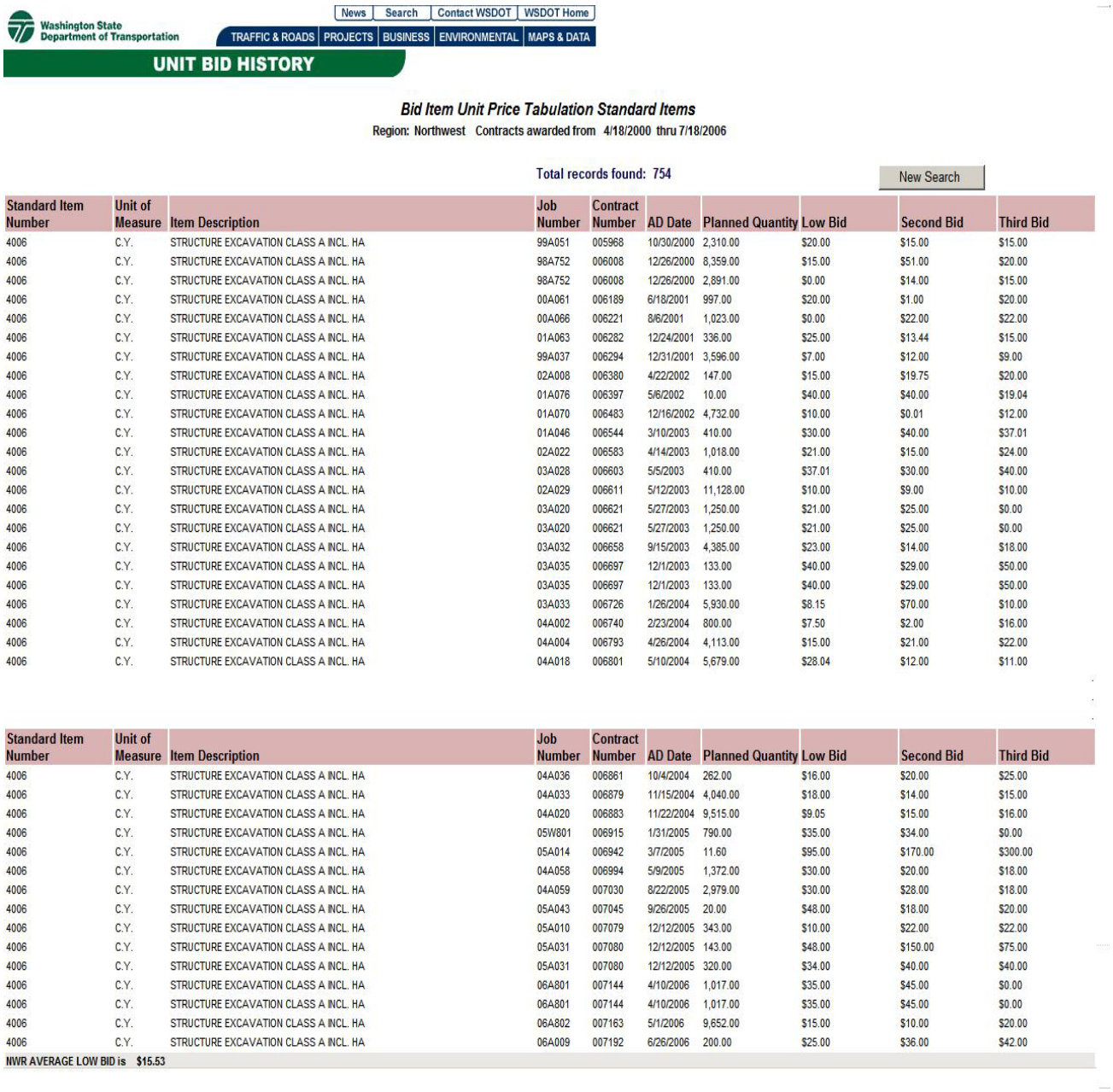


Figure 60. WSDOT Unit Bid Analysis.


Washington State Department of Transportation

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UNIT BID HISTORY

Bid Item Unit Price Tabulation Standard Items

Region: Northwest Contracts awarded from 4/18/2000 thru 7/18/2006

Total records found: 754

New Search

Standard Item Number	Unit of Measure	Item Description	Job Number	Contract Number	AD Date	Planned Quantity	Low Bid	Second Bid	Third Bid
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	99A051	005968	10/30/2000	2,310.00	$20.00	$15.00	$15.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	98A752	006008	12/26/2000	8,359.00	$15.00	$51.00	$20.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	98A752	006008	12/26/2000	2,891.00	$0.00	$14.00	$15.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	00A061	006189	6/18/2001	997.00	$20.00	$1.00	$20.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	00A066	006221	8/6/2001	1,023.00	$0.00	$22.00	$22.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	01A063	006282	12/24/2001	336.00	$25.00	$13.44	$15.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	99A037	006294	12/31/2001	3,596.00	$7.00	$12.00	$9.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	02A008	006380	4/22/2002	147.00	$15.00	$19.75	$20.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	01A076	006397	5/6/2002	10.00	$40.00	$40.00	$19.04
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	01A070	006483	12/16/2002	4,732.00	$10.00	$0.01	$12.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	01A046	006544	3/10/2003	410.00	$30.00	$40.00	$37.01
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	02A022	006583	4/14/2003	1,018.00	$21.00	$15.00	$24.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A028	006603	5/5/2003	410.00	$37.01	$30.00	$40.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	02A029	006611	5/12/2003	11,128.00	$10.00	$9.00	$10.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A020	006621	5/27/2003	1,250.00	$21.00	$25.00	$0.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A020	006621	5/27/2003	1,250.00	$21.00	$25.00	$0.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A032	006658	9/15/2003	4,385.00	$23.00	$14.00	$18.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A035	006697	12/1/2003	133.00	$40.00	$29.00	$50.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A035	006697	12/1/2003	133.00	$40.00	$29.00	$50.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	03A033	006726	1/26/2004	5,930.00	$8.15	$70.00	$10.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A002	006740	2/23/2004	800.00	$7.50	$2.00	$16.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A004	006793	4/26/2004	4,113.00	$15.00	$21.00	$22.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A018	006801	5/10/2004	5,679.00	$28.04	$12.00	$11.00

Standard Item Number	Unit of Measure	Item Description	Job Number	Contract Number	AD Date	Planned Quantity	Low Bid	Second Bid	Third Bid
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A036	006861	10/4/2004	262.00	$16.00	$20.00	$25.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A033	006879	11/15/2004	4,040.00	$18.00	$14.00	$15.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A020	006883	11/22/2004	9,515.00	$9.05	$15.00	$16.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	05W801	006915	1/31/2005	790.00	$35.00	$34.00	$0.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	05A014	006942	3/7/2005	11.60	$95.00	$170.00	$300.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A058	006994	5/9/2005	1,372.00	$30.00	$20.00	$18.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	04A059	007030	8/22/2005	2,979.00	$30.00	$28.00	$18.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	05A043	007045	9/26/2005	20.00	$48.00	$18.00	$20.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	05A010	007079	12/12/2005	343.00	$10.00	$22.00	$22.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	05A031	007080	12/12/2005	143.00	$48.00	$150.00	$75.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	05A031	007080	12/12/2005	320.00	$34.00	$40.00	$40.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	06A801	007144	4/10/2006	1,017.00	$35.00	$45.00	$0.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	06A801	007144	4/10/2006	1,017.00	$35.00	$45.00	$0.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	06A802	007163	5/1/2006	9,652.00	$15.00	$10.00	$20.00
4006	C.Y.	STRUCTURE EXCAVATION CLASS A INCL. HA	06A009	007192	6/26/2006	200.00	$25.00	$36.00	$42.00

NWR AVERAGE LOW BID is $15.53

Figure 61. Unit Bid Analysis - Inquiry Results.

WSDOT also uses Bid Tabs Pro, developed by Oman Systems, for accessing historical bid details. The database for this system is built using the historical data stored in EBASE. Unlike the Unit Bid Analysis system, Bid Tabs Pro lets the user generate historical reports based on different search criterions such as:

- By contractor
- By job

- By pay item
- Compare 2 con (contractors)
- PI (Pay Item) search
- Letting report
- Con (contractor) analysis
- Comp analysis
- Market analysis

The search by pay item option (see Figure 62) lets the estimator specify the number of bids to be included in the search (e.g., all bids, low bid, low two, or low three bids), the counties and regions, and the quantity range and the project size (in dollars). Figure 63 shows typical output for search requested based on input parameters of interest.

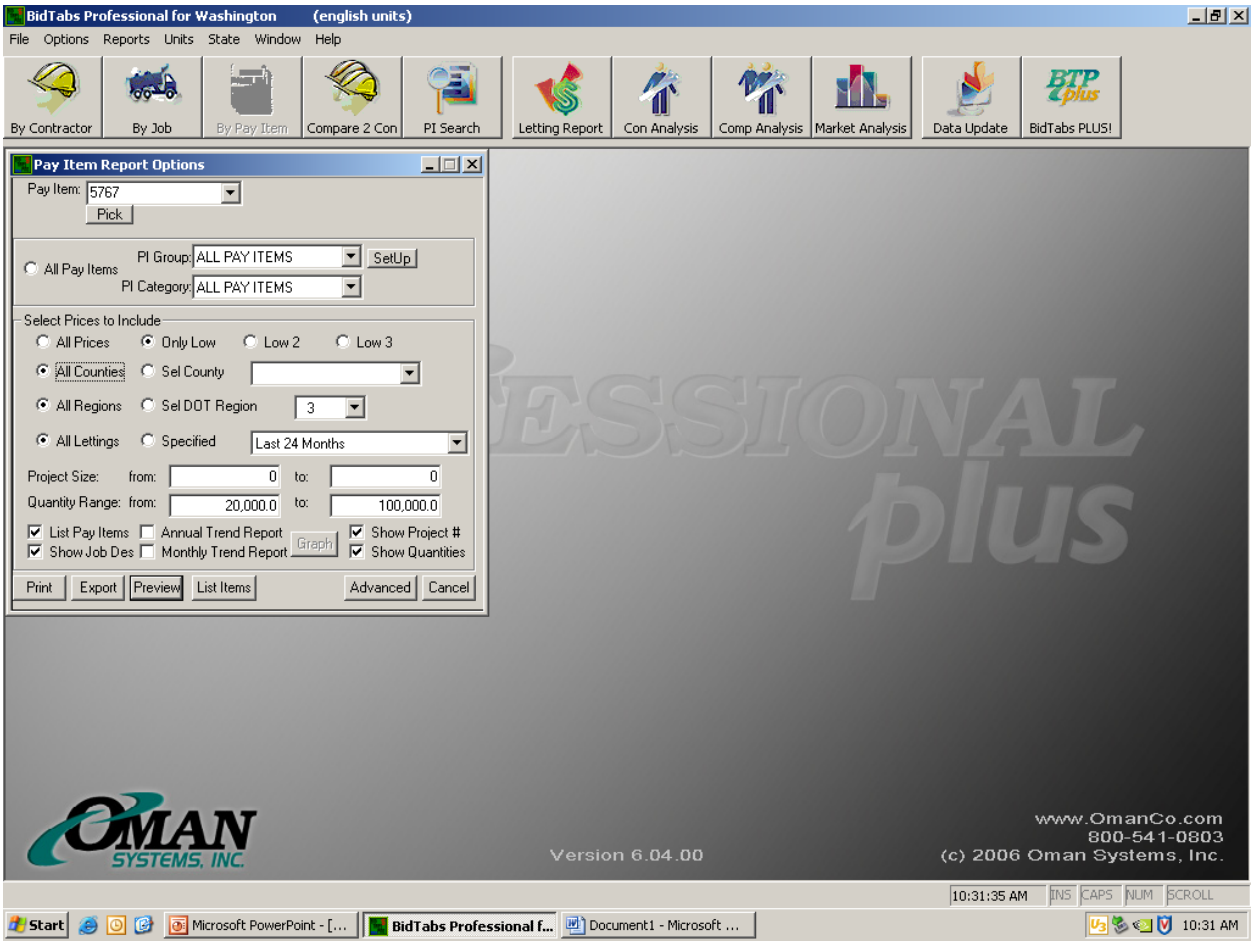


Figure 62. WSDOT Bid Tabs Pro - Search By Pay Item.

