A Planning Phase Decision Tool for ABC

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September 2011

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Oregon State University

FHWA-sponsored pool funded study, TPF 5(221), Technical Advisory Committee

State	Members and Titles
Oregon	Benjamin Tang, P.E., Br Preservation Manager Steve Soltesz, Research Coordinator Dawn Mach, Bridge Fin. Analyst Holly Winston, Sr. Local Bridge Standards Engineer
FHWA	Mary F. Huie, Highways for LIFE, Program Coordinator Tim Rogers, P.E., Division Bridge Engineer Nat Coley, Asset Manager
California	Paul Chung, Sr. Bridge Engineer
Iowa	Ahmad Abu-Hawash, Chief Structural Engineer
Minnesota	Kevin Western, Bridge Design Engineer
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

- 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 accelerated construction approaches.

- Who: Transportation specialists and decision-makers

Project Goals and Target Users

- Goals of Project
  - Bring Accelerated Bridge Construction (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
  - Program planners

ABC

- ABC includes technical innovations and management techniques.
  - Prefabricated bridge elements and systems (PBES)
    - Superstructure systems (composite units, truss spans)
    - Substructure systems (abutments, caps/columns, piers)
    - Totally prefabricated bridges
  - Management practices
    - Staged construction
    - A+B contracting
    - I/D contracting
    - Lane rentals

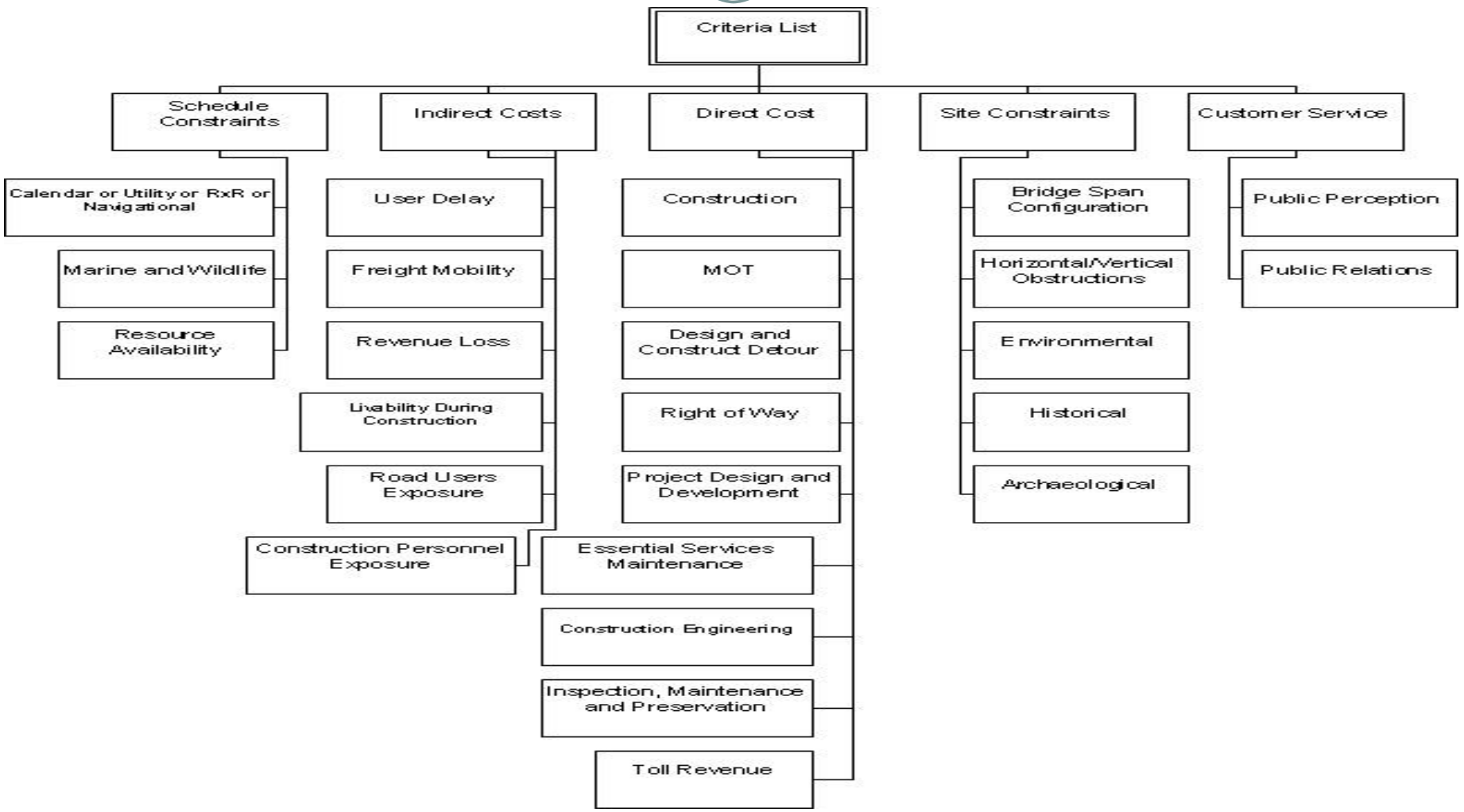
Agenda

1. Identification and organization of criteria
2. Defining decision-making criteria
3. AHP analysis details
4. AHP examples for bridge replacement projects
5. Software for AHP analysis

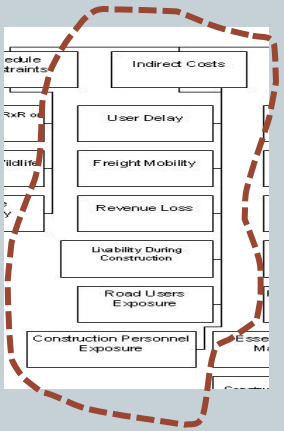
1. Criteria Identification

- TAC team members along with research team developed a comprehensive list of criteria that are relevant to the decision of when to use ABC tools/methods for a project. Each criteria was defined and sub-criteria were defined, as appropriate.

