

# MULTI-STATE ABC DECISION TOOL AND ECONOMIC MODELING

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Toni Doolen, PhD

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School of Mechanical, Industrial, and Manufacturing Engineering  
Oregon State University

# ABC Pooled Fund Study – TAC Members

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<b>State</b>	<b>Members and Titles</b>
Oregon	Benjamin Tang, P.E., Br Preservation Mgr Steve Soltesz, Research Coordinator Dawn Mach, Bridge Fin. Analyst Holly Winston, Sr. Local Bridge Std Engr
FHWA	Mary F. Huie, Highways for LIFE, Program Coordinator Tim Rogers, P.E., Division Bridge Engr Nat Coley, Asset Manager
California	Paul Chung, Sr. Bridge Engineer
Iowa	Ahmad Abu-Hawash, Chief Structural Engineer
Minnesota	Kevin Western, Bridge Design Engr
Montana	David Johnson, Bridge design Engineer
Texas	Courtney Holle, Transportation Engineer
Utah	Daniel Hsiao, P.E., S.E., Sr. Project Manager
Washington	Bijan Khaleghi , Design Engineer DeWayne Wilson, Bridge Management Engineer

# Overall Project Objective

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- ❖ **What:** A tool to help analyze different alternatives and determine which construction approach for a specific bridge project is preferred. Focus is on being able to compare conventional and ABC approaches.
- ❖ **Who:** Transportation specialists and decision-makers

# Project Goals and Target Users

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## ❖ Goals of Project

- Bring ABC to ordinary (bread and butter) bridges
- Create a tool that can communicate decision rationale
- Assists users of ABC elements in making ABC standard process (standardization)

## ❖ Target User Population

- Project managers
- Engineers
- Project owners
- Budget offices

# Agenda

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1. **Criteria definitions**
2. **Criteria hierarchy**
3. **Decision-making approach**
4. **ABC vs. Conventional decision-making examples**
5. **Software for AHP analysis**

# 1. Criteria Examples

**Criteria**



**Sub -Criteria**



**Definitions**



Criteria	Sub -Criteria	Definitions
Indirect Costs	User Delay	This factor captures costs of user delay at a project site due to reduced speeds and/or off-site detour routes.
	Freight Mobility	This factor captures costs of freight delay at a project site due to reduced speeds and/or off-site detour routes.
	Revenue Loss	This factor captures lost revenues due to limited access to local business resulting from limited or more difficult access stemming from the construction activity.
	Livability During Construction	This factor captures the impact to the communities resulting from construction activities. Examples include noise, air quality, and limited access.
	Road Users Exposure	This factor captures the safety risks associated with user exposure to the construction zone.
	Construction Personnel Exposure	This factor captures the safety risks associated with worker exposure to construction zone.

# 2. Criteria Hierarchy

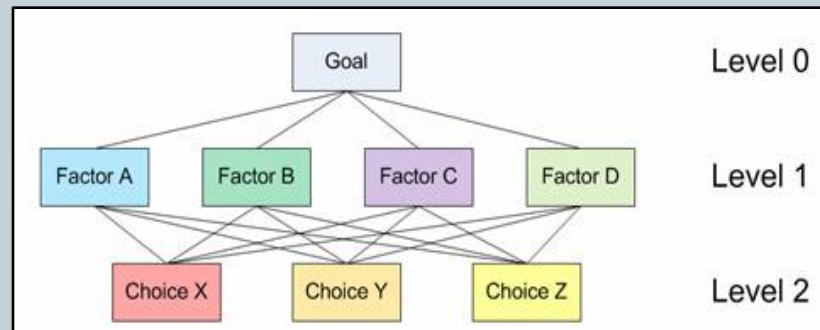
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# 3. Decision-Making Approach

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- ❖ AHP (Analytic Hierarchy Process) is a decision-making technique designed to select the best alternative from a set of alternatives evaluated against several criteria (Saaty & Vargas, 2001).
- ❖ The decision maker performs simple pair-wise comparisons that are used to develop an overall priority for ranking each alternative.



