Construction Staging Workshop
An Effective Value Methodology Application

2015 AASHTO Value Engineering Peer Exchange Workshop

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Introduction

Presentation Objectives

1. Explain how the value methodology (VM) was adapted into a *Construction Staging Workshop*

2. Describe workshop results

3. Share lessons learned

4. Demonstrate VM flexibility & application
Introduction - Outline

- Introduction
- Project Overview
- Workshop Scope
- Workshop Process
- Workshop Results
- Lessons Learned & Conclusions
- Application
Introduction

- Project: “Park Over the Highway” (POH)
  - Client: Missouri Department of Transportation (MoDOT)
  - MoDOT request: Construction Staging Workshop at 50% plans
Introduction

- Purpose of Workshop
  - Confirm/refine staging plan
  - Shorten schedule
  - Reduce construction impacts
  - Unify involved agencies (7)
Introduction

- No MoDOT Construction Staging Workshop guidelines
- Value methodology employed for workshop:
  - Organization
  - Structure
  - Process
  - Common language (functions)
Project Overview

POH part of larger Gateway Arch revitalization

Jefferson National Expansion Memorial (JNEM) Gateway Arch – downtown St. Louis
Project Overview

Arch from Courthouse

I-70 at Arch grounds

Courthouse from Arch

Walnut St. Bridge
Project Overview

- Arch Revitalization Project Partnership
  - National Park Service (NPS)
  - CityArchRiver 2015 Foundation (CAR2015)
  - Missouri Department of Transportation (MoDOT)
- 50th anniversary celebration - 2015
Project Overview

JNEM/CAR2015 Revitalization Project
Project Overview – Land Bridge

POH Project Scope

Note: I-70 from the Poplar St. Bridge 0.5 miles south of the POH to the new Stan Musial/Veterans Memorial Bridge 1.50 miles north of the POH was remarked I-44 in February 2014.
Project Overview – Land Bridge

Arch grounds/Luther Ely Square - Uninterrupted Pedestrian Mall

Before

After
Project Overview – “Ramps” Project

“Ramps” Project Scope
Project Overview

Involved Agencies

- National Park Service
  - Headquarters
  - Local project management
  - Gateway Arch operations

- CAR2015
  - Foundation
  - Consultant architects

- MoDOT
  - Local project management
  - Consultant engineers

- Federal Highway Administration (FHWA)

- City of St. Louis Streets Department

- St. Louis Metro Transit

- Illinois Department of Transportation (IDOT)
Project Overview

Viewpoint Diversity

- Aesthetics/function/cost
- Motorist/pedestrian priority
- Efficient construction/business, motorist, Arch disruption
- Construction impacts/long-term O&M impacts
- Architectural/engineering perspectives
- Esteem value/utility value priority
Project Overview

- Separate POH and Ramps contracts
- Completion date: October 2015
- Estimated construction cost: $21.9 million
Critical Project Concerns

1. Meet Arch 50th anniversary schedule

2. Prevent perception: downtown St. Louis “closed for business”

3. Cost secondary
Workshop Scope - Focus

- Construction staging plan
- Constructability
- Schedule
- Stakeholder/user impacts
Workshop Scope - Timing

- 50% plans stage
  - Best agency feedback opportunity
  - Sufficient detail
  - Assess constructability, staging & impacts
<table>
<thead>
<tr>
<th>Organization</th>
<th>Number of Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoDOT</td>
<td>4</td>
</tr>
<tr>
<td>FHWA</td>
<td>1</td>
</tr>
<tr>
<td>NPS</td>
<td>5</td>
</tr>
<tr>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>CAR2015</td>
<td>2</td>
</tr>
<tr>
<td>POH designer</td>
<td>3</td>
</tr>
<tr>
<td>Ramps designer</td>
<td>3</td>
</tr>
<tr>
<td>Construction specialist</td>
<td>1</td>
</tr>
<tr>
<td>Construction specialist</td>
<td>1</td>
</tr>
<tr>
<td>Utility liaison</td>
<td>1</td>
</tr>
<tr>
<td>IDOT</td>
<td>2</td>
</tr>
<tr>
<td>Workshop facilitator</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25</td>
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</table>
Workshop Scope - Challenges

- Large team
- One day
- Diverse viewpoints
How was value methodology job plan modified?
Workshop Process

VM Job Plan Modifications – Overview

Information: project cost/time model

Function Analysis: functionality review
“means & methods” functions customer FAST – during const.

