Paired Value Comparison as a Consensus-building Tool for Multi-party, Multi-attribute Decisions

"How Can We Agree on Value?"

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Baltimore DAAG Meeting

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- Why Multi-attribute (*the problem*)?
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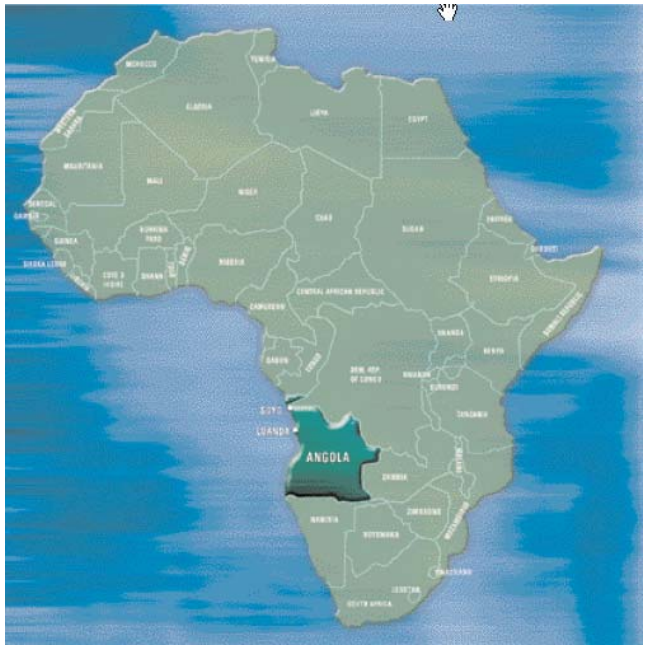
About Angola LNG* (*the project*)

- Angola is one of the world's deep water oil exploration "hot spots."
  - More than 50 significant oil discoveries … are believed to contain at least 10 billion barrels of oil.
- With the increase in oil production will come large quantities of associated gas.
  - Historically, in the absence of a local market, associated gas has been flared or re-injected into the gas reservoirs.
- Sonangol, the state oil company, and its oil producing partners are developing the Angola LNG Project to reduce flaring of a non-renewable resource and curtail gas injection…
  - Angola LNG is a joint venture project involving Sonangol and affiliates of Chevron, ExxonMobil, Total, and BP.



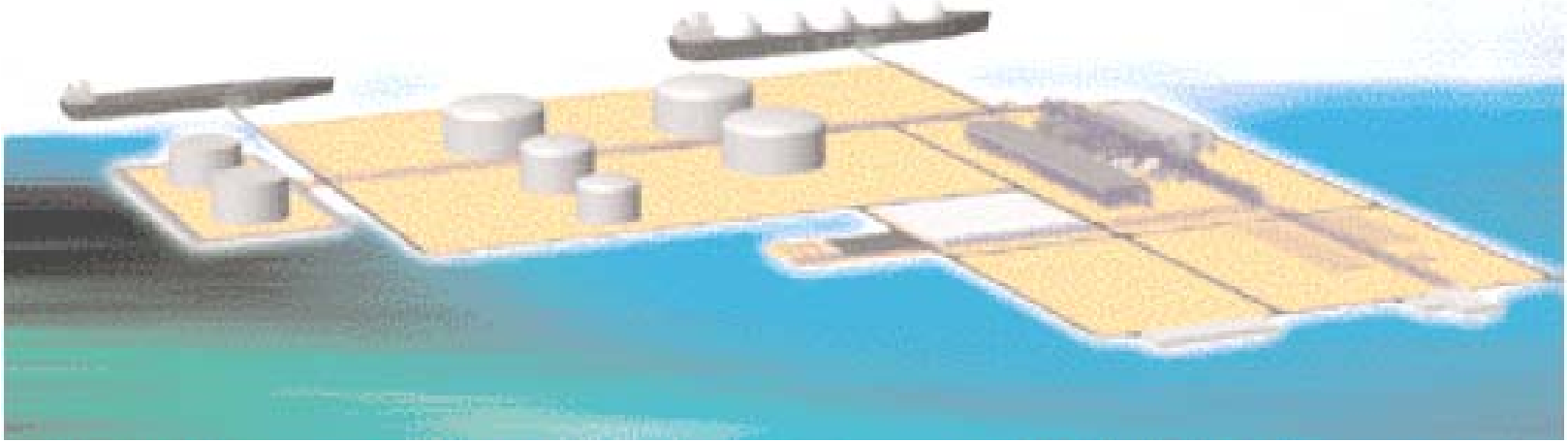
* *Source: "Leading with Vision" brochure, GasTech, Angola LNG*

Why Multi-attribute (*the problem*)?

