Key Message
Welcome participants to AASHTO Estimating Course.

Background Information
Introduce yourself and share information regarding your experiences with estimating and with teaching this class. Recognize the sponsorship of AASHTO and NCHRP in developing the course materials.

Interactivity
Before the class begins, greet each student individually and find out something about them, like their location, their job function, and estimating experience. If an executive is attending the overview in the first part of the course, ask them to help you introduce the course by providing their perspective on the importance of estimating and on its job relevance for attendees.

Notes
This is also a good time to cover logistics and administration. The participants will need to know about breaks, lunch, location of bathrooms, telephones, smoking areas, start and stop times, and forms to be completed.
Cost Estimation Course
Introduction


Key Message
Part I of this course will focus on issues related to cost estimating.

Background Information
This course will focus on several issues related to cost estimating:

• Why we do cost estimates and why are they important?
• When do we prepare estimates in terms of project development process phases?
• Who performs and/or is involved in cost estimating?
• What are the main issues and challenges of cost estimating?
• Where is cost estimating performed (i.e., District, Central Office, Both)
• How are four key cost estimating techniques used to prepare cost estimates?

Interactivity
Ask the participants if there are other issues they would like to cover.

Notes
None
Key Message
The purpose of the course really relates to improving consistency and accuracy of cost estimates regardless of when they are prepared in the project development process.

Background Information
This course was developed to support the implementation of the AASHTO Practical Guide to Cost Estimating vision. Cost Management will be covered tomorrow.

Interactivity
None

Notes
None
Key Message
Estimating has art and it is not just about calculating numbers.

Background Information
This is an interesting question. Many of you are planners or design personnel where your main project responsibilities are related to preparing technical information such as traffic operations analysis, concept drawings, preliminary plans and specifications. In the cost estimating field you use this information to prepare estimates. You have to interpret technical information and often make calculations to develop quantities of material for different items of work. This, perhaps, is the science involved in cost estimating. What then is the art in cost estimating? We would say the art is, for example, having the skill to conceptualize a work component, relate the construction of this component to the site conditions and then apply a unit price that reflects site conditions as well as current market conditions.

Interactivity
Ask the participants this question and explain their answer.

Notes
None
What is a Cost Estimate?

- an approximation of the probable cost of these different components
- is not a single number
- has uncertainty and risk associated with its elements and the project environment
- is used as a basis for making financial decisions

Key Message
Cost estimates are complex documents and have much uncertainty associated with them.

Background Information
Some key answers to the question, “What is a Cost Estimate?” include that an estimate is made up of many categories, elements, and items. However, these components may not be completely defined at the time the estimate is prepared. A cost estimate is only an approximation of the probable cost of these components. There is uncertainty associated with any estimate. There are unknowns that may not be understood. Remember then that an estimate is not a single number but more likely a range of numbers. Finally, a cost estimate is used to make financial decisions regarding a specific project or groups of projects also known as a program.

Interactivity
None

Notes
None
Why is Cost Estimating Important?

Used in making financial decisions!

- Basis for projecting funds needed for programs
- Used to prioritize projects in benefit/cost analysis
- Determining funds required to deliver specific projects
- Provides a baseline for project control

Key Message
Cost estimating provides key information for making critical financial decisions.

Background Information
Estimates are the basis for financial decisions in the following areas:

- Cost estimates determine how much money is needed over some period of time to support key plans and programs such as the Long Range Plan, Intermediate Highway Improvement Plan, and the Statewide Transportation Improvement Program (STIP).
- Most DOTs do not have sufficient funds to design and construction every project that is needed. So projects are prioritized. Cost estimates can be used in benefit/cost analyses to prioritize a list of projects within a program.
- At some point in the project development time line this project cost estimate will become the baseline cost or budget used to control the funds allocated to the project.

Interactivity
Ask the participants if they agree.

Notes
None
Why is Cost Estimating Important?

Used in making financial decisions!

- Basis for obligating specific funds for project phases
- Basis for cash flow requirements over time
- Determine fair price for work
- Basis to compare Contractors bids for award

Key Message
Cost estimating provides key information for making critical financial decisions.

Background Information
Estimates are the basis for financial decisions in the following areas:

- Cost estimates are used to obligate funds such as for the STIP budget or for construction at bid.
- Program Management needs to know when the funds are needed so when an estimate is combined with a schedule a project cash flow is prepared.
- Determine fair price for contract work
- Compare/analyze contractor’s bids and whether to award or not

Interactivity
Are there other reasons why cost estimating is important?