Creative: 3 sub-teams

Evaluation: workshop output – idea list

Development: design team/post workshop

Presentation: design team/post workshop
Information Phase

- **Pre-Work**
  - Value methodology adaptation/workshop process
  - Information package
  - Site visit/site photographs
  - Superintendent of Streets meeting
  - Cost/time models (POH, Ramps, combined)
  - Functions/FAST materials
  - Breakout sub-teams
Information Phase

- Information package 1 week prior
- Project presentation
- Site visit via PPT slides
### Information Stage

#### Project Cost/Time Model

**MoDOT - Total (PoH & I-70 Ramps)**

<table>
<thead>
<tr>
<th>Percent of Construction Cost Vs Cost Item</th>
<th>Bridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIDGES</td>
<td>37.33%</td>
</tr>
<tr>
<td>PAVEMENT (BASE/SURFACE/C&amp;G/SIDEWALK)</td>
<td>27.49%</td>
</tr>
<tr>
<td>TRAFFIC SIGNALS &amp; LIGHTING</td>
<td>12.38%</td>
</tr>
<tr>
<td>DRAINAGE</td>
<td>9.68%</td>
</tr>
<tr>
<td>PAVEMENT REMOVAL</td>
<td>5.43%</td>
</tr>
<tr>
<td>M.O.T</td>
<td>4.92%</td>
</tr>
<tr>
<td>BRIDGE REMOVAL</td>
<td>4.40%</td>
</tr>
<tr>
<td>MISCELLANEOUS (PM, SIGNING, ETC.)</td>
<td>4.21%</td>
</tr>
<tr>
<td>EARTHWORK/erosion control</td>
<td>2.38%</td>
</tr>
</tbody>
</table>

**MoDOT J612413 - Practical Design Workshop**

<table>
<thead>
<tr>
<th>PoH &amp; I70 Ramps</th>
<th>Baseline Cost Estimate August 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITEM NO.</td>
<td>COST ITEM DESCRIPTION</td>
</tr>
<tr>
<td>1</td>
<td>BRIDGES</td>
</tr>
<tr>
<td>2</td>
<td>PAVEMENT (BASE/SURFACE/C&amp;G/SIDEWALK)</td>
</tr>
<tr>
<td>3</td>
<td>TRAFFIC SIGNALS &amp; LIGHTING</td>
</tr>
<tr>
<td>4</td>
<td>DRAINAGE</td>
</tr>
<tr>
<td>5</td>
<td>PAVEMENT REMOVAL</td>
</tr>
<tr>
<td>6</td>
<td>M.O.T</td>
</tr>
<tr>
<td>7</td>
<td>BRIDGE REMOVAL</td>
</tr>
<tr>
<td>8</td>
<td>MISCELLANEOUS (PM, SIGNING, ETC.)</td>
</tr>
<tr>
<td>9</td>
<td>EARTHWORK/erosion control</td>
</tr>
</tbody>
</table>
Function Analysis Phase

- Project Functionality *Review*
  
  - Common understanding of project purpose, need and key design elements
  
  - Aid identification of alternative creative ideas
  
  - Focus team on constructability, construction staging and user impacts
Functionality 101

- Functions answer the question: “What does it do?” – active verb/measurable noun
- Higher order; basic; secondary
- Examples (Arch, bridge, wall)
Project Functionality Review

Value/Function Illustration

- **Esteem Value**
  - Illustrate history
  - Symbolize gateway
  - Memorialize pioneers
  - Inspire spectators
  - Display ingenuity
  - Signify St. Louis
  - Attract visitors

- **Utility Value**
  - Elevate visitors
  - Afford (bird’s eye) view

![Tram and observation deck illustration]
CAR2015 Goals are Project Functions

- Create place
- Catalyze vitality
- Honor character
- Create (city/Arch) connection
- Embrace river/east bank
- Reinvigorate story
- Create attractors
- Mitigate (transportation) impacts
- Develop (sustainable) future
- Enhance experience
Functions can also be thought of in this way:

