Capacity Building Workshop

NCHRP Report 574 and Beyond: Where were We, Where are We, and Where are We Going?

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Outline

• History

• Advances

• Current Environment

• Wrap Up

• Discussion
The Problem

Cost Increases!

State Highway Agencies face a major challenge is controlling project budgets over the time span between the initiation of a project and the completion of construction.
Consistency and Accuracy
Solution!
Strategic Focus
Definitions

• **Strategy**: “a plan of action intended on accomplishing a specific goal.”

• **Method**: “a means or manner of procedure, especially a regular and systematic way of accomplishing something [action].”

• **Tool**: “something used in the performance of an operation [method].”
Development
Two-Phase Approach

• Phase 1 – **State of Practice Review**
  – Comprehensive literature review
  – Detailed agency interviews
  – Potential Strategies, Methods, and Tools (SMTs)

• Phase 2 – **Guidance Document**
  – Guidance development around SMTs
  – Guidance testing and validation
  – Implementation
NCHRP 8-49
Guidebook Results

- 18 primary cost escalation factors
- 8 Strategies to address cost escalation factors
- 30 implementation Methods
- 90 Tool applications
- 1 agency level process map
- 3 generic CE/CM process maps for project development phases
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<tr>
<th>Internal</th>
<th>External</th>
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<tbody>
<tr>
<td>1. Bias</td>
<td>1. Local Concerns and Requirements</td>
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<td>2. Delivery/Procurement Approach</td>
<td>2. Effects of Inflation</td>
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<td>3. Project Schedule Changes</td>
<td>3. Scope Changes</td>
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<td>5. Scope Changes</td>
<td>5. Market Conditions</td>
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<td>7. Poor Estimating</td>
<td>7. Unforeseen Conditions</td>
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<td>8. Inconsistent Application of Contingencies</td>
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<td>9. Faulty Execution</td>
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<td>11. Contract Document Conflicts</td>
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Cost Escalation Factors
1. Management
2. Scope/Schedule
3. Off Prism
4. Risk
5. Project Delivery/Procurement
6. Document Quality
7. Estimate Quality
8. Integrity
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Guidebook Results
Example Strategy

Cost Escalation Factors

Engineering and Construction Complexities
Poor Estimating

Estimate Quality Strategy

Use Qualified Personnel and Uniform Approaches to Achieve Improved Estimate Accuracy
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Guidebook Results
Example Methods in Programming (aka Scoping)

• Consistency
• Document Estimate Assumptions and Basis
• Creation of a Project Baseline

Why?

Project Complexity

Tips for Success

Tools
Creation of Project Baseline Method in Programming

**Why** – Need a cost performance benchmark

**Project Complexity** – Required for every project

**Tips for Success** – Major project elements must be defined

**Tools** – Project Baseline
- Cost Containment Table
- Scope Change Form
NCHRP 8-49
Guidebook Results

Example Tools in Programming

• Standardized Estimating and Cost Management Procedures
• Project Estimate File
• Project Baseline

✓ What is it?  ✓ Tips
✓ Why 🎒  ✓ Resources
✓ What does it do?
✓ When 🕒
✓ Examples
Project Baseline in Programming

**What is it?** – Sets basis for controlling costs

**Why?** – Cost management cannot be performed effectively without a baseline budget

**What does it do?** – Provides management with a tool for making decisions when changes occur

**When** – Project is programmed

**Examples** – WSDOT Scoping Process

**Tips** – Need certain level of detail to track changes

**Resources** – Principled Based Project Management - Chapman
Basic Process Steps

Define Scope (Input)

Estimating Process

- Determine Estimate Basis
- Prepare Base Estimate
- Determine Risk/Set Contingency
- Review Estimate
Basic Process Steps

Estimate Management

- Obtain Approvals
- Communicate
- Monitor for Change
- Evaluate Change
- Adjust Baseline Estimate
Cost Estimating And Cost Estimate Management during Programming

NCHRP 8-49
Guidebook Results
Advances

- NCHRP Report 625 – Right of Way Cost Estimation and Management
- NCHRP Report 658 – Risk Management
- Texas A&M MS Thesis – Sliding Scale Contingency Assessment
- TxDOT Synthesis – Construction Unit Cost Development
Moving From Theory to Practice: Can We Avoid These Situations?

I need a cost estimate on your project.

I have no idea. I haven't even gathered the user requirements.

Don't worry. I won't hold you to the estimate.

Yes you will. You will put it in the plan. Forget we had this conversation, and fire me when I go over budget.

Give me a number or I'll fire you right now.

Okay, it will cost ten million dollars.

That's too high. If you already know the cost, why are you asking me?

So you'll feel like you had input. Is input supposed to feel this bad?
“Theory to Practice”

Mn/DOT Scoping Process

- Framework – NCHRP Report 574 and Mn/DOT Scoping Process
- Methodology with rigor
- Industry involvement – Mn/DOT Professionals
- Academics with right industry experience
- Know user expectations
- Deliverable – “How to” Manual
Development

Process Model

Conversion
# Total Project Cost Components

## TOTAL PROJECT COST ESTIMATE

### RAW TOTAL

- Total Before Inflation

### DIVISION

- Engineering, Construction and Right-of-Way

### GROUP

- Engineering; Internal; Primary Construction; Letting; and so on.