1. Criteria Organization



2. Defining Criteria (Example)



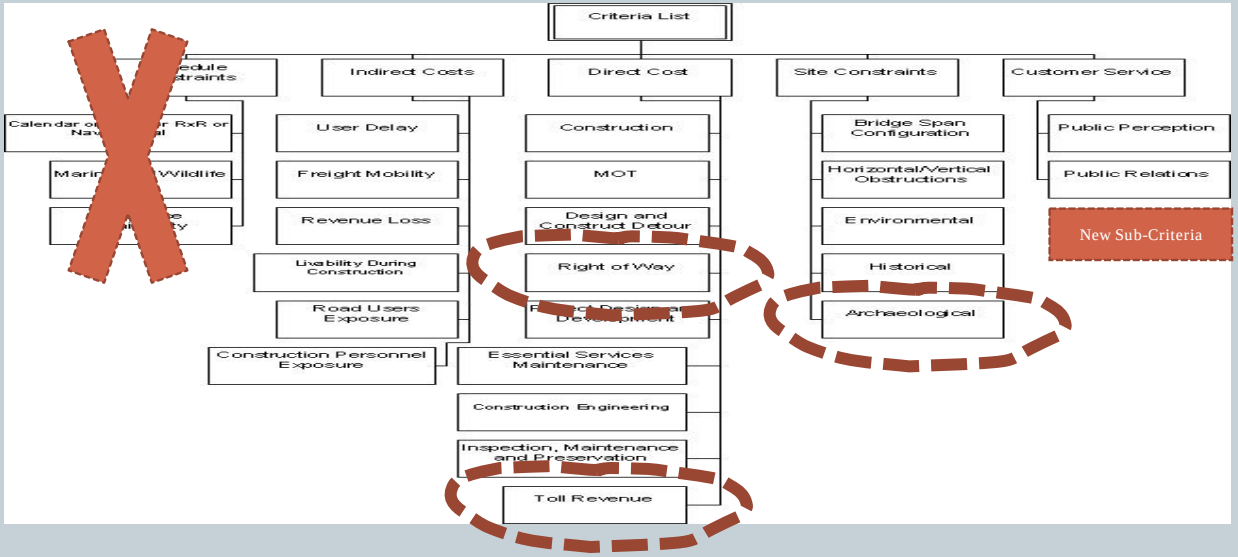
Criteria	Sub -Criteria	Definitions
Indirect Costs	User Delay	This factor captures costs of user delay at a project site due to reduced speeds and/or off-site detour routes.
	Freight Mobility	This factor captures costs of freight delay at a project site due to reduced speeds and/or off-site detour routes.
	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.

3. AHP Analysis Details

- AHP (Analytic Hierarchy Process) is a decision-making technique designed to select the best alternative from a set of alternatives evaluated against several criteria.
- The decision maker performs pair-wise comparisons that are used to develop an overall priority ranking for each alternative.
- Criteria are compared to assess the relative importance of one criteria over another criteria or of one sub-criteria over another sub-criteria from the same category of criteria.
- AHP enables several criteria to be included in an analysis, but requires the decision-maker to complete only pair-by-pair comparisons (pairwise)

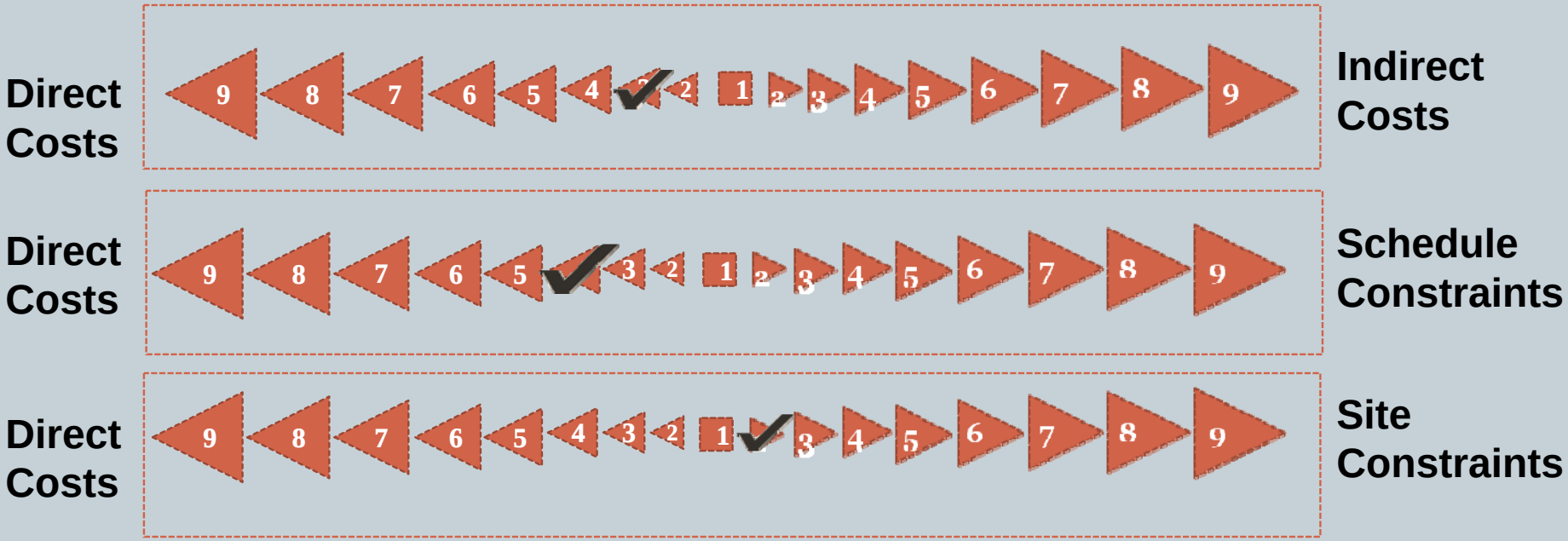
AHP Analysis Details (continued)

- A decision maker can insert or eliminate levels and elements as necessary to sharpen the focus on one or more parts of the analysis. Less important criteria and sub-criteria can be dropped from further consideration.