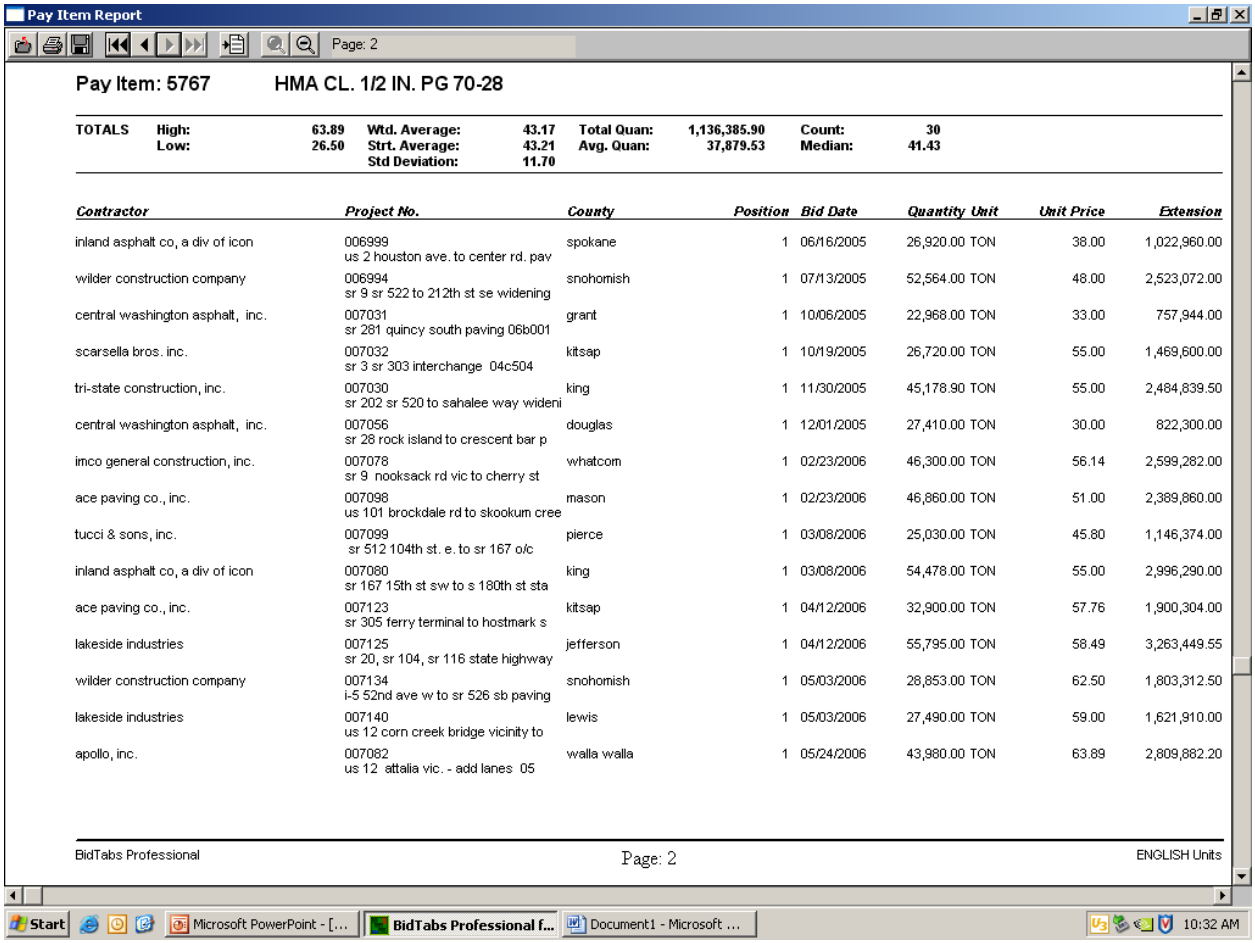


Figure 63. WSDOT Bid Tabs Pro - Search Results (By Pay Item).

Another search option uses the “By Job” criteria. The estimators can review all the bids or just the bid data for the low bidder based on a job number, as shown in Figure 64. The output of this search (see Figure 65) provides a list of line items used by the winning bidder for that particular job id.

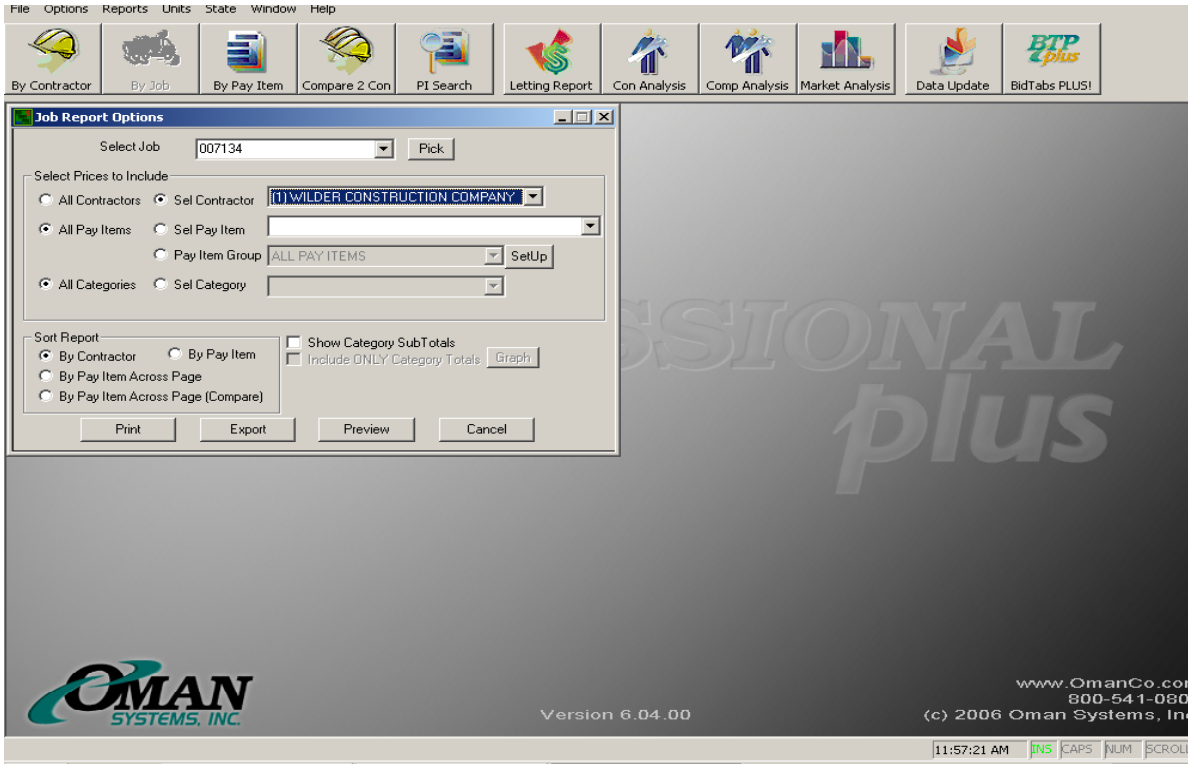
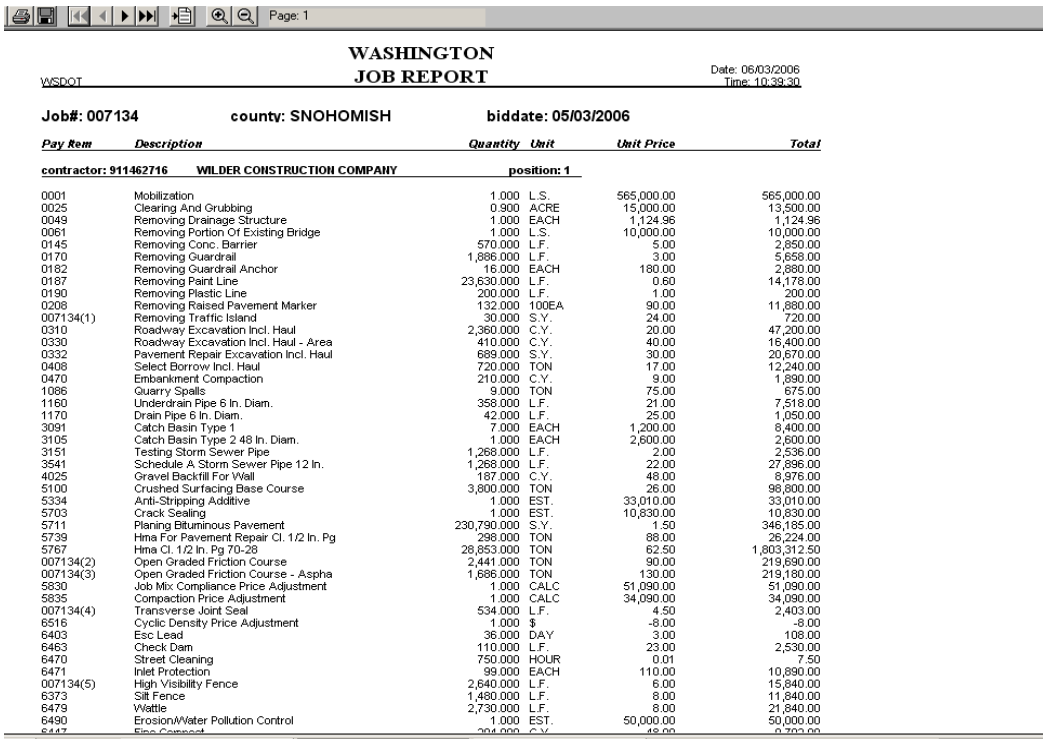


Figure 64. WSDOT Bid Tabs Pro - Search by Job.



WASHINGTON
JOB REPORT

WSDOT — Date: 06/03/2006 Time: 10:39:30

Job#: 007134 **county: SNOHOMISH** **biddate: 05/03/2006**

contractor: 911462716 WILDER CONSTRUCTION COMPANY **position: 1**

Pay Item	Description	Quantity	Unit	Unit Price	Total
0001	Mobilization	1.000	L.S.	565,000.00	565,000.00
0025	Clearing And Grubbing	0.900	ACRE	15,000.00	13,500.00
0049	Removing Drainage Structure	1.000	EACH	1,124.96	1,124.96
0061	Removing Portion Of Existing Bridge	1.000	L.S.	10,000.00	10,000.00
0145	Removing Conc. Barrier	570.000	L.F.	5.00	2,850.00
0170	Removing Guardrail	1,886.000	L.F.	3.00	5,658.00
0182	Removing Guardrail Anchor	16.000	EACH	180.00	2,880.00
0187	Removing Paint Line	23,630.000	L.F.	0.60	14,178.00
0190	Removing Plastic Line	200.000	L.F.	1.00	200.00
0208	Removing Raised Pavement Marker	132.000	100EA	90.00	11,880.00
007134(1)	Removing Traffic Island	30.000	S.Y.	24.00	720.00
0310	Roadway Excavation Incl. Haul	2,360.000	C.Y.	20.00	47,200.00
0330	Roadway Excavation Incl. Haul - Area	410.000	C.Y.	40.00	16,400.00
0332	Pavement Repair Excavation Incl. Haul	689.000	S.Y.	30.00	20,670.00
0408	Select Borrow Incl. Haul	720.000	TON	17.00	12,240.00
0470	Embankment Compaction	210.000	C.Y.	9.00	1,890.00
1086	Quarry Spalls	9.000	TON	75.00	675.00
1160	Underdrain Pipe 6 In. Diam.	358.000	L.F.	21.00	7,518.00
1170	Drain Pipe 6 In. Diam.	42.000	L.F.	25.00	1,050.00
3091	Catch Basin Type 1	7.000	EACH	1,200.00	8,400.00
3105	Catch Basin Type 2 48 In. Diam.	1.000	EACH	2,600.00	2,600.00
3151	Testing Storm Sewer Pipe	1,268.000	L.F.	2.00	2,536.00
3541	Schedule A Storm Sewer Pipe 12 In.	1,268.000	L.F.	22.00	27,896.00
4025	Gravel Backfill For Wall	187.000	C.Y.	48.00	8,976.00
5100	Crushed Surfacing Base Course	3,800.000	TON	26.00	98,800.00
5334	Anti-Stripping Additive	1.000	EST.	33,010.00	33,010.00
5703	Crack Sealing	1.000	EST.	10,830.00	10,830.00
5711	Planing Bituminous Pavement	230,790.000	S.Y.	1.50	346,185.00
5739	Hma For Pavement Repair Cl. 1/2 In. Pg	298.000	TON	88.00	26,224.00
5767	Hma Cl. 1/2 In. Pg 70-28	28,853.000	TON	62.50	1,803,312.50
007134(2)	Open Graded Friction Course	2,441.000	TON	90.00	219,690.00
007134(3)	Open Graded Friction Course - Aspha	1,686.000	TON	130.00	219,180.00
5830	Job Mix Compliance Price Adjustment	1.000	CALC	51,090.00	51,090.00
5835	Compaction Price Adjustment	1.000	CALC	34,090.00	34,090.00
007134(4)	Transverse Joint Seal	534.000	L.F.	4.50	2,403.00
6516	Cyclic Density Price Adjustment	1.000	$	-8.00	-8.00
6403	Esc Lead	36.000	DAY	3.00	108.00
6463	Check Dam	110.000	L.F.	23.00	2,530.00
6470	Street Cleaning	750.000	HOUR	0.01	7.50
6471	Inlet Protection	99.000	EACH	110.00	10,890.00
007134(5)	High Visibility Fence	2,640.000	L.F.	6.00	15,840.00
6373	Silt Fence	1,480.000	L.F.	8.00	11,840.00
6479	Wattle	2,730.000	L.F.	8.00	21,840.00
6490	Erosion/Water Pollution Control	1.000	EST.	50,000.00	50,000.00
6447	Fine Compost	204.000	C.Y.	48.00	9,792.00

Figure 65. WSDOT Bid Tabs Pro – Search Results (By Job).