### CATEGORY

- Project Development; State Share of Letting; Utilities; Railroads; and so on

### ELEMENT

- Related Work (e.g. Excavation; Paving; Bridges; etc)

### ITEM

- Specific Work with Unique Number
  - (e.g. 2105607/00021: Excavation-Common
    2105607/00025: Excavation-Subgrade)
Gated Process

Gates:
- G1: To Enter HIP
- G2: To Proceed to Scoping
- G3: To Enter STIP
- G4: To Remain in STIP/Proceed to Design
- G5: To Proceed to Letting
- G6: To Solicit/Approve Bid Price
- G7: To Proceed to Construction

Diagram:
1. Planning Phase
2. HIP (Program)
3. Scoping Phase
4. STIP (Program)
5. Design Phase
6. Letting Phase
7. Post-Letting

Steps:
- Prepare Planning Report
- Approved Planning Report
- Enter and Continue in HIP
- Periodic HIP Project Cost Updates
- Prepare Scoping Report
- Annual STIP Project Cost Amendment(s)
- Prepare Design
- Approved District Design Submittal Letter
- Letting Phase
- Solicit/Approve Bid Price
- Construction Phase
“Theory to Practice”
Right of Way

DOT ROW Processes

- Framework – NCHRP Report 574
- Developing a “How To” Guide
- Interviews with ROW Experts
- Adapted CE/CM Process for ROW
- Expended ROW Tools
“Theory to Practice”
Risk Management

Project Development Phases

- Framework – NCHRP Report 574 and the MnDOT TRM
- Developed “How To” Guide
- Case Studies in Risk Management
- Guidebook Format Similar to ROW Guide
- Expand Risk Management Tools

How?

Project Complexity
Cost Estimate at Any Phase

Total Project Estimate = Base + Contingency (plus inflation)

Reflects Estimated Dollars Associated with Uncertainty
Risk Management Process Framework

- Identify
- Assess/Analyze
- Mitigate and Plan
- Allocate
- Monitor and Control
- Update Contingency

Scalable for Project Complexity
Adaptable to Project Development Phases
Cost Estimates and Contingency
(w/Total Project Cost Estimate = Baseline Estimate)

Project Development Process

Baseline Estimate & Total Project Cost Estimate
“Theory to Practice”
Risk Management

Ohio DOT

- NCHRP Report 658 Tool
- Test Ohio Sliding Scale Contingency Concept
- Delphi Technique
- Develop Sliding Scales for Three Levels of Project Complexity
- Tie to Risk Management Process

Idea?

Project Complexity
The Delphi Technique

1. Problem Formulation
2. Panel Selection
3. Round 1 Delphi Query
   - Round 1 Group Response Analysis
   - Controlled Feedback in round 2
4. Round 2 Delphi Query
   - Round 2 Group Response Analysis
   - Controlled Feedback in subsequent rounds
5. Subsequent Rounds
6. Analysis of Results
7. Presentation of Report
Moderately Complex Projects

Sliding Contingency Scale

- Low
- MLE
- High

Percent Contingency

Phase of Project Development

Planning  Programming  Design 1  Design 2  Design 3
Construction Unit Costs Database

Project Development Phases

- Framework – NCHRP Report 574 CE Process Flowchart
- Tie Historic Database to Estimating Base Costs
- Survey and Interviews
- Compile Results
- Illustrate Different Requirements
- Proposed Unit Cost Development Framework
Construction Unit Costs Database

Submitted Bids

Acquiring Unit Cost
- Information Systems
- Type of Historical Bid Data

Applying Unit Cost
- Calendar Duration
- Statistical Technique
- Number of Bids
- Factors influencing Unit Prices

Storing Unit Cost
- Information Systems
- Calendar Duration
- Listing of Historical Data
- Categories of Historical Data

Accessing Unit Cost
- Information Systems

General
- Estimating Techniques & Tools
- Innovative Approach

Prepare Base Estimates

Determine Risk/Contingency

Historical database

Estimating Techniques & Tools
- Innovative Approach

Unit Cost Development Framework
NCHRP 20-7, Task 278
Cost Estimating Guide

- Create a National Standard Approved by AASHTO
- Sponsor – AASHTO Subcommittee on Design, Technical Committee on Cost Estimating
- Focus on Key Estimating Techniques
- Tie to Generic Estimating Process (Report 574)
- Content
  - Parametric
  - Risk Based
  - Bid Based
  - Cost Based
- Under Development
Current Environment

• Economic Downturn

• ARRA Projects

• Resource Constraints

• Market Conditions
Ten Key Principles

Cost Estimating Practice

• Complete every step in the cost estimate process
• Document estimate basis
• Identify risks
• Anticipate external cost influences
• Perform estimate reviews
Ten Key Principles

Cost Estimate Management

- Make estimating a priority
- Set a project baseline cost estimate
- Create cost control mechanisms
- Create estimate transparency
- Protect estimators
Issues and Challenges
Questions, Answers, and Discussion!