Notes
None
**Introduction: Cost Estimating Challenges**

- Definitive project solutions.
- Quantify major areas of uncertainty in project scope and cost.
- Evaluate the completeness and quality of early project estimates.
- Track the cost impact of scope development.

**Key Message**
There are a number of challenges around cost estimating.

**Background Information**
Project cost estimating is a major challenge for state transportation agencies (STAs). This challenge is the result of four critical project management and development issues. First, project solutions are difficult to define due to the lack of specific project information early in the project development process. Second, it is often difficult to quantify major areas of variability and uncertainty in project scope and cost. Third, it is difficult to evaluate the completeness and quality of early project estimates. Many assumptions are often required. And fourth, it is difficult to track the cost impact of scope development that occurs between cost estimates.

**Interactivity**
What challenges do you encounter when performing cost estimating on your projects?

**Notes**
These challenges are address through a structured and formal cost estimating process.
Introduction: Cost Estimating Challenges (cont’d)

- Insufficient knowledge about ROW costs
- Project location characteristics
- Environmental mitigation requirements
- Traffic control requirements
- Work-hour restrictions

Key Message
There are a number of challenges around cost estimating.

Background Information
The four main challenges identified on the previous slide are amplified because of many factors. There may be insufficient knowledge about right-of-way requirements and associated costs. There is a need to understand project location characteristics as they influence design and construction and hence cost. Environmental mitigation requirements may not be clear. Traffic control requirements impact construction as do work-hour restrictions. All of these challenges influence project cost estimates especially during the early stages of project development.

Interactivity
What challenges do you encounter when performing cost estimating on your projects?

Notes
These challenges are address through a structured and formal cost estimating process.
Key Message
There are a number of challenges around cost estimating.

Background Information
There are other process-related factors that make cost estimation a challenge. The estimator must make an assessment of the cost impact of engineering complexities and constructability issues surrounding the project. Understanding the cost impact of changes related to economic and market conditions is vital. Understanding the potential cost impact of changes due to regulatory requirements, local governmental and stakeholder interests, and community expectations is also an important consideration.

Interactivity
What challenges do you encounter when performing cost estimating on your projects?

Notes
These challenges are addressed through a structured and formal cost estimating process.
Cost Estimation Publications

- NCHRP Project 8-49,
  - Achieving estimating consistency & accuracy

- NCHRP Report 574
  - Cost estimating strategies, methods, and tools

  - Developing & managing estimates for STAs

Key Message
Key publications on cost estimating guidance.

Background Information
Historically, cost escalation or increases have been problematic within the STA environment. One significant reason behind this problem is attributed to poor estimating practices including the inconsistent application of contingency. The National Cooperative Highway Research Program (NCHRP) Project 8-49, completed in 2007, focused on the issue of cost escalation and produced a guidebook on highway project cost estimating and cost estimating management aimed at achieving greater estimating consistency and accuracy. The Project 8-49 guidebook, NCHRP Report 574, provides appropriate strategies, methods, and tools to develop, track, and document realistic cost estimates during each phase of the project development process. As a supplement to this NCHRP work, the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Design’s Technical Committee on Cost Estimating has developed a manual entitled A Practical Guide to Estimating, which specifically serves those charged with developing and managing estimates for STAs.

Interactivity
None

Notes
In addition, the Minnesota DOT has developed a comprehensive “how to” Technical Reference Manual on cost estimating.
Key Message
Project development phases and typical activities.

Background Information
Due to slight variations in the terms used by the state transportation agencies to describe their project development phases, a generic set of terminologies is presented in this workshop consistent with other published documents.

Interactivity
None

Notes
A generic project development process will be presented.
Project Development Phases

- Planning
- Alternative Identification and Evaluation
- Preliminary Design
- Final Design

Key Message
Key project development phases used in the AASHTO guidebook.

Background Information
Project development phases are identified in this slide. To ensure the applicability of terms, STAs from across the country participated in a vetting of the four phases. Typically, an STA will prepare project cost estimates during each of the four phases of project development.

Interactivity
What is your STAs project development process phases?

Notes
The actual phases or steps in the project development process will vary depending on the STA.
Scoping Activities

- Environmental analysis
- Alternative analysis
- Preferred alternative selection
- Public hearings
- ROW impact
- Environmental clearance
- Design criteria and parameters
- Funding authorization

Key Message
Typical scoping phase activities.

Background Information
This slide presents typical scoping phase activities.

Interactivity
Are these likely activities covered in your STA’s scoping process?

Notes
This phase is often called Preliminary Design.
Design Activities

- ROW development and acquisition
- Preliminary plans for geometric alignments
- Preliminary bridge layouts
- Surveys/Utility locations/drainage

Key Message
Typical design phase activities.

