7.19 Estimating

Accurate and detailed cost estimates are a vital component of successful projects. They assist in budgeting projects and defining project scope. Good cost estimates allow for the most efficient use of available funds for developing and constructing projects. See the UDOT Statewide Estimate Review Process for additional information on reviewing Engineer's Estimates.
http://www.udot.utah.gov/main/f?p=100:pg:17399505805118733 79:::1:T,V:1624

Cost estimates need to be updated continuously during project design. The cost estimate includes all construction costs including incentives, right-of-way, utilities, design, and construction engineering. The initial project estimate is completed in the Concept Report. See the Concept Cost Report Estimate Form example below. Use this form as a tool for producing the concept level estimate. The Design Engineer will notify the Project Manager at any time during the design phase of the project if the estimate exceeds the commission-approved amount for the project so the short fall can be rectified.

Concept Cost Estimating Form

PIN ----- PROJECT # ----- PROJECT NAME

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	
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%		
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**

The Concept Phase Design Process and Concept Cost Estimate Form are on the UDOT web page at: http://www.udot.utah.gov/index.php/m=c/tid=721

The project designer's responsibility is to compile and keep the project estimate updated. Each design group is responsible to complete their own estimates for all work performed on their respective portion of the project. For example, the roadway designer will be responsible for the estimate on the roadway items, the structural designer will be

responsible for the structural items, the utilities engineer will be responsible for the utilities estimate, the right-of-way engineer will be responsible for the right-of-way estimate, etc. It is also the responsibility of each design group to develop the Measurement and Payment and input their items, quantities, and unit costs into PDBS.

PDBS tracks the history of bid items and can help determine unit bid prices for cost estimates. For information or help on PDBS see: http://www.udot.utah.gov/index.php/m=c/tid=899/item=18793/d=full/type=1. The project designer will set up the Engineer's Estimate in PDBS for the project.

Estimating is not an exact science. There are several methods and tools that can be used to develop good costs and produce the most accurate estimate possible. Using these resources and good engineering judgment will place estimates and projects on a path to success.

Some cost areas to include in an estimate are:

- Roadway
- Landscaping
- Structures
- Hydraulics
- Right-of-Way
- Utilities
- Signals
- Lighting
- ATMS
- Incentives/Bonuses
- Preconstruction Engineering (PE) Cost
- Construction Engineering (CE) Cost
- Public involvement

Inflation

Inflation is difficult to predict. Current projected inflation values are found in the Concept Cost Estimate Form on the UDOT web page at http://www.udot.utah.gov/index.php?m=c&tid=721. UDOT updates these values annually. Include inflation until the project bid opening and allow for schedule slippage.

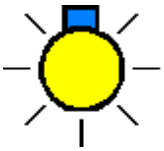
Contingency

Contingency is essential to establish a reasonable project cost. It helps account for minor items of work that are not quantified at early stages of projects. It also accounts for inaccuracies introduced during preliminary design where broad based assumptions are often necessary. A good rule of thumb is 25 percent at concept, 15 percent at scoping, 10 percent at Plan in Hand. Clearly define scope and design by Plan in Hand so contingency defined above is no longer necessary. Change order contingency is placed in projects to cover issues that require changes during construction. This is typically 10 percent of the construction amount and must remain in the project estimate through advertising. It is a separate item from the normal project contingency.

Project Cost Estimate

A project cost estimate is the sum of the contracted items and other items such as preconstruction engineering cost (PE), the construction engineering cost (CE), right-of-way cost, and utility cost, in one estimate. Project cost accuracy varies considerably depending on the stage of project development as well as the project scope. A cost estimate prepared in the early development of a complex project several years from advertisement will be less accurate than a straight forward project with a completed design. Project estimates become more accurate the closer the project is to advertisement.

As a general rule:



1. Concept estimates are considered sufficient if they are between 100-125 percent of the final project price.
2. Scoping estimates are considered sufficient if they are between 100-115 percent of the final project price.
1. Plan in Hand estimates are considered sufficient if they are between 100-110 percent of the final project price.
2. PS&E estimates are the engineer's final estimate. There may be minor changes to this estimate before advertising due to PS&E comments but the changes will not be substantial.

At the concept level the engineer may not have all the information necessary to develop an estimate for every item of work. Anticipate what the major pay items of work will be in order to develop an overall project estimate in the early project stages. The estimate will become further refined as all items and costs are clearly identified as the project progresses towards PS&E.