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
<th>Implementing Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Order</td>
<td>Need of the project</td>
<td>Planning</td>
</tr>
<tr>
<td><strong>Project</strong> (Basic)</td>
<td>How project function meets need</td>
<td>Concept Engineering</td>
</tr>
<tr>
<td><strong>Facility</strong> (Required Secondary)</td>
<td>How a project facility/component accomplishes the project function</td>
<td>Design Engineering</td>
</tr>
<tr>
<td>Means/Methods</td>
<td>How a project facility/component is brought into existence</td>
<td>Construction</td>
</tr>
</tbody>
</table>
Project Functionality Review

- FAST Diagrams 101
  - Technical FAST
  - Customer FAST

- Example bridge FAST diagram
Project Functionality Review

National Park Service Value Analysis Study #3

JNEM FAST Diagram
Project Functionality Review

- Workshop Target Function Categories
  - Facility design (designer viewpoint)
  - Constructability/construction staging (contractor viewpoint)
  - User operations and safety (stakeholders/users viewpoint)
Facility Design Functions

- Key cost items from cost/time model
- Pre-prepared 2-word-function list for each cost item
- Others added by workshop team
Project Functionality Review

- **Facility Design** Functions – bridge examples:
  - Connect grounds
  - Span I-70 & walls
  - Support (live) load
  - Transfer loads
  - Drain runoff
Construction “Means & Methods” functions examples:

- Cast (in place) concrete
- Maintain access
- Safeguard workers
- Store materials/equipment
- Stage construction
How develop **customer/user-oriented** functions (during construction)?
Customer/User-Oriented Functions:
- Modify/enhance basic functions or project elements
- Are not essential to performance of the task
- Are essential to increase customer/user acceptance
- Can apply to facility design or its **construction**
Project Functionality Review

Customer/User-Oriented Functions (during construction)

Assure Dependability – function has at least one of these attributes:
- Makes project element stronger, more reliable, more effective
- Makes it safer to use
- Lengthens life or minimizes maintenance
- Protects environment

Assure Convenience – function has at least one of these attributes:
- Makes it more convenient to use
- Facilitates maintenance/repairs
- Furnishes instructions and directions
- Enhances spatial arrangements

Satisfy Stakeholders – function has at least one of these attributes:
- Makes user’s life more pleasant (i.e. reduces noise)
- Satisfies individual desires
- Makes element appear to be better in user’s opinion

Attract Stakeholder – function has at least one of these attributes:
- Emphasizes visual/aesthetic aspects
- Projects favorable image
Customer/User-Oriented Functions (during construction)

Assure dependability
  • Focus on construction safety

Assure convenience
  • Focus on motorist/pedestrian delay & wayfinding

Satisfy stakeholders
  • Focus on business owner/customer desires/impacts

Attract stakeholders
  • (CAR2015 scope)
Project Functionality Review

- **User-Operations functions**
  - **Assure dependability** examples
    - Safeguard motorists
    - Safeguard pedestrians
    - Protect environment
Project Functionality Review

- **User-Operations Functions**
  - **Assure convenience** examples
    - Inform motorists
    - Reduce delays
    - Reduce closure time
Project Functionality Review

- **User-Operations Functions**
  - **Satisfy stakeholders** examples
    - Maintain business access
    - Maintain church access
    - Accommodate emergency vehicles
Project Functionality Review

Overall POH/Ramps FAST Diagram

1. Technical FAST
2. How construct?
3. Customer FAST/How reduce impacts?
Project Functionality Review

POH/Ramps Technical FAST Diagram

Design/Constructability Portion – Facility Functions
Project Functionality Review

POH/Ramps FAST Diagram – How construct?

Staging/Constructability Portion – “Means & Methods” Functions
Project Functionality Review

POH/Ramps FAST Diagram – How reduce impacts?