4.7.1.5 Applying Unit Cost Information

WSDOT considers three to six months of historical data for establishing the unit prices, with Unit Bid Analysis and Bid Tabs Pro providing the estimators with the necessary historical prices for estimation. The estimating guideline of WSDOT identifies the important factors influencing the development of unit prices. Some of the important factors include:

- **Geographic Consideration** – The location of the project, urban or rural, distance from location of material sources affects the unit price accordingly.
- **Quantity Consideration** – Large quantities of a given material leads to lesser unit prices. Very large quantities of certain materials might lead to an increase in the unit prices.
- **Item Availability** – Readily available items cost less than materials that are in short supply.
- **Scheduling/ Lead Time** – Contractors schedule their resources to be more efficient and competitive in their bidding. As a result, the lead time should be considered when preparing the estimates based upon the time when it is to be actually built.
- **Difficult Construction/ Site Constraints** – Increases the construction cost for the contractor.
- **Estimating Lump Sum Items** – The contractors take on extra risk due to the use of lump sum items and as a result increase the unit price to counter the extra risk.

- **Force Account** – The contractors do not bid on force account items, as there is less incentive to reduce cost or perform the work diligently. When using force account items, the estimator should try to establish the scope of work to be performed.

- **Timing of Advertisement** – The timing of advertisement and fluctuations of bid prices due to different seasons affect the unit prices.

- **Expected Competition/ Contractor Availability** – Projects scheduled late in the year after the contractors have scheduled their work for the year increases the bid prices.

- **Specialty Work/ First Time Used** – Projects having first time used items or specialty works have to adjust for contractor's lack of experience with the item and the potential increased risk in construction.

The estimating guideline provides the estimators only with factors to be considered when establishing the unit prices, but the adjustment of unit costs is still largely based on engineering judgment and experience of the estimators.

5. TEXAS DEPARTMENT OF TRANSPORTATION

5.1 CONSTRUCTION UNIT COST INFORMATION

5.1.1 General Section

TxDOT uses the historical bid-based estimation technique to prepare cost estimates from the planning phase through the PS&E phase of project development. Preliminary estimates are prepared using Excel spreadsheet in all the three districts (Bryan, Dallas, and Fort Worth). Estimators update the same Excel spreadsheet until the design phase is reached. Fort Worth is the only district, of the three interviewed, using Trns*port Estimator to prepare estimates during the design phase. The Bryan district extensively uses the Trns*port Estimator to prepare Engineer's Estimate whereas in Dallas and Fort Worth, Estimator is used by the consultants to prepare the estimates. The Engineer's Estimates are updated into the Design and Construction Information System (DCIS) residing within their ROSCOE system. DCIS is a mainframe system used by TxDOT for managing the project estimates and permits changing the unit prices and quantities. ROSCOE then draws information from DCIS to generate the bid documents furnished to contractors. ROSCOE does this by listing primary bid items and their quantities. Figure 62 shows the estimation framework used within TxDOT, and Figure 67 shows the interaction between ROSCOE, DCIS, Trns*port Estimator, and the Excel spreadsheet.

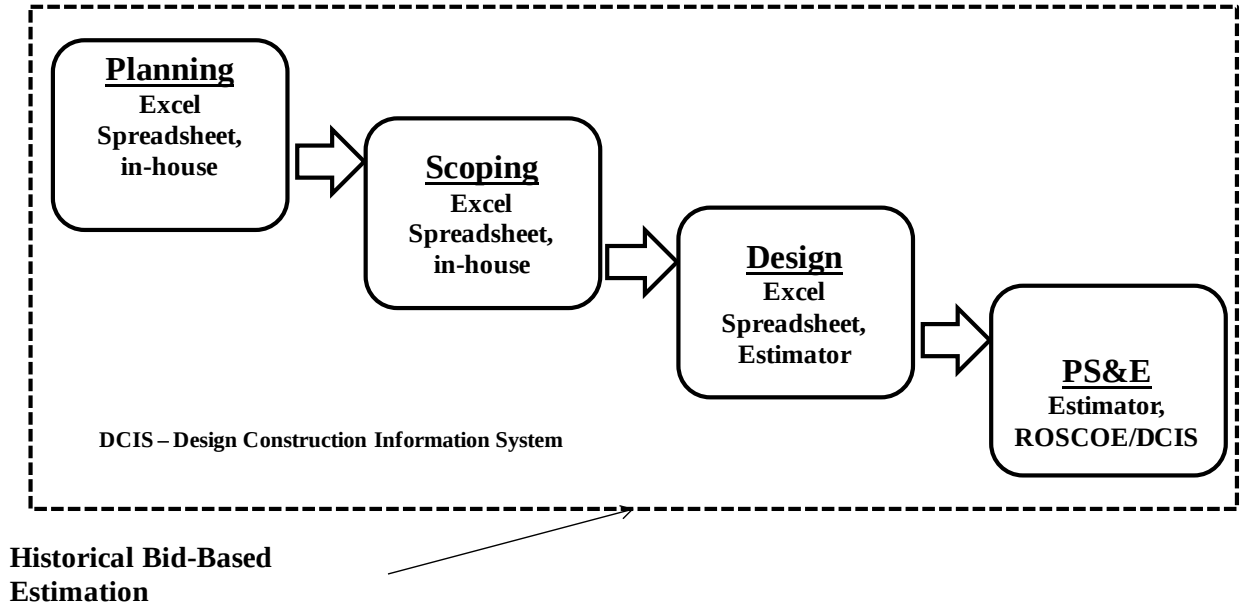


Figure 66. TxDOT Estimation Framework.

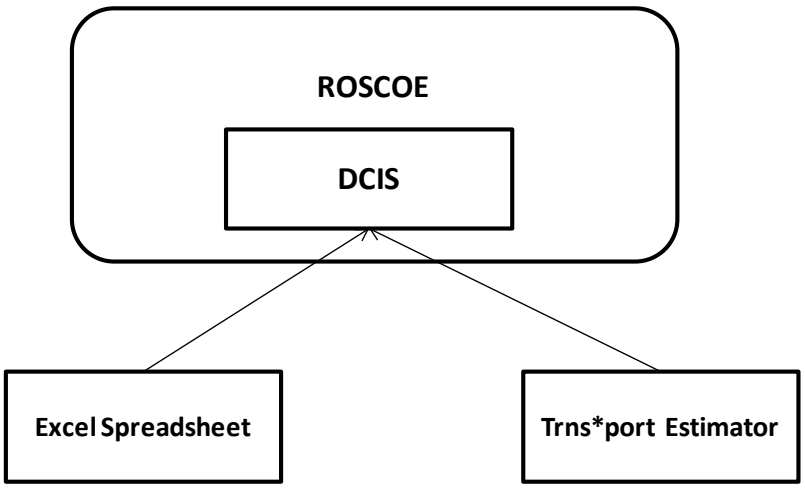


Figure 67. Interaction between DCIS, Estimator, and Excel Spreadsheet.

5.1.2 Acquiring Unit Cost Information

TxDOT uses DCIS to acquire all the bid details from the submitted low bids. The district offices use the average low bid information available on the TxDOT website in preparing the estimates. The three districts also review other bids to establish a range of prices used for each bid item. The unit costs can also be acquired from a Site Manager Spreadsheet available on their intranet (Crossroads). This spreadsheet provides the estimators with the current prices for each item of work along with their quantities for individual projects under construction.

The TxDOT website (http://www.dot.state.tx.us/services/design/estimator.htm) maintains the catalog of current historical unit prices, which is downloaded and used in Trns*port Estimator.

5.1.3 Storing Unit Cost Information

Historical unit costs are stored within DCIS. The database holds one month and twelve month moving averages available for each item of work. The historical unit costs are stored as standard construction line items, and averages are available for the entire state and for each district within TxDOT.

5.1.4 Accessing Unit Cost Information

Districts use the one-month and twelve-month moving average available on their website at http://www.txdot.gov/business/avgd.htm as a source of historical unit costs. The website maintains the statewide moving average as well as moving averages for each district. Unit costs are also available for maintenance projects, again sorted based on district and the entire state (see Figures 68 and 69). Estimators also use bid data from similar projects currently under construction or recently completed when arriving at the unit cost.

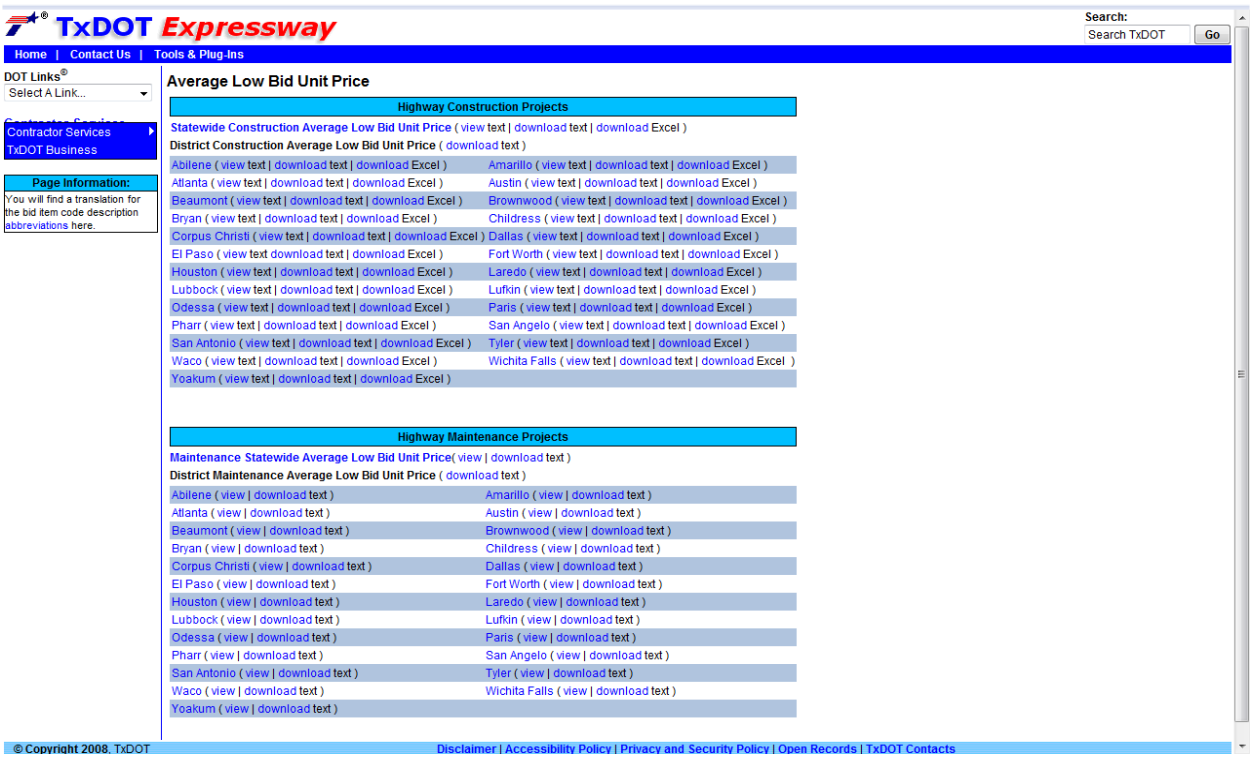


Figure 68. TxDOT Average Low Bid Unit Price.

