Selection of Alternative Quality Management Systems for Highway Construction

Wednesday, October 12, 2016
Today’s Presenters

• **Moderator**  
  Tim Aschenbrener, FHWA

• **Principal Investigator**  
  Keith Molenaar, University of Colorado Boulder

• **Co-Principal Investigator**  
  David Sillars, Oregon State University
NCHRP is...

A state-driven national program

- The state DOTs, through AASHTO’s Standing Committee on Research...
  - Are core sponsors of NCHRP
  - Suggest research topics and select final projects
  - Help select investigators and guide their work through oversight panels
NCHRP delivers...

Practical, ready-to-use results

• Applied research aimed at state DOT practitioners
• Often become AASHTO standards, specifications, guides, manuals
• Can be directly applied across the spectrum of highway concerns: planning, design, construction, operation, maintenance, safety
A range of approaches and products

- Traditional NCHRP reports
- Syntheses of highway practice
- IDEA Program
- Domestic Scan Program
- Quick-Response Research for AASHTO
- Other products to foster implementation:
  - Research Results Digests
  - Legal Research Digests
  - Web-Only Documents and CD-ROMs
NCHRP Webinar Series

- Part of TRB’s larger webinar program
- Opportunity to interact with investigators and apply research findings.
Today’s Presenters

• Keith Molenaar, University of Colorado Boulder
• David Sillars, Oregon State University
Presentation Agenda

- Research objectives and approach
- Quality assurance organizations
- QAO selection approach
- QAO tool examples
- Questions and answers
Presentation Objectives

By the end of the presentation, you will be able to:

• Describe the *business case* for using alternative quality management systems for highway design and construction projects

• Explain the *five alternative quality assurance organizations* (QAO) models defined in NCHRP Report 808

• *Apply the QAO selection tool* on a highway design and construction project
Business Case

• Alternative quality management systems are addressing changes in DOT business practices
  - Project size and complexity
  - Changing demographics
  - Use of alternative delivery methods
  - Every Day Counts
NCHRP 10-83 Research Objectives and Products

Objectives
• Identify and understand alternative quality management systems
• Develop guidelines for their use in highway construction projects

Products
• A Guidebook to match appropriate QMS to alternative delivery methods
• Research Report that addresses implications of adopting the guidelines
Research Team

- University of Colorado Boulder
  - Keith Molenaar, Elizabeth Kraft, Christofer Harper
- Oregon State University
  - David Sillars, Landon Harmon
- Iowa State University
  - Douglas Gransberg, Nicole West, Ghada Gad
- Advisory Board
  - Kristen Betty, KBA, Robert Burns, CH2M Hill, Debra Brisk, Hennepin County, David Brown, Parsons and James Hunt, PBS&J
Research Methods

Phase I
1. Evaluate State of the Practice
2. Document Alternative QMS Approaches
3. Case Studies and Content Analysis
4. Critical Analysis of Alternative QMS
5. Comparison to Baseline QM Systems
6. Interim Report

Phase II
7. Develop Guidebook
8. Incremental Improvement of Baseline QMS
9. Develop Final Report
# Case Studies

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<tr>
<th>#</th>
<th>Agency</th>
<th>State</th>
<th>Size</th>
<th>Delivery Method</th>
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<td>D-B</td>
<td>US 160 4th Lane Addition</td>
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<td>7</td>
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<td>D-B</td>
<td>I-15 Widening-Beck Street</td>
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<td>PPP</td>
<td>SH130 Turnpike Extension</td>
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Validation and Calibration Interviews

- State project staff from 23 different projects across 13 different states were interviewed
Presentation Agenda

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- Quality assurance organizations
- QAO selection approach
- QAO tool examples
- Questions and answers
Quality Assurance Organizations

The big five
What is a quality management organization?

The assignment of the quality management roles and responsibilities for a project from concept through completion.

What are the fundamental characteristics of project QMOs within the highway design and construction industry?
Three Systems Exist

- FHWA / NCHRP / AASHTO System
- QA / QC System
- Quality Management System
Highway Project Design and Construction QAO

The generic framework:
- quality roles,
- interrelationships,
- quality activities.