# Criteria Comparisons

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- ❖ Comparisons between criteria and sub-criteria are performed using data from actual measurements or using a pre-determined qualitative scale
- ❖ The comparison is used to assess the relative preference for one criteria over another criteria
- ❖ AHP enables several criteria to be included in an analysis, but requires the decision-maker to complete only pair-by-pair comparisons (pairwise)

# Pairwise Comparisons Example

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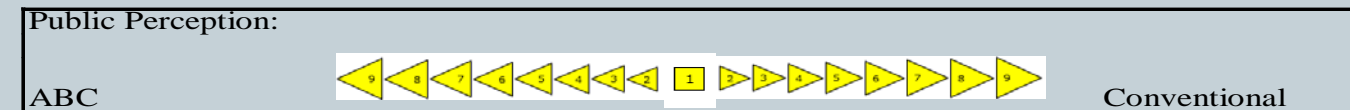


Level 1

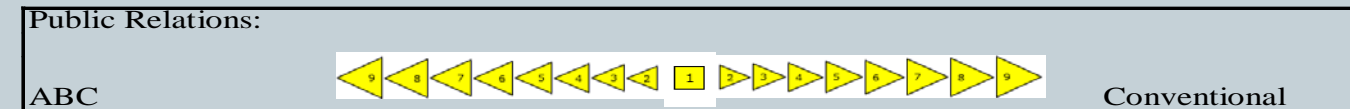
## Customer Service:



Level 2



Level 3



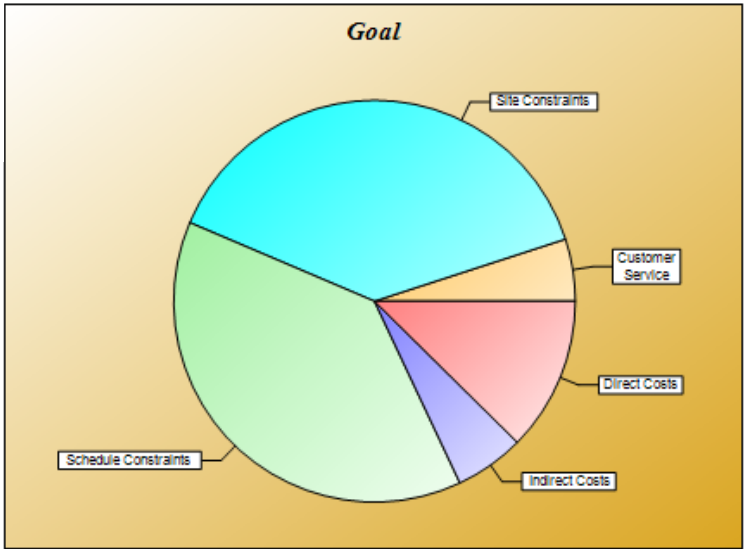
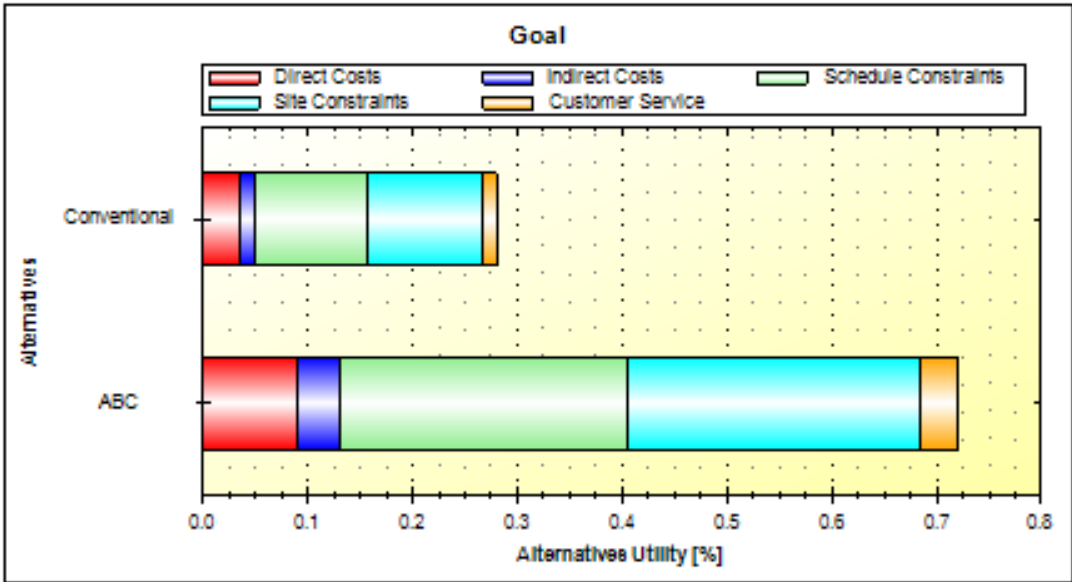
**4. ABC VS. CONVENTIONAL  
DECISION-MAKING USING  
AHP  
EXAMPLES**