COMPUTER SECTION — TEXAS DEPARTMENT OF TRANSPORTATION — D19-C

AVERAGE LOW BID UNIT PRICES BY DISTRICT — PAGE 1

DISTRICT 18

ITEM NO	DESCRIPTION	UNITS	JULY 31, 2008 QUANTITY	JULY 31, 2008 AVG BID	TWELVE-MONTH-MOVING QUANTITY	TWELVE-MONTH-MOVING AVG BID	TWELVE-MONTH-MOVING USAGE
100	SERIES						
100 2002	PREPARING ROW	STA	50.370	10.00000	2,127.860	12,860.47143	31
100 2003	PREPARING ROW(TREE)(5" TO 12" DIA)	EA			52.000	496.32385	2
104 2001	REMOVING CONC (PAV)	SY	2,717.000	6.00000	236,852.000	4.28109	18
104 2009	REMOVING CONC (RIPRAP)	SY	13.000	20.00000	4,475.500	9.52736	12
104 2011	REMOVING CONC (MEDIANS)	SY	437.060	6.00000	5,876.060	7.34767	9
104 2013	REMOVING CONC (FOUNDATIONS)	SY			611.000	12.54000	1
104 2015	REMOVING CONC (SIDEWALKS)	SY			6,590.670	6.72529	10
104 2017	REMOVING CONC (DRIVEWAYS)	SY	675.000	6.00000	22,204.740	7.49155	16
104 2021	REMOVING CONC (CURB)	LF			41,378.440	2.12157	10
104 2022	REMOVING CONC (CURB AND GUTTER)	LF			8,986.000	6.29114	4
104 2023	REMOVING CONC (CTB)	LF			1,106.000	10.14738	2
104 2024	REMOVING CONC (RETAINING WALLS)	SY			542.000	42.70849	3
104 2025	REMOVE CONC (WINGWALL)	CY			70.000	84.15000	1
104 2027	REMOVING CONC (APPR SLAB)	SY			360.000	8.00000	1
104 2028	REMOVING CONC (MISC)	SY			1,142.000	14.22329	4
104 2029	REMOVING CONC (CURB OR CURB & GUTTER)	LF			11.000	30.00000	1
104 2036	REMOVING CONC (SIDEWALK OR RAMP)	SY			1,042.400	6.50000	1
104 2037	REMOVE CONC (RAIL)	LF			385.000	18.51532	3
104 2040	REMOVING CONC (PAVERS)	SY			193.000	12.00000	1
105 2002	REMOVING STAB BASE AND ASPH PAV (2")	SY			4,395.000	3.59983	2
105 2008	REMOVING STAB BASE AND ASPH PAV (6")	SY			4,498.000	4.77679	4
105 2011	REMOVING STAB BASE AND ASPH PAV (2"-6"	SY			189,471.000	2.93451	4
105 2013	REMOVING STAB BASE & ASPH PAV (9")	SY			820.000	4.00000	1
105 2014	REMOVING STAB BASE & ASPH PAV (7"-12")	SY			28,837.000	2.82108	3
105 2015	REMOVING STAB BASE & ASPH PAV (8"-10")	SY	5,762.000	4.00000	50,669.000	3.90367	8
105 2021	REMOVING STAB BASE AND ASPH PAV (0-4")	SY			398.300	7.00000	1
105 2045	REMOVING STAB BASE AND ASPH PAV (2"-8"	SY			1,822.000	3.00000	1
105 2046	REMOVING STAB BASE & ASPH PAV (0"-10")	SY			2,642.000	3.34000	1
105 2052	REMOVE STAB BASE & ASPH PAV (4"-5")	SY			99,924.000	1.31000	1
105 2055	REMOVING STAB BASE AND ASPH PAV(9"-14"	SY	337.430	15.49999	18,599.430	5.68142	2
105 2059	REMOVING STAB BASE & ASPH PAV(13"-18")	SY	3,212.850	7.50000	42,957.850	5.64958	2
106 2001	OBLITERATING ABANDONED ROAD	STA	17.590	200.00000	24.500	574.36816	3
110 2001	EXCAVATION (ROADWAY)	CY	50,819.950	5.00000	797,696.700	5.66957	32
110 2002	EXCAVATION (CHANNEL)	CY			32,068.000	8.51726	10
112 2001	SUBGRADE WIDENING (ORD COMP)	STA			21.700	798.52304	2
132 2005	EMBANKMENT (FINAL)(ORD COMP)(TY C)	CY			1,935.000	21.33282	4
132 2006	EMBANKMENT (FINAL)(DENS CONT)(TY C)	CY			1,334,439.600	8.20882	25
132 2008	EMBANKMENT (FINAL)(DENS CONT)(TY D)	CY			60,703.000	1.00000	1
132 2025	EMBANKMENT (FINAL) (DENS CONT) (TY C1)	CY	3,933.280	5.00000	296,888.280	5.66757	3
132 2026	EMBANKMENT (FINAL) (DENS CONT) (TY C2)	CY	12,333.930	10.00000	507,794.930	5.13657	3
134 2001	BACKFILL (TY A)	STA			292.710	280.46394	3
134 2002	BACKFILL (TY B)	STA			320.210	104.32794	3

Figure 69. TxDOT Average Low Bid Unit Prices for Dallas.

Estimators at the central office in Austin use a Site Manager spreadsheet to gather the latest unit prices on active projects. District estimators can use this spreadsheet to compare unit prices derived from other sources. The spreadsheet titled '***Item Search by Nbr Desc or SupplDesc***' is available under the Contract Administration section within Crossroads. Estimators are given an option to search items of work based on item number, description, and supplemental description. Figures 70, 71, and 72 provide the results for the three search options. Knowledge of this spreadsheet is not widely known within TxDOT.

SiteManager Item Search by Description — Report Date: 09/19/2008

Description Queried: FLEX BASE

District	Area Office No.	County	CSJ	Project No.	Contract No.	Letting Date	Cont Status	Spec Yr	Line No.	Item Code	SP	Item Description	Orig Bid Qty	CO Item QTY	Total Bid QTY (N+O)	Bid Price	Qty Installed to Date	% PCT (R/P*100)	UOM
WICHITA FALLS	051	COOKE	004501049	NH 2005(138)	01063020	20050111	CMPL	1993	0090	01340507	000	BACKFILL (TY A)(FLEX BASE)	3.00	0.000	3.00	$ 1,000.00	0.000	0.000	STA
HOUSTON	061	FORT BEND	018802037	NH 2004(399)	05043224	20040512	ACTV	1993	0125	01340507	000	BACKFILL (TY A)(FLEX BASE)	322.00	0.000	322.00	$ 100.00	322.000	100.000	STA
HOUSTON	061	FORT BEND	054303057	CPM 543-3-57	01043208	20040109	ACTV	1993	0065	01340507	000	BACKFILL (TY A)(FLEX BASE)	688.00	(688.000)	0.00	$ 110.00	0.000	0.000	STA
HOUSTON	061	FORT BEND	141502036	STP 2004(706)	09043224	20040910	ACTV	1993	0085	01340507	000	BACKFILL (TY A)(FLEX BASE)	2.24	0.000	2.24	$ 1,350.00	0.000	0.000	STA
HOUSTON	061	FORT BEND	168301031	STP 2004(89)	12033015	20031204	ACTV	1993	0095	01340507	000	BACKFILL (TY A)(FLEX BASE)	61.99	0.000	61.99	$ 125.00	61.990	100.000	STA
HOUSTON	061	FORT BEND	168506027	STP 2004(186)	01043021	20040108	ACTV	1993	0110	01340507	000	BACKFILL (TY A)(FLEX BASE)	60.00	(60.000)	0.00	$ 162.30	0.000	0.000	STA
HOUSTON	061	FORT BEND	168506027	STP 2004(186)	01043021	20040108	ACTV	1993	0111	01340507		BACKFILL (TY A)(FLEX BASE)	0.00	242.000	242.00	$ 296.59	242.000	100.000	STA
HOUSTON	061	FORT BEND	196502006	STP 2004(735)	10043208	20041015	ACTV	1993	0100	01340507	000	BACKFILL (TY A)(FLEX BASE)	4.84	0.000	4.84	$ 725.00	4.840	100.000	STA
BRYAN	053	ROBERTSON	004906072	CPM 49-6-72	10043227	20041015	ACTV	1993	0080	01340507	000	BACKFILL (TY A)(FLEX BASE)	55.68	0.000	55.68	$ 320.00	55.680	100.000	STA
PHARR	053	HIDALGO	086501066	STP 2004(176)MI	01043010	20040108	ACTV	1995	0115	02475241	009	FLEX BASE (RDWY DEL)(TY D GR	9,826.50	0.000	9,826.50	$ 17.87	9,826.500	100.000	M3
PHARR	053	HIDALGO	086501083	STP 2004(512)MI	10043204	20041015	ACTV	1995	0130	02475241	009	FLEX BASE (RDWY DEL)(TY D GR	14,336.00	0.000	14,336.00	$ 20.50	12,912.289	90.069	M3
LUFKIN	053	ANGELINA	116501022	STP 2008(671)HS	06083018	20080610	ACTV	2004	0125	04002010	004	CUT & RESTORING PAV (FLEX BA	228.00	0.000	228.00	$ 20.00	168.000	73.684	SY
YOAKUM	057	AUSTIN	024001021	BR 2009(044)	09083005	20080909	PEND	2004	0690	04002010	004	CUT & RESTORING PAV (FLEX BA	31.00	0.000	31.00	$ 85.00	0.000	0.000	SY
YOAKUM	057	AUSTIN	027108016	STP 2008(432)	03083219	20080305	ACTV	2004	0175	04002010	004	CUT & RESTORING PAV (FLEX BA	104.00	0.000	104.00	$ 34.00	121.000	116.346	SY
AUSTIN	050	CALDWELL	011503022	STP 2008(474)	04083226	20080409	ACTV	2004	0105	04002010	000	CUT & RESTORING PAV (FLEX BA	177.00	0.000	177.00	$ 26.00	0.000	0.000	SY
DALLAS	059	ELLIS	104801020	SFT 1048-1-20	06083032	20060608	ACTV	2004	0167	04002010		CUT & RESTORING PAV (FLEX BA	0.00	177.300	177.30	$ 34.00	177.300	100.000	SY
YOAKUM	058	GONZALES	021604011	SFT 216-4-11	08083252	20060809	ACTV	2004	0070	04002010	004	CUT & RESTORING PAV (FLEX BA	134.70	0.000	134.70	$ 85.00	134.700	100.000	SY
YOAKUM	058	GONZALES	021604011	SFT 216-4-11	08083252	20060809	ACTV	2004	0605	04002010	004	CUT & RESTORING PAV (FLEX BA	242.00	0.000	242.00	$ 85.00	168.000	69.421	SY
LUFKIN	053	HOUSTON	235701010	STP 2007(773)HS	08073034	20070807	ACTV	2004	0095	04002010	004	CUT & RESTORING PAV (FLEX BA	41.00	0.000	41.00	$ 55.00	41.000	100.000	SY
LUFKIN	054	NACOGDOCHE	181002019	STP 2007(409)SE	04073028	20070410	ACTV	2004	0155	04002010	000	CUT & RESTORING PAV (FLEX BA	229.00	0.000	229.00	$ 24.00	400.700	174.978	SY
LUFKIN	054	NACOGDOCHE	230001017	STP 2008(841)HS	08083020	20080807	ACTV	2004	0120	04002010	004	CUT & RESTORING PAV (FLEX BA	426.00	0.000	426.00	$ 20.00	0.000	0.000	SY
LUFKIN	055	SAN AUGUSTIN	039005005	STP 2007(103)HS	12063224	20061206	ACTV	2004	0115	04002010	004	CUT & RESTORING PAV (FLEX BA	139.00	0.000	139.00	$ 28.00	201.890	145.245	SY
LUFKIN	054	SHELBY	017504075	STP 2007(712)HS	07073235	20070711	ACTV	2004	0110	04002010	004	CUT & RESTORING PAV (FLEX BA	45.00	0.000	45.00	$ 50.00	86.500	192.222	SY

Figure 70. TxDOT Item Search by Description - Site Manager Spreadsheet.