Customer-Oriented FAST
User Operations & Safety (During Construction)

- Assure/Facilitate Dependability
- Assure/Facilitate Convenience
- Satisfy Stakeholders
- Attract Stakeholders

- Safeguard Motorists
- Safeguard Pedestrians
- Protect Environment
- Inform/Direct Motorists
- Reduce Delays
- Reduce Closure Time
- Maintain Business Access
- Maintain Church Access
- Accommodate Emergency Vehicles
- CAR 2015 Scope

Customer-Oriented Portion –
User Operations & Safety Functions

HOW? – Secondary CSW Scope

TECHNICAL FAST
(Design/Constructability)

Primary Const. Staging Workshop Scope

WHY?
Creative Phase

Three sub-teams:

1. **Facility Design** (designer viewpoint)
   - Focus on *Facility* functions
   - Objective: increase value and constructability; identify potential VECPs
2. Constructability/Construction Staging (contractor viewpoint)

- Focus on *Means & Methods* functions
- Objective: increase constructability, optimize construction staging; identify options to shorten schedule
3. **User Operations & Safety** (stakeholders/users viewpoint)

- Focus on *Operations & Safety* impacts
- Impacted users: MoDOT, Park Service, city, Metro transit, businesses, church, motorists, pedestrians
- Objective: reduce adverse impacts during construction
Creative Phase

- After sub-teams brainstormed creative ideas separately:
  - Sub-teams reported ideas to whole team
  - Whole team added ideas to sub-team lists
**Evaluation Phase**

- Qualitative impact classification: cost, time & user impact

<table>
<thead>
<tr>
<th>PROBABLE EFFECT ON FUNCTION</th>
<th>PROBABLE EFFECT ON COST/TIME/CONSTRUCTABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase</td>
</tr>
<tr>
<td></td>
<td>Requires additional funding (2+)</td>
</tr>
<tr>
<td></td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
</tr>
<tr>
<td>Same</td>
<td>Possible different approach (3)</td>
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<tr>
<td></td>
<td>(4)</td>
</tr>
<tr>
<td>Decrease</td>
<td>Scope deferral or elimination (2-)</td>
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<tr>
<td></td>
<td>(1)</td>
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<tr>
<td></td>
<td>(1)</td>
</tr>
</tbody>
</table>

- Idea rating by team voting
- **Workshop output**: classified/rated idea list
Development Phase

Post-Workshop Tasks

- Draft *Workshop Summary* – by workshop facilitator
  - Summary of workshop process
  - Ideas grouped & tabulated by sub-team category
  - Idea classifications & team ratings included
  - Supplemental constructability memorandum
Development Phase

Post-Workshop Tasks

- *Supplemental Constructability Memorandum* – by construction specialist
  - Comments on workshop ideas & additional ideas
  - Estimates of time savings
  - Monetization of estimated time savings
Post Workshop Tasks

- Design team analysis & development of feasible ideas
- Preliminary disposition of ideas by design team
- Presentation/preliminary dispositions meeting - 6 weeks after workshop
Disposition/Implementation

- Final dispositions by MoDOT
- Updated *Workshop Summary* sent to all workshop team members for comment
- Final *Workshop Report* incorporating workshop team comments
- Incorporation of accepted ideas into final construction documents
## Workshop Results

### Workshop Time Allocation

<table>
<thead>
<tr>
<th>Phase</th>
<th>Workshop Hours</th>
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<tr>
<td>Information</td>
<td>3.50</td>
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<tr>
<td>Functionality Review</td>
<td>1.00</td>
</tr>
<tr>
<td>Creative</td>
<td>1.50</td>
</tr>
<tr>
<td>Evaluation</td>
<td>1.00</td>
</tr>
<tr>
<td>Development</td>
<td>post-workshop</td>
</tr>
<tr>
<td>Presentation</td>
<td>post-workshop</td>
</tr>
<tr>
<td>Lunch &amp; Breaks</td>
<td>1.00</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>8.00</strong></td>
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</tbody>
</table>
## Workshop Results

### Creative Ideas Summary by Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>Facility design</td>
<td>33</td>
</tr>
<tr>
<td>Constructability/staging</td>
<td>49</td>
</tr>
<tr>
<td>User operations &amp; safety</td>
<td>44</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>126</strong></td>
</tr>
</tbody>
</table>