# Project A: Copano Bay Bridge in Texas

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- ❖ **Connecting the cities of Rockport/Fulton and Lamar**
- ❖ **11,010 feet long, with a 129' wide and 75' tall navigation channel**
- ❖ **Data for this project was obtained from Texas DOT**
- ❖ **Alternatives Compared: Cast in Place (Conventional method) versus Pre-Cast Caps (ABC method)**
- ❖ **Best Alternative: ABC is highly preferred**
- ❖ **Critical Factors: Schedule Constraints and Site Constraints**

# Project A Results

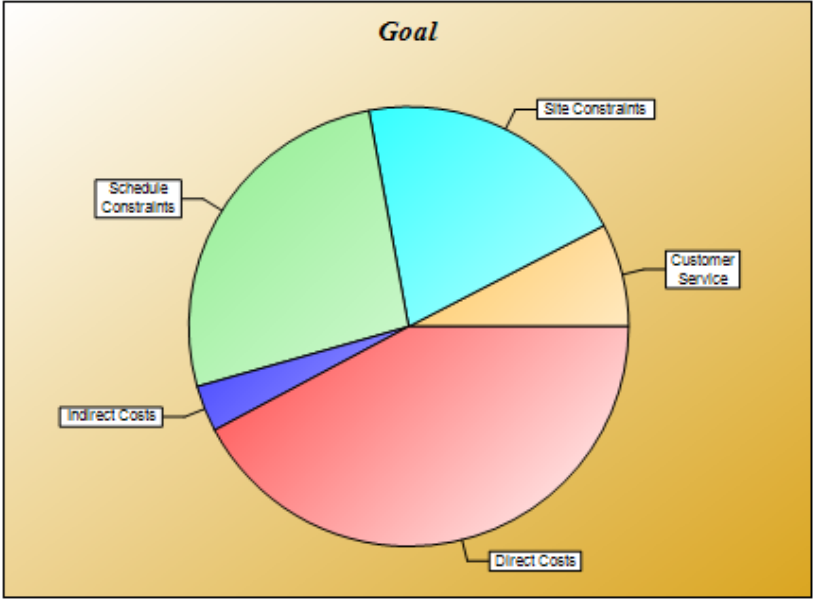
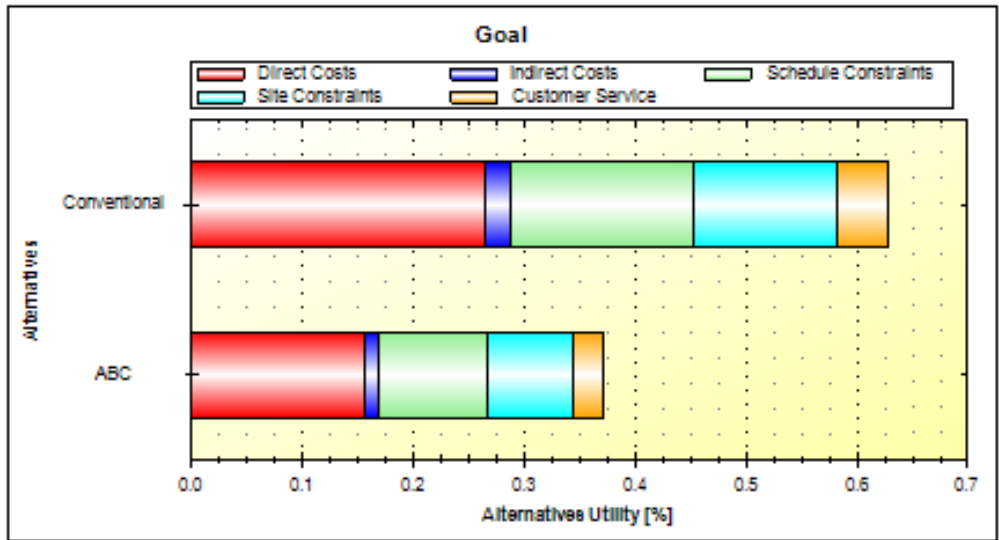