SiteManager Item Search by Number

Date Report: 09/19/2008

Item Nbr Queried: 03162399

District	Area Office No.	County	CSJ	Project No.	Contract No.	Letting Date	Cont Status	Spec Yr	Line No.	Item Code	SP	Item Description	Orig Bid Qty	CO Item QTY	Total Bid QTY (N+O)	Bid Price	Qty Installed to Date	% PCT (R/P*100)	UOM
ABILENE	051	TAYLOR	000606090	IM 0202(221)	07073017	20070710	ACTV	2004	0100	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	47,170.000	0.000	47,170.000	$ 2.65	47,705.000	101.13	GAL
ABILENE	051	TAYLOR	000618044	HP 2007(669)	07073203	20070711	ACTV	2004	0195	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	32,154.000	0.000	32,154.000	$ 3.00	540.000	1.68	GAL
ABILENE	051	TAYLOR	003401118	STP 2007(752)	08073220	20070808	ACTV	2004	0095	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	8,696.000	0.000	8,696.000	$ 3.50	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	0135	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,676.000	0.000	1,676.000	$ 3.75	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	0670	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,894.000	0.000	1,894.000	$ 3.75	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	1175	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,842.000	0.000	1,842.000	$ 3.75	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	1690	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,717.000	0.000	1,717.000	$ 3.75	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	2240	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,581.000	0.000	1,581.000	$ 3.75	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	2840	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,598.000	0.000	1,598.000	$ 3.75	0.000	0.00	GAL
ABILENE	051	TAYLOR	005401022	BR 2008(467)	02083204	20080208	ACTV	2004	3410	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	1,600.000	0.000	1,600.000	$ 3.75	0.000	0.00	GAL
AUSTIN	050	BASTROP	026513004	BR 2007(627)	06073205	20070608	ACTV	2004	0145	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	2,274.000	0.000	2,274.000	$ 5.00	0.000	0.00	GAL
AUSTIN	050	BASTROP	114902017	BR 2008(816)	08083220	20080808	ACTV	2004	0105	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	5,756.000	0.000	5,756.000	$ 5.20	0.000	0.00	GAL
AUSTIN	050	LEE	021102022	BR 2007(671)	07073227	20070711	ACTV	2004	0125	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	26,762.000	0.000	26,762.000	$ 3.00	4,362.000	16.30	GAL
AUSTIN	050	LEE	047302031	STP 2007(787)HS	08073222	20070808	ACTV	2004	0110	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	30,376.000	0.000	30,376.000	$ 3.20	28,695.000	94.47	GAL
AUSTIN	050	LEE	047302031	STP 2007(787)HS	08073222	20070808	ACTV	2004	0535	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	5,274.000	0.000	5,274.000	$ 3.20	4,700.000	89.12	GAL
BRYAN	050	BRAZOS	054004061	STP 2009(016)	09083207	20080910	PEND	2004	0070	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	14,059.000	0.000	14,059.000	$ 4.70	0.000	0.00	GAL
BRYAN	051	BRAZOS	011701041	NH 2008(252)	12073223	20071205	ACTV	2004	0120	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	8,323.000	(1,247.000)	7,076.000	$ 2.37	8,000.000	113.06	GAL
BRYAN	051	BRAZOS	054004044	STP 2006(593)	06083001	20080610	ACTV	2004	0310	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	54,971.000	0.000	54,971.000	$ 3.40	0.000	0.00	GAL
BRYAN	051	BRAZOS	239901022	STP 2008(683)RG	09083001	20080909	PEND	2004	1010	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	10,672.000	0.000	10,672.000	$ 5.20	0.000	0.00	GAL
BRYAN	054	LEON	033503040	STP 2008(287)	01083023	20080108	ACTV	2004	0175	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	25,654.000	0.000	25,654.000	$ 2.85	4,150.000	16.18	GAL
BRYAN	053	ROBERTSON	004908053	BR 2009(014)	09083203	20080910	PEND	2004	0120	03162399	000	ASPH (AC-20-5TR OR AC-12-5TR)	4,845.000	0.000	4,845.000	$ 4.60	0.000	0.00	GAL

Figure 71. TxDOT Item Search by Number - Site Manager Spreadsheet.

SiteManager Item Search by Description

Report Date: 09/19/2008

Description Queried: COMPU

Tip: Enter description using UPPER CASE, lower case, and Sentence Case for a complete search. Only one entry may be made at a time.

District	Area Office No.	County	CSJ	Project No.	Contract No.	Letting Date	Cont Status	Spec Yr	Line No.	Item Code	SP	Item Description	Supplemental Description 1	Orig Bid Qty	CO Item QTY	Total Bid QTY (N+O)	Bid Price	Qty Installed to Date	% PCT ($/Q*100)
EL PASO	051	HUDSPETH	000205039	IM 10-1(226)	01003002	20000104	ACTV	1995	5769	54095001		COMPUTER EQUIP (DESKTO	CONTRACTOR INSTALLATIO	0.00	1.000	1.00	$ 6,890.87	1.000	100.000
EL PASO	051	HUDSPETH	000207038	MG 2001(188)	01013002	20010103	CMPL	1995	5769	54095001		COMPUTER EQUIP (DESKTO	INSTALLATION OF COMPUTE	0.00	1.000	1.00	$ 7,289.87	1.000	100.000
EL PASO	051	HUDSPETH	000205039	IM 10-1(226)	01003002	20000104	ACTV	1995	5770	54095002		COMPUTER EQUIP (PRINTER	CONTRACTOR INSTALLATIO	0.00	1.000	1.00	$ 948.98	1.000	100.000
EL PASO	051	HUDSPETH	000207038	MG 2001(188)	01013002	20010103	CMPL	1995	5770	54095002		COMPUTER EQUIP (PRINTER	INSTALLATION OF PRINTER	0.00	1.000	1.00	$ 948.98	1.000	100.000
EL PASO	052	EL PASO	092406245	C 924-6-245	12043012	20041207	ACTV	1993	0400	96040501	000	CONTRACTOR FORCE ACCO	COMPUTER EQUIPMENT	1,000.00	0.000	1,000.00	$ 1.00	0.000	0.000
EL PASO	051	EL PASO	092406257	ITS 2004(802)	12053011	20051201	ACTV	2004	0200	96062001	000	FORCE ACCOUNT ID 1	EL PASO-COMPUTER EQUIPI	8,610.00	0.000	8,610.00	$ 1.00	0.000	0.000
EL PASO	051	EL PASO	092406257	ITS 2004(802)	12053011	20051201	ACTV	2004	0460	96062002	000	FORCE ACCOUNT ID 2	ODESSA COMPUTER EQUIPN	8,610.00	0.000	8,610.00	$ 1.00	0.000	0.000
AUSTIN	050	CALDWELL	091422044	BR 2001(830)	11023225	20021108	CMPL	1993	0335	96080501		UNIQUE CHANGE ORDER ITI	COMPUTER & PRINTER RENT	0.00	4.000	4.00	$ 25.00	4.000	100.000
AMARILLO	050	POTTER	004201027	NH 2004(12)	11033204	20031105	ACTV	1993	0405	96080501		UNIQUE CHANGE ORDER ITI	COMPUTER, PHONE & SUPP	0.00	1.000	1.00	$ 2,784.00	1.000	100.000
AMARILLO	050	POTTER	263504014	STP 2002(763)	10033209	20031009	ACTV	1993	0666	96080501		UNIQUE CHANGE ORDER ITI	ADDITION OF COMPUTER, PC	0.00	1.000	1.00	$ 1,921.65	1.000	100.000
BEAUMONT	053	NEWTON	030502038	MG 2001(254)	02013067	20010207	CMPL	1993	0960	96080503		UNIQUE CHANGE ORDER ITI	COMPUTER EQUIPMENT FOR	0.00	1.000	1.00	$ 1,972.55	1.000	100.000
SAN ANTONIO	055	WILSON	014303024	NH 2000(456)	06003059	20000607	CMPL	1993	0645	96080508		UNIQUE CHANGE ORDER ITI	COMPUTER & SET UP	0.00	1.000	1.00	$ 2,960.99	0.000	0.000
SAN ANTONIO	055	WILSON	014303024	NH 2000(456)	06003059	20000607	CMPL	1993	645	96080509		UNIQUE CHANGE ORDER ITI	COMPUTER PRINTER	0.00	1.000	1.00	$ 276.12	0.000	0.000
SAN ANTONIO	055	WILSON	014303024	NH 2000(456)	06003059	20000607	CMPL	1993	0647	96080510		UNIQUE CHANGE ORDER ITI	COMPUTER SOFTWARE	0.00	1.000	1.00	$ 1,057.20	0.000	0.000
FORT WORTH	054	TARRANT	017201035	NH 2002(36)	08023006	20020806	CMPL	1993	1035	96080514		UNIQUE CHANGE ORDER ITI	PURCHASE & SETUP OF ITEI	0.00	1.000	1.00	$ 294.26	1.000	100.000
AUSTIN	098	TRAVIS	313601138	TTA 2005(103)	10043401	20041015	ACTV	1993	0076	96080514	000	UNIQUE CHANGE ORDER ITI	CO #13 MODIFICATION TO HV	0.00	1.000	1.00	$ 28,606.30	1.000	100.000
SAN ANTONIO	058	BEXAR	052104190	NH 2005(136)	01053201	20050112	ACTV	1993	1467	96080526		UNIQUE CHANGE ORDER ITI	COMPUTER ROOM TERMINA	0.00	2.000	2.00	$ 1,368.68	2.000	100.000
AUSTIN	051	BURNET	137603025	STP 2005(896)	08063207	20060809	ACTV	2004	0725	96082001		UNIQUE CHANGE ORDER ITI	LAPTOP COMPUTER W/WIRE	0.00	1.000	1.00	$ 1,557.15	1.000	100.000
LUBBOCK	053	LAMB	005205037	NH 2007(012)	10063002	20061004	ACTV	2004	0912	96082001	000	UNIQUE CHANGE ORDER ITI	WIRELESS INTERNET SERVI	0.00	1,000.000	1,000.00	$ 1.00	672.000	67.200
AMARILLO	050	POTTER	027501139	IM 0401(189)	12053006	20051201	ACTV	2004	0246	96082001		UNIQUE CHANGE ORDER ITI	COMPUTER, PRINTER & SUP	0.00	1.000	1.00	$ 2,350.00	1.000	100.000
FORT WORTH	056	SOMERVELL	025903042	BR 2005(305)	04053003	20050407	ACTV	2004	0541	96082001		UNIQUE CHANGE ORDER ITI	LAPTOP COMPUTER	0.00	1,400.000	1,400.00	$ 1.00	1,658.850	118.489
DALLAS	051	DALLAS	009510042	STP 2006(095)N	05063029	20060509	ACTV	2004	0697	96082009		UNIQUE CHANGE ORDER ITI	DESKTOP COMPUTER-LS	0.00	1.000	1.00	$ 1,056.54	1.000	100.000

Figure 72. TxDOT Item Search by Supplemental Description - Site Manager Spreadsheet.

Using the filter option available within Excel, users can change the search results to suit their requirements. For example, the estimator is estimating the unit price of 200 square yards of Flex Base. By searching for Flex Base in this Excel spreadsheet (either by Item Number or Description search) and setting the filter on 'Total Bid Qty' column to show only quantities within a certain range of 200 square yards, the estimator can check unit prices against current price (see Figure 70).

In addition to using one-month and twelve-month moving averages, estimators also look at the bid tabulation details for all the projects (See Figure 73). This helps the estimator assess the price used by four low bidders for the project and identify the range of bids submitted by the

contractors. Bid tabulations and bid totals are maintained under Contract Letting section within the Construction Division (http://www.dot.state.tx.us/business/bt.htm). Bid information is divided into construction, maintenance and local let projects. Figure 73 shows sample bid tabulation from a recently let construction project.

TxDOT Expressway

Search TxDC

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Tabulation of Bids for Project STP 2008(683)RGS

Last Update: Tuesday, September 9, 2008

Text version of this page

County: BRAZOS
Type: CONST RAILROAD GRADE SEPARATION STR
Time: 413 WORKING DAYS
Highway: FM 2818
Length: 5.646
Limits:
From: AT UPRR IN COLLEGE STATION
To: DOT NO. 743219D

Let Date: 09/09/08
Seq No: 3001
Project ID: STP 2008(683)RGS
Contract #: 09083001
CCSJ: 2399-01-022
Check: $100,000.00
Misc Cost: $327,916.00

Estimate	$23,268,621.45	% Over/Under	Company
Bidder 1	$20,854,415.32	-10.38%	KNIFE RIVER CORPORATION - SOUTH
Bidder 2	$22,784,360.69	-2.08%	W.W. WEBBER, LLC
Bidder 3	$25,931,271.22	+11.44%	BIG CREEK CONSTRUCTION, LTD.
Bidder 4	$26,751,463.02	+14.97%	A. L. HELMCAMP, INC.

Item Code	Description	Unit	Quantity	Unit Est.	Bidder	Unit Bid
1002002002	PREPARING ROW	STA	88.800	3000.00	1 2 3 4	2500.000 1918.000 5000.000 4000.000
1042011	REMOVING CONC (MEDIANS)	SY	198.000	45.00	1 2 3 4	15.000 12.000 10.000 30.000
1042022	REMOVING CONC (CURB AND GUTTER)	LF	2429.000	7.00	1 2 3 4	2.800 5.000 10.000 10.000
1052008	REMOVING STAB BASE AND ASPH PAV (6")	SY	9144.000	5.00	1 2 3 4	3.000 4.000 2.640 5.000
1052058	REMOVING STAB BASE & ASPH PAV (10" - 12"	SY	2286.000	7.00	1 2 3 4	3.600 5.000 7.930 9.000
1102001	EXCAVATION (ROADWAY)	CY	141136.000	5.50	1 2 3 4	0.000 0.000 3.000 6.000
1322004	EMBANKMENT (FINAL) (DENS	CY	187971.000	8.00	1	0.000

Figure 73. TxDOT Bid Tabulations.