The Angola LNG Project includes the complete value chain, including:

- Pipelines from FPSO's and (eventually) wells (non-associated gas from previously discovered fields)
- LNG Plant and Marine Terminal
- LNG Shipping Fleet
- Regasification Terminal and Pipeline Capacity to Markets

The Project must evaluate proposals to provide equipment, construction and capacity for each part of the value chain. Economics (financial) is ***only one part of the evaluation***.



How does Multi-attribute Fit into the Decision Analysis Process (*the flow*)?

Typical DA Frame:

- Problem Statement
- Issue Raising
- Situation Analysis
- Stakeholder Analysis
- Objectives Hierarchy
- Decision Hierarchy
- Decision Tree
- Strategy Table
- Influence Diagram

Typical DA Analysis:

- Financial Model
- Risk and Uncertainty Assessment
- Tornado
- Cumulative Probability
- VOI / VOC
- Implementation

Multi-attribute Analysis:

- Additional Attributes
- Attribute Weights
- Attribute Scoring
- Qualitative versus Quantitative: Trade-offs

Where Use Paired-value Comparison (within *the* multi-attribute *process*)?

- Additional Attributes
- Attribute Weights: Facilitation
  1. Equal weighting
  2. Next alternative: "Edwards" weights*
     - i = case, n = number of items

$$weight = \sum_{j=0}^{n-i} \frac{1}{(i+j)n}$$

  3. **Next alternative: paired-value comparison**
  4. Last alternative: direct assignment
- Attribute Scoring
  1. **Paired value comparison**
  2. Direct scoring
- Qualitative versus Quantitative: Trade-offs
  1. **Paired value comparison of "efficient frontier" cases**
  2. Qualitative discussion

** Source: Ward Edwards, personal conversation*

Why Use Paired-value Comparison (*the motivation*)?

Relative to direct scoring, a paired comparison process to score alternatives (for each of the selection attributes) was selected because:

- Paired comparison leads to a systematic, methodical, and thorough evaluation,
- Thinking behind the scoring is easily captured and documented,
- The process is relatively resistant to bias and gaming, and
- It stimulates the thinking process and is relatively resistant to group think.

How does Paired-value Comparison Work (*the method*)?

Example 1: Weighting Attributes

1. Set up a matrix (usually in Excel®) where each attribute is compared with each other attribute.
2. Compare attribute 1 with attribute 2.
   - Which is more important? Why? "Headline" the thinking!
   - Strong or mild preference?
     Score 0 for tie, 1 for mild, 2 for strong preference.
   - Record results
3. Repeat for each possible combination
4. Add up scores for each attribute.
5. Convert to percentage for each attribute. These are your weights.

How does Paired-value Comparison Work (*the method*)?

Example 2: Scoring Attributes

1. Set up a matrix (usually in Excel®) where each item to be scored (e.g. proposal) is compared each other item *for each attribute*.
2. Compare proposal 1 with proposal 2 for the first attribute.
   - Which is preferred? Why? "Headline" the thinking!
   - Strong or mild preference?
     Score 0 for tie, 1 for mild, 2 for strong preference.
   - Record results
3. Repeat for each possible combination of proposals.
4. Repeat for each attribute.
5. Add up scores for each proposal.
6. Weight the added up scores according to the attribute weights.
7. Convert to percentage for each proposal. These are your scores.

How does Paired-value Comparison Work (*the method*)?