Above the dotted line:
- Agency responsibility

Below the dotted line:
Left – designer
Right - builder
Distinguishing among project QAOs

Five distinct structures are defined, distinguished by reactive vs. proactive nature of the system:
- Deterministic,
- Assurance,
- Variable,
- Oversight, and
- Acceptance

Each QAO has its place in the spectrum of projects and project delivery methods.
Deterministic QAO

Deterministic –

A common approach to quality within the highway industry.

The agency retains all project quality roles, responsibilities and activities.
Assurance –

Agency responsibility for acceptance in design and construction and the decisions to release the design for construction and to release construction for final payment.

These responsibilities can be performed in-house or by an independent consultant/engineer.
Assurance QAO

Assurance –

May vary depending on the contracting method

Separate designer / builder

Design/build contractor

Some shared quality assurance may occur
Variable QAO

Variable—

The defining characteristic:

the functional approach to quality between design and construction may differ, depending on project conditions
Variable QAO

Variable–

May functionally vary:

Separate designer / builder

Agency design assurance

Agency complete design quality
Oversight QAO

Oversight—

- Agency releases the designs for construction and final construction payment
- Designer is responsible for design acceptance and QC
- Contractor is responsible for construction acceptance and QC

Agency has no direct control over quality management of the project, but ensures quality management plans and activities
Oversight QAO

Oversight–

• Agency releases the designs for construction and final construction payment
• Designer is responsible for design acceptance and QC
• Contractor is responsible for construction acceptance and QC

Agency has no direct control over quality management of the project, but ensures quality management plans and activities with adequate agency verification
Oversight QAO

Oversight—

- Agency releases the designs for construction and final construction payment
- Designer is responsible for design acceptance and QC
- Contractor is responsible for construction acceptance and QC

Agency has no direct control over quality management of the project, but ensures quality management plans and activities

In design-build, this separation does not exist
Acceptance QAO

Acceptance –

Primarily found in PPPs:
• Agency only has responsibility for final project acceptance and verification testing
• Contractor has all other quality responsibilities
QAO summary

QAO structures vary

- Agency standard practices
- Project delivery methods
- Project specifics that demand special QA practices

<table>
<thead>
<tr>
<th>Quality Assurance Organization</th>
<th>Design Acceptance</th>
<th>Design QC</th>
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<tr>
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<td>Concessionaire</td>
<td>Concessionaire</td>
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</tbody>
</table>

* with adequate agency verification
QAO summary quick guide
Presentation Agenda

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QAO selection process

Major factors to consider

• Project characteristics
• Agency culture and practices
• Industry capacity

• These factors lead to a 3-step QAO selection process
  1. Identification of barriers
  2. Pre-selection preparation
  3. QAO selection
QAO Tools
Research identified 26 tools
Pre-Award Tools
  • Owner Led
  • Contractor Led
Post-award tools
  • Design Review
  • Construction: Testing
  • Construction: Process Controls
  • Construction: Training

Broken down by effectiveness for chosen QAO
QAO Tools

Tool selection follows this path

1. Understand the agency’s requirements and needs
2. Determine the special project conditions
3. Establish the business case for the QAO
4. Choose tools shown to be effective under various QAOs
QAO Tools

Tools Organization

• What is it?
• Why use it?
• What does it do?
• When to use it?
• How to use it?
• Tips
• Examples
Tool Example: Pre-Award, Owner Led Requirements Management-Verification

What is it?
• Systems engineering approach to:
  (1) development
  (2) communication
  (3) fulfillment
  (4) verification

Why use it?
• Clarity in defining requirements

What does it do?
• Clarifies and communicates expectations

When to use it?
• In design and construction

How to use it?
• Data driven, but scalable with spreadsheets and databases

Examples
• CDOT I-25 TREX Project
• MSHA Intercounty Connector Project
• ODOT Columbus Crossroads
Tool Example: Post Award, Design Review
Over-the-Shoulder Agency Reviews

What is it?
• Informal agency design review

Why use it?
• Support compliant designs

What does it do?
• Provides in-process design reviews

When to use it?
• Prior to formal design submission

How to use it?
• Through collocation and structured communication

Examples
• MnDOT TH 61 Hastings Bridge
• UDOT I-15 Widening
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By the end of the presentation, you will be able to:

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✓ Apply the QAO selection tool on a highway design and construction project
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