5.1.5 Applying Unit Cost Information

TxDOT uses one-month and twelve-month moving averages based on low bids for establishing unit prices. Sometimes a three-month moving average is also considered for greater understanding of the prices. The use of twelve-month moving averages evens out the effect of using only the low bid. Weighted moving averages, used in determining the unit prices, are preferred over simple averages since they take into consideration the effect of quantities when arriving at the unit price. Some of the important factors influencing the unit prices are location of the project and quantity. Though there is no process guidance on how to adjust unit prices for quantities, a general rule of thumb often followed is the higher the quantity, the lower would be the unit price, but up until a point. Cost estimates are updated on a yearly basis. For example, if

four percent annual inflation is considered and the project is five years away from letting, then add 20 percent inflation to the estimates. For items having no historical data or that are unique to a project, prices are established by contacting suppliers and contractors, looking at the statewide and maintenance averages or by contacting adjoining districts. Estimators prefer not to refer to the catalog unit prices for hot mix asphalt, cement, and steel because of their high volatility in recent times. Adjustments to unit prices are completely based on the experience and engineering judgment of the estimators. In its PS&E Preparation manual, TxDOT maintains a list of factors to be considered when adjusting unit bid prices but does not provide the quantitative factors to be used when making the adjustments. Following are the factors outlined in the manual to be considered when adjusting unit prices:

- Project size
- Project location
- Traffic conditions
- Construction season
- Accessibility
- Restrictive conditions
- Availability of materials
- Specifications
- Construction time
- Plan clarity
- Bidder competition

5.2 SIMILARITIES AND DIFFERENCES

The research team compared the responses to the interviews from the seven state agencies to the replies from the three TxDOT districts to identify similarities and differences in the development of unit prices for cost estimating. The comparison is based on replies received for the five sections of the survey, namely the general section, acquiring unit cost, storing unit cost, accessing unit cost, and applying unit cost information sections.

5.2.1 General

The following were the similarities and differences observed from the replies received for the general section of the surveys and interviews.

- TxDOT, similar to UDOT, NYSDOT, FDOT and Caltrans, uses historical bid-based estimating until the final phase of the project development. The only exceptions are VDOT and MnDOT, which use cost-based estimating for preparing their final engineers estimate.
- The three districts interviewed within TxDOT rely on Excel spreadsheets for developing estimates in the planning and scoping phase and some in the design phase. This is similar in approach to MnDOT and NYSDOT.
- TxDOT, VDOT and NYSDOT use the commercial Estimator software of Trns*port system for preparing the final Engineer's Estimate. VDOT, FDOT and NYSDOT also use a commercial software system (Trns*port CES) for preparing their final estimates.
- UDOT (PDBS) and WSDOT (EBASE) are the only agencies, among the SHAs interviewed, with an in-house developed system to prepare the Engineer's Estimates.
- TxDOT, similar to VDOT, UDOT and WSDOT, maintains a list of factors to be considered when adjusting unit prices. But unlike them, TxDOT does not maintain any guidance on estimating procedure to be followed in different project development phases.
- Among the agencies using bid-based estimating, FDOT and NYSDOT are considering the use of cost based approach for estimating major items of work.

5.2.2 Acquiring and Accessing Unit Cost Information

The similarities and differences in the replies received for acquiring and accessing unit cost information section are as follows:

- TxDOT captures only the low bid information (internet), though the districts tend to look at all the bids while preparing the estimates. Similarly, VDOT and Caltrans also capture low bid information to determine the average low bidders for entire state and districts.
- Unlike TxDOT, Caltrans acquires information from all bidders and VDOT from the three low bids as well.
- Other agencies acquiring all the bids are MnDOT, FDOT, WSDOT and UDOT.
- Similar to VDOT, NYSDOT uses the three low bids for determining the unit costs.

5.2.3 Storing Unit Cost Information

The replies received for the storing unit cost information section showed the following similarities and differences:

- TxDOT (DCIS) like UDOT (PDBS) and Caltrans (BEES), uses an in-house system for storing historical bid details, while the remaining agencies rely on commercial BAMS/DSS for storing bid histories.
- All agencies, including TxDOT, have historical unit costs available based on statewide, districts, and counties. FDOT and Caltrans are the only two agencies with bid data for market areas as well.
- Similar to TxDOT, all agencies use standard construction line items as the preferred form for storing historical unit costs. But VDOT, Caltrans, and NYSDOT store these data by work categories and project types as well.

5.2.4 Applying Unit Cost Information

The similarities and differences in the replies received for applying unit cost information section are as follows:

- TxDOT uses only a one-month and a twelve-month weighted moving average for establishing unit prices. UDOT is the only other agency, similar to TxDOT, using a weighted moving average for durations of one quarter and one year. UDOT also uses seven to twelve months of historical data for establishing unit prices.
- The remaining agencies differ from TxDOT on the calendar duration used for establishing unit prices.
    - NYSDOT and MnDOT, similar to UDOT, use seven to twelve months of historical data.
    - Caltrans, WSDOT, and FDOT use only four to six months of historical data for determining the unit price.
- TxDOT, like the remaining seven agencies interviewed, uses simple average and weighted average for determining the unit prices. Unlike other agencies, TxDOT does not consider regression analysis as one of statistical techniques to be used for determining unit costs.
- On the application of these statistical techniques, TxDOT, VDOT, UDOT, NYSDOT, Caltrans, WSDOT, and FDOT use it for determining both major and minor items of work.

- MnDOT is the only agency to use simple average or regression analysis for estimating minor items of work.

Some of the other replies that differed from TxDOT's approach are:

- VDOT uses regression analysis for determining the unit costs if sufficient historical data is available. Otherwise, VDOT prefers to use the weighted average.

- Caltrans maintains a comparison of Engineer's Estimate to Low Bidders to study the influence of number of bidders on bid prices.

6. CONCLUSION AND RECOMMENDATIONS

The replies from the survey and the interviews were used as basis for drawing conclusions for this study. The results showed that state highway agencies have different approaches for developing unit costs. Though some state agencies have a systematic process in place for preparing project estimates, they have no written documentation on the entire process, including documentation for developing unit costs. SHAs that were interviewed did not have a formal process or method to adjust unit prices for project characteristics (e.g., complexity, location, size), current market conditions (e.g., bidding environment), or current day prices (e.g., inflation). Adjustments to unit costs were based mainly on experience and engineering judgment of the estimators in all the state agencies. Some state agencies, including TxDOT, did have a list of factors to consider but did not have a methodology for applying these factors to adjust unit costs.

After analyzing the replies received from the various state highway agencies for the surveys and the interviews, the research team identified the following recommendations. The researchers based these recommendations on the comparison of replies received from the three TxDOT districts with national level responses. The recommendations are divided into short term recommendations, requiring minimal changes to the existing system, and long term recommendations. Long term recommendations would likely require considerable changes to the existing system. Each recommendation has a section explaining its potential importance to TxDOT and a section providing sources for further information on implementing the recommendation.

The outcomes of this synthesis were dependent upon the practices of other SHAs. Since there were no structured and *comprehensive* processes for development and adjustments of unit costs, this synthesis provides only potential recommendations provided based on observations related to similarities and differences between TxDOT and other SHAs.

6.1 SHORT TERM RECOMMENDATIONS

Consider using Cost-Based Estimating for items of work related to hot mix asphalt, steel, and concrete. These materials have shown vast fluctuations in the recent past.

Why:

The final estimate for projects having large quantities of hot mix asphalt, steel, and concrete tend to be dictated by the prices of these three items. Obtaining the right price for these three items is crucial to prepare an accurate Engineer's Estimate. Due to large fluctuations in the prices of hot mix asphalt, steel, and concrete in the recent past, adopting a historical bid-based estimation for these items of work does not provide an accurate unit price. The historical bid data can no longer be relied upon because they do not represent the actual trend. Whereas adopting cost based

approach for these items can help in achieving a more accurate unit price since this approach uses more recent prices and covers different components of work.

Where:
NYSDOT, VDOT, and MnDOT use a cost based approach for estimating the prices of these three items. These agencies generally use a cost based approach for estimating major items of work in the final PS&E phase of project development. FDOT is another agency looking at using cost based approach for estimating major items of work.

Consider Estimator (Trns*port) for implementation in all district offices for developing construction project estimates in the PS&E phase as well as in the design phase of project development.

Why:
The three TxDOT districts interviewed as part of this synthesis use Estimator software in different ways. In one district, only the consultants use it for preparing their estimates while another has the district personnel alone using them. Also one of the districts uses Estimator late in the design phase itself, while the rest start to use it for preparing only the Engineer's Estimate. Having all the districts use Estimator software to build their estimates, in both the design and PS&E phases, can ensure uniformity in the estimation process and consistency in the estimates. This could be an important step if TxDOT decides to adopt a cost-based estimation using Estimator software for preparing design level and final Engineer's Estimate.

Consider the Site Manager Database spreadsheet that is available on Crossroads (TxDOT's intranet) for accessing more current unit cost data on various line items in all district offices.

Why:
The Site Manager spreadsheet, available on Crossroads, provides the estimators in all districts with the latest unit prices for the line item being estimated. Apart from using the one-month and twelve-month averages, this spreadsheet provides the unit prices from current/recently completed projects.

Using the spreadsheet, the unit prices for the last three, six, and nine months can be searched to observe their trend. Further analysis of unit prices can be carried out after arranging them based on the quantity being estimated. This spreadsheet can be a valuable source for obtaining current unit prices from ongoing TxDOT projects.

Where:
Site Manager Spreadsheet is available on Crossroads (TxDOT's intranet) under the Construction Division's Contract Administration section.

6.2 LONG TERM RECOMMENDATIONS

Consider reviewing the use of Cost-based estimating for project estimation in the Design and PS&E phases or a combination of both cost-based estimating and historical bid-based estimating, with cost- based estimating used to estimate major items of work.

Why:

The cost based approach is preferable for estimating unique projects or projects where the location, market factors, and the volatility of material prices make the use of historical bid-based estimation unreliable. Also, contractors use a cost based approach to prepare their bids. When using cost-based estimation, different components of work like the equipment rate, material rate, production rate, and crew size are considered for preparing the estimates. Since this is similar to the contractors' approach, there is a possibility for reducing the difference between the Engineer's Estimate and the low bids submitted. As a result, overall accuracy improves.

Where:

State agencies like MnDOT, VDOT, and CDOT extensively use cost-based estimation for preparing their Engineer's Estimate as well their design level estimates.

Consider studying the effort required to implement cost-based estimation in the Estimator software.

Why:

Though cost-based estimation provides better estimates, performing the estimation is more time consuming than the historical bid-based approach. Substantial effort is needed for setting up libraries for equipment rates, material rates, production rates, and crew size to be used in the system. Performing a study on the effort required to transition to cost based approach becomes all the more important. This could prove crucial if TxDOT decides to adopt a cost-based estimating.

Where:

Colorado Department of Transportation (CDOT) moved away from the bid-based estimation approach to a combination of cost-based/historical bid-based estimating to prepare their Engineer's Estimate using Estimator software. TxDOT could look to the effort undertaken by CDOT for this conversion as guidance when implementing the cost-based estimating.

Consider using other information systems to access unit costs more efficiently.

Why:

Accessing recent bid history is critical to developing accurate prices for various line items. An efficient system that quickly and effectively sorts through historical data can be a valuable asset

to estimators. Software like Bid Tabs Pro allow the user to search through historical data, identify the usage of particular pay item, obtain pricing trends, and double check current costs based on regions, county, and state averages. As a result the time spent by the estimator searching the database for unit costs is cut down. Before implementation, TxDOT might have to sort out possible problems with the use of Bid Tabs Pro in terms of licensing and availability of data within the system.

Where:

Oman Systems makes this software, and WSDOT is one of the state agencies currently using Bid Tabs Pro. WSDOT is a source to understand the full capabilities of this tool. (Refer Appendix C for complete contact information of all the respondents.)

Consider developing an approach similar to the Red Flag Analysis of the Utah Department of Transportation to adjust estimates based on unique project and site characteristics.

Why:

UDOT makes use of Red Flag Analysis to aid estimators in developing an Engineer's Estimate that takes into consideration the different factors affecting the project cost. It helps estimators increase or decrease the final estimate based on factors like location, start date of construction, bidding season, contractor interest, that affect the project costs. This allows the estimators to account for project characteristics influencing the final estimate.

Where:

UDOT's Red Flag Analysis can be further studied for a similar implementation by TxDOT that is suited to its requirements.

Consider developing guidelines for adjusting unit prices during different project phases.

Why:

TxDOT could benefit from having a guideline on adjusting unit prices, outlining the factors to be considered when arriving at a cost for a particular pay item. This makes the estimation process more standardized and enables the estimators, especially the new estimators, to better understand the factors that they need to look into when determining the unit costs and how to make adjustments based on project characteristics. There can also be a knowledge database that serves as a repository of various challenges faced while estimating different TxDOT projects and how the estimators handled these challenges. This can be an important source of information for all estimators.

Where:

UDOT, WSDOT, and VDOT have guidelines on factors that the estimators need to look into when determining the cost for a particular item of work.