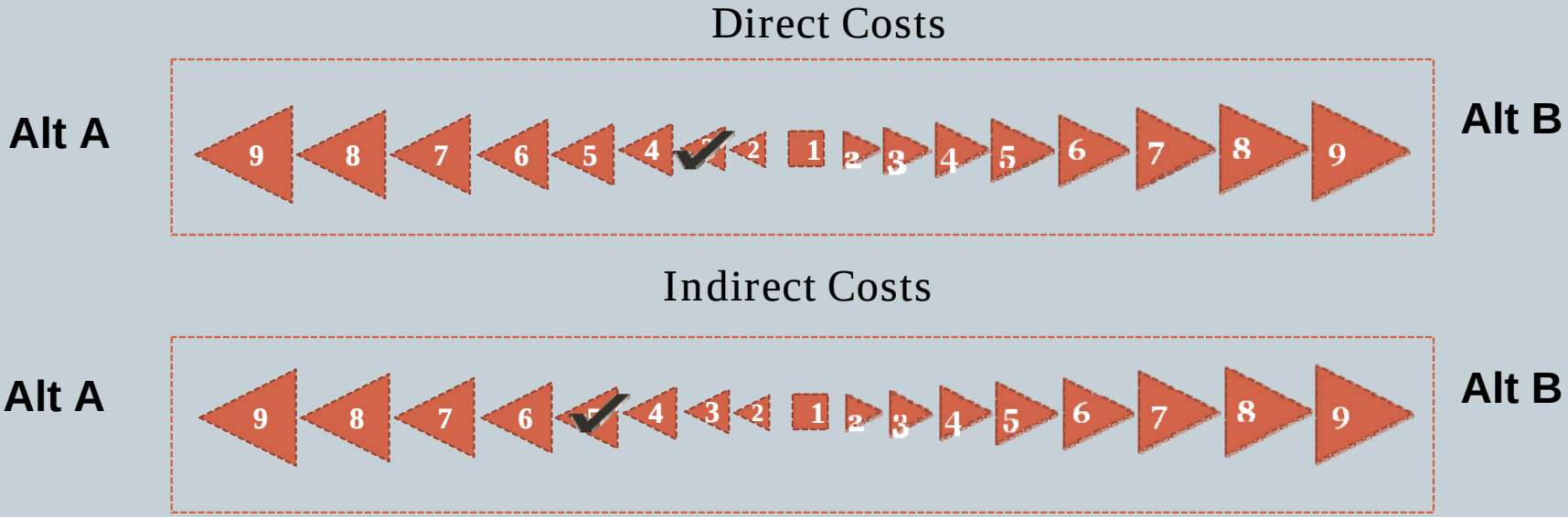
AHP Analysis Details (continued)

- Comparisons between criteria and between sub-criteria are performed using data from actual measurements or using a qualitative scale.



AHP Analysis Details (continued)

- Comparisons are also used to assess the extent to which one alternative satisfies a criteria over another alternative.