Background Information
This slide presents typical design phase activities.

Interactivity
Are these likely activities covered in your STA’s design process?

Notes
None
**Final Design Activities**

- Plans, specifications, and estimate (PS&E) development—final ROW acquisition
- Final pavement and bridge design
- Traffic control plans
- Utility drawings
- Hydraulics studies/final drainage design
- Final cost estimates

**Key Message**
Typical final design phase activities.

**Background Information**
This slide presents typical final design phase activities.

**Interactivity**
Are these likely activities covered in your STA's final design phase?

**Notes**
None
**Key Message**
Estimating types and purpose vary.

**Background Information**
As projects progress through the project development process, cost estimates are required. The types of estimates and their purpose will vary according to project phase and the level of project maturity.

**Interactivity**
None

**Notes**
This is an important topic because there are different technique STA’s use for estimating projects. Understanding their purpose will help ensure the right technique is used during the right PDP phase.
Key Message
A cost estimation classification system links level of project definition to type and purpose of estimates.

Background Information
This slide shows level of project maturity (or level of definition) and implies uncertainty through the use of methods and possible ranges related to estimate types.

The information shown on this slide emphasizes that cost estimates have different purposes in support of project development, different methods are used during project development, and estimate ranges are very wide with little project maturity to very tight at full definition (i.e., completed plans and specifications). Thus, appropriate estimate techniques and tools vary based upon project development phase.

Interactivity
Do you generally agree with the ranges?

Notes
Briefly explain the importance of understanding the broad concepts presented in this slide, that is, there is a link between maturity, purpose, methodology, and range. These concepts go together within a phase.
Cost Estimating Process

- Cost estimating process steps are supported by:
  - historical data
  - market and macro-environment conditions
  - cost estimating techniques and tools
  - third-party requirements

Key Message
Cost estimating process require inputs from a variety of sources.

Background Information
Cost estimating is a process comprised of a series of steps. Each step is critical to developing consistent and accurate estimates during each phase of project development. The steps in the process are supported by key inputs such as historical data, market and macro-environment conditions, cost estimating techniques and tools, and third-party requirements.

Interactivity
Any other key inputs?

Notes
Project definition characteristics might be included. There is a step in the proposed estimating process that captures project definition characteristics as a basis for estimating known costs.
Cost Estimating Process (cont’d)

- Total Project Cost:
  - Engineering/design
  - Right Of Way
  - Construction

- Project baseline cost is tied to:
  - Project definition
  - Construction letting date

Key Message
Total project cost components and baseline development.

Background Information
In the early phases of project development, STAs must prepare estimates that characterize total project cost (TPC). The main components of TPC are engineering/design, right of way, and construction. Included in these general components would be costs related to environmental mitigation and utility relocation requirements. The estimating tools and techniques differ depending on the component of TPC being estimated.

At a point in the project development process, the estimated project cost must be used to set a baseline cost for management purposes. This baseline cost is tied to a baseline project definition and construction letting date. The baseline project definition, cost, and schedule should be set prior to programming a project into the IRP or no later than before a project is included in the STIP.

Interactivity
Do you agree with these concepts?

Notes
The focus on this course is estimating construction costs.
Key Message
Key estimating process steps are primary focus of this training.

Background Information
This workshop focuses on the two cost estimating process steps shown in this slide: (1) prepare base estimate; and (2) determine risk and set contingency. These critical steps are supported by estimating techniques and tools that are used throughout the transportation industry. The steps demand that a project cost estimate be composed of a base estimate and a contingency. The base estimate is defined as the most likely project cost estimate in any phase, which normally includes all estimated known project costs. Project contingency is defined as an estimate of costs associated with identified risks, the summation of which is added to the base estimate. The sum of the base estimate and contingency reflects the total project cost estimate (also adjusted for inflation).

Interactivity
None

Notes
Emphasize that the base estimate covers knowns and the risk/contingency step covers unknowns and estimate variability. Also, these steps were verified through nationally focused research projects.
Key Message
Application of contingency over the project development phases.

Background Information
As shown in this Figure, the relative magnitude of the base and contingency costs changes over time. During planning, there are numerous unknowns, and quite often the base estimate is less than the contingency dollar estimate. Over the duration of the project development process, the base estimate increases while the contingency amount decreases. The shift between the base and contingency relates to the level of project maturity, that is, as project definition advances, the level of unknowns or risks should decrease. Some of the risk dollars are shifted into the base estimate work items as quantities are defined, while other risk dollars may be mitigated.