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APPENDIX A

TxDOT SURVEY RESULTS

Sl No	DOT	Estimation Process	Formal Process/Systematic Tool(Y/N)	Estimation System Used	Web Location	Point of Contact	Other Information
1	Tennessee	Tennesse does not have a system that will develop prices based on the complexity. Tennessee makes use of their "In House" system to break down prices received from various bidders based on the quantity, time period, county,region.	N	Using In house program for breaking down bid items	NA	Daid Donoho, Director of construction, TDOT	
2	West Virginia	Maintains "Average Unit Bid" list on a yearly basis	N	NA	NA	NA	
3	Kentucky	No formal process to categorise the unit prices based on complexity, difficulty or type of projects when developing the final engineers estimate	N	NA	NA	Ryan Griffith, Transportation Engineer Branch Manager	
4	New Hampshire	No Formal process to determine the unit prices for the contract	N	NA	NA	Theodore Kitsis,P.E., Administrator Bureau of Construction	
5	Virginia	VDOT has staff of estimators preparing the VDOT's Bid for the project. The process include "rational cost estimate" for 65% value of the contract. The balance (35%) is generally determined by the Trns.port statistically. This is used in the early design life of the project, however on most project, for advertisements the estimate is based on bid histories. The estimation process is given in the Estimation Guideline Procedure manual of VDOT	Y	Trns.port	http://www.virginiadot.org/business/const/default.asp	Tom Thompson, State Estimates and Bids Engineer,VDOT	
6	Iowa	The estimation process doesn't consider the project complexity or the difficulty when preparing the estimate. These are generally done using the Trns.port software. For negotiating contract modifications, summary of the awarded prices is used to compare with the requested prices.	N	Trns.port	NA	Roger Bierbaum, Contracts Engineer	
7	Alaska	The Alaska DOT doesn't have a formal, systematic tool for estimating unit prices. The estimates are generally prepared based on the past bids with adjustments for uniqueness of work.	N	NA	NA	Pat Carrolll, Design Group Chief	
8	Missouri	The estimation process involves using the historical unit bid prices for each district. The justification is looked at with the quantities involved and difficulty in performing the work.	N	NA	NA	Randy Hitt, Asst State Construction and Materials Engineer.	
9	Vermont	Vermont uses the Trns.port suite of softwares (Estimation SW like the CES, Estimator) for estimating. The project complexity, difficulty or type of project are manually adjusted based on the project managers consideration.	N	Trns.port	NA	Mike Fowler	
10	Illinois	IDOT uses the ProEstimating Heavy (Oman Systems) for estimation of construction process. This is supplemented by the Oman's Bid Tabs Professional for historical cost associated with non-major items. The impact on the production rates, equipements needed for the major line items like the earth work, paving and structure due to the complexity and size of the project is determined based on the knowledge and experience of the estimator	Y	ProEstimating Heavy, Bid Tabs Professional	NA		http://www.hcss.com, http://www.bid2win.com, http://www.harddollar.com, Http://www.infotechfl.com/software_solutions/estimator.php

Sl No	DOT	Estimation Process	Formal Process/Systematic Tool(Y/N)	Estimation System Used	Web Location	Point of Contact	Other Information
11	Colorado	The estimation process was changed from Historical bid based platform to combined cost based/historical approach. In cost based estimation, the costs are determined reviewing the material, labor and equipments seperately. The estimators use the Davis Bacon for labor rates and Blue book for equipments rate.Also a 10% to 20% profit or overhead factor is considered depending on the work type, number of plan holders etc. Historical based estimation or basic estimation procedure involves estimating a project using the historical bid information for all items of work, determining the major line items that comprise a minimum of 20% value of biddable item total, re-evaluating unit prices of major line items using a cost based approach.	Y	NA	NA	Gus Bieber, Engineering Estimates Program Manager	
12	Florida	FDOT doesn't have a formal process to account for project complexities and difficulty. FDOT uses the Trns.port CES for estimation. Separate cost libraries are maintained in CES for projects with time duration less than 2 years and 2 years or greater.	Y	Trns.port CES	NA	Cherri Sylvester	
13	New Jersey	NJDOT uses the Trns.port CES system for estimation purpose.	Y	Trns.port CES	http://www.state.nj.us/transportation/business/trnsport/estimation.shtm	Joe Weber, Project Manager TRNS.port	AASHTO Tracer product
14	Indiana	No system with that detail present for them	N	NA	NA	NA	
15	Georgia	No system that handles the project complexities, difficulties in the estimation process. The Weighted average for all pay items based on quantities are used by the estimating section to come out with the estimates for each letting.	N	NA	NA	Gregory T Mayo,P.E. Director of Construction GADOT	
16	Rhode Island	RIDOT uses the weighted average unit prices for estimates. But it doesn't consider the project complexities, type of work and difficulty.	N	NA	NA	Christos Xenophontos, Administrator, Contract Administration Section	
17	Wyoming	No formal process	N	NA	NA	NA	
18	North Dakota	No formal process using a systematic tool at this time	N	NA	NA	NA	
19	Nevada	No formal process at this time	N	NA	NA	Gary Selmi, Chief Construction Engineer	
20	Oregon	Oregon DOT uses the Trns.port estimating system to make the regional, work type and quantity cost adjustments. For the labor, material and equipment rates, manual cost development in done. Oregon is currently reviewing the use of TRACER for estimation purpose	Y	Trns.Port Estimation System, Tracer	NA	John Riedl, PE, Senior Cost Engineer	AASHTO's Estimation TRT-Development of Combined Bid History and Cost Estimating System

Sl No	DOT	Estimation Process	Formal Process/Systematic Tool(Y/N)	Estimation System Used	Web Location	Point of Contact	Other Information
21	Lousiana	Lousiana DOT does not have a system that categorises the items based on the project type. Weighted average unit cost cost is used for the estimation purpose.	N	NA	http://www.dotd.la.gov		http://www.dotd.louisiana.gov/cgi-bin/construction.asp
22	Caltrans	Caltrans doesn't have a systematic tool for developing unit prices	N	NA	NA	Ray Titt	
23	Washington	WsDOT uses the historical bid costs in developing Engineer's estimate. However the system doesn't consider the project type and complexity.	Y	NA	NA	David Mariman, WSDOT States Specification Engineer	
24	Maryland State Highway administration	Price Index History is used as the basis for the estimation	N	NA	NA	Mark Flack	
25	Ohio	ODOT utilizes the unit bid prices for estimation purpose. The office of estimation has a separate web site for the estimation process. The Ohio DOT keeps historical bid data in a database searchable by the rest of the department when estimating for a new work.	Y	NA	http://www.dot.state.oh.us/contract/estimating/itemsearch.asp	Bob Jessberger, ODOT, Construction Specialist	The database helps search by item numbers of description which gives bid data from the past years for similar work with a similar quantity
26	Mississippi	Mississippi DOT doesn't have a systematic tool that does estimation based on the complexity and the difficulties	N	NA	NA	NA	
27	District DOT	No system at this time	N	NA	NA	NA	
28	Maine	Maine DOT doesn't have a systematic tool. Past prices on similar projects are used	N	NA	NA	Scott Bickford, Contracts & Specifications Engineer	
29	Kansas	Kansas DOT doesn't have a formal process. Average Bid tab is used and estimation is done manually taking into consideration the project, area and quantity.	N	NA		Susan Darling,Asst Bureau Chief, Construction & Maintenance	
30	Utah	Utah uses PDBS Estimates Module which allows the user to pull all average bid prices or prices based on Date Range, quantities or location.	Y	PDBS	NA	Thomas LeHolm,Manager, Contracts, Est & Agreements	The PDBS is likely to be in their Intranet, as it is available to the users of the PDBS system.

Sl No	DOT	Estimation Process	Formal Process/Systematic Tool(Y/N)	Estimation System Used	Web Location	Point of Contact	Other Information
31	Oklahoma	Oklahoma DOT uses the Trns.port modules for estimation purpose. The Trns.port doesn't provide the bid prices based on the type of project or the complexity	Y	Trns.port	NA	Brad Hartronft (bhartronft@odot.gov)	
32	Arkansas	AHTD relies on engineering judgement for an appropriate unit price when the factors like the project type, complexity and difficulty are giving suitable weights when making the decision	N	NA	NA	Charles Clements, Engineer of Roadway Design	
33	Minnesota	MnDOT uses the Cost Estimation System (CES) of the Trns.port for preparing the Engineer's Estimate. Supplemental Agreements or work orders are prepared using the historical averages and cost based methods as well but without using CES	Y	Trns.port	NA	Nancy Sannes,Estimating Unit	
34	Alabama	Alabama DOT doesn't have a formal tool for use when evaluating quotes/prices for added work post-letting. Bid history is used for the purpose of estimation.	N	NA	NA	-	
35	Montana	Montana DOT is in the process of hiring a Cost Estimator that will establish unit price data using the actual cost data. Currently Decision Support System (DSS) and Estimator of the Trns.port suite of softwares are used to create catalogs for prices to be generated. The bid history prices are adjusted for quantity, region, complexity and type of project.	Y	Trns.port	NA	Suzy Price	
36	Massachusetts	Massachusetts relies on the construction bid cost data. MaDOT uses an application to eliminate the high/low values and uses the remaining costs for a weighted unit price average.	Y	NA	http://www.mhd.state.ma.us/PE/WeightedAverageCriteria.aspx	Carol Hebb, P.E Construction Engineer	
37	New York	NysDOT uses the Trns.port suite of Softwares for Estimation.	Y	Trns.port	https://www.nysdot.gov/portal/page/portal/main/business-center/trns-port/modules	David L. Kent, P.E., Design Quality Assurance Bureau	The web address gives a list of modules that they use in the Trns.port application for developing Engineer's estimate

APPENDIX B

ONLINE SURVEY QUESTIONNAIRE

Request for Participation

Background

The Texas Transportation Institute (TTI) is undertaking a research project to develop a ***Synthesis on Construction Unit Cost Development*** for the Texas Department of Transportation (TxDOT). The synthesis focuses on how other State Highway Agencies (SHAs) develop unit prices for construction and maintenance project estimating. It will explore current practices in determining the unit costs based on historical bids and/or historical production rates, crew sizes and material costs. Information on the processes and procedures followed by other SHAs will form the basis from which recommended best practices and a procedure to implement these practices will be provided to TxDOT. An additional focus of this synthesis is describing for cost estimating purposes a methodology whereby historical data is adjusted based on project conditions.

Historical Data

Four generic phases are used in this research to characterize the project development process. These phases are shown below with a brief description of the plan or program they support:

- Planning – concept definition to support a 20 year long range plan
- Scoping – basic scope definition to place a project into a priority program (10 years or less from the project letting date)
- Design – development of plans and specifications to support a project in the State Transportation Improvement Program (4 years or less from the letting date)
- PS&E – final plans and specifications to support an Engineers' Estimate for letting a project for construction

Cost estimation occurs repeatedly throughout the four project phases. The types of estimating techniques used vary depending on the project phase and level of project scope information available. Historical cost data that supports the preparation of estimation also varies based on the estimating techniques. Historical bid prices are often used when preparing cost estimates. At the PS&E phase, bid pricing is the most common approach, although some SHAs use production rates, crew sizes, labor wage rates, material costs and equipment cost to build up a unit price for their Engineers' Estimates. Historical bid prices are more frequently used for estimates prepared in the scoping and design phases. In the planning phase, historical unit prices are often used to develop average lane mile costs for planning estimates. Thus, the use of historical bid pricing and other related approaches to how historical data is developed for cost estimation across the project development process is of interest to TxDOT.

Survey Structure

The research team has formulated a questionnaire to identify good practices specifically with respect to unit cost development. The survey questionnaire is divided into the following sections: ***Section I-Construction Unit Cost,*** addressing the unit cost information for construction projects and ***Section II-Maintenance Unit Cost,*** addressing the unit cost information for maintenance projects. The ***Section I-Construction Unit Cost*** is divided into five sections. The first is a ***General*** section**,** which focuses on identifying whether your state agency has a structured construction unit cost database and unit cost development procedure in place. The second section is ***Acquiring Unit Cost Information,*** which identifies the use of any system that extracts unit cost information from the past contract details and stores them in an historic cost database. ***Storing Unit Cost Information*** is the third section focusing on how the unit cost details are stored in the database. The last two sections are ***Accessing Unit Cost Information,***

which identifies the presence of any mechanism to access historic unit cost information and ***Applying Unit Cost Information,*** which focuses on the use of the unit cost information in the estimation process.

Key Definitions are:

- **Unit Cost Database**

  Unit Cost Database is a repository of the cost associated with all standard items of work taken from the previously awarded contracts or bids and stored in a suitable format which will aid the estimator when preparing cost estimates for highway projects.