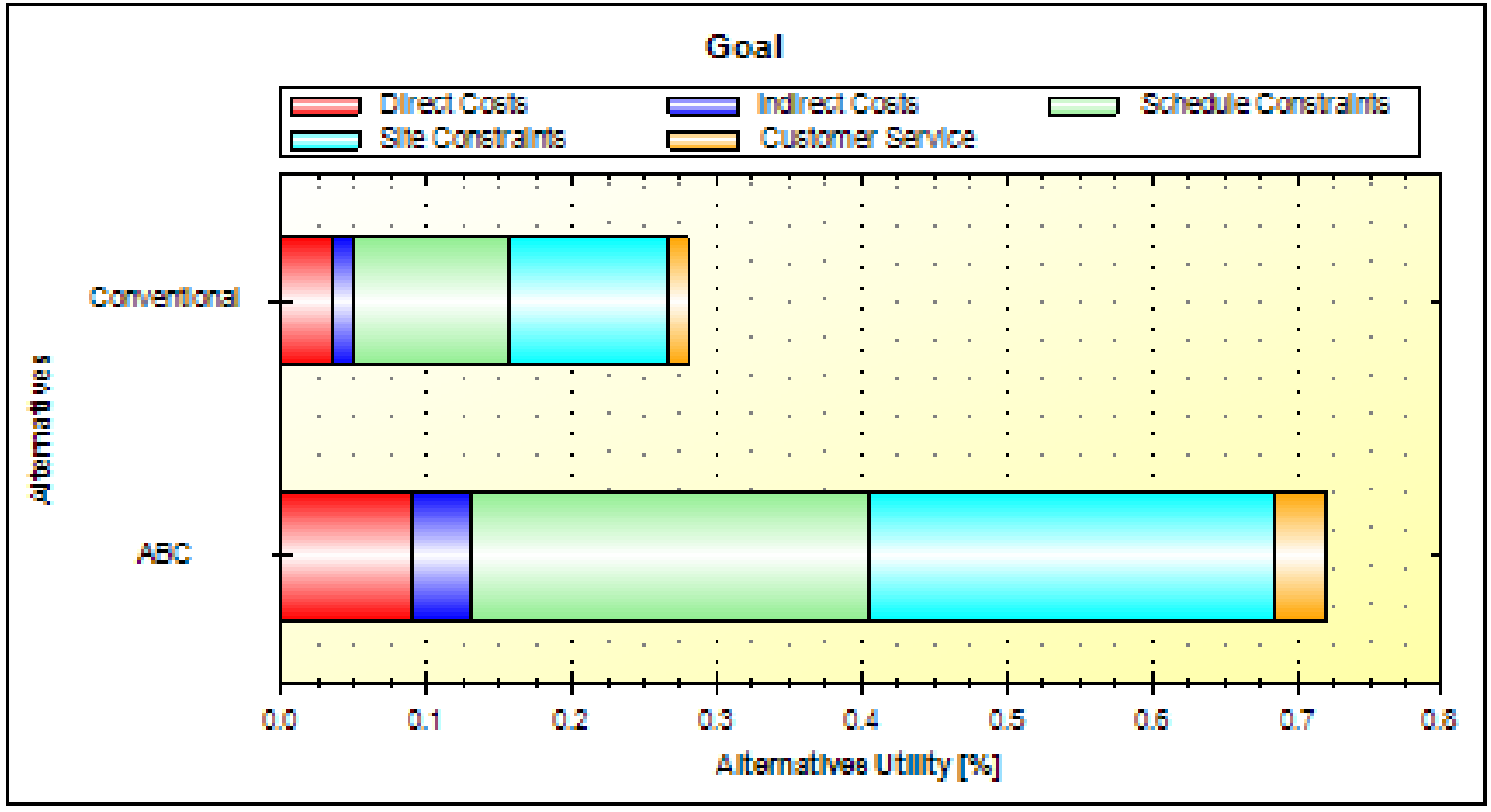


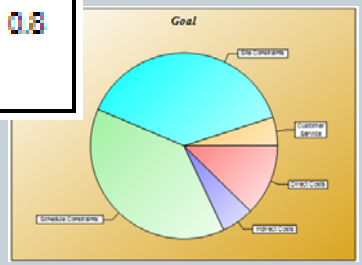
4. AHP EXAMPLES FOR BRIDGE REPLACEMENT PROJECTS

Project A: Copano Bay Bridge in Texas

- 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





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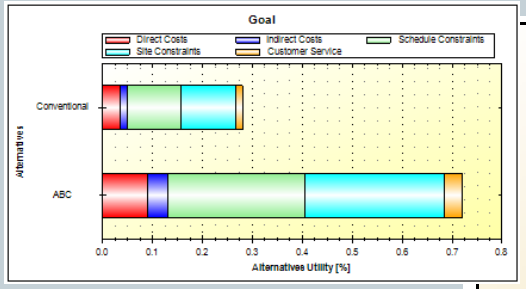
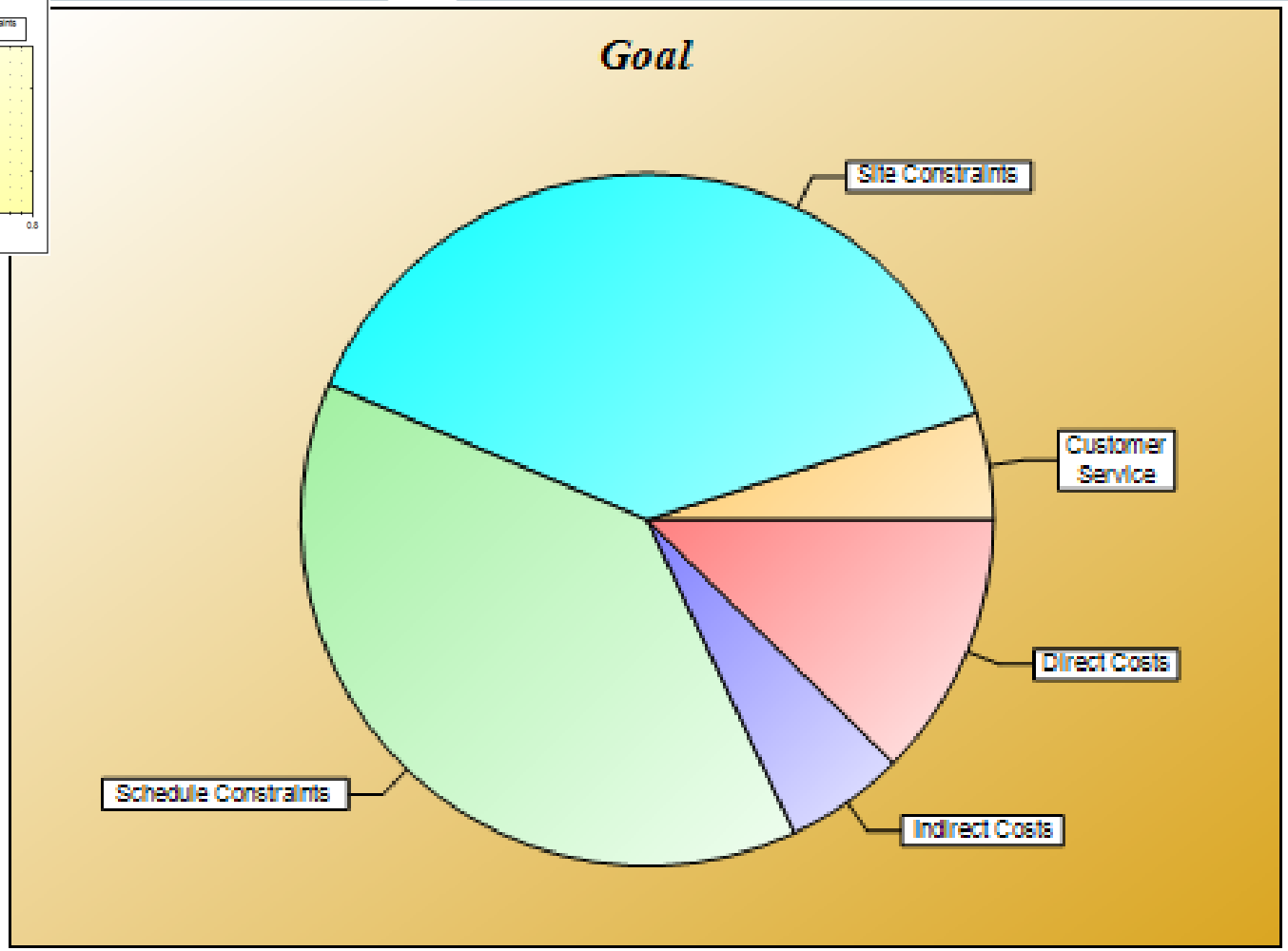
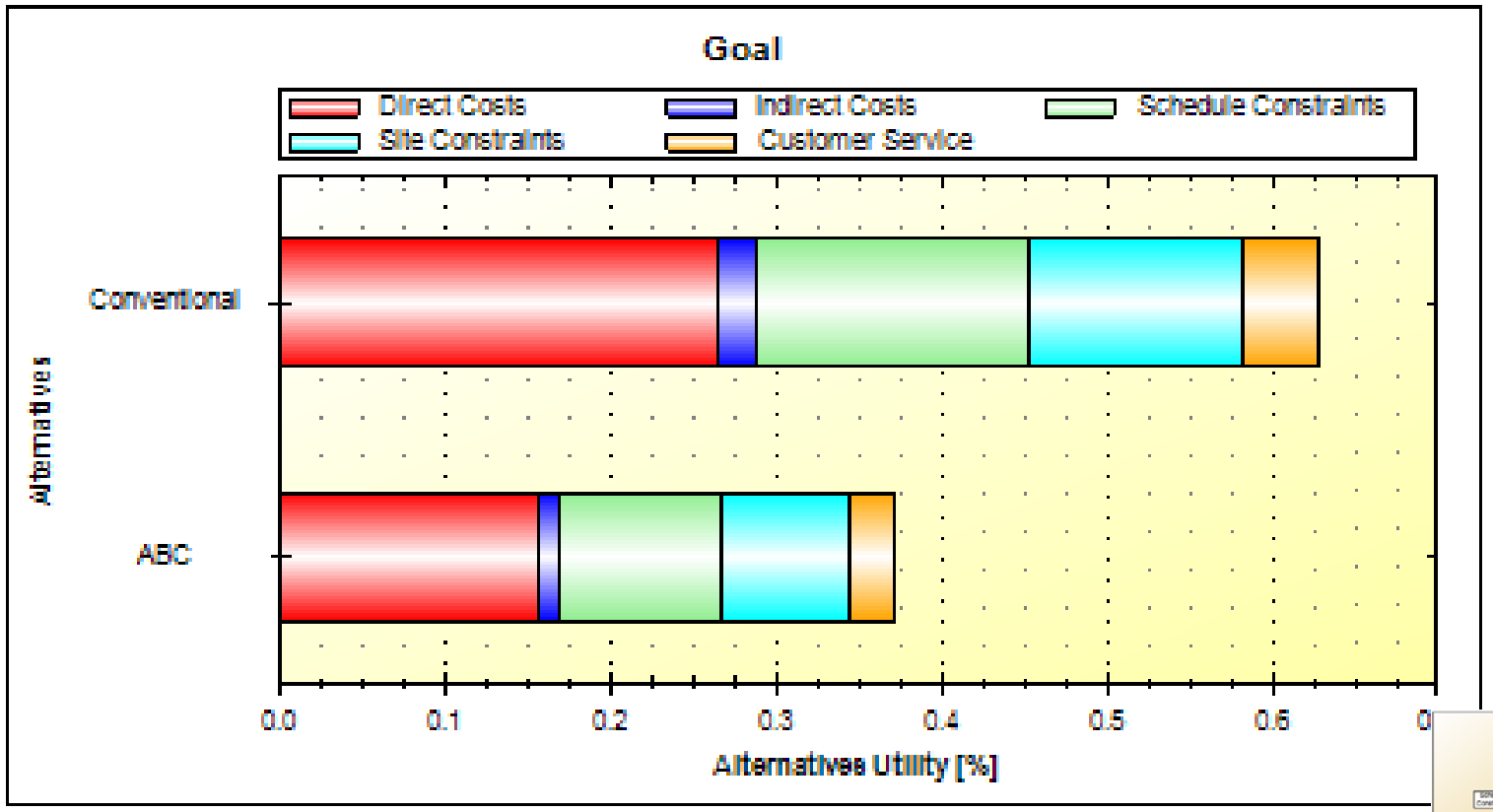