# Project B: Clear Creek Bridge in Oregon

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- ❖ Located on Clear Creek, Gulick Lane
- ❖ Existing Bridge length: 29ft steel girders on concrete vertical abutments
- ❖ Data for this project was obtained from Oregon DOT
- ❖ Alternatives Compared: Conventional construction versus ABC
- ❖ Best Alternative: Conventional
- ❖ Critical Factor: Direct Costs

# Project B Results



## **5. ABC DECISION- MAKING SOFTWARE STRUCTURE**

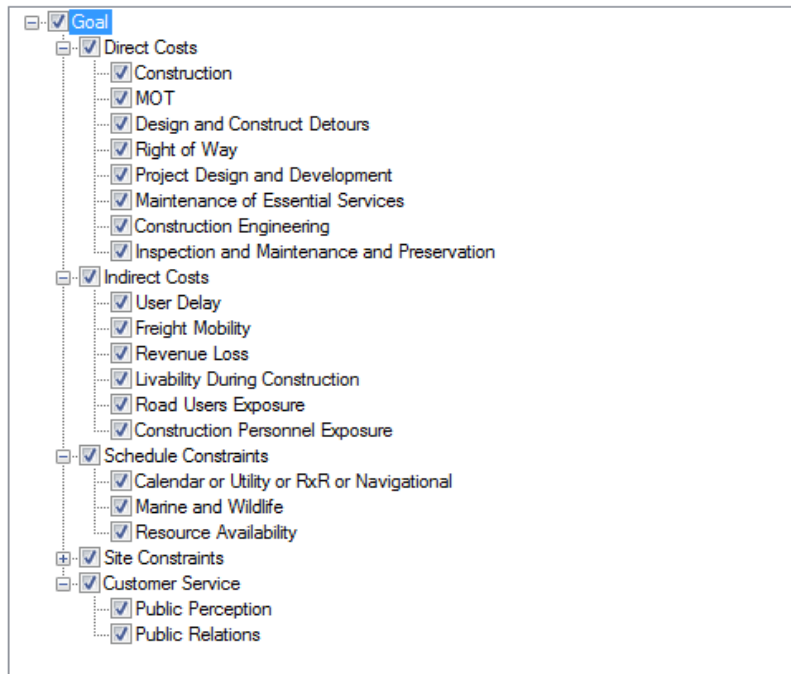
# Hierarchy

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AHP Decision Making Software

File Help

Decision Hierarchy Pairwise Comparison Results Cost Weighted Analysis



Add Child

Save State

Remove

Load State

Reset to Default

Save Hierarchy

Load Hierarchy

Check All

Set Alts.