Engineer's Estimate

The final engineer's estimate details the total project cost and is given to advertising by the engineer. The construction bid items portion of the estimate must be under 110

percent of the low bid. It is desirable for the estimate to be within 10 percent of the low bid.

The following steps outline general guidance in preparing the bid item portion of the Engineer's Estimate

1. Compile quantities for items of work. Match the quantity accuracy to the current level of design.
2. Determine unit bid prices for all quantified items of work. Document how unit prices were developed. Use the **Pay Item Cost Estimate** for guidance on determining unit prices.
3. Each department or discipline provides quantities and costs for their respective items of work.
4. Compile the estimate for all items of work from each department.
5. Add necessary contingency for unknown items, miscellaneous items, and inflation.
6. Conduct a Red Flag Analysis on the estimate. The Red Flag Analysis may be eliminated or Red Flag cost increases may be overridden with thorough documentation. See the Estimator's Corner on the UDOT website at http://www.udot.utah.gov/index.php?m=c&tid=1624 for documentation and instructions for conducting the necessary analysis.
7. Verify that the estimate is on target for project delivery and identify areas of concern. Confirm sufficient approved funding for all aspects of the project. Work through the necessary channels, beginning with the UDOT Project Manger, to identify scope modifications or the use of additives/alternate bidding to remain within the approved funding. Additional funding may also be pursued through the appropriate channels if scope changes are not possible.
8. Perform quality control/quality assurance (QC/QA) procedures according to the UDOT Quality Control/Quality Assurance Guidelines on the estimate and backup documentation including Red Flag Analysis.

Pay Item Cost Estimate

A Pay Item Cost Estimate determines the cost contractors might reasonably charge UDOT for a single item of work. The estimate for an item of work may vary from project to project due to various factors of the job. An Engineer's Estimate Price Comparison report in PDBS will compare each item to the average unit bid price for that item. Use this report with caution since it does not currently utilize any quantity criteria. Use this report as a tool but not a substitute for individually evaluating costs based on sound engineering judgment. There may be other factors that affect unit bid price. Some factors to consider are:

1. Location – Is the project in a remote area of the state? Is this an area where projects historically get a minimal number of bidders?
2. Time of Year – Contractors like to build backlog for the upcoming construction season in the winter months. Bidding in the summer months usually yields higher unit prices and fewer bidders since contractors are busy in the summer months. Resources such as equipment, labor, and materials can also be in short supply in the busy summer construction season.

3. Constructability – Are there unique items on the project? Consider non-traditional items of work and the difficulty of construction. Is this an item that has been built before? Is it new and innovative? How familiar are contractors with the construction methods?
4. Quantity of the item – Small quantities generally dictate higher unit prices such as a project that only has 20 feet of pipe, 500 tons of HMA, or 30 feet of curb and gutter.
5. Limitation of operations – What limitations will there be on working hours? Is traffic control unique or difficult? Will there be lane closure restrictions?
6. Availability of Materials – Are there shortages of materials like cement, steel, or oil? How close are the nearest aggregate pits or HMA hot plants?
7. Familiarity of a process – Are there any new or innovative processes or construction methods on this project?
8. Specialty equipment – Do contractors have the equipment they need or will they need to acquire it for this project?
9. Risk to Contractors – Innovative contracting, such as A+B, where the risk may outweigh the incentive.
10. Construction schedule – Do the special provisions provide the contractor flexibility to adjust the start date so they can coordinate resources with their other current projects? Time restrictions or a short schedule places more risk on contractors and produces higher costs. Allowing a flexible schedule when possible can produce significant cost savings for projects.

There are many methods that a designer might use to determine the price of an item. Some suggestions for estimating the cost of an item are:

1. Use the PDBS database to obtain cost data from past projects.
    a. Use the various filters for project location, Region, County, quantity, funding, and date range can provide a better average unit price for an item. Set the filters to use all funding sources, bids, and projects provides better information.
    b. Specify a quantity range to obtain data for similar quantities, which greatly affects the unit price.
    c. Use a date range to determine recent cost of items. The previous four months provides the best data but the past year can be used with caution.
    d. Print and file PDBS reports used to determine prices as backup documentation.
2. Use a percentage of the contract project cost to determine the cost of an item. For example use a percentage of the roadway construction cost to determine a price for traffic control (see next section).
3. Contact contractors or estimators to ask what they estimate the item of work to cost. Contractors appreciate hearing about upcoming projects.
4. Evaluate current contractor workload. Prices trend upward when the market is saturated with work. Remember that many contractors that do UDOT work also do work in the private sector.
5. Ask other people in UDOT who may have experience working with that item.
6. Use the RSMeans Construction Cost Data manual. This publication is a resource for estimating various items. It provides information on labor, equipment, and overall unit prices.