Interactivity
None

Notes
Emphasize that at some point prior to the design phase a baseline cost estimate must be set so costs can be managed during the design and final design phases. The graphic also illustrates that the cost estimate that is initially developed during planning theoretically should be the same at final design.
Estimating Focus (cont’d)

- **Determine Estimate Basis**
  - Collection of project information.

- **Review and Approve Estimate**
  - Unbiased analysis of estimate basis & assumptions.

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**Key Message**
Other cost estimating Steps

**Background Information**
The cost estimating process shown in the previous slide has three other steps that are critical to preparing accurate and consistent total project cost estimates as shown in this slide:

*Determining the estimate basis* includes collection of information about the project definition, project characteristics, and input/requirements of different functional disciplines involved in the project. Specific information might include drawings, design parameters, project complexity, and project location (e.g., rural and/or urban). The cost estimator uses this information to prepare the base estimate.

*Reviewing and approving the estimate* involves completing an unbiased analysis of estimate basis and assumptions to include the estimate methods used and completeness of the estimate in terms of covering the project’s definition, verifying cost data, quantities, and calculations; and understanding differences between the current estimate and previous estimates. The approval component of this step ensures management accountability for the final cost estimate, noting any changes from previous estimates.

*Determining the estimate communication approach* is the final estimating process step. This step involves communication of key information to both internal and external project stakeholders. This communication is critical to achieving estimate transparency and credibility. The communicated information should explain the estimate basis, estimated costs including key assumptions, and estimate uncertainty. The communication document should be very concise with only key information provided to the reader.

**Interactivity**
None

**Notes**
These steps were verified through nationally focused research projects.
Key Estimate Techniques

• Conceptual Estimating
  – Development of planning or early scoping phase estimates.

• Bid-based Estimates
  – Use element and bid item with quantities and good historical bid data.

Key Message
Key estimate techniques covered in the AASHTO guidebook.

Background Information
Part I of this workshop covers the following cost estimating techniques in separate modules:
• Conceptual Estimating.
• Bid-based Estimates.

Conceptual or parametric estimating techniques are primarily used to support development of planning or early scoping phase estimates when minimal project definition is available. Statistical relationships and/or non-statistical ratios between historical data and other project parameters are used to calculate the cost of various items of work (e.g., center lane miles or square foot of bridge deck area).

Historical bid-based estimating is an approach that relies heavily on element and/or bid item with quantities and good historical bid data for determining item cost. The historical data normally is based on bids from recent projects. The estimator must adjust the historical data to fit the current project characteristics and location. The historical data must also be adjusted to reflect current dollars. With the use of historical bid data, estimators can easily prepare cost estimates. This approach is the most commonly used method for STAs in developing cost estimates for their transportation projects.

Interactivity
None

Notes
These two techniques are covered in Modules 3 and 4.
Key Message
Key estimate techniques covered in the AASHTO guidebook.

Background Information
Part I of this workshop covers the following cost estimating techniques in separate modules:
• Cost-based Estimates.
• Risk-based Estimates.
Cost-based estimating considers seven basic elements: time, equipment, labor, subcontractor, material, overhead, and profit. Generally, a work statement and set of drawings or specifications are used to “take off” material quantities required for each discrete task necessary to accomplish the project bid items. From these quantities, direct labor, materials, and equipment costs are calculated based on estimated production rates. Contractor overhead and profit are then added to this direct cost. The total cost divided by the quantity gives the estimated unit price for the work item.

Risk-based estimating combines (1) traditional estimating methods for known items and quantities with (2) risk analysis techniques to estimate uncertain items, uncertain quantities, and risk events. The risk-based portion of the estimate typically focuses on a few key elements of uncertainty and combines Monte Carlo sampling and heuristics (rule of thumb) to rank critical risk elements. This approach is used to establish the range of total project cost and to define how contingency should be allocated among the critical project elements.

Interactivity
None

Notes
These two techniques are covered in Modules 5 and 6.
AASHTO Practical Guide to Cost Estimating

Part I

•Cost Estimate Techniques

Key Message
The course content begins with Part I.

Background Information
Part I focuses on four key cost-estimate techniques as follows:

Module 3 – Conceptual Estimating
Module 4 – Bid-Based Estimating
Module 5 – Cost-Based Estimating
Module 6 – Risk Based Estimating

Interactivity
None

Notes
Ask the participants if there are any general questions at this point.
Resources

Image References

http://www.galenfrysinger.com/china_countryside.htm
http://idealevents.co.ke/planning/
http://www.advanceenrg.com/design.html
http://www.fdi-one.com/cost_estimating_services_value_engineering_construction_budget_colorado.html
http://howtoblogabook.com/does-your-blogged-book-have-a-reason-to-exist/