# Criteria Comparisons

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AHP Decision Making Software

File Help

Left / Right

Decision Hierarchy Pairwise Comparison Results Cost Weighted Analysis

Direct Costs  9  7  5  3  1  3  5  7  9

Indirect Costs

Direct Costs  9  7  5  3  1  3  5  7  9

Schedule Constraints

Direct Costs  9  7  5  3  1  3  5  7  9

Site Constraints

Direct Costs  9  7  5  3  1  3  5  7  9

Customer Service

Indirect Costs  9  7  5  3  1  3  5  7  9

Schedule Constraints

Indirect Costs  9  7  5  3  1  3  5  7  9

Site Constraints

Indirect Costs  9  7  5  3  1  3  5  7  9

Customer Service

Schedule Constraints  9  7  5  3  1  3  5  7  9

Site Constraints

Schedule Constraints  9  7  5  3  1  3  5  7  9

Customer Service

[-] Goal

- [+] Direct Costs
- [+] Indirect Costs
- [+] Schedule Constraints
- [+] Site Constraints
- [+] Customer Service

Save Comparison

Process

Save State

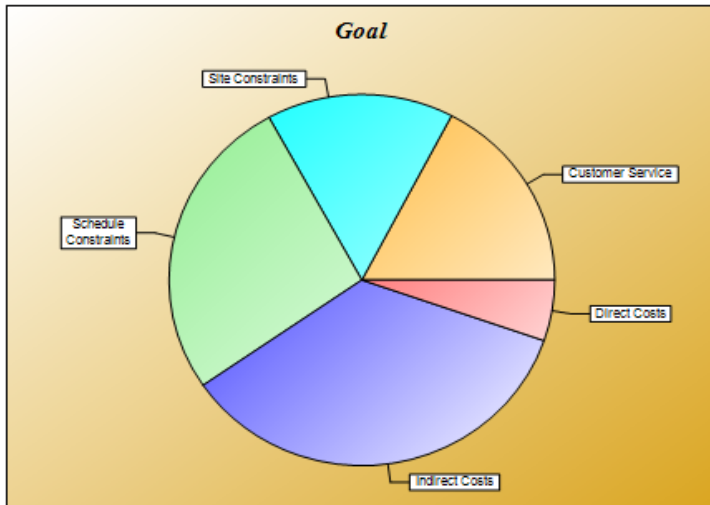
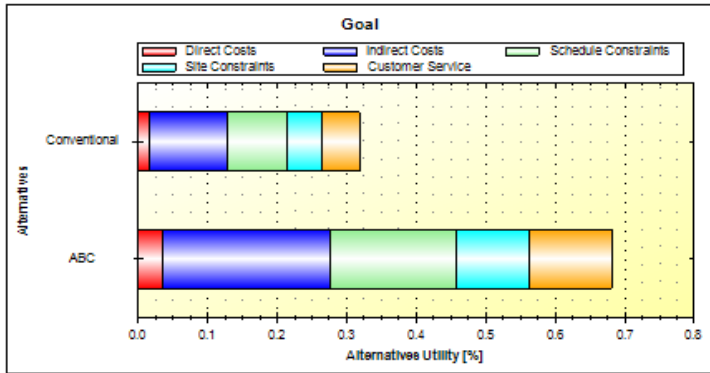
# Results

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AHP Decision Making Software

File Help

Decision Hierarchy Pairwise Comparison Results Cost Weighted Analysis



-- Alternatives Utility [%] --

ABC: 0.681  
Conventional: 0.319

-- Criteria Utility Contribution [%] --

Direct Costs:  
ABC: 3.6 Conventional: 1.7  
Indirect Costs:  
ABC: 23.9 Conventional: 11.2  
Schedule Constraints:  
ABC: 18.1 Conventional: 8.5  
Site Constraints:  
ABC: 10.7 Conventional: 5  
Customer Service:  
ABC: 11.8 Conventional: 5.5

-- Synthesized Criteria Weights --

Direct Costs: 5.3%  
Indirect Costs: 35.1%  
Schedule Constraints: 26.6%  
Site Constraints: 15.7%  
Customer Service: 17.3%

Goal

Direct Costs= (0.053)  
Indirect Costs= (0.351)  
Schedule Constraints= (0.266)  
Site Constraints= (0.157)  
Customer Service= (0.173)

# Questions/Discussion

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- Toni L. Doolen, PhD
- Oregon State University
- [doolen@engr.orst.edu](mailto:doolen@engr.orst.edu)
- 541-737-5641