7. Use the Estimator's Corner section on the UDOT website located at: http://www.udot.utah.gov/index.php?m=c&tid=1624. This site contains a compilation of recent data identifying trends in material costs, price indexes, contractor input/availability, and the market in general. There are also lessons learned from past projects.
8. Call a vendor for a price quote for an item. Add cost for installation and profit into the item. RSMeans Construction Cost Data is a good source for labor and equipment costs necessary to install the item.
9. Research financial and engineering publications for data on market trends, price indexes, and inflation. Many easily accessible publications contain information on oil prices, labor information, etc.

Lump Sum Cost Estimating

When using lump sum as your quantity, consider the same factors to determine cost as used in the **Pay Item Cost Estimate** of this section. Some items lend themselves well to lump sum measurement and others do not. When deciding to use lump sum for quantity instead of unit price, consider the following:

1. How much risk is being placed on the contractor because of unknown quantities?
2. What is being accomplished by making the item Lump Sum? Is it easier for construction inspectors to not measure the item? Does the benefit of not measuring outweigh the associated risk of price renegotiation from quantity overrun or under run? Is it easier to address construction quantity issues by bidding the item with a unit price?
3. Is it possible to easily make it a unit price pay item?

A good example of a lump sum pay item is traffic control. Making traffic control a lump sum item saves the construction inspector from counting every traffic control item daily to calculate payment. It saves paying separately for items such as barrels, panels, construction signs etc. The contractor's risk is minimal because they design traffic control for the project, and understand the plans to stage the project.

A poor example of using the lump sum pay item is HMA. Things such as tolerances in the sub grade, compaction, and mix design make this a high-risk item to bid as lump sum.

Some items can be paid by plan quantity. Examples of this are roadway excavation, granular borrow, and untreated base course. Plan quantity provides the contractor a total quantity for payment. The associated risks are similar to a lump sum item with an estimated quantity.

The more risk that is placed on a contractor by making it a lump sum item, the higher the cost of that item will be. One way to decrease the contractor's risk is supplying an estimated quantity. This quantity must be carefully calculated. Overruns or under runs from the estimated quantity may give the contractor cause to renegotiate the item price.

A guide for estimating lump sum amounts for traffic control is to use five percent of the roadway construction cost as a base. This amount may differ depending upon the contract amount, traffic control complexity, and the time frame it remains in place. Complex urban projects have traffic control costs up to 10 percent.

Other items that are typically bid as lump sum are mobilization and surveying. Mobilization is typically 10 percent of construction costs. Approximately one percent of construction costs is a general guideline for surveying, but consider the amount and difficulty of the necessary survey work to adjust that value.

Utilities

Prepare estimates for all utility work done by the contractor in compliance with Federal regulations regarding utility work. The Region Utilities Engineer is a good resource for utility related issues. Typically the Region Utilities Engineer obtains the estimates from utility companies that are relocating facilities within the project limits. Obtain and include all utility costs in the estimate as early in the project as possible.

Designers make detailed estimates of the utility adjustment work to be performed by the contractor. Include separate summaries in the plans showing items and quantities for the utility work so it can be reported separately.

Summary Sheets

Accurate quantities are essential for a good estimate. The Excel Summary Sheets and the Modeler in Inroads are tools used to generate and check quantities as items are identified and the construction drawings progress toward completion. Summary sheets must match the PDBS system. Summary spreadsheets are located on the Internet at: http://168.178.125.90/UconSupplemental/CaddDownloads/CaddDownloads.htm.

Summary Sheet Quantities

Summary Sheet spreadsheets are a cost-estimating tool to track all items of a developing Engineer's estimate. Formulas can be used to calculate quantities based on stationing and offsets, or dimensions of the items.

Round total of surfacing quantities shown on surfacing summary sheets to the nearest whole number for the "use" total, except where the quantity exceeds 10,000. For quantities greater than 10,000 rounding up to the next number that ends with a zero in the last place is permissible. For example: 12,412 would round up to 12,420.

Summary

Estimating can be one of the most difficult phases of a project. It requires good judgment, research, experience, and diligent maintenance through the entire project schedule. It is very important to keep estimates up to date. Communication and input from all members of the project team are necessary to produce an accurate and well-defined estimate.