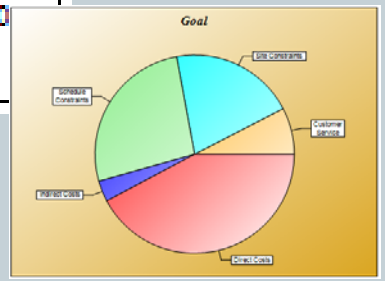


Project B: Clear Creek Bridge in Oregon

- Located on Clear Creek, Gulick Lane
- Existing Bridge length: 29’ 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





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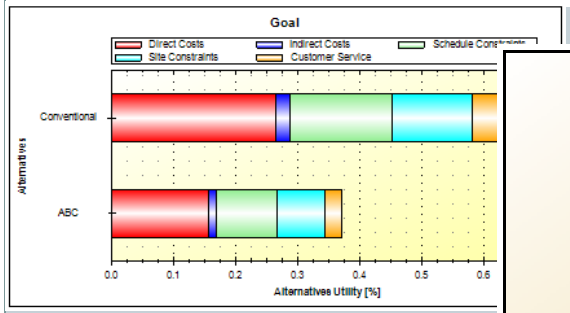
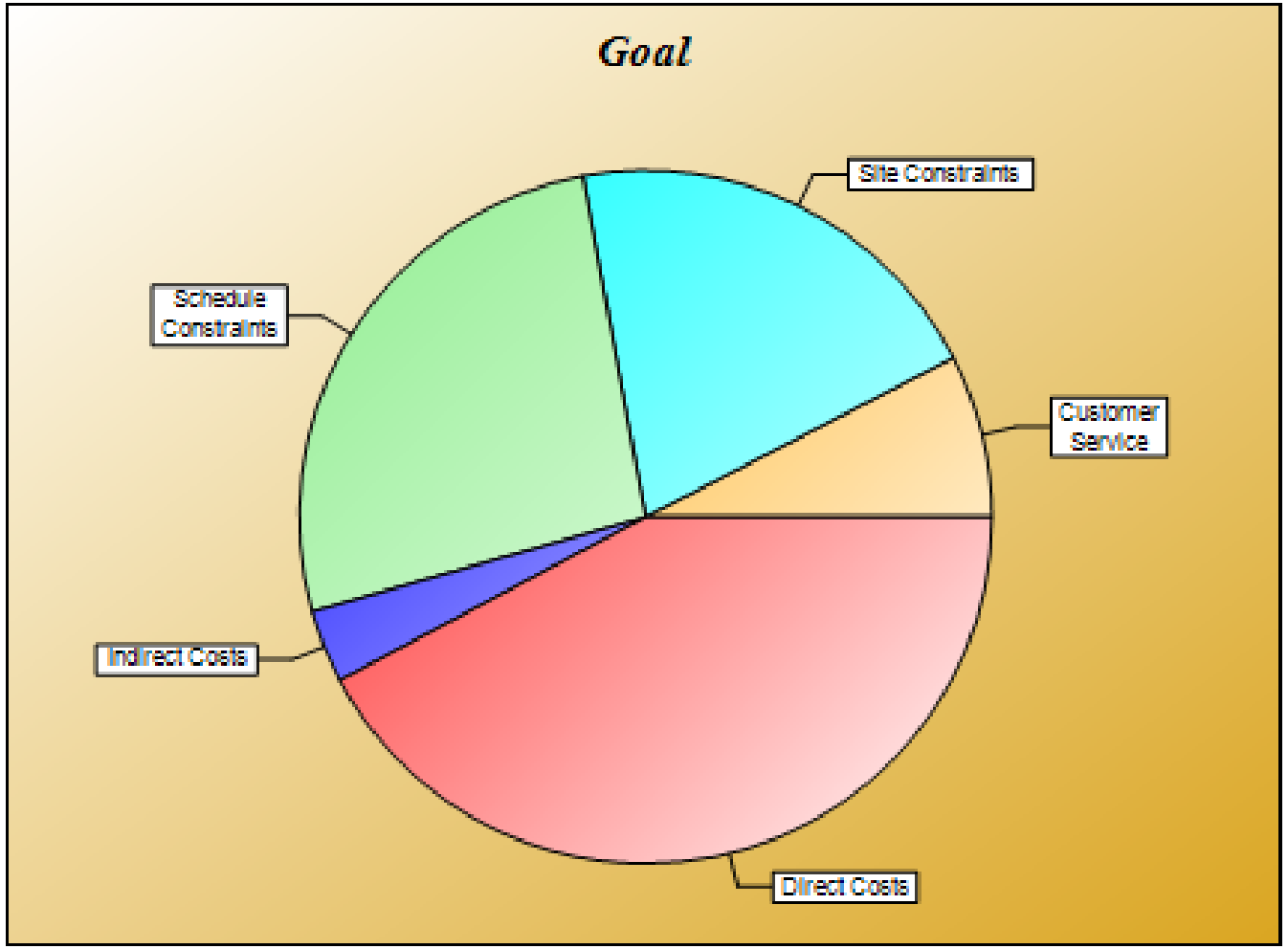
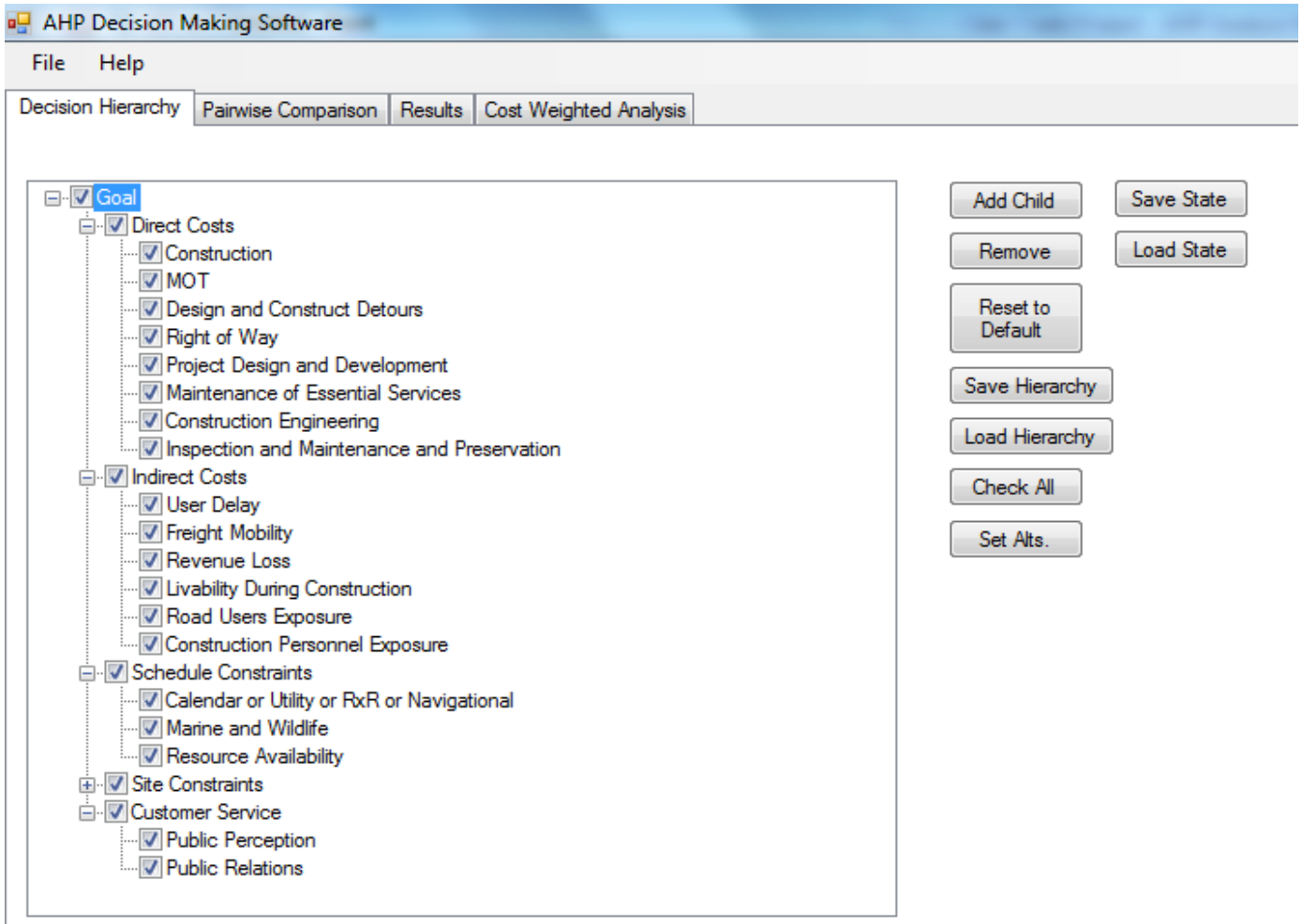