- **Historical Bid-Based Estimating**

  Historical Bid-Based Estimating is a method used in developing estimates using the data from the **unit cost database**. The unit prices from this database may be adjusted to reflect the specific project/location (geographic) conditions.

- **Cost-Based Estimating**

  Cost-Based Estimation is a method used in developing project estimates using a production rate and the cost associated with labor, materials, and construction equipment. By estimating the cost of each component required to complete the work together with a Contractor's profit and overhead an estimated unit price for the work can be developed. This method also takes into account the unique character of the projects, geographical influences, market factors and the volatility of material prices.

Respondent's Information

Agency :

Name :

Title :

Email :

Telephone Number :

SECTION I

Construction Unit Cost

General

1. Is Historical Bid-Based Estimating your agency's **primary** estimating technique?
   a. Yes
   b. No

If 'Yes' for Question 1, please answer Question 2.

2. If Historical Bid-Based Estimating is used, in which project phases is it **most often** applied? [Select all that apply]

- Planning - concept definition to support a 20 year long range plan
- Scoping – basic scope definition to place a project into a priority program
- Design – development of plans and specifications to support a project in the State Transportation Improvement Program
- PS&E – final plans and specifications to support an Engineers' Estimate for letting a project for construction

3. Is Cost Based Estimating your agency's **primary** estimating technique?
   a. Yes
   b. No

If 'Yes' for Question 3, please answer Question 4 and Question 5.

4. If Cost Based Estimating is used, in which project phases is it **most often** applied? [Select all that apply]

- Planning - concept definition to support a 20 year long range plan
- Scoping – basic scope definition to place a project into a priority program
- Design – development of plans and specifications to support a project in the State Transportation Improvement Program
- PS&E – final plans and specifications to support an Engineers' Estimate for letting a project for construction

5. If Cost Based Estimating is used, does your agency periodically track the following? [Select all that apply]

- Actual production rates and crew sizes
- Current material unit costs
- Actual construction equipment production rates

6. Does your agency use a computer based system for preparing estimates during different phases of the project development?
   a. Yes
   b. No

If '**Yes**', please provide the name of system used in different phases of project development given below. Also specify whether the system is commercially available or an in-house developed program.

(e.g., Trns*port Cost Estimating System – Commercial and/or Excel Spreadsheet – In-House)

Planning:

Scoping:

Design:

PS&E:

7. Does your agency have a well documented process or procedure for developing unit costs for construction cost estimating (process/procedure covers acquiring, storing, accessing and applying unit costs)?
   a. Yes
   b. No

   If '**Yes**', please provide the web address if it is accessible over Internet or a copy of the document?

8. Is your agency using any innovative techniques for developing unit costs for construction cost estimating (e.g., maintaining libraries of historical unit costs based on market areas)?
   a. Yes
   b. No

Acquiring Unit Cost Information - Construction

9. How is cost data for the unit cost database acquired from bid details?

   a. Commercial Software (e.g., BAMS/DSS)
   b. In-House Software
   c. Both
   d. Other, specify

10. Which types of historical bid data are acquired from bid details in your agency?

- Low bid only
- Low and second bid
- Three lowest bid
- All bids excluding single bid that may be higher or lower
- All bids except high and low bid
- All bids

Storing Unit Cost Information - Construction

11. Where is historical unit costs maintained within your agency?
    - Computer software (e.g., BAMS/DSS) – Commercial
    - Computer software – In-House
    - Spreadsheet – In-House
    - Other

    If **Other**, please specify.

12. Over what calendar duration are historical unit costs stored in the database?
    - One Month
    - Twelve Months
    - Three Years
    - Five Years or more

13. Are historical unit costs available based on:
    - Statewide only
    - District/Regions only
    - Market areas
    - Counties
    - Other

    If **Other**, please explain.

14. How does your agency store historical unit cost information (Select all that apply)?
    - Standard construction line items
    - Different work categories (e.g., Grading/Excavation, Asphalt, Bridge, Traffic Control)
    - Project types (e.g., Bridge replacement, lane widening , intersection reconstruction etc)

Accessing Unit Cost Information - Construction

15. Can historical unit costs be accessed over your agency's:
    a. Internet
    b. Intranet
    c. Both
    d. None

    If available over Internet, please provide the web address.
16. Does your agency have a system to sort and summarize historical unit cost data based on different input parameters (e.g. standard line item number, project size, quantity range, time period)?
    a. Yes
    b. No

17. Is the above system developed [select all that apply]
    - Commercially (e.g. Bid Tabs Pro)
    - In-House

18. If Commercially available system, please provide the name of the system
19. If In-House system, can it be accessed over the Internet? If '**Yes**', please provide the web address

Applying Unit Cost Information - Construction

20. Over what calendar duration are historical unit costs averaged to create the unit cost data for estimating? [Select dominant choices]
    - One Month
    - Twelve Months
    - Three Years
    - Five Years or more
21. What statistical techniques are used to determine the unit prices for cost estimating? [Select all that apply]
    - Simple Average
    - Weighted Average
    - Median
    - Mode
    - Scatter plots with best fit
    - Other, specify
22. What items of work are these statistical techniques most often applied to?
    - Major items of work
    - Minor items of work
    - Both
    - Other, specify

23. Does your agency use Moving Averages for determining the historical unit costs?
    a. Yes
    b. No

If 'Yes', answer the Questions 22 and 23.

24. What time period is considered for calculating the moving average?

25. What type of moving average is considered?
    a. Weighted Moving Average
    b. Simple Moving Average

26. Does your agency have a formal process/method (documented) to adjust historical unit prices for project size, project location and project complexity when preparing a cost estimate?
    a. Yes
    b. No

27. Does your agency have a formal process/method (documented) for adjusting the unit prices to reflect the current market condition (e.g., bidding environment)?
    a. Yes
    b. No

28. Does your agency have a formal process/method (documented) for adjusting historical unit prices to reflect the current day prices (i.e., impact of inflation)?
    a. Yes
    b. No

SECTION II

Maintenance Unit Cost

1. Does your agency maintain a database for maintenance unit costs?
    a. Yes
    b. No

2. Does your agency have a well documented process or procedure for developing historical unit costs for maintenance projects (process/procedure covers acquiring, storing, accessing and applying unit costs)?
    a. Yes
    b. No

3. Please describe the differences (if any) in the procedure for acquiring, storing, accessing and applying of maintenance unit cost data from that of construction unit cost given in Section I? (Enter NA if not applicable)

APPENDIX C

RESPONDENTS CONTACT INFORMATION

Agency	Name	Title	Email	Telephone Number
District of Columbia Department of Transportation	Ardeshir Nafici	Deputy Chief Engineer	ardeshir.nafici@dc.gov	202 671-4689
NCDOT	RON DAVENPORT	STAE ESTIMATING ENGINEER	RON DAVENPORT	9192504128
Hawaii Department of Transportation	Ross Hironaka	Project Manager	ross.hironaka@hawaii.gov	(808) 692-7575
	Jamie H. Ho	Construction and Maintenance Engineer	jamie.ho@hawaii.gov	808-587-2185
DelDOT	Tom Clements	Assistant Director, North Construction	thomas.clements@state.de.us	302-894-6340
Maine DOT	Scott Bickford	Contracts & Specifications Engineer	scott.bickford@maine.gov	207-624-3533
Utah Department of Transportation	Jason R. Henrie, PE	UDOT Estimate Reviewer (Contract Employee)	jhenrie@utah.gov	801-957-8605
Virginia Department of Transportation	Richard P. Kiefer	Estimates Process Engineer	richard.kiefer@VDOT.virginia .gov	804-786-3837
Iowa Department of Transportation	Roger Bierbaum	Contracts Engineer	roger.bierbaum@dot.iowa.gov	515-239-1414
New Hampshire,Department of Transportation	David S. Smith	Sr. Consultant Supervisor	dssmith@dot.state.nh.us	603 271 7421
Louisiana Department of Transportation (LaDOTD)	Brian Buckel	Chief Construction Engineer	bbuckel@dotd.la.gov	225-379-1503
Illinois Department of Transportation	Jerry Cameron	Engineer of Estimates	Jerry.Cameron@Illinois.gov	217-785-3483
Oregon Department of Transportation	John Riedl, P.E.	Senior Cost Engineer	John.J.Riedl@odot.state.or.us	503-986-3886
West Virginia Division of Highways	Todd Rumbaugh	Director of Contract Administration	trumbaugh@dot.state.wv.us	304-558-3304
Arkansas Highway and Transportation Department	Linda Gunn	Senior Design Engineer (Roadway)	linda.gunn@arkansashighways.com	(501)569-2533
Wyoming Department of Transporation	Mark R Eisenhart	State Construction Engineer	mark.eisenhart@dot.state.wy.us	307-777-4459
Tennessee Department of Transportation	David Donoho	Director of Construction	david.c.donoho@state.tn.us	615-741-2414
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Nebraska Department of Roads	Claude Oie	Construction Engineer	coie@dor.state.ne.us	402-479-4532
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Texas Department of Transportation	Ali Habibi	Transportation Engineer	ahabibi@dot.state.tx.us	512-416-2597

APPENDIX D

FOLLOW UP INTERVIEW QUESTIONNAIRE – VDOT

MEMORANDUM
June 4, 2008

TO: Richard Kiefer
Virginia Department of Transportation

FROM: Stu Anderson
Principal Investigator

SUBJECT: Unit Cost Development Phase II Interview

Thank you for participating in the Unit Cost Development Survey concerning methods to derive unit prices for construction and maintenance project estimating. We are interested in discussing in detail your process for developing unit prices and have set up a telephone interview for June 4, 2008 at 2.00 pm EST. We have attached your response to our earlier survey on unit cost development for reference along with the questions we plan to discuss with you during our telephone interview.

If you have any questions, please contact me by telephone at 979-845-2407 or by email at s-anderson5@tamu.edu.

Texas Department of Transportation (TxDOT) and Texas Transportation Institute (TTI)
Synthesis on Construction Unit Cost Development (Phase II)

BACKGROUND

The Texas Transportation Institute (TTI) is undertaking a research project to develop a 'Synthesis on Construction Unit Cost Development' for the Texas Department of Transportation (TxDOT). The synthesis focuses on how other State Highway Agencies (SHAs) develop unit costs for construction and maintenance project estimating. Phase I of the project involved conducting an online survey to identify SHAs conducting considerable work in the development of unit prices for estimation purposes. The survey was divided into two parts. Part I, Construction Unit Cost Information, had five sections addressing different aspects of unit costs, namely:

1. General Section;
2. Acquiring Unit Cost Information;
3. Storing Unit Cost Information;
4. Accessing Unit Cost Information; and
5. Applying Unit Cost Information;

Part II of the survey covered Maintenance Unit Cost Information development.

Phase II of this project focuses on understanding current processes regarding the development of the unit prices in greater detail. Phase II follows the five sections described above for Construction Unit Cost Information. Your response to the Phase I survey for each of the five sections formed the basis for this followed up telephone interview.

General

1. How does your agency arrive at unit cost information support the following estimating programs:
    - In-House Excel (Planning)
    - Project Cost Estimating System (Scoping)
    - Trns*port PES (Design)
    - Estimator – Rational Estimate (PS&E)

2. What information does your In-House Excel program capture about the project?
3. How does your agency use the In-House Excel program to derive a preliminary estimate?
4. Does your agency make any assumptions for inflation, contingency, preliminary engineering and construction engineering, etc. that are used in the In-House Excel program? If so, how do these assumptions change based on project type, project conditions, complexity and size, etc.?
5. How does the Project Cost Estimation System (PCES), used in your scoping phase, work in preparing the estimate?

6. How is the Trns*port PES software used in your design phase?
7. How is the rational estimate performed?
8. What are the innovative techniques used by your state agency for developing construction unit cost?
    a. How is it helping your agency in the estimation process?

Acquiring Unit Cost Information

9. Besides the Blue Book for rental rates, what other sources do you consider for determining the rental rates?
10. How is the information from the In-House Excel program and PCES used by the Trns*port system?

Applying Unit Cost Information

11. What criteria(s) does your agency consider when adjusting the RS Means Data for production rates?
    a. How does the criteria change based on:
        - Project phase
        - Project Condition, Project type, complexity, and size, etc.
12. What does the second increment in the labor rate estimation cover? Is it to adjust for inflation or any other factor?
13. What criterion does your agency use to categorize major and minor items of work?
14. How does your agency establish the prices for major and minor items of work?
15. Does your agency compare the historical data available for district and state when determining the unit cost? Do you modify the historical unit cost based on the comparison? If so, how?
16. How does your agency use the 'weighted average' and/or 'scatter plots' in establishing the unit price?
17. What is the rationale behind using historical data available over 12 month's time to determine the unit price instead of using recent historical data?

Maintenance Unit Cost

18. What information does your maintenance unit cost database contain and how different is it from construction unit costs database?
19. How does your agency arrive at the unit prices for maintenance projects?