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**AASHTO**

**The Voice of Transportation**
### Workshop Results

#### Disposition Summary

<table>
<thead>
<tr>
<th>Sub-Team</th>
<th>A</th>
<th>A-M</th>
<th>A*</th>
<th>R</th>
<th>OS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Design</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>18</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>Constructability/construction staging</td>
<td>9</td>
<td>1</td>
<td>21</td>
<td>10</td>
<td>8</td>
<td>49</td>
</tr>
<tr>
<td>User operations &amp; safety impacts</td>
<td>15</td>
<td>2</td>
<td>11</td>
<td>1</td>
<td>15</td>
<td>44</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>27</td>
<td>6</td>
<td>37</td>
<td>29</td>
<td>27</td>
<td>126</td>
</tr>
</tbody>
</table>

**TOTAL ACCEPTED IDEAS:** 27 + 6 = 33

A = accepted; A-M = accepted with modifications; A* = accepted, already in baseline design; R = rejected; OS = out of scope
Workshop Results

- **Example Accepted Ideas**
  - **Single construction contract** – POH and Ramps Projects
    - Allows concurrent construction operations
    - No overlap of separate contract construction zones
    - Separate material storage areas not needed
    - Shortens construction schedule 2-3 months
Workshop Results

Example Accepted Ideas

- Close Walnut Street bridge; detour Old Cathedral traffic
  - Timed to avoid peak church season
  - Simplifies construction
  - Shortens construction schedule
Example Accepted Ideas

- Single construction contract
- Close Walnut Street bridge/detour Old Cathedral traffic
- Incentivize Walnut Street bridge construction
  - Contractor bonus to shorten construction time
  - Estimated time savings: 15 calendar days
Workshop Results

- Example Accepted Ideas
  - End-bent foundations: cored H-piles on rock
    - Eliminates pile-driving
    - Eliminates vibration & noise impacts on businesses & church
    - Also reduces risk of H-pile striking existing wall foundation
Example Accepted Ideas

- Single construction contract
- Close Walnut Street bridge/detour Old Cathedral traffic
- Incentivize Walnut Street bridge construction
- End-bent foundations: cored H-piles on rock
- Pedestrian wayfinding message boards
Workshop Results

- **Construction Time Savings**
  - 14 of 33 accepted ideas reduced calendar time
  - Estimated net calendar day savings: 3-4 months
  - Benefit: shortened schedule or schedule contingency
Workshop Results

- Construction Cost Savings
  - Cost savings of individual accepted ideas not calculated
  - Monetization of estimated time savings: $0.8 to $1.1 million
Workshop Results

- **Stakeholder/User Operations & Safety Impact Reductions**
  - Shortened schedule = *reduced user, stakeholder and economic impacts*
Workshop Results - Summary

- Workshop Goals Met
  - 33 accepted ideas vs. 10-12 goal
  - Improved constructability/shorter schedule (3-4 months shorter)
  - Reduced user/stakeholder impacts
  - Potential $0.8 to $1.1 million cost savings
  - Increased agency unity/cooperation
Lessons Learned – Team Feedback

- **Opportunities for improvement**
  - Additional workshop time
  - Less presentation time; more evaluation time

- **Strengths of workshop**
  - Open communication/team interaction
  - Interagency coordination
  - Discussion of project & staging plan by all stakeholders gives them ownership into decision-making
  - Ideas get considered in this environment that would generally get dismissed by certain interests
Lessons Learned

- Pre-work crucial
- 50% plans were ideal design level
- More workshop time desirable
- Post-workshop technical memo extended construction specialist value
- Idea-list workshop output effective
Conclusions

- Value Methodology has wide range of applications
- Value Methodology can be used for a *Construction Staging Workshop*
Application

- Other Potential *Construction Staging Workshop* Applications
  - Supplement a VE Study performed in concept stage
  - Smaller projects with no VE study
  - Multiple-agency project needing harmonization
  - Post award with awarded contractor
Project Construction

H-pile installation

Girders in place

Walnut Street deck placement

Completed land bridge deck
Project Construction

Geofoam installation on land bridge & Luther Ely Square drainage installation

- Courtesy CityArchRiver Foundation on-site Webcam
Project Construction

View of construction from top of Arch

- Courtesy CityArchRiver Foundation
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