6. ABC DECISION-MAKING TOOL

Hierarchy


AHP Decision Making Software
File
Help
Decision Hierarchy
Pairwise Comparison
Results
Cost Weighted Analysis
Goal
Direct Costs
Construction
MOT
Design and Construct Detours
Right of Way
Project Design and Development
Maintenance of Essential Services
Construction Engineering
Inspection and Maintenance and Preservation
Indirect Costs
User Delay
Freight Mobility
Revenue Loss
Livability During Construction
Road Users Exposure
Construction Personnel Exposure
Schedule Constraints
Calendar or Utility or RxR or Navigational
Marine and Wildlife
Resource Availability
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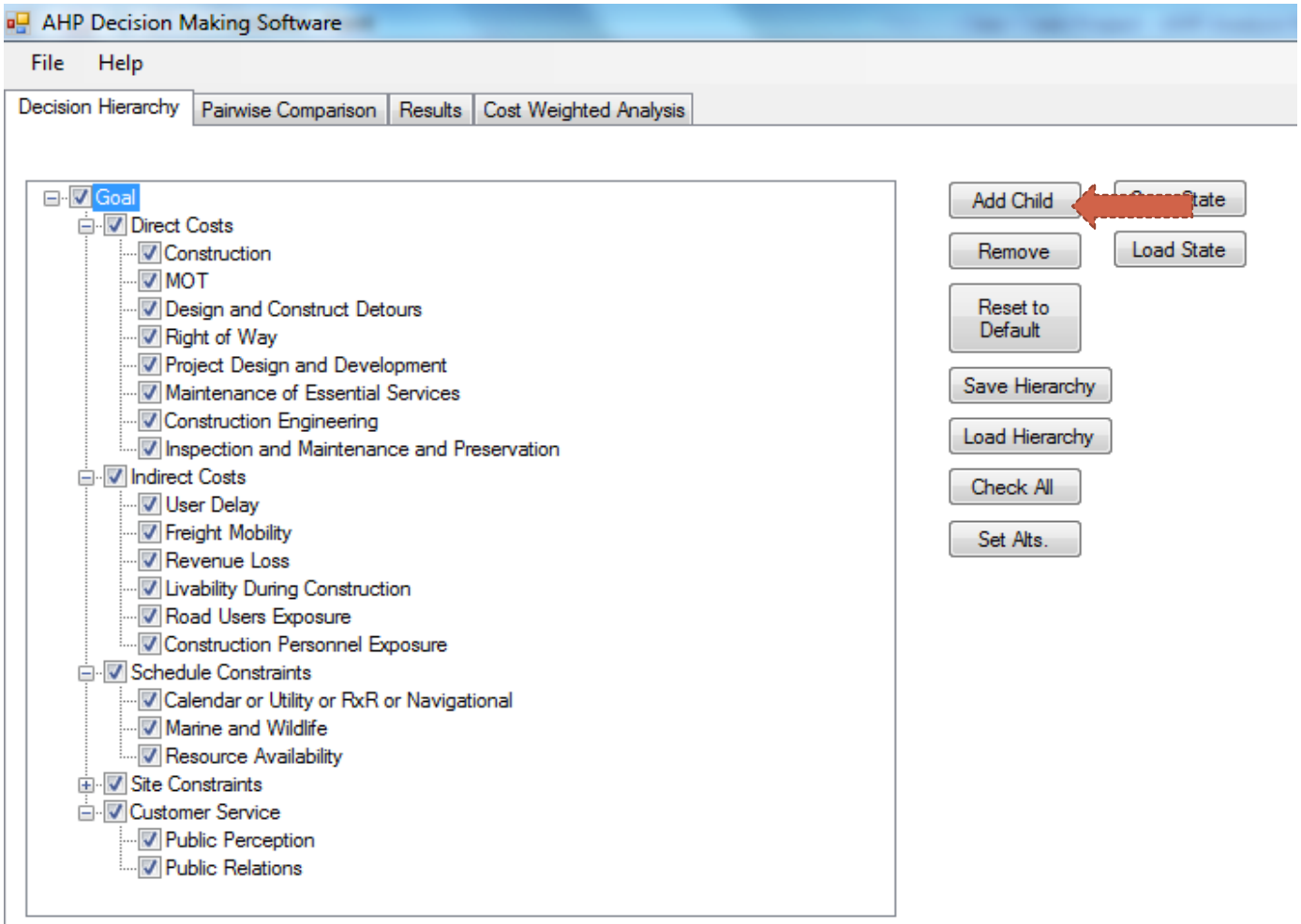
Public Relations
Add Child
Save State
Remove
Load State
Reset to Default
Save Hierarchy
Load Hierarchy
Check All
Set Alts.