Example 3: Value versus Economic (usually cost) Comparisons

1. Examine all proposals and/or combinations of proposals (portfolio).
   - Plot score (value) versus economics (cost).
   - Select proposals and/or portfolios of interest.
2. Set up a matrix (usually in Excel®) where each proposal is compared with each of the other proposals (or portfolios).
3. Compare proposal 1 with proposal 2.
   - Which is more important? Why? "Headline" the thinking!
   - Strong or mild preference?
     Score 0 for tie, 1 for mild, 2 for strong preference.
   - Record results
4. Repeat for each possible combination
5. Add up scores for each proposal.
6. Convert to percentage for each proposal. Compare versus the original value versus cost graph. Insights? Consensus?

How does Paired-value Comparison Work (*the method*)?

Paired Comparison: Compliance with Spec					Description		Score	Pct	Combo	Rationale
	B	C	D	E						
A	***a1***	***a1***	***a2***	***e2***	**Shipyard "A"**	A	4	22%	A vs B	A included all options; B did not include 2.
	B	***c1***	***b2***	***e2***	**Shipyard "B"**	B	2	11%	A vs C	A included all options; C did not include 1.
		C	***c2***	***e2***	**Shipyard "C"**	C	3	17%	A vs D	D did a poor job of compliance with spec; A acceptable.
			D	***e3***	**Shipyard "D"**	D	0	0%	A vs E	E almost 100% compliant; A acceptable.
				E	**Shipyard "E"**	E	9	50%	B vs C	C slightly better than B.
									B vs D	D did a poor job of compliance; B acceptable.
Factor							18	100%	B vs E	E almost 100% compliant; B acceptable.
1	**Low**								C vs D	D did a poor job of compliance; C acceptable.
2	**Med**								C vs E	E almost 100% compliant; C acceptable.
3	**High**								D vs E	E clearly superior to D.

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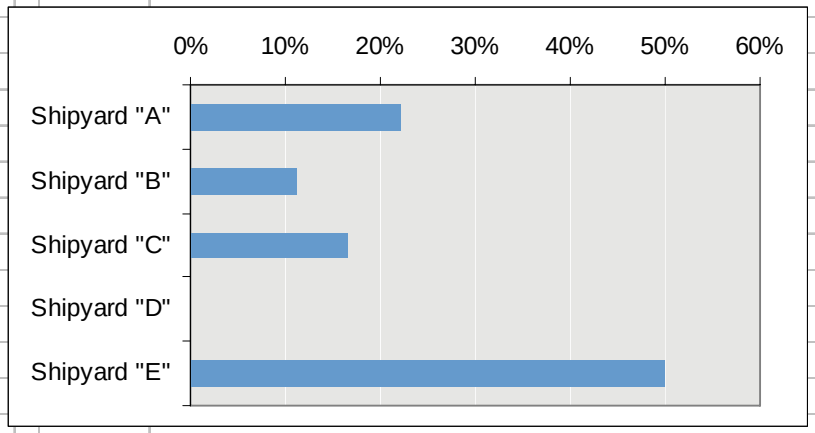
Do not enter anything into cells with black printing.



Can I Use This Tool (*the application*)?

Paired-value comparison is easy to use. Items to consider from a facilitation standpoint:

- Set up your templates before your team meeting.
- Take frequent breaks during the scoring process, as it can be tedious.
  - Capture headlines quickly – use experienced (fast) recorder – but make sure that the team's rationale is recorded for *each* pairing.
- Restrict subject matter expert "voting" to areas of their expertise.

Conclusion: We Can Agree on Value!

Paired-value comparison has worked well as a multi-attribute decision analysis tool:

- Weighting: achieved consensus among different stakeholders (who all had input).
- Scoring: thorough, rigorous, and documented results which were understood and accepted by independent verification teams.
- Value / Cost Trade-offs:
  - Risk/reward discussion stimulation
  - Understand additional value obtained for additional expenditure

The process is relatively easy to facilitate but can be tedious (take frequent breaks!).

Appendix: “Edwards” Weights

Weight depends only on the number of attributes and the rank of an attribute within the list.

$$weight = \sum_{j=0}^{n-i} \frac{1}{(i+j)n}$$