Hierarchy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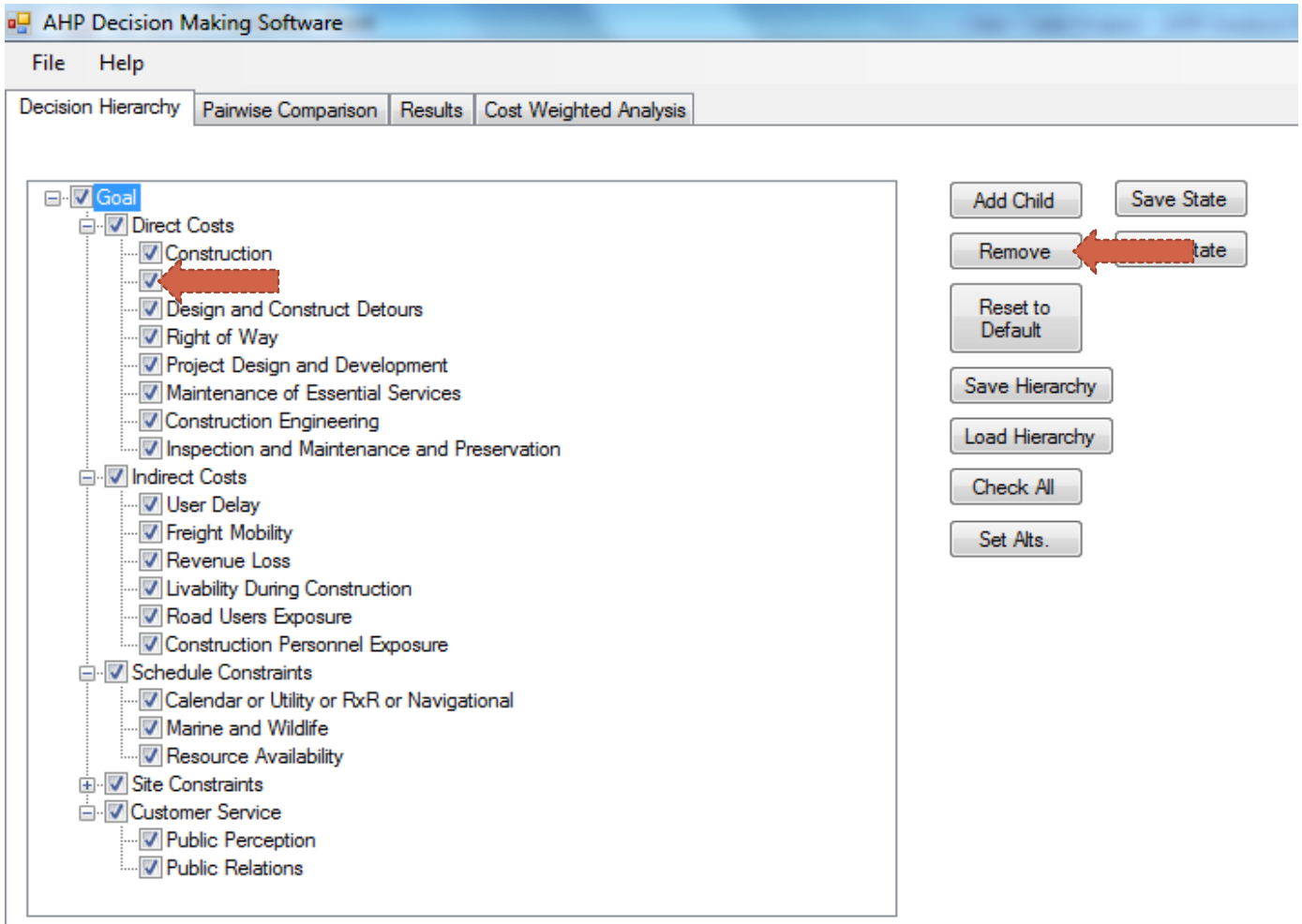
Hierarchy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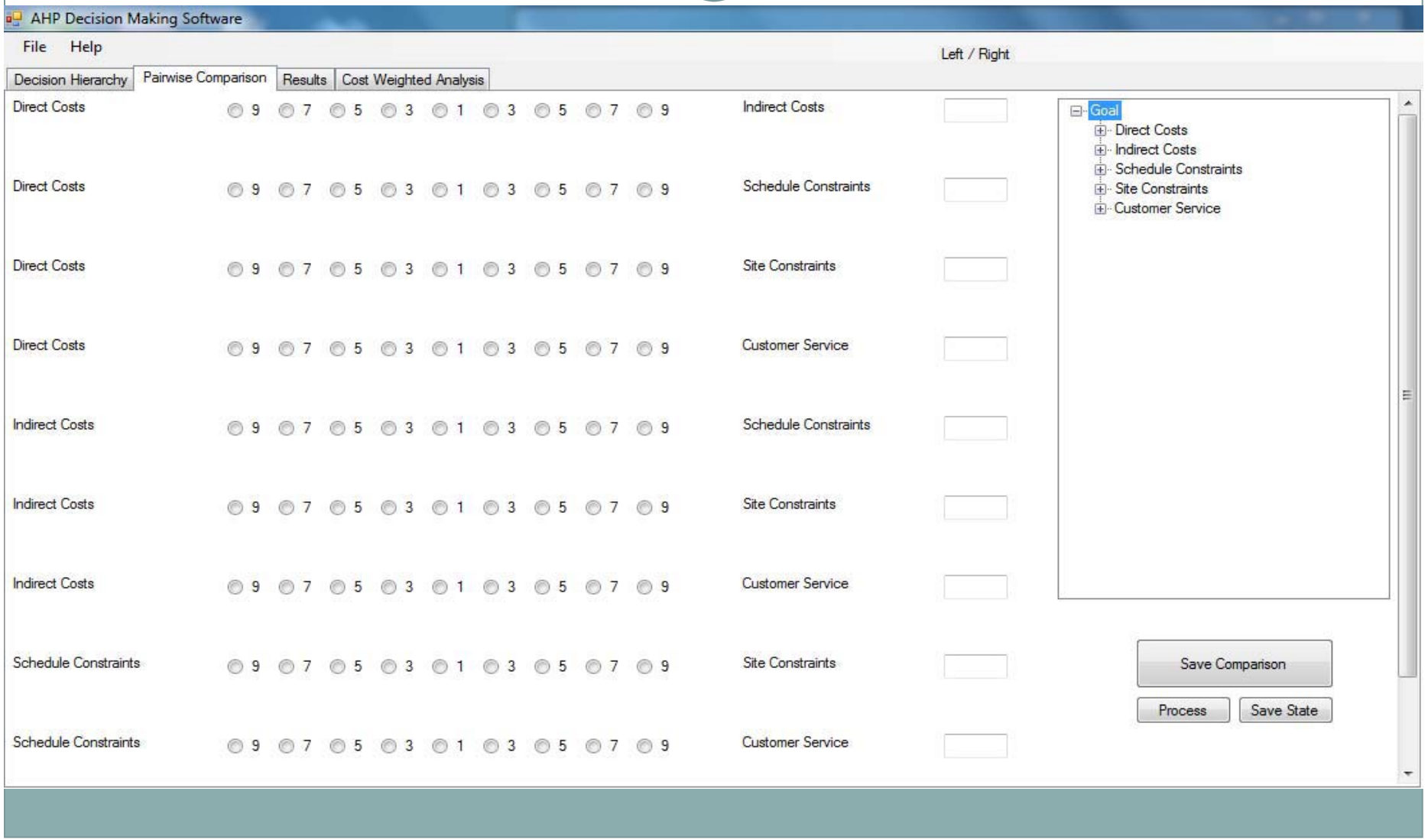
Criteria Comparisons

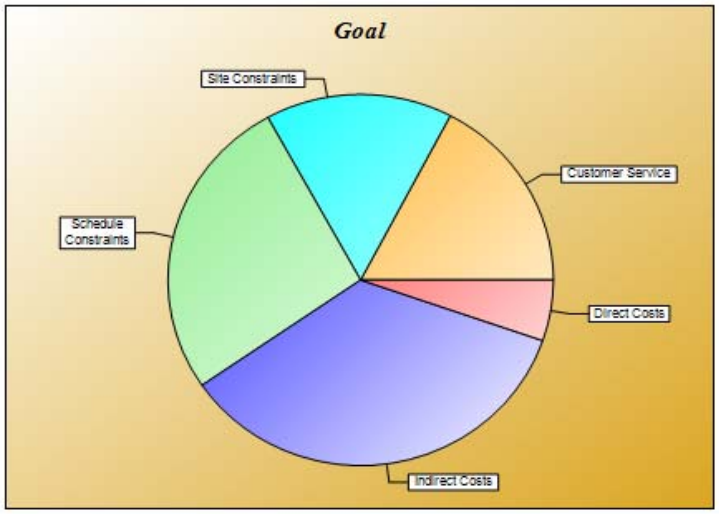


Results

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)

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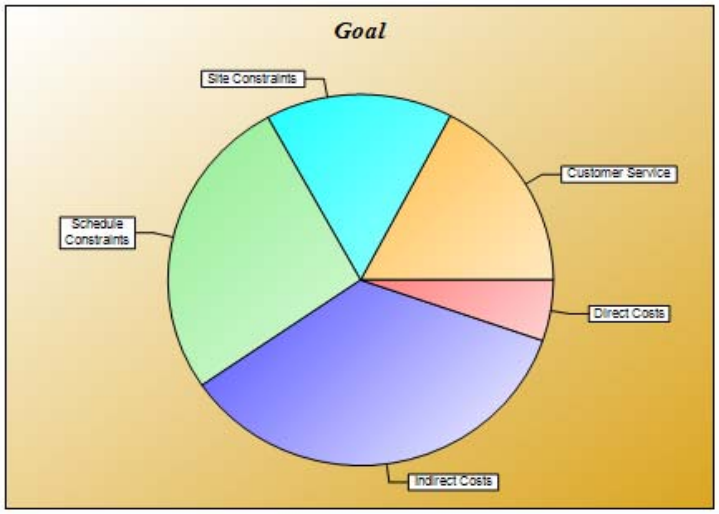

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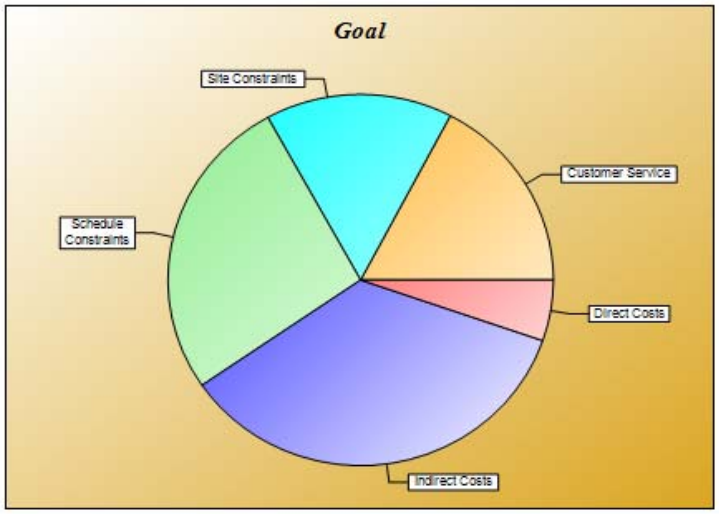

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Contact Details

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